

**A COMPREHENSIVE ANALYSIS OF THE BUTCHERING ACTIVITIES
PERFORMED AT THE FINCASTLE BISON KILL SITE (DIOx-5)**

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Dedication

This thesis is dedicated to my family (Dad, Mum, Dave and crew!) who have been, and always will be, my #1 fan, no matter what I do, or where I end up. Finally, to Shawn, my professor, but even more so, my friend, who convinced me that I could win the hardest battle that I have ever been faced with; completing my masters.

ABSTRACT

The Fincastle site (DIOx-5) is located in Southern Alberta, Canada. Excavations from 2004-2007 unearthed a significant number of lithic artefacts, fire-broken rock and a dense bone bed. Radiocarbon dates (ca. 2500 BP) place the single occupancy kill site in the Late Middle Prehistoric Period.

This thesis investigates the butchering activities that took place in the East Block of the site, where 60,000 bone fragments were collected. Of these faunal remains, 5,540 records were processed and examined using Brumley's (1991) Bone Unit (BU) analysis scheme. They were then assigned to a Bone Unit Butchering Category, a classification system created to identify specific butchering activities. Detailed analyses of the articulations, location and quantity of impact and/or cut marks, and specific fracture types and lengths were also carried out.

The evidence shows that both primary and secondary butchering operations occurred at Fincastle, including joint dismemberment, meat removal, marrow extraction and grease rendering processes.

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One misconception that people have when it comes to working on a thesis is how much ‘behind the scenes’ work goes on. Let me tell you, it is what you think multiplied by one hundred and sixty. That is what it takes to be a Master’s student. Many people congratulate me on my work and say “I would not be able to do that.” Well, they are wrong. They can, if they put their minds to it. And the best way that I can prove this is by the fact that “I did it.” And if you know me, that is suiting. I have been a part of many high-level sports, including three separate university sports teams (hockey, soccer and rugby), as well as training with the Canadian Field Hockey team and attending several National Championships for Soccer, Rugby and Field hockey. For me, to take on a Masters was by far the hardest ‘competition’ that I have ever faced. It was my most fierce competitor of all time. At several times, I thought that I was defeated. This however, is not the case. I have many wonderful supporters who convinced me that I would ultimately win against my most feared competitor: academia.

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This brings me to my final dedications. There are a select few to whom I wish to dedicate this thesis. First, I would like to dedicate this thesis to my family. To Dave (and ‘crew’!), Denise and Andy, thank you for being my #1 fans. I would bet my piggy bank on you guys to be those in the ‘front row’ holding homemade posters saying “Go Ang Go.” This time, the sidelines are not in a cold rink, on a field or driving endless hours to get me half way across the country for two different provincial championships in one weekend.

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CHAPTER 1 – INTRODUCTION

Introduction

The Fincastle Bison Kill Site (DIOx-5), located approximately 100 km east of Lethbridge in Southern Alberta, Canada, is a significant Middle Prehistoric Plains Site. It was formally surveyed in 2003 because it was being looted, and since then a team of researchers lead by Dr. Shawn Bubel at The University of Lethbridge has been studying it. The discovery of Sonota/Besant projectile points made of Knife River Flint, other lithic tools, fire-broken rock and thousands of bison bones suggested a kill event that was followed by butchering activities at the site. Focus areas of the Fincastle project include geoarchaeology and the study of the site's stratigraphy; zooarchaeology involving the analysis of the faunal remains; the study of the lithic artefacts (Varsakis 2006); and spatial analyses involving GIS applications (Leiff 2006). All aspects of the project add to the understanding of the cultural activities that took place at the site 2500 years ago, and to the Middle Prehistoric Period as a whole.

This thesis contributes to the Fincastle project by analyzing a subset of faunal remains from the site. The knowledge gained from studying these ecofacts aids in the understanding the site as a whole.

Research Goals

The main research objective of this thesis is to examine the faunal remains from the East Block of the site in order to determine the butchering activities that took place. In order to understand the subsistence strategies used by the ancients at Fincastle, it is necessary to distinguish between primary and secondary butchering operations, to identify the processing activities that took place, and to determine the extent to which the

butchers utilized the carcasses. Through the detailed analysis of the faunal remains, specific butchering patterns can be seen. The direct and indirect evidence on the bones can reveal joint dismemberment, meat removal, marrow extraction and grease rendering.

The comprehensive analysis of the faunal remains provides details regarding the subsistence strategies used by these Middle Prehistoric bison hunters. By understanding the extent of the butchering, the subsistence patterns can be distinguished and compared to other Prehistoric sites.

Analysis Framework

All archaeologists work within a theoretical framework, therefore recognizing this is important as it can influence the (type of) data collected and interpretations drawn. Much of the research undertaken within the Fincastle project falls under a processual archaeological framework because it follows a structured scientific method. Processual archaeology originated from the ideas of Lewis R. Binford (1968) in the 1960s. As summarized by Fagan (1996: 628) the scientific method is described as:

“... the formulation and empirical testing of hypotheses leading to the development of different types of universal and statistical law-like generalizations. These generalizations would be designed to describe the interactions of various cultural elements or components and how these interactive patterns change over time to produce similarities and differences in the archaeological record.”

The faunal analysis of the East Block of Fincastle followed a systematic scientific method. In order to determine the butchering operations that took place at Fincastle, the faunal remains from the three excavation seasons were sorted, catalogued and analyzed in the laboratory. During the analysis phase, the element fractures and direct evidence on the bone elements, such as impact marks and cut marks, were used to distinguish primary

and secondary butchering operations. It was hypothesized that the bone bed would reveal butchering characteristics, and it was hoped that this evidence could be compared to other archaeological sites on the plains so a broad comparison could be made. Since this level of detailed faunal analysis is rarely seen in the archaeological literature, this thesis also serves as a reference on how to examine an assemblage for butchering evidence.

Chapter Overview

In order to carry out this research, the Fincastle Site was examined in the context of Plains Archaeology. This required reviewing reports on plains sites that had butchering patterns associated with the faunal remains and providing an overview of the Fincastle excavations and laboratory work. The focus of this research, however, is on the faunal analysis results and how they attest primary and secondary butchering activities.

Chapter 2 – Faunal Analysis Literature Review

This chapter's purpose is to provide a general overview of the butchering evidence seen at plains archaeological sites. It does not cover all plains archaeological sites documented in the literature. Instead it serves to place the Fincastle Site in the broad context of plains prehistory, focusing specifically on the butchering operations at these archaeological sites.

The faunal evidence relating to the butchering processes that was reviewed includes bone preservation; primary and secondary butchering operations; the bone bed; specific butchering evidence (impact marks, cut marks, fracture patterns, carcass segmentation, marrow and grease extraction); and specific element evidence (split into each element).

The information gained from this literature review served as the starting point for the detailed faunal analysis performed in this study. Furthermore, the research results presented in this thesis follow the formula other scholars used to describe their results. This allowed for greater cross-site comparisons to be made.

Chapter 3 – Fincastle Site Excavation and Laboratory Methodology

The Fincastle project as a whole is introduced in Chapter 3. The site is outlined in detail, including its location, environment and available fauna. The excavation methods used in all three field seasons are described. Grid layout, screening techniques and in field recording methods are discussed. The site's stratigraphy and radiocarbon dates are also included. Following the field work, all collected material was brought and stored at The University of Lethbridge, where an in depth laboratory aspects of the project took place.

The second part of this chapter outlines the cataloguing and analysis process of the faunal remains used for this research. Aspects of in the laboratory work included sorting; cleaning and labelling each in situ bone; and group processing the sieved material. Further steps in the analysis of these ecofacts included determining their level of preservation, element identification, side, age, species, weight and Bone Unit (BU) assignments. A detailed description of John Brumley's (1991) BU classification system for ungulate faunal remains is reviewed and the new classification system created for this thesis is explained. This BU Butchering Category Classification System is the framework used for the analysis of the butchering process.

Chapter 4 – Fincastle Faunal Analysis

Chapter 4 includes the analysis of the ‘mammal large’ and *Bison bison* faunal assemblage from the East Block of the Fincastle Site. The information gained through the detailed examination of each element in relation to the butchering operations that took place at the site, are discussed in detail.

Chapter 4 follows a similar outline to Chapter 2 in order draw site comparisons of the data. It begins with information on bone quantities, preservation, side, age, weight, articulations and a minimum number of individuals (MNI). The bulk of the chapter presents the data gathered for each bone element. All elements were assigned to a BU and placed into a Butchering Category. When appropriate, specific butchering evidence was highlighted. Chapter 4 deals with the direct evidence on the faunal remains and presents the data collected. The major butchering patterns discerned from the analysis are summarized and discussed in a separate section at the end of the chapter.

Chapter 5 – Conclusion

Chapter 5 discusses the data presented in Chapter 4, and offers final conclusions from the faunal analysis. Specific butchering evidence is discussed in relation to the overall butchering operation (primary or secondary operations). The information gained from the indirect evidence is also presented.

The findings from the analysis of the Fincastle faunal remains were compared to the results from other sites reviewed in Chapter 2. Finally, some suggestions for the future analysis of the Fincastle faunal remains are highlighted, and closing comments are given.

Appendices

There are also three appendices included with this thesis. The first (Appendix I) is a glossary of the faunal terms used. Appendix II consists of BU tables for the 5540 faunal elements analyzed from the East Block. The number of records for each BU is listed. Appendix III, which is a document wherein the new BUs created for the Fincastle project are inserted into Brumley's (1991) document, serves as a descriptive reference for the faunal analysis. Each BU discussed in this thesis is included in this appendix.

CHAPTER 2 – FAUNAL ANALYSIS LITERATURE REVIEW

Introduction

This chapter serves as a brief review of the archaeology of the Great Plains Region of North America in relation to faunal remains. It includes findings from all three time periods: the Early Prehistoric Period (11,500 – 7500 BP), the Middle Prehistoric Period (7,500 – 1,250 BP) and the Late Prehistoric Period (1,250 – 250 BP). This chronology is used by most archaeologists working in this region (see Vickers and Brink 1986 for an excellent overview of these periods). They are based on the primary hunting tools and techniques used at these times; the spear in the Early Prehistoric, the atlatl/dart in the Middle Prehistoric and the bow and arrow in the Late Prehistoric Period.

The projectile points in the archaeological record can reflect the hunting techniques used; but by looking at these artefacts in combination with the faunal assemblages, subsistence strategies can be better understood. Studying the faunal remains provides a great deal of information on the hunting and butchering techniques used at the sites. Essentially, there must be direct faunal evidence in order to conclude that subsistence related activities took place.

This chapter does not summarize all the available literature, but rather generalizes the nature of the faunal record by looking at selected sites, drawing attention to important trends and finds relating to the butchering methods. When possible and relevant, details relating to the faunal assemblages at the archaeological sites are noted. Table 2.1 lists the main sites reviewed in this study.

Table 2.1: Main sites reviewed for this research.

Time Period	Site	Reference
Early Prehistoric (ca. 11,500 – 7,500 BP)	Agate Basin	Frison and Stanford 1982
	Carter/Kerr-Mcgee	Frison 1984
	Casper	Frison 1974
	Horner	Frison and Todd 1987
	Hudson-Meng	Agenbroad 1978
Middle Prehistoric (ca. 7,500 – 1,250 BP)	Deer Creek	Larson, et al. 1984
	EgPn-111	Head, et al. 2002
	EhPp-1 (Coal Creek)	McIntyre 1978
	Gull Lake	Kehoe 1973
	Head-Smashed-In Buffalo Jump	Brink and Dawe 1989
	Muhlbach	Gruhn 1969
	Ruby	Frison 1971
	Sun River	Greiser, et al. 1985
Late Prehistoric (ca. 1,250 – 250 BP)	Boarding School Bison Drive	Kehoe 1996
	Estuary Bison Pound	Adams 1977
	Ross	Vickers 1980
	Vista Rock Shelter	Wood 1968
	Wardell Buffalo Trap	Frison 1973

Faunal Analysis

Faunal analysis involves classification which will be separated in the chapter as follows: 1) taphonomy (natural and cultural situations); 2) primary and secondary butchering; 3) the bone bed (articulation and disarticulation); 4) butchering evidence including impact marks, cut marks, fracture patterns, carcass segmentation and marrow and grease extraction; 5) the butchering operation; and 6) specific element evidence. The zooarchaeologist ties the faunal analysis together, but each aspect of the classification plays a significant role in helping to determine how the butchers separated, stripped and utilized the fallen carcasses.

Taphonomy

Taphonomy is the study of what happens to animal remains after death. As defined by Lyman (1994: 515), taphonomy is “the science of the laws of embedding or burial; the study of the transition, in all details, of organics from the biosphere into the lithosphere.” Taphonomy includes both natural and cultural situations. Noe-Nygaard (1977: 236) notes that natural processes deal with the degree of bone fragmentation in a deposit, uninfluenced by man. It is expressed in the resistance of the various bones to mechanical destruction. Fragmentation as a result of human activity is a cultural process.

Bone preservation is a large factor in taphonomic studies. Both natural and cultural situations affect bone preservation. Natural situations include weathering, root etching, trampling and carnivore activity. Human induced cultural scenarios involve manipulation of the bone via actions such as boiling or burning the remains.

Weathering

Different environments preserve bone in different ways. Preservation reflects the amount of wind, rain, snow, sun, and other elements to which the bones are exposed. Bones in highly acidic soils or alluvial environments decompose at a much faster rate than those buried in sandy sediments in an arid environment. If water comes in contact with bone, the bone may start to break down, soften or become waterlogged. The bones periosteum (hard outer layer) may begin to deteriorate and butchering evidence, such as cut marks or impact marks, may disappear. The condition of preservation will determine how much physical faunal evidence remains.

At the Estuary Bison Pound Site, for example, Adams (1977: 67) concluded that due to the poor preservation of the faunal remains the butchering techniques could not be

distinguished. In contrast however, Frison (1974) noted good bone preservation at the Casper Site. He summarized that the bone bed seemed relatively untouched and was probably covered by blowing sand after the butchers left the site. Alternatively, at sites such as Head-Smashed-In (Brink, et al. 1986) and the Boarding School Bison Drive Site (Kehoe 1996) it was reported that bone preservation deteriorated from good to poor as the excavation units deepen. In these cases, earlier remains are not as well preserved as later remains. Each of the cases reflects different environmental conditions attesting to the importance of examining the natural formation processes that have affected the sites.

Root Etching

Bone or root etching has been described in the literature as broad, smoothed-bottomed, U-shaped grooves on the faunal remains (Andrews and Cook 1985: 685). They usually appear as sinuous lines on the periosteum of bones. They are thought to be the result of acids released from the roots of flora material. There have been few studies on this taphonomic process, and it must be noted that these lines may be caused from micro-organisms or moss growth (Lyman 1994: 375). Although further study is needed in this area, these unique line features were classified as root etching in this research.

Trampling

Trampling is the crushing or splintering of bone by animals (including humans) walking or wallowing over the faunal remains. Haynes (1983: 111) stated that “the most common destructive effects of trampling and dust wallowing seen on bison ranges are splintering and crushing of ribs, vertebrae and scapulae at the sites.” However, he also added that no cultural fracture patterns have been produced from the direct trampling of long bones.

Carnivore Activity

Carnivore activity is seen on bones that have been scavenged by animals after the kill event. Gnaw marks are defined as teeth impressions left on a bone when an animal chewed it. Certain teeth and actions leave definable marks on the bones. Haynes (1983: 105) suggested that when a carnivore gnaws on a bone the force of their levering, pulling and biting down can create spiralling cracks on the compact tissue. He believed this kind of incomplete fracturing is easily seen on lightly weathered bones. Small rodents may also leave visible chewing marks on bones, but do not crush the bone like a wolf or bear can. Haynes provided a good description as to where on the bones the carnivores chew. He noted that because the epiphyses of the long bones contain the most bone grease and nutrients, the animals generally select them. As the cancellous tissue is consumed, the diaphysis sometimes starts to open. Once the epiphyses are consumed, the carnivores usually abandon that element, leaving the shaft fragments alone (ibid). In his opinion the shaft fragments will lack signs of crunching, tooth perforations, or gnawing (Haynes 1983: 105).

Several archaeological sites comment that carnivore activity had affected the faunal remains. Vickers (1980: 125 and Brink and Dawe (1989: 160) had no doubt that there was carnivore activity at the Ross Site and Head-Smashed-In, but they could not firmly conclude this because of poor bone preservation. At the Deer Creek Site, however, direct evidence of carnivore activity was present. Larson, et al. (1984: 70) recovered three separate femora revealing gnaw marks on each of the epiphyses, with chew marks on a single scapula. Furthermore, McIntyre (1978: 121) reported a calcaneum and a lateral malleolus with two chew marks (located on the distal section of the calcaneum and the anterior/medial section of the malleolus) at EhPp-1.

Burning and Boiling of Bone

The burning of faunal remains was suggested to have occurred at the Estuary Bison Pound Site (Adams 1977). Based on the stratigraphical record, Adams (1977: 100) concluded that the pound was used often over a few years. He interpreted the ash deposits and burned remains to reflect the purposeful burning of the remains to alleviate the stench. By controlling the smell, the pound could be used again quickly. Better documented in the literature, however, is the association of burned bones with hearth features. Hearths could have been used for heat, to keep warm during butchering, a source of light, and/or cooking but many scholars assume these features with burned and charred bone relate to butchering activities. Bone boiling for grease extraction is a secondary butchering operation that can yield burned bone fragments. This activity alters the bone and thus plays a role in the bone preservation after discard. Bone grease processing is discussed in greater detail below.

Primary vs. Secondary Butchering Sites

One of the main goals in faunal analysis research projects is to determine if primary and/or secondary butchering occurred at the site. Primary butchering is defined as the removal of sections of the carcasses to be further processed. It is the 'rough' processing of the carcass. Primary butchering was the predominant technique at a kill site. The Early Prehistoric Horner Site (Frison and Todd 1987), located in Wyoming, was interpreted as a primary kill site, at which certain bone elements were removed to be further processed. The same activities took place at EgPn-111 (Head, et al. 2002), which had a relatively high axial skeleton concentration for a Middle Prehistoric Site.

To clarify, the skeleton is divided into two main groups: the axial and appendicular skeleton. Looking specifically at the bison skeletal structure (as there is element variation amongst all vertebrates), the axial skeleton includes: the skull, mandible, hyoid, vertebral column, ribs, sternum, sacrum and pelvis. The appendicular skeleton includes: forelimb elements (scapula, humerus, radius, ulna, carpals, metacarpals, and phalanges 1-3) and hind limb elements (femur, patella, tibia, tarsals, metatarsal and phalanges 1-3). An increased quantity of axial remains tells the archaeologist that the site is a primary butchering site, as these elements tend to be too bulky to carry from the kill area to the 'secondary' processing area. Defined as the 'shleppe' effect, involving the presence and/or absence of certain faunal elements, it can be a good indication as to whether primary or secondary butchering occurred at a site.

Sites such as Carter/Kerr-Mcgee (Frison 1984) in Wyoming and EgPn-111 (Head, et al. 2002) in Alberta, had selective removal of lower limb elements left at the kill site, which points to primary butchering. Alternatively, secondary butchering was being performed at the Dodd and Phillips Ranch base camp sites in South Dakota (White 1954). Select elements were transported to these sites from the kill site where the primary butchering took place.

The abundance of disarticulated appendicular elements is associated with secondary butchering. At Head-Smashed-In Buffalo Jump (Brink, et al. 1985), for example, the majority of the primary butchering occurred at the kill site located below the jump. At the processing area several meters away from the base of the cliff, most of the secondary butchering operations took place. Secondary butchering is the detailed

manipulation of the carcass to remove the meat, marrow and/or to extract bone grease. Commonly, secondary butchering is seen in the processing areas of a site, not the kill site.

At the Middle Prehistoric site of Muhlbach in central Alberta, Gruhn (1969: 138) reported that most of the long bone elements (appendicular skeletal remains) were broken into small pieces, probably for marrow and grease extraction. She also stated that there were few skull fragments recovered, indicating that the skulls were probably smashed for the recovery of the brains and tongue. Alternatively, the skulls may not be in this area if they were left at the kill site ('shleppe' effect), which would also suggest that secondary butchering took place in this area.

Secondary processing seems to be reported more in the literature than primary butchering, but could be because primary processing can be erased by the secondary butchering operations.

The Bone Bed

The spatial context of the faunal remains can be a key factor used to study the butchering operations that took place at a site. Specifically, articulated and disarticulated portions of the carcass together with voids and concentrations of particular elements, can indicate how the animals were processed.

Articulations

When an animal is mobile, its bones are in correct anatomical position, meaning that they are positioned as they were when the animal was born. Articulations are sections of the body maintaining these positions. Bones can be adjoined at the joints, held on by the muscles, skin and/or tendons and ligaments associated with the particular elements. If the soft tissue is missing, they would maintain this spatial context. A

common example of an articulation recovered from a site is a left distal humerus with a proximal radius/ulna, which was found in the Folsom level at the Agate Basin Site (Frison and Stanford 1982: 221). Basically, the forelimb was removed from the anatomical carcass at the bottom portion of the humerus, at the lower limb junction with the radius and ulna. This articulated unit relates to primary butchering activities. Articulations are documented throughout prehistory and range from two single elements together to a nearly complete carcass. Almost every element has been documented in an articulated state.

Articulations can be associated with both primary and secondary butchering. The type of element and the frequency of articulated units play a significant role in determining what type of butchering they are associated with. Frison (1974) believed that the carcass was initially butchered and then moved to another location for further butchering, based on the types of articulations recovered from the Casper Site in Wyoming. In this case, larger numbers of axial element articulations compared to appendicular ones suggest primary butchering at the Early Prehistoric kill site. He further noted (1974: 48) that there were articulations of the skull, cervical (including the axis and atlas) and the thoracic vertebrae separated from the rest of the body. He summarized that the total number of articulated units was 231, which were further divided into several bone units including: 132 axial skeleton units, and 99 appendicular units (with the front leg outnumbering the hind leg 53 to 47), and 6 combined axial/appendicular skeletal remains left intact (Frison 1974: 64).

At several other sites the lower limb elements were discarded from the butchering operation, and were left at the primary kill areas (Agate Basin [Frison and Stanford

1982], EgPn-111 [Head, et al. 2002], Gull Lake [Kehoe 1973], Muhlbach [Gruhn 1969] and Estuary [Adams 1977]). These appendicular articulating elements ranged from the carpals/tarsals to the third phalanx, or were comprised of smaller units within the lower leg body segment. It is commonly understood that these articulations point to primary butchering activities. Due to the fact that lower legs have little to no useable meat attached to them they were discarded early in the butchering process.

However, there are variances in the different assemblages after examination of particular lower limb articulation units. At Gull Lake in South-western Saskatchewan, Kehoe (1973: 154) analyzed the metacarpals and metatarsals together (collectively known as the metapodials) and concluded that most of the elements were complete. Some were found in isolation while others were found in articulating units. This suggests that this lower leg unit was connected with the primary butchering operation at the Middle Prehistoric site. The butchers chose not to use the metapodials for marrow extraction or other secondary butchering operations. Alternatively, at the Early Prehistoric Agate Basin Site in the High Plains of Wyoming, Frison and Stanford (1982: 226) concluded that even though some metapodials were found in articulating units, over 65% of the metapodials were broken at the center of the shaft, probably for the recovery of marrow. Additional butchering patterns relating to the articulations of metapodials are highlighted below, when the butchering operation and specific element evidence is discussed.

Many sites throughout the Prehistoric time periods document a relatively larger number of axial elements, particularly portions of the vertebral column. At EgPn-111 (Head, et al. 2002), Ruby (Frison 1971), and the Muhlbach Site (Gruhn 1969), several

vertebral column articulations were found, all of which are associated with primary butchering. In contrast to the large number of these articulation elements at a site, a low number can indicate that a secondary butchering operation occurred. For example, Kehoe (1996) summarized that at the Boarding School Bison Site in Montana, the three separate bone layers displayed different butchering techniques. The first bone layer at this Late Prehistoric site seemed to reflect more of a primary butchering operation, possibly to prepare for carcass transportation, as there were many articulated units recovered, most of which were vertebral column units (Kehoe 1996: 71). Bone Layers Two and Three differed from Layer One in that secondary butchering seems to have been conducted immediately after the primary operation at the same location. This was shown by the absence of articulations and the fact that all of the bones yield secondary butchering evidence (ibid). Kehoe further concluded (1996: 71) that the articulations and bone bed preservation aided in the distinguishing of the layers into two separate cultural groups; Layer One differing from Layers Two and Three.

With regard to smaller joint articulations, many archaeologists have commented that these were present at their sites and remarked that they indicate secondary butchering operations. In the kill area at the Ruby Site in the Powder River Basin, Wyoming, the most common butchering units recovered were the humerus-radial/ulna joint, and the femur-tibia joint articulation in the hind leg (Frison 1971: 83). Frison noted that the majority of the proximal ends of the femur and humeri articulations were broken and had deep gouge marks. This indicates that these appendicular articulations were used in a secondary butchering operation.

There seems to be little variance in articulation types in the three Prehistoric Periods. With that said, no two sites have identical numbers of articulation units. Generally, a larger number of articulating elements are found in the earlier time periods. The Early Prehistoric sites of Casper (Frison 1974) and Carter/Kerr-Mcgee (Frison 1984) show high articulation counts (132 at Casper and 27 from Carter/Kerr axial skeleton units, 99 appendicular units from both sites) compared to none recovered from Layers 2 and 3 of the Boarding School Bison Drive Site (Kehoe 1996: 71) in the Late Prehistoric Period. Kehoe (1996: 90) concludes that the latter site had an “extensive butchering and bone rendering [operation].” The Boarding School Site is the only site reviewed that recorded no articulations.

Overkill

Articulations may suggest that overkill has taken place. Overkill means that the butchers could not utilize all of the meat of the animal(s). The number of articulations and their context can be key indicators as to whether or not overkill occurred at a site.

The data gathered from the Early Prehistoric Period sites of Horner, Hudson-Meng, and Casper suggest overkill took place. There were six near complete carcasses at the Horner and Hudson-Meng Sites and two carcasses at the Casper Site. Agenbroad (1978: 34) summarized that one of the six carcasses at Hudson-Meng in Nebraska, had a damaged skull that was still articulated with the vertebral column down to about the mid thoracic region. The right forelimb and the rib cage was in relative position to the articulation, while the rest of the skeleton was concluded to have been destroyed by a nearby hearth centre. The Casper Site had two carcasses lying in the ‘spread eagle’ position, with the hind legs and the pelvis articulated with the vertebral column (Frison

1974: 48). These site examples are good indicators of overkill, assuming, of course, that they were killed by human hunters.

Interestingly, however, even though Agenbroad (1978: 51) stated that he found six nearly complete carcasses remaining in articulation at the Hudson-Meng Site, he confidently reported that 99% of the animals were subjected to a complete butchering operation, leaving nothing to waste. Frison and Todd (1987) also propose that the six near complete skeletons at the Horner Site were fully processed and not wasted. They suggested that the hides were removed, and that the one side of the animal was stripped of the flesh, and then turned over to remove the meat from the other side. They stated that “stripping the meat from carcasses is a process that can be accomplished quickly and easily with a simple tool assemblage, without disarticulation of the skeletal element” (Frison and Todd 1987: 100). Without direct evidence, such as cut marks on the bones, as reported for this site, this hypothesis cannot be proven, and therefore overkill, in fact, took place.

Overkill can also be shown by elements that have been disarticulated from the body but have not been further butchered. Frison (1974: 49) noted that there were common waste patterns at the Casper Site. He noted that several long bones were not utilized for bone marrow extraction, that the brains were not removed (only one skull had a break in the occipital), and that the majority of the mandibles were intact. This type of evidence is more commonly recorded for the Early Prehistoric Period; but with the number of lower leg articulations and several complete elements recorded at sites such as Gull Lake (Kehoe 1973) from the Middle Prehistoric Period and the Estuary Bison Site (Adams 1977) from the Late Prehistoric Period, overkill likely occurred then as well.

Throughout the Prehistoric periods, an animal was not always fully used; but the degree of animal use varied among sites. Overkill can suggest times of plenty, compared to periods of stress when meat was scarce, but it may also relate to cultural selection. Distinguishing the difference in the archaeological record is difficult.

Disarticulation

When elements are separated from their natural anatomical position in the body, the elements are said to be in a disarticulated state. The element no longer belongs to a joint and is not found in direct contact with any other element. Joint dismemberment is a process that occurs in order to separate bones to remove meat or gain access to marrow and/or grease. For example, the lower limb can be separated from the upper hind limb by striking the distal end of the tibia and cutting the ligaments of the tarsals, thus removing the proximal end of the metatarsal from the joint. In this case, the state of total disarticulation is shown by the metatarsal, tibia and tarsals found completely separated from one another in the bone bed. The bones may remain complete, but could be smashed into fragments during secondary butchering operations.

Completely disarticulated bone beds are associated with secondary butchering as this context suggests that the bones have been further processed for meat removal, marrow and/or grease extraction processes. Sites such as Head-Smashed-In (Brink, et al. 1985, 1986, Brink and Dawe 1989), Casper (Frison 1974) and Ross (Vickers 1980) that yield high percentages of fragmented bone elements (specifically a large number of unidentifiable to specific element long bone fragments), provide examples of a disarticulated bone bed, thus indicating that a secondary butchering operation occurred. Disarticulation, as opposed to articulation, is noted more often in the later periods,

suggesting that the butchering operations came to rely on secondary butchering operations and full carcass utilization.

Furthermore, the types of elements found in disarticulation at a site may relate to the site's function. Most of the kill sites previously mentioned yield high concentrations of lower limb elements (in articulation as well as in disarticulation) and axial elements. On the other hand, fragmented ribs are evidence of processing activities. For example, the Late Prehistoric Estuary Site in Saskatchewan had 117 and 674 identifiable rib fragments of varying sizes in Layers One and Two, respectively (Adams 1977: 62, 93). Of these counts, only two of 117 were complete in Layer One and seven of 674 in Layer Two (ibid). The high numbers of fragmented ribs point to secondary butchering activities. At the Vista Rock Shelter in Missouri there was an abundance of disarticulated, butchered phalanges recovered that Wood (1968: 176) noted as being an abnormal element pattern for a Late Prehistoric hunting station. These elements were usually left at the original kill sites, so the fact that they were disarticulated and butchered suggest that the phalanx were transported to this site to be further processed for grease (ibid).

Butchering Evidence

Butchering evidence on bone includes impact marks, cut marks and fracture patterns. These specific features can indicate what type of butchering operation that took place because primary and secondary butchering activities will produce different physical evidence on a bone. Primary butchering consists of hide removal, joint dismemberment (segmentation) and meat removal, whereas secondary butchering involves detailed meat, tongue, brain and nasal cartilage removal and smashing the bone into smaller portions for

marrow extraction and grease rendering. There is no cut and dry division between these two types of butchering in respect to site type classification. Marrow extraction, for example, has been documented to occur at a kill site for immediate consumption (Hudson-Meng, Agenbroad 1978) and at a secondary processing area after the long bones have been taken away from the kill area (Head-Smashed-In, Brink, et al. 1986; and The Ross Site, Vickers 1980). Assessing the butchering activities requires the careful examination of the bone and its context. Each feature of the butchering process is outlined below.

Impact Marks

Impact marks are the indentations left on the bone from a blow from a blunt object. They are created when the bone cavity (diaphysis) is opened, and the epiphysis is separated from the diaphysis; and when the bones are smashed into small unidentifiable pieces during the grease extraction process. These activities are associated with secondary butchering activities, but impact marks can also occur during rough butchering in the primary stage as well.

Kooyman (2004: 189) showed that impact marks should be examined from the perspective of their frequency and their placement on the bone. Kooyman (2004: 199) argued that bone breakage for carcass segmentation and/or meat removal should have impact ratios of one or less in general, whereas striking the element for marrow extraction can create at least three marks to ensure a more elongated fracture in the marrow cavity. Smashing the bone for grease rendering should result in an even greater number of impact marks, upwards of at least five or six per element. However, he went further to state that it may not be possible to distinguish marrow extraction from carcass

segmentation on the basis of impact marks alone, although there should be a distinct difference from the grease extraction process (ibid). Not every strike to a bone will leave a direct impact mark, but when they are present, their frequency and location need to be examined by archaeologists.

Unfortunately, little focus has been placed on this aspect of the faunal analysis of sites in the literature. For example, Frison (1974: 36) vaguely concluded that there were only a few humeri that had chop marks from the sharp tools used to remove them in butchering at the Casper Site. 'Hack' marks on the mandibular notch immediately below the condyle were noted by Head, et al. (2002: 59) at the EgPn-111 Site. Even though these quite specific features were commented on (compared to most of the literature), there was no indication as to the number of impact marks on the elements themselves. The number of strikes can be an important factor in determining what type of butchering activity took place.

Cut Marks

When preservation is good, cut marks seem to be more commonly noted in the archaeological record than impact marks. Cut marks are defined as straight lined grooves created when a sharp implement comes in contact with a bone. They are created during the primary and secondary processes from hide removal, meat stripping and cutting on tendons/ligaments during joint dismemberment.

As previously mentioned, preservation plays an important role in the analysis of a site, especially in the study of the faunal remains. Cut and impact marks, fracture patterns and other faunal related evidence are lost when the bone is poorly preserved. For the Agate Basin Site, Frison and Stanford (1982: 217) reported that the bones were too

deteriorated to preserve butchering features, and the fragmentation of the bone was too extreme to deduce breakage patterns. They do contradict themselves however, as they go on to report that in all of the different phases of the site there was evidence of cut marks on the bones. In the Hell Gap Level they reported cut marks on two bison ribs (Frison and Stanford 1982: 172), and in the Folsom Level, three bone fragments had cut marks, one of which was a rib that had a cut mark on the dorsal surface (Frison and Stanford 1982: 218). Also relating to the Folsom Level, they wrote that skinning marks were found on two metatarsals from large mature animals. One metatarsal had 47 cuts on the dorsal surface from the nutrient foramen to the mid-shaft, on both sides of the vascular groove, while the other was broken at the proximal and distal ends, with five transverse cuts on the anterior lateral side at the centre of the shaft (Frison and Stanford 1982: 218).

Several sites with well-preserved faunal remains were able to provide evidence relating to the skinning process at the site, a butchering technique connected with cut-mark evidence. The skinning process that was described by Frison (1974: 36) at the Casper Site would not be detectable if the preservation was poor. Frison reported that the metacarpals and metatarsals had diagonal and transverse cut marks on the diaphyses of the bones, which were likely connected with this process. He suggested that this would be a good place for the butchers to start the skinning the animal due to the short hair and direct skin to bone contact, which allowed for a good sized puncture hole to be created. He noted further that it would also be logical to start the skinning process anterior toward the posterior body portion as this is the natural growth direction of the hair, thus making it easier for a 'sawing' motion to be implemented in the hide removal (ibid). In the later time periods, similar findings on the metacarpals and metatarsals were recorded. The

Deer Creek Site (Larson, et al. 1984) and the Wardell Buffalo Trap (Frison 1973) both have bones with cut marks on the shafts of the metapodials with regard to hide removal. At the Estuary Site, Adams (1977: 100) reported that hide removal (shown by encircling marks on several metatarsals) began in the pound area.

Another activity associated with cut-mark evidence is the removal of meat. Again, this may relate to either primary or secondary operations depending on the site. Distinguishing the difference between cut marks for primary meat removal vs. secondary activities is difficult, and is not specifically documented in the literature. Instead, authors seem to present a more generalized picture of the process. However, by combining the cut-mark evidence with the type of remains (its completeness, body section and context in the bone bed) one may be able to distinguish between them. For example, ribs that have cut marks near the proximal end are probably associated with the primary butchering operation. Kehoe (1973: 154), for example, mentioned that numerous rib fragments at the Gull Lake Site had cut marks near the head (proximal end). This was likely connected with primary butchering for meat removal or joint dismemberment.

It is interesting to note, however, that many of the rib heads remained in articulation with the thoracic vertebrae at other sites, implying that the body was being divided into section to remove the meat. At the EgPn-111 Site (Head, et al. 2002: 63) cut marks were on the proximal ends of the ribs as well as the mid shaft. The archaeologists concluded that the marks differed and were related to rib segmentation as the shaft cut marks seemed to bear thick and thin parallel marks. Similar to the findings of Head, et al. (2002) on the rib shafts, Adams (1977: 93) reported 37 rib elements containing butchering 'scratches', 34 with transverse marks and three with parallel marks. Cut

marks on 24 of the 37 specimens were located on the lateral surface of the shafts and the remaining 13 on the medial surface (ibid). These shaft cut marks seem to associate more with secondary butchering, or detailed meat removal operations.

There are many other bone elements documented with cut marks that suggest meat removal. The Wardell Site had three separate examples of scapulae with cut marks connected to the joint dismemberment process. Frison (1973: 39) noted that there were no smash marks related to the cut marks, and concluded that the cut marks aided in the cutting of muscle attachments and ligaments to separate the scapulae from the humerus. Similar reports were made based on the Deer Creek (Larson, et al. 1984) and Gull Lake (Kehoe 1973) fauna, both concluding that cut and hack marks were present in relation to joint dismemberment and meat stripping. At the Middle Prehistoric Coal Creek Site in Alberta (EhPp-1), McIntyre (1978: 119) reported that cut marks were present on a calcaneum that also contained fracture marks. The cut marks were located distal to the tuber calcis and along the lateral and medial shaft sections, probably for removing the attached ligaments that join the calcaneum to the tibia. Other sites documenting similar evidence of joint dismemberment include EgPn-111 (Head, et al. 2002), Wardell Buffalo Trap (Frison 1973) and the Casper Site (Frison 1974). These sites yielded cut marks on the carpals and tarsals, elements associated with joint dismemberment. These elements are situated in the fore- and hind limbs respectively, and both are found at important junctures in the legs. They are transition points of the lower limbs.

There are, however, inconsistencies with regard to the division between the upper and lower limb. Many sites imply that the upper and lower forelimb joint is at the distal radius and carpals. Other sites document the distal humerus, proximal radius/ulna being

the division. For clarification in this study, the upper forelimb contains the scapula, humerus, radius and ulna, while the lower forelimb contains the carpals, metacarpals, and phalanges. The upper hind limb contains the femur, patella and tibia, and the lower hind limb contains the tarsals, metatarsals and phalanges (see Figure 2.1). The reason the upper forelimb includes the radius and ulna in this research is because there is an abundance of useable meat associated with these elements. As already discussed above the 'lower limbs' were frequently discarded as little to no useable meat was associated with them.

Fracture Patterns

The way in which a bone breaks reflects the type of fracture pattern on an element. The different actions a particular element is subjected to result in different patterns of breakage. Therefore, several types of fracture patterns are present in the archaeological record. A desiccation fracture, as summarized by Hurlburt (1977: 10) for example, occurs from the drying effects of burning or weathering the bone, whereas the more commonly documented spiral fracture results from stress being applied to the mid-shaft of a bone. Haynes (1983: 112) stated that "the attributes associated with bones broken when fresh are: 1) the presence of relatively smooth fracture surfaces; 2) the presence of acute or obtuse angles formed by the intersection of fracture surfaces with outer surfaces of the shaft; and 3) no difference in the colour of fracture surfaces of the outer compacta."

The spiral fracture, which is associated both with joint dismemberment and marrow extraction, is the most common fracture type. It is defined as a smooth 'U'-shaped fracture on the shaft of a bone. Spiral fractures can contain longitudinal fracture

edges, allowing for an easier access to obtain the marrow from the medullary cavity (ibid). Kooyman (2004: 190) introduced the idea of the long and the short spiral fractures. He classified fracture lengths of 6 cm or more as long spiral fractures, while short spiral fractures are 6 cm or less. The fracture measurement is taken from the shaft of the bone. The longitudinal fracture pattern is the long straight edge running parallel to the diaphysis of a long bone. Short spiral fractures better serve carcass segmentation and meat removal at the impact point (Kooyman 2004: 199). Kooyman suggested that by measuring the longitudinal fracture edge, the archaeologist can distinguish the difference between a spiral fracture for marrow extraction and one for joint dismemberment.

Hurlburt (1977: 10) added an interesting observation relating to transverse fracture lines traveling on the diaphysis of the bones. Transverse fracture patterns run perpendicular to the long shaft of the bone. He suggests that fracture lines can be diverted when the bone becomes thicker, such as near a tuberosity.

Unfortunately, specific fracture pattern analysis is almost absent in the literature. Kehoe's (1973: 153) interpretation of a spiral fracture for marrow extraction at the Gull Lake Site is one of a few examples where fracture patterns were noted. He reported that the breaks on the humerus characterized marrow extraction as they bore 'V'- shaped breaks. At the Muhlbach (Gruhn 1969) and Estuary Sites (Adams 1977) several long bones broken at a certain distance from the epiphysis were documented. Adams (1977: 95) reported that 12 of 18 distal radii had breaks between $\frac{1}{4}$ and $\frac{1}{2}$ of the shaft. Even though neither author mentioned differences between breaks for marrow compared to dismemberment, they concluded that the bones with a portion of the shaft still attached relate to marrow extraction activities. At most of the other sites reviewed, it was

concluded that there was marrow extraction, but there was a failure to show the fracture pattern evidence.

Joint Dismemberment

Joint dismemberment involves separating portions of the carcass into individual units for further butchering. This is a primary butchering technique done directly at the location of the kill and is one of the first steps in the butchering operation. This process is discussed further in the butchering operation and individual element evidence sections of this chapter.

Marrow Extraction

Marrow extraction is a secondary butchering operation that can be located either at the kill site or the processing/camp site. Marrow is found within the shafts of bones, specifically the large long bones in the appendicular skeleton. It is rich in nutrients and was an important source of food for the ancient hunters.

Hurlburt (1977: 15) noted that there are two types of marrow: red and yellow. Red marrow is predominantly found in the epiphyses while yellow marrow is situated in the cavities of the long bones. Yellow marrow is pure fat in nature and contains valued nutrients. The red marrow is greasier and is why the epiphyses of long bones are consumed first by scavengers (see Haynes 1983). Humans extracted this red marrow by boiling the bones for grease.

Both red and yellow marrow contains oleic acid. Jones and Metcalfe (1988: 419) noted that certain elements contain more oleic acid than others. The percentage of oleic acid in bone marrow increases with distance from the axial skeleton, therefore the small bones of the foot contain more than larger long bones. Knowing this in combination with

the state of the bone bed (i.e., complete bones vs. incomplete pieces fractured for marrow, or smashed long bone fragments for grease rendering), one can determine the degree of secondary processing.

As mentioned above, the easiest way to obtain marrow is to smash the shaft portion of a long bone, creating a long spiral fracture with a large opening into the shaft enabling easy access to the marrow inside the shaft cavity. Many sites document the occurrence of marrow extraction, but fail to note the evidence to support this claim. The Gull Lake, Estuary and Muhlbach Sites are a few of the sites that note direct bone breakage patterns characteristic of marrow extraction. Reports from the Sun River Site (Greiser, et al. 1985), Head-Smashed-In (Brink, et al. 1986) and the Casper Site (Frison 1974), suggested the occurrence of marrow extraction based on the association of the remains to hearth features.

At the Hudson-Meng Site, Agenbroad (1978) mentioned that there was relatively little bone marrow extraction occurring at the site compared to other sites in the Early Prehistoric Period. He reported that the only evidence of marrow extraction comes from the burned, broken and smashed long bone fragments in the hearth areas. Their small amounts indicate casual use of marrow; however, this conclusion seems misleading when compared to Kooyman's (2004) fracture pattern evidence of marrow extraction. Having a concentration of burned long bone fragments seems to be associated more with grease rendering than it does with marrow extraction. Frison and Stanford 1982 also seemed to confuse the two processes. The authors reported that there was an abundance of proximal humeri, tibia and distal femur sections at the Agate Basin Site. They then concluded that the bones that had been smashed beyond recognition for marrow extraction (Frison and

Stanford 1982: 270). They were unclear as to which process occurred at the Agate Basin Site. Was it marrow extraction from the humerus, tibia and femur epiphyses, or grease rendering from the unidentifiable fragments of these elements?

Grease Rendering

Grease extraction or rendering is a secondary butchering operation that can occur at a kill or a processing site. The recovery of the grease is achieved by smashing the bones into small pieces and boiling them to release the grease from within the epiphysis or shaft fragments. Because bone tissue is impregnated with bone grease, the bones need to be smashed into small fragments and cooked in heated water for an extended period of time to skim the fat from the surface of the water (Brink 1997: 260). Kooyman (2004: 199) stated that each bone element would require at least five ‘break causing’ impact blows to fragment the bone into small enough pieces to be boiled. Brink (1997: 260) discussed the distribution and variability of the fats in the bone structure, which relates to the red and yellow marrow types. It is widely accepted that the choice grease is found in the epiphyses, associated with the red marrow (Hurlburt 1977: 15).

In order to better understand element selection for grease extraction, Brink (1997: 260) conducted an experiment on the front and hind leg bones of three plains bison (*Bison bison*). The experiment included one mature male bison (6.5 years old), a sub-adult female (ca. 3.5 years old) and a sub-adult male bison (3 years old). His study was designed to “evaluate the relative abundance of fat in the three portions of each of the six major leg bones; proximal end, distal end and medial shaft of the humerus, radius-ulna, metacarpal, femur, tibia and metatarsal” (Brink 1997: 261). His results showed that there were similar percentage patterns of fat content in all three bison, and that the greatest

grease percentages were from the proximal tibia, distal femur, proximal metatarsal, distal radius-ulna and distal tibia (Brink 1997: 261). The highest fat weight percentages were in the proximal humerus and the distal femur, both yielding twice as much fat than any other bone unit. The proximal metapodials and the distal tibia are the lowest ranked fat weight bones, while the distal humerus, metapodials and radius-ulna, proximal tibia, radius-ulna and femur have intermediate fat weight (Brink 1997: 264).

Brink compared his results to that of Binford's (1978) Grease Index, suggesting that oleic acid tends to increase distally in the leg bones of temperate and northern mammals due to the unsaturated fatty acids having lower melting points. Oleic acids are required in limb bones located furthest from the core in order to prevent them from becoming stiff in colder weather. In contrast, however, the weight of bone grease is generally greater in larger limb elements, located closer to the core (Brink 1997: 266). Jones and Metcalfe (1988: 419) added to this argument by suggesting that in times of a food shortage, skeletal elements that yield a high percentage of oleic acid will be utilized, whereas if the food is of abundance (such as a large kill site), these lower limb elements tend not to be utilized. However, bone grease was used in the further processing of meat, more specifically to make pemmican, as mentioned at the Muhlbach Site (Gruhn 1969).

Grease rendering usually takes place in conjunction with marrow extraction operations, as the bones are already being altered for the retrieval of marrow. The bones are then further smashed into smaller pieces. At sites such as Sun River (Greiser, et al. 1985), Head-Smashed-In (Brink, et al. 1986), and Muhlbach (Gruhn 1969) there are indications that grease rendering took place alongside marrow extraction. All show the presence of burned small bone fragments in relation to a hearth feature in the processing

area. Evidence of fire, such as an abundance of fire-broken rock and/or burned bone remains, is needed to confirm grease extraction.

When one compares the Hudson-Meng and Agate Basin Sites (mentioned in the marrow extraction section) with the grease rendering evidence at the Sun River, Head-Smashed-In and Muhlbach Sites, the conclusion of marrow extraction seems incorrect. Evidence at the latter sites seems to suggest grease rendering rather than marrow extraction activity. Unfortunately, as with marrow extraction, the literature fails to produce accurate physical evidence of grease rendering on individual elements at sites. What is clear is that grease extraction tends to be the last butchering process implemented, and is by far, the most destructive butchering operation performed.

The Butchering Operation

Frison (1973) summarized a generic butchering pattern that seems to be consistent, not only in the Late Prehistoric Period, but also the Early and Middle Prehistoric Periods. He stated that the butchering process seemed to change little throughout the Prehistoric periods. His defined butchering pattern serves as a guideline for this research regarding the faunal remains at the Fincastle Bison Kill Site.

Frison (1973) stated that after the bison were killed, they were first subjected to the primary butchering operation, and then further processed on site or moved to another for the secondary butchering operations, such as marrow extraction or grease rendering. He noted that the butchering operation started with the removal of the hide. Hide removal generally began at the metacarpals and metatarsals, as these are the bones that have the most direct bone-hide contact with little to no muscles laying in-between. The Casper Site, however, had an alternative hide removal process. Frison (1974) explained

that there are two main types of butchering techniques to remove the hide. The butchers can lay the bison on its side and cut the hide from one side, retrieving the other side when the carcass is flipped over (Frison 1974: 35). The other method is to place the animal in a 'spread eagle' position to remove the hide, which would result in a different layout of the bones.

With the hide removed, meat stripping could begin. Frison (1973: 39) noted that this stage involved cuts and breaks on or around the origin/insertions of the muscles in order to pull out the entire length of the muscle; and that the front legs seem to be removed first, usually separated entirely from the rest of the carcass. This is seen at the Hudson-Meng Site, for example, where Agenbroad (1978: 36) concluded that the upper forelimb butchering pattern involved the smashing the proximal end of the humerus to disarticulate the element. This was shown by the fact that 96% of the recovered proximal humeri had been smashed at the head, neck or lateral tuberosity.

