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What's For Dinner?: A Faunal Analysis of the Bison, Elk, and Bighorn Sheep Bones from the Windy Bison Site (48YE697), Yellowstone National Park, Wyoming

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WHAT'S FOR DINNER?: A FAUNAL ANALYSIS OF THE BISON, ELK, AND BIGHORN SHEEP BONES FROM THE WINDY BISON SITE (48YE697), YELLOWSTONE NATIONAL PARK, WYOMING

By

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Abstract

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What's For Dinner?: A Faunal Analysis of the Bison, Elk, and Bighorn Sheep Bones from the Windy Bison Site (48YE697), Yellowstone National Park, Wyoming

Chairperson: Douglas H. MacDonald

Archaeologists have discovered hundreds of prehistoric sites around the shores of Yellowstone Lake, Wyoming indicating that Native Americans lived, hunted, and gathered in the region for 11,000 years. This thesis attempts to identify the Native American subsistence strategies that were conducted around the shores of Yellowstone Lake, specifically along the northeast shore. The objective is to define how Native Americans exploited the bison, elk, and bighorn sheep that were observed at the Windy Bison Site (48YE697). This objective is approached through analyzing the faunal remains that were documented at 48YE697. The analysis will be conducted using zooarchaeological methods to determine the economic utility of the identified carcass remains. Economic utility is defined as the amount of useful meat, marrow, and/or grease that is associated with a bone. Also, the economic utility will be determined through the development of utility indices that will reflect whether a given carcass element is a high-utility or a low-utility element. In addition, the determination of high-utility or low-utility elements will contribute to the understanding of how hunter-gatherers selected and transported specific carcass elements from a processing/kill site to a residential site. The selection and transportation decisions are based the central place foraging perspective. Furthermore, the approached objective is through a combination of theoretical perspectives that highlight: 1) the seasonal movements of people; 2) why bison, elk, and bighorn sheep were the primary fauna species identified at 48YE697; and 3) why and how hunter-gatherers make decisions on carcass element selection, and transportation. The last methods for approaching the objective is the combination of archaeological, ethnographic, and ethnohistoric data. The overall combination of utility indices, theoretical perspectives, archaeological, ethnographic, and ethnohistoric data allows for an understanding of hunter-gatherer subsistence and mobility strategies at Yellowstone Lake, Wyoming to be understood.

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Table of Contents

List of Figures

List of Tables

List of Photographs

Chapter One

Introduction

Millions of people visit Yellowstone National Park (YNP) to see and explore the beautiful Yellowstone landscape (Figure 1). Before YNP was established in 1872, Native Americans lived throughout the region, and one of the main areas that appeared to attract Native Americans, and continues to bring people back to the park today is Yellowstone Lake. Yellowstone Lake lies in the heart of the Greater Yellowstone Ecosystem (GYE), and is the largest natural high elevation lake in North America sitting at 2,356 meters (7,731 feet) amsl. (NPS 2017). For 40+ years, archaeologists have discovered prehistoric sites all around the shores of Yellowstone Lake, indicating that Native Americans have been visiting, and hunting and gathering in the area for 11,000 years (Hale and Livers 2013).

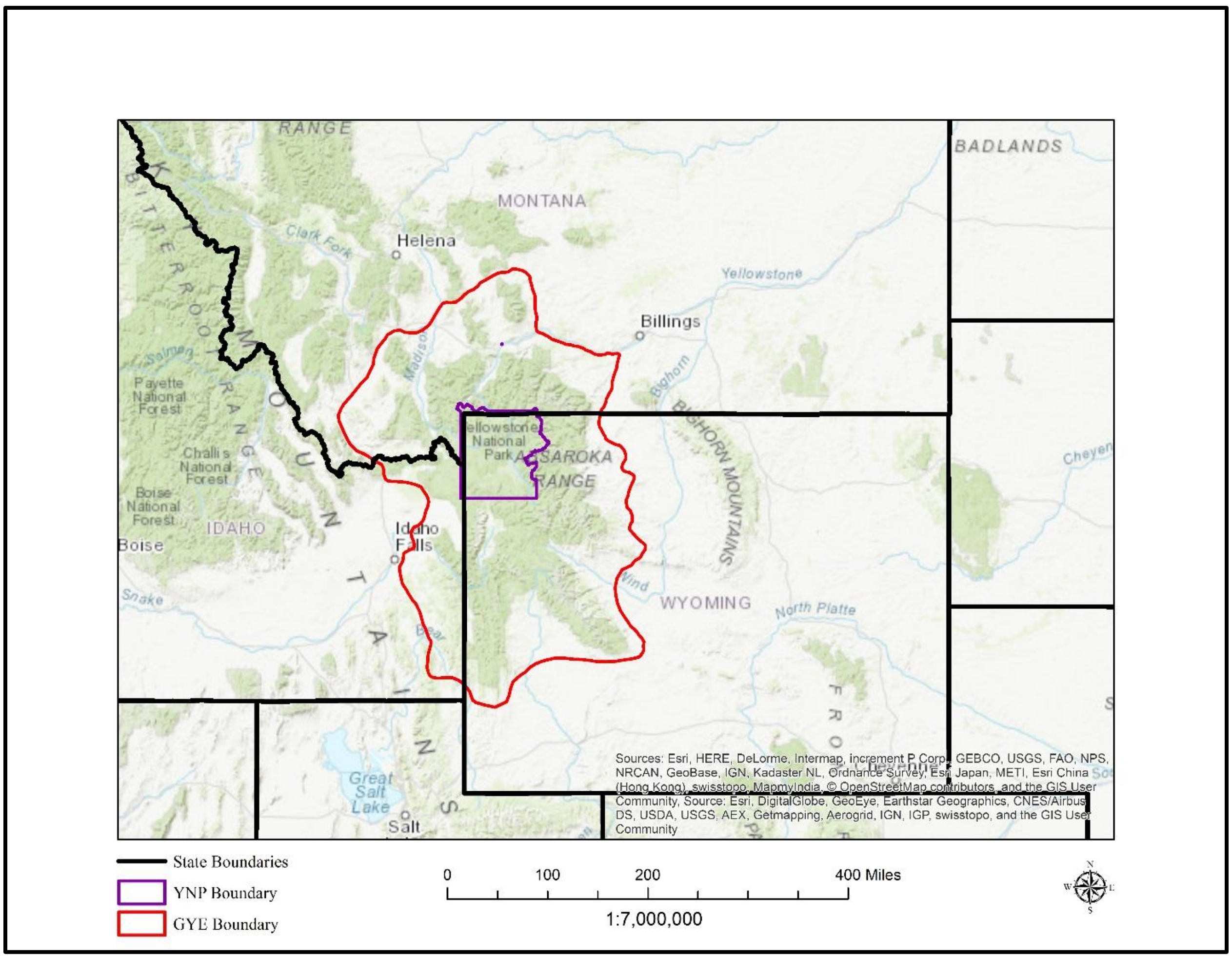

Figure 1: Topographic map of the Greater Yellowstone Ecosystem (GYE) and Yellowstone National Park (YNP)

This thesis attempts to identify the Native American subsistence strategies that occurred around the shores of Yellowstone Lake, especially along the northeast shore. The objective is to define how Native Americans exploited the bison, elk, and bighorn sheep that were discovered in a bone bed along the northeast shore of Yellowstone Lake (Figure 2). This objective is approached through a central place foraging framework that presents the assumption that hunter-gatherers should maximize their delivery rate or the amount of energy carried back to the residential location per unit foraging time (Cannon 2003). In other words, if a game animal (i.e. bison, elk, bighorn sheep) was killed further away from a residential location (central location) the hunter(s) should butcher the animal at the point of capture, leaving behind the low-utility carcass parts at the processing site, or kill site, and transporting the high-utility carcass elements back to the central camp (Cannon 2003).

The objective is also approached using zooarchaeological methods to determine the economic utility (meat, marrow, and/or bone grease associated a bone) of the carcass elements that were discovered at 48YE697. Lastly, a combination of theoretical literature and perspectives, ethnographic data, ethnohistoric data, and archaeological data and methods will be used towards the objective.

Thesis Layout

Chapter two provides a background description of: 1) the Windy Bison Site (48YE697); 2) the environmental setting of Yellowstone Lake; 3) the YNP prehistory; and 4) the prior archaeological research at Yellowstone Lake. Chapter two will present where 48YE697 is located, as well as what type of environment the site lies within. In addition, the prehistory of YNP, and the prior archaeological research at Yellowstone Lake is addressed to reflect the different transitional time periods (Paleoindian – Late Prehistoric) that occurred throughout the Yellowstone landscape. The Late Prehistoric Period will be discussed even further in the background chapter due to this study primarily focusing on the Late Prehistoric Period.

Also, in the prior archaeological research section of this chapter, there will be figures and tables that display all Late Prehistoric sites that have been identified around the shores of Yellowstone Lake, including islands. There will also be six key Late Prehistoric sites that are described to present how they may resemble similar characteristics to the possible seasonality, settlement, and mobility patterns that occurred at 48YE697.

Chapter three provides an overview of literature and theoretical perspectives of how food resources play a role in the transportation, mobility, subsistence, and settlement decisions made by hunter-gatherers. Central Place Foraging is one theoretical perspective that will be addressed to explain how and why hunter-gatherers make field processing and transportation decisions based on the distance from their residential location. A second theoretical perspective focuses on the migration patterns of animals. This discussion will be directed towards the movements of the bison, elk, and bighorn sheep, considering these were the fauna species recovered from the Windy Bison site. One goal for addressing migration patterns is to establish an understanding of why these fauna were discovered at the Windy Bison site. A second goal is to potentially understand how and where hunters obtained these animals.

Chapter four highlights the methods and materials used to analyze the faunal assemblage recorded at 48YE697. The methods conducted in this research includes constructing a quantification summary table that displays the number of identified specimens (NISP), minimum number of elements (MNE), minimum number of individuals (MNI), and the minimum number of animal units (MAU). In addition, the purpose of the quantification summary table is to separate the identified carcass elements from the unidentified elements, as well as to determine how many fauna species were present at the site. The definitions of these variables are defined in chapter four. The second method is collecting the carcass element weights of the bison, elk, and bighorn sheep that were discovered at 48YE697. This method is conducted by adapting the carcass element weights of a spring adult male bison from Emerson's 1990 research, and the caribou and domestic sheep weights from Binford's 1978 research. The caribou and domestic sheep carcass elements weights are used because of the similarities between elk and caribou, and bighorn sheep and domestic sheep. The third method is developing economic utility tables and indices that reflect the economic values of the different carcass elements that were recovered from the Wind Bison site, as well as missing from the site. The last method will be to develop an ethnohistoric table reflecting the cultural importance of bison, elk, and bighorn sheep, as well as how these animal may have possibly been used by Native Americans occupying the area.

Chapter five presents the analysis and results of the faunal remains (bison, elk, and bighorn sheep) identified at the Windy Bison site. The results are presented in economic utility tables and indices. There will be four utility indices and tables constructed to present which carcass parts are high-utility and low-utility. In addition, the purpose of the tables and indices is to determine which carcass elements are likely to be field processed and transported from a kill/processing site to a residential site. Chapter six provides a discussion on the results that were produced in chapter five, as well as future research that can be conducted from this thesis. One future research topic that will be addressed in chapter six is trying to connect 48YE697 to a residential site through the analysis of lithic artifacts that were identified from other observed archaeological sites in the area. Lastly, chapter six will provide concluding comments about this research.

In summary, the goals for this thesis are to: 1) understand the Native American subsistence strategies that occurred around the shores of Yellowstone Lake; 2) present different methods and strategies that contribute towards understanding faunal assemblages within the archaeological record; 3) and provide other research opportunities such as determining if there is a possible residential site in close proximity to the Windy Bison site. The focus of goal one is to be able to understand why and how hunters make decisions when obtaining food resources. The second goal focuses on the faunal bones and why they were present and/or missing from the archaeological site. The third goal is set up to produce other research directions that can contribute towards understanding how Native Americans hunted and gathered, and moved throughout the Yellowstone landscape.

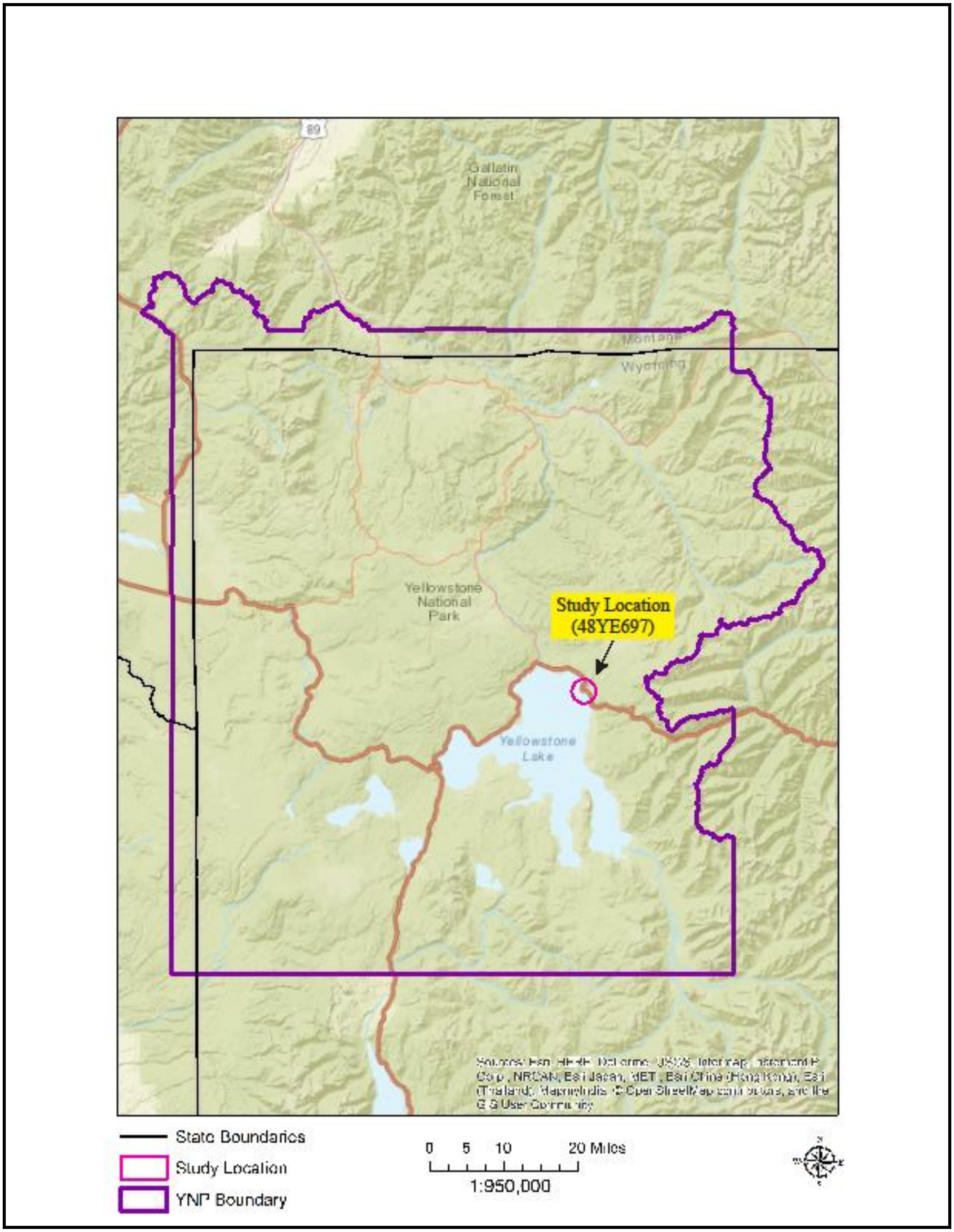

Figure 2: Topographic overview of YNP and the study location (48YE697)

Chapter Two

Background

This chapter provides a background description of the Windy Bison Site (48YE697), as well as brief overviews of the environmental setting, YNP prehistory, and the prior archaeological research around Yellowstone Lake.

Site Description

Windy Bison Site (48YE697)

The Windy Bison Site (48YE697) is a Late-Prehistoric site that lies within eolian sands located on the eastern edge of Sedge Bay at Yellowstone Lake, Wyoming (Figure 3) (Cannon et al. 1997). The vegetation in the area indicates this site is in a mesic meadow that contains a variety of vegetation including: Lodgepole pine (*Pinus contorta*), Subalpine fir (*Abies bifolia*), Engelmann spruce (*Picea engelmannii*), pussytoes (*Antennaria*), wild rose (*Rosa*), lupine (*Lupinus*), larkspur (*Delphinium*), sticky geranium (*Geranium viscosissimum*), and sagebrush (*Artemisia*) (Cannon et al. 1997). This site was initially discovered in 1989 by the Midwest Archaeological Center (MWAC), who partnered with National Park Service the road reconstruction program to conduct inventory, testing, and excavation work along the East Entrance road (Cannon and Hale 2013). While conducting inventory in the area, the investigators observed a bone in an eroded cutbank along the shoreline of Yellowstone Lake. Testing of the site was conducted in 1990 across many areas of the site, but the primary testing was on the bone bed (Cannon and Hale 2013). In 1993 and 1994 data recovery excavations were conducted on the bone bed producing 376 pieces of predominately tertiary flakes, one chert graver, and one chert scraper. The employable units on these tools indicated they were for heavy working such as cutting bone or wood (Cannon and Hale 2013).

Photograph 1: Overview of 48YE697; view southeast

Also, the bone bed was excavated to a depth of 110 cmbd, producing two stratigraphically, seperated radiocarbon ages (upper and lower). The upper age of the bone bed was 360 ± 60 BP, based on a charcoal wood fragment that was collected from a burn zone in the west wall of the bone bed. The lower radiocarbon age was 800 ± 60 BP; this age was produced by a collagen age from an unburned bison rib. (Cannon and Hale 2013). In addition, a soil sample was also collected from within the skull and body cavity for extraction of insect remains to determine seasonality (Cannon and Hale 2013). Interestingly, during the testing, there were no insect carcasses recovered, which indicates that that the bison was possibly killed during the cold season (winter – early spring) (Cannon and Hale 2013).

There were also 116 faunal elements discovered between the 1990, 1993, and 1994 excavations; 59 of them being recovered from the bison bone bed. The total number of bison elements that were recovered from the two excavations were 58, which was almost an entire skeleton of a four-year-old bull bison. Also, some of the bison elements that were recovered showed sign of butchering activities (Cannon and Hale 2013). In addition, the anterior portion of the humerus diaphysis, the hyoid, and the distal-lateral surface of the tibial crest of the left tibia contained score marks (Cannon and Hale 2013). Score marks are produced when the teeth of a carnivore, scavenger, or in this case, humans make contact with the bone through the process of gnawing (Binford 1981a).

Photograph 2: Overview of 48YE697 from Sedge Bay; view northwest

Additionally, there was one elk ulna discovered in the bison bed, and two other elk elements, an unsided metatarsal and the portion of a right illlium, discovered in the cutbank below the bone bed in 1990 (Cannon and Hale 2013). In addition to the bone bed, the fifth cervical vertebrae of a bighorn sheep was identified from the same excavation unit as the bison and elk elements. There was also the right portion of a skull, including a palate, maxilla, zygomatic arch, and M2 of a meadow vole that was documented in the bone bed; the death was considered most likely from natural causes due to the common population of this species in the area (Cannon and Hale 2013). With the bone recovery of three different large game animals in the same bone bed, and the bones found on the cutbank below the bone bed provides a possible indication that the bone bed may have been larger before eroding into the lake (Cannon and Hale 2013).

In addition to faunal remains being documented at this site, there was one fused section of a trunk vertebrae that was identified as being part of a white sucker (*Catostomus commersoni*), which is considered a non-native fish species to Yellowstone Lake. Also, based on the pleural and neural spines that were chewed or broken off, and the ligaments that were still connected to the vertebrae, this specimen is interpreted as modern, and was carried over by a raptor, and then brought into the bone bed area by rodents (Cannon et al. 1997). Thus, there is no implication of fishing as a subsistence strategy based on these fish remains (Macdonald et al. 2012:271).

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Environmental Setting

Yellowstone Lake is a fascinating region of the Greater Yellowstone Ecosystem that has been formed through a variety of volcanic, hydrothermal, earthquake, and glaciation activity. Yellowstone Lake is the largest high-elevation lake in North America. The lake sits at an elevation of 7,731 feet, there is about 141 miles of shoreline, the lake is about 20 miles long (north/south) by about 14 miles wide (east/west), the lake has an average depth of about 42 meters, and a maximum depth of 131 meters (NPS 2017).

One of major formations that was created from these activities was the Yellowstone Caldera. The Yellowstone caldera is a large rhyolite flow that was formed by a massive volcanic eruption that occurred roughly 640,000 years ago (NPS 2017). The caldera occupies close to 1/3 of the parks area and is about 85 km wide by 45 km long (Dzurisin et al. 2012) In addition, the Yellowstone caldera contributed to the creation of Yellowstone Lake. The West thumb of the lake was created by a smaller eruption that occurred about 174,000 years ago. The southern half of the lake continued to be formed through glacier processes.

A few of the major rivers that flow through YNP that were used as travel corridors for Native Americans are the Yellowstone River, Madison River, and Snake River. The Yellowstone River is the only river that flows in and out of the lake. The river flows into the lake from the southern end and exits from the northern end of the lake near Fishing Bridge.

YNP has close to 1,300 native plants and 225 nonnative plants. There are nine conifers including Lodgepole pine (*Pinus contorta)*, Whitebark pine (*Pinus albicaulis),* Engelmann spruce (*Picea engelmannii*), White spruce (*Picea glauca*), Subalpine fir (*Abies bifolia*), Douglas-fir (*Pseudotsuga menziesii*), Rocky Mountain Juniper (*Juniperus scopulorum*), Common juniper (*Juniperus communis*), and Limber pine (*Pinus flexilis*). Lodgepole pine dominate about 80% of the total parks forest. Some of the hard-wood trees that found within the park are Quaking Aspen (*Populus tremuloides*) and cottonwoods (*Populus*). A few of the shrub species that are found in the park include common juniper, a variety of sagebrush, and Rocky Mountain maples (NPS 2017).