The butchers would then move to the hind leg to remove the large overlying lateral muscles. The patella would be removed by chopping or smashing the major trochanter. The next strike was on the tuber coxae to chop loose the distal end of the ilium in order to release the attached muscles. The transverse processes of the lumbar vertebrae would also have been smashed to release the sub-lumbar muscles. The pelvic muscle, longissimus (hump meat and side muscles associated with the ribs and spinous processes) and the loin muscles, were also released (Frison 1973: 42). At the Ross Site, Vickers (1980) concluded that the even though the site had no distinct butchering pattern present, this activity was seen. He noted that eight of 195 identified rib elements were the proximal end, and he concluded that these ribs were cut out in sections and taken with

the meat to be further processed (Vickers 1980: 153). Striking the ribs at the proximal end will easily release the large side muscles from the carcass as this is where most muscle to bone attachments were on the rib sections themselves.

After the large side and hump muscles were removed, the neck muscles could then be retrieved and the rib briskets and internal organs. The removal of the skull from the vertebral column was common, however the actual timing of this when this butchering operation is not known (Frison 1973: 17). At some sites, e.g., Casper (Frison 1974), Boarding School (Kehoe 1996), EgPn-111 (Head, et al. 2002), and Deer Creek (Larson, et al. 1984) there is also removal of the tongue, brain and nasal cartilage, but these activities are not summarized in the general pattern of the butchering operation.

The butchers would return to the hind leg to remove it from the pelvis in one of two ways. They either smashed the head of the femur, such as at Gull Lake (Kehoe 1973) and Hudson-Meng (Agenbroad 1978), or smashed the acetabulum of the pelvis, as seen at EgPn-111 (Head, et al. 2002). The lower leg muscles would then be recovered and the separation of the upper hind limb from the lower limb would occur. A common place to separate the upper from the lower hind limb was at the tarsals-distal tibia section, found at sites such as EgPn-111 (Head, et al. 2002) and the Boarding School Bison Drive Site (Kehoe 1996). Finding both ways to remove the hind leg at a single site is also common, as is the case at the Casper Site (Frison 1974) and the Wardell Buffalo Trap (Frison 1973).

The last step in the general primary butchering operation is to flip over the bison carcass to retrieve the other side of the body muscles and the remaining hide, repeating the butchering process for forelimb and hind limb removal as well.

Specific Element Evidence

Within this section, individual elements from the axial and appendicular skeletons are discussed separately. The butchering evidence documented in the academic literature is discussed in relation to the element, and related to Frison's butchering process. To reiterate, the axial skeleton includes the following elements: skull, mandible, hyoid, cervical vertebrae, thoracic vertebrae, lumbar vertebrae, ribs, sternum (including costal cartilage), sacrum, pelvis and caudal vertebrae. The appendicular skeleton includes the forelimb elements: the scapula, humerus, radius, ulna, carpals, metacarpals and phalanges 1-3; and the hind limb elements; the femur, patella, tibia, tarsals, metatarsals and phalanges 1-3. This section follows this order, keeping with the general layout of faunal remains sections seen in the literature.

The phalanges of the forelimb and hind limb will be discussed together in the hind limb section, as these elements, when disarticulated from the metapodials, are virtually impossible to classify to a specific limb. This is a common approach to faunal analysis.

Discussions on each individual element include evidence such as articulations, impact and/or cut marks to describe what occurred during the butchering operation. In some cases, specific numerical evidence was also included. This section serves to tie together the sections above as well.

Axial Skeleton

Skull

It is commonly noted that the skulls were often left at the site as they possess little usable meat. Horn cores, however, were reported at few sites, such as Estuary (Adams 1977), Gull Lake (Kehoe 1973) and Muhlbach (Gruhn 1969). The absence of these

elements may be an indication that the horns were taken from the site to be utilized elsewhere. There are many sites that yielded a large number of UID skull fragments leading the excavators to conclude that the brain was removed, but they could not denote a specific butchering technique (Ruby [Frison 1971] and Estuary [Adams 1977]). There are however, a few sites that have specific evidence of brain removal. One way to remove the brain is to enter the skull at the temporal/occipital region. At the Agate Basin Site, for example, the brain was removed by entering the left side of a skull through the temporal fossa (Frison and Stanford 1982: 222). Similar findings were seen at the Gull Lake Site, where Kehoe (1973: 152) reported that brain removal was achieved through the base of the skull. This was done by smashing the squamous, temporal and occipital bones from below, after the removal of the mandible and tongue. At the Hudson-Meng (Agenbroad 1978) and Casper Sites (Frison, 1974), the skulls contained holes in the occipital lobe, also showing brain removal.

Other scholars argued against brain removal by smashing the occipital region. Instead, they state that the evidence on the occipital bones suggests skull segmentation from the atlas. At the Wardell Buffalo trap (Frison 1973) and EgPn-111 (Head, et al. 2002) the skull was reportedly removed by striking the occipital lobes of the skull. Head, et al. (2002: 58) stated that one occipital had a hack mark on it, while Frison (1973: 46) reported a common breakage pattern of strikes on the occipitals. At both of these sites the archaeologists offer an alternative explanation of how the brain was removed.

Frison (1973: 46) reported a chopped hole in the frontal bone for brain removal at the Wardell Site. This is a less commonly reported butchering technique, but it is supported by Agenbroad (1978: 40) at Hudson-Meng and by Kehoe (1973: 152) at the

Gull Lake Site, where they noted evidence for the breaking of the frontal bone from above to access the brain cavity.

Another way to remove the brain is to enter the skull through the maxillae/palate region. For this to occur, the skull has to be separated from the vertebral column as well as the mandibles, and flipped upside down in order to smash the palate. At the Boarding School Bison Drive Site, Kehoe (1996: 71) concluded that the skulls usually were turned upside down to smash the basal section of the cranium in order to recover the brains.

Many scholars reported smashed sections of the maxillae, but could not deduce a butchering pattern from them (Gull Lake [Kehoe 1973], Muhlbach [Gruhn 1969] and Estuary [Adams 1977]). At the Wardell Site, however, chop marks on the palate bones were reported. Frison (1973: 46) suggested that the flipping and smashing the palate region was not necessarily for the recovery of brains, but could be to recover the nasal cartilage. This suggestion seems to be more popular in the literature. There were similar findings at the Casper Site (Frison 1974) where the palate, maxillae and nasal bones were broken to gain access to the nasal cartilage were noted. Agenbroad (1978: 44) reported that at Hudson-Meng, there was evidence of maxilla fragments and some palate fragments associated with the nasal sections of the skull. This supports his theory of removing the nasal cartilage by first smashing along the suture lines of the maxillary and molar bones on both sides of the skull, and then chopping upwards toward the dorsal junctures of the sutures of the maxilla. Kehoe (1996) also reported nasal cartilage being removed at the Boarding School Site. He added an alternative method to that of Frison and Agenbroad, however, where the smashing occurred on the frontal/nasal sections of the skull to gain access to the nasal cavity (Kehoe 1996: 71).

Mandible

Butchering evidence on the mandibles relates to three distinct purposes. The first is for primary butchering (joint dismemberment) and the other two are for secondary butchering (tongue removal and marrow extraction).

There are several ways that the mandibles were removed from the skull, all of which yield specific butchering features. One method is to remove the mandible from the skull by means of smashing the temporal condyles of the skull. This results in the release and breakage of the coronoid process of the mandible (Frison 1973: 46). The Wardell Site was the only site studied that had evidence of this method. Most scholars reported a more common pattern where the coronoid processes of the mandibles was smashed for joint dismemberment, noted by some mandibles containing breaks on the diastema, such as at the Wardell Site. The EgPn-111 Site was the only site to have cut marks which resulted from the process of segmentation. Head, et al. (2002: 59) reported having many hack and cut marks on the diastema and one mark on the mandibular notch immediately below the condyle.

Kehoe (1973: 152) reported three different primary butchering techniques involved in mandibular segmentation at Gull Lake. The first and most common method, also seen at the Estuary and EgPn-111 Sites, is to place the skull on its side and then break the ascending ramus immediately below the coronoid and condyle joint. This way each mandible can be removed separately. The second method is to break the mental foramen of both halves. The anterior ends can then be separated at the symphyseal surface. The last step is to cut loose the remaining attached muscles for complete segmentation to occur (ibid). The third way to remove the mandibles, which was rarely done, is to strike below the molars. After the strike, the mandibles can be pried free,

separating them at the condyle joint from the skull. While this method is the least common, as Kehoe (1973: 153) stated, it is the most easily recognized due to the obvious smash marks left on the bone. Evidence at the Estuary Site (Adams 1977) may support this less common method. The 16 mandibles split anterior to the first premolar all have evidence of being split longitudinally, below or through the root sections of the teeth (Adams 1977: 91). Once the mandibles were removed from the skull, secondary butchering processes could take place.

The tongue is known to be a delicacy among modern groups and scholars assume that this was true for ancient societies as well. It may have been consumed at the site during the butchering operation, or processed later. There is less physical evidence for tongue removal when compared to joint dismemberment; however, most authors mention this as part of the secondary butchering operation. Frison (1971) and Kehoe (1996) stated that tongue removal occurred at the Ruby and Boarding School Sites but they offered little physical evidence to support their claims. At Hudson-Meng, Agenbroad (1978: 44) concluded that tongue removal probably occurred based on the fact that over 70% of the recovered mandibles were broken at the ascending ramus. Head, et al. (2002: 59) noted similar breakage patterns at EgPn-111. Kehoe (1973: 152) reported a consistent breakage pattern of separating the mandible along the sympheseal surface, which aided in the removal of the tongues. Furthermore, the mandibles at the Casper Site contained a few cut marks on the medial side in order to cut the mylohyoideus muscle that holds the tongue to the hyoid bones (Frison 1974: 48). Similar cut marks were reported at Deer Creek (Larson, et al. 1984) and the Wardell Site (Frison 1973). Cut marks were also recorded on 19 separate mandibles at the Estuary Site but Adams (1977: 92) did not

indicate which specific butchering operation they belonged to. They could be connected to joint dismemberment, tongue removal or marrow extraction.

The third use of the mandibles is to obtain the marrow from them. Very few sites in the reviewed literature mentioned this secondary butchering operation. The reports from Estuary (Adams 1977), EgPn-111 (Head, et al. 2002) and Gull Lake (Kehoe 1973) are the only ones to document that the mandibles were further utilized for marrow extraction. All three scholars reported similar physical evidence of reducing the ramus section (either at the ascending, lateral, posterior or horizontal borders) of the mandibles into smaller pieces in order to obtain the small amount of marrow available.

Hyoid

The hyoid bone is associated with the tongue. It is a fairly accurate assumption that hyoids with butchering evidence on them attest that the tongues were taken from the carcass and further processed. Many scholars reported the hyoids being absent at the primary butchering site, indicating that they were removed with the tongue and further processed elsewhere. In contrast, Brink and Dawe (1989: 144) concluded that with the near absence of hyoids recovered in the processing area, the tongues were removed at the kill site. This may support the idea that the tongues were consumed while the primary butchering occurred. There are a few sites in the literature that yielded hyoids, two of which had physical butchering evidence. At the Estuary Site 26 complete hyoids were recovered (Adams 1977: 91), while EgPn-111 yielded a fairly high number of hyoid shaft fragments (NISP = 61) (Head, et al. 2002: 49). The distal ends of the hyoids were missing at the Casper Site, leading Frison (1975: 48) to conclude that they were probably

being removed with the tongues. Frison (1973: 46) also reported this pattern at the Wardell Site.

Cervical Vertebrae

The cervical vertebrae section of the spinal column has seven individual elements that together make up the neck portion of the spine. Cervical 1 (C1) is classified as the atlas, which articulates with the skull. C2, the axis, allows the head to ‘swivel’ from side to side. C3 has similar characteristics, though C7 is different as it is a transition bone that bears similar body and transverse process characteristics to articulate with the thoracic vertebral column elements that follow. C7 has a large spinous process in comparison to C3 because it is associated with the hump meat of the bison. The atlas and axis bones can be classified as unique bone element, and have been separated out in this analysis.

As already noted in the skull section, one common way to remove the skull from the vertebral column is to strike the occipital bones. Alternatively, the skull can be removed from the atlas by smashing sections of the atlas to release the occipital condyles from the joint capsule. This was found at EgPn-111 (Head, et al. 2002) and at the Wardell Site (Frison 1973). Also seen at both the sites and EhPp-1 (McIntyre 1978), was the joint dismemberment of the atlas from the axis. Head, et al. (2002: 70) described this separation as smashing the anterior dens (the articular process) of the axis, while Frison (1973: 46) noted the chopping off of the atlas wings as well as the dorsal spine of the axis in order to pry the joint apart. These methods of skull removal may be valid, but there is an absence of evidence attesting to skull and atlas bone units in articulation and atlas bone elements with butchering evidence. At the Gull Lake Site, however, Kehoe (1973: 153) noted that the skull was removed by cutting the axis and atlas juncture. The anterior

articular processes of the axis had cut marks, showing joint dismemberment, with the axis bearing more butchering evidence than the atlas (*ibid*). Similar findings were seen at the Hudson-Meng Site, where Agenbroad (1978: 40) documented that 100% of the atlas and axes had breaks associated with joint dismemberment. Moreover, the axes were left in association with the other cervical vertebrae, while the atlases were recovered in close proximity to the skulls.

Despite how the skull was removed, the butchers would retrieve the neck muscles if desired. Because a small amount of meat is associated with the C1-6 elements, several articulated cervical vertebrae units have been found at several sites. The articulating units range in terms of which elements are present, with no two sites sharing the same features. There is, however, some degree of commonality, and many sites indicate these articulations as belonging to a primary butchering operation, e.g., EgPn-111 (Head, et al. 2002), Vista Rock Shelter (Wood 1968) and Muhlbach (Gruhn 1969). Common articulations of the cervical vertebrae at EgPn-111 included several C2-4 elements together and C3-6, and in one case, C2-6 (Head, et al. 2002: 60). They also noted that there was a large C3-7 articulation that had a unique butchering pattern to it. On each of the cervical vertebrae the left transverse processes were removed, suggesting that the neck muscles were stripped from the left side of the animal as it lay. The right side was not utilized, as the transverse processes were all intact and bore no physical evidence of butchering (*ibid*). The Wardell and Gull Lake Sites were the only other sites in the reviewed literature that had similar physical evidence to EgPn-111.

Thoracic Vertebrae

The thoracic vertebral column section contains 14 individual elements and is classified as the mid-section of the vertebral column. All 14 elements have similar characteristics, with a robust body section, large transverse processes that articulate with the ribs, and a thick spinous process. The main difference seen in the thoracics is the spinous process length which decreases as they get further away from the head. This is due to the nature of the back muscles and where they attach. Thoracic 1-5 (T1-5) have large spinous processes, whereas T6-9 have a slightly smaller (shorter) process. This is where the hump meat muscles originate and insert onto the bones. Thoracic 10-14, show more distinct changes in spinous height and thickness, and has smaller spinous processes. Thoracic 14 is also a transition bone. Its characteristics change slightly from the main body shape and bear more lumbar vertebrae features. For example, the anterior articular processes differ in shape from the general smooth gliding joint to a more rounded articular clasp joint.

Joint dismemberment did occur, but was rarely documented. At the Agate Basin site cut marks and breakage patterns located not only at the base of the spine but also between the articular processes were noted by Frison and Stanford (1982: 220). The cuts on the articular processes were probably related to joint dismemberment, whereas the marks on the spinous processes were for meat removal.

It is common to find the thoracic vertebrae in various articulated units at a site. This attests that primary butchering was the main butchering operation associated with the thoracics. The evidence at the EgPn-111 and Muhlbach Sites supports this. The Wardell Site, however, had a common vertebral column articulation that differed significantly from the others found. Frison (1973: 48) noted that in several cases, the

entire T1-14 was in articulation, with the C7 as well as the 1st and 2nd lumbar vertebrae (L1 and L2). The thoracics are bulky, and other than the spinous processes themselves, bear little use to the butchers. As a result, they were left at the primary kill site. At most sites having an abundance of thoracic vertebrae, the majority of the spinous processes were removed from the element. For example, at the Estuary II Site, Adams (1977: 93) reported that 94 of the 97 recovered thoracics had their spinous processes removed. Furthermore, 29.8% of the 94 had the spines removed between $\frac{1}{4}$ and $\frac{1}{2}$ the way up the spine, while the other 70.2% were severed at the base of the spine (ibid). This butchering pattern of removing the spinous process at the base of the spine was recorded in the literature, and was related to the hump meat removal process. Sites such as EgPn-111, Gull Lake, EhPp-1 and Casper all have evidence of meat removal similar to that of the Estuary Site.

There are few cases, however, that evidence that secondary butchering processes occurred on the thoracic vertebrae. The Head-Smashed-In bone bed (Brink and Dawe 1989: 144) contained four complete but disarticulated thoracic vertebrae, a rare find. This attests that a secondary butchering operation occurred not only because they were disarticulated from all other elements, but also because the spinous processes were still attached. Detailed meat removal was done by not removing the spinous processes. At the Estuary and Deer Creek Sites, there was evidence of secondary butchering on the actual spinous processes. Larson, et al. (1984: 76) summarized that there were cut marks on both the articulated and disarticulated thoracic elements at the Deer Creek Site. Some of the cuts were located on the base of the spine while others extended longitudinally up the length of the spine, showing a more detailed cutting operation occurred.

The interesting butchering pattern that was found at the EgPn-111 Site with regard to the cervical vertebrae was also seen in the thoracic section. Head, et al. (2002: 61) reported having a T8-12 articulation with only the left transverse processes removed. The right side processes were intact. Again they concluded that the left side of the body was utilized and the right side was untouched. This suggests that an overkill situation occurred. The butchers must have had plenty of meat so did not need to flip the bison carcass over to retrieve the rest of it.

Lumbar Vertebrae

There are five individual lumbar vertebrae elements classified together as the lower back. Lumbar 1-5 (L1-5) are consistent in shape and size, all having a short spinous process and long and thin transverse processes. The only subtle change is in the body, where L1 is a more rounded shape (consistent with the thoracics), while L5 has a more oval shaped posterior body because it articulates with the sacrum. The transverse processes are distinct in comparison to the other vertebral column elements. They are associated with several smaller muscle attachments, mainly the sub-lumbar muscles (deeper muscles).

There is little butchering documentation in the literature relating to the lumbar vertebrae. It seems that most scholars did not report the presence of lumbar vertebrae. This could be for two reasons: 1) the absence of lumbar vertebrae at the sites; or 2) no butchering evidence was found on the bones so they were not mentioned. Adams (1977: 92) reported no lumbar fragments recovered in Level One, and only six fragments in Level Two of the Estuary Site. No butchering evidence was recorded with the recovered lumbar elements from Level Two. This implies that the former assumption is correct.

The connection of the lumbar vertebrae to primary butchering activities is seen at two sites. At the Wardell Site, Frison (1973: 46) reported that some of the L1 and L2 spinous processes were removed, probably at the same time as the thoracic spinous processes for quick meat extraction. Kehoe (1973: 153) concluded that the transverse processes were broken and removed with the side meat from the Gull Lake Site to be further processed. At the EgPn-111 Site, Head, et al. (2002: 61) reported the same primary butchering pattern as Kehoe. The sub-lumbar muscles containing the removed transverse processes were taken away for further butchering.

Secondary butchering can occur on the lumbar vertebrae but it is rarely documented. The Casper Site is the only site reviewed to have lumbar associated with a secondary butchering operation. Frison (1974) noted that the butchers seemed to take more time on the sub-lumbar muscles, shown by the majority of the lumbar vertebrae being left fully intact with the complete transverse processes attached (Frison 1974: 45) at the site.

Ribs

The ribs are a part of the axial skeleton that articulate with the thoracic vertebrae, and are associated with the sternum. They attach to the sternum with cartilage. There are 14 right and 14 left elements, with Rib 1 (R1) articulating with T1, and so on. There is some variance seen in the physical structure of the ribs. R1 has the shortest shaft length, and is also the thickest. It has a distinct robust distal end and also has a thick tubercle and head on the proximal end. Ribs 2-4 also have short shafts, but are thinner than R1; all have thick tubercles and heads. Ribs 5-13 all have long shafts with a fairly consistent thickness. The proximal ends on these ribs change from large to small as they move

further away from the cranial section of the animal. Ribs 5-7 have large tubercles, R8-10 have medium sized ones and R11-13 have small tubercle articular surfaces. In relation to the head size, R5-10 have medium heads (smaller than R1-4), and R11-13 have small heads. Rib 14, differs only in the shaft size, as it is shorter than R13 but has the same proximal head and tubercle characteristics to it.

Ribs are documented at every butchering site. This is because there are a large number of elements in each bison (28 in all), they are quite large in size, and are easy to break which results in more fragments. Most sites had a large number of rib fragments compared to complete ribs. This can be related to both primary and secondary butchering, or to taphonomic processes. With that said, it is easy to distinguish between the two butchering operations by faunal analysis.

Joint dismemberment is not a commonly documented occurrence; however, most of the sites reviewed showed primary butchering breakage on the ribs themselves. At EgPn-111, Deer Creek, Gull Lake, Ruby, Casper and Agate Basin, the proximal ends of the ribs were commonly in articulation with the thoracic vertebrae. Many bore evidence of smashing immediately below the proximal end of the rib to separate it from the shaft. However, at the Casper Site and Agate Basin, an alternative method of separating the proximal end from the shaft was documented. At the Casper Site, Frison (1974: 45) proposed that the ribs were rarely chopped off, but were pulled or snapped loose. Frison and Stanford (1982: 220) concluded that the snapping technique at both the Casper and Agate Basin Sites had distinct breakage patterns, differing from a smash mark. Whether smashed free or snapped loose, the ribs were separated.

Another common find between the sites is that most have few to no complete ribs but a large number of rib shaft fragments. There are also a few sites where rib shafts were smashed further into the shaft, which could possibly indicate more of a secondary butchering operation.

At the Wardell Site, for example, Frison (1973: 46) remarked that it was common to find rib shafts smashed free from the proximal end, several inches into the shaft. This could have been for bulk meat removal, but it can also indicate a more intense, detailed meat removal operation to collect the inter-costal muscles. At the EgPn-111 Site, Head, et al. (2002: 102) documented a rare find, where the proximal end was separated from the shaft a few inches down, leaving the mid-distal section of the shaft largely untouched. He also noted that the ribs had a variety of cut marks. EgPn-111 and Deer Creek, both document having cut marks near the proximal end, concluding that they attest element separation. However, both sites also concluded that there were cut marks connected with meat removal. Larson, et al. (1984: 77) remarked that many ribs from Deer Creek contained cut marks on both the internal and external surfaces of the rib shafts. This is an indication that a more detailed secondary butchering operation took place, where the butchers took the time to remove the inter-costal muscles.

Sternum and Costal Cartilage

The sternum is the breast bone of the skeleton. It is a thin flat element that is associated with the ribs, which are connected to them with costal cartilage. Cartilage is defined as “a type of connective tissue consisting of chondrocytes in lacunae embedded in a dense network of collagen and elastic fibres” (Tortola 1999: 846). It is not as dense as bone, and can deteriorate quickly at a site depending on the depositional environment.

Cartilage preservation is either classified as excellent (present) or not, amounting to no preservation.

There are few references for either element in the archaeological record. This is probably due to their structure. The sternum is so thin that preservation is rare. It could have been broken into unidentifiable pieces, or taken from the site with the brisket. At the Wardell Site, Frison (1973: 46) mentioned a breakage pattern of ribs in relation to removing the brisket; however, he concluded that the sternum was absent from the bone bed. He also reported similar brisket removal patterns at the Casper Site but made no mention of the sternum (Frison 1974: 45). At the Agate Basin Site, Frison and Stanford (1982: 220) noted that the sternum and costal cartilage were “conspicuously absent in the bone beds and were probably carried away” for further processing. Interesting, this is the only mention of cartilage in the reviewed literature.

As mentioned above, cartilage can deteriorate like other perishable material such as leftover meat, sinew or hide. In some cases, however, cartilage can preserve well, though no known literature documents this. Alternatively, many sites document the presence of fetal bone. At sites such as Estuary, Ruby and Head-Smashed-In, to name a few, fetal bone was present. While this may be the case, differentiating between fetal bone and cartilage is difficult. It may be possible that fetal bone has been miss-identified in the archaeological record as these particular elements have similar characteristics. Recovered cartilage has a ‘spongy’ look to it, and fetal elements bear a similar makeup as it grows into hard compact bone. This would account for its absence in archaeological reporting.

Sacrum

The sacrum consists of five vertebrae that fuse together after the first few years of the animal's life. Head, et al. (2002: 61) indicated that portions of unfused Sacrum 1-5 (S1-5) were found at EgPn-111 as well as fused S1-2 sections. The sacrum articulates with L5 of the vertebral column and the 1st caudal vertebra (Ca1). The sacrum bears little to no useable meat, therefore it has limited butchering evidence associated with it.

A few sites, mention was made of the recovery of sacral fragments (Muhlbach [Gruhn 1969] and Estuary [Adams 1977]). The Boarding School Site and EgPn-111 have brief element segmentation butchering patterns where the sacrum was struck at the top section to release it from L5. Head, et al. (2002: 63) also reported that many of the recovered sacra were in articulation, with the lumbar vertebrae, ranging anywhere between L1-4 to S1-2. The Wardell Site was the only site to indicate two distinct sacrum lumbar joint dismemberment practises. Frison (1973: 48) concluded that the lumbar vertebrae were separated from the sacrum by: 1) chopping the top of the sacrum, more specifically in the dorsal direction into the transverse processes from both sides of the sacrum; or 2) chopping in the ventral direction directly into the body of the sacrum, presumably after the large longissimus muscle had already been removed.

Caudal Vertebrae

The caudal vertebrae articulate with the sacrum and make up the tail of the animal. There are ten caudal vertebrae altogether that range in size and shape. Caudal 1-2 (Ca1-2) have large body sections with pronounced transverse processes. Caudal 3-6 show a decrease in body size. They are classified as medium bodied, with little transverse processes. The Ca7-10 elements have small body structures, and have no

processes associated with them at all. Each element decreases in size as it moves away from the head of the animal.

Caudal vertebrae, though mentioned at most sites, are rarely present. Many sites conclude that the absence of caudal vertebrae recovered means they were removed with the hides and taken elsewhere. During quick hide removal the tails are also taken, and either discarded later or used with the hide. They also could have been used as artefacts. Kehoe offered an alternate explanation to the low numbers of caudal vertebrae at the Gull Lake Site. He noted that they may have been removed with the hide (1973: 153), but also proposed that they were removed at the site prior to taking the hides away from the site. This could indicate that detailed hide removal, a secondary butchering operation, occurred at the site. With the absence of physical evidence on the bones, however, this remains speculative.

Pelvis

The pelvis is the last section of the axial skeleton to be discussed. It contains a left and a right side that articulate together at the pubis symphysis. The hind limb is also in articulation with the pelvis via the femur. The reviewed literature points to two ways in which to separate the pelvis from the femur.

The first and more common joint dismemberment method is to strike the pelvis, mainly on the acetabulum. The acetabulum contains three sections that form a capsule known as a ball and socket joint. The ball and socket joint is the strongest type of joint in the skeleton, which houses the femoral ball. In order to completely separate the femur from the socket joint, the acetabulum must be smashed through. At EhPp-1, EgPn-111

and the Boarding School Sites, evidence suggested that the acetabulum was the most frequent section of the pelvis struck for joint dismemberment.

At the Gull Lake and Carter/Kerr-Mcgee Sites, joint dismemberment occurred not only on the pelvis, but also on the femur, which is the second joint dismemberment method.

A few sites document the removal of the pelvis/femur joint by striking the neck or shaft of the femur, thus leaving the proximal end in articulation with the acetabulum. Agenbroad (1978) noted that there were several pelvis portions articulated with the femoral heads found throughout the bone bed at the Hudson-Meng Site. Either way, the joint was disarticulated in order to strip the meat from the bone.

It is not clear as to how the meat was stripped, as some of the larger overlying muscles would have to be stripped prior to the removal of the hind leg, while other muscles were removed after the joint dismemberment occurred. This is best understood in Frison's generalized butchering operation as outlined above. Several sites do document evidence for meat removal from the pelvis. However, at the Wardell Site, Frison (1973: 46) described the cutting loose of the tuber ishium (or the entire distal end of the ishium), which aided in the removal of the large posterior and medial hind limb muscles. In order to chop the pubis loose, aiding access to the sacrum, the butchers would force an internal rotation of the entire pelvis unit. This operation was done in order to recover the smaller, more internal muscles. The Estuary, Ruby, Muhlbach and Casper Sites all have similar evidence of this process. There were several fragments of the ishium and ilium recovered. At EgPn-111, Head, et al. (2002: 66) reported that pelvis elements as a whole had a high degree of fragmentation (NISP = 241), with the one

exception of a complete pelvis unit (both the left and right sides still in articulation) and one nearly complete unit. The complete element bore three hack marks on it: two were located on the distal ishium, and one on the ilium, near the acetabulum (ibid). These impact marks are characteristically similar to other sites showing meat removal. These butcher marks suggest that the meat was recovered from this carcass without breaking the bones.

Appendicular Skeleton – Upper Forelimb

Scapula

The scapula is a large flat bone that is bulky, and was generally left at the kill site after the primary butchering of meat retrieval was performed. Most of the literature reviewed regarded the scapula as a discarded bone element; however, it was used as an agricultural tool in later time periods, such as at the Vista Rock Shelter (Wood 1968: 175).

Frison (1973) mentioned that in the butchering operation, the forelimb was usually fully removed from the rest of the carcass. Many of the reviewed sites showed similar operations, e.g., Boarding School (Kehoe 1996), Wardell (Frison 1973), Estuary (Adams 1977) and EgPn-111 (Head, et al. 2002). The forelimb was removed in different ways. With regard to the Estuary Site, Adams (1977: 102) concluded that the forelimb was either removed by: 1) lifting the entire leg and striking the scapula; or 2) first extracting the lateral tuberosity and then breaking the scapula to ensure its full removal. Other sites suggest that the joint separation and limb removal occurred at the scapula/humoral joint. Head, et al. (2002: 63) said that separating the scapula from the humerus involved striking the glenoid fossa, acromion and the upper borders of the flat

blade. At the Hudson-Meng and Casper Sites, an alternative method of scapula/humeral joint separation was found. At the Casper Site, Frison (1974: 36) noted that the humerus was chopped at the proximal end, immediately below the articular surface. Almost all of the recovered scapulae at the site were complete, with little to damage on them from primary butchering (ibid). The Wardell Site (Frison 1973: 39) had three scapulae bearing cut marks that relate to the joint dismemberment process. Frison mentioned that the cuts were probably for meat removal before the joint separation occurred.

The scapula has several muscle attachments near its head, neck and spine. Several sites documented evidence of breakage patterns and cut marks aiding in meat removal from the scapula. Frison (1973) documented striation marks around the supraspinous and infraspinous fossae at the Casper Site, while Adams (1977) and Larson, et al. (1984) concluded that the glenoid fossa had cut marks on it, probably aiding in the removal of the attached muscles. Both the spine and glenoid fossa are where muscle attaches to the scapula. Head, et al. (2002) noted that after the leg was disarticulated, the scapula blade sections were removed from the upper front limb and neck muscles at the site.

Only at Gull Lake was there evidence of the scapula being further processed for marrow extraction. The head (distal section of the element) does contain higher grease contents than the flat blade sections. Kehoe (1973: 153) documented that the infraspinous and the supraspinous fossae on both sides of the spine had a sub-triangular pattern to them (ibid). Although not extremely convincing, breakage near the neck and head sections of the scapula would expose the small amount of marrow. Whether the break patterns were created due to this secondary butchering activity remains debatable.

Humerus

The humerus is the largest bone in the fore leg. It has the thickest diaphysis and epiphysis of any of the skeletal elements because it is a major weight bearing bone of the body. It articulates with the scapula on the proximal end and with the radius/ulna on the distal end. The humerus is connected with both primary and secondary butchering operations. In many cases, the primary butchering evidence is destroyed by the secondary butchering operations.

Evidence of joint dismemberment is strong however. Already discussed in the scapula section, the proximal articular surface of the humerus was more commonly disarticulated by smashing the scapula, even though one case had evidence of the proximal humerus being smashed for removal. For separation of the humerus/radius/ulna joint, however, the ratio of distal humerus recovered compared to proximal ends is higher. For example, at the Estuary Site, Adams (1977: 94) reported that there were four proximal epiphyses recovered compared to 18 distal ends. All 22 elements were broken as close to the epiphysis as possible, which shows breakage for joint dismemberment. Similar ratios were found at EgPn-111 (23 distal to 5 proximal) (Head, et al. 2002: 53), while an astounding distal/proximal ratio was recorded at Head-Smashed-In (146 distal to 21 proximal) (Brink and Dawe 1989: 107). These ratios may be associated with the secondary butchering process of grease extraction. The proximal end of the humerus contains more grease than the shaft and distal epiphysis, thus being further processed and less evident at a site.

Fractures and impact marks associated with joint dismemberment compared to marrow extraction or grease rendering differ (see the fracture pattern section of this chapter). At the Agate Basin Folsom level bone bed, for example, Frison and Stanford

(1982: 220) mentioned two distinct fracture patterns recovered on the humerus. The first is a depressed fracture from a heavy blow on the neck or head. This break is characteristic of joint dismemberment. The second, more common breakage pattern recovered was a fracture located between the centre of the shaft and the deltoid tuberosity. The authors concluded this to be evidence of marrow extraction. At most sites, there was marrow extraction occurring on the humerus, e.g., Casper (Frison 1974), Agate Basin (Frison and Stanford 1982), Muhlbach (Gruhn 1969), EhPp-1 (McIntyre 1978), Vista Rock Shelter (Wood 1968) and Estuary (Adams 1977). However, they failed to record the physical fracture pattern, which should be a common feature on all of the appendicular long bone elements. There are a few sites, however, that document marrow extraction well.

Adams (1977: 94) noted marrow extraction evidence at the Estuary Site by impact marks located approximately 5 cm above the distal epiphysis (on the lateral side) that formed a split down the shaft. Similarly, Gruhn (1969: 137) reported that at Muhlbach, the distal shaft was commonly broken off, with a diagonal break approximately 10-20 cm into the shaft, making it easy to access to the marrow cavity. Finally, McIntyre (1978: 120) suggested that marrow extraction occurred at the EhPp-1 Camp Site. He had evidence of a distal section with a spiral fracture pattern running up the shaft. He also mentioned that the shafts were reduced, probably for grease rendering purposes.

It is interesting that few sites mention the use of the humerus for grease extraction. This is noteworthy considering the proximal humerus is one of the top-ranking grease-producing bones (Brink 1997). Many sites had a few humerus fragments, but authors failed to connect these data to the butchering process. Most authors

generalized the grease extraction process as part of the 'long bone' category (see Appendix I), and attributed the absence of recovered epiphyses (and sometimes the absence of the shaft as well) with grease rendering. At the Vista Rock Shelter, however, Wood (1968: 175) noted that the recovered humerus shaft fragments had impact mark evidence on them, indicating that marrow and grease extraction did, in fact, occur at the shelter. Archaeologists must separate butchering evidence from carnivore chewing marks, as the high content of grease in the epiphyses of the long bones also attracted animals.

Radius

The radius is another thick-shafted long bone that acts as a weight-bearing bone in the forelimb. It articulates with the humerus, ulna and carpals. However, its articulation with the ulna is unique. At the proximal end, the radius and ulna together form the hinge joint of the upper leg with the distal humerus. The radius/ulna joint fuses together upon animal maturity. In contrast, the distal end of the ulna is actually fused to the distal shaft of the radius, and has no relation to the articulation of the carpals. The radius is also a bone that is usually fully processed in both primary and secondary butchering operations.

For joint dismemberment, the radius has a less frequent butchering pattern compared to the humerus in the archaeological record. There were some articulated units found at sites, which mainly consist of the distal epiphysis with the carpals at EhPp-1, Gull Lake and Muhlbach. Kehoe (1973: 154) reported having a relatively large number of lower forelimb articulated units at Gull Lake, consisting of the distal radius/ulna to the phalanges. He suggested that the lower leg was not utilized because the site was in time of 'plenty'. In the Folsom level at the Agate Basin Site there were several articulated

units, consisting of the left distal humerus and proximal radius/ulna, probably from joint dismemberment (Frison and Stanford 1982: 221). Regardless of the articulations, both the proximal and distal disarticulated epiphyses are relatively equal in recovered butchering units. Head, et al. (2002: 53) reported a high frequency of proximal radius portions ($n = 26$ proximal compared to 10 distal elements) at EgPn-111, and concluded that for this joint dismemberment to occur all three elements involved (radius, ulna and humerus) had a high degree of fragmentation to them from smashing the joint free. This may explain why few proximal articulations were recovered. However, some sites had a close ratio of proximal to distal ends. For example, at the Estuary Site, Adams (1977: 94) reported 23 proximal to 18 distal epiphyses, and one complete element. At the Wardell Site, distal epiphyses outnumber proximal portions. Frison (1973: 42) reported that at this site, the radius was split in two separate pieces, showing that the front leg was removed toward the distal end. No site had specific fracture patterns for joint dismemberment, but many had evidence of secondary butchering.

Marrow extraction from the radius was found at several sites, including Estuary, EgPn-111, Agate Basin and Muhlbach. At Agate Basin, Frison and Stanford (1982: 220) reported that marrow was recovered by smashing the posterior proximal end of the radius. This occurred by either first removing the ulna from the radius, or by smashing the ulna into the radius at the same time as opening the marrow cavity. The Muhlbach Site was the only one with a consistent breakage point within the shaft, probably for the recovery of marrow. Gruhn (1969: 137) concluded that the proximal and distal ends were relatively even in frequency, both ends bearing a fracture approximately 10 cm into the shaft. Alternatively, the only site at which the radius was further utilized for grease was

EhPp-1. McIntyre (1978: 121) concluded that grease extraction took place at the Camp Site, shown by a shaft section containing smash marks on the mid-posterior lateral surface.

Ulna

The ulna, as described in the radius section, articulates with the humerus and the radius. Its purpose is not for bearing weight but for joint movement and stability at the proximal end. It is also a major muscle attachment area.

Most of the authors suggest that meat removal and not joint dismemberment or secondary butchering were dominant with regard to the ulna. More often than not, as mentioned above, the radius was the bone that yielded evidence of joint dismemberment from the humerus. However, a few authors did report the ulna being separated from the radius, e.g., Gull Lake (Kehoe 1973), Vista Rock Shelter (Wood 1968 and Estuary (Adams 1977). At the Estuary Site, for example, Adams (1977: 95) noted that the ulna was deliberately separated from the radius in different ways. Out of 23 recovered ulnae, seven were missing the olecranon epiphysis, 11 had the shaft broken near the proximal end and 12 were smashed close to the radial junction. Of these last 12, four of the distal olecranon ulna sections had butcher marks on the anterior and posterior surfaces, indicating that meat removal occurred (ibid).

Adams was not the only one to report that the olecranon, the attachment point for the triceps muscle, was butchered for meat removal. Casper, EhPp-1, Muhlbach, EpPn-111 and Gull Lake, all had the olecranon either butchered or completely missing, presumably carried away with the meat for further butchering. At the Gull Lake Site, Kehoe (1973: 154) noted that the olecranon was smashed free at the proximal end's

cubitus joint near the humerus. McIntyre (1978: 120) reported another butchering pattern at EhPn-1. There, the butcher marks were on the semilunar notch and the shaft in order to free the olecranon and triceps muscle.

Appendicular Skeleton – Lower Forelimb

Carpals

The carpals are a collective unit consisting of six separate bones. They each have two names associated with them. The first name, which is used in the Fincastle analysis, is an individual name that closely relates to other mammal skeletal structures (for example, humans). The second name, which is listed here in parentheses, is a more specific description of where the actual element rests in the skeleton. Both names can be interchanged, and they are both used throughout the literature.

There are two layers of carpals, each containing three individual elements. The upper row (described from the lateral to medial) which articulates with the radius includes the scaphoid (radial carpal), lunate (intermediate carpal) and cuneiform (ulnar carpal). Directly below this row (also lateral to medial respectively), lays the magnum (fused 2nd and 3rd carpal), and unciform (4th carpal), and posterior to these is the pisiform (accessory carpal). The scaphoid-lunate-cuneiform elements are all situated in a row, whereas the magnum-unciform-pisiform creates a more of a triangular shape that articulates with the metacarpal.

The carpals are a critical juncture because they separate the upper from the lower forelimb. There is little usable meat associated with the carpals, thus are commonly left at the kill sites. Very few sites document any butchering evidence relating to these elements, and many sites fail to even mention that carpals were recovered from their site.

At sites such as EgPn-111 and Gull Lake, carpals in articulation with the lower limb elements were reported. Other sites, however, showed some butchering evidence that was more related to joint dismemberment and the primary butchering operations of cutting the ligaments that hold together the upper and lower limb sections. At the Wardell Site, Frison (1973: 42) reported cut marks on a scaphoid element, and concluded that this was probably due to cutting the lateral ligament of the leg. Very similar findings were noted at the Casper Site (Frison 1974). At the EhPp-1 Site, McIntyre (1978: 118) reported a single lunate that had butchering evidence on its proximal articulation surface as well as a scaphoid that was butchered between its medial and lateral sides (McIntyre 1978: 121). He concluded that these marks demonstrated joint separation directly on the carpals, and not on the radius or metacarpal, which is a different butchering technique relating to joint dismemberment. Interestingly, the lunate is a rare element to bear butchering marks as it is located in the middle of the three upper row carpals. It would have to have been already separated from the radius in order to strike it on the proximal articulation surface.

Metacarpal

The metacarpals are located in the lower limb and articulate with the lower row of carpals (magnum, unciform and pisiform) and the 1st phalanx (both the medial and lateral phalanx). As previously mentioned the metacarpal yields little usable meat and is commonly in abundance at the kill sites. It was common to find the metacarpals in articulation with other lower limb elements, and many sites yielded a high percentage of complete metacarpals, e.g., Boarding School (Kehoe 1996), Estuary (Adams 1977) and

EgPn-111 (Head, et al. 2002). However, these elements had primary and secondary butchering evidence associated with them.

Metacarpals are a good place to start hide removal, as is outlined by Frison (1973) in his butchering operation. Sites such as EgPn-111 (Head, et al. 2002: 66), Estuary (Adams 1977: 95) and Agate Basin (Frison and Stanford 1982: 227) had cut marks on the shaft section of the bone, where the skin-to-bone contact is thinnest. Cut-mark evidence on the bones is more characteristic of hide removal, whereas element section ratios would be more indicative of joint removal or marrow/grease extraction.

As mentioned in the radius section, a few sites evidence the lower limb being removed at the bottom of the radius. There are some sites, however, that relate the proximal metacarpal epiphyses to joint dismemberment. For example, Adams (1977: 95) reported having 16 proximal epiphyses, compared to nine distal ends. He also reported 16 complete metacarpals, thus indicating that various lower leg removal operations occurred at the Estuary Site. An interesting observation was mentioned at the Hudson-Meng Site in relation to breakage patterns for joint dismemberment. Agenbroad (1978: 37) proposed that the lower fore and hind limbs were removed fairly consistently from the carcass. The Breakage patterns were similar in style, with 22% of the metacarpals broken at the proximal end in comparison to 19% proximal metatarsals. This makes sense considering both fore and hind lower limbs are similar in structure and meat capacity. It is difficult to relate his finding to other sites, since many reports combine the two elements in analyses under the rubric 'metapodials'. The Vista Rock Shelter and the Muhlbach Site both yield evidence of breaks on the metapodials. Gruhn (1969: 137) mentioned that a common breakage point on the metapodials was located between 10 and

20 cm on the shaft at the Muhlbach Site, but was probably not for joint dismemberment but more for secondary butchering operations.

Authors mentioned that the metacarpals (or metapodials) were used for marrow extraction (Adams 1977, Wood 1968, Kehoe 1973 and Head, et al. 2002), but the Muhlbach and the Agate Basin Sites were the only sites that presented evidence of this process. Similar to the findings of Gruhn (1969), Frison and Stanford (1982: 227) reported that a left distal metacarpal bore a spiral break originating near the centre of the shaft.

Grease rendering was mentioned in relation to metapodial elements at only one site in the reviewed literature. At EgPn-111, Head, et al. (2002: 66) mentioned that due to few shaft fragments recovered ($n = 2$), there was a high possibility that marrow and grease extraction was an operation performed by the butchers at EgPn-111.

Appendicular Skeleton – Upper Hind limb

Femur

The femur is the largest bone in the bison skeleton but it is not as thick as the humerus. Like the humerus in the forelimb, the femur is the major hind limb weight bearing bone. It articulates into the pelvis, with the head of the femur (femoral ball) acting as the ball of the 'ball and socket' joint, which allows for a strong yet mobile movement in the leg. The distal femur is associated with the patella and articulates with the tibia. The femur is a highly processed bone in butchering as it is involved with joint dismemberment, meat removal and marrow/grease extraction.

Frison (1973) explained that the large overlying muscles have to be removed prior to joint dismemberment. After the muscles have been removed, there are a few ways to

remove the femur from its articulating elements. As discussed, the femur can be removed from the pelvis in two ways: at the pelvis (see the pelvis section), or at the proximal femur. There are a few sites where the head of the femur was smashed in order to separate it from the pelvis. At the Hudson-Meng Site, for example, Agenbroad (1978: 37) reported joint separation by striking the proximal epiphysis. At the Casper Site, it was noted that all but two femorae were heads removed from the acetabulum (Frison 1974: 41), and Kehoe (1973: 154) reported a common occurrence of the head of the femur being broken off for joint separation at the Gull Lake Site. Interestingly, McIntyre (1978: 119) reported that the EhPp-1 Camp Site lacked proximal femur epiphysis, indicating that they were removed and left at the kill site.

How the femur and tibia were separated is less frequently recorded. At the Ruby Site, a common breakage unit involving the distal femur and proximal tibia (Frison 1971: 83) was reported, but this added no additional information to this pattern. However, Frison (1974: 41) mentioned that at the Casper Site, the distal trochlea was often smashed in order to remove the patella. Frison also mentioned that a breakage pattern was detected on the proximal femur at the Wardell Site. He reported having evidence of breaks immediately below the major trochanter, but could not determine if the breakage was for joint dismemberment or marrow extraction (Frison 1973: 48).

Many authors mention that marrow extraction occurred but they failed to note physical evidence on the bones. At EgPn-111, however, Head, et al. (2002: 68) reported a few shaft and epiphysis fragments that had thick hack marks. Gruhn (1969: 137) noted a common breakage pattern at Muhlbach. Breaks of 5-10 cm into the proximal and distal shaft probably relate to marrow extraction purposes and not joint dismemberment. At a

few sites, it was reported that the absence of femur elements was an indication that the bone was either fully removed from the site for further processing (Estuary [Adams 1977] and EgPn-111 [Head, et al. 2002]) or was utilized for marrow extraction or, more likely, grease rendering.

Grease extraction from the femur is a common butchering process reported throughout the literature. This makes sense as it contains one of the highest volumes of grease and fat according to Brink's grease experiment (1997). Physical evidence for grease rendering was presented by McIntyre (1978: 119) at EhPp-1. Several small shaft fragments from the medial mid shaft area contained cut marks. This was due to the smashing and preparation of the bone for grease extraction. At the Vista Rock Shelter (Wood 1968: 175) and the Gull Lake Sites (Kehoe 1973: 154) authors reported a large number of small, smashed up epiphysis and identifiable shaft pieces, some of which had been burned. White grease would be desired from the proximal femur and therefore, this element would usually appear absent from the archaeological record. Brink, et al. (1986: 208), however, found at Head-Smashed-In that the proximal femur was a fairly common element recovered in the bone bed and did not seem to be utilized as much in comparison to other major grease rendering bones (such as the proximal humerus, tibia or distal femur).

There was only one site that had chew marks on the femur element, the Deer Creek (Larson, et al. 1984: 77). The authors could not determine if it was from scavengers after the hunt or from carnivores associated with the hunters.

Patella

The Patella is known as a ‘floating’ bone that is associated with the anterior distal femur and the anterior proximal tibia. A floating bone is attached by ligaments and tendons and has no bone to bone contact, allowing for a smooth gliding motion to occur throughout the joint. The patella is rarely mentioned in the literature, likely because it is of little to no use to the butchers. When noted, most of the literature concentrates on segmentation of the knee joint.

At Gull Lake, Kehoe (1973: 154) reported that all of the recovered patellae were unaltered and isolated, concluding that they were severed at the kill site while separating the tibia from the femur. At a few other sites, there was better indication as to how the patellae were removed. Frison reported that the patellae were commonly removed by striking the distal trochlea of the femur, illustrated by a few patellae with hack marks on them at the Wardell (1973: 42) and Casper Sites (1974: 41). Another method of patella removal was seen at the Hudson-Meng Site, where Agenbroad (1978: 37) reported a common butchering pattern of striking and crushing the patella into the anterior proximal tibia, which aided in the separation of the entire knee joint. Forty-nine of the recovered patellae complimented this primary butchering operation (ibid).