The Yellowstone landscape also has the largest concentration of mammals than any other state in the U.S. There are 67 different mammals that reside in the ecosystem, and there are eight large ungulate species and seven large predators. The large ungulate species includes bighorn sheep (*Ovis canadensis*), bison (*Bison bison*), elk (*Cervus canadensis*), moose (*Alces alces shirasi*), mountain goat (*Oreamnos americanus*), mule deer (*Odocoileus hemionus*), pronghorn (*Antilocapra americana*), and white-tailed deer (*Odocoileus virginianus*). The seven large predators include black bear (*Ursus* *americanus*), grizzly bears (*Ursus arctos horribilis*), Bobcat (*Lynx rufus*), mountain lions (*Puma concolor*), coyote (*Canis latrans*), wolves (*Canis lupus*), and wolverines (*Gulo gulo*) (NPS 2017).

Photograph 3: Four bull bison near 48YE697; view north

Prehistory of Yellowstone National Park

There have been roughly 2,000 archaeological sites discovered and studied within YNP that provides evidence of Native Americans living and using the Yellowstone landscape for a very long time (MacDonald 2018). To gain a better understanding of how long Native Americans occupied the Yellowstone landscape, cultural chronological periods are developed. The cultural chronological periods include: Paleoindian (11,000 to 8,000 years ago); Early Plains Archaic (8,000 to 5,000 years ago); Middle Plains Archaic (5,000 to 3,000 years ago); Late Plains Archaic (3,000 to 1,500 years ago); Late Prehistoric (1,500 to 300 years ago); and Historic Period (300 years ago to present) (Hale and Livers 2013).

<u>Paleoindian (11,000 – 8,000 years ago)</u>

The Paleoindian period was the earliest known date of human presence on the Yellowstone landscape. The Clovis culture were the first group of people to exist in the Yellowstone region, dating between 11,500 to 10,900 uncalibrated radiocarbon years B.P. They were a big game hunting culture that hunted a variety of animals, ranging from extinct ice-age animals of mammoths, horse, and camel to existing animals such as bison, bighorn sheep, and rabbit. There are three confirmed Clovis points that have been discovered in YNP. Two of the three Clovis points were discovered at Yellowstone Lake. The first Clovis point is a point base that was documented in 2013 at the Raspberry Beach Site (48YE1578), located at the far southern end of the South Arm of Yellowstone Lake near the mouth of Chipmunk Creek (MacDonald and Nelson 2018). The energy-dispersive x-ray fluorescence (ED-XRF) analysis that was conducted, indicated that this point was constructed from Teton Pass obsidian, which is located 100 km (~62 miles) south of YNP near Jackson, Wyoming (MacDonald and Nelson 2018).

The second Clovis point, discovered by the University of Montana in 2012, was recovered from site 48YE1330. This site is located 6 km northwest of Raspberry Beach (MacDonald Na Nelson 2018). The third Clovis point to be recovered in YNP was by the University of Montana in 2007 at the Yellowstone Bank Cache Site (24YE355) near Gardiner, MT (Pfau 2015). This Clovis point was produced from red porcellanite, which is to be sourced in the eastern Montana/Wyoming region (MacDonald and Nelson 2018).

A fourth Clovis point discovery, located just north of the park boundary, was when the Gardiner post office was being constructed and the base of an obsidian Clovis point was recovered (Janetski 2002). Furthermore, roughly 100 miles from Yellowstone Lake's northern shore is the oldest and closest Clovis site to YNP, the Anzick Site (Beecher 2015). The Anzick site is a burial site that dates to 11,040 B.P. and is considered prime example of the variety of tools that existed during the Clovis period (White 2015). The tools that were discovered alongside the burial included bifaces, blades, cores, scrapers, and projectile points (Bauchman 2016).

The second culture to exist after the Clovis culture were the Folsom people. The Folsom culture existed between 10,900 to 10,200 years ago (MacDonald 2012). The evidence of Folsom existence hasn't actually been discovered in YNP but there was a Folsom point found in the Bridger-Teton National Forest, located just south of Yellowstone National Park. The discovered Folsom point was sourced back to Obsidian Cliff, which indicates that Folsom people would have traveled through the Yellowstone landscape to obtain lithic sources (Hale and Livers 2013). Folsom points usually had noticeable fluting, fine marginal retouch, prominent basal ears, and a deep concave or recurved base (Hofman and Graham 1998). "Folsom technology was highly curated, with staging in the reduction of cores and preform, where as Clovis technology, large bifacial cores of high-quality stone served as a variety of tools forms, and provided the flakes and bifaces from which all other tool forms could be derived" (Hofman and Graham1998:98).

When the Folsom culture faded around 10,200 years ago, Native Americans stopped using Folsom points and began using the Agate Basin and Hell Gap stemmed lanceolate points (MacDonald 2012). "Agate Basin projectile points are elongated and lanceolate, with narrow, tapered bases and slightly convex blades" (MacDonald 2012:48). Agate Basin points have been discovered throughout Yellowstone. One Agate Basin projectile point was discovered along Alum Creek which is located in Hayden Valley (Hale and Livers 2013). There were also two other Agate Basin points discovered along the shoreline of Yellowstone Lake between Fishing Bridge and Pumice Point. There were four Hell Gap projectile points discovered along the shoreline of Yellowstone Lake during a survey in 1958-1959 (Hale and Livers 2013). "Hell Gap points are shouldered with a broad tip and stem that tapers toward the base of the point. The base of the point varies from straight to slightly concave" (Hofman and Graham 1998:109).

A third transition period was the Cody Complex (9,500 – 8,000 years ago). Cody Complex sites are normally associated with bison hunts. The Cody Complex was associated with a variety of tools which included Cody knives, and Alberta, Eden, and Scottsbluff stemmed lanceolate projectile points (Hale and Livers 2013; and Hofman and Graham 1998). Cody knives are similar to an Alberta projectile point tow where they are re-sharpened to an asymmetrical blade and used for cutting activities (MacDonald 2012). One of the more famous Cody Complex sites is Osprey Beach (48YE409/410). The Osprey Beach site was not associated with bison hunting but the site had a large diversity of subsistence. The site contained a wide variety of stone materials including lanceolate points, Cody knives, and stone abraders (Johnson et al. 2013). The variety of stone tools that were discovered were produced from ten different obsidian sources and chert. The large variety lithic sources indicate that Native Americans would have traveled long, and short distances throughout the Yellowstone landscape, and possibly even traded with other cultural groups (MacDonald 2012).

Additionally, there has been more than 50 archaeological sites in YNP that have contained Cody complex artifacts (MacDonald and Nelson 2018). Two nearby sites, the Mummy Cave site and the Horner site, also contained artifacts produced from Obsidian Cliff obsidian that date to 9,000 years old. These two sites are east of YNP, so it is likely that Late Paleoindians inhabiting these two sites would have traveled westward from the North Fork Shoshone River Valley, and through the Clear Creek Valley or the Cub Creek Valley, then along the north shore of Yellowstone Lake, eventually reaching Obsidian Cliff (MacDonald and Nelson 2018).

Early Plains Archaic (8,000 – 5,000 years ago)

When the Paleoindian period ended nearly 8,000 years ago, the Early Plains Archaic period began. The Early Plains Archaic period occurred during what is called the Altithermal climatic period. The Altithermal was a period of increasingly hot and dry climate conditions (Meltzer 1999). Some believe the hot and dry conditions caused the bison and human populations to decrease, resulting in a low-density of Early Archaic archaeological sites being discovered (MacDonald 2012). When bison populations decreased, hunter-gatherers would have transitioned from primarily hunting bison to obtaining a diversity of subsistence (MacDonald 2012). The bison population decrease would have led to less group hunting and more individual hunting (MacDonald 2012). The individual hunting patterns resulted in the switch to side-notched projectile points, which corresponded to the adoption of the atlatl (MacDonald 2012). Additionally, hunter-gatherers would have settled in areas that were located closer to predictable water sources such as lakes, streams, or springs (Sheehan 1995). However, some researchers believe that even though human and game populations diminished during the Altithermal, it was unlikely that the people would have abandoned the area entirely, but instead developed different subsistence strategies (Reeves 1973).

There were a few sites discovered that indicated communal bison hunting still existed, but two important bison kill sites are the Hawken site, and Head-Smashed-In Buffalo Jump. The Hawken site is a bison kill site located south of Sundance Wyoming near the Black Hills (Frison 1978). The Hawken site is an arroyo trap that dates between 6,470 to 6,270 years ago (Frison 1998). There were at least 100 individual *Bison occidentalis* recovered in an arroyo with a large number of Early Plains Archaic side-notched projectile points, 16 knives, eight choppers, and two hammerstones (Cunnar 1997; and MacDonald 2012). The communal hunt most likely occurred during early winter and was performed by driving the bison up a steep-sided arroyo until reaching a knickpoint barrier that formed into a natural trap (Frison 1978). Head-Smashed-In Buffalo Jump is located in southwestern Alberta, Canada near the southern edge of the Porcupine Hills (Brink 2008). Head-Smashed-In Buffalo Jump has radiocarbon dates between 5,600 to 5,080 years ago from levels that contained a small number of Early Archaic projectile points, mainly local quartzite with a few exotics (Frison 1998).

A third Early Archaic site, not a bison kill site, is the Fishing Bridge Point site (48YE381). 48YE381 is a key site located on the northwest shore of Yellowstone Lake near the outlet of the Yellowstone River (MacDonald 2013). This site resulted in the discovery of six burn features that were recovered in 2009 by Dr. Douglas MacDonald and the MYAP team (MacDonald et al. 2012a). In addition, of those six features, one reflected as being Early Archaic. The wood charcoal that was collected contained a radiocarbon dating of 5,910 ± 50 years B.P. (MacDonald et al. 2012a). In addition to this Early Archaic feature, there was a high pollen value from grasses, which suggests that Early Archaic hunter-gatherers were collecting and using edible plant resources that were available at Yellowstone Lake (MacDonald et al. 2012a).

Furthermore, the location of the Fishing Bridge Point Site is a prime example of where Early Archaic hunter-gatherers would have settled during the Altithermal climatic period. The area of the site consists of cooler and moisture temperatures that would allow grasses and other plants to grow richer and more attractive for a variety of animals (MacDonald 2013). While there were no faunal remains found during the 2009-2010 field study, the protein residues from the stone tools that were recovered indicated that hunter-gatherers were using those tools to obtain and/or process a variety of flora and fauna (MacDonald et al. 2012a). In addition, the thirteen lithic artifacts (3 Early Archaic, 4 Middle Archaic, 3 Late Archaic, and 3 Late Prehistoric) that were tested for protein residue, all three of the Early Archaic tools were tested positive for bovine (projectile point), bear (projectile point fragment), and deer (utilized blade) (MacDonald et al. 2012a).

Middle Plains Archaic (5,000 – 3,000 years ago)

The Middle Plains Archaic was a period of bison and human population increase, as well as the transition from obtaining a variety of subsistence to primarily hunting bison (MacDonald 2012). The Middle Archaic also experienced an increase in the variety of projectile points. Hunter-gatherers utilized Oxbow and McKean projectile points, as well as other varieties including Mallory, Duncan, and Hanna (Hale and Livers 2013). Oxbow projectile points are smaller, squat versions of the larger, lanceolate McKean projectile points that have indented or concave bases (MacDonald 2012). McKean projectile points are lanceolate with indented bases, and convex to straight blade edges that are narrower at the base than in the middle (Frison 1978, MacDonald 2012). Mallory projectile points are thin, wide at the blade, deep side-notched, and have either a straight, slightly concave, or a deep indented base (Davis and Keyser 1999; and Frison 1978). Lastly, Duncan projectile points are stemmed with sloping shoulders, and Hanna projectile points have distinct shoulders with a slight expanding stem (Frison 1978).

Additionally, as the human population increased so did the number of archaeological sites across the Yellowstone landscape. One Middle Plains Archaic site that was discovered outside YNP is the Airport Rings site (24YE357). 24YE357 was discovered by the Montana Yellowstone Archaeological Project (MYAP) team in 2007 and is located in the Gardiner Basin just north of Gardiner, Montana (Livers 2009). This site is considered different than other Middle Archaic sites in the region, not because of the lithics that were recovered, but because it contained a hearth that had a radiocarbon dating of 4,500 years ago (Livers 2009). The hearth was an excellent discovery because it possibly indicates the earliest dated stone circle in the region. Stone circles didn't generally occur until after the Middle Plains Archaic period (MacDonald 2012).

Another Middle Plains Archaic site is the Fishing Bridge Point Site (48YE381), previously discussed in the Early Archaic section. During the 2009-2010, Dr. MacDonald and the MYAP team recovered three Middle Archaic features that contained radiocarbon dates of 2840 ± 40, 2920 ± 40, and 3100 ± 40 years B.P. (MacDonald et al. 2012a). In addition, according to MacDonald et al. 2012a, the Middle Archaic Native Americans inhabiting the Fishing Bridge Point Site (48YE381) used more variety of lithic sources compared to the Early Archaic, Late Archaic, and Late Prehistoric. There were more obsidian and dacite sources associated with the Middle Archaic, and with artifacts produced from Obsidian Cliff, Crescent H., Teton Pass, and Bear Gulch obsidian sources (MacDonald et al. 2012a). Also, there were four lithic artifact tools recovered from the Middle Archaic period, two of which tested positive for blood protein. The first tool was a knife that had positive protein of deer and dog; the second tool, Middle Archaic projectile point, tested positive for bovine (i.e. bison) (MacDonald et al. 2012).

<u>Late Plains Archaic (3,000 – 1,500 years ago)</u>

The Late Plains Archaic period most likely continued to see an increase in human population, which has provided an increase of the number of Late Plains Archaic archaeological sites being discovered (MacDonald 2012). This period also continued to use of hearths and tepees. Bison hunting was the primary subsistence pattern in the Great Plains, while a diverse subsistence pattern continued in the mountains (MacDonald 2012). Hunter-gatherers also increased the use of bison jumps and corrals to be more efficient in obtaining bison meat (MacDonald 2012). People traveled further distances and developed trade relationships with other cultural groups (Hale and Livers 2013). For example, there are Late Archaic midwestern Woodland period archaeological sites in Ohio and Illinois that contained lithic materials that were sourced back to Knife River Flint in North Dakota and Obsidian Cliff obsidian in Yellowstone National Park (Hale and Livers 2013; and MacDonald 2012). Other characteristics of the Late Plains Archaic period was the use of dog travois, which was used to carry equipment, and pottery (MacDonald 2012). Pottery, specifically Besant pottery is rare in YNP but can occasionally discovered in the northeastern part of Montana (Pfau 2015). Besant pottery that is discovered in Montana is most likely from trade that occurred among cultural groups living throughout the Missouri River Valley (Pfau 2015).

This period also experienced a new variety of projectile points including Pelican Lake and Besant. Pelican Lake projectile points are deeply side-notched with barbs on the corners, and have convex, straight, or concave lateral body edges. The bases are generally convex to straight, and sometimes concave, which is rare (MacDonald 2012; and Reeves 1970). Besant projectile points are deeply side-notched and most often have convex body edges, but at times they can have straight edges (Reeves 1970). Also, the bases may be convex or straight, but at times they can have a convex base (Hale and Livers 2013).

A Late Plains Archaic site that was discovered in the very northern part of YNP is the Yellowstone Bank Cache Site (24YE355). This site was discovered in 2007 by UM MYAP, in which they excavated four roasting pit features that indicated this site had multiple occupations during the Late Archaic period (MacDonald and Maas 2010). The four features were packed with a variety of local vegetation including sagebrush, juniper, pine, alder, and maple that were used as a fuel source (MacDonald and Maas 2010). The site was used to process food items such as medium to large sized animals including deer and other unidentified game animals, as well as plant debris including Chenopodium seeds and pinecones (MacDonald 2012). 24YE355 was also used for toolmaking to produce knives, unifaces, sidescrapers, and an end scraper (MacDonald 2012). The lithic sources that the tools were produced from included Obsidian Cliff obsidian and Crescent Hill Chert. Hunter-gatherers would have accessed the Obsidian Cliff source by following the Yellowstone River to the Gardiner River and then connecting to Obsidian Creek which now follows Route 89 through the park (MacDonald and Maas 2010). The access route to Crescent Hill chert was easier to which hunter-gatherers would have traveled approximately 20 miles up the Yellowstone River through the Black Canyon and then connecting to smaller streams that lead to the chert source (MacDonald and Maas 2010).

<u>Late Prehistoric (1,500 – 300 years ago)</u>

The Late Prehistoric period was best known for communal bison hunting. Bison hunts normally resulted in hundreds of bison being killed during one hunt, while during the Late Archaic period there would only be about a dozen bison killed (MacDonald 2012). This period likely experienced an increase in stone circles, buffalo kill sites, and Late Prehistoric arrow points which suggests that the human population also increased (MacDonald 2012). The bow and arrow was also adopted during this period and it was a much more reliable hunting tool than the atlatl because hunters could move quicker and have a more accurate shot (MacDonald 2012).

In addition, the bow and arrow allowed for smaller projectile points such as Avonlea and Late Prehistoric side-notched points to be produced. The smaller points were an advantage because they took less time to make and they didn't have to be made from the best lithic raw material (Hale and Livers 2013). Avonlea projectile points are a transitional point type that reflects the larger Archaic atlatl point and the very small arrow point that was introduced 1,300 years ago (MacDonald 2012). This type of projectile point is thin with small, shallow, and somewhat wide side-notches, as well as serrated blade edges, and concave bases (Kehoe and McCorquodale 1961). The most common projectile point between 1,200 and 300 years ago is the Late Prehistoric Side-notched point. This projectile point has a straight base with shallow side notches, as well as a straight to convex blade with a triangular shape (Hale and Livers 2013).

Another technological innovation that became highly used during the Late Prehistoric period was pottery. Pottery was mainly used by people who were living in or near permanent villages (MacDonald 2012). Three main pottery styles that have been discovered in the Montana archaeological record includes Avonlea pottery, Crow pottery, and Intermountain pottery (MacDonald 2012). Avonlea pottery is the earliest pottery style in Montana dating between 1,500 to 1,000 years ago and is most often discovered in northern Montana, as well as parts of North Dakota, and southern Alberta and Saskatchewan. Avonlea pottery has a globular shape, and is tempered with grit and impressed with either a net-type pattern, a groove exterior design, or both (MacDonald 2012). Crow pottery was introduced about 500 years ago from North Dakota. Crow pottery is tempered with grit; has a globular shape with an S-shaped rim; and has a smooth exterior and interior (MacDonald 2012). Lastly, Intermountain pottery was created by the Shoshone from Wyoming and Utah approximately 1,200 years ago (MacDonald 2012). Shoshone pottery has a globular shape with flanged bases and flat bottoms, and lacks rim treatment. The exterior and the interior of the pottery is smooth (MacDonald 2012). This type of pottery is mostly discovered in northern Wyoming, but there has been rare discoveries of it in southern Montana. One of the only Late Prehistoric pottery sites that has been discovered in YNP is the First Blood Site (48YE449/457). 48YE449/457 is located on the West Thumb of Yellowstone Lake near the mouth of Arnica Creek (Cannon and Hale 2013). The initial recording was during the 1958-1959 archaeological survey when 33 pottery sherds were discovered during excavation work that resembled Intermountain Ware (Cannon and Hale 2013).

The Late Prehistoric period was also a period when historically known Native American tribes occupied the Yellowstone landscape. There are 26 Native American tribes that are associated with Yellowstone National Park. The more commonly known tribes to inhabit the Yellowstone landscape included the Crow, Blackfeet, Bitterroot Salish, Shoshone, Bannock, and the Nez Perce.

Crow

The Crow speak a Siouan language similar to the Hidatsa people of North Dakota (MacDonald 2018). The Crow made their way onto the Yellowstone landscape no earlier than 1,000 years ago

(MacDonald 2018). When they arrived to Yellowstone they settled in what would be the eastern and northern boundaries of YNP (Spence 1999). Before the Crow arrived in Yellowstone, they were once joined with the Hidatsa people of western North Dakota (MacDonald 2018). They lived in farming villages along the Missouri River (Hanson 1998). The story of the separation is explained by Denig (1961c: 137-138) who tells that the tribal nation was governed by two factions that were headed by two different chiefs who were jealous of one another, and who were trying to be in charge. One day during buffalo hunt, the wives of the two chiefs argued over the manifolds or upper stomach of one of the bison cows. The argument began with words exchanging, and then knives were eventually pulled, resulting in one of the women being killed. Both nations began fighting and killing several from both sides. When the fighting was over, about half of people (Crow) migrated away from the Missouri River towards the Rocky Mountains, while the other half (Hidatsa) remained living along the Missouri River.

When the Crow migrated towards the Rocky Mountains they settled along the Powder River, Wind River, Big Horn River, and the Yellowstone River (Denig 1961c). The areas where the Crow settled also had excellent food resources available. From the mountain bases of the east side to the mouth of the Yellowstone River, bison, elk, antelope, bighorn sheep, black-tailed and white-tailed deer, and grizzly bears roamed throughout. Also, the creeks provided unlimited amounts of beaver, fish, and waterfowl (Denig 1961c). According to Nabokov and Loendorf (2004), there is little data of where and how the Crow ventured into the Yellowstone landscape. However, it said in stories by the Mountain Crow that they traveled through the narrow gap that they call home of their mythic Little People, located just south of present-day Pryor, Montana. From there they traveled with their travois through a valley in the Arrow Mountains and eventually winding through V-shaped canyons which flowed into what would be YNP. Travelers today can drive on State Road 120 heading south from Cody, Wyoming and see the rivers and canyons that the Crow would have traveled through heading towards Yellowstone (Nabokov and Loendorf 2004). Additionally, when YNP was established in 1872, part of the park boundary was within the Crow reservation (MacDonald 2018). The Crow reservation, in 1872, occupied about 8 million acres within Wyoming and Montana; the reservation boundary was established through the Fort Laramie/Horse Creek Treaty of 1851 (MacDonald 2018).