Tibia

The tibia is another major weight bearing bone of the upper hind limb. It is articulated with the femur and is associated with the patella to form the knee joint. It also articulates distally with the tarsals (astragalus) and the lateral malleolus. Even though at a few sites some complete tibia elements were reported, e.g., Estuary (Adams 1977) and

EgPn-111 (Head, et al. 2002), the tibia, like the femur, is a highly utilized element in both primary and secondary butchering operations.

Joint dismemberment has already been covered in the femoral and tarsals sections, and because few sites had broken tibias with the joint separations, there is little evidence to discuss. At the Hudson-Meng Site, however, Agenbroad (1978: 37) mentioned that smashing the tibia crest may have aided the knee joint separation. This could also help release the attached muscles. Kehoe (1996: 71) concluded that the tibia was removed from the femur at the mid-shaft, as he noted a large number of lower limb elements commonly in articulation with the distal tibia at the Boarding School Bison Drive Site. As is the case with bison bone elements, the tibia reveals an increased number of distal ends to proximal ends recovered. A prime example of this is seen in the Head-Smashed-In assemblage where 175 distal ends compared to 37 proximal ends were recovered in the processing area (Brink and Dawe 1989: 107). Two other sites with similar distal to proximal ratios were the Estuary Site (19 distal to two proximal) (Adams 1977: 95) and EgPn-111 (MNE 40 distal to 12 proximal) (Head, et al. 2002: 53). These ratios are probably an indication of joint dismemberment rather than marrow and grease extraction.

At the Muhlbach Site, Gruhn (1969) presented a good argument to explain how the ratios of distal to proximal tibia sections are related to primary or secondary butchering operations. She noted that the distal ends were often broken in a diagonal pattern ranging from 5-10 cm above the epiphysis, whereas the proximal ends were more commonly diagonally-fractured 10-20 cm below the epiphysis (Gruhn 1969: 137). Breaking the long bones further into the shaft is usually an indication that marrow

extraction occurred. Other authors also mentioned that marrow extraction occurred, but failed to note the specific evidence for this operation.

Appendicular Skeleton – Lower Hind limb

Tarsals

The tarsals are a collective group composed of four individual elements. Like the carpals, they may have more than one associated name that can be interchanged. For the Fincastle analysis, the first name will be used and the alternative name given in parentheses. The tarsals are larger in overall shape and size than the carpals, and are positioned on the lower leg differently. They have more of a proximal to distal orientation in the hind leg, rather than in lateral-medial rows. The calcaneum is the largest of the tarsals, which protrudes posterior out from the leg. It articulates with the astragalus (talus), which is situated below the calcaneum and somewhat anterior. The astragalus also articulates with the tibia (proximal end) and distally to the navicular cuboid (fused 4th and central tarsal). The navicular cuboid is below the astragalus in the leg, and distally articulates with the cuneiform pes (2nd and 3rd fused tarsal). It is the last element in the tarsal family. Both the navicular cuboid and the cuneiform pes articulate with the metatarsal.

The tarsals, like the carpals, are the point of upper vs. lower hind limb portions. The separation, again, relates to the absence of useable meat associated with the elements of the lower limbs. Many sites had a high number of recovered tarsal elements and articulations with other lower limb elements, e.g., EgPn-111, Estuary, and Gull Lake, all of which point to some evidence of primary butchering.

Joint dismemberment of the upper and lower limb at the tarsals seems to be a common practise at the sites reviewed. At the Wardell Site, for example, Frison (1973: 46) reported a few astragali with cut marks on the posterior medial side, and marks on a few calcaneums, probably for cutting the ligaments that hold the tibia to the tarsals. Similar findings of cut marks were on the astragalus and navicular cuboids at Gull Lake (Kehoe 1973: 154) and EgPn-111 (Head, et al. 2002: 69).

The only mention of a breakage pattern other than joint dismemberment was by Frison (1974) at the Casper Site. He noted that the tuber calcis was commonly removed in order to release the gastrocnemius muscle.

Metatarsal

The metatarsals are similar to the metacarpals of the forelimb, but they can be easily distinguished from them because the proximal articulation surfaces are distinct. The metatarsal has both a medial and lateral side but is shaped in almost a square orientation, whereas the metacarpal proximal end is much wider, rounder and has a much larger medial articular surface. This is because more weight is distributed toward the front and center of the animal. The diaphyses also differ, with the metatarsal being a bit longer, thinner and more square. The metacarpal shaft, however, is much more robust (again due to the weight distribution), flatter and thicker. The metacarpal also has a much more pronounced vascular groove on the anterior shaft. The distal ends are similar, however, and can lead many archaeologists to lump the two elements into the generic metapodial category. Admittedly, it is time consuming to distinguish between the distal condyles, but it can be done. The metatarsals differ by a slight flare in the lateral section

of the articular surface. The metatarsal seems to be smaller in nature and less robust than the metacarpal.

The metatarsals are similar to the metacarpals when it comes to the documented literature. Because they yield little to no usable meat, they are commonly in articulation with the other hind limb elements. However, at a few sites, specific primary butchering was connected to them, most of which relates to joint dismemberment, concentrating on the separation of the distal end of the metatarsal from the 1st phalanx. At EhPp-1, McIntyre (1978: 121) recovered two metatarsals that had been butchered immediately above the distal end, while Head, et al. (2002: 69) reported that at EgPn-111, four separate elements bore hack marks on the distal condyles. Interestingly, however, Head, et al. (ibid) reported proximal sections at the kill site, even though no particular joint dismemberment was reported.

At the Estuary Site, Adams (1977) noted several different sections of the metatarsals that had fracture patterns. They could be related to joint dismemberment or marrow extraction. Several of the recovered metatarsals had fractures located near the proximal end, while others had fractures near the mid-shaft. More detailed information is needed in order to distinguish the difference between joint dismemberment and marrow fracture patterns. No site in the reviewed literature connected metatarsals with the extraction of marrow or grease directly. In fact, at EgPn-111, Head, et al. (2002: 69) stated that marrow removal did not occur even though the metatarsal portions were fragmented within the bone bed.

Phalanx (1st, 2nd, and 3rd)

The phalanges (phalanxes) are a collective group of elements categorized by three distinct bone elements. Within each foot, there are three pairs (two 1st phalanxes, two 2nd phalanxes, and two 3rd phalanxes), and each bison contains six individual phalanx elements per leg, 24 in all. The first phalanx is at the proximal section of the phalanges. It has a long and slender shaft compared to the 2nd and 3rd, and has articulation points on both the proximal and distal ends. They articulate to the proximal sesamoids, the distal metapodials and the 2nd phalanxes. The 2nd phalanx has a shorter and rounder shaft, and yields both proximal and distal articulation points that articulate with the distal sesamoids, the 1st phalanx and the 3rd phalanx. The 3rd phalanx is one of the most easily recognized bones in the bison anatomy. It is also referred to as the hoof. It has an articulation point on the proximal end that attaches with the 2nd phalanx. The distal end has a distinct triangular shape, and has a unique outer surface, similar to the horn structure. The proximal articulation points of all three elements are distinct from one another. The 1st phalanx is square and has two separate articulating surfaces. The 2nd phalanx is more rounded, and the 3rd phalanx is slender and rectangular in shape.

It would be time consuming to analyze every individual phalange at a site, which is why most authors group the phalanges together. There are, however, a few authors who have added some detailed butchering remarks associated with these elements. One must be kept in mind that unless the phalanges were found in articulation at the site, with an identifiable metapodial element (i.e., left metatarsal), it is impossible to distinguish which leg the individual phalange came from. With this said, the general rule used in the

Fincastle faunal analysis is that a phalange is recorded as a 1st, 2nd, or 3rd phalanx of a leg (unless specified as an articulation).

The phalanges are often left at kill sites because there is no useable meat associated with them. It is also common to find them in articulation, e.g., Gull Lake (Kehoe 1973) and Estuary (Adams 1977) or in abundance throughout the kill sites, e.g., Estuary (Adams 1977), Vista Rock Shelter (Wood 1968), Gull Lake (Kehoe 1973), Muhlbach (Gruhn 1969), EhPp-1 (McIntyre 1978) and EgPn-111 (Head, et al. 2002). There were only two sites reviewed where physical evidence on phalanges was mentioned, both associated with primary butchering operations.

Head, et al. (2002: 70) reported that at EgPn-111, one of the recovered 1st phalanges had deep parallel cut marks on the proximal posterior surface, and two complete 2nd phalanges had thick hack marks on the posterior distal lateral surface. At the Estuary Site, Adams (1968) discussed similar marks on the shafts of a 1st phalanx and three 2nd phalanxes, concluding that this operation was associated with cutting the tendons and ligaments located in the lower foot, in order to help remove the metapodial elements.

Lower Limb Accessory Bones

Sesamoids, Lateral Malleolus, 1st Tarsal, 5th Metacarpal, Manus and Pez

Although these elements are generally absent in the literature, they are mentioned here because they will be discussed in the Fincastle faunal analysis. A brief description of each element is included here to retain consistency in this faunal overview.

The sesamoids are small bones associated with the metapodials, phalanges 1 and 2, and the tarsals. It is impossible to distinguish between the sesamoids unless they are

found in an articulated state, and it is also time consuming for the archaeologist to identify each one. Because they generally have no relation to the butchering operation, they are usually not studied. One can, however, determine if the sesamoid is a proximal or distal element. The proximal sesamoid is round in shape and has an articulation point that articulates to the posterior distal metapodial and 1st phalanx. The distal sesamoid is much thinner and has more of a rectangular shape, but also has one articulation point attaching to the posterior distal 2nd phalanx.

The lateral malleolus is commonly mistaken for a tarsal. It is located at the distal lateral end of the tibia. It is a small, flat bone that articulates with the tibia but has meaningful no function or use in the butchering operation. Only the Wardell Site mentioned the element outside of general NISP charts. Frison (1973: 36) noted that in order to release the gastrocnemius muscle (the large posterior calf muscle), the butchers must strike the tarsals immediately below the lateral malleolus to help release the muscle from the tibia.

The last of the bones are small in nature and are all located in the lower limb portions of both the fore and hind limbs. The 1st tarsal is a small oval-shaped bone that has a small articulation point. The 5th metacarpal has a small articulation point on the proximal end and has a tail-like structure that thins out to the distal end. It articulates with the posterior metacarpal. The manus and pez bones are tiny and, unless are found in an articulated state, are rarely reported at a site. They are less than 1 cm in size and seem to have more of a spongy bone exterior than a compact bone structure. Manus is associated with the forelimb, whereas the pez is associated with the hind limb. They are both associated with the anterior distal 2nd phalanx.

Summary

The analysis of faunal remains clearly involves more than simply determining what type of animal was found at the site, and what weapon was used to kill it. Details of each fragment of bone recovered in a bone bed can lead to an interpretation of the taphonomic processes that occurred. This is the basic goal of the zooarchaeologist: to recognize and analyze the bones, connect them to the site's environment and relate them to the subsistence activities carried out by the hunters.

In conjunction with the analysis of a site's stone tools, the faunal remains can give an indication of what type of site it is (killing, processing area, camp, etc.). Primary kill sites can include a high number of projectile points, scrapers and choppers, all of which play an important role in the primary butchering operations. Primary butchering operations at the kill site, such as hide removal and carcass segmentation, will yield a tool kit accompanied by an increase in articulated axial elements and an increase in the heavier, non-meat rendering elements, such as pelvis fragments and lower limb bones. Secondary sites, such as processing areas, differ in stone tools and faunal remains since this is where detailed secondary butchering operations occur. The presence of hearths and a source of water are necessary in order to fully perform all types of secondary butchering. Detailed meat removal, marrow extraction and grease rendering are attested by the presence of bones in a disarticulated state, accompanied with an increase in appendicular elements and a decrease of articulated elements.

Once the nature of the bone bed type is determined, the more detailed faunal analysis involves identifying specific cut marks or impact marks, which can also indicate primary or secondary butchering. Cut and impact marks can be associated with joint dismemberment, meat removal and/or marrow/grease extraction. Specific fracture

patterns can determine if an element was broken for joint separation or further processing, as a spiral fracture pattern would indicate. The size of the fracture can be a key indicator of the butchering activity and its specific location on the bone. Although this is known by many archaeologists, details regarding the evidence on the bones themselves, and their contexts are rarely discussed. Specific fracture patterns, let alone measurements and the impact marks associated with the breakage, are largely absent in the literature. Fincastle is an exception to the norm and this thesis analyzes the butchering operations at this site in detail in the following chapters.

CHAPTER 3 – EXCAVATION AND LABORATORY METHODOLOGY

Site Introduction

The Fincastle Site (DIOx-5) is located approximately 100 km east of Lethbridge, Alberta, and approximately 4 km south of the Oldman River (Figure 3.1). The site is situated in a parabolic dune, within the low sand hills grasslands. The Litchfield family leased the land for over a century.



Figure 3.1: Location of the Fincastle Bison Kill Site, approximately 100 km east of Lethbridge, Alberta, Canada.

Environment

During the Late Pleistocene (approximately 12,000 BP), the southern Alberta Plains were covered by the Laurentide Ice Sheet (Beaty 1975: 63). When the ice began to

melt and recede, the landscape started to change from the Pleistocene Ice Age environment to that of the warmer Holocene. The dunes formed and migrated, gathering sediment over thousands of years by Aeolian processes. The dune field related to the site mainly consists of large longitudinal dunes, with their long axes paralleling the southwestern Chinook winds (Beaty 1975: 71). Eventually, the environment stabilized, allowing vegetation to grow in the area. With the appearance of semi-stable vegetation (discussed below), a variety of animals began to migrate into the region. There have been a number of periods in which the dunes were moved; however, the arms of the parabolic dune are now fully covered in vegetation, hindering the dune from further migration. There is an active marsh located approximately 1 km west of the Fincastle Site. The site is on Crown Land that is used for grazing cattle.

Fauna

The non-domesticated animals that currently reside in this prairie grassland environment include several species of birds, such as pelican, duck, grebe, prairie chicken, sparrow and burrowing owl; and smaller animals such as the Richardson Ground Squirrel, rattle snake and spade-footed toad. There are also larger mammal species, such as antelope, pronghorn deer and coyote.

In the Middle Prehistoric Period (ca. 7,500 – 1,250 BP), *Bison bison* roamed this area. It was likely the dominant animal in the region, migrating over a broad area of the grasslands to follow food sources. Small animals (such as rabbit and squirrel) and several carnivore species (wolf and bear) would have been also present. Otherwise, the fauna would have been similar to that presently at the site.

Excavations

The Fincastle Site has been known to the local population for years, but when the site was looted in 2003, members of the community contacted the Archaeological Society of Alberta and the Historical Resources Management Branch of Alberta Community Development to inform them of the situation.

An investigation was conducted by volunteers from the Archaeological Society of Alberta (ASA) to determine the extent of the damage caused by the looter and to establish the significance of the site. Dr. Shawn Bubel, Professor of Archaeology at The University of Lethbridge and President of the Lethbridge Centre, Archaeological Society of Alberta, surveyed and mapped the site in order to record the damage done by the recent looting. Included in the survey was surface collection and shovel testing. In conjunction with the surface collection, local collectors agreed to show the team their projectile points recovered from surface exposures at the site. Based on these collections and the artefacts recovered during the surface survey of the site, the remains seemed to date to the Middle Prehistoric Period, with the overwhelming dominance of Besant/Sonota (ca. 2000-1300 BP) style projectiles. Shovel testing was then conducted in order to determine if there were any *in situ* archaeological remains left at the site. The positive shovel tests and the projectile assemblage suggested further investigation should be done (Figure 3.2). Dr. Bubel was then assigned to excavate the site.



Figure 3.2: Example of a positive test pit at the Fincastle Site.

Three field seasons were carried out in the form of archaeological field schools. Students from The University of Lethbridge and Red Crow College participated in the excavations, as did a number of volunteers from the Archaeological Society of Alberta and the local community. Figure 3.3 shows the areas of excavation and testing across the site over the three excavation seasons.

The 2004 excavations began in the West Area in order to determine the degree of damage to the site from the looting and to locate *in situ* material. Twenty 1 x 1 m units were placed in and around the disturbed area. Meanwhile, five test pits were dug about 50 m from the West Area, closer to the crest of the dune. Four of these pits revealed an

intact, dense bone bed consisting of large mammal bone. Further faunal analysis confirmed that the bones were mainly *Bison bison*.

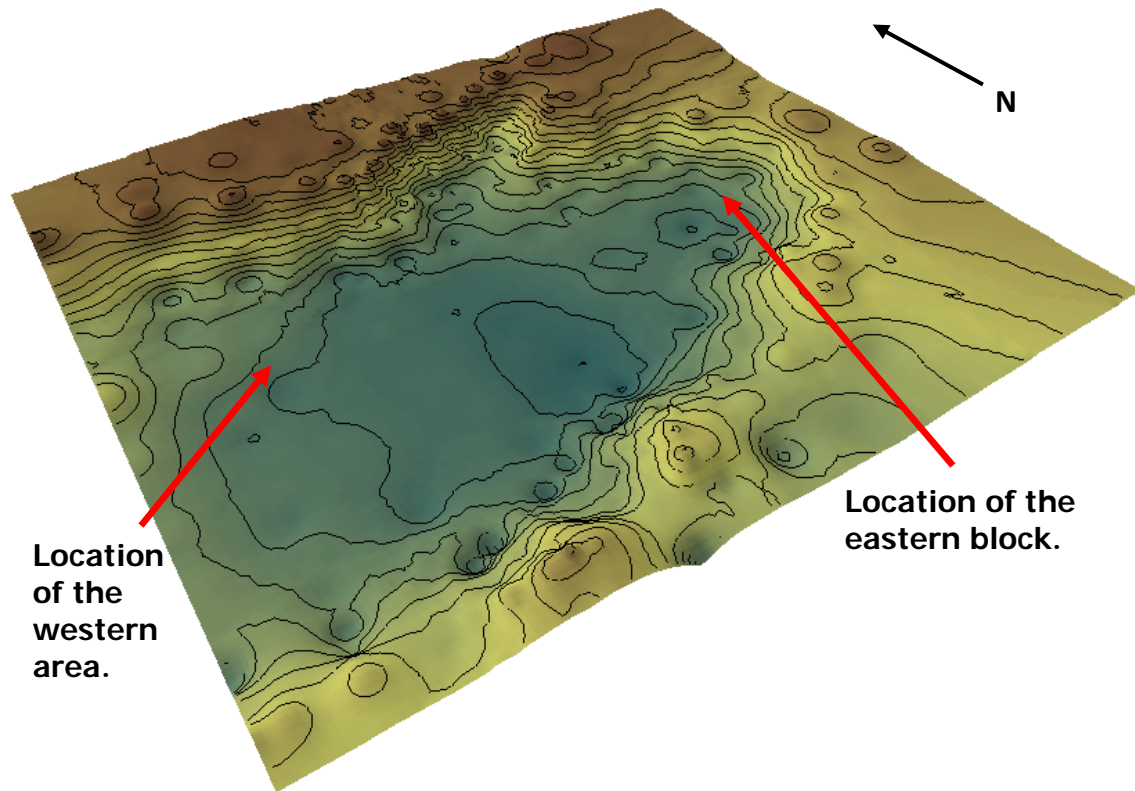


Figure 3.3: Overview of the two main excavation areas of the Fincastle Site. The DEM was generated at 25 cm intervals with data measured by a Total Station in the field.

When the West Area units were finished, the team was moved to the east where the positive test pits were located. A checkerboard grid measuring 11 x 4 m was laid out, and 36 units were excavated (Figure 3.4).

At the end of the summer, fifty-six 1 x 1 m units were excavated. Although some *in situ* material was found in the West Area, most of the units yielded few archaeological remains. By concentrating in the East Block, more information on the hunting strategy, butchering practises and other cultural activities of the site's occupants could be gained. It is for this reason that the following field seasons concentrated on this part of the site.



Figure 3.4: 1 x 1 m checkerboard units of the East Block of the Fincastle Site.

The Fincastle excavations were re-opened in 2006. Following a two-year hiatus, the team returned to find more looting and disturbed areas due to cattle trampling. After cleaning and recording the disturbed material, the excavations continued with the aim of expanding the block to determine the extent of the bone bed. New excavation units were added to the north and south of the East Block, known as the North Block and South Block Extensions of the East Block area. These new units were placed to follow the high density sections of the bone bed revealed from the 2004 excavations. Twenty 1 x 1 m units were excavated in the 2006 season; thirteen units in the North Block and seven units in the South Block.

Eighteen test pits were also mapped out, from the west edge of the East Block to the West Area in order to connect the two areas. Nine 50 x 50 cm units following an east/west transect were positioned 5 m between each other. A second transect 10 m to the north was also laid out but not excavated until 2007. The first nine test pits (TP 10-18)

were completed in 2006, while the other nine (TP 19-27) to the north were opened in 2007.

The 2007 field season was the final excavation season for the Fincastle Site. The objectives were similar to the previous seasons, with the focus on recording the *in situ* material and looking at the spatial extent of the bone bed. Because there were ten units remaining in the 2004 checkerboard pattern, these were excavated first. These units had not been excavated in 2006 because they were thought to be too damaged from the trampling and looting. Thankfully, the excavations proved otherwise. The north-eastern edge of the East Block still remained unclear at that point because the density of the bone bed was high in the end units. Therefore, fifteen 1 x 1 m units were added to the North Block, to expand the horizontal view of the site. Only two 1 x 1 m units were added to the South Block, as the southern extension of the bone bed yielded a low density of remains. A total of one hundred and one 1 x 1 m units were excavated over three field seasons in addition to twenty-three 50 x 50 cm test units (Figure 3.5). With these units complete, the site was then backfilled.

Field Techniques at Fincastle

Due to the field school emphasis of the excavations, more attention was given to excavation and recording techniques than would normally be done at a plains site. This emphasis also resulted in increased spatial data associated with the site and its remains. Although more time was needed to excavate and record the excavations, the results allow for a more comprehensive analysis of the site, including the study on the butchering practises carried out by the occupants of Fincastle.

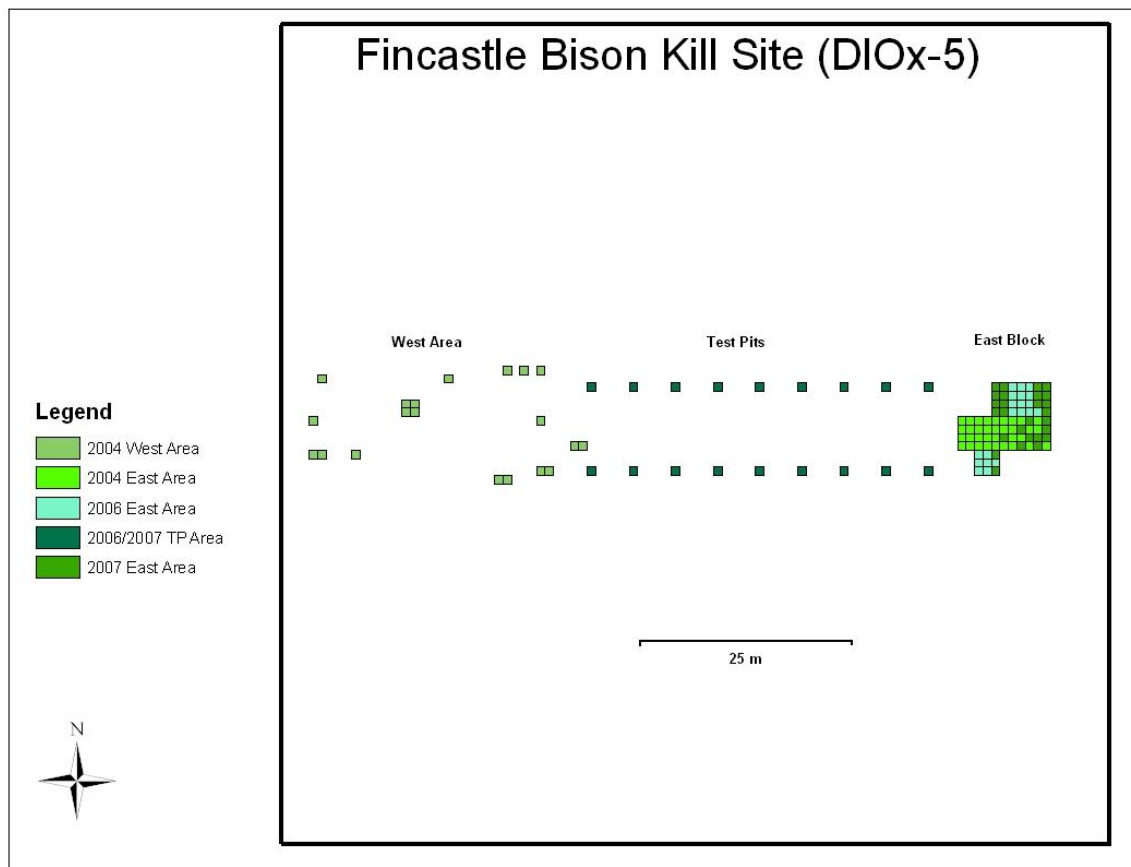


Figure 3.5: Overview of the excavated units per field season: 101 units and 23 test pits were completed.

Grid Layout

One by one meter units were used in order to control the stratigraphy, and excavate the site with 25 or more students as easily as possible. The units were set out using the Total Station and triangulation. Each 1 x 1 m unit was assigned its measured (arbitrary) coordinates (i.e., 559N 596E) connected to five base points. Rebar was hammered into each corner of the unit, and string was tied around it, in order to maintain its edges while excavating. With the use of the Total Station, the height of the SW corner rebar was measured and recorded. Whenever possible, a datum string was tied to this corner and was used to measure the depth of the archaeological material. The datum

string was tied on a different corner (mainly NW) for the few cases that the SW corner was not useable. With the height of the datum string known, the elevation of each archaeological remain and/or level was simply noted as centimetres below datum (BD). This method was used rather than a below-surface measurement because the topography varied significantly across the site.

The units were excavated in 5 cm levels. Archaeological remains recovered from each 5 cm level were recorded as such. If the remain was *in situ* its horizontal location (north and east) were measured from the strung edges of the unit. Its depth was recorded using the datum string as described above. Each measurement was done by hand, using a measuring tape and plum bob for the depth.

The 5 cm level depths (level 1 = 0-5 cm BD, level 2 = 5-10 cm BD, etc.) included the screened material and sediment records.

Screening

Due to the high concentration of micro debitage at the site, a 1/8th inch mesh dry sieve was used instead of the standard 1/4 inch mesh used in Plains Archaeology. This was the only screen size used because the sandy sediments were easily separated from the archaeological material. Every excavated bucket of sediment was sieved and all cultural materials were collected. Elements such as lithics, faunal remains and fire-broken rock (FBR) were separated and placed into screen/level bags. The bags were assigned unique field numbers and recorded in the field books. The screen bags for each level could consist of more than one element.

Recording

The recording method included the photographing, measuring, recording and bagging of the archaeological remains. The bone bed was fully exposed and a photograph was taken in each unit before the bones were recorded and removed. Moreover, articulations, features, tools and noteworthy concentrations were photographed.

Each *in situ* element was recorded a minimum of three times. The field number of the artefact was recorded in the field book along with its 3-D coordinates, and any other relevant information. These data were also written on the artifact's bag and on the associated level graph. The main reason for the multiple recording of each remain was to ensure its correct documentation. Each remain was recorded in the same manner. In the case of a faunal remain, it was first fully exposed, then the North, East, and Below Datum measurement (taken from the base of the bone) was taken at the centre of the bone and recorded in the field book and on the field tag. It was then carefully mapped at a 1:5 scale on the level graph with its field number noted. Only after all the information was recorded, and the bone was drawn, was it removed from the ground. In cases where the bone bed was dense, a 5 cm level had several graphs associated with it to ensure no overlaps between bones occurred. The excavated remains and all field records were then taken to The University of Lethbridge for analysis.

Stratigraphy

A basic recording of the sediment was done for each 5 cm level. Soil colour was determined using the Munsell Soil Classification System, and a field particle test done to record the sizes of the particles, sorting and moisture content. The soil horizon or

sediment level was also noted. This information will eventually be used to connect the archaeological deposits with their stratigraphical context.

The stratigraphy of the site indicates that it was a single-event kill site. This is seen by the single layer bone bed lying directly on clay, buried by sandy deposits (Figure 3.6). Furthermore, the homogeneity of the stone tool assemblage (projectile points) confirms its single-event identity (Varsakis 2006). Projectile points and other tools were in context with the bone bed. Figures 3.7 and 3.8 illustrate the association of artefacts and faunal remains. The Aeolian processes that occurred at the site since it was occupied play an important role in its preservation. The West Area and the South Block each has shallower levels, while the bone bed becomes deeply buried closer to the crest of the dune. Faunal preservation is better the more deeply buried the remains.



Figure 3.6: Single bone bed seen in stratigraphical section in the East Block.



Figure 3.7: Projectile point directly below a 3rd Phalanx.



Figure 3.8: Chopper tool associated with a radius with impact marks.

The context of the deposits above the clay deposits remains consistent, with the depth of the sands above the cultural layer increasing toward the east and north of the East Block. Each unit has a fairly consistent stratigraphical profile.

Typically, each unit revealed a Regosol soil, consisting of a dark-brown, silty sand 'A' horizon directly below surface grass and shrubbery. The 'B' horizon is a light-brown, fine sand that varied in thickness depending on the location of the unit. An

occasional bone fragment or piece of debitage was found within the ‘B’ horizon above the bone bed, but this was most likely due to Aeolian reworking and/or bioturbation. Bioturbation is a common occurrence at Fincastle. Several types of small animals have created tunnels and burrows throughout the site, creating sediment movement. Krotovinas created by the smaller rodents, worms and anthropods riddle the stratigraphy.

The cultural deposits were located at the base of the ‘B’ horizon, directly above the ‘C’ horizon, which consisted of a mottled-orange/grey, gleyed clay of glacial origin. This is a thick sterile glacial/lacustrine deposit.

Radiocarbon Dating

There were seven radiocarbon samples submitted to Beta Analytic Inc. for dating. All were *Bison bison* pieces. The results are presented in Table 3.1. With the exception of the two samples taken from disturbed deposits, approximately 15 cm above the bone bed, the dates are consistent in placing the site’s occupation at ca. 2500 BP.

Table 3.1: Radiocarbon dates confirm a ca. 2500 BP date.

Beta Sample Number	Date Processed by Beta	Fincastle Excavation Context	Bone Element	Conventional Radiocarbon Age
201909	15/3/2005	East Block, Bone Bed (2004)	Lumbar Vertebra	2540±50
201910	15/3/2005	East Block, Bone Bed, Upright (2004)	Metacarpal	2490±60
241254	20/3/2008	West Area, Bone Bed (2004)	First Phalanx	2490±40
241255	20/3/2008	West Area, Bone Bed (2004)	First Phalanx	2610±40
241256	20/3/2008	Northern Extension of East Block, Above Bone Bed (2007)	Second Phalanx	1310±40
241257	20/3/2008	Northern Extension of East Block, Above Bone Bed (2007)	Lone Bone Fragment	3100±40
241258	20/3/2008	East Block, Bone Bed Upright (2007)	Metacarpal	2680±40

Laboratory Faunal Analysis

The archaeological remains recovered during all three field seasons were processed and analyzed at The University of Lethbridge. This thesis deals with only the laboratory process and analysis of a subset of faunal remains, which are identified in Chapter 4.

The following steps in the analysis were carried out: 1) Cataloguing; 2) Preservation determination; 3) Attribute identification including the element, side of remain, age, weight, species, Bone Unit; and 4) any specific butchering evidence associated with each remain.

Cataloguing

The faunal remains from each unit were catalogued at the same time to maintain consistency and check for field errors. The bone bags were laid out in individual baskets in order of their assigned field number, with the screen bags at the beginning of that level. The bones were removed from the bag and placed in the cleaning basket with the original field tag (cut from the bag). Using a toothbrush and dental pick if necessary, each bone was cleaned to expose all surfaces. No water was used in this process. After the bones were cleaned, clear nail polish was applied to a 'discrete' flat area of the bone. A unique, identifying catalogue number was then written on the nail polished area of the bone, with the site name (for example, DIOx-5/2345). A final coat of clear polish was put over the catalogue number.

Each screen bag was cleaned and sorted to separate the teeth, burned and identifiable elements into three collective groups. Any identifiable bones are pulled from the screen bag and placed into an individual basket. A catalogue number was assigned to

these pieces and recorded on the bones as was done for the *in situ* elements. Once these three screen groups were separated, they were counted and bagged. A catalogue number was assigned for the bag but was not written on any element.

Each bone's field tag was cross-referenced with the information in the field books and the level graphs. Once the information was confirmed and/or corrected if necessary, the catalogue sheets were filled out by hand. The catalogue sheet included the following columns of information: Catalogue number, Field number, Block, Unit North, Unit East, *In situ* North, *In situ* East, Quadrant, Datum, Datum height, Level, Depth minimum, Depth maximum, Depth exact, Context, Comments, Feature, Articulation, Articulation catalogue number, Count, Element, Completeness, Species, Bone Unit, Bone Unit notes, Side, Age, Weight, Preservation, Processing evidence, Processing notes, Unit ID and Excavation year.

Once the catalogue sheets were filled, each bone was placed in a breathable plastic bag, with its associated catalogue number placed in a small bag alongside it. The bones were then stored on a ring in numerical order and placed in storage boxes for that particular unit. At this point they were ready for analysis.

Preservation

Determining the bone preservation at an archaeological site is an important part of faunal analysis. As discussed in Chapter 2, many sites documented having poor bone preservation, leaving little physical evidence on the bones to be analyzed. This hinders the archaeologist's ability to determine specific butchering operations. When preservation is good, evidence such as cut marks can be visible. It is important to note the level of preservation on the faunal remains and clearly state how this assessment was

made, since there is no universal classification system with regard to preservation. The faunal remains from Fincastle were classified into one of the preservation categories listed in Table 3.2.

Table 3.2: Fincastle faunal preservation categories.

Category	Description
Good	Little to no sign of weathering. Smooth bone surface.
Well	Visible weathering. Bone has minimal flaking.
Fair	Significant weathering present. Flaking or breaking is apparent on the bone.
Poor	Extreme weathering. Entire bone is fragmented and falling apart.

Table 3.3: Faunal weathering categories.

Weathering category	Description
Water and/or mineral absorption	Weight is heavier. Bone is darker colour. Bone is probably associated with the 'good' preservation category.
Bleaching	Exposure to sun. White in colour. May affect the entire bone or portions of it.
Flaking	Spongy bone is crumbling (end of bones). Compact 'hard' bone is flaking and is fragmentary (shafts).
Root Etching	Roots carving squiggly lines into the bone. Hard to detect on 'fair' to 'poor' bones.
Trowel Marks	Fresh, straight marks on the bone. Will often be a different colour than the surface of the bone.

The preservation classification is done independently from the completeness of the element, as they may reflect cultural butchering processes and not necessarily preservation factors. For example, a single long bone fragment measuring less than 5 cm could fall into the 'good' category, whereas a nearly complete mandible in 20 pieces

could be classified as ‘poor.’ All of the screen bags were automatically classified as ‘poor’ due to their fragmentary nature.

Specific weathering or excavation impact marks were also noted where applicable. The most common are listed in Table 3.3 above.

Element identification

Each piece of bone must be identified, if possible. Essentially the archaeologist must determine what type of bone it is and its element classification (i.e., a femur is part of the appendicular skeleton). Knowing this information is critical in the faunal analysis process, as it leads to the determination of the nature of the bone bed and butchering activities.

To properly identify each bone, a *Bison bison* skeleton of a sub-adult male from the Royal Alberta Museum was used as a comparative collection. Non-bison remains were identified with collections at the University of Alberta. Most of the faunal remains recovered in the field are ‘incomplete’ pieces of a bone element, and are recorded accordingly.

Side

With the element of the bone determined, the next step is to ‘side’ it using the comparative skeleton. Some of the axial skeletal remains are not paired, and are therefore sided as non-applicable (NA). In cases when ‘siding’ a bone was impossible due to its fragmentary state, the side of the element was classified as ‘undeterminable’ (UD). Screen bags will always be sided as UD for consistency.

Age

Similar to Isobel Hurlburt's (1977) *Faunal Remains from Fort White Earth N.W.Co. (1810-1813)*, the main determining feature for classifying the age of the Fincastle specimens is the degree of epiphyseal fusion. As an animal grows, there are visual changes in the bone structure where the diaphysis meets the epiphysis. At a young age, the two bone portions are not fused together, but are associated with one another with a small layer of cartilage. Bone ossification alters the epiphyseal cartilage causing the fusion of the bone portions. The rate of bone ossification is dependent on the animal. There are also differing fusion rates throughout the skeleton as each element has a different rate. Little is known about bison fusion rates, especially animals that lived thousands of years ago, so only a basic age determination can be given. More research is needed in order to determine a more precise age of the animals.

Table 3.4: Age classification categories.

Age Classification	Evidence (Epiphyseal Fusion)
Adult	The diaphysis and epiphysis are fully intact with no visible line present. Full bone ossification has occurred.
Sub-Adult	The diaphysis and epiphysis are intact with a visible line between them. Bone ossification has started but is not complete along the entire epiphyseal line.
Juvenile	The diaphysis and epiphysis are separated and have a cartilaginous exterior (a distinct 'bumpy' soft surface). Bone ossification has not yet begun. The portions are found separate from one another.
Fetal	Distinction between the epiphysis and diaphysis is not possible. Bone structure is similar to the look of the 'spongy' bone of cartilage.
UD	Broken pieces lacking fusion portions. All screen bags.

Despite this challenge, determining the age of the bone can help assess the makeup of the herd and the time of year the kill took place. The following five categories were used for this analysis: 1) Adult; 2) Sub-adult; 3) Juvenile; 4) Fetal; and 5) Undeterminable (UD). These categories are based solely on epiphyseal fusion and are defined in Table 3.4, above.

The size of the bone can also indicate age, but due to the variability between the sexes this technique was not used with the Fincastle assemblage.

Species

Without complete bone elements, determining the species of the animal is challenging. Bones too poorly preserved are classified as undeterminable (UD). Bones offering some preserved attributes can be placed into a broad species group such as Mammal Large. It would be safe to assume that, for example, a long bone fragment over 5 cm in length would not belong to a smaller mammal such as a rabbit or rodent. Due to the fragmentary nature of the Fincastle assemblage, most of the bone elements were recorded as mammal large, but *Bison bison* can be identified as well by using the comparative skeleton. There are also some confirmed cases of large canids and rodents.

Weight

The weights of the individual bones and screen bags of bones were recorded to the nearest tenth of a gram. This can help assess the density of the bone bed in relation to the butchering process.

Bone Unit System

John Brumley's (1991) *Bone Unit of Ungulate Faunal Remains* was used as a reference to distinguish the aspect of a specific bone in the assemblage. Bone Unit identification works by assigning the bone in question to a specifically described portion of the element. When the bone matches the category assigned by Brumley, it was recorded as such. If not, a new BU was defined. The BU references used for this analysis are included in Appendix III.

The purpose of the Bone Unit (BU) system is to systematically classify faunal remains recovered from archaeological sites. The results can then be used to better study the butchering activities carried out at the Fincastle Site and others. In theory, data from each site can be directly compared to other sites to study the butchering practises that took place. Unfortunately, with the exception of the Head-Smashed-In Buffalo Jump 1985/86 field season's final report on faunal analysis (Brink and Dawe 1989), no other published final reports note the BU results, though at several plains sites the system has been used. The absence of published reports makes it difficult to compare Fincastle to other sites at this time but as more scholars incorporate the BU system into their analysis and publish their results this will change. Moreover, as more scholars use this system, additional Bone Units will be defined, as the case with the faunal analysis completed for the Fincastle Site (see Appendix III for these additions). Note: all Bone Units added by the Fincastle project have been marked with an asterisk (*).

As discussed in Chapter 2, at every site with butchering activities had some evidence of joint dismemberment. These reports, however, were vague with regard to butchering processes. Questions such as, "were the bones impacted directly on the joint" or "was the impact administered on the shaft section," cannot be answered. If impacted

on the shaft, at what distance from the epiphysis does the evidence (impact marks or fracture pattern) reside? What type of fracture pattern was created from the impact?

Using the Bone Unit (BU) system, Brumley devised specific BU numbers that provide the answers to many of these questions. For example, it is easy for the butchers to smash the shaft of the element to carry out joint dismemberment. They would also want to impact the shaft as close to the joint as possible to make it easier to further process the bone. In the tibia section of Brumley's BU system, a BU4 is described as the "complete distal end of the tibia with 0 – ¼ of [the] adjoining shaft present" (Brumley 1991). Therefore, it would be safe to conclude that if a site contained several tibia BU4 bone elements, the butchers used a systematic butchering pattern to separate the lower leg from the distal aspect of the tibia from the tarsals. This is one example of how the BU system can be used to identify butchering events. The BUs connected to such specific butchering activities have been outlined below.

Almost every site mentioned in Chapter 2 had marrow extraction but again, most scholars failed to present the physical evidence. The long bones of the appendicular skeleton, including the femur, tibia, humerus, radius, metacarpal and metatarsal, are the most common elements utilized for marrow extraction. These specific elements from the Fincastle assemblage were examined for marrow extraction using the BU system. Bone Units that represent marrow extraction consist mainly of the proximal and distal epiphysis with ½-¾ of shaft adjoining it. It would be more common to have a large portion of shaft with the epiphysis (over ½) but depending on the length of the spiral fracture and how much of the marrow cavity was opened, it is possible to see a varying shaft length. Two examples of BU elements showing marrow extraction include BU29 of

the radius section, which is defined as “consisting of the lateral half of the element only, [being] split sagittally” (Brumley 1991), and BU19 from the humerus section, defined as being the “complete distal end of the humerus with $\frac{1}{2}$ - $\frac{3}{4}$ of [the] adjoining shaft length represented” (Brumley 1991).

Unlike the BUs characteristic of marrow extraction, grease rendering requires the chosen skeletal elements to be broken into small pieces and further processed by boiling the bone fragments to extract the grease. In several instances, breaking the bones for grease can create many small unidentifiable portions of the bone. A long bone fragment (LBF), may be connected to this activity. Small fragments of the epiphyses can also be connected with grease rendering, but these pieces are identifiable based on distinguishable shapes and articular surfaces.

Bone Units reflecting grease extraction are represented by small pieces of both the epiphysis and diaphysis, including BU18 from the radius section, defined as a “medial to distal fragment of [the] shaft from along [the] anterior surface...” (Brumley 1991), and BU35 of the humerus section, defined as “fragments of [the] humoral head” (Brumley 1991).

Evidence gained from using Brumley’s BU System is discussed in detail in Chapter 4.

Bone Unit Butchering Category Classification System

By building on Brumley’s BU System and combining Kooyman’s (2004) fracture pattern analysis (discussed in Chapter 2), an encompassing BU Butchering Category Classification System was created to study Fincastle’s faunal remains; specifically to examine the butchering processes and to connect the Fincastle faunal assemblage with

other plains archaeological sites. This system allows for the systematic study of the butchering process, including what type of butchering (i.e., primary or secondary) took place. There are seven Butchering Categories defined in the following analysis and summarized in Table 3.5.

Butchering Category 1: Joint Dismemberment

This is the first of two categories connected with joint dismemberment (primary butchering). Flat/irregular bones (see Appendix I for bone type classifications) missing aspects of their distal and proximal sections fall into this category, such as a BU17 skull section defined as the “complete or fragmentary portion of one of the occipital condyles – either [the] left or right” (Brumley 1991). As presented in Chapter 2, one way to remove the skull from the atlas bone is to strike the occipital condyles, to remove it from the rest of the element. This activity would be seen as a skull BU17.

Butchering Category 2: Joint Dismemberment

This second joint dismemberment category includes long bones that consist of less than $\frac{1}{4}$ of the overall shaft associated with the appropriate epiphysis. A short spiral fracture pattern would be the more common spiral fracture present. A prime example is a tibia BU9, which is defined as the “complete proximal end with 0 – $\frac{1}{4}$ of the proximal shaft length represented” (Brumley 1991).

Butchering Category 3: Meat Removal

This category includes all bone types because ‘meat removal’ is a generalized process that includes both primary meat removal as well as secondary butchering processes of the brain, tongue and nasal cartilage. The bones will have specific

attachment points or tuberosities missing that attached the bone to the muscles. A skull BU13, defined as “essentially the complete zygomatic process of [the] temporal and immediately adjacent portion of the temporal condyle” (Brumley 1991), is an example of a bone falling into a butchering activity. In this case, the butchers were probably accessing the brain from the side of the skull. Any hyoid that shows breakage is said to reflect tongue removal (for primary meat removal), an example of which is a hyoid BU12. Brumley (1991) defines a hyoid BU12 as the “unit consists of [the] dorsal extremity and 0 – ½ of [the] shaft. [The] muscular angle [is] removed.” For most of the long bones, the primary meat removal evidence is often masked by the secondary butchering practises, such as marrow extraction, or further breaking the bone into small fragments for grease rendering.

Butchering Category 4: Marrow Extraction

This category includes all bone types that contain marrow. The long and short bones typically have ½ of the shaft present, adjoining to the appropriate epiphyses. A long spiral fracture pattern is typical as it allows for easier access to the marrow cavity. In the case of the humerus, BU19, defined as the “complete distal end of the humerus with ½-¾ of [the] adjoining shaft length” (Brumley 1991), is a good example of this category. There may be some cases where a longitudinal fracture pattern is present, exposing the entire medial or lateral shaft cavity, such as in the case of the femur BU31, which is defined as the “unit consist[ing] of the medial portion of the element only, split along the sagittal plane” (Brumley 1991). For the few flat bones that contain marrow (scapula and mandible), their fracture patterns may vary in style from a long spiral to a short or longitudinal fracture. Either way, a decent sized opening is necessary. A

mandible BU45, defined as the “ventral portion of [the] mandible extending from [the] interalveolar border to [the] angle of [the] mandible” (Brumley 1991), is a good example of where the bottom of the mandible was longitudinally fractured to expose the small marrow cavity.

Butchering Category 5: Grease Rendering

The first of two grease-rendering categories includes all bone types. Bone elements that have been primarily butchered for meat and/or marrow may be further processed and smashed into small fragments to extract their grease. Category 5 specifically includes small fragments of the epiphyses associated with red marrow. Red marrow, as discussed in Chapter 2, is the more ‘choice’ type of grease. A radius BU27, defined as “fragments from the proximal end of the radius” (Brumley 1991), is a good example of a Category 5 remain. Grease is also in flat/irregular bones, such as the astragalus. An astragalus BU17, which is defined as “a fragment of the distal lateral trochlear surface” (Brumley 1991), can be the result of grease rendering. These smaller, more compact elements also contain red marrow, but in less quantities than the long bone epiphyses. As a result, these bones may only have been used in times of need.

Butchering Category 6: Grease Rendering

This second grease rendering category is made up of long bone pieces. It is associated with the yellow marrow located in these shafts. This is less desirable grease, but it was rendered at many sites. To get at this grease, the shaft sections of the long bones were smashed into smaller fragments to make the boiling process shorter and easier. A femur BU18 defined as “fragments of the femoral shaft” (Brumley 1991) is a perfect example of this butchering category.

Butchering Category 7: Undefined

This last category includes BUs that evidence joint dismemberment, marrow extraction or grease rendering but which one is undeterminable. In many cases the bones have spiral fractures located between 0-½ way up the shaft (long bones), which can indicate either joint dismemberment or marrow extraction. Examples of this include a Femur BU12 as it “consists of [the] complete distal end and ¼-½ of [the] adjoining shaft” (Brumley 1991), and a metacarpal BU7, which consists of the “complete distal end of [the] metacarpal with ¼-½ of [the] adjoining shaft represented” (Brumley 1991). The measurement of a fracture approximately ¼ into the shaft is, in this Butchering Category System, a distinguishing factor between joint dismemberment and marrow extraction. However, these two examples (among others) attest to the difficulty distinguishing between these categories. Therefore, the bones are grouped into this undefined butchering category.

In rare cases, grease rendering may be evident on the same bones as joint dismemberment or marrow extraction if the epiphyses portions are missing; separated from the spiral fracture patterns located on the shaft. A good example is seen on a metatarsal BU15 where “one or more of either [the] distal condyles and from 0 – ¼ of the adjoining shaft” (Brumley 1991) are present. In cases such as this, both the joint dismemberment and grease rendering are noted.

Bone Units that do not fit into one of these seven categories offer little information with regard to understanding butchering activities, and were not included in this study.

Table 3.5: Bone Unit Butchering Category System.