Blackfeet

The Blackfeet arrived in the Yellowstone region around 1800 (Nabokov and Loendorf 2004). According to Nabokov and Loendorf (2004), authors of *Restoring a Presence: American Indians in Yellowstone National Park*, an ethnographic study of Native Americans in the park, the Blackfeet traveled from northern Montana and southern Canada and entered the northern Yellowstone landscape by passing through the Bridger or Flathead Passes near Bozeman Montana. As the Blackfeet made their way out of the passes they would have entered into Paradise Valley, which is just south of Livingston Montana. While traveling through Paradise Valley, Native Americans most likely traveled along the Yellowstone River until reaching area of what is now the town of Gardiner Montana (Nabokov and Loendorf 2004).

During the time when the Blackfeet were first documented (around 1801) to arrive on the Yellowstone landscape, they were a tribe of about 15,000 people, with roughly 9,000 warriors. With an extremely large group size, other tribes feared them because the Blackfeet were known to perform war-like actions among others (Nabokov and Loendorf 2004). For example, when the Blackfeet occupied the northern region of Yellowstone, they forced the Shoshone tribe out of their territory while raiding and stealing their horses. They also caused trouble for any fur trappers that traveled through the landscape by attacking and driving them back out into the plains (Nabokov and Loendorf 2004).

Salish

The Salish were another tribe that visited the Yellowstone landscape. They referred to the Yellowstone area as: 1) K ali ssens (Yellowstone); 2) n' aq es ocq?etKw (Hot Water Coming out of the Ground, or Hot Springs); and 3) mo'mo'tu'lex (Smoke from the Ground). They are people of the Salish-speaking language (Nabokov and Loendorf 2004). According to Nabokov and Loendorf (2004), Carling Malouf's opinion was that the Salish were originally based around the confluence of the Gallatin, Madison, and Jefferson Rivers, which is now the area of the town Three Forks. Eventually, as the Salish occupied the Flathead Lake area, Bitterroot Valley, and the Upper Clark Fork area, they would travel east back to their old hunting grounds in search for bison (Nabokov and Loendorf 2004). The early nineteenth century Bitterroot Salish traveled seasonally, just like the Blackfeet did, in search for bison meat. During their seasonal patterns they would remain in the Bitterroot Valley during the summer months hunting and gathering a diversity of resources, and then travel east towards Yellowstone in the fall to hunt bison (Nabokov and Loendorf 2004).

By about 1800 the Salish made the trip to Yellowstone a biannual tradition by following Sinkakatiiwax (the People's Trail) (Nabokov and Loendorf 2004). The route would have started near Stevensville Montana and continued north through the Bitterroot Valley, and eventually reaching the Missoula Montana area. When entering Missoula, the Bitterroot Salish would have connected to Pattee Creek which flowed between the old Fort Missoula and the University of Montana (UM) (Nabokov and Loendorf 2004). From UM they turned towards the Clark Fork River and followed that to the Blackfoot River in which then they traveled along the north bank of the river for nine miles. Then they crossed over to the south side of the river and continued north until reaching Drummond Montana. From Drummond, the Bitterroot Salish continued to travel on the south side of the Little Blackfoot River towards Garrison. Before reaching Garrison, they crossed the river once again following the north bank of the river towards Avon Montana (Nabokov and Loendorf 2004).

From Avon they traveled towards Elliston Montana where they reached two creeks that flow into the river from the north and from the south. They followed the northernmost creek for a short period until turning east to travel through a pass (possibly Mullan Pass) in the Continental Divide and then traveling down into Helena where they reached the Missouri River; the Salish called the Missouri River *ep iyu ntwe?tkwus or "river of the red paint"* (Nabokov and Loendorf 2004). From the Missouri, the Salish traveled into the Big Belt Mountains and continued east traveling between the Castle Mountains (Little Belt Mountains) and the Crazy Mountains. When moving through this area, the Salish connected with the South Fork of the Musselshell where they saw the first signs of bison. According to Nabokov and Loendorf (2004), there is no further details of how the Salish may have traveled from the Musselshell to Yellowstone. However, it is said that the Salish would have reached the northern rim of the Yellowstone Plateau through the Bridger or Flathead Passes, same way as the Blackfeet did (Nabokov and Loendorf 2004).

Shoshone

The Shoshone are a tribe that have different bands within the main tribe. For instance, there are the Mountain Shoshone, also referred to as Tukudika (Sheep Eaters), Eastern Shoshone (Kukundika – Buffalo Eaters), and the Northern Shoshone (Agaidika – Salmon Eaters). In the Shoshone-speaking language, the term *dika* is translated as "eaters of" because of the dependency for specific food resources (Loendorf and Stone 2006). Each one of these groups visited, hunted and gathered, and lived throughout the Yellowstone landscape. Today, the Mountain Shoshone and the Eastern Shoshone reside on Wyoming's Wind River Reservation, while the Northern Shoshone reside with the Bannock on Idaho's Fort Hall Reservation (Nabokov and Loendorf 2004).

The Sheep Eaters were the 'permanent' residents in the high country of the Yellowstone landscape, as well as throughout other areas of Wyoming, northern Idaho, and southern Montana (Nabokov and Loendorf 2004). The term 'permanent' doesn't refer to as the Sheep Eaters living in stationary villages in the same area for the entire year; but it refers to the Sheep Eaters as being semi-nomadic and following migrating Bighorn Sheep throughout the Yellowstone landscape year around (Nabokov and Loendorf 2002). Much of the Sheep Eater movements within Yellowstone were often along trails that went in a north to south direction following rivers and creeks. One of the primary sites near Yellowstone, Mummy

Cave, is located near one of the prehistoric trails the Sheep Eaters may have used; and today park visitors and drive along that prehistoric trail (Loendorf and Stone 2006). A second trail that may have been used by the Sheep Eaters runs south along Eagle Creek for approximately 30 km (19 miles) until reaching the junction of Thorofare Trail. The Thorofare Trail connects with Absaroka Mountains to the north with the Wind River Mountains to the south (Loendorf and Stone 2006). Continuing from the junction of Eagle Creek Trail and Thorofare Trail, the Sheep Eaters may have traveled south connecting with a series of other mountain trails that led into the Wind River valley. Another direction they may have traveled would have been to turn north onto the Thorofare Trail and travel along the eastern shore of Yellowstone Lake, and connecting with the trails that run throughout the northern portion of the park (Loendorf and Stone 2006).

One of the unique characteristics of the Sheep Eaters was the ability to hunt Bighorn Sheep successfully. The Sheep Eaters were masters at hunting bighorn sheep because they learned the behaviors of Bighorn Sheep. For instance, they knew that when bighorn sheep were surprised they would run upslope onto rock outcrops where it was safe; however, as the Sheep Eaters figured that out, they would construct pits from large boulders approximately 60 – 90 meters (200 – 300 ft.) upslope from open areas of grass that provided a food source for bighorn sheep (Loendorf and Stone 2006). Once the pits were constructed, along with the 4 ft. x 5 ft. x 3 ft. branches and deadwood laid over the top of the pit, the hunters and their dogs would walk slowly in a quartering direction towards the bighorn sheep and push them upslope. As the sheep were trying to escape upslope, the hunters in the pits above would wait until the sheep were close and then pop out of the pits and shoot the bighorn sheep using their bow and arrow (Loendorf and Stone 2006).

A second hunting strategy used by the Sheep Eaters were bighorn sheep drive lines. This hunting strategy was also based on the behavior of bighorn sheep. For instance, the Sheep Eaters understood that during the rutting season in late November, bighorn sheep would gather together on open bare ridges where they could see long distances, and if they felt threatened, they could run downhill for a short time before turning back uphill to escape (Nabokov and Loendorf 2004). When the Sheep Eaters figured this behavior out, they would construct large V-shaped trapping structures made from deadfall and rock cairns in the bighorn sheep escape routes to where the bighorn sheep were funneled between the fencing and driven into catch-pens. The catch-pens were often located in trees where it was hidden, and they are approximately 4.5 – 7 meters (15 – 24 ft.) long and 2 – 4 meters (8 – 14 ft.) wide. In addition, the catch-pens were accessed by a sloping entry ramp constructed from logs, as well as soil and vegetation covering the pen to help conceal their traps (Loendorf and Stone 2006; Nabokov and

Loendorf 2004). Once the bighorn sheep entered the catch-pen, they would be killed by being hit in the head with clubs (Loendorf and Stone 2006).

Bannock

The Bannock are a Shoshone-speaking tribe that are often referred to as Kutsshuyndike (buffalo eaters); Penointikara (honey eaters); and Shohopanaiti (cottonwood Bannock) (Nabokov and Loendorf 2004). Today, the Bannock reside with the Northern Shoshone on Fort Hall Reservation near Pocatello, Idaho (Nabokov and Loendorf 2004). The Bannock occupied the Yellowstone landscape between the late eighteenth to early nineteenth century. They lived in the Snake River and Blue Mountain region of eastern Oregon and would travel west in the fall towards Yellowstone to hunt bison. These hunting trips to Yellowstone became annual events up until the park was established in 1872, when Native Americans were no longer allowed to perform their traditions and the U.S. government forcefully removed them from the Yellowstone area and placed them on reservations (Nabokov and Loendorf 2004). The forced removal of Native Americans sparked two famous wars between Native Americans and the U.S. government; the Bannock War of 1878 and the Nez Perce of 1877 (discussed in next section).

The Bannock War of 1878 began when the Bannock and Shoshone argued against Euro-Americans being able to farm within traditional camas field near Fort Hall, Idaho (MacDonald 2018). Soon after their camas fields were taken over and destroyed, a group of Bannock and Shoshone fled into YNP, forcing General Nelson A. Miles to gather up troops to pursue the Bannock and Shoshone. During their pursuit, the troops set up in an area where they waited for two hours to surprise the group of Bannock and Shoshone. During the surprise attack, the Bannock and Shoshone group lost 80 lives, 250 horses, and 32 prisoners, while the U.S. Calvary lost 40 lives, and a bill to the U.S. Treasury that was over $556,000 (MacDonald 2018; and Nabokov and Loendorf 2004). After the war was finished, many Bannock and Shoshone people were sent to Fort Brown in Wyoming, while others escaped and went back to Fort Hall, Idaho (Nabokov and Loendorf 2004).

Nez Perce

The Nez Perce lived in northeastern Oregon, southeastern Washington, and northern Idaho (MacDonald 2018). They entered the Yellowstone area from the west around 1805 where they hunted and gathered. Their primary travel route was on the Nez Perce Indian Trail, which other tribes including the Spokanes, Salish, and the Cayuse would use for trading horses with the Nez Perce (Nabokov and Loendorf 2004). Upon arrival to the Yellowstone area they were a large tribe of about 6,000 people. They were known for their social and commercial relationships with other tribes, as well as friendly traders with the Crow and European settlers (Nabokov and Loendorf 2004).

The Nez Perce are a tribe, just like the Bannock and Shoshone (discussed above) that was involved in a war, the Nez Perce War of 1877, with the U.S. government over forced removal and being placed on reservations. The war began in late summer of 1877 when the Nez Perce, under the leadership of Chief Joseph, escaped from the reservation to join the Lakota Sioux chief Sitting Bull in Canada (MacDonald 2018). The group of 700 Nez Perce traveled three months through deep canyons and high mountains for approximately 1,200 miles, including 84 miles through YNP (MacDonald 2018). When the Nez Perce entered the park, they encountered a part of tourists, known today as the Radersburg Party. During the encounter, several Nez Perce warriors took the party hostage and traveled northward towards the Madison River where eventually, the warriors looted the wagons, stole supplies, and killed two hostages from the party, as well as took three more hostages (MacDonald 2018).

After the final stand of the Radersburg Party, which is located along the Nez Perce Creek just a few miles north of the Grand Loop Road, Chief Joseph led the Nez Perce across the Yellowstone River to the north shore of Yellowstone Lake where they set up camp. After leaving the campsite, the Nez Perce traveled into the Sunlight Basin, located in the northeastern corner of YNP, where they crossed over Dean Indian Pass and the Chief Joseph Scenic Byway (MacDonald 2018). After crossing over the pass, a group of U.S. military, led by Generals Howard and William T. Sherman chased the Nez Perce along the Clark's Fork Canyon, where eventually the Nez Perce escaped and ended up in the Bear-Paw Mountains of north-central Montana just 50 miles from the Canadian border (MacDonald 2018; and Nabokov and Loendorf 2004). However, in October the U.S. military caught up to the Nez Perce and captured them (MacDonald 2018).

Prior Archaeological Investigations Around Yellowstone Lake

Yellowstone National Park has only had about 4% of its landscape archaeologically surveyed within the last 40 years (Hale and Livers 2013). There have been approximately 300 sites discovered and documented around the shores Yellowstone Lake (MacDonald 2018). Archaeological investigations around the lake increased in the 1980's when the Midwest Archaeological Center (MWAC), an NPS facility located in Lincoln Nebraska, started conducting surveys near the Fishing-Bridge area and along the East Entrance road (Hale and Livers 2013). The Windy Bison Site and the Steamboat Point Site were sites that were discovered during these archaeological investigations

Another archaeological investigation at Yellowstone Lake was when a group of archaeology students from Wichita State University discovered four stone tools on a beach in the West Thumb area of Yellowstone Lake in 2000. The four stone tools that were discovered were related to the Paleoindian period, specifically the Cody Complex (9,500 – 8,000 years ago) (Shortt 2002). The area where the stone tools were observed became known as the Osprey Beach Locality or the Osprey Beach Site (48YE409/410). Based on the dates of when these tools were produced, the Osprey Beach site is viewed as the oldest pre-contact site in Yellowstone (Yellowstone Lake) (Shortt 2002).

After the Wichita State University field crew documented the site, the Museum of the Rockies (MOR) returned shortly after to further test and excavate the site between 2000 – 2003. (Johnson et al. 2013; and Shortt 2002). During the MOR investigations, there were 15 Cody knives, 29 points (including tips and fragments), four cores (including fragments), 34 gravers and burin, two wedges, 12 retouched/utilized flakes, four side scrapers, three end scrapers, 17 bifaces, three knives, 12 sandstone abraders, one edge-ground cobble/anvil, two hide abraders, two adzes, one drill, two hammerstones, and one manuport observed (Johnson et al. 2013:65). Many of these tools that were documented contained blood residue that was traced back to a variety of game including rabbit, bighorn sheep, bear, deer, and bison (MacDonald 2012). The variety of blood residue from different game animals is interesting because it highlights the diverse economy that is associated with this site compared to other Cody Complex sites that are primarily connected with bison hunting (Shortt 2002).

Archaeological sites around Yellowstone Lake have been studied to determine the seasonality of when Native Americans may have occupied the area. According to Ann Johnson, who is a former YNP archaeologist, sites around the lake were most likely occupied during the warmer months of the year. This may be likely because May through October are the only months that have an average temperature around 50°F. The remaining months, November through March, receive about 50 cm (20 inches) of snow each month with an accumulation of about a meter (3 ft.) or more from November through April. Also, between December and mid-late May, Yellowstone Lake is frozen with about 60 cm (24 inches) of ice (MacDonald et al. 2012). In addition, Johnson’s reasoning for seasonality to occur at the lake is because Native Americans establish their movements and settlement patterns based on resource availability, and during the winter months the elk, deer, and bison migrate from the lake region down to lower-elevation valleys. The migration patterns of animals indicate that Native Americans would have left the lake region and followed the animals to lower-elevations (Johnson 2002).

Johnson also highlights that boats were a probable use during the warmer months due to archaeological sites being located on the five islands of Yellowstone Lake. However, a problem with this speculation is that there is very little existing evidence that supports the idea. MacDonald (2012;2018) explains that if boats were used at the lake there should be more evidence of their manufacture in the archaeological record (MacDonald 2018). For instance, there has only been one woodworking tool identified around the shores of Yellowstone Lake; and two adzes observed at the Osprey Beach site during the 2000 – 2003 excavations. However, it was unclear if there was any woodworking wear on those tools (MacDonald 2018). A second reason why boats were most likely not used is low-density of lithics on the south shore. Dr. MacDonald suggests that if boats were used to transport people around the lake, they should have also been used to transport lithic materials to save energy and maximize lithic material availability, which means the lithic densities should be similar around different shorelines of the lake (MacDonald 2018).

The documentation of different lithic materials within archaeological sites around the lake is another way to understand how people traveled, used the landscape, and obtained resources. The most dominate lithic source that was used throughout the prehistory was Obsidian Cliff obsidian (Sanders 2002). Obsidian Cliff obsidian was such a highly used lithic source that there are Hopewell Mounds in Illinois and Ohio that contained obsidian that was sourced back to Obsidian Cliff in YNP. Obsidian Cliff is located about 25-30 miles north/northwest of the north shore of Yellowstone Lake, and it covers about 3,580 acres (Nelson 2015; and Sanders 2002). Most archaeological sites that are located on the north shore of the lake contain about 80 percent of Obsidian Cliff obsidian.

Other lithic sources that have been identified around the lake include Park Point, Bear Gulch, Teton Pass, Cougar Creek, and Crescent Hill chert. Park Point obsidian is located along the eastern shore of Yellowstone Lake (Mclintyre et al. 2013). Park Point covers approximately 600 meters (1,969 feet) of shoreline and is mostly small obsidian pebbles and cobbles that are eroding out of Lava Creek Tuff (Mclintyre et al. 2013). Bear Gulch is another obsidian source that is located about 150 km (93 miles) west of Yellowstone Lake in the Centennial Mountains near the state-line of Idaho and Montana (MacDonald et al. 2012; Nelson 2015; and Park 2010). Bear Gulch obsidian was also known to be one of the major sources associated with Paleoindian artifacts (Nelson 2015). Teton Pass is a fourth obsidian source that is located near Jackson Hole, Wyoming (Park 2010). Cougar Creek is a fifth obsidian source that was used by Native Americans, and it is located about 3.5 km (2 – 3 miles) north of Seven Mile Bridge near the west entrance of YNP. Cougar Creek obsidian appeared to be a poor-quality source with many white inclusions throughout the material, which makes it difficult for a fine-flaking process to occur (Park 2010). The sixth lithic source that was heavily used by Native Americans, especially during the Middle and Late Archaic periods, was Crescent Hill chert. This chert source it is located approximately 50 km (31 miles) north of Yellowstone Lake between Gardiner and Tower Junction (MacDonald et al. 2012; and MacDonald 2014).

Key Regional Late Prehistoric Sites

There have been numerous Late Prehistoric sites documented around the lake, as well as in other parts of the GYE (Figures 4 and 5). There are three key Late Prehistoric sites that have been excavated in the Yellowstone Lake region that provide knowledge of the Late Prehistoric Native American lifeways. The three sites include: 48YE449, 48YE475, and 48YE549. Furthermore, there are three other sites that resemble Late Prehistoric occupation, and those include: 24YE353, 24YE357, and Mummy Cave. Table 1 and 2 below presents the Late Prehistoric sites that have been recovered at Yellowstone Lake. Figures 4 and 5 show key site locations.

Table 1: Late Prehistoric sites at Yellowstone Lake, Wyoming

East Shore Sites	**Age**
48YE678	LA; Late Prehistoric
48YE2080	MA; Late Prehistoric
48YE2082	LA; Late Prehistoric
48YE2083	LA; Late Prehistoric
48YE2084	LA; Late Prehistoric
48YE2085	MA; Late Prehistoric
48YE2090	Late Prehistoric?
48YE2105	Late Prehistoric?
Flat Mountain Arm Sites	**Age**
48YE1381	LA; Late Prehistoric
48YE1383	Late Prehistoric; LA
48YE1384	Late Prehistoric; LA
48YE1387	Late Prehistoric
48YE1388	EA; MA; Late Prehistoric
48YE1602	LA; Late Prehistoric
48YE1604	MA; LA; Late Prehistoric
Island Sites	**Age**
48YE442	LA; Late Prehistoric
48YE475	Late Prehistoric
North Shore Sites	**Age**
48YE1	Paleo.; EA; MA; LA; Late Prehistoric
48YE304	Paleo.; EA; MA; LA; Late Prehistoric
48YE392	Late Prehistoric
48YE549	Paleo. EA; MA; LA; Late Prehistoric
Northeast Shore Sites	**Age**
48YE695	LA; Late Prehistoric
48YE696	Late Prehistoric
48YE697	Late Prehistoric
48YE701	Paleo.; MA; LA; Late Prehistoric
Northwest Shore Sites	**Age**
48YE381	Paleo.; MA; LA; Late Prehistoric
48YE417	Paleo.; MA; LA; Late Prehistoric
48YE1553	Paleo.; Late Prehistoric
48YE1556	EA; Late Prehistoric
48YE1558	Paleo.; MA; LA; Late Prehistoric

48YE2102	Late Prehistoric
48YE2109	Late Prehistoric
48YE2111	Late Prehistoric
South Arm Sites	**Age**
48YE1329	EA; LA; Late Prehistoric
48YE1337	MA; LA; Late Prehistoric
48YE1576	Paleo.; MA; LA; Late Prehistoric
48YE1631	EA; MA; LA; Late Prehistoric
48YE1698	Paleo.?; Late Prehistoric
48YE1703	Paleo.?; MA; LA; Late Prehistoric
48YE1705	Late Prehistoric
Southeast Arm Sites	**Age**
48YE252/253	EA; MA; LA; Late Prehistoric
48YE736	MA; LA; Late Prehistoric
48YE1588	Paleo.; EA; MA; Late Prehistoric
48YE1589	Late Prehistoric
48YE1591	Paleo.?; MA; Late Prehistoric
48YE1592	Paleo.; Late Prehistoric
South Shore Sites	**Age**
48YE231	Paleo.; MA; Late Prehistoric
48YE409/410	Paleo.; EA; MA; LA; Late Prehistoric
48YE1642	LA; Late Prehistoric
48YE1645	LA; Late Prehistoric
48YE1656	Late Prehistoric
48YE1670	Late Prehistoric
48YE2190	MA; LA; Late Prehistoric
West Thumb Sites	**Age**
48YE246	Late Prehistoric
48YE396	Paleo.; MA; LA; Late Prehistoric
48YE397	MA; Late Prehistoric
48YE449	EA; MA; LA; Late Prehistoric
48YE454	MA; LA; Late Prehistoric
48YE650	MA; Late Prehistoric
48YE652	EA; LA; Late Prehistoric

Table 2: Late Prehistoric sites at Yellowstone Lake containing faunal evidence

Site	Age	Fauna	Evidence
48YE1	Paleo.; EA; MA; LA; Late Prehistoric	Bear, Deer, Dog, Elk, Rabbit	Blood Residue
48YE381	Paleo.; MA; LA; Late Prehistoric	Bovine, Bear, Deer, Dog	Blood Residue
48YE392	Late Prehistoric	Elk	Bone
48YE409/410	Paleo.; EA; MA; LA; Late Prehistoric	Bear, Bighorn Sheep, Bison, Deer, Rabbit	Blood Residue
48YE475	Late Prehistoric	Bison	Bones
48YE549	Late Prehistoric	Rabbit	Blood Residue
48YE696	Late Prehistoric	Deer	Blood Residue
48YE697	Late Prehistoric	Bighorn Sheep, Bison, Elk	Bone
48YE701	Paleo.; MA; LA; Late Prehistoric	Bighorn Sheep, Cat, Dog, Rabbit	Blood Residue

48YE1553	Paleo.; Late Prehistoric	Bovine, Deer, Rat	Blood Residue
48YE1588	Late Prehistoric	Unidentifiable	Bone
48YE1631	EA; MA; LA; Late Prehistoric	Ungulate (deer, elk, etc.)	Tooth fragment

48YE449 (The First Blood Site) is located near the mouth of Arnica Creek. 48YE449 is divided into three different sections; the first section is Subarea East, the second section is Subarea West, and the third section is subarea 457 (Cannon and Hale 2013). This site is a key site at Yellowstone Lake, as well as in the park because it is one of the only Late Prehistoric sites in YNP that contained evidence of pottery being used. Subarea East is the first area that was initially discovered in 1958-1959 by MSU archaeologists that recovered 33 pottery sherds, as well as one chert projectile point, four retouched obsidian flakes, four obsidian biface fragments, one rhyolite biface fragment, one quartzite biface, and a mottled reddish grey chert biface (Cannon and Hale 2013). The pottery sherds that were discovered resemble an Intermountain Ware, and the inclusions in the paste indicates that the clay was located locally (Cannon and Hale 2013). During excavations (shovel tests) in this subarea, there were five more pottery sherds documented, along with one obsidian corner-notched projectile point (Late Holocene), one red obsidian serrated projectile point tip (Late Prehistoric), and one triangular obsidian point with corner notches and a straight base (Late Holocene) (Cannon and Hale 2013).

Additionally, Subarea East produced radiocarbon dates from soil samples with average dates around 1320 calibrating years B.P. (Cannon and Hale 2013). During the investigation at Subarea West, this section of 48YE449 produced a larger variety of lithic artifacts; no additional pottery sherds were recorded. The lithic artifacts that were observed included: one indented base obsidian point (McKean types), one point fragment with a straight serrated blade of banded tan chert (Avonlea type), one obsidian corner-notched straight-based point with a radiocarbon date of 1500 years B.P.; and one obsidian point base fragment possibly Middle Holocene (Cannon and Hale 2013). In addition, two wood charcoal samples were collected from two features that produced radiocarbon dates of 4575 ± 67 B.P., and 1626 B.P. (Cannon and Hale 2013). The third area, Subarea 457, was investigated in 1992, with a recovery of a large amount of debitage, obsidian being the primary lithic source. There was also a side-notched projectile point with a convex base that was observed as being similar to the Blackwater side-notched pints that were documented at Mummy Cave, dating to about 7630 years B.P. (Cannon and Hale 2013). Overall, 48YE449 contains evidence that this site was being occupied from Middle Archaic through the Late Prehistoric period.

Dot Island (48YE475) is a small island located at the mouth of the West Thumb (Cannon 1997). This island is covered with an open overstory of lodgepole pines. The west end of the island is steeply banked due to the constant wave action occurring. Furthermore, 48YE475 was initially investigated in 1992 with a recovery of six bison elements. The six bison elements documented at the site included: one left femur, a left and right metatarsal, a left fused second and third tarsal, and a left lateral second and third phalanges (Cannon 1997).

The exact age of the carcass elements is unknown, but the investigators estimated the age to be 9,000 years B.P. or younger. The estimated the age was based on the age of the shoreline that faunal elements were discovered in. The minimum ages of shorelines along the northwestern shore of Yellowstone Lake, and in the West Thumb area were used to produce an age for the faunal elements. According to the shoreline data in the West Thumb area, the shorelines at 48YE475 closely resemble S4 shorelines, which dates to 9000 B.P. (Cannon 1997). However, in 2016, Dr. MacDonald and the University of Montana field crew team investigated the island, and recovered a bison tibia on the same bank of the initial investigation (1992) that had a radiocarbon age of 760 ± 30 B.P. (Late Prehistoric) (Beta-444704).

This site is a key site because it presents the interpretation that Late Prehistoric Native Americans may have been accessing the island to obtain bison that were occupying the island, or that Native Americans were living on the island and hunting bison on the main land of Yellowstone Lake and transporting the faunal elements back to the island to consume or use. In addition, Dr. MacDonald and the UM team, collected a charcoal sample from a fire-horizon that had a radiocarbon dating of 2120 ± 30 years B.P. (Beta-44705), indicating that the island had a brush fire during the Late Archaic period.

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Site 48YE549 (Fishing Bridge Pump Station Site) is another Late Prehistoric site that is located north of Fishing Bridge near several dirt roads that access the rental cabins and the water treatment plant behind the Fishing Bridge General Store (Livers and MacDonald 2010). This site was initially documented in 2006 by Reeves et al. 2006, while conducting inventory of sites along the Yellowstone River's eastern bank from the Fishing Bridge Peninsula north to the Upper Falls (Livers and MacDonald 2010). During the initial observation, there were numerous projectile points recovered from the surface, including one Early Archaic point, and one Late Archaic point (Livers and MacDonald 2010). This site was again visited in 2010 by Dr. MacDonald and the University of Montana field crew. During the 2010 recording, there were numerous lithic artifacts that identified 48YE549 as being a Late Prehistoric occupation.

There were five Late Prehistoric projectile points documented, along with three features. Two of the Late Prehistoric features observed at the west end of the of the site, were aged between 240 – 940 years ago. The third feature, located in the east end of the site, suggested the site was occupied about 220 years ago (Livers and MacDonald 2010). Furthermore, all three features suggested that this was site was used as a short-term camp. The reason for this suggestion is because the features were built on the surface with no preparation. Also, there was a low artifact density with the features; most of the artifact density was obsidian and chert debitage from tool production and maintenance (Livers and MacDonald 2010). In addition, of the 438 lithic artifacts documented near the features, 97.5% was debitage, while the remaining was five unifaces (four utilized flakes, and an endscraper), and six bifaces (two late stage, two points, one mid-stage fragment, and one indeterminate fragment) (Livers and MacDonald 2010).

During the recording of 48YE549, there were 40 lithic artifacts collected and submitted for testing/sourcing. Of those 40 samples, 36 of them were associated with the Late Prehistoric Period (Livers and MacDonald 2010). In addition, 34 of the Late Prehistoric artifacts were sourced to Obsidian Cliff, while the remaining two artifacts were linked to Teton Pass (near Jackson, Wyoming). Also, the two Teton Pass artifacts suggests that there was southward movement by Late Prehistoric Native Americans (Livers and MacDonald 2010). Furthermore, three Late Prehistoric projectile points that were recovered from the site were tested for blood protein. Two of the three of points were tested positive for rabbit (Livers and MacDonald 2010).

A fourth Late Prehistoric site is the Malin Fish Hole site (24YE353). This site is located along the Yellowstone River roughly 5 miles (8 km) upriver from Gardiner, Montana (Cannon 1997). The site is also located about 50 miles northwest of Yellowstone Lake. During the initial investigation, numerous lithic artifacts were documented on the surface of the site. The lithic artifacts observed include: edge-ground cobbles, hammerstones, scrapers, bifaces, and cores (Cannon 1997). In 1989, there were three test units put in at the site; two of the test units were placed over fire-rock features that were eroding out of the bank, and the third test unit was placed over a lithic concentration (Cannon 1997).

The test unit that was placed over the lithic concentration produced 57 specimens, but the only identifiable carcass parts were a tooth fragment from a deer, elk, or some other artiodactyl, and the left sesamoid of a bighorn sheep (Cannon 1997). The second test unit was placed a fire-rock feature, and produced 334 carcass elements. The recovered elements were associated with 14 taxonomic groups, and at least seven genera. A sample of the fauna include, bighorn sheep, wapiti (i.e. elk), bison, northern pocket gopher, and water vole. In addition, a charcoal sample that was collected from the feature produced a radiocarbon dating of 1260 ± 50 B.P.. Also, the feature contained high levels of pollen, which suggests that the feature was used to process plants. The feature also contained evidence of fauna being roasted (Cannon 1997).

Furthermore, the third test unit contained 430 faunal bones that reflected 10 taxonomic groups. Some of the fauna samples included bighorn sheep, northern pocket gopher, mouse, wapiti, bison, deer, antelope, and water vole (Cannon 1997). In addition, a charcoal sample was collected from the feature, and produced a radiocarbon dating of 1180 ± 60 B.P. (Cannon 1997). The most significant evidence to be documented from this test unit are the bones (vertebrae) from a fish, specifically a sucker. These two elements were recovered from the matrix of the 1180 ± 60 B.P. hearth (Cannon 1997). Also, the recovery of the fish bones makes this site important because it is the first site in the park to contain evidence of fish being possibly exploited by Native Americans.

The Airport Rings site (24YE357) is a key Late Prehistoric site because it contains 11 stone circles. This site is located north of Gardiner, right along the Old Yellowstone Road (Livers 2009). The site was initially observed by Tom Jerde in 1986, and resurveyed and mapped by Dr. MacDonald and the MYAP team in 2007 (Livers 2009). In 2008, the MYAP team revisited the site to conduct archaeological excavations (test units) at three of the 11 stone circles observed stone circles (Livers 2009). During the first investigation by Jerde, there were 11 stone circles observed, historic debris, a possible historic foundation, and lithic scatters consisting of debitage (Livers 2009). While investigating the site in 2008, the MYAP team discovered a Late Prehistoric tri-notch projectile point on the surface roughly 500 feet from the site. A second artifact that was observed on the surface near the site was a quartzite end scraper.

Additionally, in 2008, three (Features 4, 6, and 8) out of the 11 stone rings were excavated. These three features were excavated because they were the most intact, and provide potential knowledge of how the site was used during the Late Prehistoric Period (Livers 2009). Features 4 and 8 were excavated because there were portions of rock that was exposed in the center of the rings that provided dateable archaeological knowledge of the site. Feature 4 consisted of two hearths (features 4.1 and 4.2) that were located in the interior of the stone ring. A wood charcoal sample was collected from each hearth which yielded radiocarbon dates of 340 ± 40 B.P. for Feature 4.1, and 4520 ± 40 B.P. for Feature 4.2 (Livers 2009). Feature 6 was excavated because it was the smallest stone circle that could provide knowledge of its age and how it was utilized (Livers 2009). In total, there were 39 test units (14 in feature 4, 12 in feature 6, and 13 in feature 8) that were excavated at these three stone rings (Livers 2009).

In addition to the excavation of the three stone rings, a total of 687 lithic artifacts were documented, including 350 lithic artifacts from Feature 4, 178 from Feature 6, and 155 from Feature 8. The majority of the lithics that were identified in Feature 4 consisted of flaking debris (160+ flakes), however, there were also 15 stone tools recovered. The stone tools that were recovered included: five unifaces, 10 bifaces, and five projectile points. Two of the unifaces were produced from Crescent Hill chert, while two other unifaces were produced from obsidian. The fifth uniface was a small red chert or porcellanite end scraper (Livers 2009). The projectile points that were recovered included three Late Prehistoric side-notched points, one Middle Archaic Oxbow point base, and one untyped (possibly Late Archaic) point fragment (Livers 2009). Two of the three Late Prehistoric projectile points were produced from Obsidian Cliff obsidian, while the third Late Prehistoric projectile point was sourced to Crescent Hill chert (Livers 2009). The fourth projectile (Middle Archaic) was produced from a translucent obsidian, and the fifth projectile point (possible Late Archaic) was sourced to Crescent Hill chert (Livers 2009). The diversity of projectile points, as well as the hearth ages, indicates that this stone circle was being occupied during multiple time periods, beginning in the Middle Archaic Period (4500 years ago) (Livers 2009).

The artifacts observed in Feature 6 included 174 flakes and four biface fragments (Livers 2009). Two of the four biface fragments were identified as projectile points, and the other two fragments were a late stage biface, and a mid stage biface (Livers 2009). The two projectile fragments were identified as Late Prehistoric, one being an Avonlea point, and the other being an Avonlea or another Late Prehistoric type point (Livers 2009). Additionally, the majority of the late stage reduction flakes that were observed, were concentrated in the northeast corner of Feature 6. The location of the flaking debris provides an indication that this site was used as a cold weather camp, in which activities occurred inside the tipi (Livers 2009). However, considering there was not a hearth observed within the interior of the stone ring, this possibly indicates that the site was occupied during the warmer season with the hearth being located outside the lodge (Livers 2009).

During the excavation of Feature 8, there were 138 flakes, three unifacially retouched flake tools, and one possible hammerstone documented (Livers 2009). Also, similar to Features 4 and 6, the late stage flaking debris that was observed inside the ring possibly suggests that the reduction activities were focused towards the fire in the center of the lodge (Livers 2009). Furthermore, while excavating Feature 8.1 (hearth or roasting pit), there was large amount charcoal and fire-cracked rock recovered which indicates the fire was burning very hot and fast (Livers 2009). A sample of the charcoal of was collected from the feature and yielded a radiocarbon dating of 270 ± 50 B.P. (Livers 2009). Also, during the excavation process, there was a thick ash layer that was observed in the northeastern section of the stone ring. The thick layer of ash within the interior of the stone ring possible indicates that the fire was burning during a winter storm, and a southwesterly wind was blowing through the tipi and blowing the ash against the east/northeast area of the interior tipi (Livers 2009).

Lastly, there was also a total of 208 faunal elements that were documented from the excavations. Feature 4 consisted of 101 carcass elements, including six large game animals (i.e. bison, elk), three medium mammals (i.e. deer, pronghorn, bighorn sheep), and two general game animals (Livers 2009). The hearth (feature 4.1) in Feature 4 contained 34 carcass elements, including nine being identified as bison, one unidentified large game animal, one unidentified medium game animal, and 23 unidentified elements (Livers 2009). Feature 6 had one unidentified carcass element, and Feature 8 consisted of two elements belonging to a large game animal that contained evidence of being burned (processed for food); two elements of a general game animal (burned); and 11 elements being unidentified, also burned (Livers 2009). In addition, the hearth (Feature 8.1) in Feature 8 contained a total of 57 carcass elements that contained evidence being burned; the elements include three large game animals, and 54 unidentified elements (Livers 2009).

The last Late Prehistoric site to be discussed is Mummy Cave (48PA201). Mummy Cave is a large rock shelter that was highly associated with the subsistence of bighorn sheep. This site was initially investigated in 1963, and is located along the Shoshone River and U.S. Highway 14 and 20, roughly 34 miles west of Cody, Wyoming (Husted and Edgar 2002). The site is also located about 40 miles east of Yellowstone Lake. During the excavation of Mummy Cave, investigators revealed 38 cultural layers (Husted and Edgar 2002). Cultural layers 36 and 38 are significant Late Prehistoric layers that contain evidence of how Native Americans lived within the region. Cultural layer 36 has a radiocarbon date of 1230 ± 110 B.P., and cultural layer 38 yields a radiocarbon date of 340 ± 90 B.P. (Husted and Edgar

2002). The oldest cultural layer at this site is layer four, which consist of a radiocarbon date of 9230 ± 150 B.P. (Husted and Edgar 2002).

During the excavation of cultural layer 36, investigators recovered a large number of lithic artifacts. The artifacts that were observed included: 158 flakes (combination of modified and utilized), 167 projectile points, 39 knives, 31 scrapers, 23 gravers, 12 blanks, 9 choppers, 22 rough stones (i.e. axes, cobble anvil, hammerstones, grinding stones, etc.), and 3 polished stones (i.e. beads and pendants) (Husted and Edgar 2002). In addition, there were 30 fire pits recovered; 22 of the fire pits were rock-filled roasting pits, and the remaining eight were basin-shaped fire pits (Husted and Edgar 2002). These fire pits would have likely been used for cooking, and for keeping warm. One of the ways these firepits were possibly used was by placing stones on a bed of hot coals, and when the stones became heated, food would be placed on top and then covered with dirt or mulch for several hours (Kornfeld et al. 2010).

Furthermore, there were also elements of a trap or snare that were recovered. One element is a stick with a short cylindrical length that is tied within a central portion of a long length of two-ply S-twist *Yucca* cordage (Husted and Edgar 2002). The Y*ucca* cord is wrapped around each end of the stick five times. There is also an overhand knot at one end of the cord (Husted and Edgar 2002). A second element contains a short section of twig with two-ply S-twist cordage looped around it eight times (Husted and Edgar 2002). If the two elements reflect a snare, it could have been used to obtain smaller rodents. For instance, pack rats can occupy caves, moving throughout cracks and other openings in canyon walls (Frison 2004). Native Americans could have potentially used the snare by placing it inside the hole or crack in the wall and waited for the pack rat to emerge, and once emerged the snare would be drawn tight around its neck (Frison 2004).

In addition to the excavation of cultural layer 36, there were 33 bone specimens, six antler specimens, and one horn specimen recovered. Also, only five of the 33 bone specimens were identified with a fauna species. The five elements included one tibia awl (sheep), one perforated awl (deer or sheep), one scapula saw (sheep), one bear tooth (black bear), and one beaver tooth (Husted and Edgar 2002). The six antler specimens observed were associated with mule deer, and the single horn specimen belonged to a bighorn sheep (Husted and Edgar 2002). The recovery of both bighorn sheep and mule deer elements in the same cultural layer was likely due to the fact that both of these fauna species are found in the same habitat. Male mule deer normally occupy the same type of environment as bighorn sheep; rough, rimrock country (Kornfeld et al. 2010). The presence of these two fauna species in the same habitat, would allow for hunters to obtain two different meat sources in the same location without having to make a second trip to a different location.

Cultural layer 36 also contained small fragments of bone and scales from an unidentified fish species (Husted and Edgar 2002). The fish elements contributes to the possibly thought that fishing may have been a subsistence strategy that Native Americans conducted when living in the area. In addition to the bone and scales, there was a notched pebble that was recovered from layer 36 that may have acted as a net sinker for catching fish. The Mummy Cave site, as well as the Malin Fish Hole site (24YE353) (previously discussed) are two significant sites that contains evidence that fishing possibly occurred within the Greater Yellowstone Ecosystem. In addition to these two sites, there were also two fishing artifacts, held at the Smithsonian Institution, that were supposedly collected from Yellowstone Lake. The two artifacts include: one notched stone/net sinker, and one possible prehistoric fishing lure. However, these two artifacts are not well-documented, and the provenience, age, and cultural affiliation is unknown (MacDonald 2018). The only current data available are ethnographic accounts that discuss that the Shoshone and Bannock knew Yellowstone Lake contained fish, but it is unclear if they actually fished at the lake (MacDonald 2018).

The most significant discovery in the Mummy Cave cultural layer 36 was a human burial that was uncovered from a rock cairn. The body was resting on its right side in a flexed position facing the shelter wall with the head facing to the west (Husted and Edgar 2002). In addition, one of the wrist joints on the body was broken (Husted and Edgar 2002). Furthermore, the body was wrapped in a bighorn sheep robe or blanket and sewn together with a sinew (Husted and Edgar 2002). The hair on the back of the head contained a chord that was possibly used to tie the hair back. In addition, near the left ear was an ornament produced from feathers and fur strips (Husted and Edgar 2002).

Cultural layer 38 was a thin layer that consisted of 14 projectile points, two end scrapers, and 47 pottery sherds (Husted and Edgar 2002). The pottery sherds were part of a single vessel that was produced through the process of lump-modeling, and finished with a paddle (Husted and Edgar 2002). One of the pottery traditions during the Late Prehistoric Period was the Intermountain Pottery Tradition (Frison 1978). This pottery tradition is normally affiliated with the Shoshone, which were known to inhabit the area where Mummy Cave is located (Frison 1978). The pottery sherds that were discovered at the First Blood site (48YE449) also appeared to be part of the Intermountain Pottery Tradition. The style of the Intermountain pottery is often a flowerpot shape with a flat bottom; it is also thick and poorly fired with ungraded tempering material of different sizes (Frison 1978). In addition, the pottery recovered from the Mummy Cave has a flat base that connects with the body of the vessel that has a goblet (flowerpot) shape (Husted and Edgar 2002). The similarities between the pottery sherds observed at the First Blood site and at Mummy Cave likely indicates use of both sites by the Shoshone during the Late Prehistoric Period.

Chapter Three

Theory

This study is derived from the principles of processual and optimal foraging theory. The goal for this chapter is to provide an overview of these two theories, as well as the concepts within, to understand the behaviors and decisions hunter-gatherers possibly conducted when living on the Yellowstone landscape. Additionally, this chapter will provide a strategy and a model that reflects the possible decisions hunter-gatherers made when encountering and obtaining resources.