Butchering Category	Associated Butchering Process	Description
1	Joint dismemberment	- Elements will be missing specific aspects on either distal or proximal sections. - Includes: IRREGULAR/FLAT BONES
2	Joint dismemberment	- Long bones consisting of less than ¼ of the shaft with the associated epiphysis. - Should have a short spiral fracture pattern. - Includes: LONG BONES
3	Meat Removal	- Element specific aspects have been removed, including muscle attachments and tuberosities - Cut marks present (if visible). - Includes: ALL BONE TYPES
4	Marrow extraction	- Element consists of over ½-¾ the shaft and may be associated with the epiphysis. - Should have a long spiral fracture pattern, and an associated large shaft opening. - Includes: ALL BONE TYPES
5	Grease rendering (Red Marrow)	- Element is a small fragment of the proximal or distal epiphyses (choice grease locations). - Includes: ALL BONE TYPES
6	Grease rendering (Yellow Marrow)	- Element is a small fragment of the shaft section, consisting of no more than ¼ of the shaft. - Includes: LONG BONES
7	Undefined (Joint, Meat, Marrow or Grease)	- Elements that have characteristic features of joint dismemberment, meat removal, marrow extraction or grease rendering. - Shaft sections could fall between ¼-½ of the entire shaft length. - Fracture pattern may be undeterminable. - Element may have a specified marrow fracture pattern but also contains missing aspects from either epiphysis. - Includes: ALL BONE TYPES

Specific Butchering Evidence

With all the above steps in the faunal analysis complete, more specific butchering evidence was recorded if detected. This included any other evidence that was seen on the bones. Examples of this evidence included butchering breaks (joint dismemberment and or marrow extraction/grease rendering), articulations, cut marks, worked bone and chew

marks. As noted in Chapter 2, the identification of these features is important for understanding the cultural nature of the faunal assemblage.

Summary

Fincastle is a single occupancy bison kill site with a dense bone bed, dating to ca. 2500 BP. Over three excavation seasons (2004, 2006, and 2007), a portion of the Fincastle Site was unearthed. Initial excavations took place in the West Area, where most of the looting took place. Because the West Area yielded few archaeological remains, the excavations were shifted to the East Block where the bone bed was found by a series of test pits. The last two seasons were spent excavating the East Block, where eighty-one 1 x 1 m units were completed. A total of one hundred and one 1 x 1 m units in addition to twenty-three 50 x 50 cm test pits were excavated across the site.

The East Block was excavated in a checkerboard pattern to follow the stratigraphy. The units were excavated in 5 cm levels, screening all sediment collected. When an artefact was discovered, it was recorded three dimensionally. These measurements were recorded on the field bags, and in the field book, and the remains were drawn on the appropriate level graph at a 1:5 scale.

The context of the archaeological remains together with the radiocarbon dates confirmed a single-occupancy kill site. The bone bed was directly over a glacial/lacustrine deposit of mottled gleyed clay, and was covered by Aeolian sands later subjected to pedogenesis. The detailed field excavations and record methods of the site allowed for an in-depth study of the butchering activities that took place.

The laboratory analysis phase of this research was a time-consuming and lengthy process. With that said, each step taken was an important aspect to the overall analysis of

the archaeological material from the Fincastle Site. Each faunal remain was placed in its appropriate unit, cleaned, assigned a catalogue number, and re-bagged for future storage. A master database was created to record the details of each ecofact. The database contains information pertaining to the field record as well as faunal information such as: preservation, element identification, side, age, species, weight, BU classification and specific butchering findings.

Once all these steps in the analysis were completed the bones were placed into the Bone Unit Butchering Classification System, allowing for the study of butchering (primary and/or secondary) activities. These results are presented in Chapter 4. Through the comprehensive analysis of the faunal remains an assessment of the butchering practises that took place at the site can be done, and eventually cross-site comparisons can be made.

CHAPTER 4 – FAUNAL ANALYSIS

Introduction

As discussed in Chapter 3, the Fincastle Site (DIOx-5) is a single occupancy site, shown by the fact that the bone bed is well defined and lies directly above the clay level. The bone bed extends over a significant section of the site, more than 50 m², with its boundaries still to be determined.

Since the laboratory analysis of the archaeological remains is still in progress, the focus of this thesis is on the faunal remains from the East Block as this analysis is now complete. All other locations including the West Block, East Block North and South, and the test pits will be completed in the coming years. Therefore, this research serves as the foundation upon which other analyses will be built.

This chapter presents the butchering evidence found by the analysis of the faunal remains. It begins by discussing the nature of the bone bed and touches on the preservation of the remains, the age of the assemblage and the number of bison present. It also includes articulation evidence as well as primary and secondary butchering information. The bulk of the chapter examines each faunal element in detail and connects it to the Butchering Category System. The chapter summary then ties these data together.

East Block Bone Bed

The focal area of this thesis, the East Block, is at the eastern end of the site, close to the crest of the dune (see Figure 3.3). The East Block contains 44 m² (4 units north/south x 11 units east/west). The Northern and Southern Extension areas branch off from the main East Block. The area used for this research thesis is highlighted in red in Figure 4.1.

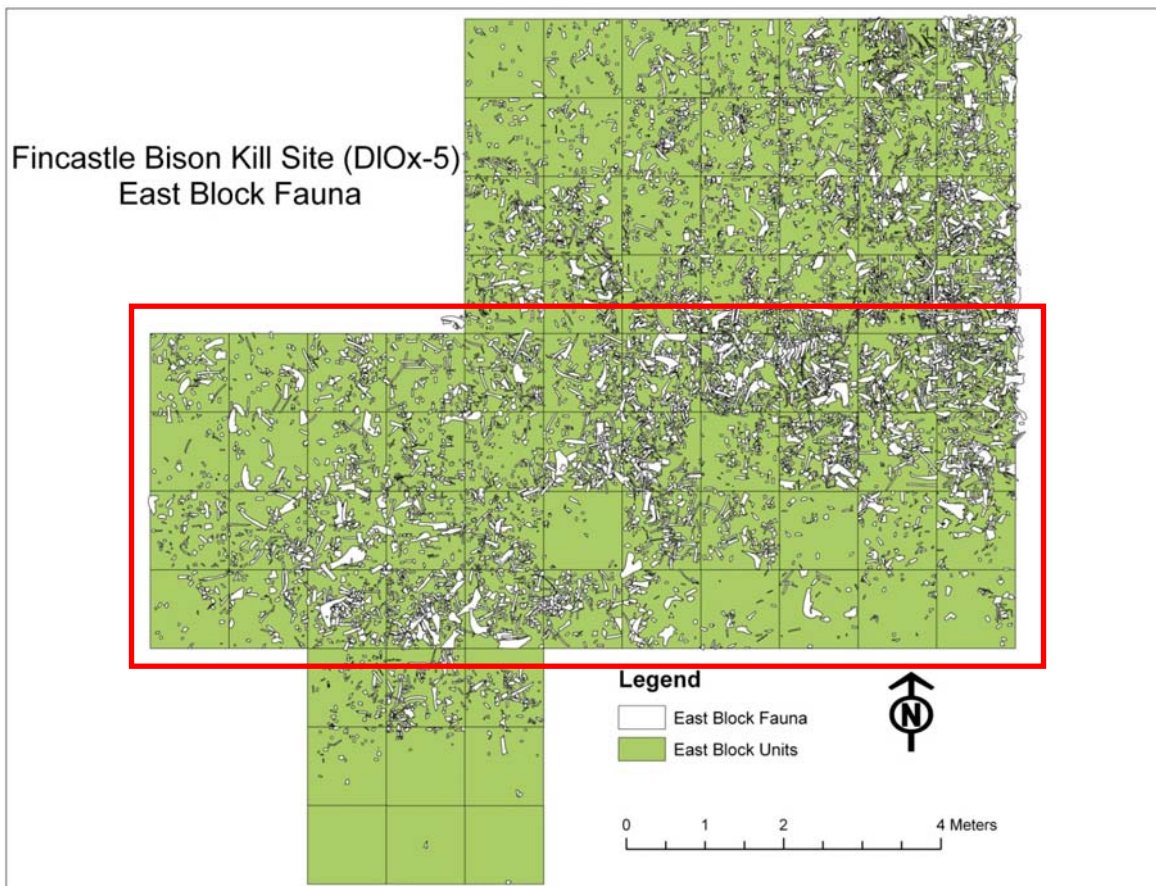


Figure 4.1: East Block section of the Fincastle Bison Kill Site used in this faunal study.

A total of 7,538 faunal records including elements recovered from the screen were entered into the East Block faunal database. Of these records, 6,602 were identified elements leaving 936 screen bag records. The element count does not necessarily mean that they were individual fragments however, as many records had a number of fragments from one bone. A total of 60,828 bone fragments make up this assemblage. The breakdown of these pieces can be seen in Figure 4.2.

The total number of bone fragments can be further broken into specific categories. From the 43,076 pieces in the screen bags, 1,174 faunal records were identified as a specific element, which is a total of 1,556 bone pieces from this collection. There were

an additional 716 records of tooth, unidentifiable (UID) small bone fragments and unidentifiable burned fragments from the screen bags that included 41,013 individual small fragments from these database records.

The East Block contained a number of faunal elements connected to the single occupancy kill. When possible, each bone fragment was assigned to a 'species' category, as defined in Chapter 3. The majority of the elements fall into the *Bison bison* and Mammal Large categories. *Bison bison* was determined only when the element matched physical features (such as articulation points) in the comparative collection or reference literature. If it did not, but was large enough to be placed into the Mammal Large category, it was assigned to this group. Other categories included canid remains and small mammals mainly consisting of rodent bones probably from a more recent animal burrowing into the bone bed. The only two categories included in this study are the *Bison bison* and Mammal Large categories, as these directly relate to the butchering activities that took place at the site.

If the faunal piece was not recovered from the screen, it most likely fell into the category of 'identifiable bone elements'. A total of 17,752 fragments were identified, and of these, 16,196 fragments comprised the 5540 elements classified according to their Bone Unit (BUed). The long bone fragments (LBF) are not included in the 5540 element count ($n = 544$ LBFs) as they are not associated with a BU. The same is true for the cartilage elements ($n = 14$).

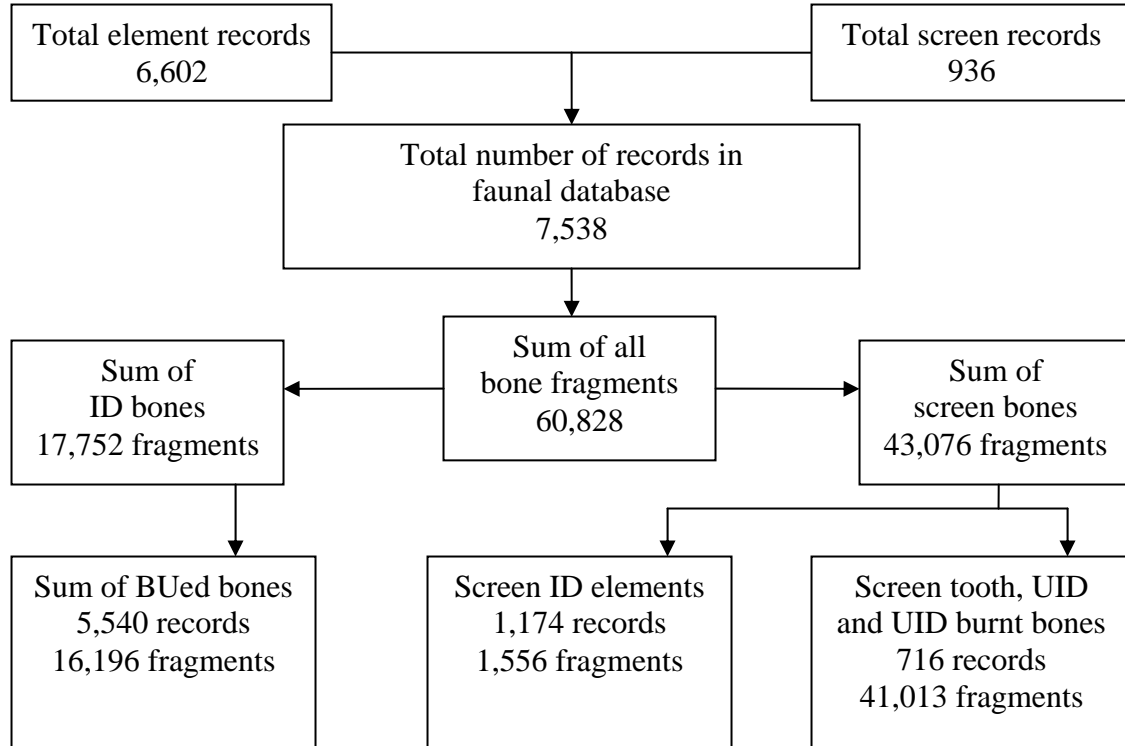


Figure 4.2: Fincastle’s East Block faunal assemblage records and bone counts.

The 5540 BUed element records are the basis of the following faunal analysis. Each bone element and the BU associated with it are discussed in detail following each element section below.

Preservation

The state of preservation of each faunal remain was individually classified during the analysis, and was placed within one of the four preservation categories described in Chapter 3: ‘Good’, ‘Well’, ‘Fair’ and ‘Poor’. Overall, the preservation of the East Block section of the site may be defined as ‘Well’, as 83.6% of the 5540 BUed elements were assigned to the ‘Well’ or ‘Good’ categories. A more specific breakdown per category may be seen in Table 4.1.

Table 4.1: Fincastle faunal assemblage preservation percentages.

Preservation Category	Percentage
Good	27.7
Well	55.9
Fair	12.3
Poor	4.0

Screen bag counts are not included in this classification as all screen bags were automatically assigned to ‘Poor’, because they were not preserved well enough to be assigned to an element or a BU number. This is the same for long bone fragments, which were also excluded from Table 4.1. The long bone fragments are a vital part of the Fincastle faunal analysis. However, it required a separate preservation classification system (see specific element evidence). Most of the long bone fragments were well preserved (Table 4.2).

Table 4.2: Fincastle long bone fragment preservation percentages.

Preservation Category	Percentage
Good	0.9
Well	84.9
Fair	11.6
Poor	2.6

Considering the age of the site, Fincastle is one of the best-preserved Middle Prehistoric sites relative to those reviewed in Chapter 2. If the majority of a faunal assemblage falls into the ‘Fair’ to ‘Poor’ preservation categories, much of the detailed butchering evidence is lost. This is not the case for Fincastle. The ‘Good’ to ‘Well’ preservation in the East Block allowed for a detailed element analysis. Specific butchering evidence was seen on several bone elements and is described in detail in the specific element evidence section.

Chewing

There are few examples of chewing marks on the faunal remains at Fincastle. There are two probable explanations for the absence of chew marks. The first may be attributed to the site being covered fairly quickly with sediment, considering the location of the site and its Aeolian environment, thereby rendering the bones inaccessible to scavenging animals. The second may be due to the possible association of the site with a standing body of water: the bones may have been submerged after butchering, thus preventing scavengers from obtaining them.

The only bone element to yield chewing evidence was the rib bone. On six separate rib shaft fragments unearthed in the East Block, small mammal teeth marks are present. It is difficult to determine if the chewing occurred at the time of the kill or after the butchers abandoned the site.

One rib element (BU8) has several chew marks on the ventral costal groove, while a BU11 shaft fragment contains multiple small toothed chew marks. Two BU16 rib elements have chewing present; one on the top edge of the shaft, and the other seems to have two distinct patterns of small mammal tooth marks on the costal groove. The last rib element that has chewing evidence is on a small BU15 element. The element contains a pitting pattern on the lateral portion of the shaft (Figure 4.3).



Figure 4.3: Rib (Cat. No. 4404) with pitting pattern from chewing.

Side

A right vs. left element comparison was conducted on all BUed elements. The overall totals are summarized in Table 4.3. A side category of ‘not applicable’ (NA) was assigned to bones that do not have a matching pair (i.e., the vertebral column).

Table 4.3: Fincastle side comparison.

Right		Left		NA		UD	
Total #	%	Total #	%	Total #	%	Total #	%
1239	22.4	1298	23.4	745	13.4	2258	40.8
Total number of BUed elements						5540	

The percentages of right and left bones are close, which would be the case in most faunal assemblages. Most of the bones varied between zero- and a five-count difference between the lefts and the rights; however, there are a few bones that seemed to have a larger side spread. For the hind limb long bones, the femur yielded 11 left elements to 6 right elements, whereas the tibia yielded only 13 left sides compared to 20 right sides. Both elements were accompanied by a high undeterminable (UD) category ($n = 11$ femur

and $n = 35$ tibia UD). From the forelimb, the humerus yielded 19 lefts to ten rights (with 26 UDs), and the radius included 39 lefts to 20 right sides (with 17 UDs). Interestingly, in the forelimb, both the humerus and radius yield higher concentrations of left sides within the East Block, whereas the hind limb elements show differing results from one another. There is an indication that the upper hind limb was butchered as a unit, though with the overall low representation for the femur and tibia ($n = 35$ femur and $n = 69$ tibia BUs), no upper hind limb butchering pattern can be distinguished.

With regard to the lower limb, the metacarpal reveals 28 lefts to 17 right sides. Only one was classified as UD. Most of the carpals have similar left/right ratios; however, the lunate and pisiform differ by more than five elements. The lunate has 17 left to 27 right sides, and the pisiform accounts for 8 left sides compared to 13 right sides (with one UD classification). Finally, there were some observations with regard to the left and right sides of the phalanxes (which include phalanx 1–3). These are summarized in Table 4.4.

Table 4.4: Phalanx 1-3 element side comparison.

Element	Right	Left	UD
1 st Phalanx	125	113	5
2 nd Phalanx	103	114	1
3 rd Phalanx	96	95	1
TOTAL	324	322	7

There has been no determination here if the individual phalanx element belonged to the right or left side of the body, or to the forelimb or hind limb. When using the terms ‘right’ and ‘left’ for either phalanx, the following rule was applied: the phalanx (in general) is either ‘a’ left or ‘a’ right of ‘a’ leg. For example, Catalogue Number 4507 from the East Block faunal assemblage is classified as a complete ‘left’ 1st phalanx. This

particular element has the distinct characteristic of a lateral proximal articulation point that is more pronounced than the medial proximal articulation point. The opposite physical characteristic would be seen for a 'right' sided 1st phalanx. Each of the three phalanges (1, 2 and 3) have their own unique articulation points used as determining factors that allow the bones to be distinguished as a 'right' or 'left' side of 'a' leg.

According to Table 4.4, the number of left vs. right sides for both the 1st and 2nd phalanx shows a slight variation. This variance is similar to the other elements mentioned above (i.e., the femur and tibia). The total of combined left phalanxes (P1-3) is almost identical to the combined right sides; however, the seven UD phalanx elements are insignificant with regard to their impact to the overall count.

The ribs showed a slight left to right numerical differentiation. There are a total of 386 left ribs compared to 357 right ribs. Moreover, a staggering 1,283 rib elements were classified as undeterminable. The reason for this is explained in the rib section of the specific element evidence below.

Unfortunately, a total of 2,258 bone elements could not be given a 'side' classification because they did not bear enough distinguishable evidence, such as articulation points or specific side curvatures. These 2,258 elements were classifiable for specific elements, into a BU and placed within the Butchering Classification System.

Age

Approximately half of the faunal remains from the East Block (2686 of 5540) were able to be aged using the features defined in Chapter 3. The aged remains at Fincastle include adult, sub-adult and juvenile *Bison bison* or mammal large individuals

(Table 4.5). Adult bones make up the largest portion of the identified assemblage, followed by juvenile and sub-adult remains (1,709, 813 and 164 respectively).

Table 4.5: Number and percentage of aged faunal remains per age category.

Age Category	Number	Percentage
Adult	1709	64
Sub-adult	164	6
Juvenile	813	30
Total	2686	100

A thorough analysis of this aspect of the assemblage was not conducted, though the age of the elements was noted if it related to the butchering activities carried out at the site. This point aside, it is interesting that there are no fetal elements at Fincastle. This is not a rare occurrence, as no fetal remains were reported at several sites. Fincastle, however, does contain well-preserved cartilage fragments, suggesting that if there were fetal elements, they should have been preserved. As discussed in Chapter 2, fetal elements have similar characteristics and internal bone structures to cartilage and can be misidentified. The absence of fetal elements suggests that the kill took place in late summer or early fall.

Sex

To date, no formal analysis has been carried out to determine the sex of the faunal assemblage at Fincastle. Preliminary sexing of animals can be done directly in the field if certain bones are unearthed. For example, if the bone bed has several pelvises, a quick distinction between the sexes can be, as a female pubis section characteristically is more 'U'-shaped than 'V'-shaped. Skulls with large horn cores, attest to the presence of large male bison. These easily distinguishable bone features have not been found at the site.

Another way of sexing animals is to take specific measurements on bone elements, particularly the long bones, tarsals and carpals. This was not able to be performed as part of this research.

Weight

Each faunal remain was weighed to the nearest tenth of a gram to study the overall bone density of the site. The results can help understand the butchering in that highly fragmented remains will presumably weigh less than complete elements. A general weight per element is presented in Table 4.6. Note the large weight difference between the minimum and maximum weights recorded. Further analysis on the weights of the remains was not carried out as part of this thesis research, though it will be incorporated in future studies within the Fincastle project.

Table 4.6: Fincastle bone weights for Mammal large and *Bison bison* elements combined.

Element	Min. Weight Recorded (g)	Max. Weight Recorded (g)	Aver. Weight of Element (g)
Astragalus	7.2	131.6	78.3
Atlas	8.7	547	149.7
Axis	5.3	267.1	89.6
Calcaneum	3.6	171.1	79.7
Cartilage	1.9	44.8	13.5
Centrum	0.1	32.4	3.9
Femur	16.7	349.5	76.5
Humerus	4.2	598.8	94.2
Hyoid	0.4	11.5	4.4
LBF	0.8	114.4	17.2
Mandible	1.3	825.7	123.1
Metacarpal	8.7	410.4	171.0
Metapodial	2.5	37.6	17.5
Metatarsal	1.6	434	112.3
Navicular cuboid	17.6	98.3	56.4
Patella	28.3	70.1	52.5
Pelvis	1.9	406.5	77.3
First Phalanx	1.2	65.7	30.5

Second Phalanx	0.9	44.5	21.2
Third Phalanx	2.5	47.4	21.8
Radius	4.6	411	90.4
Rib	0.1	151.8	16.6
Sacrum	3.6	241.9	54.9
Scapula	1.5	803.4	49.7
Skull	0.2	420.7	30.6
Sesamoid	0.7	9.7	3.4
Tibia	5.2	447	76.2
Tooth	0.1	91.9	9.7
Tooth, incisor	0.3	6.6	2.5
Tooth, molar	0.3	60.6	24.3
Tooth, premolar	5.8	17.6	10.0
Tooth, root	0.7	13.6	3.6
Ulna	2.1	342.3	64.2
UID	0.2	838	38.8
UID, burned	0.1	43.5	4.0
Caudal vertebra	0.1	26.6	4.1
Cervical vertebra	1.2	296.1	66.9
Lumbar vertebra	1.6	236.2	42.5
Thoracic vertebra	2.0	300.3	47.3
Lateral Malleolus	3.0	15.4	10.3
Fifth Metacarpal	0.5	7.0	2.8
Scaphoid	6.4	39.8	22.6
Cuneiform	2.6	28.9	17.6
Lunate	8.3	34.6	20.0
Unciform	0.7	26.9	15.9
Magnum	6.9	38.9	23.4
Pisiform	2.5	17.2	8.0
Cuneiform Pes	3.3	18.3	10.5
First Tarsal	0.1	104	5.1
Second Metatarsal	0.4	4.2	1.7
Manus V	0.2	5.6	1.5
Pez II	0.2	0.4	0.3

Minimum Number of Individuals (MNI)

The Minimum Number of Individuals (MNI) calculation is the only part of this analysis that uses the elements specifically assigned to *Bison bison*. Several elements were examined for the MNI calculation. The astragalus yielded the highest MNI results ($n = 35$) for the East Block. It is of interest to include the numbers for the other elements

(Table 4.7) to validate their assessment. Even though the astragalus has the lowest BU1 percentage, the remains were in large enough pieces to rule out the possibility that the separate fragments came from the same original element. The MNI of 35 based on the astragalus elements is high, but the navicular cuboid at $n = 33$ supports this large number. Considering that the site is a single occupancy kill site, there was a large number of bison killed and processed in the 44 m² area.

Table 4.7: Element comparison for an MNI calculation for the East Block.

Element	Right	Left	UD	BU1 percentage
Magnum	25	26	0	100
Scaphoid	24	25	0	92.0
Astragalus	35	26	2	87.7
Cuneiform Pes	23	23	2	95.8
Navicular cuboid	31	33	1	98.5

Primary vs. Secondary Bone Beds

There is no doubt that primary and secondary butchering activities were conducted at Fincastle, based on the presence of articulated elements as well as disarticulation and fracture patterns.

Primary butchering is generally seen in association with the axial skeleton. This is generally true for Fincastle, though there are several examples within the axial skeleton that reveal a more detailed butchering operation. The ribs, for example, which account for 36.4% of the overall faunal assemblage and 61.6% of the axial elements, have direct evidence for both primary and secondary butchering activities. The main difference between primary and secondary butchering is directly related to the fracture pattern and impact mark location on the rib element, which is discussed in detail in the rib element evidence section. Other elements also revealed both primary and secondary butchering.

The difference between the numbers of axial vs. appendicular elements is quite significant. In the East Block, there are 3,298 BUed axial skeletal elements compared to 2,242 appendicular ones. Based on a complete bison skeleton, approximately 45% of the animal is a part of the axial skeleton. The high percentage of axial pieces (about 60% of the assemblage) at Fincastle suggests the loss of appendicular bones by the butchering process. It should be noted, however, that there are several elements within each group that could not be BUed, such as the 14 recovered cartilage pieces belonging to the axial skeleton and 544 long bone fragments from the appendicular skeleton.

Evidence of both primary and secondary butchering is presented in what follows. Articulations are discussed with specific BUs showing both primary and secondary operations. Fincastle yields significant information that is rarely seen in Plains Archaeology, allowing us to study the butchering that took place at the site as well as aiding in our understanding of subsistence patterns as a whole.

Complete Elements

Within the East Block, there is an overall low complete BU1 element ratio (Table 4.8). Only 27.9% of the bones are complete elements. This is to be expected as the bone bed was subject to both primary and secondary butchering operations.

A more detailed analysis was conducted by determining which body section contains a high ratios of complete elements compared to a few complete elements. These results are summarized in Table 4.9.

Table 4.8: Fincastle complete BU1 percentages of each element.

Element	BU1	Other	Total	BU1 %
Astragalus	57	8	65	87.7
Atlas	1	11	12	8.3
Axis	0	11	11	0.0
Calcaneum	41	33	74	55.4
Carpal	4	3	7	57.1
Centrum	0	316	316	0.0
Femur	0	35	35	0.0
Humerus	0	56	56	0.0
Hyoid	0	57	57	0.0
Mandible	7	200	207	3.4
Metacarpal	28	18	46	60.9
Metapodial	0	14	14	0.0
Metatarsal	18	62	80	22.5
Navicular cuboid	64	1	65	98.5
Patella	10	1	11	90.9
Pelvis	0	37	37	0.0
First Phalanx	188	55	243	77.4
Second Phalanx	195	23	218	89.4
Third Phalanx	159	33	192	82.8
Radius	1	75	76	1.3
Rib	4	2026	2030	0.2
Sacrum	0	11	11	0.0
Scapula	0	214	214	0.0
Skull	0	182	182	0.0
Sesamoid	318	15	333	95.5
Tibia	0	69	69	0.0
Ulna	5	49	54	9.3
Caudal vertebrae	76	33	109	69.7
Cervical vertebrae	1	71	72	1.4
Lumbar vertebrae	0	44	44	0.0
Thoracic vertebrae	0	210	210	0.0
Lateral Malleolus	22	1	23	95.7
Fifth Metacarpal	17	4	21	81.0
Scaphoid	46	4	50	92.0
Cuneiform	35	2	37	94.6
Lunate	43	1	44	97.7
Unciform	38	4	42	90.5
Magnum	51	0	51	100.0
Pisiform	21	1	22	95.5
Cuneiform Pes	46	2	48	95.8
First Tarsal	24	1	25	96.0
Second Metatarsal	18	0	18	100.0
Manus V	5	0	5	100.0
Pez II	4	0	4	100.0
TOTAL	1547	3993	5540	27.9

Table 4.9: Fincastle BU1 (complete) limb element percentages.

Body section	Total BUed Elements	BU1 Elements	BU1 Percentage
Hind limb	517	304	58.8
Forelimb	725	294	40.6
Lower Limb	1727	1442	83.5

The lower limb combines both the fore and hind limb lower elements (including the metapodials, carpals or tarsals, phalanxes, sesamoids, and small accessory bones) resulting in the overall higher BUed element counts. Combined, the BU1 complete element percentage is 83.5%, which is an indication that the lower limb elements were less utilized for secondary processes. The lower limb elements are not commonly associated with the primary butchering operation of meat removal or joint dismemberment, as there is little meat in this section of the bison. One exception to this high BU1 percentage is the calcaneum, which has a 55.4% BU1 amount. A possible explanation for this lower percentage could be from the separation of the upper from the lower hind leg. A detailed analysis of this and other tarsals was performed and summarized under the tarsals – calcaneum section of the specific element evidence.

Articulations

The East Block had a total of 211 elements found in articulation. The articulations support both primary and secondary butchering operations. Some of the articulated units were in pairs, but there were a large number of units with three or more elements together. The articulated units that do not have direct evidence with regard to primary or secondary butchering operations were not expanded on, but several are highlighted in the East Block. Table 4.10 shows a breakdown of all of the articulated elements at Fincastle.

Appendicular Skeletal Articulations

There are a total of 121 articulated appendicular elements. The majority of these belong in the lower leg. As seen in Table 4.10, the lower leg represents 95% ($n = 115$) of the articulated appendicular assemblage. These can be further divided into three categories including lower forelimb, lower hind limb and a combined lower limb group.

The lower forelimb elements include the magnum, unciform and metacarpal (includes the metapodial). Together, they represent nine articulated elements. There are too few recovered elements in this category to formulate any butchering patterns by the articulations. However, these elements represent a general primary butchering operation.

The last lower limb category includes all of the other elements not placed within the upper fore and hind limb categories. As summarized in Table 4.10, these elements include the 1st, 2nd and 3rd phalanges, sesamoid, 5th metacarpal, 1st tarsal, 2nd metatarsal and the manus V. Combined, they represent 69.6% of the total lower limb element articulated assemblage ($n = 80$). These 80 individual elements are included in several different articulations of various element numbers. There were several lower limb element articulations that contained four or more individual elements. Interestingly, they range in age from juvenile to adult. Indicating if the articulations were of an adult, sub-adult or juvenile gives an indication that the butchers processed several ages, not only ‘the’ adults or ‘the’ juvenile animals. Fincastle yielded articulated elements in all three age ranges (adult, sub-adult and juvenile).

In one case, there is one 1st, 2nd and 3rd phalanx articulation. Even though this articulation tells little with regard to butchering patterns, it does show the specific location this part of the carcass was left, and the age of the animal. These phalanges are

all lateral phalanxes from a juvenile left hind limb. The 1st phalanx is articulated with an unfused distal end of a metatarsal.

Table 4.10: Number of Fincastle appendicular vs. axial articulated elements.

Appendicular Skeleton						Axial Skeleton	
Upper Forelimb	Total	Upper Hind limb	Total	Lower limb	Total	Element	Total
Humerus	2	Tibia	1	Astragalus	5	Axis	2
Radius	2			Calcaneum	3	Cervical vertebrae	13
Ulna	1			Cuneiform pes	4	Thoracic vertebrae	24
				Navicular cuboid	5	Lumbar vertebrae	6
				Metatarsal	9	Caudal vertebrae	11
				Magnum	1	Vertebrae (general)	2
				Unciform	1	Centrum	13
				Metacarpal	6	Rib	16
				Metapodial	1	Sacrum	1
				1 st phalanx	29	Mandible	2
				2 nd phalanx	19		
				3 rd phalanx	16		
				Sesamoid	10		
				5 th metacarpal	1		
				1 st tarsal	3		
				2 nd metatarsal	1		
				Manus V	1		
TOTAL	5	TOTAL	1	TOTAL	115	TOTAL	90
APPENDICULAR TOTAL					121	AXIAL TOTAL	90
TOTAL EAST BLOCK ARTICULATED ELEMENTS							211

The other interesting lower limb articulation is combined with the tarsals and a metatarsal of an adult left hind limb. This articulated unit includes ten elements (tarsals, a metatarsal, phalanxes and sesamoids). This articulation shows a primary butchering

operation but gives no indication to a specific butchering pattern. Nine of the ten elements are complete BU1 elements, including the metatarsal. It is only the 3rd phalanx that is in an incomplete state. The 3rd phalanx, BU18, contains both proximal articulation points but only yields the lateral half of the element. This is probably due to post depositional weathering and not from cultural butchering.

One articulated unit that combines the lower hind limb with the upper hind limb elements also shows primary butchering operations, but shows a specific butchering pattern as well. This element was exposed to primary butchering operations. This articulation is from an adult *Bison bison* left hind limb that includes the tibia, astragalus, cuneiform pes, navicular cuboid and metatarsal (Figure 4.4).

All four tarsals are complete BU1 elements. In this case, joint dismemberment occurred on the tibia of this hind leg, shown by the breakage patterns on the distal tibia. The tibia, a BU4 element that contains approximately ¼ of the shaft, shows joint dismemberment. The metatarsal, on the other hand, is classified as a BU3 element which contains close to half the overall shaft. With each of the lower limb elements being complete, this is an indication that this particular lower left hind limb was not further utilized after being removed from the upper leg.

The tibia associated with this particular articulation was the only upper hind limb element in an articulated state. This indicates that the butchers segmented the upper and lower leg in the lower hind limb portion, and seemingly utilized the majority of the upper hind limb long bones. The same goes for the upper forelimb elements. There are a total of five upper forelimb elements in an articulated state, one of which is worth mentioning in detail. This articulation includes a right juvenile radius-humerus joint. The humerus is

a BU16 distal element consisting of ¼-½ of the shaft. The proximal radius is a BU10 element that contains approximately ½ the overall shaft. The joint was segmented on the humerus (primary butchering), and possibly at a second location in the lower limb (carpals or below). The radius shows the secondary butchering operation of marrow extraction.



Figure 4.4: Hind limb articulation, including the tibia, tarsals, metatarsal and 1st phalanx from unit 559N 598E in the East Block.

Axial Skeletal Articulations

The axial skeleton, representing 42.7% of the total East Block articulations, contains 90 individual elements summarized in Table 4.10. The majority of vertebral column axial articulated units show primary butchering operations, with the elements revealing specific butchering operations. There are several articulated units that contain

three or more vertebrae; some of them include two different vertebral elements. For example, one articulated unit contained cervical 5 to thoracic 1 (four elements). Each element is missing sections of the spinous process as well as one or more transverse processes, which points to primary meat removal.

Another vertebral column section included four juvenile lumbar vertebrae elements which also showed primary butchering. A third interesting articulation is of the tail section made up of four sub-adult caudal vertebrae (Figure 4.5). The caudal vertebra is the only axial element that shows a more detailed (secondary) butchering operation. It is unusual to find caudal vertebrae at a site, let alone in articulation, because they are typically taken with the hide for further processing. Eleven of the 109 caudal vertebrae (10.1%) were unearthed in an articulated state (see the caudal vertebrae section for more detail). The tail articulations, combined with the overall high caudal element count, indicate that detailed hide removal occurred at Fincastle.

There are two significant articulation units that show the primary butchering operations of joint dismemberment and meat removal combined. The first is an articulation that includes seven elements: four adult thoracic vertebrae in articulation with three left proximal rib elements. The vertebral column indicates that the butchers segmented the vertebral column into sections, and the proximal rib pieces indicate that this section was further butchered for meat removal. The same butchering pattern is also seen in the second example, which contains seven elements, including two juvenile thoracic vertebrae (one is the 7th thoracic, 'mid back'), one anterior centrum and four right proximal ribs.



Figure 4.5: Caudal vertebrae articulation from unit 559N 598E in the East Block.

Specific Element Evidence

The following section identifies the butchering evidence associated with each type of element in the East Block of the Fincastle Site. Details regarding BUs, fracture patterns, cut marks, impact marks, element quantities and other noteworthy aspects are included. The types of butchering activities are identified where possible. The BUs for each element and the associated remains from Fincastle are noted in Appendix III. This section begins with the axial skeletal elements and follows with the appendicular bones. The results of this analysis are summarized at the end of the chapter.

Axial Skeleton

Skull

There were a low number of unearthened skull fragments in the East Block. A total of 182 fragments were collected. Of these, 57.1% of the 184 fragments ($n = 105$) were classified as skull BU35 (Table 4.11). Bone Unit 35 is described as a small fragment of the skull identifiable by its shape and internal structure but it cannot be connected to a specific cranial section. These provide little information as to a butchering pattern for ‘meat’ removal. Considering how large the skull is, the low number of remains may mean they were removed from the primary kill site to an unexcavated area at Fincastle, or possibly, to another location altogether, as the skulls are known to be used for cultural reasons other than butchering operations.

Table 4.11: Number of skull elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	10	0	0	3	7	19	0	No Evidence				No Evidence			
1	15	1	0	3	9	0	0								
1	17	4	0	3	12	0	0								
1	20	0	0	3	13	2	1								
1	28	0	0	3	18	0	0								
1	48*	1	0	3	22	0	0								
				3	23	0	0								
				3	29	2	0								
				3	30	2	0								
				3	31	0	0								
				3	34	0	0								
				3	36	0	0								
				3	39	0	0								
				3	45*	4	0								
TL		6	0	TL		29	1								

Furthermore, low-element ratios exist for the atlas and axis vertebrae elements ($n = 12$ atlas, and 11 axis fragments), which may support skull removal. These two bones, in conjunction with the skull seem to have been separated from the rest of the body. The low numbers of all three elements shows that joint dismemberment of the head did occur, but there is no indication as to where the skulls (and vertebrae) were moved to. This finding aside, in five cases (four BU17s and one BU48*), there were fragments of the occipital condyles in the bone bed. This is the only location of the skull where joint dismemberment is performed at the back of the skull. None of the five occipital condyles had evidence of impact marks.

As noted, there is little useable muscle meat associated with the skull. The term 'meat' in this case includes the tongue, brain and nasal cartilage. There are some indications that each activity occurred at the site; however, the extent of nasal and brain removal cannot be determined due to the low number of recovered skull elements.

For brain extraction, one butchering pattern seems to be evident. There are 19 BU7 elements. There are also four separate BU45* pieces, which is similar to BU7. Both BUs are small fragments of the maxilla bone, though some include teeth and palate bone sections. Breaking this part of the skull is one way the butchers would gain access into the brain cavity.

Another way that the brain cavity may have been accessed is through the temporal/zygomatic region. There are a few fragments (two BU13s and two BU29s) of the temporal lobes that fit into Butchering Category 3. One BU13 has direct evidence. This element is a portion of the temporal condyle and zygomatic arch combined. There are two impact marks present, one on each end. More specifically, there is one impact on

the temporal and one on the zygomatic arch, each strike aiding in the removal of the temporal section from the skull. With this skull section removed, a hole is created allowing access into the brain cavity from the side of the skull.

The last process related to meat removal is for the tongue. There is evidence at Fincastle that the tongues were collected directly after the kill, in the context of the bone bed. More of the evidence, however, relates to the mandible and hyoid bone elements, and is summarized in element evidence sections below. Tongue-removal evidence relating to the skull comes from breakage patterns near the paramastoid processes. Breaking the paramastoid processes allows better access to the zygomatics, where the mandible can be removed and with it comes the tongue. Though low in numbers, there is trace evidence in the Fincastle faunal assemblage for this breakage pattern (BU15 or BU13 are two examples).

Mandible

A striking observation from the East Block faunal assemblage is the high number (207 fragments, of which seven [3.4%] are complete) of mandible elements. Considering the MNI is 35, the number of mandible fragments is greater than would be expected. Moreover, the few skull pieces in the bone bed indicate that the mandibles were separated from the skulls and processed in this area of the site. They were not removed from the site like the skulls seem to have been.

The mandible is mainly associated with primary butchering operations, such as joint dismemberment and meat removal. However, in some cases, the mandible has been utilized for the small amount of marrow that lies within the ventral margin. In all, 99 elements point to joint dismemberment in the Fincastle faunal assemblage (Table 4.12).

Based on the breakage patterns seen, there are two distinct ways in which the mandible has been separated from the rest of the body.

Table 4.12: Number of mandible elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	2	3	1	3	18	31	0	4	12	1	0	No Evidence			
1	3	2	1	3	23	4	0	4	14	6	0				
1	4	2	0	7	5	3	0	4	15	11	0				
1	6	12	0	7	8	2	0	4	45	0	0				
1	7	19	2	7	20	2	1	4	49	2	0				
1	10	1	0	7	22	2	0	7	13	0	0				
1	11	0	0	7	26	2	0	7	43	6	1				
1	16	2	0	7	39	2	0	7	46	0	0				
1	17	4	0	7	42	3	0								
1	25	2	0	7	43	6	1								
1	27	4	0	7	44	3	0								
1	29	14	0	7	47	0	0								
1	30	1	0												
1	31	0	0												
1	32	6	0												
1	35	0	0												
1	36	0	0												
1	38	0	0												
1	40	1	0												
1	48	5	0												
1	50	1	0												
1	54*	1	0												
7	5	3	0												
7	8	2	0												
7	13	0	0												
7	20	2	1												
7	22	2	0												
7	26	2	0												
7	39	2	0												
7	42	3	0												
7	44	3	0												
7	46	0	0												
7	47	0	0												
TL		99	5	TL		60	2	TL		26	1				

The first is to separate the two mandibles via the distal ends. By comparing the distal vs. proximal ratios, there are 16 distal elements compared to 59 proximal that, according to the Butchering Category System, are associated with joint dismemberment. Distally, the mandibles were struck at fairly similar locations. Twelve of the 16 distal elements are BU6 portions. They were all smashed between the symphyseal surface and the 1st premolar. The butchers struck this location because it is a thinner section of the mandible, which allowed the element to be ‘snapped’ easier, and pulled apart from the hyoid and skull.

The second and more frequent way in which the mandibles were separated from the skull was by breaking the proximal end. A total of 59 BU elements are associated with Butchering Category 1 for this case of joint dismemberment. Thirty-three of the 59 were located specifically on the coronoid process (19 BU7s, and 14 BU29s).

Two of the mandible BU7s have direct impact evidence. The first fragment yields two impact marks. One smash mark is located on the coronoid process and the second is located immediately below the coronoid process, creating a transverse fracture. These impact marks show joint dismemberment from the skull.

The second BU7 element contained a series of cut marks located on the tip of the coronoid process. These cut marks could have been created when the butchers used a knife to separate the muscles and tendons associated with the temporal-mandibular joint.

Two other elements contain direct evidence of joint dismemberment on the proximal end. The first is a BU2 piece that has one impact mark on the medial aspect directly below the articular condyle. Therefore, this mandible was already separated

from the skull as the impact is on the medial aspect. It would be difficult to strike the medial side if the mandible was still attached to the skull.

The last element that shows joint dismemberment is a mandible BU3 that yields three separate impact marks. There is one mark on the lateral portion of the ascending ramus, directly below the articular condyle. A second impact is located on the medial side of the ascending ramus, while the last impact mark is on the articular condyle. Of the three marks, it seems that the medial impact mark occurred after the joint was separated, as it would be hard to make a good impact on the inside of an attached mandible. The lateral and condyle marks probably resulted from the actual dismemberment as the actual dismemberment strikes had to have occurred on the outside of the element.

As discussed, meat removal from the mandibles definitely occurred, as the tongues were removed at the site. According to the Butchering Categories, a total of 60 BU elements can show meat removal. However, only two of these reveal direct evidence. Bone Unit 20 fits into Butchering Category 7, and is split between joint dismemberment and meat removal. There is a transverse fracture that runs through a molar, dividing the mandible in half. Due to the location of the fracture, it is probably for gaining access to the tongue, but joint dismemberment cannot be ruled out in this case. The other is a BU43 element that is discussed below, as it is also a part of the common butchering pattern that is present.

With regard to the overall meat removal category, there is a common butchering pattern evident at the site. Bone Unit 18 and BU43, represent a small portion of the cheek teeth section. Combined, 37 of the 60 meat removal elements (61.7%) fit into

these two BUs (31 BU18s and 6 BU43s). Even though BU43 fits into the Butchering Category 7, the direct evidence on one of the elements seems to be related to meat removal more than marrow. Interestingly, one BU43 mandible element contains multiple cut marks on the medial side of the ventral margin (Figure 4.6). This is a prime location for tongue removal. The mandible was probably segmented and broken prior to cutting it, as they are on the medial aspect.



Figure 4.6: Mandible (Cat. No. 7664) depicting cuts on the medial aspect of the ventral margin.

One of the seven complete (BU1) mandibles unearthed had direct meat removal evidence . There was one impact mark located on the medial aspect of the ventral boarder near the ascending ramus. It could be that the mandible was separated from the skull by smashing the temporal condyles of the skull, though this is only speculation. The mark on the medial aspect indicates that the tongue was retrieved from the mandible, even though it is still fully intact.

Although the mandible is usually associated with primary butchering, the Fincastle faunal assemblage contains a few mandibles further processed for their marrow. According to the Butchering Classification System, a total of 26 elements may show marrow extraction. The BU15 ($n = 11$) and BU14 ($n = 6$) mandibles combined account for 17 of the possible 26 elements for marrow extraction (65.4%). The BU43 has direct evidence on it as well. There seems to be a common butchering pattern for marrow extraction occurring at the site. In Brumley's BUs, mandible BU15 is the ventral margin section that contains the small marrow cavity within it, and BU14 is the cheek teeth section that is situated directly above the ventral margin. The margin needs to be split open in order to obtain the marrow, as it is a long thin section situated directly below the teeth. The marrow would be hard to obtain if the proximal ascending ramus and distal symphyseal surfaces were smashed off with a short spiral or transverse fracture pattern.

Hyoid

The hyoid is a thin, flat bone that is commonly missing from bone beds, presumably because the butchers took the hyoid with the tongue to a secondary site and/or weathering decreased the likelihood of recovering the hyoid during excavation. As expected, there were no complete hyoid BU1 elements unearthed in the East Block. However, an unexpectedly large number ($n = 57$) of hyoid fragments were recovered.

There is no doubt that the tongues were removed in this area of the Fincastle site. This is shown by the mandibles, and the hyoid, which is directly associated with the tongue. Any BUs connected with the element was classified under Butchering Category 3 (meat removal), and are summarized in Table 4.13.

Table 4.13: Number of hyoid elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
No Evidence				3	2	4	1	No Evidence				No Evidence			
				3	3	4	0								
				3	4	7	0								
				3	5	2	0								
				3	6	0	0								
				3	7	2	0								
				3	8	24	1								
				3	9	2	0								
				3	10	3	1								
				3	11	6	1								
				3	12	1	1								
				3	13	0	0								
				3	14*	2	0								
				TL		57	5								

Since the entire hyoid is associated with the tongue, knowing the number of remaining articulation points can indicate possible butchering patterns. The loss of articulation points can attest to the number of strikes it took to separate the tongue from the hyoid (Table 5.14). The majority of the hyoids were struck more than once as 28 of the 33 were missing more than one articular end. There is no consistency on the hyoid where this butchering pattern occurred, but most of the breaks were on the proximal end.

Table 4.14: Number of hyoid bones missing a specific number of articulation points.

Number of articulation points missing per element	Total Number of elements
Missing 1 articulation point	5
Missing 2 articulation points	13
Missing 3 articulation points	15
TOTAL	33

In four separate cases, there is direct impact evidence on the mid shaft and proximal ends of the hyoids. The first is a BU10 that contains a single impact mark on the mid shaft. A hyoid BU12 contains two impact marks, one on the mid shaft and another on the muscular angle, which is similar to a BU2. The last hyoid (BU11) has three impact marks, one on the mid shaft, a second on the proximal angle and a third impact mark on the muscular angle (Figure 4.7).



Figure 4.7: Hyoid (Cat. No. 4491) with three impact marks.

The remaining hyoid elements not included in the above table fall into Brumley's BU8, which consists of small fragments of the shaft ($n = 24$). These are small fragments presumably directly related to tongue removal, but only one of these contains direct evidence. The BU8 element has one impact mark on its shaft immediately below the proximal end. The impact mark seems to create the separation between the proximal and distal ends of the hyoid.

Atlas

At Fincastle, few atlas fragments were unearthed in the East Block (Table 4.15). Twelve fragments were collected, only one of which was a complete BU1 (8.3%). This was an unexpected occurrence, considering that the atlas is a part of the cervical vertebrae which are often associated with primary butchering operations. The atlas is connected with one of two ways to separate the skull from the body. The low number of collected atlas fragments may indicate that there is a section of the unexcavated site to which the skulls and the axis vertebrae were taken.

Through the analysis of the few atlas fragments, six possible Bone Units fit into Butchering Category 1 (joint dismemberment). None of the six elements yield direct evidence, however. Furthermore, no evidence was recorded for meat removal or the secondary butchering practises of marrow and grease as these caloric sources are not typically associated with this element.

Table 4.15: Number of atlas elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	2	2		No Evidence				No Evidence				No Evidence			
1	3	2													
1	7	0													
1	8	0													
1	10	0													
1	11	0													
1	12	1													
1	13	0													
1	14*	1													
TL		6													

Axis

Similar to the atlas bone, the axis was only represented by a small number of fragments ($n = 11$) in the East Block (Table 4.16). The axis is associated with primary butchering operations, including joint dismemberment and meat removal, rather than marrow and grease rendering activities as they are not typically associated with it.