Processual Theory

Processual theory plays a role in this study because it focuses on the formation processes, including the operation of physical, chemical, and the organic structures of archaeological assemblages (Johnson 2004). For example, the botanical and faunal remains that are discarded in the archaeological record can be studied to interpret why, and how hunter-gatherers may have settled and moved throughout the landscape. The remains also present how hunter-gatherers may have collected and foraged for plants and animals. Furthermore, archaeologists study faunal remains as a strategy for interpreting how the carcass elements were used; why they were discarded; and why specific bones were left behind or transported back to another location (Johnson 2004).

Furthermore, the study of faunal remains has been one of the most productive research focuses that archaeologists have pursued (Johnson 2004). One of the more valuable strategies for understanding faunal assemblages within the archaeological record is by constructing economic utility indices. Economic utility indices quantify and scale the elements of an animal based on the amount of food (i.e. meat, marrow, and grease) an element contains (Metcalfe and Jones 1988).

Economic utility indices were originally developed by Lewis Binford during his 1978 ethnoarchaeology work with the Nunamiut Eskimo of north-central Alaska. The economic utility indices that he constructed were based on the anatomical characteristics of caribou and sheep. His goal was to construct utility indices that reflect how different parts of an animal contain different quantities of food components (meat, marrow, and grease). The assumption behind economic utility indices is that when a hunter or a group of hunters kill a large animal far away from their residential camp, they are unable to transport the entire carcass back to the camp; resulting in the hunters having to butcher the animal at the point of capture, and then transporting certain elements back to their central camp (Metcalfe and Jones 1988).

Additionally, economic utility indices are a useful tool because they provide a sense of knowledge of the possible transportation, and consumption decisions conducted by hunters (Metcalfe and Jones 1988). Lastly, the production of economic utility indices has continued to be used by other researchers that have focused on a variety of other animals including, bison (Emerson 1990), white-tailed deer (Madrigal and Holt 2002), antelope (O'Brien and Liebert 2014), wild boar (Rowley-Conwy et al. 2013), and phocid seals (Lyman et al. 1991).

Optimal Foraging Theory

Optimal foraging theory (OFT) and processual theory go hand-in-hand because they both focus on the past behaviors and decisions made by hunter-gatherers. Optimal foraging theory is a subset of evolutionary ecology, in which it's applied towards understanding human behavior, morphology, and life history (Broughton et al. 2010). OFT is built from numerous models that reflect how hunter-gatherers make decisions to maximize the net rate of energy gain (Bettinger et al. 1991). The decision that are most often conducted include diet choice, foraging location and time, foraging group size, and settlement location (Bettinger et al. 1991). The OFT model used in this study is the Central Place Foraging (CPF) model, which attempts to solve problems such as: 1) where to locate a central place (residential site) in relation to foraging locations; and 2) once a central location is established, what types of food resources should be pursued and obtained?; which patch(s) should be used, and the load size?; and how much of the food source should be transported back to the central camp (Sutton and Anderson 2010:84)?

The CPF model in this study (Figure 6) predicts that the hunters subsistence decisions will change as the round-trip travel time increases from a central camp to a foraging location, and then back to the residential camp (Bettinger and Malhi 1997). For example, if a hunter kills a large game animal (i.e. elk) further away from their residential site, they may decide to field process the animal at the kill site, and transport the selected carcass parts (high-utility) back to a central location. The reasoning for making this decision is so the hunter can increase the rate of energy delivery back to a residential camp (Cannon 2003). In other words, the hunter doesn't want to burn more calories going back home than what they burned during the search trip. The field processing of selected carcass elements will allow the hunter to save and obtain more food calories.

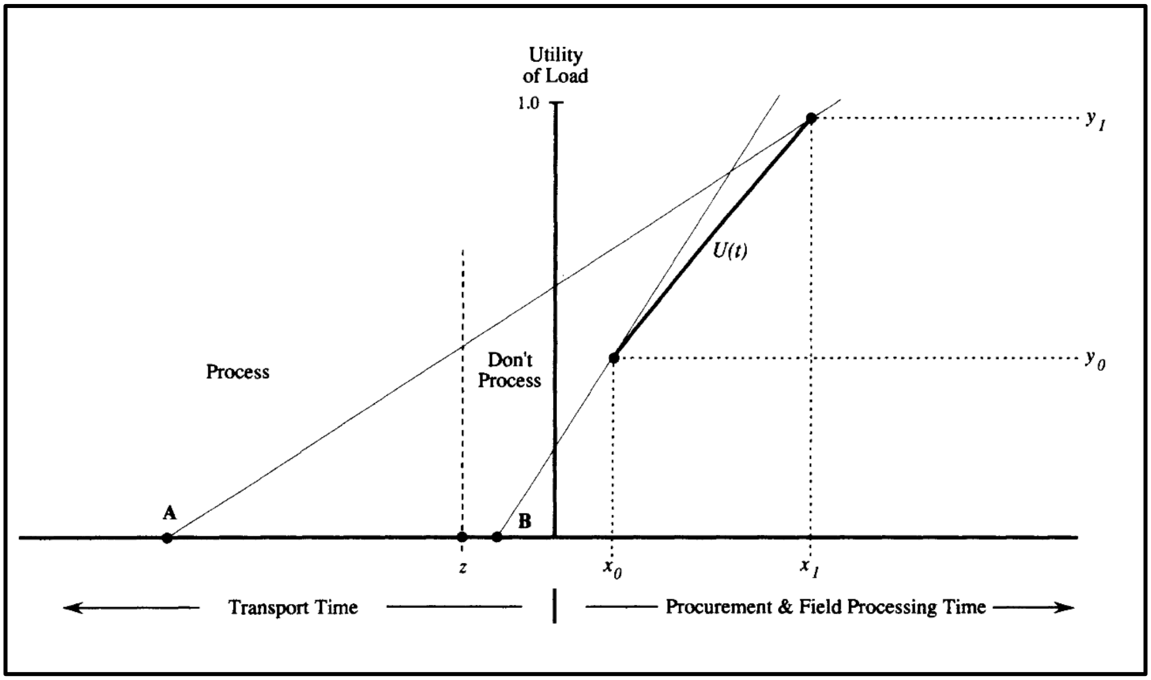

Figure 6: Central Place Foraging Model – figure adapted from Metcalfe and Barlow 1992

The purpose of using this model for this research, as well as why other researchers (Barlow and Metcalfe 1996; Bettinger and Malhi 1997; Bird and Bliege 1997; and Metcalfe and Barlow 1992) have used this model, is to grasp an understanding of which carcass elements are more likely to be removed from a carcass, and transported back to a residential site; it is also used to determine which carcass elements are likely to be left behind at the kill/butchering site. In addition, the assumption for this model is that there are low and high valued carcass elements, and that the hunter will decide which parts, and how much of those parts will be removed before transporting the remaining carcass elements back to camp (Beck 2008).

Lastly, according to Cannon (2003), the logic behind CPF models is that if a hunter spends more time field processing the animal carcass, then more low-utility elements should be removed from the carcass load and transported back to the central camp; resulting in the utility of the transport load (measured in calories per unit weight) being increased. On the other hand, if a hunter spends more time field processing an animal as the transport distance increases, then a smaller portion of low value carcass elements should be transported back to the central camp when further away foraging locations are used (Cannon 2003).

Seasonal Transhumance

This section of the chapter presents the idea that people schedule their movements based on when food resources become available in a specific area. The goal of this concepts is to provide reasoning of why the remains of bison, elk, and bighorn sheep were discovered at 48YE697.

Kelly (1983) highlights that optimal foraging models primarily focus on the foraging strategies rather than the mobility strategies. However, mobility strategies are an important contributor the development of foraging strategies. Mobility strategies are defined as "the nature of seasonal movements of hunter-gatherers across a landscape: mobility strategies are one facet of the way in which hunter-gatherers organize themselves in order to cope with problems of resource acquisition (Kelly 1983:277). One pattern based on seasonal movements is seasonal transhumance. Seasonal transhumance is defined by Davis (1963:202) as "the practice of changing abode in a regular and traditionally recognized way, as natural food crops are followed."

The focus of seasonal transhumance was brought to attention by Davis (1963) who studied hunter-gatherer settlement patterns in the western Great Basin. The hunter-gatherers in this area followed a seasonal transhumance by moving throughout different elevational zones in search for food sources that became available during certain times of the season (Davis 1963). The reasons for hunter-gatherers to follow this type of seasonal cycle is because: 1) it allows them to collect and use a variety of resources that become available at different elevations; and 2) it gives hunter-gatherers climatic protection (Davis 1963:202). For instance, hunter-gatherers who lived in the lower elevation valleys in or near the Yellowstone landscape during the winter months (assuming people were living and moving throughout the Yellowstone landscape on a seasonal basis) would collect food resources that were available. During the warmer months, they would move into higher elevations to obtain food resources that were available during the warmer months.

A second scholar, (Arthur 1966), also applied the seasonal transhumance cycle to the northwestern Great Plains. Arthur (1966) investigated 44 archaeological sites within the 100 miles of the Yellowstone River Basin (beginning at the north boundary of YNP). Arthur (1966) discovered that sites that were located in lower elevations, north of the park, contained a variety of grinding tools such as manos, metates, and cobbles that would have been used toward plant materials; while sites that were located in the higher elevations near, or in YNP, mainly consisted of hunting tools (i.e. projectile points). Additionally, Arthur (1966) observed that the sites located in the higher elevations were smaller in size, compared to the sites that were located in lower elevations of the river basin.

The different tool types, as well as the size differences between the lower elevation and high elevation sites are a strong indicator that hunter-gatherers were moving into different elevational zones to obtain different food sources. For example, the sites that are located in lower elevations may have been used during the winter months where there were a dense variety of plants that could be obtained. Also, the sites that contained more grinding tools provides a possible indication that meat sources may have been scarce in the area, forcing hunter-gatherers to obtain more plant sources than meat sources. Also, one possible reason for more hunting tools to be found in higher elevation sites is due to hunters following game animals that would move into higher elevations during the summer months to obtain new vegetation that became available. In addition, as snow levels diminished, game animals were able to access higher elevations, which would also allow hunters to access the higher elevations.

Bender (1983) explains that if hunter-gatherers were following a seasonal transhumance cycle, then they would have scheduled their movements on a year-to-year agenda as way to select campsites located in specific areas that contained available resources. Bender (1983) also mentions that the goal for hunter-gatherers would have been to schedule their movements through different elevational zones as a strategy for intercepting food resources that became available during the year.

The concept of resource scheduling and seasonality was addressed as early as 1968 by Kent Flannery. Flannery studied the scheduling and seasonality techniques of the prehistoric peoples of Mesoamerica. Flannery (1968:227) states that “scheduling involves a decision as to the relative merits of two or more courses of action.”. For example, food gathering groups in the Great Basin would depend on scouting reports from relatives based on what animals or plants are available, or will become available as they were passing through specific locations (Flannery 1968).

Similar to Flannery’s study, Binford (1978:169) describes Nunamiut Eskimo groups traveling away from a central camp to monitor the location and availability of food resources. The reasons for groups to monitor food resources is because: 1) they can obtain knowledge and information about how many animals are present, as well as the timing of their movements; and 2) to be able to kill and obtain meat early. Additionally, the monitoring and scouting reports would provide groups with an idea of when food sources can be exploited, as well as if there has been any changes or differences in the growing season, or animal migration dates (Flannery 1968). Flannery (1968) also describes seasonality and scheduling as being an opportunistic mechanism that allows plants and animals to not be over-harvested, as well as for there to be an opportunity for an equal balance between food resources every year.

The concepts of seasonal transhumance, and seasonality and scheduling has become valuable for explaining faunal assemblages produced by hunter-gatherers (Bender 1983). For example, the knowledge of when and where animals migrate can be an important factor for understanding why the carcass elements of specific animals (bison, elk, and bighorn sheep) would have been discovered at 48YE697. These concepts are also important for understanding why hunter-gatherers may have settled, moved, or hunted and gathered in this specific area.

Bison was one fauna type that was discovered at 48YE697. Bison are migratory animals in which they move from lower wintering grounds in the spring to higher elevational ranges in the summer; repeating this movement in the fall (Meagher 1973). Figures 7 and 8 display the seasonal routes and locations of Yellowstone bison herds. Figure 7 represents the migration routes of the historical Mountain Bison (*Bison bison athabascae*) that were once present in YNP before the 1902 introduction of Plains bison. The locations and routes presented on the map were constructed based on early sightings and occasional bones being discovered in certain areas including along the Gardner River, near Mammoth Hot Springs, and on the Mirror Plateau (Meagher 1973).

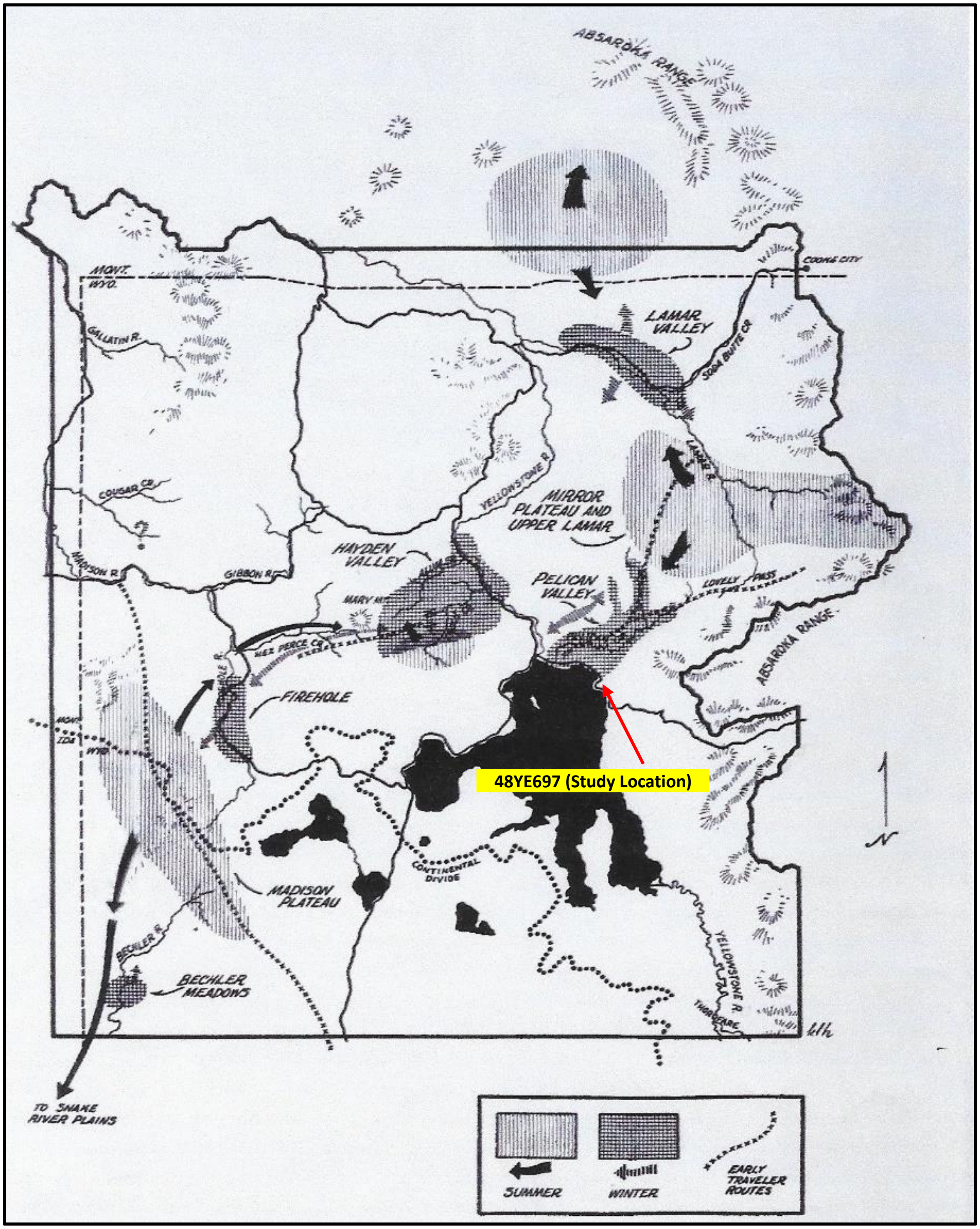

Figure 7: Historic map of bison migration routes in YNP – figure adapted from Meagher 1973

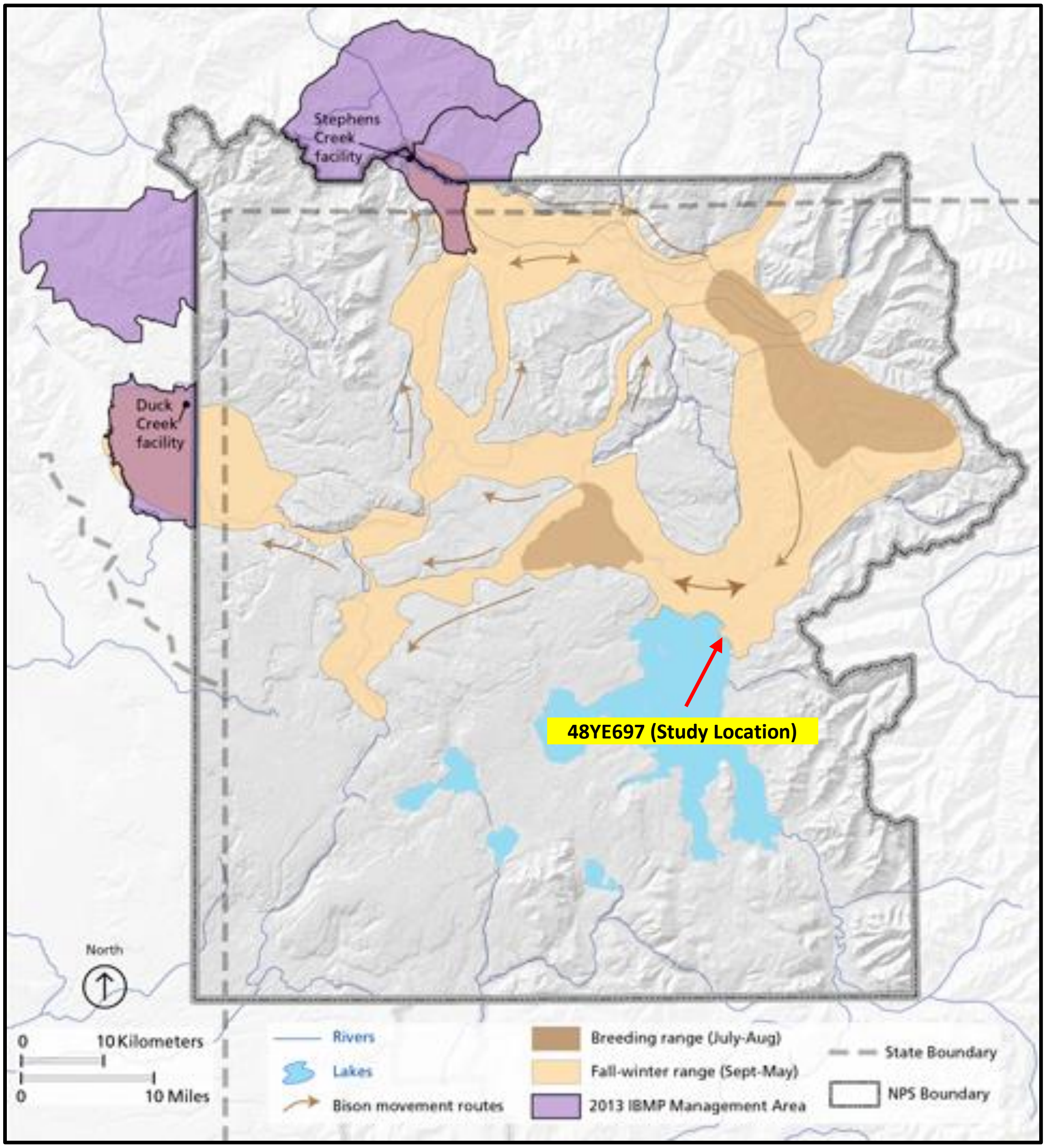

Figure 8: Modern-day bison migration routes in YNP – figure adapted from NPS 2018

Figure 8 represents the migration patterns of the modern-day Yellowstone bison (*Bison bison*). According to (Meagher 1973:26), the present-day bison are a hybrid of two subspecies which include the Plains bison from Montana and Texas, and the Mountain Bison. The plains bison from Montana and Texas were introduced to the park in 1902 as an attempt to recover the bison population (Meagher 1973).

The important connection between these two figures that the ranges and migrations routes of the Mountain bison and the modern-day bison are still the same. The modern-day bison continue to follow the same migration paths after 100+ years. In addition, the importance of Figure 8 is that it highlights the Steamboat Point area, the location of 48YE697, as being placed in the bison migration route between the Pelican Valley and the Upper Lamar. According to historical accounts from early travelers, there was a bison trail that connected the Pelican Valley to the Upper Lamar that went across the Mirror Plateau, and then crossed over Lovely Pass, located between Raven and Mist Creeks (Meagher 1973). According to a study that was conducted on bison movements between the Pelican Valley and the Upper Lamer, wintering bison herds would begin their movements from the lower and upper Pelican Valley to the Upper Lamar during the first week of June (Meagher 1973). The bison herds were observed in early summer near the lower ridges of the Upper Lamar including Mount Norris, Cache-Calfee and Miller Creek ridges, and Little Saddle Mountain (Meagher 1973). From the end of June to mid-July, herds began to move higher towards the east boundary of the park near the Hoodoos, Canoe Lake, and Saddle Mountain. In late July to early August, bison herds began to reverse their migration pattern by moving down ridges, and crossing the Lamar River heading towards the Mirror Plateau where bison traveled along the northeast rim of Flint Creek to Upper Raven Creek, eventually making their way back to the Pelican Valley area (Meagher 1973).

The figures presenting the bison migration routes and ranges is important in this research because it indicates that bison continue to use the same migration paths and ranges as they did before YNP was established. The figures are also important because they show 48YE697 as being located in the migration routes, which reflects why the faunal remains of bison were discovered at 48YE697.

Furthermore, understanding the migration patterns of bison, as well as other animals, helps towards determining the possible locations of other archaeological sites that may contain faunal remains. For example, Figure 9 highlights the locations of where bison remains have been discovered. The two sites, 48YE353 (Malin Fish Hole site) and 48YE366 are located near the north boundary of the park, which appears to be located near the fall and winter migration paths. The other two sites on Figure 9, one of which is the Windy Bison site, are located within the migration routes and ranges of the Pelican Valley, and the Upper and Lower Lamar; the location of these four sites provides a visual of why there were archaeological sites that contained bison remains.

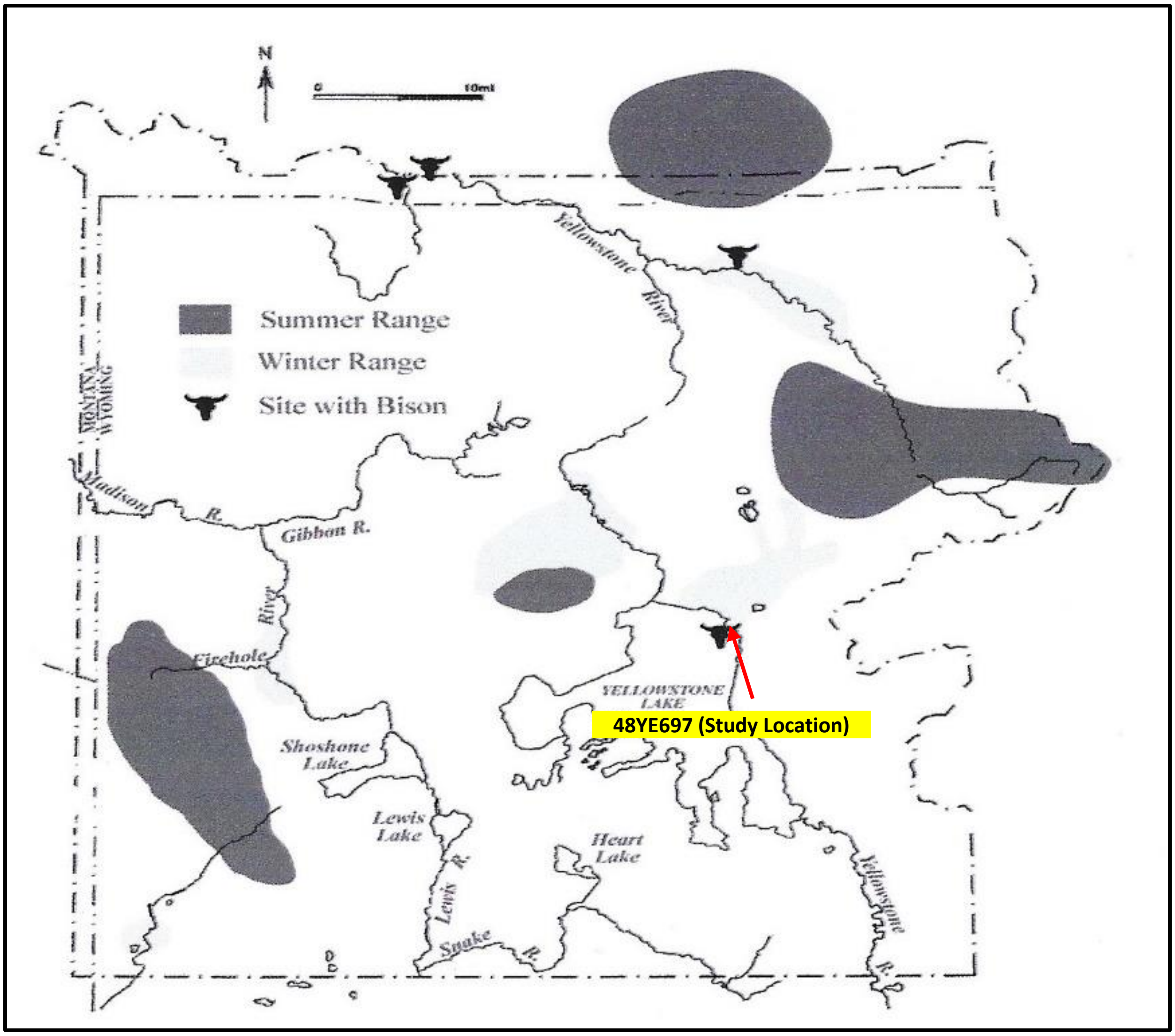

Figure 9: Map displaying bison migration routes and archaeological sites with bison remains – figure adapted from Cannon 2001

A second migration example that provides evidence of why the remains of a specific fauna were documented at 48YE697 is elk migration patterns. Elk are another migratory animal that moves between their summer and winter grounds each year. Figure 10 presents the migration movements of Yellowstone elk herds. Similar to the migrations paths of bison, the Steamboat Point area (48YE697) is located in the area where elk are known to reside during certain times of the year. In 2007 and 2008, the Montana Fish, Wildlife, and Park (FWP) conducted a study on the Northern Yellowstone elk herd (the elk herd that inhabits the area around 48YE697) to determine when the elk herd begin their migration process. Results from the 2007 study show that the herd began to move away from their winter ranges (north of YNP) on April 14th and arriving at their summer grounds on June 14th. During the

2008 study, the elk herd began to migrate on April 27th and arriving to their summer range around July 20th (Cunningham et al. 2008).

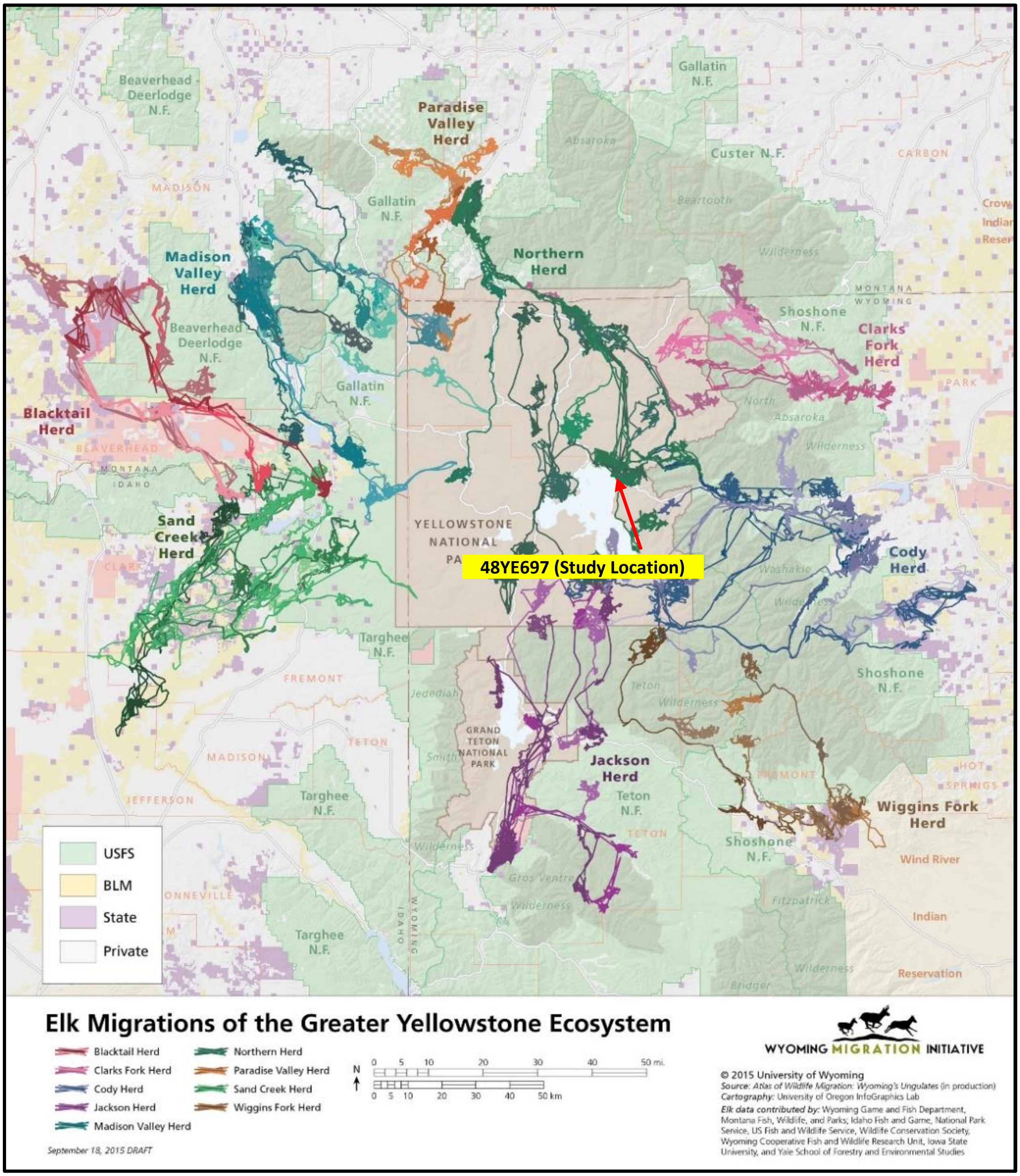

Figure 10: Map of migration routes for different elk herds in YNP – figure adapted from Greater Yellowstone Migration 2018

The figures displaying the ranges and migration patterns of bison an elk presents the idea that if hunter-gatherers monitored and studied the seasonal movements of these animals, they would have been able to schedule their own movements that would allow for them to intercept these resources as they migrated out, or into the area.

The last concept that reflects why these specific animals may be found in this area, is the landscape, and what it offers. For instance, 48YE697 lies in a landscape that is surrounded by thermal areas and features. A thermal area is defined as a geologic unit consisting of one or more thermal features associated with hydrothermal altered ground, hydrothermal mineral deposit, geothermal gas emissions, or heated ground (Vaughan et al. 2014). Thermal features are defined as a vent, or a small cluster of related vents emitting gasses, hot water, or both (Vaughan et al. 2014). Figure 11 presents a map of the thermal activity that occupies the area near 48YE697. The largest thermal area near 48YE697 is Turbid Lake, which is a 1 km (diameter) hydrothermal explosion crater located roughly 2.5 miles northeast of the Windy Bison site. Turbid Lake is considered one of the largest unfrozen bodies of water in the winter. A possible reason for this is because of the thermal waters of Turbid Springs, which lies at the southern end of Turbid Lake, as well as the underwater thermal vents located in the area (Vaughan et al. 2014). The importance of thermal locations is that they provide warmth for animals during colder times of the season, as well as food resources (i.e. plants). Thermal areas would have also been beneficial for hunter-gatherers because they would have provided them with a place to search for food resources if it was still cold when they arrived into the area.

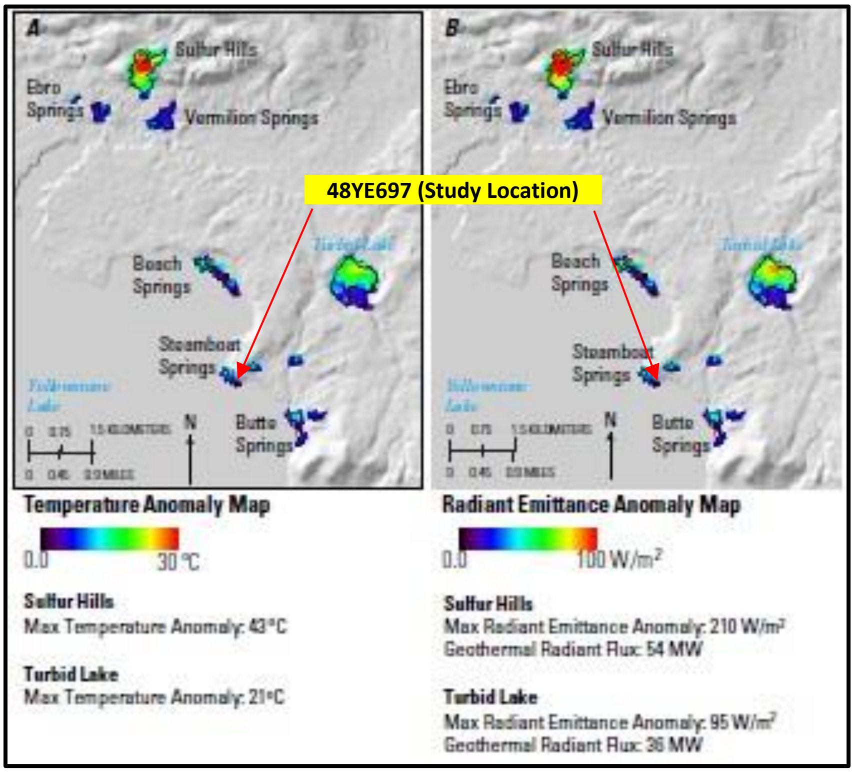

Figure 11: Map displaying the thermal features located near 48YE697 – figure adapted from Vaughan et al. 2014

Mobility and Site Patterning

In addition to understanding the importance of seasonal transhumance, and how hunter-gatherers may have scheduled their movements based on available resources, it is also important to understand how hunter-gatherers possibly moved in and out of a site, or between multiple sites. Binford (1980) describes the movements of hunter-gatherers as being characterized by two types of mobility strategies: 1) residential mobility, and 2) logistical mobility. These two mobility strategies were studied by Lewis Binford (1980) during his ethnoarchaeology fieldwork with the Nunamiut Eskimo as a way to understand how hunter-gatherers move throughout the landscape in pursuit of resources; and also how their mobility strategies provide an understanding of the spatial patterning in archaeological sites.

Binford's (1980) approach was based on a systemic perspective in which he states "human systems of adaptation are assumed to be internally differentiated and organized arrangements of formally differentiated elements. Such internal differentiation is expected to characterize the actions performed and the locations of different behaviors. This means that sites are not equal and can be expected to vary in relation to their organizational roles within a system" (Binford 1980:4). This quote is used to explain that there are different types of sites that are associated with different activities. For instance, 48YE697 reflects the type of site where the killing and/or field processing has occurred, while a residential site is where multiple day-to-day activities such as sleeping, eating, and making tools occur.

Residential mobility is identified as being a strategy practiced by foragers, who practice a 'mapping on' strategy (Binford 1980). 'Mapping on' refers to when foragers move their residential camps fairly often to other locations where resources are known to be found (Binford 1980). Foragers commonly associate themselves with two different site types; the residential base, and the location. The residential base is the primary site for subsistence activities, as well as processing, manufacturing, and maintenance activities. A location site (i.e. 48YE697) is where small activities are performed such as killing, and/or field processing (Binford 1980).

Additionally, location sites that are used for processing can be expected to contain a larger number of butchering tools and lithic debris; have fire features and heat-altered rock; possibly contain a large diversity of faunal species, depending on the type of site, length of occupation, and the types of activities that occur; and lastly, primarily contains broken, high-utility faunal elements, and a few articulated skeletons (Byerly et al. 2007:138). On the other hand, if a location site is where a kill has taken place, the site may include a natural or man-made trap; a higher concentration of projectile points; a low number of fire features, and heat-altered rock; a low species diversity; and a large number of whole bones, usually low-utility elements, and articulated skeletons (Byerly et al. 2007:138). In addition, location sites (i.e. 48YE697) are commonly located in the foraging radius of the residential base. The foraging radius is identified as the area searched and exploited by task groups who leave the residential site using an 'encounter approach' as a strategy to obtain resources that the group can transport back to the residential site in the same day (Binford 1981b).

The second mobility strategy, logistical, is identified by Binford (1981b) and (Binford 2001) as being a point-to-point movement practiced by collectors. This type of movement is associated with residential camps that are not being constantly moved to another location based on an encounter approach (Binford 2001). Instead, a point-to-point movement is identified as residential sites being placed in known locations (i.e. Steamboat Point area) where resources are available, and collectors or task groups can travel short or far distances away from the residential site (Binford 1980). In addition, if food resources (i.e. bighorn sheep, bison, or elk) are obtained successfully by collectors, they may decide to field process and transport the food source back to a residential location (Binford 1980).

As task groups are away from the residential camp, they may develop four different types of sites including: locations (discussed in residential mobility), field camps, stations, and/or cache sites (Binford 1980). These four types of sites are used when task groups travel outside of the foraging radius, also known as the logistical radius. The logistical radius is referred to as the zone that is used by task-groups who remain away from the residential base camp for at least one night before returning back to central camp (Binford 1981b).

Location sites within a logistical mobility strategy are used the same way as in a residential mobility strategy, in which they are places where procurement and field processing activities occur (Binford 1980). Field camps are sites used by collectors to sleep, eat, and maintain themselves as they are away from their residential base camp (Binford 1980). Field camps are also constructed and differentiated based on the types of resources that are being pursued (Binford 1980). Stations are identified as sites where task groups gather and obtain information about a resource (i.e. elk migration patterns) (Binford 1980). Additionally, stations can be used as ambush stations and/or hunting blinds that allow the task groups to develop hunting strategies, but not necessarily perform those strategies right away (Binford 1980)

The developed hunting strategies are organized around the types of resources the task-groups are trying to pursue. The reasoning for this is because different food resources have different behaviors, which is why hunting strategies are planned based on how specific animals behave and react in certain circumstances. For example, when bison are spooked by a predator, they will flee as a herd rather than scatter individually, making them an easier target for the predator (Carlson and Bement 2012). One example of a hunting strategy is for task groups to construct drive-lines in areas where they know bison occupy or tend to escape when they are in danger. The purpose of a drive line is to funnel the bison herd towards a specific location where they can be intercepted by hunters sitting in blinds, or to be driven off jumps or into arroyo traps. The last site used by collectors are cache sites. Cache sites are developed to store large bulk items from a procurement that is too large for a task group to transport back to their residential base camp (Binford 1980).

In summary, processual and optimal foraging theory focuses on the past behaviors and decisions made by hunter-gatherers. Processual theory is used in this research to determine why specific faunal elements were discarded, and why other elements were transported. OFT is used to determine how high-utility and low-utility carcass elements play a role in the transportation decisions made by hunters. The overall goal for hunters is to obtain more calories through food resources than to burn while traveling back home, or searching for food. In addition, the assumption is that when a hunter is further away from a residential site, they will field process and transport the high-utility elements, leaving the low-utility elements back at the kill or processing site.

The concept of seasonal transhumance focuses on the scheduling of seasonal movements by hunter-gatherers. One of the ways in which hunter-gatherers schedule their seasonal movements is resource availability. The purpose of scheduling seasonal movements to have the opportunity to intercept resources as they become throughout the year. A strategy for determining when to move is to monitor the resources. In this research, it would be based on the migration patterns of bison, elk, and bighorn sheep. If hunters monitored the migration patterns of these animals, they would have been able to schedule when they should move into the area to intercept these animals as they were moving in or out of the region.

The purpose of presenting the migration patterns of the bison and elk was to possibly understand why the faunal remains of bison, elk, and bighorn sheep were discovered at 48YE697. The mobility strategies and site patterning described by Binford was presented to determine how hunter-gatherers may have moved throughout the Steamboat Point area, and what type of sites they may have produced while living in the area. In addition, the mobility and site patterns also presented what type of activities occur with the different site types. Lastly, the combination of these theoretical perspectives allows for the interpretation of what type of site 48YE697 is, and why certain carcass elements were at 48YE697, and also missing from this site.

Chapter Four

Methods and Materials

This chapter provides details of the materials and methods used to analyze the bison, elk, and bighorn sheep remains discovered at the Windy Bison Site (48YE697). The goal for this research is to construct economic utility indices using zooarchaeological methods as a way to determine the economic value of carcass elements; and to interpret the field processing and transportation decisions made by hunters.

Materials

The materials used to analyze the faunal remains, and to construct economic utility indices includes:

1) Binford, Lewis R. 1978 *Nunamiut Ethnoarchaeology*. Academic Press, New York.

2) Cannon, K.P., K.L. Pierce, P. Stormberg, and M.V. MacMillan 1997. *Results of Archaeological and Paleoenvironmental Investigations Along the North Shore of Yellowstone Lake, Yellowstone National Park, Wyoming:1990-1994*. National Park Service, Midwest Archaeological Center, Lincoln.

3) Emerson, Alice Marie 1990. *Archaeological Implications of Variability in the Economic Anatomy of Bison bison*. Ph.D. dissertation, Department of Anthropology, Washington State University, Pullman.

4) Metcalfe, Duncan, and Kevin T. Jones 1988. A Reconsideration of Animal Body-Part Utility Indices. *American Antiquity* (53)3, pp. 486-504.

The Cannon et al. 1997 report is used in this research to construct tables that include the types of faunal elements, the species of those faunal elements, the side and portion of the element, and lastly, the cultural modifications (i.e. score marks) of the element. Emerson's 1990 dissertation is highly important for this thesis because it provides the carcass weights (including meat, marrow, and grease) of an individual bison, which is useful in determining the utility of the bison discovered at 48YE697. Binford's 1978 *Nunamiut Ethnoarchaeology* book is used similar to Emerson's 1990 data to provide weights for the bighorn sheep and elk remains. Lastly, Metcalfe's and Jones's 1988 research is used as a rule for calculating, and determining the different weights for the food components associated with the documented, and missing carcass elements from 48YE697.

Methods

Review of the Cannon et al. 1997 report began by gathering the previously developed tables in the report that contained all of the information collected from the 1990 – 1994 investigations. The report contained tables and results of the different faunal elements that were discovered at 48YE697; the side and portion of the element; and if there were any natural or cultural modifications on the elements.

Once the tables were obtained from the report, a quantification summary was constructed using zooarchaeological methods, which included the number of identified specimens (NISP), minimum number of elements (MNE), minimum number of individuals (MNI), and the minimum number of animal units (MAU). Additionally, the quantification summary is used for two reasons: 1) it provides a simple visual of what elements were discovered at 48YE697, and 2) to construct utility indices that provide the economic value for the faunal remains. The economic value for each carcass element will include meat, marrow, and grease.