Table 4.16: Number of axis elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	2	0		3	3	1		No Evidence				No Evidence			
1	7	2		3	6	0									
1	8	0		3	9	0									
1	11	0		3	10	1									
1	13	1		3	14	0									
1	15	0													
1	17*	2													
1	18*	1													
TL		6		TL		2									

There were six possible axis fragments that fit into Butchering Category 1 (joint dismemberment) none of which contained direct evidence.

Unlike the atlas bone, however, the axis has small muscle attachment locations located on the spinous and transverse processes. Even though only small neck muscles are associated with the axis, they were still utilized at many sites. Using Brumley's BUs, two Fincastle axis fragments could indicate meat removal. One BU3 and one BU10 axis fragment fit into Butchering Category 3. Neither have direct evidence.

Cervical Vertebrae

The cervical vertebrae, specifically C3-7, yielded 72 fragments from the East Block excavations. Cervicals 1 and 2 (atlas and axis) have been analyzed as bone elements separate from the rest of the cervical vertebrae and do not contribute to the cervical element counts. This remaining section of the vertebral column is mainly associated with primary butchering operations, including joint dismemberment and meat removal. The cervical vertebral column is a unique area of the spine. The first few cervicals (C3-6) are associated with the small neck muscles that attach to the transverse processes. The last cervical (C7) acts as a major muscle attachment point for the hump meat on the large spinous process.

As summarized in Table 4.17, 19 possible cervical fragments could be associated with joint dismemberment. Sixteen of these fall into Butchering Category 1, and three are placed in Butchering Category 7, paired with meat removal. None of the BUs associated with joint dismemberment contain direct butchering evidence.

It seems that the butchers separated the cervical vertebral column from one another, instead of discarding them either in articulated states or near complete elements for no further processing. There are a high number of cervical BU3 elements ($n = 13$) and BU8 ($n = 3$) fragments included in Butchering Category 1. These two BUs are similar as they both lack the overall body but consist of only being the articular processes (either the anterior or posterior), which are what attach each cervical vertebra together.

Alternatively, 13 of the 72 cervical elements were articulated, which is to be expected because the cervicals are usually only primarily processed. These articulated elements have been associated with meat removal (see articulation section of Chapter 4).

None of the articulated elements was complete, showing that some degree of processing occurred. Moreover, the vertebrae themselves were all missing some section of the transverse processes. It is not clear if these articulated elements were specifically segmented into butchering sections and taken to a processing area.

Table 4.17: Number of cervical elements per vertebrae Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	3	13	0	3	4	3	0	No Evidence				No Evidence			
1	8	3	0	3	12	4	0								
1	30	0	0	3	13	5	0								
7	22	2	0	3	15	0	0								
7	31	0	0	3	16	20	1								
7	37*	1	0	3	21	0	0								
				3	27	7	0								
				3	29	0	0								
				3	34*	2	0								
				7	22	2	0								
				7	31	0	0								
				7	37*	1	0								
TL		19	0	TL		44	1								

Quite a large number of cervical elements are associated with meat removal; 44 of the 72 elements show possible meat removal patterns. Under Butchering Category 3, BU16 has a high link to meat removal. This was no surprise as Fincastle's BU16 elements are always missing a section of the spinous process and one or more of the transverse processes.

Finally, one BU16 had direct evidence of Butchering Category 3. This cervical element revealed clear transverse fractures on the ventral branches (transverse processes), showing that the large side and hump meat muscles were taken.

Thoracic Vertebrae

The thoracics yield the highest number of vertebral column fragments unearthed in the East Block. Of the 210 fragments, none was complete. The thoracics, like the other vertebrae, are associated with primary butchering operations, particularly meat removal as their spinous processes are associated with the major hump meat. Joint dismemberment can occur between individual vertebrae elements or at the rib heads that attach to the transverse processes.

There are three BUs that fit into Butchering Category 1 (joint dismemberment). Of these, BU13 (section of the transverse process only), represented seven of the possible 10 BUs recovered from Fincastle (Table 4.18). The rest of the elements fall into Butchering Category 7, combined with meat removal. There are nine BUs classified as Butchering Category 7, with a possible 48 individual elements unearthed from the East Block.

Within Butchering Category 7, six individual thoracic elements contain direct evidence. The first is a thoracic BU23. This element contains a single impact mark on the posterior section of the basal spine, probably to aid in the removal of the spinous process from the vertebral arch. The next five are BU15s, which have a missing spinous process as well as missing one or both of the transverse processes that articulate with the ribs. There are 30 BU15 fragments in the Fincastle faunal assemblage. Three of the five BU15s that contain direct evidence have a short spiral fracture pattern located on the basal section of their spinous processes. Two of these elements are missing both of the transverse processes, while the other is only missing the left transverse process. The fourth BU15 with direct evidence has one impact mark on the anterior section of the basal

spinous process. The impact mark created the short spiral fracture pattern that is present, which aided in the removal of the spinous from the rest of the element.

Table 4.18: Number of thoracic elements vertebrae per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	13	7	0	3	2	39	3	No Evidence				No Evidence			
1	20	0	0	3	3	2	1								
1	21	3	0	3	4	23	3								
7	9	5	0	3	5	11	1								
7	11	2	0	3	7	8	0								
7	12	2	0	3	8	2	2								
7	15	30	5	3	10	5	1								
7	23	5	1	3	14	3	0								
7	24	1	0	3	16	4	0								
7	29	1	0	3	17	1	0								
7	30	1	0	3	18	14	1								
7	36*	1	0	3	22	3	0								
				3	39*	2	0								
				7	9	5	0								
				7	11	2	0								
				7	12	2	0								
				7	15	30	5								
				7	23	5	1								
				7	24	1	0								
				7	29	1	0								
				7	30	1	0								
				7	36*	1	0								
TL		58	6	TL		165	18								

Within Butchering Category 7, six individual thoracic elements contain direct evidence. The first is a thoracic BU23. This element contains a single impact mark on the posterior section of the basal spine, probably to aid in the removal of the spinous process from the vertebral arch. The next five are BU15s, which have a missing spinous process as well as missing one or both of the transverse processes that articulate with the ribs. There are 30 BU15 fragments in the Fincastle faunal assemblage. Three of the five

BU15s that contain direct evidence have a short spiral fracture pattern located on the basal section of their spinous processes. Two of these elements are missing both of the transverse processes, while the other is only missing the left transverse process. The fourth BU15 with direct evidence has one impact mark on the anterior section of the basal spinous process. The impact mark created the short spiral fracture pattern that is present, which aided in the removal of the spinous from the rest of the element.

The last BU15 element also has an impact mark on the anterior portion of the basal section of the spinous process, which created a short spiral fracture (Figure 4.8). This impact mark seemingly aided in the removal of the spinous process. What differentiates this BU15 from the others is that it lays in articulation with one other thoracic BU15 element and associates with a BU7, probably of the same original vertebrae (BU7 is a large section of the spinous process).



Figure 4.8: Thoracic vertebra (Cat. No. 3415) with an impact mark and short spiral fracture.

Much of the thoracic evidence fits into Butchering Category 3 relative to meat removal. Thirteen BUs fit into this category. A total of 117 possible elements recovered in the East Block show meat removal (Table 4.19). Twelve of these Butchering Category 3 elements contain direct evidence.

What is clear is that the meat removal processes do not fit into the primary rough meat removal process with which the thoracics are commonly associated. At Fincastle, the butchers performed rough and detailed meat removal processes (primary butchering and secondary butchering). Primary butchering can be associated with the removal of the bottom section of the spinous process. The butchers would have smashed the basal section to remove it from the vertebral arch and body, for initial rough meat removal purposes.

Table 4.19: Number of thoracic elements per Bone Unit that show primary (rough) meat removal.

BU	Definition	Total number of elements	Elements containing direct evidence
2	Large basal section of spinous with articular processes present.	39	3
16	Small basal section of spinous, missing the articular processes.	4	0
22	Consists of the posterior articular processes only.	3	0
	TOTAL	46	3

Three BUs relate to rough meat removal. A total of 46 elements possibly evidence primary (rough) butchering, which constitutes 21.9% of the overall thoracic bone assemblage. BU2 is the most common element connected to this process, comprising 84.8% of the rough butchering thoracic elements (Figure 4.9).



Figure 4.9: Thoracic vertebra (Cat. No. 4314) representing the common BU2 elements. Also note the impact marks.

Three of the BU2s contain direct evidence of rough meat removal. All three have two separate impact marks. The first of the two marks is located on the basal section, near the posterior articular processes. These impacts would have aided in the initial separation of the spinouses from their vertebral arch. The second set of impact marks are located on the spinous process themselves (all at varying lengths above the articular processes). One of the three BU2 elements contains a distinct transverse fracture pattern on the spinous shaft, created from the impact mark. These second sets of impacts would have aided in the further removal of the spinous process, allowing the proximal sections to be taken with the meat from the bone bed.

Bone Unit 2 is similar to both BU16 and BU22. These latter BUs were also recovered in the bone bed ($n = 7$), but none revealed direct evidence.

Another interesting observation is that a more detailed secondary butchering of the thoracics for meat removal occurred in the East Block (Table 4.20). In fact, a higher

percentage of elements evidence detailed meat removal than rough butchering. A total of 63 thoracic vertebrae elements (30% of the total thoracic assemblage) fall into secondary (detailed) meat removal. There are five BUs that all have a different sized spinous process that relates to the amount of meat associated with removal by secondary processing.

Table 4.20: Number of thoracic elements per Bone Unit that show secondary (detailed) meat removal.

BU	Definition	Total number of elements	Elements containing direct evidence
7	Mid section of spinous process over 10 cm in length	8	0
18	Mid section of spinous process less than 10 cm in length	14	1
14	Very proximal end of spinous process	3	0
3	Entire spinous process minus the articular processes	2	1
8	Entire spinous process including the particular processes	2	2
4	Entire body intact with up to ½ of the spinous process attached	23	3
5	Entire body intact with near complete spinous process attached	11	1
	TOTAL	63	8

Bone Unit 7 and BU18 are similar, differing only in the overall length of the spinous present. Combined, they account for over ¾ of the ‘detailed’ meat removal BUs (75.9%). They suggest that the butchers originally removed the spinous process at the basal section (such as a BU2 in the ‘rough’ butchering stage), and further stripped the spinous processes of the hump meat before removing it from the bone bed. The BU7 element that was associated with the two thoracic vertebrae articulation, as mentioned above, indicates the more detailed meat removal process. The butchers originally removed the spinous process from the BU15 element, creating the BU7 (large spinous

fragment), and discarded the articulated vertebrae once the spinouses were removed. No thoracic BU7 elements contained direct evidence, though one of the 14 BU18 did. This element had three separate impact marks, all located near one another on the mid section of the spinous process.

The next section of the spinous process fits into BU14. Though none of the three recovered contained direct evidence, they are a rare find. In most cases, these proximal sections are taken with the meat to be further processed. These indicated that the butchers took time to remove the meat from the bones at the site (secondary meat removal).

Bone Unit 3 and BU8 are similar and are also rare finds in a bone bed. They further evidence that a more detailed meat removal process occurred at Fincastle. Even more interesting is that three of the total four (one of two BU3s and both of the BU8s) contain direct evidence.

The BU3 element has five separate impact marks that can be seen in Figure 4.10. The first impact mark is located on the proximal aspect of the basal section of the spinous. This impact created a transverse spiral fracture pattern, which was probably related to the initial separation of the spinous process from the vertebral arch. There is a second impact located on the anterior mid shaft border. The last three separate impact marks are located on the posterior mid shaft section. Impacts two to four (mid-shaft impacts) were probably created when the butchers removed the meat from the spinous (in different directions), and then discarded the element in the bone bed.

The two BU8s that have direct evidence both have fracture patterns on the distal (basal) sections, probably a result of an initial element separation of the spinous and the

vertebral arch sections. They also both reveal transverse fracture patterns on the proximal ends, with over $\frac{3}{4}$ of the overall spinous process left intact. Unlike the above described BU3, no impact marks are present, but due to the length and dual fracture patterns on each element, there is no doubt that secondary meat removal occurred.



Figure 4.10: Thoracic vertebra (Cat. No. 7384) with five impact marks encircled on the spinous process.

The most noteworthy discovery from the East Block is the number of BU4 and BU5 elements recovered. Even though BU4 and BU5 are classified as Butchering Category 3, they are similar to BU15, which is classified as a Butchering Category 7 element. The main difference is the presence of the transverse processes. The transverse is in BU4 and BU5, whereas BU15 may be missing one or both of the processes. This is significant because when the transverse processes are intact, there is no indication of joint dismemberment from the ribs occurring, meaning that the butchers removed the meat without separating the thoracics from the ribs.

Taken together, BU4 and BU5 comprised 53.97% of the elements that show secondary butchering ($n = 34$). Of the 34, four have direct butchering evidence (three BU4s and one BU5).

All three of the BU4 elements with direct evidence consist of a complete body (with transverse processes), and contain a short spiral fracture between $\frac{1}{4}$ and $\frac{1}{2}$ up the spinous process. Only one of these BU4 elements has an impact mark that is directly associated with the fracture pattern. The BU5 element is similar to those of BU4, consisting of a complete body section. There is only a small section of the proximal spinous process removed via a transverse fracture pattern (Figure 4.11). There is no impact mark associated with the fracture pattern.



Figure 4.11: Thoracic vertebra (Cat. No. 7602) with evidence of secondary meat removal.

There are several other thoracic elements that possibly show meat removal. However, they cannot be used to distinguish between ‘rough’ and ‘detailed’ butchering. This is the case with the 12 thoracic elements that have direct evidence of meat removal, with one exception. The thoracic BU10 element has two separate impact marks, located on both the anterior and posterior sections of the basal spine, which together create a short spiral fracture pattern. None of the BUs were classified into Marrow Extraction or Grease Rendering Categories due to fact that the thoracic vertebrae do not yield usable marrow or grease.

Lumbar Vertebrae

There were only 44 lumbar vertebrae fragments recovered from the East Block at the Fincastle Site, which is the lowest number of all recovered vertebral column elements. No BU1 complete elements were recovered, and only six of the recovered fragments were in an articulated state. Of the BUs that could show joint dismemberment, Fincastle only produced five elements (one BU4, one BU12, two BU12's and one BU22), none of which have direct evidence on them (Table 4.21).

Primary meat removal is a commonly associated with the lumbar vertebrae. There are 20 lumbar elements could relate to meat removal practises, however, these yield no direct evidence of this primary butchering operation.

As is the case with the other vertebral elements, no evidence was recorded for marrow extraction or grease rendering.

Table 4.21: Number of lumbar vertebrae elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	4	1		3	6	6		No Evidence				No Evidence			
1	12	1		3	7	0									
1	13	0		3	8	4									
1	14	0		3	9	5									
7	5	2		3	10	0									
7	15	0		3	18	1									
7	22	1		3	21	1									
				7	5	2									
				7	15	0									
				7	22	1									
TL		5		TL		20									

Ribs

The ribs were the highest recovered element in the East Block at Fincastle, accounting for 36.4% of the overall faunal assemblage. A total of 2,030 rib elements were unearthed, 99.8% of which are incomplete. With the high numbers of rib fragments, there is no doubt that they were butchered, but the rare find of four complete BU1 rib elements was also unearthed in the East Block. The ribs are a part of the axial skeleton, thus are mainly associated with primary butchering operations, though no direct evidence was associated with the ribs from Fincastle.

Table 4.22: Number of rib elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	2/8	164	46	3	5	38	7	No Evidence				No Evidence			
1	³ / ₄ /6	162	9	3	⁷ / ₁₁	15	4								
1	9	29	0	3	15	985	30								
1	13	3	0	3	16	400	28								
1	14	3	0	3	18	14	0								
1	21*	35	2	3	20	9	1								
1	22*	28	1	7	10	52	19								
1	25*	7	0	7	17	27	1								
7	10	52	19												
7	17	27	1												
TL		510	78	TL		1540	90								

Joint dismemberment is seen in the rib fragments. A total of 510 elements may show joint dismemberment, with 79 elements falling into Butchering Category 7, combined with meat removal. The remaining 431 elements are classified into Butchering Category 1.

In Table 4.22, some of the BUs that fall into Butchering Category 1 have been grouped together for the Fincastle faunal analysis because they have similar

characteristics. BU2 and BU8 are analysed together as they only differ in their shaft lengths (BU2 has a shorter shaft length [0-5 cm], whereas BU8 has 5-10 cm of associated shaft). They both have complete proximal ends (intact head and tubercle). Figure 4.12 shows both types. Bone Units 3, 4 and 6 are also lumped together because they have between 0 – 10 cm of shaft.



Figure 4.12: Rib (Cat. No. 7928 above) and Rib (Cat. No. 7919 below) depicting BU2 and BU8 respectively. Both show joint dismemberment.

Two specific butchering patterns were created when separating the proximal end of the rib from the thoracic vertebrae. The smashing of the shaft less than 10 cm from the neck is reflected in 326 rib fragments. One hundred sixty-four BU2 and BU8 elements were unearthed (119, and 45 respectively) and a total of 162 BU3, 4 and 6 elements were recovered (7, 117, and 38 respectively). A distinct joint dismemberment butchering pattern is seen in the BU2s, which account for 36.5% of the 326 elements. The BU4s, on

the other hand, account for 35.9%. The main difference between these two BUs with regard to the butchering pattern is that the rib BU2 elements were only smashed on the shaft. They must have also been separated from the thoracic vertebrae by striking the transverse processes of the thoracics. The BU4 elements on the other hand, were struck on the shaft between 0-10 cm, but were also struck a second time on the shaft/neck section to remove them from the thoracics. The thoracics may not have been impacted to remove these specific ribs.

Direct evidence pertaining to these butchering patterns on the BU2, 3, 4, 6 and 8 elements have also been analyzed in the same categories, as seen in Table 4.23. Since a high number of rib elements contained direct evidence (78 for joint dismemberment), a separate table was created to summarize the impact marks. The elements were separated by counting the overall number of impacts on each individual element.

Table 4.23: Number of ribs per Bone Unit group that have direct impact mark evidence of joint dismemberment.

Definition	BU	Proximal or Distal	Number of impacts	Number of impacted elements
Intact proximal end with 0-10 cm of shaft	2/8	Proximal	1	30
	2/8	Proximal	2+	12
Butchered proximal end with 0-10 cm of shaft	3/4/6	Proximal	1	0
	3/4/6	Proximal	2+	8
TOTAL				50

Out of the 78 joint dismemberment elements that have direct evidence, 50 of them reveal impact marks. The majority of the rib elements with impact marks only contained one ($n = 30$). Only 12 BU2/8 elements contained two or more impacts. Therefore, rarely did the butchers need to strike the ribs more than once. Interesting, however, is that there were only eight BU3/4/6 elements of the 50 that contained direct evidence and all of

these contained two or more impact marks. This could be because the butchers utilized a snapping technique as well as initial impacts to separate the shaft from the proximal end.

No specific rib element is discussed separately with regard to the butchering process with the exception of two BU2 ribs and one BU4 element that have cut-mark evidence. Cut marks are generally associated with meat removal. However, the locations of these cuts indicate that they were created while separating the ribs from the thoracics. The locations of these cuts are on areas of the ribs where no meat attaches. Both of the BU2 elements have multiple cuts on the ridge of the tubercle, whereas the BU4 element yielded multiple cut marks on the neck section.

Two other rib elements that have cut-mark evidence are located on BU21* elements. These BUs lack impact marks, and are therefore not included in Table 4.23, above. Both of the BU21 rib elements have cut marks located on their neck portions. One of the two elements contains cuts is on the lateral side, whereas the other rib neck section has encircling marks around the entire neck. The location of these cut marks indicates that they were created during the joint dismemberment process. The head and tubercle are missing from the neck sections, probably as a result of the separation between the rib shaft and the thoracic vertebrae.

There is also no doubt that the side meat attaching to the ribs was also removed in the East Block at Fincastle. Out of the 2,030 rib fragments recovered, 1,540 fit into the meat removal category, comprising the highest percentage of any element of the overall assemblage for a specific butchering operation (75.9%). Very similar to the thoracic vertebrae, this evidence indicates that there was both primary (rough) meat removal as well as secondary (detailed) meat removal. The majority of the ribs seemed to have been

exposed to a more detailed meat removal process. The evidence for this is summarized in Table 4.24.

Table 4.24: Number of rib elements per Bone Unit that have direct impact mark evidence of secondary (detailed) meat removal.

Definition	BU	Proximal or Distal	Number of impacts	Number of impacted elements
Intact proximal end with 10 cm+ of shaft	5	Proximal	1	3
	5	Proximal	2+	3
Butchered proximal end with 10 cm+ of shaft	17	Proximal	1	0
	17	Proximal	2+	1
Intact proximal end with over 90% of shaft	20	Both	1	1
	20	Both	2+	0
Shaft only ranging between 1-10 cm	15	Both	1	13
	15	Both	2+	13
Shaft only ranging between 10-20 cm	16	Proximal	1	12
	7/11	Distal	1	1
	16	Proximal	2+	14
	7/11	Distal	2+	2
Shaft only consisting of 90% or more	10	Proximal	1	3
	10	Distal	1	0
	10	Proximal	2+	11
	10	Distal	2+	2
TOTAL				79

As previously mentioned, BUs were placed into Butchering Category 7 (BU10 and BU17), because they cannot be distinguished between joint dismemberment and meat removal. It may be possible that they were utilized for both. It was likely that the butchers removed the shafts with the meat from the kill site to further process it elsewhere.

Bone Unit 10 has the entire shaft present, but is missing the proximal end (head, tubercle and neck). The elements could have been originally impacted at the proximal shaft (leaving a BU2 element behind), and then further removed from the meat at the site.

Rib BU10s cannot be associated with primary (rough) butchering; they must be regarded as detailed meat removal because the shaft is intact. A high number of BU10's were recovered ($n = 52$), and 19 of them have direct evidence on them indicating detailed meat removal. Eleven of the 16 contain impact marks located on the proximal end of the shaft, and have been impacted two or more times. Two of the BU10 elements with impact marks are worth describing in detail as they both contain fracture patterns as well as impact marks.

The first BU10 element has two impact marks located on the proximal and distal sections of the shaft. There are two fracture patterns associated with the impact marks. One is a short spiral fracture located immediately below the neck, probably a result of primary joint dismemberment. The other fracture is a transverse fracture pattern located on the distal end of the shaft. This fracture line is likely a result of a more detailed meat removal operation (Figure 4.13).



Figure 4.13: Rib (Cat. No. 7918) with impact marks and fracture patterns showing detailed meat removal.

The second BU10 element consists of a long spiral fracture pattern on the proximal shaft with an impact mark on the costal groove. This was probably the result of

joint dismemberment. There was another impact mark located on the distal end of the shaft, likely the result of detailed meat removal.

There are three BU10 elements that have direct evidence of cut marks that seem to attest to detailed meat removal. Their cut marks are long and deep with multiple lines on the lateral section of the mid shaft. The butchers probably separated each rib from the vertebrae, and removed the side meat from them.

There was only one BU17 element of the 27 recovered from the East Block that had direct evidence. This element had at least two impact marks on the shaft section, but there is not enough evidence to indicate a specific butchering pattern.

As summarized in Table 4.22 above, six Bone Units fall into Butchering Category 3 relative to meat removal. Ninety of the 1,461 rib fragments that fall into Butchering Category 3 have direct evidence, and the majority of this direct evidence is in the form of impact marks. Most ribs were struck at least two times. It is interesting that the BU15 and BU16 elements impacted once compared to two or more times, show similar counts. Considering their location on the shaft (mid shaft), they must have been impacted on both ends of the shaft. It is difficult to explain why only one impact mark is visible. Two situations may explain the absence of two or more impact marks. First, it could be due to preservation factors, as the rib shafts are fairly thin and easily subjected to post-depositional processes; or second, because part of the rib was originally snapped off, leaving a smoother edge. At this point, it cannot be confirmed as to why the BU15 and BU16 elements lack the impact marks.

Regardless, all of the Butchering Category 3 impacted rib fragments have similar butchering characteristics. Of these, three show more unique impacts. The first is a

BU11 rib element that has two impact marks on the lateral distal ends. The marks are larger and deeper than the other impact marks and indicate that a large chopping tool was used to separate the bone from the meat. This element also has chew marks. The second rib is a BU15 element. It too, has a deep chopper impression on the mid shaft. The last is a BU22 rib element that has four separate impacts, including two deep circle impressions on the neck section. These were probably created during joint dismemberment. The other two marks are located on the shaft and likely aided in detailed meat removal.

There are a total of eight rib fragments that have cut-mark evidence. The cut marks on each of the elements all show a more detailed meat removal process, as they all fall within Butchering Category 3. The first is a BU5 element that has deep cut marks on the lower border of the neck. It is possible that the cut marks aided in joint dismemberment. However, the fact that the inter-costal muscles are associated with the proximal shaft may mean that the cuts could have resulted from meat removal. Both of the cut marks on the rib BU8 elements are located on the costal groove and show direct meat removal. They are all parallel to the costal groove. One of the two cut marks rest directly over the small fracture pattern that was probably resulted from the rib separation, indicating that the fracture was from primary butchering and the cut marks were from meat removal.

The remaining five rib elements with cut marks on them are BU15 and BU16 shaft fragments. Both these BUs are associated with detailed meat removal, and differ only in their overall measurement. Bone Unit 15 consists of a mid shaft section measuring less than 10 cm in length, whereas BU16 consists of a mid shaft fragment measuring between 10-20 cm in length. Combined, they account for 89.9% of the rib

fragments showing meat removal and 68.2% of the entire Fincastle rib assemblage. From these numbers alone, there is no doubt that the rib bones were separated from the meat directly at the kill site.

There are three rib BU15 elements with cut marks. Two of these have multiple cut marks on the ventral faces. The third rib BU15 has evidence that the inter-costal muscles were removed based on the deep cuts on both the top and bottom ridges of the mid shaft fragment. The cuts originated on the ridges and crossed the ventral face (Figure 4.14).



Figure 4.14: Rib (Cat. No. 8161) with deep cut marks on the ridges of the mid shaft.

On top of the sheer number of rib fragments recovered that show secondary (detailed) meat removal, the four complete BU1 rib elements are noteworthy. Even though they are complete, they too were also subject to meat removal, as they were in a disarticulated state. They could have been separated from the thoracic vertebrae by smashing the transverse processes of the vertebrae and then carefully removed from their associated meat. This is, of course, speculation since there is no direct butchering

evidence on the complete elements. It may be that these ribs were not utilized at all, considering the site seems to show meat waste (a time of 'plenty').

Costal Cartilage

A unique and important find unearthed at Fincastle is the presence of cartilage. There are 14 separate cartilage elements preserved in the East Block, all of which are costal cartilage. None of the cartilage elements have been assigned a BU identification number as cartilage does not exist in Brumley's Bone Unit Classification system as a bone element.

Over ½ of the cartilage fragments (57.1%) recovered at Fincastle are from the same excavation unit (Unit 652n, 598e), one of which was complete (Figure 4.15).



Figure 4.15: Complete cartilage element (Cat. No. 4840).

There is no previously recorded evidence of cartilage fragments revealing any sort of butchering evidence. Two cartilage elements do seem to have some post-depositional evidence on them, however.

One element has marks similar to the rib elements with chew marks. The chew marks appear to be from a small mammal, probably a rodent. Though the actual time of chewing cannot be determined, it probably occurred after the butchers abandoned the site. The second cartilage fragment appears to have a hole in it (Figure 4.16). It cannot be determined if there is a cultural reason for this on it or a result of post-depositional process. The element was not found in articulation with any other element, thus indicating it had been removed from the carcass.



Figure 4.16: Weathered cartilage element (Cat. No. 4785).

Sacrum

Excavations in the East Block of Fincastle produced few sacral fragments (Table 4.25). Of the 11 fragments unearthed, only two may be associated with joint dismemberment. Neither of these sacral BU18 elements, however, yielded any direct evidence. The sacrum is generally associated with primary butchering therefore, no evidence relating to meat removal, marrow extraction or grease rendering is noted.

Table 4.25: Number of sacrum elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	11	0		No Evidence				No Evidence				No Evidence			
1	17	0													
1	18	2													
1	19	0													
1	20	0													
TL		2													

Caudal Vertebrae

Caudal vertebrae are not a common find at plains archaeological sites. This could be because they are not preserved, not recorded during the excavation because they are small or, more likely, because the tail was taken with the hide from the site during primary butchering. It is extremely significant that at Fincastle there were 109 caudal vertebrae unearthed in the East Block alone, indicating that the tail was not taken with the hide from the site and that some sort of detailed hide removal was occurring. The nature of the hide removal process is undeterminable at this time however.

The caudal vertebrae make up the second highest element count of the Fincastle vertebral column assemblage, following the thoracics. Seventy-six BU1s (69.7%) were complete, indicating that a number of the tails were simply discarded. There were 11 caudal elements in small articulations (see Figure 4.5 in the axial articulation section), which is another rare find that shows a more detailed tail removal process. The lithic tools in the bone bed help confirm that hide removal took place. A number of side scrapers, end scrapers and knives were found in the East Block, strengthening the proposed idea of a more detailed meat removal involving the caudal vertebrae.

Table 4.26: Number of caudal vertebrae elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	2	8		No Evidence				No Evidence				No Evidence			
1	3	0													
1	4	8													
1	5	0													
1	6	0													
1	7	1													
1	8	0													
1	9	1													
1	10	2													
1	11	1													
1	12*	0													
1	13*	1													
1	14*	3													
1	15*	2													
1	16*	2													
1	18*	1													
TL		30													

Thirty fragments of various caudals (Ca1-10) have breakage patterns that fit into the Bone Unit Classification System for joint dismemberment, but none have direct evidence (Table 4.26). The other butchering processes are not associated with the caudal vertebrae as no meat is associated with the caudals, and their small size would yield little to no marrow and/or grease.

Centrum

The vertebral column centrums offer interesting insights into the Fincastle faunal assemblage. The centrums were listed Brumley’s BUs and are additions to the BU classification. They were assigned a specific BU number associated with juvenile bison. The element was not assigned a BU1, complete element category. This is not to say that

there are no complete centrums present; they are categorized relative to their relation with the vertebral column. For example, BU10* consists of the anterior cervical centrum and BU4* incorporates the posterior centrum of a thoracic vertebra.

There were a total of 316 centrum elements unearthed in the East Block. What is interesting here is that the relatively high number of fragments indicates that there were several juvenile bison at the site. Though centrums cannot be classified into a Butchering Category, they contribute to our understanding of the season the site was occupied and offer a vertebral column element comparison. The centrum BUs from Fincastle are summarized in Table 4.27.

Table 4.27: Number of centrum elements per Bone Unit.

Bone Unit	Number of Individual Records	Affiliated vertebrae element	Total number per vertebrae element
10*	37	Cervical	59
2*	22	Cervical	
3*	13	Thoracic	49
4*	36	Thoracic	
5*	7	Lumbar	17
6*	10	Lumbar	
7*	184	Unidentifiable	N/A
8*	6	Caudal	7
9*	1	Caudal	
Total	316	Total	122

The quantities of centrums belonging to the cervical and thoracic vertebrae are interesting. Considering that there are seven more thoracic vertebrae elements in the vertebral column and 138 individual fragments more (210 thoracic fragments vs. 72 cervicals), there should be more thoracic centrums in the East Block. This, however, is not the case. A number of factors can contribute to this. It could be that a large

percentage of the BU7* unidentifiable centrum fragments belong to thoracic vertebrae, or that these missing bones were subjected to significant weathering and/or trampling. The latter suggestion is not likely as this would be the case for all four vertebral elements. The low numbers of lumbar and caudal vertebrae are not surprising, nor are the unidentifiable fragments ($n = 58.2\%$ BU7*s), as these bones are thin and easily broken.

Pelvis

The pelvis is a large section of the bison's anatomy that is connected with a few different large muscle groups. It is mainly associated with primary butchering operations, such as joint dismemberment and meat removal, though certain sections could possibly yield a small amount of desired grease. In the East Block at Fincastle there was a relatively low representation of pelvis fragments unearthed (Table 4.28). Only 37 fragments were recovered, none complete.

Due to the low number of recovered pelvis elements (as well as the low femur representation), no butchering pattern can be distinguished with regard to how the joint was separated. There are, however, 22 pelvis fragments that fit into a Butchering Category (13 fragments in Butchering Category 1 and 9 fragments in Butchering Category 7 split with meat removal). It is possible that the pelvis sections of the animals were processed in another section of the site, similar to what is suggested for the skulls.

There are four elements that reveal direct evidence of joint dismemberment. The first is a pelvis BU4 within Butchering Category 1. The element contains three distinct impact marks that surround the ilium shaft, indicating that it took at least three strikes to separate this pelvis from the articulated femur.

Table 4.28: Number of pelvis elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	4	3	1	3	9	1	1	No Evidence				5	2	2	0
1	5	2	0	3	12	0	0					5	8	0	0
1	6	0	0	3	15	0	0					5	14	1	0
1	7	5	0	3	16	0	0					5	40	0	0
1	18	2	0	3	21	0	0								
1	27	1	0	3	22	0	0								
1	33	0	0	3	23	0	0								
1	35	0	0	3	24	0	0								
1	37	0	0	3	26	0	0								
7	10	4	1	3	29	0	0								
7	19	5	2	3	30	0	0								
7	25	0	0	3	32	1	0								
7	34	0	0	3	36	0	0								
				3	38	0	0								
				3	41	2	0								
				7	10	4	1								
				7	19	5	2								
				7	25	0	0								
				7	34	0	0								
TL		22	4	TL		13	4					TL		3	0

Three other pelvis elements with direct evidence on them fall into Butchering Category 7, spit with meat removal. The first is a BU10 which has a small impact mark on the ilium shaft. The other two fragments are BU19 elements. One has a transverse fracture on the ilium shaft near the acetabulum (Figure 4.17). It may also have a transverse fracture pattern on the ishium but it was exposed to weathering.

The second BU19 element has an impact mark on the ilium shaft. The actual purpose of these impact marks on the BU19 elements cannot be determined because distinguishing between joint dismemberment and meat removal based on the locations on their ilium and ishium shafts is not possible.



Figure 4.17: Pelvis fragment (Cat. No. 2597) with a transverse fracture near the acetabulum.

There is one pelvis fragment with direct evidence of meat removal, however. A BU9, falling into Butchering Category 3, has one impact mark on the ilium shaft and one mark on the ishium shaft. The impact marks are both a fair distance away from the acetabulum, indicating that the strikes were not related to joint dismemberment, but were a result of stripping the major hind limb muscles.

There are three cases (two BU2s and one BU14) of pelvis fragments in the faunal assemblage that could relate to grease rendering activities. These BUs fit into Butchering Category 5, possibly resulting from the retrieval of the red marrow.

Appendicular – Upper Forelimb

Scapula

There were a total of 214 scapulae fragments unearthed in the East Block of the Fincastle Site. None was a complete BU1 element. This was expected since the scapulae are often broken during the primary butchering processes and are used in some cases for

the secondary butchering practises of marrow extraction and grease rendering. These elements are also fairly prone to weathering and/or trampling on the thin flat blade sections.

Based on Brumley’s BUs, 16 possible elements could show joint dismemberment. Two of these 16 elements have direct evidence on them as summarized in Table 4.29, reside in Butchering Category 7 therefore, they are paired with meat removal or marrow extraction purposes. The first is a BU2 element consists of a short spiral fracture on the neck. There are also two impact marks separate from the fracture line, indicating that this was not a single-strike butchering operation. It may be that the butchers utilized this specific area of the scapulae (the neck) for a dual purpose of both primary and secondary butchering, but had no need to break the element twice.

Table 4.29: Number of scapula Bone Units that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	3	0	0	3	5	3	2	7	2	3	1	5	27	1	0
1	4	1	0	3	6	14	1	7	13	0	0	7	37*	2	0
1	22	2	0	3	7	2	0	7	37*	2	0				
1	33	0	0	3	9	2	0								
7	2	3	1	3	20	1	0								
7	13	0	0	3	25	2	0								
7	16	5	0	3	30	0	0								
7	17	5	1	3	34	2	0								
				3	36*	1	0								
				3	38*	1	0								
				7	16	5	0								
				7	17	5	1								
TL		16	2	TL		38	4	TL		5	1	TL		3	0

The second Butchering Category 7 element is a scapula BU17 with a single impact mark on the lateral border. The rest of the element has been exposed to

weathering and may have lost further evidence of this process. This impact location is where some of the muscles 'glide' over and where it may have been removed to gain access to the under riding rib cage. Unfortunately, the actual primary butchering operation cannot be determined from a single impact mark.

There are some scapulae elements recovered from Fincastle that have direct evidence, however. Of the possible 38 BU elements classified for meat removal, four elements have direct evidence. One of these four has been discussed under Butchering Category 7 in joint dismemberment, while the other three all fall into Butchering Category 3.

The first is a BU6 element that has one impact mark located on the lateral border. The location of the mark and size of the element, suggests meat removal. The other scapulae elements have both impact marks and cut marks. The scapula BU5 element has six impact marks. The first mark is located at the base of the spine at the 'T' intersection of the flat blade and spine. There are an additional four impacts similar to the first, situated further on the flat blade section, which served to the removal of the spine from the flat blade. The sixth impact mark is located on the top of the spine, probably for the purpose of removing the acromion. The cut marks on the top of the spine are interesting (Figures 4.18 and 4.19). The element reveals a certain degree of weathering that may have erased some of the cut marks, but they support the idea that this element was exposed to meat removal processes.

The scapula yields a small amount of marrow and grease, which is centralized in the neck portion. There were only three BUs classified as marrow extraction into Butchering Category 7. In most cases, the butchers probably originally struck the neck

section for joint dismemberment from the humerus, and then further utilizing the element for its marrow. There were only five elements from the Fincastle assemblage that may show marrow extraction, one of which has direct evidence. This BU2 element was discussed in the joint dismemberment section. A few grease rendering fragments also may be present, but with the small amount of three possible elements, no conclusions can be drawn on this secondary butchering process.

There is one last scapulae element in the faunal assemblage. There is a BU18 element that contains several cut marks on the ridges of the broken flat blade section. Scapulae BU18 elements are small fragments of the flat blade section, and do not fit into a Butchering Category. The actual purpose of the marks is unknown, but there is a possibility that they were placed on the small fragment for a cultural purpose.



Figure 4.18: Scapula fragment (Cat. No. 4360) with cut marks on the spine.



Figure 4.19: Mid section of scapula (Cat. No. 4360) showing cut marks on the spine.

Humerus

Within the East Block, 56 humerus fragments were unearthed. The humerus is the major weight-bearing bone in the upper forelimb. It contains major muscle attachments, such as the teres major and the deltoid tuberosity. It is no surprise that there were no complete BU1 humerus elements recovered, as this bone is important for both primary and secondary butchering operations. There are few BUs relative to meat removal (Butchering Category 3), likely due to the fact that the humerus also contains a large amount of usable marrow and grease. The bones are therefore often broken into smaller pieces, erasing the primary butchering evidence of meat removal. The Butchering Categories for the specific butchering operations are outlined in Table 4.30.

Joint dismemberment is a significant part of the butchering operation for the humerus. The proximal end of the humerus is a prime location to separate the entire forelimb from the rest of the body. Surprisingly, the majority of the dismemberment

evidence from the Fincastle assemblage occurs on the distal end of the humerus. Ten distal humerus epiphyses, compared to one proximal epiphysis that fit into Butchering Categories 2 or 7, show joint dismemberment. Six of the ten distal elements contain direct evidence.

Table 4.30: Number of humerus elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
2	2	4	1	7	13	8	1	4	19	0	0	5	17	2	0
2	3	1	0	7	24	0	0	4	37	1	0	5	27	0	0
2	4	1	0					4	38	0	0	5	35	3	0
2	5	1	1					7	6	6	1	5	40*	3	0
2	9	2	2					7	12	0	0	6	7	1	0
2	10	1	1					7	16	3	2	6	8	1	0
2	14	0	0					7	21	0	0	6	20	1	1
2	18	0	0					7	26	0	0	6	25	2	0
2	29	0	0					7	33	0	0	6	39*	11	0
2	30	0	0									7	6	6	1
2	31	0	0									7	13	8	1
2	34	0	0									7	28	2	0
2	36	0	0												
2	42*	0	0												
7	12	0	0												
7	16	3	2												
7	21	0	0												
7	24	0	0												
7	26	0	0												
7	28	2	0												
7	33	0	0												
TL		15	7	TL		8	1	TL		10	3	TL		40	3

Two of these are humerus BU16 elements that fit into Butchering Category 7, showing joint dismemberment and/or marrow extraction. The first BU16 element has a short spiral fracture pattern on the distal end of the shaft. It is unclear as to which butchering operation created this fracture on the shaft. The second BU16 element is

interesting. It also yields a short spiral fracture pattern on the distal section of the shaft (Figure 4.20). The location of the fracture (overall distance from the epiphysis) seems more typical of marrow extraction, but the element was found in articulation with a proximal radius. Due to the short spiral fracture pattern and the articulation, joint dismemberment seems to be the prominent butchering operation for this specific humerus. Although, this butchering fracture could have been utilized for dual a purpose without having to further break open the element to collect the marrow.

The other four humerus elements with direct evidence on them for joint dismemberment fall within Butchering Category 2. Two of them are BU9's, and both have long spiral fracture patterns located on the distal end directly above the epiphysis. One of the two element's spiral fracture is associated with an impact mark that was struck from the opposite direction to the fracture line. This particular impact mark suggests that it took at least two separate strikes to create the spiral fracture.



Figure 4.20: Humerus (Cat. No. 8137) with short spiral fracture.

The last two Butchering Category 2 humerus elements showing distal epiphysis joint dismemberment are located on a BU2 and a BU10 element. The BU2 has of a transverse fracture pattern located immediately above the distal epiphysis (Figure 4.21). No impact marks were recorded for this particular element as it was too weathered. The last is a humerus BU10 element with a single impact mark on the medial distal shaft directly above the epiphysis. The impact mark seems to have created the long spiral fracture pattern.

As mentioned above, there is a single proximal humerus element that has direct butchering evidence. The humerus BU5 element falls into Butchering Category 2. The humoral head was separated from the rest of the element by smashing it. Unfortunately, the element is also weathered so no direct impact marks associated with the fracture lines are apparent.



Figure 4.21: Humerus (Cat. No. 7457) with a transverse fracture showing joint dismemberment.

Much of the primary butchering evidence on the humerus seems to have been erased when the secondary butchering was carried out on the bones. Nine different BUs may show marrow extraction and 12 that associate with grease rendering. A total of ten elements were unearthed from the East Block of Fincastle that fit into the Butchering Categories, and possibly 40 show grease rendering (Table 4.30). All three of the marrow extraction elements that contain direct evidence fall into Butchering Category 7.

Two of the elements are combined with joint dismemberment and were described above (BU16s). The BU6 element reveals three separate impact marks all located on the proximal portion of the shaft. They are a fair distance away from the epiphysis, indicating the butchers attempted to reduce the large shaft fragment into a smaller section. Interestingly, there seems to be a similar pattern on five other humerus elements but they did not yield direct evidence. These too, were probably subjected to further size reduction purposes for marrow and/or grease rendering. It is unclear which specific secondary butchering operation these BU6 elements relate to; however, it is clear that the humerus was further utilized directly at the site.

Grease rendering is the most destructive butchering operation that occurs at a site. This is seen with regard to the humerus element at Fincastle. Forty of the 56 humeri BU fragments (71.4%) fall within the grease rendering category. There are three elements that directly show grease extraction. One humerus element (BU6) falls into Butchering Category 7 and is discussed above. The second fragment (BU13) also falls into Butchering Category 7. It has a small spiral fracture line on one edge and four separate impact marks separate from the fracture edge. The number of impact marks paired with the size of the shaft fragment denotes grease extraction; however, the unique presence of

the teres tubercle muscle attachment suggests the possibility that one or more of the impact marks was originally related to meat removal, with the other impacts occurring later. There are a total of eight BU13s that relate to this multiple butchering theory though only one has direct impact mark evidence. Unfortunately, this is speculation only as it is impossible to separate the impact marks from one another.

The last humerus element that reveals direct evidence falls into Butchering Category 6 relative to yellow grease extraction. The BU20 element has a single impact mark on the anterior distal shaft located immediately above the distal epiphysis. It is interesting that eight BUs relative to grease rendering were utilized for the red marrow, while 16 elements evidence yellow grease rendering. Considering the red marrow is the more desired grease rendering, one would expect to see a higher concentration of small epiphyses fragments.

Radius

In the East Block of the Fincastle excavations, 76 radius fragments were unearthed. Because the radius is a weight-bearing long bone, located in the upper forelimb, butchers were able to acquire meat, marrow and grease from it. The distal end of the radius, in articulation with the carpals, creates the upper/lower limb separation, which relates to joint dismemberment. The diaphysis contains a large amount of marrow inside it, and the epiphyses yield a significant quantity of desired grease. This particular element was heavily utilized both during the primary and secondary butchering process.

Using the defined butchering categories in conjunction with the Brumley's (1991) BU elements, evidence of joint dismemberment, marrow extraction and grease rendering is seen in the Fincastle radius elements. Though no actual physical evidence of meat

removal is present, meat removal as a butchering operation cannot be discounted: simply the secondary butchering processes of marrow and grease extraction have erased any primary meat removal evidence.

As detailed in the previous section on BU Butchering Category Classification, a number of radius BUs were identified that reflect butchering operations (See Appendix II). Several individual elements from the Fincastle assemblage yield specific butchering evidence for joint dismemberment, marrow extraction and grease rendering by impact marks and fracture patterns. These BUs and their numbers are listed in Table 4.31.

Table 4.31: Number of radius elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
2	2	7	3	No Evidence				4	9	4	2	5	8	1	0
2	3	12	8					4	29	0	0	5	12	0	0
2	5	0	0					4	30	1	0	5	13	0	0
2	6	0	0					4	31	0	0	5	15	1	0
2	14	1	0					7	10	5	1	5	22	1	0
7	10	5	1					7	11	4	1	5	27	1	0
7	11	4	1					7	32	0	0	5	28	2	0
7	16	1	0					7	34*	0	0	5	34	0	0
7	19	1	0									6	4	11	0
7	25	0	0									6	7	0	0
7	26	0	0									6	18	5	0
7	32	0	0									6	20	0	0
7	34*	0	0									6	21	4	1
												6	35*	2	0
												7	16	1	0
												7	19	1	0
												7	25	0	0
												7	26	0	0
TL		31	13					TL		14	4	TL		30	1

Looking at distal vs. proximal breakage patterns for the radius element, there are 17 proximal ends (12 BU3s and five BU10s) in comparison to 11 distal ends (seven BU2s and four BU11s). This gives an indication that the radius was separated at the radial-humeral joint more frequently than on the distal end of the element. It is interesting that the highest number of recovered radius elements (12-BU3s) fits into the joint dismemberment category. This is unexpected as the radius element is subjected to a large secondary butchering operation, which would erase the more primary butchering evidence. Eight of the 12 with direct physical evidence confirm this assessment.

Eleven radius elements yield direct evidence for joint dismemberment, with each individual element displaying impact marks and fracture patterns. Since joint dismemberment was the first process of the primary butchering operation these numbers match what is expected.

There are three BU2s in Butchering Category 2 with direct butchering evidence. The first BU2 radius element has one impact mark situated near the short spiral fracture, which that is located on the distal end of the shaft directly above the epiphysis. The second and third BU2 elements both have short spiral fracture patterns. A transverse fracture is associated with them, which is located at the base of the shaft immediately above the distal epiphysis. All three of these distal radius elements show joint dismemberment. More specifically, they all represent the separation of the upper and lower forelimb junction.

Eight BU3's of the 12 from the East Block also yield joint dismemberment evidence. These radius elements fall within Butchering Category 2. Three of the eight elements bear impact marks. One radius BU3 element has an impact mark that was

struck in the opposite direction to the spiral fracture pattern, which is located on the anterior aspect of the shaft. The same element has another two impact marks on the posterior shaft section that created the spiral fracture. The evidence on this radius indicates that the butchers strike the element at least three times in order to successfully separate the joint (as seen in Figure 4.22).



Figure 4.22: Ventral and dorsal views of radius (Cat. No. 3556) with spiral fracture created by three impacts.

There are also two BU3 radius elements with impact marks directly associated with their spiral fracture pattern. The location of these impact marks on the shafts directly below the proximal epiphysis indicates the segmentation of the radial-humeral joint occurred. There are five other BU3 radius elements that have spiral fracture patterns relating to the radial-humeral joint separation. One of the five has a short spiral fracture

while the remaining four reveal long spiral fractures. All five fractures are located on the proximal end of the shaft, directly below the epiphysis.

Joint dismemberment, Category 2, is typically defined as having a short spiral fracture. However, much of the evidence for the radius assemblage contains long spiral fractures. Four of five radius BU3s classified as Category 2, yield physical evidence of long spiral fractures. The remaining BU3 element has a short spiral fracture pattern, characteristic to the classification category. However, it is the actual measurement of the shaft involved (less than $\frac{1}{4}$ of the shaft present) that allows these elements to be classified as joint dismemberment, even though they have the long spiral fracture pattern associated with them. In fact, these bones may have been involved in several stages of the butchering process; first for primary butchering (joint dismemberment), and then further processed for marrow extraction, needing no extra 'treatments' to open the marrow cavity.