The number of identified specimens (NISP) refers to the number of identifiable fragments of each bone for each faunal species (Lyman 1994:44). The NISP was determined by counting the fragments and/or whole bones associated with the type of bone discovered. This quantification was used to separate the identifiable from the unidentifiable specimens collected. MNE is defined as the minimum number of individual elements which refers to the whole and the fragmentary specimens studied in the faunal assemblage (Lyman 1994: 42).

The MNI is defined as the number of individual fauna associated with the identified carcass element (Lyman 1994:43). The MNI was determined by calculating how many of the same carcass elements are present within the assemblage. For instance, there were three bison tibias discovered at 48YE697, one left, and two right tibias. An individual bison only has one right and one left tibia, so with an observation of two right tibias, the minimum number of bison would be two. The number of individual fauna is considered to a minimum because there could potentially be three individual bison at 48YE697, but it is difficult to know exactly if one right tibia is associated with the left tibia, or if the left tibia belongs to one individual, and the two right tibias belong to two other individuals.

Furthermore, the faunal elements from Cannon et al. 1997 tables were sorted into left sides, right sides, and un-sided. The un-sided is determined if the side is unknown. In addition, the reason for separating the fragments and/or whole bones is to determine the approximate number of specific bones that are in the faunal collection. For example, if there are 4 scapula fragments, and fragments 1-3 overlap, but fragment four does not overlap with the other fragments, then there could potentially be two scapula elements, a left and a right.

The minimum number of animal units (MAU), refers to the number of a specific faunal element that was discovered in the bone bed (Sutton 2007). The MAU is calculated by dividing the MNE (minimum number of elements) by the total number of times that faunal element occurs in a complete species skeleton (Lyman 1994:42). For example, if the MNE for femur is 12 (bison example), then the 12 is divided by 2, equaling 6 because there are two femurs (a left and a right) in a bison. The MAU can also be observed as %MAU, which represents a standardized value that ranks the carcass parts of a faunal assemblage (Sutton 2007). The %MAU is calculated by taking the MAU value of a carcass element and multiplying that by 100, and then dividing that number by the maximum MAU observed in the faunal collection (Lyman 1994:42). For example, if the MAU value for metatarsals is 1, then the 1 is multiplied by 100 (equaling 100). The 100 is then divided by the highest MAU value (i.e. rib = 5.5), which will equal 18.2. The 18.2 represents the frequency of the carcass element (metatarsal) in the faunal assemblage. A high frequency value means that the metatarsal is a low utility part (shortage of meat, marrow, and bone grease) and was potentially left behind by hunters (Sutton 2007).

The next process was to collect the weights of the field samples (bison, elk, and bighorn sheep). However, due to the age of the faunal remains discovered at 48YE697, the meat, marrow, and grease weights were not available use for this study. As an alternative approach, the weights from Emerson's 1990 research and Binford's 1978 research were adapted to resemble the weights and economic values of the carcass elements from the three species investigated at the Windy Bison site (48YE697).

The bison weights (meat, marrow, and grease) were used from Emerson 1990 because the research was conducted on a spring adult male. The weights from the spring adult male are used to reflect the 48YE697 bison because the bison that was discovered in the bone bed was also an adult male that was possibly obtained by hunters in the spring. The reasoning for this prediction is because the investigators who were studying the bison from 48YE697 discovered that there were no insect carcasses recorded from the bison skeleton; this means the bison was possibly killed during a cold time of year (spring or winter) when insects were not out yet (Cannon and Hale 2013).

The weights for the elk meat, marrow, and grease are adapted from Binford's 1978 field work with the Nunamiut. Binford conducted research on a bull caribou, between ages 3 – 5, that was obtained by the Nunamiut Eskimo has a strategy to determine the economic values of each carcass element, and the decisions of why the Nunamiut Eskimo obtained and transported specific faunal elements. The reason for using Binford's caribou weights is because there doesn't appear to be an elk utility index yet constructed, and due to the lack of time for this research, an elk was unable to be collected and butchered. Also, the weights of the caribou are used to resemble the elk because both elk and caribou have similar characteristics of one another. The difference between the two would be the size of the bodies, because elk are normally larger than caribou.

Lastly, the weights (meat, marrow, and bone grease) of the bighorn sheep will also be used from Binford's 1978 ethnoarchaeology research. The weights that will be adapted are from a 7 ½ year old domestic sheep. The reason for using the weights of this adult domestic sheep is due to the assumption that the bighorn sheep that was identified at 48YE697 was also an adult sheep. Also, the domestic sheep was used because it will have similar characteristics as the bighorn sheep. Similar to the elk sample, the difference between the domestic sheep and the bighorn sheep will be the body size and weight.

Furthermore, as the food component values are determined for each carcass element, they will be placed into three separate tables (meat, marrow, and grease) corresponding with the specific carcass element. Once the tables are constructed for the meat, marrow, and grease, the food component values will then be applied towards the construction of economic utility indices. A utility index for each food component (meat, marrow, bone grease) will be constructed to determine the economic value of each carcass element. There will be one meat-utility indices constructed to reflect the economic utility for the bison, elk, and bighorn sheep elements. The bison will have a separate utility index from the elk and bighorn sheep because the bison is the primary focus for this research.

Three marrow utility indices will be constructed to represent the bison carcass elements. The first index will present the marrow utility values for bison leg bones. The second index will display the marrow utility values for proximal and distal ends of bison leg bones. Lastly, the third index is a percent comparison between the amount of marrow cavity volume in proximal and distal ends of leg bones. The reason for constructing marrow utility indices just for bison is because there were carcass elements from 48YE697 that contained score marks, which possibly indicates meat or marrow was being removed or extracted from the bone during the butchering process.

Third type of economic utility index to be constructed is the grease utility index. Once again, there will be two grease utility indices constructed, one presenting the grease values for bison, and one index presenting the grease for elk and bighorn sheep. The index for the bison will show the values of each carcass part based on the weight of the grease. The index for the elk and bighorn sheep will be on the %oleic acid, which refers to the quality of grease in each carcass element (Binford 1978).

The fourth, and final type of utility index to be constructed is the standardized food utility index (S) FUI. This index will be developed to represent the bison elements. This index will be only produced for the bison because the majority of the bones that were documented at the site were associated with bison. Also, using a larger number of elements will allow the (S)FUI to reflect which carcass elements would have been utilized.

The (S) FUI refers to the economic utility of the combined meat, marrow, and bone grease of each carcass element (Metcalfe and Jones 1988). The importance of a (S) FUI is that it takes into account of the “riders” that are associated with the high-utility carcass elements. Riders are identified as low-utility elements that are still connected to high-utility elements during the fielding processing and transportation processes (Reitz and Wing 2008). In addition, riders are taken into account because it is assumed that when a hunter field processes an animal, they are dividing carcass elements into sections rather than a single carcass element (Binford 1978).

The last process for analyzing the faunal remains is to develop a table that displays ethnohistoric data of the fauna species that were discovered at 48YE697. The table will reflect how the bison, elk, and bighorn sheep were used by different Native American tribes. The uses that are described in the table include: food, utensils, accessories, tools and weapons, and other. In addition, the Native American tribes that are discussed in this table are not to be reflected as the only tribes to find bison, elk, and bighorn sheep useful. These tribes were brought to attention based on the information that was discovered during the research process of this thesis.

The faunal data from the economic utility tables and indices will be used to interpret what type of site 48YE697 reflects, processing and/or kill site. For instance, if the tables and indices display a variety of broken, high-utility elements, and few articulated skeletons, then it is possibly that the Windy Bison site was a processing site. However, if the tables and indices present a low species diversity, and a large number of whole bones, usually low-utility elements, and articulated skeletons, then 48YE697 could be considered a kill site (Byerly el al. 2007:138). In addition, economic utility indices will be used to interpret the selection and transportation decisions made by hunters. For instance, if the carcass elements that were documented at 48YE697 contain a low-utility value, then it is possible that when hunters were butchering the animal at the site, they field processed those low-utility elements, and transported the high-utility elements back to a residential location.

Chapter Five

Analysis and Results

The initial hypothesis for this study centers on the notion that when a hunter or a group of hunters kill a game animal further away from their residential site, they will field process and transport the high-utility carcass elements back to a central camp, leaving the low-utility carcass elements at the processing site or kill site. The goals for this hypothesis include: 1) determine what type of site 48YE697 represents based on the faunal remains; and 2) to understand the selection and transportation decisions made by hunters based on the faunal remains both present and absent from the site. These goals are achieved through the development of economic utility indices and tables.

Economic Utility Indices

Prior to the economic utility indices being constructed, a quantification summary table (Table 3) was produced to display the different carcass elements, including the number of complete and/or bone fragments that were recovered from 48YE697. This table was constructed by using the previously produced tables from Cannon et al. 1997 to determine the number of individual specimens (NISP), the minimum number of elements (MNE), the minimum number of individuals (MNI), the minimum number of animal units (MAU), and lastly, the standardized MAU (%MAU). When each of these values were determined, they were then totaled individually.

The NISP represents the total number of complete bones, as well as the bone fragments. The MNE is a further representation of the NISP, in which it determines if any of the bone fragments overlap with one another to produce a single faunal element. As the MNE was calculated, the number of single elements that were identified were then calculated by dividing the MNE by the number of times the bone occurs within a living animal to determine the minimum number of animal units (MAU). For example, in row seven, the MNE for the humerus is one because there was one humerus observed in the bone bed; the MNE for the humerus is then divided by two because there is a total of two humerus bones in a living animal. The MAU for this calculation is 0.5. The last value to be calculated in the summary table is the %MAU. The %MAU is the standardized value that ranks the carcass elements that were discovered in the Windy Bison bone bed. To determine the %MAU, the MAU value is divided by the largest value in the MAU column. This calculation was completed once the MAU was determined for each faunal element. For instance, the largest MAU value in the summary table is 2.2, which corresponds with the pelvis and sacrum.

The elements that resemble the pelvis (posterior, inferior illiatic spine; and illium portion) are only portions of the pelvis, but for this research, they were presented as if they were a complete pelvis. The reason for referring to the illium portion, and the posterior, inferior illiatic spine as being a complete pelvis is because the data that is used from Emerson (1990) and Binford (1978) is based on complete faunal elements. Furthermore, when the MAU value of the humerus, 0.5, is divided by 2.2, the result equals to be 0.227; this is then multiplied by 100 (standardized value), equaling 22.7. This calculation method was conducted on each carcass element.

In addition to the quantification summary table, the MNI refers to the number of individual animals that are associated with the carcass element. The majority of the carcass elements displayed in Table 3 belong to one single animal. The carcass elements that were discovered and calculated into an MNE value are only associated with a single elk and bighorn sheep. The majority of the bison carcass elements that were calculated belong to the single young, adult bull bison; however, there were two right tibias and two different thoracic elements (vertebrae's 1-14; and a fifth or sixth thoracic vertebrae) that were previously recorded in the Cannon et al. 1997 tables. The identification of the two right tibias and the two separate thoracic vertebrae elements highlights that there were two different bison present at 48YE697.

Table 3: Quantification summary for discovered faunal remains from 48YE697

Element	Bison					Elk					Bighorn Sheep				
	NISP	MNE	MNI	MAU	%MAU	NISP	MNE	MNI	MAU	%MAU	NISP	MNE	MNI	MAU	%MAU
Calcaneous															
Left calcaneous	1	1	1	0.5	22.7										
Total	1	1	1	0.5	22.7										
Carpals															
Right medial carpal	1	1	1	0.5											
Left intermediate carpal	1	1	1	0.5											
Total	2	2	1	1	45.5										
Caudal Vertebrae	5	5	1	1.25	56.8										
Fifth cervical vertebrae											1	1	1	0.2	100
Sixth cervical vertebrae	1	1	1	0.2	9.1										
Femur	2	2	1	1	45.5										
Humerus	1	1	1	0.5	22.7										
Hyoid	1	1	1	1	45.5										
Metatarsal															
Left metatarsal	1	1	1	0.5											
Unsided metatarsal						1	1	1	0.5	50					

Unsided second metatarsal	2 2 1 1		
Total	3 3 1 1.5 68.2		
Patella	2 2 1 1 45.5		
Pelvis + Sacrum			
Posterior, inferior illiatic spine (articulates with the illium portion)	2 1 1 1		
Illium portion		1 1 1 1 100	
Fifth sacral vertebrae	1 1 1 0.2		
Sacrum (sacral arches 1-4)	1 1 1 1		
Total	4 3 1 2.2 100		
Phalanges			
Front third phalanx	1 1 1 0.25		
Hind third phalanx	1 1 1 0.25		
Left front first phalanx	1 1 1 0.25		
Hind first phalanx	1 1 1 0.25		
Hind second phalanx	1 1 1 0.25		
Front second phalanx	1 1 1 0.25		
Total	6 6 1 1.5 68.2		
Radius + Ulna			
Left radius	1 1 1 0.5		
Left ulna	1 1 1 0.5	1 1 1 0.5 50	
Total	2 2 1 1 45.5		
Rib	9 7 1 0.47 21.4		
Scapula	1 1 1 0.5 22.7		
Sesamoid			
Left proximal sesamoid	1 1 1 0.06 2.7		
Total	1 1 1 0.06 2.7		
Sternum	1 1 1 1 45.5		
Tarsal			
Central tarsal	1 1 1 0.5		
Fourth tarsal	1 1 1 0.5		
Second tarsal	1 1 1 0.5		
Third tarsal	1 1 1 0.5		
Total	4 4 1 1 45.5		
Tibia			
Right tibia	2 2 2 1		
Left tibia	1 1 1 0.5		

Total	3	3	2	1.5	68.2		
Thoracic Vertebrae							
Thoracic Vertebrae (1-14)	1	1	1	1			
Fifth or sixth thoracic vertebrae (includes anterior vertebrae epiphysis)	2	1	1	0.07			
Total	3	2	2	1.07	48.6		

(S) Meat Utility Index

The quantification summary table is useful for producing economic utility indices because it contributes towards determining the economic values of different carcass elements. The economic values are based on the combination of the different food components an element contains. The food components include the meat, marrow, and grease. Each food component can be separated individually to determine the value of a carcass element. Table 4 presents the economic values for each carcass element based on meat. These values were determined by using the simplified formula from Metcalfe and Jones 1988:

$$\text{(S)MUI} = \frac{\text{gross weight of part} - \text{dry bone weight of part}}{\text{maximum part value from numerator}} \times 100$$

The gross weight of a carcass part refers to the combination of meat, marrow, and bone grease; the dry bone weight is all of those food components removed from the carcass part. When the weights for the each carcass element is determined, the weight is then divided by the largest number that was calculated in this step. For instance, the dry bone weight for an elks (Binford's Caribou) cervical vertebrae is 207 grams; this value is then subtracted from the elk's cervical vertebrae gross weight (2,122.20 grams), which equals to 1905.2 grams. The largest part value, after each carcass part is calculated, is the femur (5139.37 grams). The elk's femur value (5,139.7 grams) is then divided by the elk's cervical vertebrae (1905.2 grams) to equal 0.371; this number is then multiplied by the standardized value (100) to equal 37.1 grams. The other elk elements were calculated the same way and divided by the femurs weight value. In addition, the weights for the bison and bighorn sheep are different, but the calculation method was conducted the same way.

The calculated values that are in the bison, elk, and bighorn sheep columns of Table 4 are the values used from Emerson's (1990) and Binford's (1978) data collection. As discussed in the methods and materials chapter, the data from Emerson (1990) and Binford (1978) are used to represent the data results for the bison, elk, and bighorn sheep that were discovered at 48YE697. The reason for using their data results is because the animals that were observed from 48YE697 would have had similar characteristics as the animals used in Emerson (1990) and Binford's (1978) research.

The values highlighted in red (as shown in Table 4) are the bison carcass elements that were missing from the bone bed. They are presented to show the economic value of those parts, and to provide a possible indication of why those carcass elements were missing from the site.

Table 4: Economic meat values for bison, elk, and bighorn sheep at 48YE697

Element	Bison Weight (grams)	Elk Weight (grams)	Bighorn Sheep Weight (grams)
Caudal Vertebrae	0.7	0	0
Cervical Vertebrae	48.3	37.1	52.6
Femur	100	100	74.9
Humerus	29.7	28.9	27.1
Lumbar Vertebrae	42.6	33.2	36.9
Mandible w/tongue	0	31.1	56.8
Mandible w/o tongue	0	11.5	19.7
Metacarpal + carpal	6.4	5.2	4.6
Metatarsal	4.2	11.3	5
Pelvis + Sacrum	36.1	49.3	72.1
Phalanges	3.3	1.8	7.2
Radius + Ulna	11.6	14.7	13.1
Ribs	67.1	51.6	89.8
Scapula	30.6	44.7	42.6
Sternum	31.7	66.6	100
Thoracic Vertebrae	49.8	47.3	81.3
Tibia + tarsal	34	25.5	21.3

According to Figure 12, the elements that were missing from the site are considered to be low-utility elements. One possible reason for why these elements may have been missing from the site is because they were scavenged. A second possible is reason is that they were transported back to another location and used in a different way. For instance, mandibles were sometimes used as runners for sleds (Albers 2003b:705). Figure 12 also displays the bison femur, ribs, thoracic vertebrae, and cervical vertebrae as being high-utility elements. The fact that there are both high-utility elements and low-utility elements identified at this site possibly indicates that hunters did not kill the bison, but that it died from natural causes. However, if focusing on the second bison that contained the second right tibia and thoracic vertebrae, these two elements are low-utility elements, which presents the possibility of why these two elements were left at this site while the remaining carcass was transported to a potential nearby residential site. A third possibility of why these two elements were at this site is because they were transported here from a potential kill site further away from this site.

Additionally, Figure 12 highlights that the elk ulna and metatarsal are low utility parts, which indicates that these elements were possibly field processed and left back at the site because they didn't have much meat value. The third elk element, illium portion (pelvis region), appears to be a moderate-utility carcass element, which means it would be up to the hunter to decide whether they want to field process this element for the meat or to leave it behind at the processing site or kill site.

Lastly, Figure 12 displays the cervical vertebrae of the bighorn sheep as being a moderate utility element, similar to the elk's pelvis. Since this carcass element was discovered at the site, it possibly reflects that hunters butchered and left this element at the site due to not needing the meat from this portion of the bighorn sheep. Also, since there were very few elements belonging to the elk and bighorn sheep identified at48YE697, the data presents the interpretation that these elements were possibly field processed at this site, while the remaining carcass was transported back to a residential site that was potentially located nearby. Another interpretation is that these elements were transported to this site from a different location to be further processed.

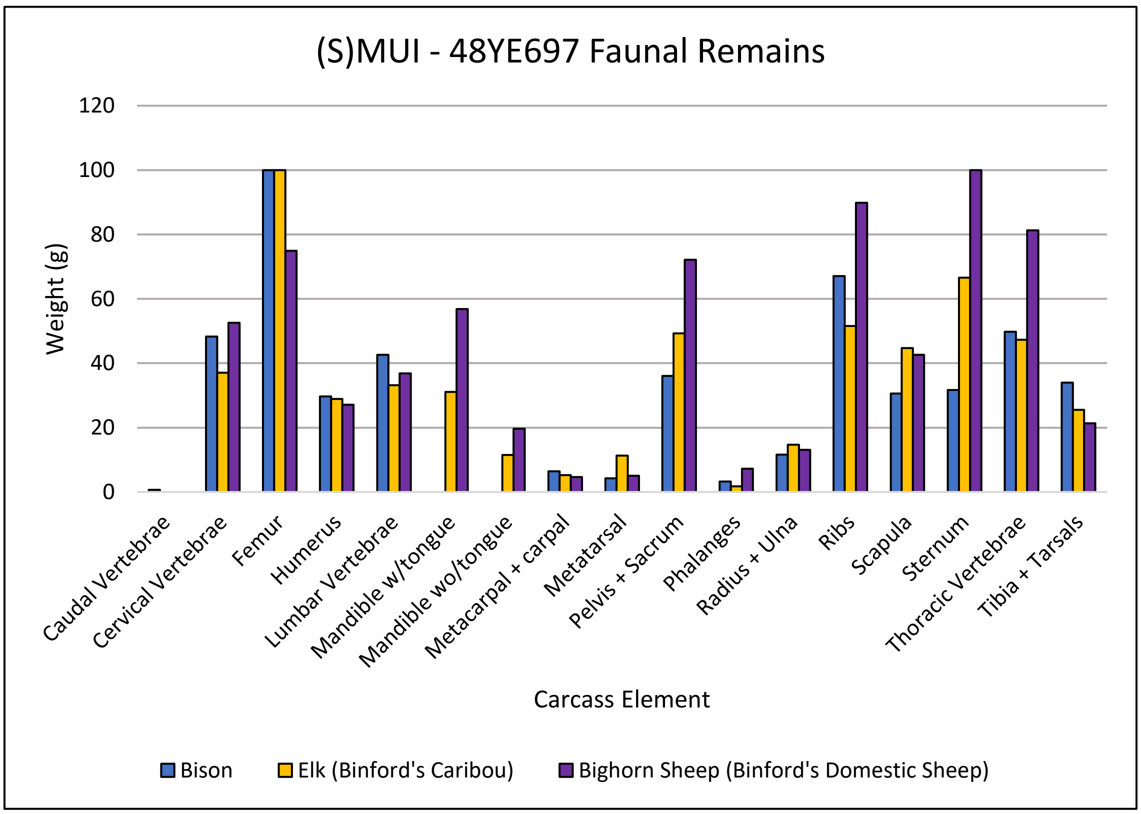

Figure 12: Meat Utility Index for bison, elk, and bighorn sheep bones

Marrow utility index (MI)

Figures 13, 14, and 15 represent marrow utility indices that focus on the bison leg bones that were documented at 48YE697. During the initial investigation of the Windy Bison Site, archaeologists documented score marks on three different elements, including the humerus, hyoid, and the left tibia.

The humerus and the tibia are both leg bones of the bison, but the hyoid is closely associated with the mandible region. The importance of the score marks is that they reflect cultural evidence of people possibly removing meat, marrow, or the tongue from these bones

Furthermore, Figures 13, 14, and 15 were constructed to determine which faunal elements have the greatest marrow utility. The marrow utility is based on the marrow cavity volume (ml) associated with each element. In addition, the figures are used to help determine why those specific faunal remains contained score marks.