There are two radius elements directly associated with the secondary butchering operation of marrow extraction. Each radius BU9 element (Butchering Category 4) contains long spiral fractures, both of which are located on the proximal shaft, allowing the marrow to be easily extracted from the bone cavity.

There were nine recovered elements from the East Block that fit into Category 7, two of which contain physical butchering evidence on them (one BU10 and one BU11). They are undetermined as to whether joint dismemberment and/or marrow extraction took place. The shaft lengths for these radius portions measure between $\frac{1}{4}$ and $\frac{1}{2}$ of the overall shaft length. An interesting observation can be made from these two radius

fragments. They are actually the same bone element that was broken into two by the butchers (Figure 4.23).



Figure 4.23: Radius (Cat. No. 8134 left and 8135 right) with a long spiral fracture.



Figure 4.24: Humerus (Cat. No. 8137) articulated with radius (Cat. No. 8134 and 8135), all bearing spiral fracture patterns.

There is a long spiral fracture pattern located on the proximal mid shaft that separates the two pieces of the juvenile right radius. The long spiral fracture indicates

marrow extraction, but it is also known from this particular case that it is directly related to joint dismemberment as well. The joint dismemberment is shown by the recovered proximal end of the radius in articulation with a humerus (Figure 4.24 above). All three of the bone elements have a fracture pattern. In sum, the butchers initially separated the joint on the radius shaft, and then utilized the element for its marrow without having to further process the bone.

The last butchering operation that was performed on the radius was grease rendering. Though there is little physical evidence for grease rendering relating to the radius ($n = 1$), 30 pieces fit within BUs that show grease rendering. One small proximal shaft fragment (BU21, Butchering Category 6) revealed two distinct longitudinal fracture lines, suggesting that it was repeatedly smashed in order to reduce the shaft to small fragments. Whether this was part of the butchering process or a factor of preservation remains unclear.

Ulna

Excavations in the East Block at Fincastle resulted in a total of 54 ulna fragments. Unlike the radius, the ulna is not a major weight-bearing bone. Its main purpose is to allow the radial-humeral joint to move. The olecranon acts as the hinge, allowing for a full range of motion and providing stability throughout the joint. The ulna also serves as a major muscle attachment point, as the olecranon is attached to the large muscles in the upper forelimb. More primary butchering operations are associated with this element, as the ulna yields small amounts of marrow and grease compared to the other long bones.

Joint dismemberment can occur on the ulna, but the radius also needs to be smashed in order to fully disarticulate the joint. According to the Butchering Category

System, Fincastle has 12 possible elements that could be associated with joint dismemberment, none of which bear direct physical evidence. These are summarized in Table 4.32. Six of these 12 fall into Butchering Category 7 (combined with meat removal), while the other six are Butchering Category 2 elements. There is also no distinguishing location on the ulna that the butchers frequently would strike. However, the largest BU collected for the ulna was the small shaft fragments (21 BU3s). Considering that there is a large number of proximal radius elements ($n = 17$, see radius section) and a low number of proximal ulna fragments, the joint dismemberment more than likely occurred on the radius rather than the ulna.

Meat removal from the radial-ulnar section, however, occurred at Fincastle. The frequency of complete elements ($n = 5$ -BU1s, 9.3%) is not surprising considering that the muscles are frequently taken from this element. There are 14 possible ulna elements from the East Block that could show meat removal. Six of the 14 fall into Category 7 of the Butchering Category System, paired with joint dismemberment, due to the fracture pattern location on the olecranon. None of these six elements have impact or cut marks.

Table 4.32: Number of ulna elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
2	8	3	0	3	2	3	0	No Evidence				No Evidence			
2	14	2	0	3	5	1	0								
2	17	0	0	3	7	0	0								
2	19	0	0	3	10	4	2								
2	20	1	0	7	6	0	0								
7	6	0	0	7	9	4	0								
7	9	4	0	7	1	2	0								
7	18	2	0												
TL		12	0	TL		14	2								

There are two ulna BU10 elements that have evidence of meat removal. They both fall into Butchering Category 2. The first element has three impact marks on it, one on the mid shaft of the distal section and two are on the proximal end. One is medial and the other is on the lateral side, creating the transverse fracture pattern that aided in the removal of the olecranon (Figure 4.25). The second BU10 element has two impact marks: one on the mid shaft of the distal end, and another on the medial aspect. This second mark created the transverse fracture that helped in the removal of the olecranon.

Both the BU10 elements that have transverse fracture patterns directly below the olecranon seem to be the result of primary butchering operations. It was easier to smash the ulna, leave the distal end and take the olecranon with the meat to be further processed. This suggestion is supported by the large number of BU3 elements (21).



Figure 4.25: Ulna (Cat. No. 7618) with a transverse fracture removing the olecranon and impact marks on the shaft.

Appendicular – Lower Forelimb

Carpals – Scaphoid, Lunate, Cuneiform, Magnum, Unciform, Pisiform and 5th Metacarpal

The carpals are located at a point of separation between the upper and lower forelimb. These six carpal elements and the 5th metacarpal, have been analyzed as a group, summarized in Table 4.33. These irregular shaped bones are compact but do provide a source of grease. According to the butchering categories, 17 individual carpal fragments (five scaphoid BU2s, one lunate BU2, two cuneiform BU2s, four unciform BU2s, one pisiform BU2, and four 5th metacarpals) fit into Butchering Category 7.

Table 4.33: Number of carpal elements (5th carpal, scaphoid, cuneiform, lunate, unciform and pisiform) per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
7	2	17		No Evidence				No Evidence				7	2	17	
7	3	0										7	3	0	
7	4	0										7	4	0	
7	5	0										7	5	0	
TL		17										TL		17	

The majority of carpals recovered from the East Block at Fincastle were complete. BU1 element ratios include: 46 of 51 recovered scaphoids (92%), 45 of 46 lunates (97.7%), 36 of 38 cuneiforms (94.6%), all 52 magnums (100% complete), 39 of 43 unciforms (90.5%), 22 of 23 pisiforms (95.5%), and 17 of 21 5th metacarpals (81%) were found in a complete state (Appendix II). A complete percentage ratio was calculated to determine possible joint dismemberment locations. Table 4.34 groups the carpals into five separate ‘sections’ that may contain more breakage patterns.

Unlike the tarsals, where the ‘upper’ bone elements showed a higher breakage pattern ratio (see tarsals section below), the carpals all yielded similar ratios. The only quantities that seem opposite to what would be expected is that the lateral carpals (scaphoid and magnum) have the highest BU1 percentage (96%), whereas the interior two carpals (lunate and unciform) show the most breakage. Even more interesting is that there was only one element that had direct butchering evidence. This unciform, which is located in the middle of the lower row of carpals, revealed two perpendicular cut marks on the anterior ridge (Figure 4.26). This could possibly be from cutting loose the hide or ligaments that run over the carpals during primary butchering. With such high complete BU1 ratios, separation of the upper and lower limb forelimb elements seemed to have occurred at either the distal radius or the proximal metacarpal, and not the carpal elements.

Table 4.34: Carpal comparison of complete BU1 elements divided into five specific anatomical sections.

Carpal section	Elements	Individual carpal BU1 %	BU1 average %
Upper row	Scaphoid	92.0	94.8
	Lunate	97.7	
	Cuneiform	94.6	
Lower row	Magnum	100	95.3
	Unciform	90.5	
	Pisiform	95.5	
Lateral	Scaphoid	92.0	96.0
	Magnum	100	
Interior	Lunate	97.7	94.1
	Unciform	90.5	
Medial	Cuneiform	94.6	95.1
	Pisiform	95.5	



Figure 4.26: Unciform (Cat. No. 3417) with cut marks on the anterior ridge.

Metacarpal

Generally, the metacarpal is subject to primary butchering relative to joint dismemberment. There is no usable meat associated with the lower limb section in general; therefore no BUs were put into the meat removal category. Secondary butchering can occur, as there is a small amount of marrow in the element as well as some desired grease. Table 4.35 notes the number of metacarpals in each of the appropriate Butchering Categories.

The metacarpal bone had an unexpected representation in the Fincastle faunal assemblage. There were only 46 metacarpal elements unearthed in the East Block and 28 of these were complete BU1 elements (60.9%). This suggests that the butchers did not need to utilize the metacarpal completely, or the metacarpals were removed from the East Block to another area of the site to be processed further. Of the remaining metacarpal fragments found, eight elements may show joint dismemberment and four had direct evidence.

Table 4.35: Number of metacarpal elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
2	2	3	1	No Evidence				4	8	0	0	5	4	4	0
2	6	1	1					4	14*	3	0	6	9	1	0
2	11	0	0					7	3	3	1	6	12	0	0
2	13	0	0					7	7	0	0	7	15*	1	1
7	3	3	1												
7	7	0	0												
7	15*	1	1												
TL		8	4					TL		6	1	TL		6	1

The first two elements fall into Butchering Category 2 relative to joint dismemberment. The BU2 fragment has two impact marks that created the short spiral fracture pattern located immediately below the proximal epiphysis. The second element is a BU6 consisting of a short spiral fracture pattern immediately above the distal epiphysis (Figure 4.27).

The other two elements fall into Butchering Category 7, showing joint dismemberment and/or marrow extraction and grease rendering. The BU3 element has two separate impact marks. One is on the anterior aspect while the second is on the posterior side. Together they created the short spiral fracture pattern roughly located in the mid shaft. The strikes could have been for joint dismemberment, thus allowing the marrow to be extracted without further butchering occurring on the element. However, the short spiral fracture would have made it difficult to extract the grease without further smashing the marrow cavity open.



Figure 4.27: Metacarpal (Cat. No. 6912) with a short spiral fracture and two impact marks.

The second Butchering Category 7 element is a BU15* metacarpal. It has three impact marks located on the lateral proximal articular surface. The order of the three impacts was determined by the location and status of the metacarpal element. First, the element had to be segmented prior to these three impact marks occurring. The first impact mark is located on the medial shaft section, directly below the epiphysis. The second impact mark was administered by a downward strike pattern (proximal to distal) located on the posterior medial shaft section, also below the epiphysis. The last impact mark was also created by a downward motion. It is located on the proximal lateral articular surface. These impact marks can be seen in Figure 4.28. For this element, joint dismemberment probably occurred prior to these impact marks. They could indicate that the element was being further reduced for grease extraction.



Figure 4.28: Metacarpal (Cat. No. 3125) with several impact marks confirming joint dismemberment.

Even though there is what seems to be direct evidence for marrow extraction and grease rendering, the overall number of elements is too small to conclude that a secondary butchering operation took place.

Appendicular – Upper Hind Limb

Femur

The femur is the largest bone in the bison anatomy. It is typically utilized in both primary and secondary butchering operations. In the East Block of Fincastle, the femur yields a low element representation in the overall faunal assemblage. Only 35 fragments were unearthed and as expected, none of the elements was complete. There are a large number of BUs that can represent both primary and secondary butchering operations. These BUs and the matching elements in the East Block are summarized in Table 4.36.

Table 4.36: Number of femur elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
2	2	3	0	3	16	0	0	4	7	2	1	5	5	0	0
2	11	0	0	7	9	0	0	4	8	0	0	5	6	0	0
2	25	0	0	7	10	1	0	4	13	0	0	5	15	0	0
2	26	1	0	7	22	2	1	4	29	0	0	5	28	0	0
2	30	0	0	7	23	0	0	4	31	0	0	5	34*	0	0
2	32	0	0	7	35*	1	0	7	9	0	0	6	3	4	0
2	38*	1	0	7	37*	1	1	7	12	0	0	6	4	7	0
7	9	0	0					7	17	0	0	6	14	0	0
7	10	1	0					7	22	2	1	6	18	4	0
7	12	0	0					7	24	1	0	6	36*	1	0
7	17	0	0					7	27	1	0				
7	22	2	1					7	33	0	0				
7	23	0	0					7	37*	1	1				
7	24	1	0												
7	27	1	0												
7	33	0	0												
7	35*	1	0												
TL		11	1	TL		5	2	TL		7	3	TL		16	0

The femur is often associated with joint dismemberment. By smashing the proximal femur, the hind leg can be fully removed from the rest of the carcass. However, at Fincastle, there are too few recovered femur elements to determine any sort of butchering pattern for joint dismemberment. There is only one element that has direct evidence to possibly suggest joint dismemberment. This BU22 element falls within Butchering Category 7, paired with meat removal and marrow extraction, has a spiral fracture pattern on the proximal shaft, but was further weathered or trampled, reducing the originality of the fracture pattern.

There are a few large muscles associated with the femur; however, due to the large amount of desired marrow and grease contained in the bone, much of the primary butchering evidence of meat removal is erased by the secondary butchering. Two

possible elements falling into Butchering Category 7 may show meat removal, but both are paired with the secondary butchering operation of marrow extraction.

There are 13 BUs that can be classified into either Butchering Category 4 ($n = 5$) or Butchering Category 7 ($n = 8$). There are seven elements that possibly show marrow extraction on the femur, only two of which belong to Butchering Category 4 relative to marrow extraction. One Butchering Category 4 element reveals direct evidence. The BU7 piece is a small shaft fragment that contains a spiral fracture pattern along the edge.

One other possible marrow extraction element with direct evidence falls into Butchering Category 7, split with meat removal. The BU37* element has two separate impact marks on the lateral posterior section, immediately below the lesser trochanter. There looks to be a spiral fracture pattern forming on the posterior aspect, but the entire marrow cavity section is exposed on the lateral anterior side. This particular element may have been originally butchered for meat removal, as the lesser trochanter is a large muscle attachment point of the femur. The spiral fracture pattern and open marrow cavity would have allowed the marrow to be taken after the meat was removed. This is supported by the fact that the spiral fracture pattern is separate from the impact marks.

There is no doubt that grease extraction did occur to some extent at Fincastle, as there were 16 possible femur BUs that fit into either Butchering Category 5 or 6 relative to grease rendering. These bones make up 45.7% of the total Fincastle femur faunal assemblage. None of these 16 elements provided direct evidence.

Patella

The East Block at Fincastle only produced 11 patella bones, ten of which were complete BU1 elements (90.9%). The single BU2 element could be attributed to joint dismemberment, though it bears no direct physical evidence (Table 4.37).

Table 4.37: Number of patella elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	2	1		No Evidence				No Evidence				No Evidence			
TL		1													

The primary butchering operation of joint dismemberment is the only butchering practise associated with the patella, since it is a ‘floating bone’ with no associated meat attaching to it, and does it not have any marrow or desirable grease.

Tibia

The tibia is a major weight-bearing long bone in the upper hind limb that is associated with a large muscle mass. There were 69 tibia fragments unearthed in the East Block of Fincastle (Appendix II). To no surprise, there were no complete BU1 elements recovered; the tibia was utilized for both primary and secondary processes. As seen in Table 4.38, each Butchering Category contains several BUs.

According to the Butchering Categories, six BUs fit into Butchering Category 2 relative to joint dismemberment, and five that fall into Butchering Category 7, each split with either meat removal or a secondary butchering process. Looking at the tibial faunal assemblage, a butchering pattern with regard to joint dismemberment of the upper and lower hind leg sections can be determined. There are 17 separate distal bone elements

that make up of less than ¼ of the shaft attached to the distal epiphysis (11 BU4s, three BU10s and three BU34*s). The 17 distal ends consist of 24.6% of all the tibia elements smashed at the distal tibial shaft in order to separate the upper hind limb from the lower limb. It seems that more of the distal tibias were smashed than the tarsals (see tarsal section). Out of the 17 distal elements, seven revealed direct evidence.

Four of the tibia BU4 elements included in this butchering pattern have direct evidence. They all fall into Butchering Category 2. The first BU4 has a transverse fracture pattern that is situated directly above the distal epiphysis. It shows two impact marks, one associated with the fracture line, the other separate from it, indicating that it took at least two strikes to smash the bone.

Table 4.38: Number of tibia elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
2	4	11	4	3	13	0	0	4	8	0	0	5	3	1	0
2	9	0	0	3	27	0	0	4	15	2	1	5	16	2	0
2	22	0	0	3	29	0	0	4	20	5	1	5	21	0	0
2	28	0	0	7	2	0	0	4	25	0	0	5	33*	0	0
2	34*	3	2	7	5	5	1	4	26	0	0	6	30*	0	0
2	35*	2	2	7	6	7	0	7	2	0	0	6	32*	21	0
7	10	3	1	7	11	0	0	7	5	5	1				
7	11	0	0	7	24	0	0	7	6	7	0				
7	14	1	0					7	10	3	1				
7	23	0	0					7	14	1	0				
7	24	0	0					7	23	0	0				
								7	24	0	0				
TL		20	9	TL		12	1	TL		23	4	TL		24	0

The next three tibia BU4 elements yielded short spiral fractures. The first has a short spiral fracture pattern with no associated impact marks. The second is a short spiral

fracture that is almost transverse in nature (Figure 4.29). No associated impact marks are visible with this fracture line either.

The other BU4 distal short spiral fracture pattern has no associated impact marks on it; however, it appears to have been struck several times. This is shown by the two separate short spiral fracture patterns running in opposing directions. Combined, the spiral fracture lines allowed the shaft and epiphysis to be separated (Figure 4.30).

Another Butchering Category 2 element involved in the hind limb butchering pattern is BU34*. Bone Unit 34* was added to the BUs during the faunal analysis process for Fincastle (see Appendix III) because, though similar to a BU4, it is juvenile in age. The epiphysis is missing at the epiphyseal line, but does not reveal any butchering on the actual epiphysis. Both of the BU34* elements contain spiral fracture patterns. One of the elements has a long spiral fracture pattern on the distal end of the shaft, with no associated impact marks. The other BU34* element has a short spiral fracture pattern. However, due to the actual size of the bone, it may in fact be closer to a long spiral fracture. Either way, the actual fracture line still resides less than $\frac{1}{4}$ the way up the shaft, indicating that joint dismemberment was the primary butchering operation on the element.

The last of the 17 tibial elements in the distinguished distal butchering pattern is a BU10. This element falls into Butchering Category 7, combined with marrow extraction. It also has a short spiral fracture pattern, but similar to the last element described, its length could be skewed due to the small size of the juvenile bone element. The fracture line measures between $\frac{1}{4}$ - $\frac{1}{2}$ up the shaft, which makes it undistinguishable between joint

dismemberment and marrow extraction purpose. This could be another example of the combination of primary and secondary butchering operations in one butchering process.



Figure 4.29: Tibia (Cat. No. 6408) with impact marks and a short spiral fracture for joint dismemberment.



Figure 4.30: Dorsal (left) and ventral (right) view of tibia (Cat. No. 8312) depicting the short spiral fractures.

There are two more elements in the faunal assemblage that reveal direct evidence for joint dismemberment. Both of the BU35* elements contain long spiral fracture patterns. One proximal tibia elements has four separate impact marks separate from the fracture pattern, indicating that the bone was struck a minimum of five times (Figure 4.31). All of the impact marks are located around the proximal epiphysis, aiding in its removal. The fracture line shows joint dismemberment, and the additional impact marks on the epiphyseal head may have been the result of further processing. Figure 4.32 shows similar impact marks on this and another tibia fragment.

Joint dismemberment was not the only primary butchering operation that took place in the East Block at Fincastle. Meat removal was also carried out; however, much of the evidence was probably erased with further butchering. Twelve elements may show meat removal, but only one has direct evidence. This BU5 element, which is a Butchering Category 7 BU, may also be associated with marrow extraction. The element has one impact mark that is separate from the visible transverse fracture line.

There are several other elements that may provide evidence for marrow extraction. A total of 23 elements suggest that secondary butchering took place at Fincastle. There are four that reveal direct evidence. Two of the four belong to Butchering Category 4 relative to marrow extraction. The first is a BU15 element. It has three impact marks on the shaft that all were struck in an opposite direction to the long spiral fracture line. This indicates that the element was struck a minimum of four times to open the marrow cavity. The second tibia element is a BU20 fragment. It has one impact mark that is separate from the longitudinal fracture line.



Figure 4.31: Tibia (Cat. No. 8185) showing at least six impact marks.



Figure 4.32: Tibia elements (Cat. No. 4308 left and Cat. No. 8185 right) with several impact marks on the proximal ends.

Interestingly, most of the evidence for marrow extraction falls into Butchering Category 7, combined mainly with joint dismemberment (69.6%). These were due to the overall shaft sizes in association with the epiphysis. Looking specifically at the posterior

tibia shaft section, it has distinct muscular groove lines, which distinguish it from all other long bone fragments. They can be distinguished from other shaft fragments fairly easily. Bone Unit 5, (mentioned above) consists of large sections of the posterior shaft, including the nutrient foramen. There are five of these fragments in the faunal assemblage. Bone Unit 6, which is similar to BU5, consists of the same posterior shaft section but are missing the nutrient foramen. There are seven of these BU6 elements altogether. There is clear evidence that marrow extraction from the tibia did in fact occur at Fincastle.

Bone Unit 5 and 6 elements would have been too big to boil effectively for grease. Therefore, even though they fall into Butchering Category 7, they are better understood as marrow extraction remains. They could have been further reduced into BU32* elements for grease rendering as these consist of small fragments of the shaft that contain muscular grooves. There were 21 BU32*s unearthed in the East Block.

Bone Unit 32* was the dominant BU collected that shows grease rendering for yellow marrow. They make up 21 out the total 24 grease rendering BUs. The other three fall into Butchering Category 5 relative to obtaining red marrow. None of the grease rendering BUs show direct evidence on them, though a butchering pattern relative to grease rendering may be distinguished based on their form.

Appendicular – Lower Hind Limb

Tarsals-Calcaneum

The calcaneum is the tarsal bone that provides the most butchering evidence. There are 71 calcaneum elements, only 41 of which were complete (Appendix II). This BU1 amount (55.4%) is low compared to the astragalus (87.7% BU1s), navicular cuboid

(100% BU1s), and cuneiform pes (95.8% BU1s). These BU1 ratios for all four of the tarsal elements are summarized in Table 4.39.

Table 4.39: Complete tarsal BU1 elements divided into specific anatomical sections.

Tarsal section	Elements	Individual tarsal BU1 %	BU1 average %
Upper row	Calcaneum	55.4	55.4
Middle row	Astragalus	87.7	87.7
Lower row	Navicular cuboid	100	97.9
	Cuneiform Pes	95.8	

After analyzing the upper, middle and lower row of tarsals, one possible explanation for the differing BU1 average percentage is that the butchers chose to separate the upper hind limb from the lower hind limb at the calcaneum. As seen in Table 4.40, several BUs are associated with joint dismemberment according the Butchering Category System. Four elements (two BU3s and two BU9s) could be directly associated with joint dismemberment and four more that fit into Butchering Category 7, combined with meat removal.

The calcaneum is the only tarsal that serves as a major muscle attachment. The muscle attaches to the proximal end of the shaft and the tuber calcis. This could be an alternate explanation as to why the BU1 ratio is much lower than it is for the other tarsal bone elements. In order to detach the muscle, the calcaneum had to be either cut into or smashed. Four elements fit into Butchering Category 3 relative to meat removal, but none have any direct evidence. Another four elements fall into Butchering Category 7 (paired with joint dismemberment), one of which does have direct butchering evidence.

Table 4.40: Number of calcaneum elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	3	2	0	3	2	1	0	No Evidence				5	4	0	0
1	9	2	0	3	5	2	0					5	11	0	0
1	16*	0	0	3	13	1	0					5	12	1	0
7	6	0	0	7	6	0	0					5	15	0	0
7	7	0	0	7	7	0	0					5	19*	1	0
7	10	0	0	7	10	0	0								
7	14	0	0	7	14	0	0								
7	17*	4	1	7	17*	4	1								
TL		8	1	TL		8	1					TL		2	0



Figure 4.33: Calcaneum (Cat. No. 6365) has a deep impression on the posterior shaft, directly below the tuber calcis.

The BU17 element could be the result of either joint dismemberment or meat removal according to the Butchering Category system, based on the location of the impact mark. The long, thin, deep impression is on the posterior shaft, located directly below the tuber calcis (Figure 4.33). Either way, the impact mark seems to have been created by a chopping tool based on its size and location on the bone.

As is the case with the other tarsal elements, grease rendering could also be connected to the calcaneum. There were two elements that fit within Butchering Category 5, neither of which contained direct evidence. Their low numbers seem to suggest this was not a common practise at the site.

Tarsals-Astragalus

A total of 65 astragalus fragments were recovered in the East Block, 57 of which were BU1 elements (87.7% complete). Even though none of the broken elements had direct evidence, several fit into the Butchering Category System (Table 4.41). There were two potential joint dismemberment elements, six fragments that may incorporate grease rendering activities, and one element that could fit into both joint and grease rendering combined (BU7).

Table 4.41: Number of astragalus elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	6	1		No Evidence				No Evidence				5	3	3	
1	11	0										5	4	1	
1	12	0										5	5	0	
1	14	1										5	17	0	
1	15	0										5	18*	1	
1	16	0										7	2	0	
7	2	0										7	7	1	
7	7	1										7	8	0	
7	8	0										7	9	0	
7	9	0										7	10	0	
7	10	0										7	13	0	
7	13	0													
TL		3										TL		6	

Tarsals-Navicular cuboid

There were 64 BU1 navicular cuboids unearthed in the East Block, all of which were complete. The location of the tarsals is known as a spot to separate the upper from the lower hind limb sections. At Fincastle, none was broken or impacted. Interestingly, the navicular cuboid is the only tarsal to yield a 100% complete ratio. This may indicate that the upper and lower leg, if split at the tarsals, occurred on the ‘upper’ tarsals (specifically the calcaneum and astragalus). This conclusion is based on the BU1 complete element ratios seen in Table 4.42, and is discussed in the calcaneum section above.

The tarsals are often attributed with grease rendering as well, as they are compact bones and contain red marrow. They would not necessarily have to be smashed into smaller sections. Brumley’s BUs have several navicular BUs that could be affiliated with grease rendering, but like joint dismemberment, there was no specific evidence of any butchering.

Table 4.42: Number of navicular cuboid elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	9	0		No Evidence				No Evidence				5	8	0	
7	2	0										5	10	0	
7	4	0										7	2	0	
7	6	0										7	4	0	
7	7	0										7	6	0	
7	11*	0										7	7	0	
												7	11*	0	
TL		0										TL		0	

Metatarsal

There were 80 metatarsal elements unearthed in the East Block at Fincastle. Out of these 80, 18 were BU1 elements, representing 22.5% of the metatarsal assemblage. Both primary and secondary butchering processes are associated with the metatarsal. However, there were no BUs placed under meat removal due to the metatarsal being in the lower hind limb with no association with usable meat.

When the distal to proximal metatarsal BUs were compared, no specific butchering pattern could be distinguished. There are 13 individual proximal elements and 16 distal elements that all fit into a Butchering Category relative to joint dismemberment.

Table 4.43: Number of metatarsal elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
2	2	5	2	No Evidence				4	4	4	1	5	16*	4	0
2	7	3	2					4	9	3	1	5	17*	2	0
2	13	0	0					4	11	0	0	6	12	3	0
7	3	6	3					4	14	0	0	6	21*	4	0
7	5	2	0					7	3	6	3	7	15	3	0
7	8	4	3					7	5	2	0				
7	10	4	1					7	8	4	3				
7	15	3	0					7	10	4	1				
7	20*	2	0					7	20*	2	0				
TL		29	11					TL		25	9	TL		16	0

There are a total of 29 individual elements represented by nine different BUs for joint dismemberment. Most of them fall into Butchering Category 7 (Table 4.43). There is direct evidence on 37.9% of the bones showing joint dismemberment. Four of the 11 elements with impact marks fall into Butchering Category 2, while the other seven are in Butchering Category 7, combined with marrow extraction.

Two of the four Butchering Category 2 elements are BU2s. The first BU2 has one impact mark on the medial side that seems to have been struck in an opposite direction to the spiral fracture pattern present. The second BU2 has at least two impact marks located on the anterior and lateral sides that created the transverse fracture pattern. The transverse fracture is directly below the proximal epiphysis.

The other two Butchering Category 2 elements, specifically showing joint dismemberment, are both BU7 pieces. The first has a transverse fracture pattern located directly above the distal epiphysis but has no impact marks. The second BU7 element also has a transverse fracture pattern directly above the distal epiphysis. There is one impact mark associated with the transverse fracture line on the anterior aspect of the element (Figure 4.34).



Figure 4.34: Metatarsal (Cat. No. 6701) with a transverse fracture indicating joint dismemberment.

Seven of 11 joint dismemberment direct evidence elements fall into Butchering Category 7. These are all combined with marrow extraction. The BU10 element has of two impact marks on the anterior distal section of the shaft, aiding in the short spiral fracture pattern.

The next three are BU3s. There were a total of six BU3's recovered in the East Block, 50% of which yield direct evidence. Two of the BU3's have one impact mark on the lateral-anterior aspect of the shaft that was struck in an opposite direction to the long spiral fracture pattern. It is interesting to note that 71.4% of all direct impact marks observed on the metatarsal shaft are located on the lateral-anterior side. The next BU3 has a long spiral fracture, but has been weathered, thus no impact marks are present.

The last three BUs in Butchering Category 7 that have direct evidence are BUs 8s. Of these, 75% show direct evidence. The first two BU8s do not have impact marks, but do have distinct fracture patterns present. One has a long spiral fracture on the mid shaft, while the other yields a transverse fracture on the mid-distal shaft section. The last BU8 element has (at least five) direct impact marks. One impact mark is located on the posterior shaft that had a strike direction opposite to the long spiral fracture pattern. There are three impact marks on the medial side of the shaft, also separate from the long spiral fracture lines. Unique to this metatarsal element, the medial impact marks were struck more than once to aid in the opening of the marrow cavity. This is seen by the impact mark directly over top of one of the medial impacts discussed above (Figure 4.35). This feature could have been created by first striking the bone to separate it from the tarsals or phalanges, and then further striking it to open the marrow cavity. The second layer of impacts could also have been an attempt to smash the shaft into smaller

pieces for grease rendering. Determining what and how many processes this bone element was exposed to is difficult.



Figure 4.35: Ventral (above) and dorsal (below) views of metatarsal (Cat. No. 4552). This element has a long spiral fracture and multiple impact marks. On the medial side (lower picture) the impact marks overlie each other.

Secondary butchering processes are shown by the metatarsal faunal assemblage, as 25 individual fragments possibly show marrow extraction. Many of these (36%) have

direct evidence ($n = 9$). As seen in the joint dismemberment ratios, one of the highest percentages of direct evidence is from these elements. However, only two of the nine elements fall into Butchering Category 4, which deals with marrow extraction. The other seven are combined with joint dismemberment. Marrow extraction can occur on the metatarsal, but does not yield as high of amounts as the other long bones (humerus, radius, femur and tibia), thus more of the breakage is typically associated with joint dismemberment.

The first of the two Butchering Category 4 direct-evidence elements is a metatarsal BU4. This BU4 element has a short spiral fracture pattern that was impacted at least twice to create the fracture on the shaft. The other is a BU9 that has a transverse fracture running the proximal section of the shaft. Even though it is a transverse fracture pattern, the actual location of the fracture line fits into the marrow extraction measurements, and is too far into the shaft to show direct joint dismemberment.

Seven of nine fragments possibly showing marrow extraction fall into Butchering Category 7 and have been discussed under joint dismemberment of the metatarsal. There are several ways to explain why the majority of Brumley's BUs belong to Butchering Category 7. The metatarsal is a long bone with a strong but thin shaft section. It contains a small amount of desired marrow. By impacting the metatarsal for joint dismemberment, the butchers could have used the same impact point and fracture pattern for marrow extraction. It would be fairly hard to re-break the element after joint dismemberment to acquire the marrow. If the shaft was further broken, it was probably more for grease extraction purposes.

A total of 16 fragments from the shaft and epiphysis could possibly evidence grease rendering at the site, though none of these BUs contain direct evidence.

Metapodials

There are 14 elements classified as metapodial BUs because it was not possible to distinguish if they were metacarpal or metatarsal elements. Since these elements contain little to no useable meat, no butchering classification for meat removal is associated with them. Joint dismemberment, marrow extraction and grease rendering may be possible on these elements, but because the pieces are fairly small, this is difficult to determine. If joint dismemberment did occur on the metapodial, there should be identifiable features on them to further be classified as a metacarpal or metatarsal. Only grease rendering may be assumed using the butchering categories. There were nine possible elements of the 14 that could be associated with grease extraction, though none of them have direct impact-mark evidence (Table 4.44).

Table 4.44: Number of metapodial elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
2	2	0		No Evidence				7	3	0		5	6	1	
2	4	0										5	11*	0	
2	9	0										5	12*	1	
7	3	0										5	13*	2	
												5	14*	3	
												6	10*	2	
TL		0						TL		0		TL		9	

Phalanx (1st, 2nd, and 3rd)

Phalanges 1-3 are found in abundance in the East Block of Fincastle. A total of 243 1st phalanx, 218 2nd phalanx and 192 3rd phalanx fragments were recorded. Of these, the majority were complete BU1 bone elements ($n = 195, 188$ and 159 respectively). These complete element percentages (1st phalanges = 77.4%, 2nd phalanges = 89.4% and 3rd phalanges = 82.8%) support the idea that the hunt was not performed in a time of need: there was a surplus of meat. The butchers did not need to fully utilize the phalanges for their grease (36 1st phalanges, 12 2nd phalanges and 16 3rd phalanges could have been attributed to grease-rendering practises). Tables 4.45, 4.46 and 4.47 show the phalanx counts. The Fincastle faunal assemblage yielded no direct evidence, such as fracture patterns and impact marks, to support grease rendering. However, the same can be said for joint dismemberment fragments (15, 4, and 12 respectively).



Figure 4.36: First phalanx with two holes that may have been drilled.

Table 4.45: Number of 1st phalanx elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
7	9	0		No Evidence				No Evidence				5	2	0	
7	10	0										5	3	2	
7	13	1										5	4	2	
7	17	2										5	5	2	
7	18	0										5	6	6	
7	19	2										5	7	1	
7	21	0										5	8	1	
7	25	7										5	14	1	
7	26	2										5	15	0	
7	29	0										5	20	0	
7	30*	1										5	22	1	
7	32*	0										5	24	1	
												5	27	0	
												5	28	3	
												5	33*	1	
												7	9	0	
												7	10	0	
												7	13	1	
												7	17	2	
												7	18	0	
												7	19	2	
												7	21	0	
												7	25	7	
												7	26	2	
												7	29	0	
												7	30*	1	
												7	32*	0	
TL		15										TL		36	

There are no phalanx BUs within the Butchering Category System associated with meat removal or marrow extraction since these lower-limb elements yield little to no useable meat. The butchers simply separated the upper and lower limb (both the fore and hind limb), and discarded a large number of lower limb elements in the East Block.

It may be of interest that one of the phalanx elements may have been culturally altered. There are two holes on the anterior diaphysis, located directly above and below the epiphysis of a 1st phalanx BU23 fragment (Figure 4.36 above). Its purpose is unclear, but it seems to be more related to cultural than butchering operations. It is weathered however, so may not be an artefact at all, but the symmetry of the holes is suspicious.

Table 4.46: Number of 2nd phalanx elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	9	3		No Evidence				No Evidence				5	2	2	
7	5	1										5	3	0	
												5	7	1	
												5	8	6	
												5	10	0	
												5	11	0	
												5	12	1	
												5	15*	1	
												7	5	1	
TL		4										TL		12	

Table 4.47: Number of 3rd phalanx elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	4	0		No Evidence				No Evidence				5	2	6	
1	5	0										5	3	7	
1	8	3										5	7	1	
1	11	2										5	12	0	
1	13	2										5	15	1	
1	17*	3										7	10	1	
1	18*	1													
7	10	1													
TL		12										TL		16	

Lower Limb Accessory Bones

Sesamoids

Similar to the phalanges assemblage (phalanx 1-3), there were a large number of sesamoid bone elements recovered in the East Block. A total of 333 sesamoids were unearthed, 319 (95.5%) of which are BU1 complete elements. The 14 incomplete BU2 sesamoid elements are associated with joint dismemberment (Table 4.48). However, no direct butchering evidence is associated with them. In fact, the breakage is probably the result of natural processes, such as weathering or trampling.

Table 4.48: Number of sesamoid elements per BU that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	2	14		No Evidence				No Evidence				No Evidence			
TL		14													

Lateral Malleolus

The lateral malleolus is a small compact bone that is not commonly found at sites. This is probably due to its size, which limits its preservation and recovery. There were 23 lateral malleolus elements in the East Block, 22 of which are complete BU1 elements (95.7%). Only one BU2 fragment had breakage that could be associated with joint dismemberment, but there was no direct evidence on it (Table 4.49). The lateral malleolus has no associated meat attached to it, nor does it contain useable marrow or grease, therefore no BU numbers were assigned.

Table 4.49: Number of lateral malleolus elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	2	1		No Evidence				No Evidence				No Evidence			
TL		1													

Cuneiform pes, 1st tarsal and 2nd metatarsal

These three bone elements are classified as small, compact, irregular bones. They are located in the lower forelimb. They are rarely found or recorded in the archaeological record, likely due to weathering or excavation methods. Joint dismemberment is the only butchering process that is associated with these elements because they have little meat, marrow or grease to perform secondary processes.

Fincastle yielded a large number of cuneiform pes ($n = 48$), with a 95.8% BU1 complete element ratio (46 BU1s). This was expected, seeing that the cuneiform pes is one of the tarsal bone elements. The other tarsal elements (calcaneum, astragalus and navicular cuboid) all yield similar percentages. There were two cuneiform pes BU2 elements, however, that could be associated with joint dismemberment (Table 4.50). Unfortunately, neither element has any direct evidence of impact marks to support this.

The only other BU2 element that was categorized was a 1st tarsal fragment. Not surprisingly, the element bore no direct evidence, as its breakage was probably the result of natural processes. 96% of the 1st tarsals were complete (24 BU1s).

There were 18-2nd metatarsals unearthed in the East Block, all of which were complete. These small accessory bones are easily affected by natural weathering, and add little evidence to the overall butchering operation.

Table 4.50: Number of cuneiform pes and 1st tarsal elements per Bone Unit that reveal specific butchering evidence.

Joint Dismemberment				Meat Removal				Marrow Extraction				Grease Rendering			
BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE	BC	BU	TL	DE
1	2	3		No Evidence				No Evidence				No Evidence			
TL		3													

Manus and Pez

The manus and pez bones of the bison skeleton are small and may be easily missed during an excavation or weathered. Fincastle is no exception. There were only five manus V BU1 elements, and four pez II BU1s recorded *in situ*.

Other

Long Bone Fragments (LBFs)

As noted in Chapter 2, long bone fragments are typically missing from faunal reports, and few scholars highlight impact mark evidence. Building on Kooyman's impact mark research (2004), the Fincastle faunal assemblage was thoroughly analyzed for impact mark evidence. Several of the long bone fragments from the Fincastle Site had impact marks.

It is hard to explain why an LBF would not have an impact mark as they are created when a long bone is struck to open the shaft. Moreover, to render grease from bones, they need to be broken into small pieces. That being said, the boiling process could have altered the state of the bones periosteum, erasing a small impact mark, or the LBF could have been the result of a misstrike. A misstrike element could have been shattered and discarded into the bone bed.

Long bone fragments with two or more impacts, can be more easily associated with grease rendering. Kooyman (2004) indicated that an LBF connected to this process usually had upwards of five or six impact marks. Fincastle yielded as many fragments with two impact marks as fragments with five or more (Table 4.51). This could be because butchers struck the bone with such force on the shaft that it broke quite easily, not requiring additional impact strikes to reduce it further. More strikes were necessary in many cases, thus producing LBFs with five or more impacts.

Within the East Block, 9.8% of the total faunal assemblage are classified as long bone fragments ($n = 544$ LBFs). These are small sections of the long bone shafts that have been broken beyond element recognition, probably to gain access into the marrow cavity and further render the grease from them. There was a large portion of the LBF collection that did not yield any impact marks. This could be the result of bone shattering and waste products, or they could be a result from alteration during the boiling phase.

Table 4.51 summarizes the 55 long bone fragments that reveal direct impact evidence. They are grouped according to the number of visible impact marks. Although a small percentage of the LBFs have direct evidence, much can be learned from these remains.

Table 4.51: Number of Long Bone Fragments per group that contain impact marks.

Number of impact marks per fragment	Total number of LBFs
1 impact mark present	4
2 impact marks present	15
3 impact marks present	13
4 impact marks present	12
5+ impact marks present	11
TOTAL	55

The majority of long bone fragments are associated with secondary butchering operations; however, there is evidence of some joint dismemberment occurring based on these bones. The following six fragments evidence the butchering process.

The first LBF has six impact marks on it, all of which are located on the shaft, near the fracture lines (Figure 4.37). The fragment is also small, meaning that grease could easily be rendered from it after it was separated from the rest of the shaft.



Figure 4.37: Long Bone Fragment (Cat. No. 7990) with six impact marks.

The second LBF also suggests joint dismemberment and grease rendering. It has five impact marks on the proximal end of the shaft, and is similar to the above LBF that associated with joint dismemberment.

The third LBF confirms grease rendering after the marrow was retrieved from the shaft. One of the impact marks had a longitudinal fracture line on one edge. It seems that the origin of the fracture line was from the impact mark. The other two impact marks on the LBF probably occurred afterwards. The purpose of the last two strikes was to further reduce the shaft for boiling preparation.

The fourth LBF worth mentioning is similar to the third as it has an impact mark that resulted in a long spiral fracture edge. Three additional impact marks are also on the periosteum, probably occurring after the initial strike that created the fracture.

The fifth LBF yields six individual impact marks (Figure 4.38). One of the impact marks created the longitudinal fracture edge, while five impact marks on the opposite edge are associated with a spiral fracture. The last impact mark is a large blunt mark directly on the periosteum. This element was first impacted for marrow and further reduced for its grease.



Figure 4.38: Long Bone Fragment (Cat. No. 6645) with six impact marks.

The last LBF that will be highlighted has six impact marks. It was also first utilized for marrow extraction and then further impacted for grease rendering. The element yielded a longitudinal fracture edge that was not associated with any impact marks. All six of the impact marks probably occurred after the initial fracture to reduce the LBF into a small piece.

Five different long bone fragments had cut marks. This was an unexpected find, as LBF's usually bear impact marks since cutting is a process that aids in the preparation

of reducing bone size in preparation for boiling. Two of the six are only possible cut marks that appear on the periosteum and will not be highlighted individually. These probably were from a previous primary butchering operation such as meat removal and not a butchering technique for reducing shaft size. The reasons for the other cut marks are also unclear, but a few possible explanations can be formulated based on the remaining three fragments.

One LBF has several straight cut marks located on a muscle attachment portion of the shaft (Figure 4.39). Due to the location and number of cuts, it is possible that the butchers cut this bone to remove the muscle. With regard to the size of the element, it may have also been further reduced in size for grease rendering purposes. A second LBF has multiple cut marks on the edge of a longitudinal fracture line. These lines are straight and deep, probably from a knife. The cuts are located on the fracture line, indicating that the cuts had to occur after the fragment was reduced in size. Unfortunately, the purpose of these cuts cannot be determined.



Figure 4.39: Long Bone Fragment (Cat. No. 3561) with straight cut marks on the shaft.

The last LBF with cut marks on it also yielded multiple impact marks. The shape of the fragment poses a few questions. There are a large number of cuts on one end of the LBF where a point shape seems to have been created (Figure 4.40). The purpose of the cuts is unknown. The shape may be culturally created or could be the result of natural processes.



Figure 4.40: Long Bone Fragment (Cat. No. 7442) with cut marks and impacts. It may be modified into an artefact.

Summary and Discussion

The East Block of Fincastle is rich in faunal remains. From the 60,828 fragments, 7,538 records were analyzed and 5,540 were classified into BUs. The butchering activities of the site's occupants were studied in detail using the evidence collected in the field and in the laboratory. Evidence for primary and secondary butchering was revealed by analyzing the articulated elements, measuring and describing the fracture patterns (shaft location and overall fracture length), examining impact and cut marks and their specific location on the elements and studying the BUs that did not reveal direct

butchering evidence. By using the Butchering Category System in conjunction with Brumley's BUs, a detailed understanding of the butchering process was achieved.

Primary Butchering Evidence at Fincastle

A significant amount of evidence supporting a thorough primary butchering operation was collected during the analysis. The butchers utilized the fallen bison directly where they were killed. This primary or 'rough' butchering operation was carried out on both the axial and appendicular skeletal elements. There is substantial evidence for joint dismemberment and meat removal. The highlights are as follows:

Mandible

Joint dismemberment was seen when the distal vs. proximal mandibular sections were compared. Twelve of 16 distal BU6 elements were broken between the symphyseal surface and the 1st premolar, yielding a 75% common breakage pattern. On the proximal end, 33 of 59 mandibles had breakage patterns associated with the coronoid process. The seven complete elements suggest that a second joint dismemberment pattern exists where the mandible was separated from the skull via the coronoid processes or temporal condyles located on the skull.

Atlas and Axis

These are summarized together since they yielded similar findings. They have a low overall assemblage representation, with only 12 atlas elements and 11 axes. This indicates that a butchering pattern occurred wherein the atlas and axis were separated from the rest of the cervical vertebrae and further removed from the bone bed with the skulls.

Thoracic vertebrae

There are a large number of thoracic vertebrae that show primary butchering operations, specifically 'rough' meat removal. One-hundred seventeen of 165 thoracic elements fall into Butchering Category 3 relative to meat removal. Bone Unit 2 is directly connected to this process and there are 39 BU2's in the bone bed. They denote that the butchers removed the spinous process at the proximal (basal) end.

Ribs

A large number of the ribs show primary butchering, including joint dismemberment and meat removal. A persistent butchering pattern for joint dismemberment was noted based on the 326 elements broken less than 10 cm from the neck. This was an easy place for the butchers to break the ribs loose to separate the thicker proximal ends from the shaft sections. 36.5% of the 326 ribs are represented by BU2s. There were 1,540 elements that represented side meat removal, shown by a high ratio of direct evidence on the rib shafts.

Humerus

The humerus was not well represented but a possible butchering pattern was still discerned. There were ten distal elements to the one proximal, indicating that the humerus was probably separated at the scapula on the proximal end, and smashed on the distal shaft section to separate it from the radius/ulna.

Radius

The radius reveals a butchering pattern in relation to joint dismemberment. The 17 proximal ends to 11 distal elements suggest that the radial/humoral joint was definitely

separated. More specifically, 12 of the 17 proximal ends were relative to the BU3 classification. They could have been created when removing meat, but they could also indicate that the lower end of the radii was not utilized as much, as with the lower forelimb elements.

Tibia

The tibia is the 'long bone' that shows the most primary and secondary butchering. A specific butchering pattern exists for the joint dismemberment of the upper and lower hind limbs. This process was primarily performed on the distal section of the tibia. There were 11 BU4s (64.7%) that reflected this butchering pattern, along with the BU10 and BU34* (24.6%) distal tibia elements. Moreover, seven of these distal elements had direct evidence.

Tarsals

The tarsals all had high complete BU1 ratios, except for the calcaneum with only 55.4% complete. Since the calcaneum is the only tarsal associated with meat removal, it was definitely exposed to primary butchering operations. Whether the breakage pattern relates to joint dismemberment or meat removal cannot be discerned, but considering the high ratio of distal tibia elements and a discerned joint dismemberment pattern, meat removal seems more likely in this case.

Metatarsals

Relatively, the metatarsals revealed the most direct butchering evidence of all the faunal elements. A unique butchering pattern was noted with regard to the origin of the impact. Five of seven elements had direct impact marks on the anterior/lateral sides and

the other two were struck on the medial/posterior side. There is an issue of a low representation, but the direct evidence is consistent (71.4%). Unfortunately, these cannot be distinguished to a specific butchering operation. This butchering pattern could be for joint dismemberment or marrow extraction.

Secondary Butchering Evidence at Fincastle

A significant amount of secondary butchering took place at Fincastle. In some cases, the evidence of secondary butchering has erased primary butchering activity. With this degree of secondary or ‘detailed’ butchering occurring, it is apparent that the butchers extracted marrow and rendered grease at the kill site rather than carrying the elements to another site. The following butchering patterns represent ‘detailed’ meat removal, marrow extraction and/or grease rendering operations.

Mandible

The mandibles show some ‘detailed’ meat removal. There is no doubt that the tongues were removed in the East Block, which is confirmed by the number of disarticulated hyoids present. Thirty-seven of the 60 possible elements showing tongue removal belong to BU18 and BU34 specifically. One of these has cut marks located on the medial aspect of the ventral margin.

The mandible evidence also attests to the secondary butchering operation of marrow extraction. There were 26 elements that may show marrow extraction based on the breakage patterns on the ventral margin. However, a few of the BUs included in Butchering Category 7 also show meat removal, making it hard to distinguish between the two.

Thoracic vertebrae

The thoracic vertebra confirmed detailed meat removal evidence. In fact, a higher percentage of thoracics show secondary rather than primary meat removal. There are 63 thoracics (30% of the 210 fragments) that show that the butchers took the time to remove the spinous processes from the hump meat. This is an unusual occurrence, as the spinous are usually removed with the meat to be further processed. The presence of several large fragments of the spinous processes, most of them measuring 10 cm or more, supports the conclusion that meat removal took place at the site.

A specific butchering pattern can be seen in the BU4 and BU5 thoracic elements. Combined, they represent 34 thoracic elements that show detailed meat removal as all the transverse processes are present and over ½ of the associated spinous process.

Ribs

In addition to primary butchering, the ribs showed a second butchering pattern that confirmed a more detailed meat removal. There were 52 rib BU10s, which are rare to find since the entire shaft is present. Together with the four complete (BU1) ribs, these elements represent a detailed meat removal because the butchers took extra time to carefully remove the shafts from the meat. The ribs are presumably broken into smaller pieces (which is also evident), in most cases, or completely removed from the site to be further processed elsewhere.

Humerus

Most of the humeri BUs suggest more of a secondary butchering operation. According to the Butchering Category System, 40 of the 56 unearthed fragments fall into the grease rendering category. It is interesting that there were double the amount of BUs

reflecting the collection of yellow marrow compared to red marrow. This was a surprise since the more desired grease is assumed to be extracted from the large humeral epiphysis.

Radius

The radius was subjected to both marrow extraction and grease rendering activities. This is shown by the high number of fragments falling into these butchering categories (14 for marrow and 30 for grease). It is no surprise that the grease rendering fragments outnumber those assigned to marrow extraction, as it is the last process the butchers implement.

Tibia

The tibia revealed a significant amount of secondary butchering. One reason for this is that the shaft section has distinct muscular striations that allow the majority of tibia 'long bone fragments' to be identified with this particular element, instead of being combined with the 'undetermined' LBFs. This enabled a specific butchering pattern for marrow extraction to be seen on the tibia. In relation to the BU5 and BU6 tibia classifications, there is no doubt that these elements were smashed into smaller sections but they still seem too big to effectively retrieve grease. Therefore, marrow extraction is suggested. The BU32* classification is similar to BU5 and BU6, however, these pieces are quite a bit smaller and point to grease rendering.

Long Bone Fragments (LBFs)

There were a large number of LBFs within the East Block. There is no doubt that the long bones of the fallen bison were broken to extract the marrow and render the

available grease. This was shown not only by the large quantity of LBFs collected, but also the large concentrations of fire-broken rock (FBR) in the bone bed. No confirmed hearth features were recovered at Fincastle, but the large FBR attests to some sort of boiling or heating occurring at the site.

Looking at the evidence on the bones themselves, 55 of the 544 LBFs had direct impact evidence. The long bones had to be struck in several places to reduce them in size. Of these, it was rare to see an LBF with only one impact mark. These could have been discarded shaft sections or were altered during the boiling process there by erasing the impact evidence. There were also five elements that had cut-mark evidence, which is a rare find considering the LBFs are smaller and were probably utilized for grease, a process which usually erases other evidence. It seems that a few of the cuts were created after the fact as some are located on the fracture lines and not the periosteum. The reason for these cut marks are unknown.

Articulations

Several articulations in the East Block also warrant further discussion here. With regard to the axial skeleton, these elements represent 42.7% of the total East Block articulations ($n = 90$ elements). Each of the axial articulated units attests to primary butchering operations. The most interesting and unique find was the articulated caudal vertebrae. Eleven caudals were found in several articulated units. This suggests that the tails were left at the site, discarded during the primary butchering process.

The appendicular elements, had a surprisingly higher articulation ratio than the axial skeleton (57.3%). Of the 121 appendicular articulated elements, 696.6% ($n = 80$) are represented by the lower limb sections (1st, 2nd and 3rd phalanges, sesamoid, 5th

metacarpal, 1st tarsal, 2nd metatarsal and the manus V). This suggests that the lower limbs were discarded during the primary butchering as well.

The tarsal articulations (calcaneum, astragalus, navicular cuboid and cuneiform pes), yielded similar articulation numbers (3, 5, 5, and 4 respectively). The lower number of calcaneum elements in articulations may be associated with the breakage patterns within the tarsals. Joint dismemberment of the upper from lower limb seems to have occurred on the calcaneum more than any other tarsal bone.

Interestingly, there are only two carpal elements (one unciform and one magnum) in an articulated state. The carpals are mainly in a complete state; therefore, they should have been found much more often in an articulated state than what was recovered, especially since they lacked direct butchering evidence.

In the following chapters these results are compared to other plains archaeological sites (Chapter 5), and final conclusions are presented (Chapter 6).

CHAPTER 5 – SITE COMPARISONS

Introduction

Since few archaeologists use Brumley's BU System (1991) to identify faunal remains, comparison of the Fincastle results with data from other sites is difficult. Nevertheless, Fincastle is not an exceptional plains site with regard to the butchering operation. Looking at the butchering operation as a whole, Fincastle, in many ways, falls within Frison's (1973) generalized primary butchering operation and shows similar primary and secondary butchering activities.

Articulations

With regard to the articulations, Fincastle seems to be similar to other sites. The Agate Basin (Frison and Stanford 1982), EgPn-111 (Head, et al. 2002), Gull Lake (Kehoe 1973), Muhlbach (Gruhn 1969), and Estuary Sites (Adams 1977) all had several lower limb articulated elements in the primary kill areas. Fincastle is no different, with a high number of articulated lower limb elements. These articulations vary, which suggests that the butchers had no common lower limb area that they favoured for removal. Frison (1974) reported more axial than appendicular elements in articulation at the Casper Site. Fincastle also yielded a high number of articulated elements, but showed the opposite with regard to axial vs. appendicular representation. This difference aside, the majority of Fincastle's articulated appendicular elements were from the lower limb, which is commonly seen in the archaeological record.

Mandibles

The results from studying Fincastle's mandible assemblage can be compared to sites throughout the Prehistoric period. Fincastle had at least one butchering pattern in relation to joint dismemberment wherein the mandible was removed from the skull by the coronoid process. There were similar butchering patterns recorded at the EgPn-111 and the Estuary Site. Kehoe (1973) also reported this striking pattern occurring at Gull Lake. He also mentioned two other locations for breakage including breakage on the mental foramen, to aid in the splitting of the two mandibles and the last section immediately below the molars. It is interesting that Kehoe summarized all three of these as joint dismemberment patterns. At Fincastle, a similar breakage pattern was seen in the premolar section (cheek teeth), however, it was concluded that this breakage pattern was not for joint dismemberment, but more for secondary butchering processes such as marrow extraction. Adams (1977) at the Estuary Site, and Head, et al. (2002) at EgPn-111, reported the presence of several cheek teeth sections because of the reduction of the ramus/teeth sections for marrow collection.

In terms of 'meat' removal, the Fincastle Site had cut-mark evidence which suggested that the tongues were being removed directly at the kill site. For the Casper (Frison 1974), Deer Creek (Larson, et al. 1984) and Wardell Buffalo Trap Sites (Frison 1973), cut marks on the medial aspect of the ramus were reported, indicating that the tongues were being removed at these sites. The locations of the cut marks are consistent with those at Fincastle.

Thoracics

The thoracic vertebrae from Fincastle can be compared to several sites. With regard to primary butchering evidence, Fincastle's thoracic assemblage yielded the highest number of articulated vertebral column elements. Similar findings were reported both at EgPn-111 and Muhlbach. Adams (1977) reported having a large number of thoracics missing the spinous processes at the Estuary Bison Pound Site. He further added that the majority of them were broken at the base of the spine (70%) while the rest were removed between $\frac{1}{4}$ - $\frac{1}{2}$ of the way up the spine. Fincastle yielded similar results, with a higher percentage of thoracics broken through the basal spine than on the mid shaft. Similar findings were also recorded at the EgPn-111, Gull Lake and Casper Sites.

It is interesting that the breakage patterns recorded between $\frac{1}{4}$ - $\frac{1}{2}$ of the way up the shaft were associated with primary meat removal. At Fincastle, these particular elements were classified as a more detailed meat removal operation. The high number of collected BU4 and BU5 thoracic elements attest to this. Findings from Head-Smashed-In Buffalo Jump offered the only supportive evidence of this detailed meat removal process. Brink and Dawe (1989) reported four complete thoracic vertebrae in a disarticulated state, ruling out an overkill situation. Even though there were no BU1 complete elements recovered at Fincastle, the BU5 elements are similar and were subjected to a detailed meat removal.

Ribs

The ribs are common bone elements documented at plains sites. However, the butchering operations related to these elements was rarely noted. Most reports noted that

ribs were found within the bone beds and that some sort of butchering activity occurred but no further information was given.

Sites such as the Gull Lake, Deer Creek, EgPn111, Ruby, Casper and Agate Basin had several proximal rib elements in articulation with the thoracic vertebrae. Considering that thoracic articulated elements are predominantly connected with primary butchering, these specific thoracic/rib articulations presumably fall into primary butchering as well. Similar articulated thoracic/rib articulations were unearthed at Fincastle, and were concluded to relate to this process. Measurement evidence relative to the breakage location on the shaft was noted at EgPn-111 and Wardell. Head, et al. (2002) reported a common butchering pattern on the ribs at EgPn-111, where the impacts occurred several inches away from the proximal end. This is similar to the Fincastle assemblage. Fincastle's BU2 and BU8 elements indicate joint dismemberment.

Head, et al. (2002) also documented that the ribs shaft fragments from EgPn-111 had cut marks. Larson, et al. (1984) also reported cut marks on the shaft fragments at the Deer Creek Site. The cut marks from the Deer Creek side are on both the medial and lateral aspects of the rib shafts, indicating that a more detailed meat removal occurred. This was also seen in this study.

Caudal Vertebrae

The caudal vertebrae from the East Block were unique finds. It is unfortunate that these elements are rarely discussed in other site reports. Kehoe's (1973) report for Gull Lake Site was the only one to mention these elements. He stated that the caudals may have been removed from the hides prior to the hide being transported to another location for processing. If this was the case, the caudal bones should have been found in the bone

bed. The absence of recorded caudal vertebrae in his analysis makes this difficult to confirm.

Scapula

The scapula is a bone element commonly recorded at sites. It is often associated with joint dismemberment. Fincastle, however, did not yield a large amount of evidence of joint dismemberment on the scapula, but rather on the humerus. This is also the case at sites such as Hudson-Meng and Casper.

Two other butchering operations connected to the scapulae recovered from Fincastle may be related to other sites. For primary meat removal operations, the spine and acromion yielded butchering evidence that confirmed that the muscles were stripped away from the element. Similar evidence was presented by Frison (1983) at the Casper Site, Larson, et al. (1984) at Deer Creek and Adams (1977) at the Estuary Bison Pound Site.

An interesting comparison can be made between Fincastle and the Gull Lake Site (Kehoe 1973) with regard to secondary butchering operations. There was only a small amount of evidence reported from each of these sites but the locations of the breakage patterns recorded attests to marrow extraction.

Humerus

A common butchering pattern relating to joint dismemberment on the humerus was seen at several sites, including Estuary, EgPn-111 and Head-Smashed-In. These sites have similar findings to Fincastle, with an increased amount of distal humerus epiphysis compared to proximal ends. At Fincastle, there were ten distal humeri compared to one proximal. The Estuary Site yielded 18 distal to four proximal (Adams

1977) and EgPn-111 23 to five (Head, et al. 2002). At Head-Smashed-In, an astounding 146 distal to 21 proximal humeri ends were recorded (Brink and Dawe 1989). This is noteworthy because separating the entire forelimb from the rest of the carcass on the thick humerus is difficult. These fragments may also relate to secondary butchering operations.

As summarized by Brink (1997), the proximal humerus contains one of the highest concentrations of desired 'red marrow' grease. The overall low representation of proximal humerus pieces may be linked to this high grease content. The butchers may have further utilized the proximal epiphyses, reducing their visibility in the archaeological record.

Another butchering operation that may be compared to other sites involves the extraction of the marrow from the shaft cavity. Fincastle's humeri were definitely utilized for marrow extraction. Both the Estuary and Muhlbach Sites also yielded marrow extraction evidence. Adams (1977) noted several impact marks on the lateral side of a humerus approximately 5 cm above the distal epiphysis that created a split further into the shaft. Gruhn (1969) also noted a distinct breakage pattern in the shaft. She mentioned that there was a diagonal break approximately 10-20 cm into the humerus shaft. The measurements recorded at the Estuary and Muhlbach Sites are similar to Fincastle's Butchering Category for marrow extraction.

Radius

At other sites, there seems to be less evidence of the radius than the humerus. This is not the case for the Fincastle assemblage. Fincastle had 17 proximal ends compared to 11 distal epiphyses, indicating that joint dismemberment was predominately

on the radius rather than the humerus. Similar findings were recorded by Head, et al. (2002). They reported 26 proximal ends to ten distal epiphyses at EgPn-111.

Most of the radius evidence discussed in the literature relates to secondary butchering operations, specifically marrow extraction. Reports on EgPn-111, Estuary, Agate Basin, and Muhlbach all mention that marrow extraction occurred. Fincastle's main evidence for marrow extraction of the radius came from a radius found in articulation with a humerus. The humerus had a spiral fracture that was affiliated with joint dismemberment. The radius was split in two, resulting in a fracture pattern that could be for joint dismemberment and/or marrow extraction.

Ulna

The ulna was mainly utilized for primary meat removal at Fincastle. This is similar to what was reported at the Muhlbach, EgPn-111, and Gull Lake Sites. These sites revealed a common breakage pattern where the olecranon was partially butchered or fully missing from the rest of the element, probably because it was removed by the butchers when they were removing the meat.

Tibia

The tibia is often part of both primary and secondary butchering operations, but most evidence falls into the former process. The same pattern of broken the tibia for joint dismemberment at Fincastle was also documented at the Muhlbach, Estuary, EgPn-111 and Head-Smashed-In Sites. The ratios of distal to proximal epiphyses are quite dramatic at these sites. For example, 40 distal compared to twelve proximal epiphyses were found at the EgPn-111 Site (Head, et al. 2002), and 175 distal to 37 proximal epiphyses at Head-Smashed-In (Brink and Dawe 1989). These ratios confirm that the upper hind limb

was commonly separated from the lower hind limb on the distal end of the tibia. Gruhn (1969) also reported an increased distal epiphysis count but noted that the distal ends commonly had diagonal breakage patterns 5-10 cm above the epiphysis, while the proximal ends were diagonally broken 10-20 cm below the epiphysis.

Gruhn's measurements for the distal ends seems to correlate with Fincastle's joint dismemberment categories, while the proximal ends measuring over 10 cm from the epiphysis seem more characteristic of marrow extraction. Marrow extraction from the tibia definitely occurred at Fincastle, and was also reported at most of the Middle and Late Prehistoric sites.

Marrow and Grease Extraction

It is interesting that Frison (1974) and Frison and Stanford (1982) associated the Casper and Agate Basin Sites with marrow extraction since it is more widely accepted that marrow and grease rendering did not come into practise until the Middle Prehistoric Period. Most of the Middle and Late Prehistoric sites reviewed had the secondary butchering operations of marrow extraction and grease rendering, but the excavators failed to present the physical evidence. The final Head-Smashed-In excavation report (Brink and Dawe 1989) is an exception to the rule. A more concentrated look at these sites, including hearth features and quantities of fire-broken rock at the site, will help determine how much grease rendering occurred. Fincastle yielded a number of fire-broken rocks associated with the bone bed and burned bone remains (including small fragments as well as complete tarsals).

Summary

The results from Fincastle can be compared with several sites that had primary and secondary butchering operations. The two sites most comparable to Fincastle are the Muhlbach and EgPn-111 Sites. All three sites are located in Alberta and date to the Middle Prehistoric Period. They yield similar evidence for primary joint dismemberment on the tibia and ulna. Primary butchering relating to the mandible and radius at EgPn-111 is similar to the results from Fincastle, while the secondary butchering operations for the humerus and tibia at Muhlbach are comparable.

Fincastle is a typical butchering site in that there is an increased intensity of secondary butchering. Detailed meat removal, marrow extraction and grease rendering are seen at most Middle and Late Prehistoric sites. The differences seen by studying the Fincastle assemblage may exist elsewhere in the archaeological record. As more detailed studies are carried out, further comparisons can be made.

CHAPTER 6 – CONCLUSIONS

Thesis Overview

The East Block of the Fincastle Bison Kill Site revealed an extensive bone bed, the focus of this thesis. The site was excavated in 2004, 2006 and 2007 and contained over 60,000 bone fragments. A total of 7,538 records were entered into the Fincastle faunal database, of which 5,540 were BUed. These 5,540 records include a total of 16,196 individual bone fragments, which make up the main database for this research. Each element underwent an in-depth analysis process, highlighting such things as its species, age, weight, side, completeness and other pieces of information. The bones were then assigned a BU and classified into the Butchering Category System. A few fragments were unable to be assigned to a BU, but that also yielded vital information: the 544 Long Bone Fragments and 14 cartilage pieces. Finally, each element was examined for any direct evidence that could indicate a butchering operation.

The main objective of this zooarchaeological research was to determine the specific butchering patterns at the Fincastle Site. More specifically, this thesis sets out to detect primary and/or secondary butchering operations if they were carried out at the site. Understanding to what extent the butchers utilized the carcasses was also an important goal of the research.

The Bone Bed

There is no doubt that the East Block bone bed was not only the primary kill site, based on the number of projectile points (Varsakis 2006), but it also a butchering site. The physical butchering evidence found by the analysis of the faunal assemblage indicates that both primary and secondary butchering occurred. There is a larger

concentration of BUed axial elements compared to appendicular (3,298 axial compared to 2,242 appendicular), which indicates that primary butchering operations were carried out. It also shows that the appendicular elements were being further broken beyond recognition in secondary butchering operations.

Primary butchering is also shown by the 211 elements found in an articulated state. These can be broken into 121 appendicular and 99 axial elements. Interestingly, most of the appendicular articulations are composed of lower limb elements (115 of 121), which is indicative of primary operations since the lower limbs yield little to no usable meat. Lower limb elements have an 83.5% completeness ratio. Selective secondary butchering occurred since these portions of the bison were discarded.

Over 80% of the faunal remains from the site fall into the well-good preservation categories, which preserved much of the direct butchering evidence. Each element group revealed some sort of butchering activity; however, not every element could be summarized into specific butchering patterns. Some element groups had too few fragments to detect butchering patterns. This point aside, the amount of evidence collected is substantial.

Fincastle's butchering patterns seem to fall within Frison's (1973) general primary butchering operation. Beginning with the removal of the hide, the forelimbs were removed then the hind limb's major muscle groups were stripped, followed by the removal of the side, hump and neck meat. Finally, the butchers returned to the hind limb to recover the rest of the meat. Once one side of the bison was utilized, it would then be flipped over. Frison's butchering operation concentrated on the primary butchering operation, though he added that the secondary butchering operations of marrow and

grease extraction occurred at the site after the initial rough butchering, or that the particular elements were taken to another site to be further processed. At Fincastle, both primary and secondary butchering operations took place at the site. These are discussed below.

Butchering Evidence at Fincastle

Primary butchering included joint dismemberment as well as rough meat removal operations. Secondary butchering activities included detailed meat removal, marrow extraction and grease rendering activities. All of these activities have been highlighted in detail in Chapter 4 under their specific elements. Evidence such as impact and marks, fracture patterns and/or proximal/distal ratios was noted, which helps to define a specific primary or secondary butchering operation.

Primary Butchering Operations

Joint Dismemberment

- 1) The mandibles were fully utilized for both primary and secondary butchering operations. They reflect a butchering pattern for joint dismemberment where the mandibles were separated from the skulls by the coronoid processes. There were 33 elements that had similar breakage patterns on or directly below the coronoid processes. This junction allowed for an easy removal from the skull and extraction of the tongue.
- 2) The distal humeri portions as well as the proximal radius portions had a higher representation than their pairing epiphyses which points to a radial/humoral joint butchering pattern. The higher number of radius proximal portions ($n = 17$) than the distal ends of the humerus ($n = 10$), suggests that joint dismemberment occurred on

the radius. Regarding the radius, it is also interesting that the distal end is outnumbered by the proximal ends. The distal radius, articulating with the carpals is the point of separation between the upper and lower forelimb. The distal radius should be better represented as the lower limbs were not utilized much at the site. It may be that the distal radius was further utilized for secondary butchering operations such as grease rendering. The same holds true for the proximal humerus, as it contains one of the highest concentrations of 'red marrow' grease.

- 3) The tibias distal epiphysis out numbered the proximal ends and all 17 had a spiral fracture pattern less than $\frac{1}{4}$ above the epiphysis, placing them into Butchering Category 2 relative to joint dismemberment. This confirmed that the main location where the upper and lower hind limbs were segmented was on the tibia.
- 4) The metatarsals show an interesting butchering pattern that could show either joint dismemberment or marrow extraction. Five of the seven elements had impact marks on the lateral-anterior aspects of the shaft. Though the numbers seem low, the five represent 71.4% of the total metatarsals in Butchering Category 7, showing joint and/or marrow extraction.
- 5) The ribs were utilized for both primary and secondary butchering. They have a common butchering pattern for joint dismemberment, seen by the 326 ribs that were smashed less than 10 cm away from the proximal end. More specifically, the BU2's represent 36.5% of the 326 elements, indicating that the butchers were smashing the shafts loose directly below the neck section trying to utilize the full rib shaft for its meat. By smashing the shafts loose less than 10 cm from the proximal end, allows the specific muscle groups could be segmented for further meat removal operations.

Rough Meat Removal

- 1) The thoracic vertebrae are similar to the ribs as they too were utilized for both primary and secondary butchering operations. The majority of primary evidence relates to the meat removal processes. Butchering was seen at the basal spinous wherein the body was frequently being separated directly on the bottom section of the spinous process ($n = 46$). By separating the spinous process, the hump meat could be segmented into body sections for further processing.

Tongue Removal

- 1) The high number of hyoid fragments recovered at Fincastle is unusual for an archaeological site for two reasons. First, the hyoids are thin bones and are easily weathered beyond recognition. Secondly, they are commonly removed from the bone bed with the tongue to further be processed at a different location. This is not the case at Fincastle. There were a total of 57 disarticulated hyoid fragments recovered, showing the detailed meat removal of the tongue directly at the site.
- 2) Several mandibles also show that the tongues were taken at the kill site as these had cut marks on the medial aspects of the ascending ramus as well as on the cheek teeth sections. These cuts had to have occurred after the mandibles were segmented as it would be difficult to cut the medial aspects if the elements were still in an articulated state.

Hide Removal

- 1) A interesting discovery was made relating to the caudal vertebrae in the East Block. There were a total of 109 caudals, 11 of which were in an articulated state. This was a rare find because the tails are generally taken from the site with the hides for further

processing or were utilized as a cultural implement. The caudal vertebrae make up the second highest number of vertebral column elements, 109 caudals compared to 72 cervical, 210 thoracic and 44 lumbar vertebrae (weighted to 32 caudals, 11 cervical, 86 thoracic and six lumbar based on the numbers of each element in the bison's anatomy). This is noteworthy because it suggests that detailed hide removal occurred at the site. The tail was cut and discarded when the hide was removed.

- 2) The presence of side scrapers, end scrapers and knives within the bone bed help confirm this assessment.

Secondary Butchering Operations

Detailed Meat Removal

- 1) The ribs represent 36.4% of the overall Fincastle faunal assemblage in the East Block. Considering that ribs make up approximately 14% of the skeletal anatomy of a bison, this amount is interesting because it shows a high representation indicating that the side meat was utilized. The most common BUs assigned were the ribs BU15 and BU16. Combined, these represented over 89.9% of the rib elements. These, together with the BU10 and BU1 elements which were rare finds, reflect a more detailed, secondary meat removal butchering operation. Many of these shaft elements have impact and/or cut-mark evidence on the medial and/or lateral aspects of the shafts, indicating that the inter-costal muscles were being retrieved as well as the shaft sections were being removed from the side meat at the site.
- 2) Detailed meat removal was seen in relation to the thoracic vertebrae. There were a large number of spinous processes in the bone bed. These are generally absent because they are usually taken to a secondary location for meat removal. Fincastle

also yielded a large number of thoracic BU4 and BU5 elements, indicating that the butchers took the time to remove the thoracic vertebrae from the hump meat without breaking off the spinouses. Also, overkill and meat wastage can be ruled out as these thoracics would probably have been left in articulation if the butchers were not going to utilize them.

Marrow Extraction and Grease Rendering

- 1) There is secondary butchering evidence on both the mandible and scapulae elements for marrow extraction. Twenty-six mandibles residing in the marrow extraction butchering category showed a common breakage on the premolars and on the distal ascending ramus, allowing for the ventral margin to be opened up. On the scapulae, there are several breaks on the neck portions, allowing for the small amount of marrow to be collected. These neck breaks could have been from joint dismemberment and further utilized for the marrow with no further processing.
- 2) Much of the primary butchering evidence was erased by the secondary butchering operation. There are numerous examples of impact marks and fracture patterns on bone fragments that represent marrow and grease extraction. The main evidence for the secondary butchering operations is associated with the long bones of the appendicular elements. Keeping in mind that grease rendering is the most destructive butchering process and the last one administered on an element, grease rendering cannot be the only secondary operation considered. The overall low percentage of complete long bones attests to marrow extraction being carried out. There was a total of 544 LBFs, 55 of which contained direct evidence. The majority of these can be classified as grease rendering fragments as they contain more than two impact marks.

This includes the shaft sections struck with the purpose of reducing the shaft to make it easier to boil the bones.

- 3) Many of the long bones fell within Butchering Category 5 and 6 relative to grease rendering. The low number of complete elements, in conjunction with the fire-broken rock in the bone bed, indicates that grease rendering occurred.

Fracture Pattern Evidence

- 1) When comparing the East Block fracture patterns to Kooyman's (2004) long and short spiral fracture pattern information, an inconsistency was found. Three distal humerus elements (two BU16s and one BU10) had fracture patterns (and associated impact marks) with an overall distance resting directly below the epiphysis, which is characteristic to joint dismemberment (according to the Butchering Category System). However, each of these humerus elements had a long spiral fracture, which is more characteristic of marrow extraction as presented by Kooyman (2004). As mentioned in Chapter 4, this could be an indication that the butchers were saving time by first separating the bone elements and then using the same entry point for the marrow without having to further break the humerus. Other examples of this were seen in the distal tibia and the radius. This study suggests that the size of the spiral fracture does not necessarily indicate marrow extraction. The location of the fracture on the long bone (i.e., its proximity to the epiphysis) may be a better indicator.

Cartilage

As discussed in detail in Chapter 4, the East Block yielded a few pieces of cartilage, which were unique finds, not to mention that a few of these elements had chew

marks. No other site reviewed in the literature had cartilage pieces. One main conclusion drawn from these 14 remains is that the overall site preservation was fairly good.

At first glance these elements may be mistaken as fetal bones, and without a good comparative collection, this mistake may be easily made. A review of the fetal elements in the published literature may be necessary.

Butchering Stations at the Kill Site

In addition to being a kill site, there are a few indications that the site might also have included specific butchering stations that lay beyond the 44 m² East Block boundary.

Several key bone elements were virtually absent from the East Block. The main missing element, the skull, is one of the largest bone elements. Though it has little to no useable 'meat', it does contain the brain, nasal and tongue organs, which are usually taken at the kill site. The East Block yielded only 184 skull fragments, 57.1% ($n = 105$) of which were classified as BU35. A BU35 is a small fragment of skull identified by its internal shape and curvature only. Most of the other skull fragments were associated with the brain, nasal and tongue removal processes. The high number of mandibles recovered in the bone bed ($n = 207$), which support the notion of tongue removal, is in sharp contrast to the skull quantities. With such a low representation of skulls in the overall faunal assemblage, it must be concluded that the skulls were removed from this section of the bone bed to be further used either for their 'meat' (organs), or possibly for a more cultural purpose.

Other evidence which points to the possibility of a butchering station outside of the East Block involves the lower forelimbs. Though the East Block contained a high

number of phalanxes (P1-3), these were not assigned to a specific limb, and were therefore not included in the lower forelimb counts. Regardless, the metacarpals had a low representation in the assemblage: only 46 were recovered in the bone bed (28 left, 17 rights, and 1 UD). Considering that there was a MNI of 35 *Bison bison* in the East Block, only 65.7% of their metacarpals were present. Further comparison of the metacarpals to the metatarsals reveals that the latter had a close representation to the MNI ratio (30 left, 33 rights and 16 UD). This indicates that the hind limbs were butchered in the kill area. Either the metacarpals were smashed beyond recognition (unlikely), or the forelimbs were removed after the initial separation to be processed elsewhere.

The pelvis and sacrum elements could also indicate a butchering station outside of the East Block. Both of these elements have a relatively low representation in the assemblage (37 pelvis and 11 sacrum fragments). This was unexpected as they are usually associated with primary butchering operations. The sacrum yields little usable meat and usually is left at the kill area. The pelvis has many large muscle attachments that can be released easily with direct blows to it. This element is bulky and is also usually left at the initial kill site. Perhaps these were taken to another butchering station.

There are a few other elements with low representations, but because they belong to the long-bone group it cannot be assumed that they were taken to an outside butchering station. These particular elements may have been reduced to smaller pieces for secondary butchering operations, such as marrow extraction and grease rendering.

Kill Occurring During a Time of ‘Plenty’

There are several indications that the kill at Fincastle occurred during a time of ‘plenty’. Based on the analysis of the faunal assemblage, it is clear that the butchers did not fully utilize the entire carcass (i.e., there was plenty of food to go around).

First, the large numbers of articulated elements in the bone bed in context with secondary butchering evidence indicates that ‘selection’ took place. Moreover, a large number of articulated and disarticulated lower limb elements were in complete or nearly complete states. Their (near) completeness and the good-well preservation of the elements confirms they were not utilized. These elements could have been processed for their grease if the hunters were in a time of ‘need’. The same can be said for the high numbers of complete carpals/tarsals and the large quantities of axial articulated elements.

Moreover, the mandible and scapula were rarely utilized for their marrow and grease. In times of ‘need’ the butchers would have collected all of the available marrow and grease, but this was clearly not done at Fincastle.

Finally, and noteworthy, the number of articulated and complete BU1 metacarpal elements suggest meat selection. There are six metacarpals in articulation and 28 complete elements. Even though the metacarpal was poorly represented in the East Block, these complete and articulated bones strengthens the theory of a time of ‘plenty’. If the butchers needed to, they would have utilized all of the available metapodials for their marrow and grease.

Future Analysis of the Fincastle Faunal Assemblage and Beyond

The main aim of this thesis was to study the faunal assemblage at the Fincastle Site to determine the butchering activities that took place, but also to advance the study of

faunal remains in general. This broader goal was achieved by the additions made to Brumley's BU Category System. Ideally, other research projects will implement the BU system into their own faunal analysis. Considering that many bison kill and processing sites have thousands of remains, a searchable database makes detailed analysis and site comparisons across time and space possible. Better site comparison studies would then lead to a greater understanding of Plains Archaeology.

This accomplishment aside, a few areas warrant improvement for the next step in the faunal analysis.

- 1) The ribs should be divided into sections to better understand the detailed butchering pattern. Currently, the 28 ribs (14 left and 14 rights) are grouped together, though they are described in detail in relation to rib head and tubercle size in Chapter 2. Indicating which rib or rib 'section' the evidence was from (for example from a 7th rib) could add more detail to the analysis of the proximal ends. This is similar to how the vertebral column is differentiated.
- 2) Determining the age and sex of the animals would provide additional information on the nature of the herd and the season of the kill. If particular animals (young vs. old for example) were selected for killing and/or butchering this could be detected. This would involve taking measurements on certain areas of the bones. This is extremely time consuming, but might yield interesting results.
- 3) A better site comparison should be conducted when the entire faunal assemblage has been analysed and connected to the other archaeological remains recovered from Fincastle. As discussed above, it is hard at this point to do a complete comparison when there are several more areas of the site to be included in the faunal analysis.

Final Conclusions

This thesis not only provided the framework to study the faunal remains discovered at the Fincastle (DIOx-5) Site, but added a number of significant conclusions based on the analysis of the elements unearthed in the East Block. A large butchering operation took place in this area where at least 35 bison were butchered. In the bone bed, both primary and secondary butchering operations took place. There is ample evidence to support the specific butchering operations of joint dismemberment, meat removal (both primary and secondary), marrow extraction and grease rendering occurring.

Primary butchering consisting of joint dismemberment and rough meat removal is shown on most bone elements. The butchers utilized the large sections of the carcass the most, leaving behind the smaller, insignificant portions such as the lower limbs. The hunt was administered during a time of plenty; otherwise the lower limb elements would have been more thoroughly utilized for their grease.

With the bone bed yielding an overall low complete element percentage and the large amount of FBR collected within the bone bed, there is no doubt that a large secondary butchering operation also took place. Many bones were reduced into smaller pieces for marrow and grease extraction. Much of the secondary butchering erased the primary-butchering operations, hindering the ability to determine a 'step by step' butchering pattern. Regardless, Fincastle is a type site for the Middle Prehistoric Period, and adds new insight into the butchering activities carried out. With the use of the BU Analysis (Brumley 1991) and the formulation of the Butchering Category System, Fincastle's detailed butchering analysis can be used as a foundation for future faunal analysis.

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APPENDIX I – DEFINITIONS OF TERMS

Anatomical position

To be in the correct anatomical position, the bones are positioned as they were when the animal was born.

Appendicular skeleton

The appendicular skeleton includes the forelimb elements (scapula, humerus, radius, ulna, carpals, metacarpals, and phalanges 1-3) and hind limb elements (femur, patella, tibia, tarsals, metatarsal, and phalanges 1-3).

Articulation

Articulations are sections of the body where the involved bone elements are maintaining a correct anatomical position. Bone to bone contact is maintained.

Articulation point

Articulation points are specific aspects on a bone that meet another articulation point of a neighbouring element. It is the ‘Bone to bone’ contact point of two separate elements. They can be located on one or both of the proximal or distal epiphysis, or on other areas of irregular bones (element dependent).

Axial skeleton

The axial skeleton includes the skull, mandible, hyoid, vertebral column, ribs, sternum, sacrum and pelvis.

Bone types

Each bone of the bison anatomy can be classified into a generalized bone type. These are summarized in the chart below.

Bone Type	Element	
Long Bone	<u>Forelimb</u> Humerus Radius Ulna Metacarpal	<u>Hind limb</u> Femur Tibia Metatarsal
Irregular Bone	Skull Cervical Vertebrae Thoracic Vertebrae Lumbar Vertebrae Caudal Vertebrae	Sacrum Patella Carpals (all types) Tarsals (all types) Phalanges 1-3
Flat Bone	Mandible Hyoid Ribs	Scapula Pelvis

Cartilage

Cartilage is a type of connective tissue containing chondrocytes in lacunae embedded in a dense network of collagen and elastic fibres. Cartilage deteriorates at a much faster rate than bone does so is rarely found in an archaeological context.

Cut marks

Cut marks are straight lined grooves that are the result of a sharp implement coming in contact with a bone.

Desiccation fracture

Desiccation fractures are elongated fractures that occur when a bone dries out during the weathering process.

Diaphysis

The diaphysis is the shaft section of a bone.

Disarticulation

When elements are separated from their natural anatomical position in the body, the elements are said to be in a disarticulated state. The element no longer belongs to a joint and is not found in direct contact with any other element.

Distal

The distal portion of a bone is the furthest from the heart.

Dorsal

The dorsal or posterior portion of a bone is its back section.

Epiphysis

Epiphyses are the end sections of a bone. Many bones have both a proximal or distal epiphysis. The epiphysis is what articulates to another bone element.

Epiphyseal line

The epiphyseal line separates the epiphysis from the diaphysis. The epiphyseal line is unfused in early age, and fuses together upon maturity. This is a major age indicator.

Chewing (gnawing) marks

Chewing marks are grooved impressions left on a bone when an animal chews it.

Impact marks

Impact marks are break indentations left on the bone from a blow from a blunt object.

Joint dismemberment

Joint dismemberment is the process that occurs in order to separate bones for each other. It is done to remove meat or to gain access to marrow and/or grease. It is a direct butchering practise.

Lateral

The lateral portion of a bone is furthest from the midline. It is the outside aspect.

Ligament

Ligaments attaches bone to bone.

Long Spiral Fracture

The long spiral fracture has a longitudinal fracture edge of 6 cm or more.

Longitudinal Fracture

A longitudinal fracture has a long straight edge that runs parallel to the diaphysis of a long bone.

Lower forelimb

The lower forelimb contains the carpals, metacarpals, and phalanges.

Lower hind limb

The lower hind limb contains the tarsals, metatarsals and phalanges.

Medial

The medial portion of the bone is closest to the midline. It is the inside aspect.

Overkill

Overkill implies a situation where the butchers did not utilize all of the meat of the animal(s). Overkill can be shown by articulations and/or elements that have been disarticulated from the body but that have not been further butchered.

Periosteum

The periosteum is the outer layer of bone.

Primary butchering

Primary butchering involves the initial removal of sections of the carcasses to be further processed. Essentially, it is the 'rough' processing of the carcass. Primary butchering mainly includes hide removal, joint dismemberment (dismemberment) and meat removal.

Proximal

The proximal portion of the bone is closest to the skull.

Red Marrow

Red marrow is predominantly found in the epiphyses of the long bones.

Root etching

Bone or root etching is defined as broad, smoothed-bottomed, U shaped grooves on the faunal remains resulting from the acids released from roots.

Secondary butchering

Secondary butchering is the detailed manipulation of the carcass to remove the meat, marrow and/or to extract bone grease. It is generally seen in the processing area of a site. Secondary butchering involves detailed meat, tongue, brain and nasal cartilage removal and marrow and grease extraction.

Short Spiral Fracture

A short spiral fracture has a curved longitudinal fracture edge that measures less than 6cm.

Taphonomy

Taphonomy is the study of what happens to an animal after death. It includes both natural and cultural processes.

Tendon

A tendon attaches bone to muscle.

Trampling

Trampling is the crushing or splintering of bone by the impact of animals (including humans) walking or wallowing over the faunal remains.

Transverse Fracture

A transverse fracture runs perpendicular to the diaphysis of the bone.

Upper forelimb

The upper forelimb contains the scapula, humerus, radius and ulna.

Upper hind limb

The upper hind limb contains the femur, patella and tibia.

Ventral

The ventral or anterior portion of a bone is its front section.

Yellow Marrow

Yellow marrow is found in the shaft cavities of the long bones. Yellow marrow is pure fat that contains valued nutrients.

APPENDIX II - FINCASTLE BONE UNITS PER ELEMENT

Skull

Bone Unit	Number of Records
3	2
7	19
11	4
13	2
14	1
15	1
16	1
17	4
29	2
30	2

Bone Unit	Number of Records
35*	105
40	5
42	1
45*	4
46*	18
47*	1
48*	1
49*	10
Total	182

Atlas

Bone Unit	Number of Records
1	1
2	2
3	2
5	5
12	1
14*	1
Total	12

Axis

Bone Unit	Number of Records
3	1
4	2
5	1
7	2
10	1
13	1
17*	2
18*	1
Total	11

Mandible

Bone Unit	Number of Records
1	7
2	3
3	2
4	2
5	3
6	13
7	19
8	2
9	4
10	1

Bone Unit	Number of Records
12	1
14	6
15	11
16	2
17	4
18	31
20	2
21	2
22	2
23	4

Bone Unit	Number of Records
24	2
25	2
26	2
27	4
28	2
29	14
30	1
32	6
33	5
34	2

Bone Unit	Number of Records
37	3
39	2
40	1
41	2
42	3
43	6
44	3
48	5
49	2
50	1

Bone Unit	Number of Records
51*	8
52*	1
53*	7
54*	1
55*	1
Total	207

Hyoid

Bone Unit	Number of Records
2	4
3	4
4	7
5	2
7	2
8	24
9	2
10	3
11	6
12	1

Bone Unit	Number of Records
14*	2
Total	57

Cervical Vertebrae

Bone Unit	Number of Records
1	1
3	13
4	3
8	3
11	1
12	4
13	5
14	1
16	20
18	1
19	1

Bone Unit	Number of Records
22	2
23*	1
27	7
33*	2
34*	2
35*	1
36*	2
37*	1
38*	2
Total	72

Thoracic Vertebrae

Bone Unit	Number of Records
2	39
3	2
4	23
5	11
7	8
8	2
9	5
10	5
11	2
12	2

Bone Unit	Number of Records
13	7
14	3
15	30
16	4
17	1
18	14
19	1
21	3
22	3
23	5

Bone Unit	Number of Records
24	1
25	1
26	3
28	5
29	1
30	1
31	1
32	3
33*	6
34*	1

Bone Unit	Number of Records
35*	2
36*	1
37*	2
38*	3
39*	2
40*	7
Total	210

Lumbar Vertebrae

Bone Unit	Number of Records
2	2
3	2
4	1
5	2
6	6
8	4
9	5
12	1
16	1
18	1

Bone Unit	Number of Records
21	1
22	1
24*	2
26*	12
27*	3
Total	44

Rib

Bone Unit	Number of Records
1	4
2	119
3	7
4	117
5	38
6	38
7	5
8	45
9	29
10	52

Bone Unit	Number of Records
11	10
13	3
14	3
15	985
16	400
17	27
18	14
19	49
20	9
21*	35

Bone Unit	Number of Records
22*	28
23*	4
25*	7
26*	2
Total	2030

Sacrum

Bone Unit	Number of Records
2	1
5	1
9	2
13	1
14	2
18	2
22*	2
Total	11

Caudal Vertebrae

Bone Unit	Number of Records
1	76
2	8
4	8
7	1
9	1
10	2
11	1
13*	1
14*	3
15*	2

Bone Unit	Number of Records
16*	2
17*	3
18*	1
Total	109

Pelvis

Bone Unit	Number of Records
2	2
4	3
5	2
7	5
8	1
9	1
10	4
13	2
14	1
18	2

Bone Unit	Number of Records
19	5
27	1
28	2
31	1
32	1
41	2
42	2
Total	37

Scapula

Bone Unit	Number of Records
2	3
4	1
5	3
6	14
7	2
8	3
9	2
11	23
14	14
15	3

Bone Unit	Number of Records
16	5
17	5
18	105
19	1
20	1
22	2
23	4
25	2
27	1
31*	1

Bone Unit	Number of Records
32	11
34	2
35*	2
36*	1
37*	2
38*	1
Total	214

Humerus

Bone Unit	Number of Records
2	4
3	1
4	1
5	1
6	6
7	1
8	1
9	2
10	1
11	1

Bone Unit	Number of Records
13	8
15	1
16	3
17	2
20	1
25	2
28	2
35	3
37	1
39*	11

Bone Unit	Number of Records
40*	3
Total	56

Radius

Bone Unit	Number of Records
1	1
2	7
3	12
4	11
8	1
9	4
10	5
11	4
14	1
15	1

Bone Unit	Number of Records
16	1
17	6
18	5
19	1
21	4
22	1
27	1
28	2
30	1
35*	4

Bone Unit	Number of Records
36*	3
Total	76

Ulna

Bone Unit	Number of Records
1	5
2	3
3	21
4	1
5	1
8	3
9	4
10	4
12	1
14	2

Bone Unit	Number of Records
15	3
18	2
20	1
21*	1
22*	2
Total	54

Scaphoid

Bone Unit	Number of Records
1	46
2	5
Total	51

Cuneiform

Bone Unit	Number of Records
1	36
2	2
Total	38

Lunate

Bone Unit	Number of Records
1	45
2	1
Total	46

Unciform

Bone Unit	Number of Records
1	39
2	4
Total	43

Magnum

Bone Unit	Number of Records
1	52
Total	52

Pisiform

Bone Unit	Number of Records
1	22
2	1
Total	23

Fifth Metacarpal

Bone Unit	Number of Records
1	17
2	4
Total	21

Metacarpal

Bone Unit	Number of Records
1	28
2	3
3	3
4	4
5	1
6	1
9	1
14*	3
15*	1
16*	1
Total	46

Femur

Bone Unit	Number of Records
2	3
3	4
4	7
7	2
10	1
18	4
20	5
22	2
24	1
26	1

Bone Unit	Number of Records
27	1
35*	1
36*	1
37*	1
38*	1
Total	35

Patella

Bone Unit	Number of Records
1	10
2	1
Total	11

Tibia

Bone Unit	Number of Records
3	1
4	11
5	5
6	7
10	3
14	1
15	2
16	2
17	1
18	1

Bone Unit	Number of Records
19	4
20	5
32*	21
34*	3
35*	2
Total	69

Calcaneum

Bone Unit	Number of Records
1	41
2	1
3	2
5	2
8	11
9	2
12	1
13	1
17*	4
18*	8

Bone Unit	Number of Records
19*	1
Total	74

Astragalus

Bone Unit	Number of Records
1	57
3	3
4	1
6	1
7	1
14	1
18*	1
Total	65

Navicular Cuboid

Bone Unit	Number of Records
1	64
Total	64

Metatarsal

Bone Unit	Number of Records
1	18
2	5
3	6
4	4
5	2
7	3
8	4
9	3
10	4
12	3

Bone Unit	Number of Records
15	3
16*	4
17*	2
18*	5
19*	8
20*	2
21*	4
Total	80

Metapodial

Bone Unit	Number of Records
6	1
7	2
8	3
10*	2
12*	1
13*	2
14*	3
Total	14

First Phalanx

Bone Unit	Number of Records
1	188
3	2
4	2
5	2
6	6
7	1
8	1
12	1
13	1
14	1

Bone Unit	Number of Records
16	14
17	2
19	2
22	1
23*	4
24	1
25	7
26	2
28	3
30*	1

Bone Unit	Number of Records
33*	1
Total	243

Second Phalanx

Bone Unit	Number of Records
1	195
2	2
4	2
5	1
6	2
7	1
8	6
9	3
12	1
13*	3

Bone Unit	Number of Records
14*	1
15*	1
Total	218

Third Phalanx

Bone Unit	Number of Records
1	159
2	6
3	7
7	1
8	3
9	1
10	1

Bone Unit	Number of Records
11	2
13	2
15	1
16*	5
17*	3
18*	1
Total	192

Sesamoid (proximal and distal)

Bone Unit	Number of Records
1	319
2	14
Total	333

Lateral Malleolus

Bone Unit	Number of Records
1	22
2	1
Total	23

Cuneiform Pes

Bone Unit	Number of Records
1	46
2	2
Total	48

First Tarsal

Bone Unit	Number of Records
1	24
2	1
Total	25

Second Metatarsal

Bone Unit	Number of Records
1	18
Total	18

Manus V

Bone Unit	Number of Records
1	5
Total	5

Pez II

Bone Unit	Number of Records
1	4
Total	4

APPENDIX III – REFERENCED BONE UNITS

Appendix III includes Brumley's Bone Units (1991) and the Fincastle 2007 additions to the Bone Unit system used in this analysis. The Fincastle additions are marked with an asterisk (*). In some cases a double asterisk (**) is assigned, which indicates that a slight change was made to Brumley's originally assigned BU. All applicable Bone Units are listed under their appropriate bone elements.

SKULL BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 3	Same as BU 2 except that the premaxilla is absent. BU 3 often consists of only a complete row of sockets cheek teeth with the other margins of the maxilla absent.
BU 7	Fragmentary section of maxilla consisting of a section, but not all of the socketed cheek teeth. Frequency indicates minimum number of elements represented.
BU 11	Complete or portion of internal and external auditory meati. Frequency indicates minimum number of meati represented.
BU 13	Consists of essentially complete zygomatic process of temporal and immediately adjacent portion of temporal condyle.
BU 14	All or major portion of malar bone. Zygomatic and temporal processes of malar. Usually both are absent or, occasionally, one present. Similar to BU 40.
BU 15	All or most of paramastoid process. May be articulated to small portion of occipital.
BU 16	Medium to small sized cranial fragment identifiable by presence of parietal temporal suture.
BU 17	Consists of complete or fragmentary portion of one of the occipital condyles, either left or right.
BU 29	All or major portion of temporal. Includes temporal crest and squamous portion of the temporal. May or may not include temporal condyle, zygomatic process of temporal and external auditory meatus.
BU 30	Fragment of nasal. Frequency indicates minimum number of elements represented. For Oldman project, frequency indicates number of pieces only.
BU 35*	Skull fragment identified by bone shape and density; characteristic of internal skull.
BU 40	Fragment of Malar portion of orbit. Similar to BU 14. (KK)
BU 42	Unit consists of occipital, including condyles, basilar portion, supra-occipital, paramastoid processes, internal and external auditory meatus, parietal, sections of the palatine, and socketed sections of teeth from both maxilla. Similar to BU 8 and BU 28.
BU 45*	Small portion of maxilla consisting of (not entire) a few teeth and some of the palatine bone.
BU 46*	Fragment of the auditory meatus separated from the temporal lobe.
BU 47*	Small to medium piece of horn.

BU 48* Similar to BU 17 and BU 28. Both occipital condyles present with basilar part of occipital completely missing.

BU 49* Section of sutures but undetermined as to which.

MANDIBLE BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element
BU 2	Proximal ½ or less of ascending ramus including complete coronoid process and articular condyle. Similar to BU 27.
BU 3	Proximal ½ or less of ascending ramus including articular condyle. Coronoid process absent. Similar to BU 27.
BU 4	Complete proximal portion of mandible. Includes coronoid process, articular condyle, and entire ascending ramus; usually severed from rest of mandible immediately behind cheek teeth. Rarely, will include M3. Similar to BU 11.
BU 5	Complete section of cheek teeth severed from rest of mandible. Ventral margin intact. May include anterior edge of angle of mandible. Includes none of ascending ramus. Similar to BU 8 and BU 42.
BU 6	Consists of all or most of symphyseal surface, all or most of alveoli for incisors and usually much or all of the interalveolar border. Similar to BU 20.
BU 7	Consists of essentially complete coronoid process. Similar to BU 29 and BU 31.
BU 8	Consists of entire portion of the mandible anterior to ascending ramus. Includes all of cheek teeth, interalveolar border, symphyseal surface and incisor alveoli. Similar to BU 42.
BU 9	Small to medium sized fragment of angle of mandible. Entire angle of mandible not represented. Similar to BU 28.
BU 10	Element complete except for coronoid process.
BU 12	Cheek teeth and most of dorsal edge of ascending ramus. Posterior margin of ascending ramus and ventral margin of horizontal ramus removed. Proximal portion of interalveolar edge may be present.
BU 14	Socketed section of cheek teeth with small portions of interalveolar ridge sometimes present. Ventral margin absent and either extreme proximal and/or distal tooth may occasionally be absent.
BU 15	Section of ventral margin of horizontal ramus. Frequency indicates minimum number of elements represented. For Oldman project, frequency indicates number of pieces only. Similar to BU 45.
BU 16	Unit consists of articular condyle and posterior half of ascending ramus. All or most of dorsal and superior margin of ascending ramus absent. The portion of the angle of the mandible present evidence clear signs of crushing. Similar to BU 36.

- BU 17 Unit consists of all of or most of posterior edge of articular condyle and portion of angle of mandible. No evidence of crushing. Similar to BU 11 and BU 16.
- BU18 Unit consists of fragmented portion of row of cheek teeth. Unit may consist of only fragment characterized by presence of empty tooth sockets; or complete or fragmentary teeth may still be present. Unit should represent no more than 3 teeth of entire tooth row. Inferior margin always absent. Note: frequency indicates number of pieces only.
- BU 20 Consists of all or most of symphyseal surface; all or most of alveoli for incisors; all of interalveolar border, and all or part of premolar section of tooth row. Ventral margin essentially intact. Similar to BU 6, BU 20 and BU 21. Teeth may or may not be in, socketed or intact.
- BU 21 Small fragment of mandible characterized by presence of portion of interalveolar border. Frequency indicates minimum number of elements
- BU 22 Element complete except for coronoid process, articular condyle and proximal portion of ascending ramus.
- BU 23 Unit consists of element with symphyseal surface and incisor alveoli removed.
- BU 24 Unit consists of small to medium sized fragment of mandible characterized by presence of dorsal margin of ascending ramus.
- BU 25 Element complete except for 1-3cm of the proximal end of the coronoid process, which has apparently been removed by crushing.
- BU 26 Element with coronoid process and anterior section in front of P-2 containing the interalveolar border, canine tooth, and the incisor teeth removed.
- BU 27 Proximal ½ or less of ascending ramus including complete articular condyle and portion but not all of coronoid process. Similar to BU 2 and BU 3.
- BU 28 All of angle of mandible with only a limited portion of margin of ascending and horizontal ramus. Similar to BU 9.
- BU 29 Medial fragment from coronoid process. Tip missing. (JB)
- BU 30 Complete articular condyle with 0-10cm of adjoining ascending ramus. Coronoid process absent. Similar to BU 32. (EMA)
- BU 32 Fragment of articular condyle with 0-10cm of adjoining ascending ramus present. Coronoid process absent.
- BU 33 Fragment of anterior portion of mandible identified by presence of all or part of mental foramen. Only the lateral aspect of the piece is present. The medial surface is absent. None of the interalveolar border, or ventral margin is represented. (DS)
- BU34 Undifferentiated mandible fragments. Generally fragments from ascending or horizontal ramus containing no landmark features. (DS)
- BU 37 Fragment characterized by presence of all or part of mandibular foramen. Coronoid process, articular condyle, dorsal and ventral margins of ascending ramus of mandible are totally absent. (DS)

BU 39	Portion of interalveolar border with adjoining portion of premolar section of tooth row. Does not include symphyseal surface or alveoli for incisors. (TH)
BU 40	Complete coronoid process plus up to ½ of adjoining surface of ascending ramus. Articular condyle absent. (KK)
BU 41	All or portion of interalveolar border. May include one or two premolars, Ventral border absent. (KK)
BU 42	All of mandible anterior to ascending ramus except incisor alveoli. Similar to BU 5 and BU 8. (KK)
BU 43	Incomplete section of cheek teeth including intact ventral margin. May include limited portions of ascending ramus.
BU 44	Element complete except for proximal portion of ascending ramus and incisor alveoli. Symphyseal surface and interalveolar border may also be absent. Similar to BU 5, BU 22 And BU 42. (KK)
BU 48	Similar to BU 26, with the exception that the section of the mandible anterior to the M1 is missing. Unit otherwise consists of the condylar process, ascending ramus, angle, and mandibular body posterior to the M1. (TVH)
BU 49	Unit consists of a portion of the row of cheek teeth, with attached parts of the coronoid and condylar processes. Similar to BU 23, but without the ventral border of the body. (WU)
BU50	Unit consists of the small “U” –shaped fragment for the juncture of the condylar and coronoid processes, with attached small portions of the ascending ramus. Anterior posterior borders of the ramus are removed. Similar to BU 27. (TVH)
BU 51*	Portion of symphyseal surface only.
BU 52*	Similar to BU 34 only specified as split sagittally into medial and lateral.
BU 53*	Too fragmentary to give specific portion of all aspects.
BU 54*	Consists of the cheek teeth section, ascending ramus and coronoid process, missing the articular condyle. Similar to BU 48.
BU 55*	Consists of the coronoid process, portions of ascending ramus, cheek section with teeth, missing articular condyle and distal end of mandible.

HYOID BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 2	Complete or essentially complete shaft of great cornu. Dorsal extremity and muscular angle completely missing.
BU 3	Fragment of dorsal extremity consisting primarily of dorsal cartilaginous surface and immediately adjacent portion.
BU 4	Medial portion of dorsal extremity formed by removal of shaft, muscular angle of dorsal extremity and dorsal cartilaginous surface. Similar to BU 11.

BU 5	Consists of posterior ½-2/3 of shaft and all of muscular angle. Dorsal cartilaginous surface has been removed. Similar to BU 9.
BU 7	Element complete except for removal of 1/3 or less of anterior end of shaft.
BU 8	Small fragment of shaft. Note: frequency indicates number of pieces only.
BU 9	Unit consist of 0 – ½ of shaft and all muscular angle. Dorsal cartilaginous surface has been removed. Similar to BU 5.
BU 10	Element complete except for removal of greater than 1/3 – 2/3 of anterior end of shaft.
BU 11	Same as BU 4, but with from posterior ¼ to all of shaft present.
BU 12	Unit consists of dorsal extremity and 0 – ½ of shaft. Muscular angle removed. Similar to BU 6. (KK)
BU 14*	Similar BU 4. Medial portion of dorsal extremity. Shaft removed, muscular angle of dorsal extremity removed. 90% of dorsal cartilaginous surface present ('cap' missing only).

ATLAS BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 2	Small to medium sized fragment containing a portion of one posterior articular surface.
BU 3	All or major portion. (greater than ¾ or either the left or right anterior articular surface) (JB).
BU 5	Element complete except for limited to extensive crushing of margins of one or both wings. Articular surfaces not damaged. (DS)
BU 12	Unit consists of dorsal tubercle and dorsal portions of anterior articular surfaces (anterior dorsal portion). Ventral anterior portions are absent, as well as all posterior portions. (WU)
BU 14*	Posterior sub-articular surface.

AXIS BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 3	Consists of complete body; dens and anterior articular process have been removed. A portion of the body may show some crushing.
BU 4	Element complete except for dorsal portion of spinous process which has been removed, probably by crushing.
BU 5	Element complete except that all or several of the following areas – the dorsal crest of the spinous process, the ventral edges of the anterior articular process, and the ventral spin-reflect evidence of light to moderate crushing.
BU 7	Complete or fragmented of dens detached from rest of element. (DS)

BU 10	Portion of transverse process identifiable by distinctive shape. (DS)
BU 13	Piece of anterior articular process.
BU 17*	Fragmented section of the body including some portion of the dens and posterior articular surface.
BU 18*	Posterior body complete, missing the dens and the spinous process. Vertebral arch may or may not be present.

CERVICAL VERTEBRAE BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 3	Small fragment consisting of either anterior or posterior articular processes. Frequently indicates number of pieces only.
BU 4	Consists primarily of dorsal 1/3 – 2/3 of vertebral body and vertebral arch. Ventral portion of body removed and transverse processes lightly damaged or completely removed. Crest of spinous process usually lightly crushed.
BU 8	Consists of both anterior articular processes and dorsal anterior 1/3 of body. Remainder of element absent.
BU 11	Element complete except for small to moderate amount of crushing on crest of spinous process only.
BU 12	One of lateral branches of transverse processes detached from the element. Frequently indicates number of pieces only.
BU13	Element complete except for complete removal of one or both lateral transverse Processes, probably by crushing. Spinous process may also be lightly battered at crest.
BU 14	Approximately 1/2 of vertebral arch including all or a portion of one anterior and one posterior articular process. None or spinous process, foramen, transversarium, or centrum represented. (JB)
BU16	Element complete except for moderate to extensive damage to the spinous process and to one or more of the lateral or ventral branches of the transverse process. (DS)
BU 18	Fragment consisting of from 0-1/4 of body; all or portion of one lateral transverse process and all or portion of one foramen transversarium. (DS)
BU 19	Quarter or less of vertebral body identifiable by presence of either anterior or posterior articular surface. Not an unfused epiphysis.
BU 22	Unit consists of the lateral 1/2 or less of vertebrae body with one foramen transversarium, and 1/2 or less of arch minus spinous process. The anterior and/or posterior articular surfaces and the lateral and ventral branches of transverse process on one side may be represented. A portion of the centrum may or may not be present. (DS)
BU 23*	Portion of spinous process.

BU 27	Dorsal anterior 1/3 – 1/2 of body plus arch and one or both anterior articular processes. Spine is usually removed and posterior articular processes may be removed.
BU 33*	Broken sagittally; missing posterior body.
BU 34*	Entire body present. May have small portions of processes attached.
BU 35*	Anterior 1/3 of the body. Anterior or posterior articular processes may be present.
BU 36*	All or most of spinous process present, top of vertebral arch with one or both articular processes.
BU 37*	Similar to BU 29, but contains the anterior articular surfaces as well.
BU 38*	Fragment of the ventral portion of the body.

THORACIC VERTEBRAE BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 2	Basal portion of spinous process with one or both posterior articular processes. Frequency indicates minimum number of elements represented. Anterior articular processes and distal end of spinous process absent.
BU 3	Unit consists of all or most of the spinous process severed near the base. Both articular processes are absent. The distal end of the spinous process is represented. The facets for the rib tubercles are absent.
BU 4	Element with all or most of the spinous process removed. The posterior articular processes are always intact. Similar to BU 5 and BU 15.
BU 5	Element with distal 1/2 or less of the spinous process removed. The rest of the element is intact.
BU 7	Large (greater than 10cm) medial fragment of the spinous process with both proximal and distal portions removed. One or both of the anterior or posterior boarder are represented. Frequency indicates number of pieces only. Similar to BU 18.
BU 8	Essentially complete spinous process severed from rest of element. Either anterior and/or posterior articular processes present. Similar to BU 3. Facets for tubercles of rib missing.
BU 9	Essentially complete body with rest of element removed. The facets for the tubercles of the ribs are absent.
BU 10	Element with all or most of spinous process. And ventral 1/3 – 2/3 of body removed. Arch, articular processes, and facets for ribs intact.
BU 11	Unit has little or no spinous process. At least one of the anterior or posterior articular surfaces is present, and the unit can have both or either side of the arch. The facets for the rib tubercles, and the body if the vertebrae are missing. Similar to BU 12.
BU 12	Unit consists of basal portion of spinous process including one or both posterior articular surfaces; and all or most or either or both sides of the arch. One or both facets for the tubercle of the ribs are present. The same as BU 11 but with one or both of the rib facets present.

- BU 13 Small fragments characterized by all portion of facet of rib tubercles. Frequency indicates number of pieces only.
- BU 14 Unit consists of fragment of spinous process characterized by presence of intact distal end. Size and shape of pieces suggest they represent 2/3 or less of spinous process.
- BU 15 Element with all or most of spinous process and one or both of tubercles of ribs removed. Anterior and posterior articular surfaces may or may not be intact. Similar to BU 4.
- BU 16 Unit consists of base of arch minus the spinous process, rib facets, and both the anterior and posterior articular processes. (TH)
- BU 17 Both anterior articular processes connected to one another by nothing but the immediate portion of the arch. (TH)
- BU 18 Small (less than 10cm) medial fragment of the spinous process with both proximal and distal portions missing. One or both anterior and posterior edges represented. No series of ridges for muscle attachment present. Similar to BU 7 and BU 25. (TH)
- BU 19 Lateral 1/2 of vertebral body slit lengthwise. Portions of both epiphyses, all or portion Of transverse processes, base of arch and articular surface missing. (EMA)
- BU 21 Essentially complete element missing one or both transverse processes (EMA).
- BU 22 One either anterior or posterior articular process detached from rest of element. (DS)
- BU 23 Half to all body with all to part of one transverse process present. Vertebral arch, spinous process, and one transverse process absent. (DS)
- BU 24 Vertebral arch with 0-5cm of adjoining shaft of spinous process; all anterior and posterior articulating processes; all or base of one transverse process, lateral 1/4-1/2 of body with costal facet for head of one rib. (DS)
- BU 25 Small to medium sized fragment of spinous process characterized by distinct series of ridges for muscle attachment on posterior surface. No articular facets or surfaces present. (DS)
- BU 26 Unit consists of anterior 1/2-2/3 of element. Posterior 1/2-2/3 of body, posterior articular processes, and all or most of spinous processes absent. (TH)
- BU 28 Posterior articular facets and posterior portion of spinous process near base. Anterior portion of the centrum, arch and spinous process missing. (WU)
- BU 29 Anterior 1/2-2/3 of element and 1/2 or more of adjoining spinous process. Posterior 1/2-2/3 of body, posterior articular processes and some of spinous process absent. (WU)
- BU 30 Unit consists of all or most of the spinous process, one or both anterior articular surfaces and one or both posterior articular surfaces and one or both sides of the neural arch. One or both sides of the facets for the tubercle of the rib are present. The unit is the same as BU 12, but possess all or most of the spinous process. (TVH)
- BU 31 Unit consists of 1/2 of the spinous process (split sagittally) and one transverse process only, attached by a small portion of the neural arch. This unit is essentially one half of BU 12. (WU)

BU 32	Unit consists of a portion of the anterior section of the centrum, with an adjoining anterior section of the spinous process. One or both anterior articulating facets may also be present. This unit is the anterior opposite of BU 28. (WU)
BU 33*	Identifiable based on curve and/or shape.
BU 34*	Portion of one epiphysis, 1/4 of body only. Similar to BU 19.
BU 35*	Less than 1/3 of the body only.
BU 36*	Similar to BU 11 with a bigger portion of the spinous process present.
BU 37*	Posterior 1/2-2/3 of element and 1/2 or more of adjoining spinous process. Anterior 1/2 – 2/3 of body, anterior articular processes and some of the spinous process absent.
BU 38*	Epiphysis of the spinous process.
BU 39*	Basal portion of spinous process with one or both posterior articular processes, plus one or both transverse processes and arch. Similar to BU 2.
BU 40*	Small to medium sized fragment of spinous process characterized by distinct series of ridges for muscle attachment on anterior surface. May have anterior articular surfaces present.

LUMBAR VERTEBRAE BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 2	All or most of spinous process. Posterior articular processes absent.
BU 3	Small fragment consisting of an anterior articular process. Frequency indicates number of pieces only.
BU 4	Small fragment consisting of a posterior articular process. Frequency indicates number of pieces only.
BU 5	Complete body detached from rest of element.
BU 6	All or major portion of transverse process removed from rest of element. Frequency indicates number of pieces only.
BU 8	Element complete except both transverse process completely or partially removed.
BU 9	Element complete except both transverse processes and spinous process completely or partially removed.
BU 12	Posterior 1/2 of spinous process with posterior articular process. (TH)
BU 16	Unit consists of complete spinous process and one or both anterior articular processes. (EMA)
BU 18	Element with all of centrum and one or both transverse processes removed.
BU 21	Unit consists of complete body, both anterior and posterior processes. None or both posterior processes may be present. Spinous and transverse processes absent. (MB)

BU 22	Unit includes one transverse process with attached posterior and anterior articular surfaces. (one or both) No centrum is present. (WU)
BU 24*	Portion of spinous process. Articular processes absent.
BU 26*	Small portion of the transverse process.
BU 27*	Full body may or may not have anterior or posterior processes. Some transverse process present.

SACRUM BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 2	Complete body of 1 st sacral vertebra body. Medial portion of ala represented.
BU 5	Fragment of 1 st sacral vertebra including one of articular processes. Frequency indicates number of pieces only.
BU 9	Fragment(s) characterized primarily by portion of median crest of sacrum. Frequency indicates minimum number of elements represented. For Oldman Dam, frequency indicates number of pieces.
BU 13	Anterior portion of 1 st sacral vertebra body. Ala not represented. Posterior portion of body absent. (DS)
BU 14	Fragment of lateral sacral crest. (DS)
BU 18	Body of 1 st sacral vertebra with all or most of both wings present. Arch intact and may or may not show evidence of crushing along crest. (MB)
BU 22*	Un-fused second to fifth vertebra.

CAUDAL VERTEBRAE BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element- caudal vertebrae with or without arches and transverse processes.
BU 2	Unit consists of one of first four or five caudal vertebra from which one or both transverse processes have been removed.
BU 4	Element with the processes missing or damaged so that unit consists of essentially intact vertebral body.
BU 7	Unit consists of ventral ½ or less of vertebral body, with arch and processes totally removed or damaged.
BU 9	Either the proximal or distal ½ of centrum of caudal vertebrae. (KK)
BU 10	Unit is similar to BU 9 (either proximal or distal half of centrum) but also includes the attached proximal or distal portion of the spinous process. (WU)
BU 11	Centrum of unit is complete, but spinous process and neural arch are missing. Both transverse processes are complete, although they may be damaged by crushing. (WU)

BU 13*	Missing articulations on anterior body (caudal 1-6).
BU 14*	Small fragment; anterior or posterior articular surface present only.
BU 15*	Portion of transverse process only from the first four or five caudal vertebra.
BU 16*	Vertebral arch and spinous process intact. Missing body and transverse processes.
BU 17*	Complete body; one or both centrums missing (juvenile).
BU 18*	Similar to BU 2, but one or both transverse removed. Missing either the anterior or posterior body.

RIB BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element. Distal articular surface or up to 5cm of distal end may be absent. Similar to BU 5 and BU 20.
BU 2	Unit consists of proximal end of rib including head, neck, tubercle and 0-5cm of shaft. Similar to BU 5 and BU 8.
BU 3	Unit consists of proximal end including head, neck, and 0-5cm of shaft. Tubercle removed. Similar to BU 2 and BU 9.
BU 4	Long to short section of shaft severed immediately below proximal end as shown by pronounced deepening of costal groove or sharp curvature present on fragmentation. Similar to BU 10 but with less of shaft present.
BU 5	Complete proximal end of element with ¼-½ of shaft represented. Similar to BU 2, BU 8 and BU 20.
BU 6	Proximal portion of element consisting of tubercle and 0-5cm of shaft. Head absent. Similar to BU 2.
BU 7	Small to medium sized section of shaft characterized by an easily discernible constriction along the posterior border near the distal end. May or may not include distal articular surface.
BU 8	Complete proximal end of rib with 5-10cm of shaft included. Similar to BU 2 and BU 5.
BU 9	Head of rib detached from rest of element. None of tubercle or shaft included. Similar to BU 3.
BU 10	Essentially complete shaft or rib with only extreme proximal end including head and tubercle removed and possibly the extreme distal articular surface.
BU 11	Small to medium sized section of shaft characterized by presence of distal articular surface. Note: dose not include constriction along the posterior border as BU 7 does.
BU 13	Rib complete except head removed. Tubercle and distal articular surface present. Distal articular surface, or up to 5cm of distal end may be absent.

BU 14	Essentially complete proximal end of rib with 5-10cm of shaft included. Small area immediately distal to tubercle crushed or removed. Similar to BU 2, BU 5 and BU 8.
BU 15	0-10cm long medial section of rib. Frequency indicates number of pieces only.
BU 16	Greater than 10cm long medial section of rib. Piece may split open, exposing internal cancellous tissue. Frequency indicates number of pieces only.
BU 17	Proximal end with tubercle present but missing head. Retains more than 5 and less than 20cm of adjoining shaft. Similar to BU 6. (TH)
BU 18	Medium to short section of rib with proximal end characterized by removal or crushing of top of head and articular surface of tubercle. Removal by either crushing or carnivore gnawing. Similar to BU 4. (KK)
BU 19	Un-fused epiphyseal head. Condition coded as weathered. (GL)
BU 20	Complete proximal end with from ½ to ¾ of total shaft length represented. Similar to BU 1 and BU 5.
BU 21*	Portion of neck only; head, shaft and tubercle removed, with 0-20cm of shaft present.
BU 22*	Small portion of tubercle only. Similar to BU 6.
BU 23*	Small portion of head only. Similar to BU 9.
BU 25*	Head and tubercle only. Neck and shaft missing.
BU 26*	Distal epiphysis.

SCAPULA BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 2	Complete glenoid cavity and tube. Scapulae severed from rest of element.
BU 4	Posterior half of glenoid cavity (posterior half of BU 2). Similar to BU 13.
BU 5**	Major portion or the entire spine of scapula. Entire posterior border always absent, but anterior border usually intact near distal end. Acromion always absent. Remainder of crest of acromion usually all present.
BU 6**	Moderate sized portion of flat blade of scapula identifiable by the presence of a portion of the lateral border. Similar to BU 14.
BU 7**	Consists of distal 1/2 – 2/3 of entire element. All of proximal margin and proximal portions of anterior and posterior margins removed. Spine usually intact except for proximal portion and acromion which is always absent. Glenoid always present and intact. Same as BU 30 except tuber scapulae present.
BU 8	Medium to large fragment of flat blade of scapula with fractured base of spine forming anterior edge. Posterior border may be, but not usually present.
BU 9**	Distal portion of crest of spine including the acromion.

- BU 11 Short portion of spine of scapula usually characterized by “T” shape cross section (rest of spine and anterior margin may or may not be intact). Posterior margin usually absent.
- BU 14** Fragment of lateral border characterized by distinctively shaped cross-section. None of glenoid fossa present. Frequency indicates number of pieces only. Similar to BU 6 except very little to none of flat blade portion of the scapula attached.
- BU 15 Element complete except for a small to moderate sized portions of flat, thin blade removed. Spine of scapula intact. Posterior and anterior margins completely or largely intact.
- BU 16 Middle portion of scapula of proximal 1/2 – 3/4 of base of spine and all or most of adjacent anterior and posterior borders intact. Entire glenoid cavity, tuber scapulae, acromion, distal border absent. All or most of crest of spine absent.
- BU 17** Consists of distal 1/3 of element. All spine and most of blade removed. Glenoid cavity, tuber scapulae and coronoid process intact. Acromion absent.
- BU 18 Fragment of flat blade of scapula with no margins present. Identifiable by distinctive thin cross-section and flat surface. Frequency indicates number of pieces only. Defined Nov. 24/86.
- BU 19 Small fragment of spine of scapula characterized by sinuous cross section. None of the acromion and none of base of spine with “T” shaped cross section represented. (JB)
- BU 20 Scapula missing all of spine including acromion. Rest of element present. (EMA)
- BU 22** Ventral portion of flat blade near distal end identifiable by groove between tuber and Scapulae and glenoid cavity. Portion of anterior and posterior margins may be present. None of glenoid fossa present. Note: bold lines in drawing indicate the area of BU which is on the reverse (ventral) face of the element. The one presented in the drawing is the dorsal view. (KK)
- BU 23** Intact distal end of scapula including acromion plus all or most of base of spine. Similar to BU 7. Anterior and posterior border missing. Crest of spine may or may not be absent. (KK)
- BU 25 Medium to large fragment consisting of anterior 1/2 – 1/3 of glenoid cavity and an adjoining section of the flat blade including anterior margin. Acromion and all or most of the spine missing. Similar to BU 21. (KK)
- BU 27 Fragment of glenoid cavity without tuber scapulae. No more than 1/3 represented from various areas of glenoid cavity except at tuber scapulae. From 0-10 cm of area adjacent (distal) to glenoid cavity represented.
- BU 31* Fragment of medial border, not including any spine.
- BU 32 Fragment(s) of anterior border – may or may not include parts of spine or base of spine. (GL)
- BU 34** Consists of complete distal end, neck and most or all of base of spine. Acromion always absent. Remaining crest of spine may or may not be present. All of proximal, anterior and posterior margins of blade removed. Similar to BU 7, 30. (MB)
- BU 35* Complete proximal end present with only a small portion of blade present. Similar to BU 15.

- BU 36* Fragment with the entire glenoid cavity and some of spine.
- BU 37* Small fragment in the neck section.
- BU 38* Acromion of spine only.

HUMERUS BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 2	Complete distal end of humerus and 0 – ¼ of adjoining shaft length.
BU 3	Medial half of distal end of humerus. Consists of all or most of medial epicondyle and 0 – ¼ of adjoining shaft length.
BU 4	Lateral half of distal end of humerus. Consists of all or most of lateral epicondyle and 0 – ¼ of adjoining shaft length.
BU 5	Portion of head of humerus and often immediately adjoining portion of neck. Similar to BU 15.
BU 6, (32)	Small to large fragment of shaft, identifiable by presence of the deltoid tuberosity. BU 32 was also assigned to this element configuration. Either BU number can be used in coding. (JB)
BU 7	Small to large fragment of shaft from along the lateral edge immediately above the lateral condyles. Unit identifiable because it includes part of the coronoid fossa and/or the olecranon fossa. Similar to BU 8 and BU 11.
BU 8	Small to large fragment of shaft from along the medial edge immediately above the medial condyles. Unit identifiable because it includes part of the coronoid fossa and/or the olecranon fossa. Similar to BU 7 and BU 11.
BU 9	Complete distal end of humerus with from 0 – ¼ of shaft represented. A small to large fragment of shaft from along the lateral edge immediately above the lateral condyles
BU 10	Complete distal end of humerus with from 0 – ¼ of shaft represented. A small to large fragment of shaft from along the medial edge immediately above the medial condyles (BU 8) is missing. Similar to BU 2 and BU 9.
BU 11	Either BU 7 or BU 8. Indeterminate as to which.
BU 13	Small to large section of shaft characterized by presence of teres tubercle.
BU 15, (22)	Complete humeral head, un-fused and detached from rest of element. Margins of unit often gnawed or battered. Differentiated from BU 5 by absence of any adjoining articular surfaces of humerus and fact that it has not been detached by butchering. Observation not made on Cactus Flower material analyzed in 1974. BU 22 was also assigned to this element configuration. Either BU number can be used in coding. (JB)
BU 16	Complete distal end of humerus with ¼-½ of adjoining shaft length represented. Similar to BU 19.

BU 17	Shattered pieces of distal end of humerus identifiable by distinctive surfaces of either the lateral or medial epicondyle. Pieces usually too incomplete to identify as being either the medial or lateral epicondyle; or left or right; and as to minimum number of elements represented. Frequency indicates number of pieces only.
BU 20	Posterior section of shaft immediately above olecranon fossa, up to 1/3 of shaft length represented, containing nutrient foramen and exhibiting beginning of olecranon fossa. Similar to BU 25 which lacks nutrient foramen.
BU 25	Posterior section of shaft above olecranon fossa. Up to 1/3 of shaft length represented and exhibits beginning of olecranon fossa. Nutrient foramen not represented. Similar to BU 20. (TH)
BU 28	Portion of medial tuberosity and intertuberal groove. (TH)
BU 35	Fragments of humeral head. Similar to BU 28. (WU)
BU 37	Unit consists of only the medial half of the element. Missing portions include the proximal lateral tuberosity and the distal lateral condyle and all lateral portions of the shaft. (WU)
BU 39*	Shaft fragments identifiable by shape and curvature.
BU 40*	Epiphysis fragment of humeral head.

RADIUS BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 2	Complete distal end of radius with 0 – ¼ of adjoining shaft length. Also commonly includes distal end of ulna fused to unit
BU 3	Complete proximal end of radius with 0 – ¼ of shaft length represented.
BU 4	Small to large fragment of shaft characterized by small segment of ulna fused to it or, simply portion of rough scarred surface adjoining unfused section of ulna. Frequency indicates number of pieces only. Nutrient foramen may or may not be present.
BU 8	Large to small portion of shaft including small portion of lateral articular facet at proximal end. Similar to BU 13.
BU 9	Large portion of proximal end consisting of all or most of large medial articular surface. Between ¼-½ of adjoining shaft represented.
BU 10	Complete proximal end of radius with ¼-½ of adjoining shaft represented.
BU 11	Complete distal end of radius and between ¼-½ of adjoining shaft represented.
BU 14	Unit consists of complete proximal end and ¾ or more of adjoining shaft. Distal end completely absent.
BU 15	Small fragment of proximal end characterized by presence of coronoid process and small to moderate portions of the adjoining medial and lateral condyles. Similar to BU 15.

BU 16	Anterior portion of distal end with articular surface and 0 – 1/3 of adjoining shaft represented. (TH)
BU 17	Un-fused, distal end of radius detached and not associated with rest of element. Condition coded as ‘weathered’.
BU 18	Medial to distal fragment of shaft from along anterior surface. Identifiable on basis of characteristic shape and form. (TH)
BU 19, (23)	Lateral half of distal and with from 0 – ¼ of adjoining shaft represented. May have distal end of ulna attached. BU 23 was also assigned to this element configuration. Either BU number can be used in coding. (TH)
BU 21	All or most of medial articular surface at proximal end with from 0 – ¼ of adjoining shaft represented. Similar to BU 9 but with less shaft. Similar to BU 7. (TH)
BU 22	Distal medial articular surface, may include portion of shaft. (EMA)
BU 27	Fragments from the proximal end of the radius. Similar to BU 7, BU 8, BU 12, BU 13 and BU 15 but indeterminate as to which. (WU) (TH)
BU 28	Broken lateral half of an un-fused distal epiphysis. Coded as ‘weathered’. Similar to BU 22. (WU)
BU 30	Unit consists of medial half of the element, split sagittally. (WU)
BU 35*	Lateral proximal fragment of the shaft. Opposite of BU 20.
BU 36*	Element is a juvenile only missing the distal epiphysis

ULNA BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element. Distal ½ or less of shaft usually broken off.
BU 2	Consists of all of semi lunar notch and three articular facets located immediately below. All of olecranon and almost all of posterior margin gone. Small portion of posterior margin located behind and below the three articular facets may occasionally be present.
BU 3	Medial to distal portion of shaft of ulna. Frequency simply indicates number of pieces represented.
BU 4	Consists of three articular facets below semi lunar notch. Moderate portion to none of semi lunar notch present. Posterior margin absent.
BU 5	Consists of proximal portion of ulna located above and posterior to semi lunar notch. Usually includes most of anterior margin above semi lunar notch. Line of fracture runs obliquely across long axis of element from upper anterior to lower posterior.
BU 8	Moderate sized portion or all of semi lunar notch. Three articular facets immediately below notch absent. Small portion of anterior margin immediately above notch usually present.

BU 9	All of semi lunar notch. Three articular facets immediately below notch present. Virtually all of shaft absent. All or most of proximal end of ulna present. Extreme posterior margin may or may not be present.
BU 10	Consists of complete distal portion of ulna with entire olecranon removed. Includes approximately half of anterior margin above semi lunar notch. Line of fracture runs obliquely across long axis of element. Similar to BU 18.
BU 12	Un-fused proximal epiphyses or olecranon detached and not associated with rest of element. Condition coded as 'weathered'.
BU 14	Consists of all of semi lunar notch and medial 2 of the 3 articular facets. Lateral articular facet or sustentaculum missing. All of olecranon and much of posterior margin are gone. None to limited portion of shaft present. Similar to BU 2, but lacks lateral articular facet or sustentaculum. (TH)
BU 15	Proximal portion of ulna with cap removed by crushing and gnawing. Distal 1/2-2/3 of shaft missing. (KK)
BU 18	Similar to BU 10. Element consists of 1/2 of distal end and most of the semi lunar notch and entire medial articular facet. Only 1/2 of distal end and entire olecranon are removed, as well as the anconaeus process and the process bearing the lateral articular facet. (WU)
BU 20	Unit consists of the lateral articular facet and 3/4 of the distal shaft. Similar to BU 13. (TVH)
BU 21*	Missing the proximal end, with most of the shaft intact. Similar to BU 15.
BU 22*	Portion of ulna characterized by curvature and shape.

CUNEIFORM BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 2**	Fragment of cuneiform.

LUNATE BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 2**	Fragment of lunate.

SCAPHOID BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 2	Unit consists of the anterior 1/2 of element. (TH)

UNCIFORM BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 2	Anterior ½ to 2/3 of element.

MAGNUM BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.

PISIFORM BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 2**	Portion of pisiform

FIFTH METACARPAL BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 2	Unit consists of any incomplete fragment of the element. (WU)

METACARPAL BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 2	Complete proximal end of metacarpal with approximately 0-1/4 of total shaft length represented.
BU 3	Complete proximal end with between 1/4 – 2/3 of total shaft length represented.
BU 4	One or more pieces from shattered proximal end of metacarpal (shattered BU 2 or BU 3). frequency indicates minimum number of elements represented by pieces. For Oldman project, frequency indicates number of pieces only.
BU 5**	Complete juvenile, but missing the distal epiphysis.
BU 6	Complete distal end of metacarpal with 0-1/4 of adjoining shaft represented. Note: many distal ends from either metacarpals or metatarsals analyzed as separate element under metapodial fragments.
BU 9	One or more small fragmentary segments of shaft identifiable as to element by cross sectional configuration, or presence of vascular groove. Individual fragments do not form complete “tube” cross section of bone. Frequency indicates number of pieces represented.
BU 14*	Laterally split, leaving either the ventral or dorsal face of the bone.

BU 15* Medial or lateral portion of the proximal end.

BU 16* Distal epiphysis only (juvenile).

PELVIS BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 2	Distal portion of shaft of ilium exhibiting flaring edge of greater sciatic notch and small part of scarred articular surface of tuber sacralae.
BU 4	Approximately 1/3 of acetabulum; portion at origin of ilium. Deep fossa on ventral surface of shaft of ilium also present. Very little of shaft of ilium included.
BU 5	Approximately 1/3 of acetabulum portion at base of ishium. Acetabular portion characterized by 'overhang' of bone above deep posterior medial notch. Unit usually includes little of surrounding bone.
BU 7	Approximately 1/3 of acetabulum consisting of small isolated articular facet located at origin of pubis. Includes none to only small portion of pubis.
BU 8, (20)	Moderate to large sized fragment of ilium characterized by the presence of a portion of the scarred articular surface with sacrum (tuber sacralae). BU 20 was also assigned to this element configuration. Either BU number can be used in coding.
BU 9	Complete acetabulum with small to moderate amounts of shaft of ilium and ishium present.
BU 10	Consists of 1/3 of acetabulum at origin of ilium. Deep fossa on ventral surface of shaft of ilium; and small portion of scarred articular surface of ilium (tuber sacralae).
BU 13	Fragment of ishiatic spine characterized by distinctive series of lineal lines on lateral surface.
BU 14	Unit consists of small fragment from portion of edge bordering obturator foramen. Frequency indicates number of pieces only.
BU 18	Unit consists of approximately 1/3 of acetabulum at base of pubis; and essentially complete shaft of pubis. Body of pubis and symphyseal surface of pubis absent. Similar to BU 33.
BU 19	Element consists of approximately 2/3 of acetabulum situated at base of ilium and ishium. Portion of acetabulum at base of pubis absent. Very little or adjoining portion of ilium and ishium represented.
BU 27	Small portion of acetabulum. Not clear what specific portion is represented. Lacks any shaft portions. (TH)
BU 28	Portion of shaft of ishium. Lacks any of acetabulum. Little or no margin of obturator foramen represented. (TH)
BU 31	Complete or essentially complete ilium and ishium, with complete acetabulum. Pubis is absent. Similar to BU 29. (KK)

- BU 32 Element consists of ilium and ishium portion of acetabulum. Up to ½ of body of ishium present, and all of shaft of ilium and all or part of sacral tuberosity. Similar to BU 29. (DS)
- BU 41 Unit consists of the shaft of the ilium only. (WU)
- BU 42 Unit consists of a small fragment of the fused symphyseal region of the pelvis, with both sides of the pelvis bone fused together. (WU)

FEMUR BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 2	All or major portion of femoral head. Small to moderate portion of neck commonly present. Similar to BU 24.
BU 3	All or major portion of trochanter minor with a small to moderate amount of adjoining shaft present. The fragment is not enclosed or 'tube-like'. Similar to BU 7.
BU 4	All or major portion of supracondyloid fossa with small to large amount of adjoining shaft length represented. The fragment is not enclosed or 'tube-like'. Frequency indicates MNE, except for the Oldman Dam project, where frequency indicates the number of pieces only.
BU 7	Medium to large 'tube-like' segment of shaft characterized by presence of trochanter minor. Similar to BU 3.
BU 10	Same as BU 9 but trochanter minor not included.
BU 18	Fragments of femoral shaft, identifiable on basis of cross sectional shape. No portion of supracondyloid fossa or trochanter minor present.
BU 20	Un-fused femoral head detached and not associated with rest of element. Code condition as 'weathered'. Similar to BU 2.
BU 22	Proximal end of element missing greater trochanter with proximal ¼-½ of shaft represented. (TH)
BU 24	Distal end with up to half of distal end of shaft represented. All or major portion of supracondyloid fossa represented. Lateral epicondyle removed. (KK)
BU 26	Medial epicondyle with 0 – ½ of adjoining shaft represented. Similar to BU 6. (KK)
BU 27	Complete femoral shaft with head, greater tochanter and distal end missing. (KK)
BU 35*	Proximal end, but missing the greater trochanter with only 0 – 1/4 of shaft represented. Similar to BU 22.
BU 36*	Fragment of the shaft with a small portion of the supracondyloid fossa present.
BU 37*	Similar to BU9 but missing the greater trochanter. Opposite of BU 10.
BU 38*	Element is the distal end with less than 1/4 of shaft present.

PATELLA BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 2	Any incomplete portion of element.

TIBIA BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 3	Proximal and, sometimes medial portion of crest of tibia with immediately adjacent portion of medial condyle.
BU 4	Complete distal end of tibia with 0 – 1/4 of adjoining shaft present.
BU 5	Section of posterior shaft surface characterized by nutrient foramen and commonly muscular lines situated on posterior surface. Similar to BU 6.
BU 6	Same as BU 5 except nutrient foramen absent. Frequency indicates number of pieces represented by BU 6 and not number of elements.
BU 10	Complete distal end with from 1/4 – 1/2 of adjoining shaft length represented.
BU 14	Complete proximal end with from 0 – ¼ of adjoining shaft length represented.
BU 15	Complete distal end with from 1/2 – 3/4 of shaft represented.
BU 16	Shattered distal end. Consists of fragments of the distal end broken into two or more pieces of various sizes and configuration. Varying amounts of adjoining shaft represented. Usually no more than 1/4 of total shaft length present. Frequency indicates minimum number of elements represented. For Oldman project, frequency indicates number of pieces only.
BU 17	Not a bone unit. Frequency indicates minimum number of elements represented by BU 16. Not coded for Oldman project.
BU 18	Un-fused proximal end detached and not associated with rest of element. Code condition as 'weathered'.
BU 19	Un-fused distal end detached and not associated with rest of element. Code condition as weathered.
BU 20	Tube-like sections of tibia shaft with all of proximal and distal ends totally missing. Bone unit may vary considerably in portion of shaft represented. (AL)
BU 32*	Long bone fragment of tibia characterized by shape or muscular grooves present on shaft.
BU 34*	Distal portion of shaft with distal epiphysis missing (juvenile). Similar to BU 4.
BU 35*	Similar to BU 22. Missing the proximal end of element and only has less than ¾ shaft associated. Missing distal end.

LATERAL MALLEOLUS BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 2	Any incomplete portion of lateral malleolus.

NAVICULAR CUBOID BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.

CUNIFORM PES BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 2	Incomplete portion of cuneiform pes varying configurations. (DS)

ASTRAGALUS BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element
BU 3	All or a portion of the medial ridge of proximal trochlea.
BU 4	All or a portion of the lateral ridge of the proximal trochlea.
BU 6	Element with all or major portion of lateral ridge of proximal trochlea removed. All or most of medial ridge of proximal trochlea present.
BU 7	Proximal 1/2-2/3 of element. Opposite of BU 2. (AL)
BU 14	Unit is essentially element, with the exception of a missing distal trochlear surface. Opposite of BU 17. (WU)
BU 18*	Fragment of the calcaneum fovea on posterior side.

CALCANEUM BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 2**	Proximal portion of element consisting of all of tuber calcis and all or most of the body.
BU 3**	Distal end of element including all articular surface and little to none of adjoining body.
BU 5**	Tuber calcis and no more than proximal half of body of calcaneum removed. Rest of element intact. Similar to BU 3.

BU 8	Un-fused tuber calcis (cap) detached and not associated with the rest of element. Code condition as “weathered.”
BU 9**	Extreme distal portion of element (facet for lateral malleolus). Often triangular in shape and corresponds to missing portions at distal end of BU 6 and 7. (TH)
BU 12	All or most of articular facet for lateral malleolus detached from rest of element. (GL)
BU 13	Element complete except for the removal of all or most of the sustentaculum tali. Opposite of BU 4. (GL)
BU 17*	Element is split sagittally; either the medial or lateral side is present.
BU 18*	Element is complete minus missing the tuber calcis (cap). Opposite of BU 8 (juvenile).
BU 19*	Element is a fragment of body characterized by shape.

FIRST TARSAL BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 2	Unit represents any fragment of the element. (WU)

2nd METATARSAL BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.

METAPODIAL BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 6	Fragmentary portion of one of the distal articular condyles. Frequency indicates number of pieces.
BU 7	Un-fused, complete distal epiphyses detached and not associate with rest of element. Code condition as ‘weathered’. Similar to BU 2.
BU 8	Either the medial or the lateral condyles un-fused and not associated with the rest of the element. Code condition as ‘weathered’. Similar to BU4.
BU 10*	Fragment of shaft. Based on muscular grooves.
BU 12*	Fragment of distal end excluding the articular condyles.
BU 13*	Fragment of distal condyle split sagittally. Either medial or lateral present.
BU 14*	Complete, or portion, of distal condyle.

METATARSAL BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete Element.
BU 2	Complete proximal end with 0 – 1/4 of shaft represented.
BU 3	Complete proximal end with 1/4 – 1/2 of shaft represented.
BU 4	Complete proximal end with 1/2 – 3/4 of shaft represented.
BU 5	Shattered proximal end pieces. Proximal end broken into two or more pieces of various sizes and configurations. From 0 – 3/4 shaft length may be represented; most commonly 1/4 – 1/3. Frequency indicates minimum number of elements represented by pieces. For Oldman project, frequency indicates number of pieces only.
BU 7	Complete distal end of metatarsal with 0 – 1/4 of adjoining distal shaft represented. Note: many distal ends from either metacarpals or metatarsals analyzed as separate element under metapodial fragments.
BU 8	Same as BU 7 but with approximately 1/4-1/2 of distal shaft length represented.
BU 9**	Complete distal end with 1/2 – 3/4 of shaft length represented.
BU 10	Shattered shaft fragment characterized by vascular groove and vascular foramen. No more than 1/2 total shaft length represented. None of the distal epiphyses present. Frequency indicates minimum number of elements.
BU 12	Shattered shaft fragment. Characterized by shaft shape. Lacks vascular groove. (TH)
BU 15	Unit consists of one of either distal condyles and from 0 – 1/4 of the adjoining shaft. The unit is similar to metapodial BU 4, but the element is identifiable to the specific metapodial. (WU)
BU 16*	Proximal posterior or anterior fragment consisting of middle foramen.
BU 17*	Consists of small medial or lateral fragments of distal condyle.
BU 18*	Proximal end with the entire shaft; missing the distal epiphysis (juvenile).
BU 19*	Distal epiphysis only (juvenile).
BU 20*	Ventral or dorsal section present of distal portion of shaft and epiphysis. Similar to BU 8.
BU 21*	Similar to BU 12, shaft fragment but has vascular groove.

PROXIMAL and DISTAL SESAMOID BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 2	Incomplete proximal or distal sesamoid of varying configuration. (DS)

P-1 (FIRST PHALANX) BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 3	Medial half of element which has been split longitudinally.
BU 4	Lateral half of element which has been split longitudinally.
BU 5	Consists of the distal-medial quarter of the element.
BU 6	Consists of the distal-lateral quarter of the element
BU 7	Consists of the proximal-lateral quarter of the element.
BU 8	Consists of the proximal-medial quarter of the element.
BU 12	Either BU 5 or BU 6. Indeterminate as to which.
BU 13	Consists of distal 1/3 – 1/2 of element.
BU 14	Consists of anterior portion of distal half of element. Defined as 84.12.05 for moose element from Crown site.
BU 16	All or portion of un-fused proximal epiphyses detached and not associated with rest of element. Coded as 'weathered'.
BU 17	Element with medial half of proximal head missing. Opposite of BU 8. (DS)
BU 19	Anterior half of the proximal end of the element. (GL)
BU 22	Anterior half of element. Opposite of BU 20. (WU)
BU 23*	Element complete, but proximal epiphysis is detached. Opposite of BU 16.
BU 24	Posterior portion of proximal end and shaft; distal end and anterior portion of proximal end missing. (WU)
BU 25	Element missing portion of posterior shaft surface. Proximal and distal articular surfaces intact. (WU)
BU 26	Medial shaft of element. Proximal and distal ends missing. (WU)
BU 28	Element missing proximal end and posterior shaft broken along the diagonal. (GL)
BU 30*	1/2 – 2/3 of distal end present. Missing 1/3 of proximal end. Similar to BU 13.
BU 33*	Distal 1/3 – 2/3 of element. Opposite of BU 2.

P-2 (SECOND PHALANX) BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element. May lack un-fused proximal epiphyses.

BU 2	Consists of complete proximal ½-2/3 of element. Defined as 84.12.05 for moose element from Crown Site.
BU 4	Consists of major portion but not complete proximal end with no or minor portion of adjoining shaft. Defined as 84.12.12 for ungulate specimen from Crown Site.
BU 5	Distal ½-2/3 of element.
BU 6	Proximal un-fused epiphyses detached and not associated with rest of element. Code condition as 'weathered'.
BU 7	Medial ½ of element. Opposite of BU 8. (EMA)
BU 8	Lateral ½ of element. Opposite of BU 7. (DS)
BU 9	Element with small portion of proximal end absent. Approximately ¾ of element remaining. (DS)
BU 12	Anterior portion of the distal articular condyle, side indeterminate. (WU)
BU 13*	Complete distal portion only missing the un-fused epiphysis. Opposite of BU 6.
BU 14*	This is the internal bone structure only, the outer bone layer, the periosteum, is removed.
BU 15*	Medial or lateral portion of proximal epiphysis (juvenile).

P-3 (THIRD PHALANX) BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete element.
BU 2	Complete proximal end of element. All or most of element distal to articular facets removed.
BU 3	Similar to BU 1 except only the extreme distal end removed (1/4 or less of entire element length removed).
BU 7	Extensor process of element. May also include limited portions of adjacent articular surfaces. Opposite of BU 5. (DS)
BU 8	Unit consists of lateral half of element, only half of articular surface present
BU 9	Lateral piece of element distinguished by the shape, foramen and porous nature of bone. (DS)
BU 10	Medial half of element split along the sagittal plane, and with extreme distal end missing. (WU)
BU 11	Lateral half of the proximal end of the element. Most of the element distal to the articular facets is missing. (WU)
BU 13	Element missing only the angle, or extreme proximal end of the articular surface of the element. Opposite of BU 4. (GL)

BU 15	Posterior half of whole element, splitting the articular surface. (GL)
BU 16*	Missing bottom portion. Opposite of BU 14.
BU 17*	Element consists of medial half of element, with one or two articular elements present. opposite of BU 8.
BU 18*	Element contains both articular surfaces (proximal), but only the lateral half of the rest of the element. Similar of BU 8.

CENTRUM BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 10	Anterior centrum on cervical vertebra.
BU 2	Posterior centrum on cervical vertebra.
BU 3	Anterior centrum on thoracic vertebra.
BU 4	Posterior centrum on thoracic vertebra.
BU 5	Anterior centrum on lumbar vertebra.
BU 6	Posterior centrum on lumbar vertebra.
BU 7	Anterior or posterior centrum unidentifiable to element.
BU 8	Anterior centrum on caudal vertebra.
BU 9	Posterior centrum on caudal vertebra.

MANUS V/PEZ II BONE UNITS

<u>Bone Unit</u>	<u>Definition</u>
BU 1	Complete manus/pez.