Table 5 presents the marrow cavity volume (ml) (values used from Emerson 1990 data) for the different carcass elements. The carcass elements highlighted in red represent the elements that contained score marks. Figure 13 presents the marrow cavity volumes (ml) for the different carcass elements. As shown in the Figure 13, the femur, humerus, and tibia contain the highest marrow utility value. Also, with the humerus and the tibia both being high-utility elements, that presents the idea that hunters were possibly trying to extract the marrow from these two bones for a food resource.

Table 5: Marrow Cavity Volume (ml) for bison leg bones

Element	Bison Marrow Cavity Volume (ml)
Femur	227.5
Humerus	209
Metacarpal	34
Metatarsal	34.5
Phalanges	15.5
Radius	101
Tibia	203.5
Ulna	12.5

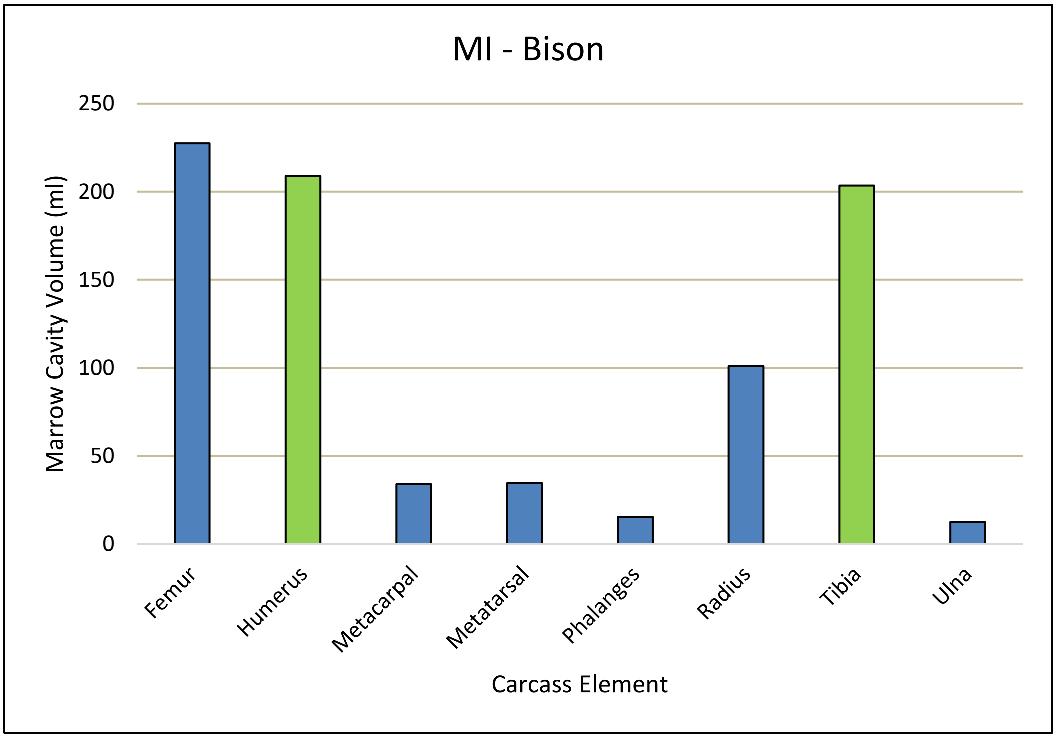

Figure 13: Marrow Utility Index for bison leg bones

Table 6 displays the marrow cavity volumes (ml) associated with the proximal and distal ends of the bison leg bones. Figures 14 and 15, highlight that the proximal side of leg bones have greater amount of marrow cavity volume than the distal sides. As previously discussed, the score marks that were on the left tibia were located near the distal-lateral surface of the tibial crest. According to Figure 14, the distal side of the tibia doesn't have a larger marrow cavity volume than the proximal side, which presents the question of why there were score marks present on the distal end rather on the proximal end?

One interpretation of why there were score marks on the distal side instead of the proximal side of the tibia is because this bison (articulated bison) had died from natural causes. This would have allowed hunters who were moving through the area shortly after its death to butcher and quickly remove any meat or marrow that wasn't spoiled while processing the hide or other elements of the bison.

Table 6: Marrow Cavity Volume (ml) in proximal and distal ends of bison leg bones

Element	Proximal Marrow Cavity Volume (ml)	Distal Marrow Cavity Volume (ml)
Femur	149	78.5
Humerus	136	73
Metacarpal	23	11
Metatarsal	24	10.5
Radius	55	46
Tibia	126.5	77

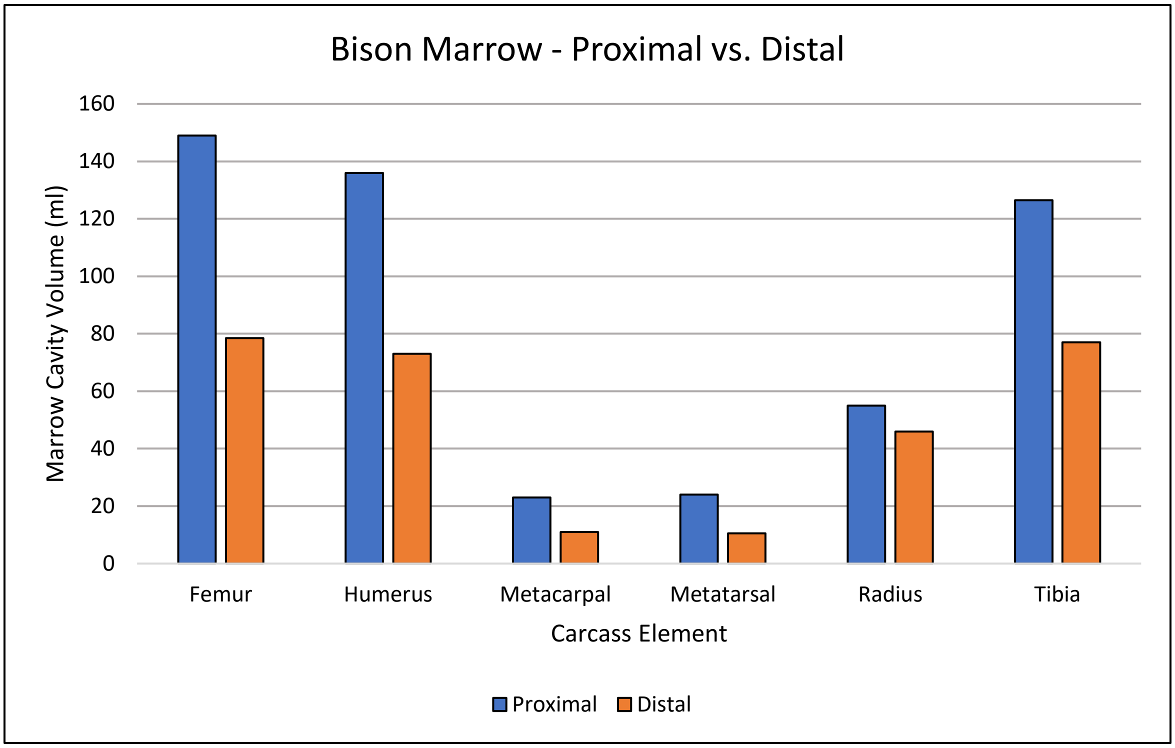

Figure 14: Marrow Utility Index for the proximal and distal sides of bison leg bones

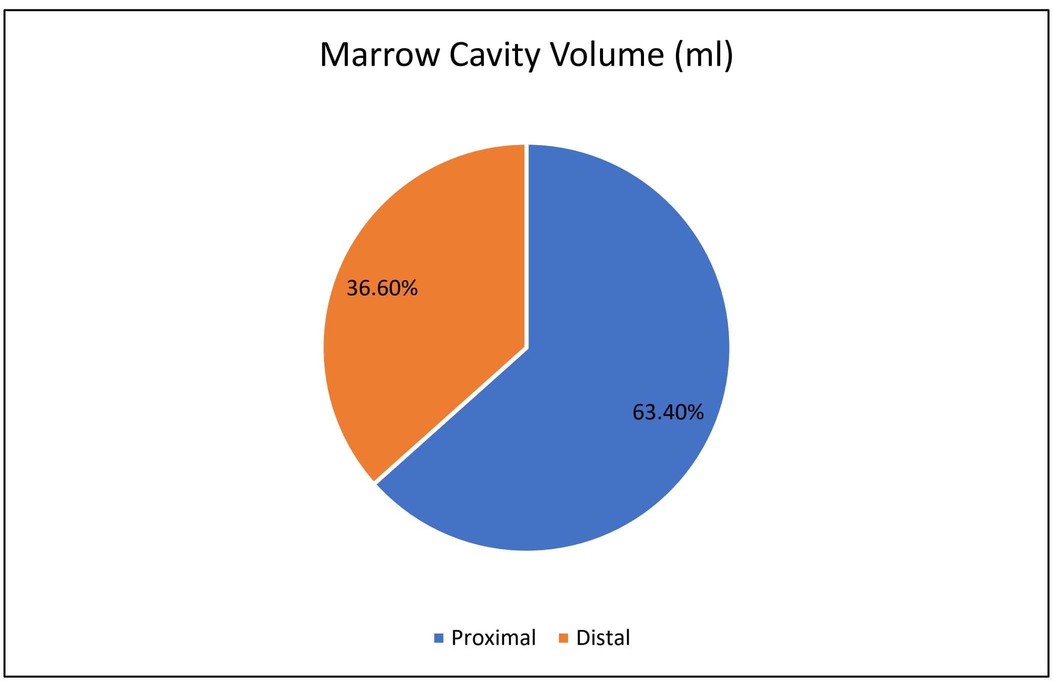

Figure 15: Marrow cavity volume differences between the proximal and distal sides of bison leg bones

Grease Utility Index (GI)

There are two grease utility indices constructed between the bison, and the elk and bighorn sheep. Figure 16 reflects the grease utility, based on the weight of the grease for the different bison carcass elements. The second utility index (Figure 17) presents the grease utility, based on % oleic acid, for the elk and bighorn sheep carcass parts. The % oleic acid refers to the quality of grease (Binford 1978). Table 7 displays the bone grease values (grams) for the bison carcass parts.

Table 7: Economic bone grease values for bison bones

Element	Bison Bone Grease (grams)
Astragalus	6.6
Calcaneous	12.1
Carpals	5.4
Caudal Vertebrae	0.6
Cervical Vertebrae	0.4
Femurs	121.9
Humerus	98.8
Lumbar Vertebrae	22.8
Metacarpals	11.3
Metatarsals	18.2
Patellas	6.2
Pelvis	71.8
Phalanges	20.8
Radius + Ulna	39.3
Ribs	36.3
Sacrum	34.3
Scapulas	8.8
Sternum	4.9
Thoracic Vertebrae	15.1
Tarsals	25.6
Tibias	53.3

The elements highlighted in red (Table 7) are elements that were not recorded at 48YE697. The highlighted elements are placed in the table to show the values of those elements, and to help determine why those elements may have been missing from the site. Figure 16 highlights the astragalus and the lumbar vertebrae (missing elements) as being low-utility elements; this makes it unclear as to why these elements were missing from the site. One interpretation is that these elements were scavenged from bears, coyotes, or other scavengers moving throughout the area.

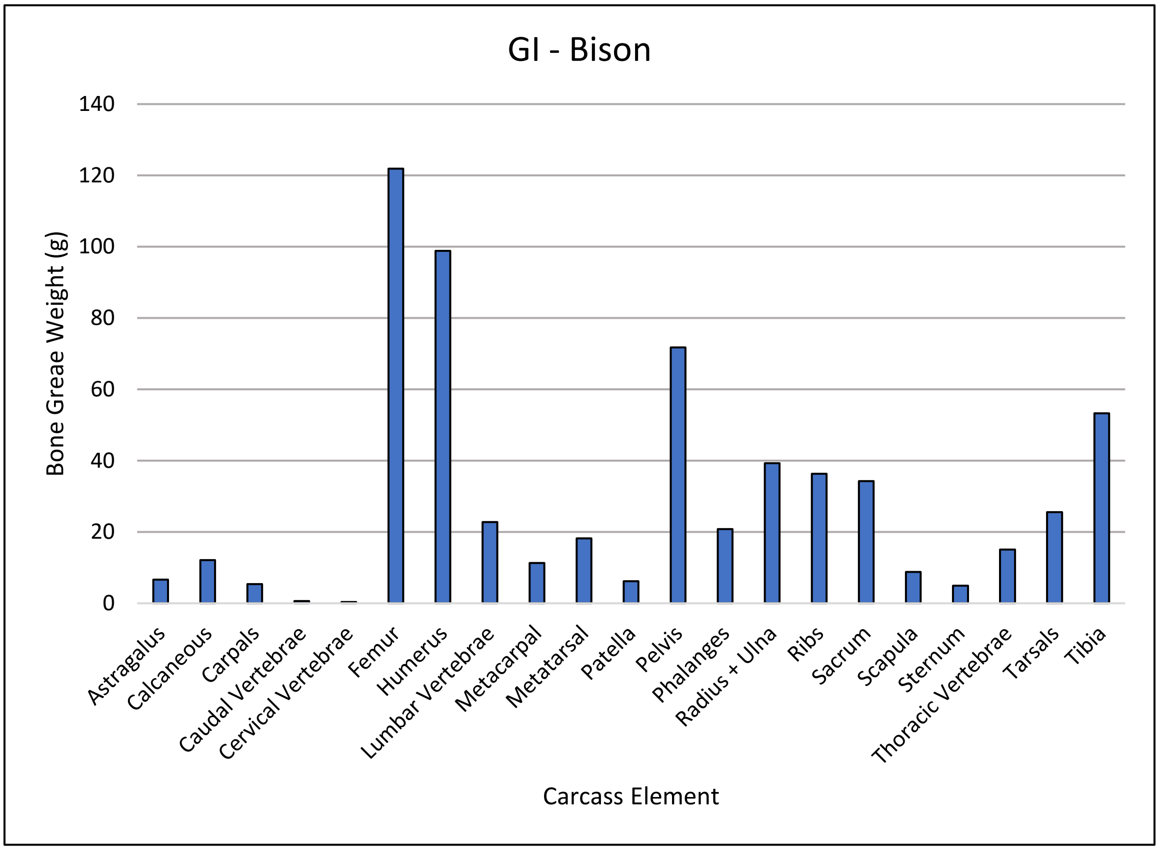

Figure 16: Grease Utility Index for bison bones

The high-utility elements that have the greatest of amount of bone grease are the femur, humerus, pelvis, and tibia. Once again, the fact that there were both high-utility and low-utility elements observed at the site, possibly indicates that the death of the articulated bison was from natural causes. However, if looking at the second bison that was observed at the site, the tibia is a high-utility element, so it presents the idea that hunters potentially butchered this element and left it at the site due to not needing the bone grease at the time. Another interpretation is that the tibia, as well as the thoracic vertebrae, was transported to this site from another location (i.e. kill site) to be further processed. Lastly, the elements with the lowest-utility values are the cervical vertebrae and the caudal vertebrae.

Table 8 displays the grease values in association with the elk and bighorn sheep carcass elements. The elk and bighorn sheep long bones were separated into proximal and distal ends to determine the quality of grease for each element. The elements highlighted in red represent the elk and bighorn sheep elements that were identified from 48YE697.

Table 8: Economic bone grease (%oleic acid) values for elk and bighorn sheep bones

Element	Elk Bone Grease (%Oleic Acid)	Bighorn Sheep Bone Grease (% Oleic Acid)
Astragalus	72	73
Calcaneous	70	74
Carpals	68	66
Cervical Vertebrae	34	29
Proximal Femur	44	41
Distal Femur	53	56
Proximal Humerus	40	39
Distal Humerus	40	40
Lumbar Vertebrae	37	34
Mandible	26	22
Proximal Metacarpal	73	72
Distal Metacarpal	78	78
Proximal Metatarsal	71	72
Distal Metatarsal	76	77
Pelvis	37	36
First Phalange	76	79
Second Phalange	78	80
Third Phalange	74	74
Proximal Radius-ulna	48	46
Distal Radius-ulna	67	66
Ribs	35	33
Scapula	33	29
Sternum	38	35
Thoracic Vertebrae	37	34
Tarsals	71	73
Proximal Tibia	54	57
Distal Tibia	71	73

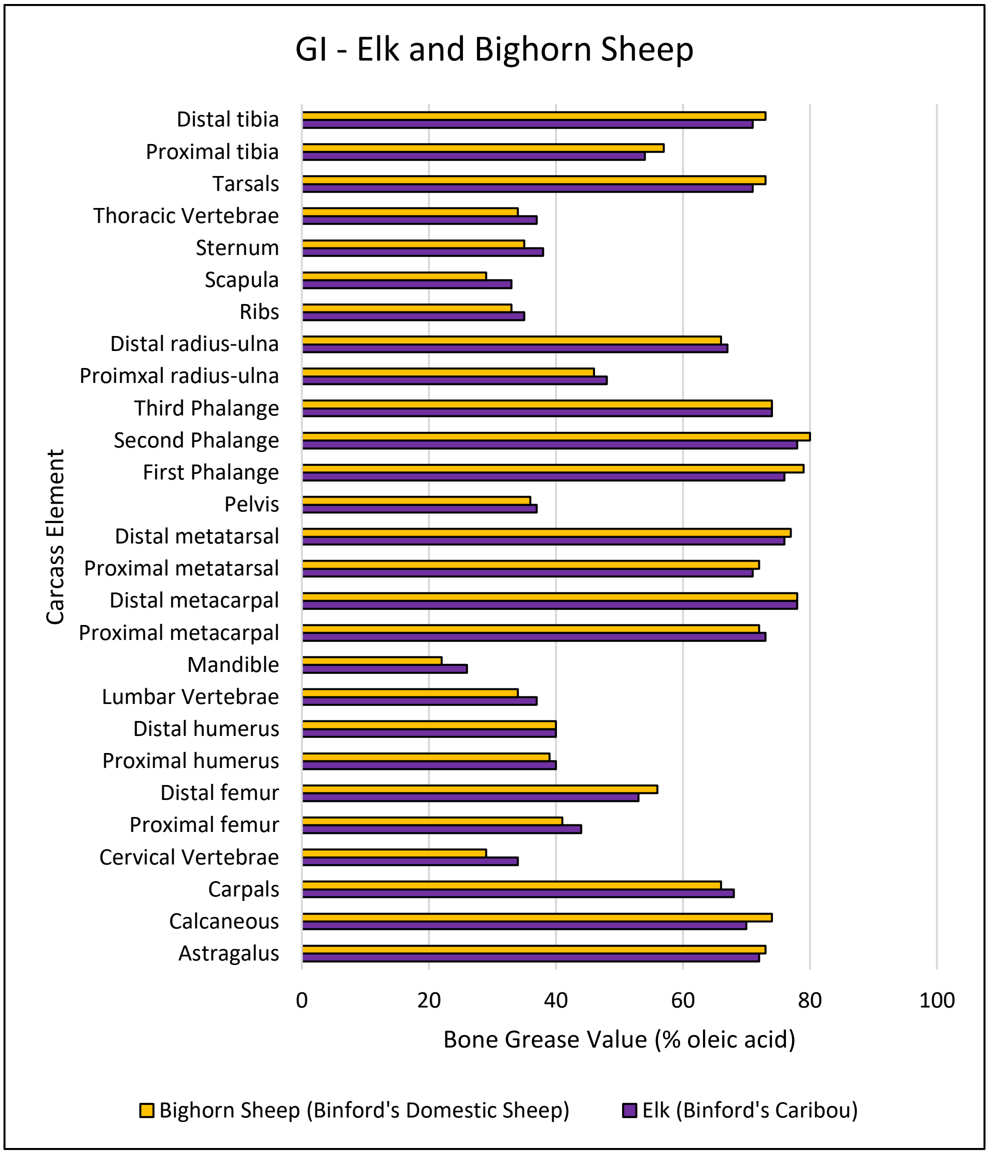

Figure 17: Grease Utility Index for elk and bighorn sheep bones

When the values were determined for each carcass element, they were placed into Figure 17. The elk metatarsal and ulna that were discovered appear to have high grease utility values. Also, the distal side of metatarsal contains more grease value than the proximal side of the metatarsal. These two carcass elements may have possibly been left at the site because hunters were not needing these elements at the time. A second interpretation is that these elements were brought to this site from another location and were further processed. However, the second metatarsal and ulna that were missing from the site, may have been transported back to a residential site to be used for food or even for a different use. For example, the Lakota will use the grease from elk bones to mix with skunk musk as a way to treat colds and other respiratory disorders (Albers 2003b:722). The third elk element, the elk pelvis region (illium portion), is observed at being a low-utility element, so that explains why this element was potentially left at the site.

In regard to the bighorn sheep, the cervical vertebrae (fifth cervical vertebrae) of the bighorn sheep that was documented contains a low amount of quality grease, which reflects the element as being a low-utility element. Lastly, the smaller elk and bighorn sheep elements that were not recorded at the site, possibly due to scavenging or transporting, included the astragalus, phalanges, carpals, and the calcaneus all contain large amounts of quality grease. These elements are to be either connected between the proximal and distal ends of the long bones, or on the foot of the animal. The connection of these smaller elements to the long bones may play a role in the increase of grease value for these elements. These smaller elements may have been transported back to a possibly residential site to be used not necessarily for food but for other uses. For example, the astragalus from the elk could possibly be used as an awl for scraping hides (Loendorf and Stone 2006:97).

(S) Food Utility Index (FUI)

The standardized food utility index (Figure 18) is produced to show the economic utility of the different carcass elements found at the Windy Bison site based on the combination of all three food components (meat, marrow, and bone grease); it is also correlated with the %MAU to reflect which carcass elements would most likely be favored during the butchering process, as well as the transportation process. Also, the (S) FUI is constructed to take into consideration of "riders", as explained in Chapter 4. Table 9 presents the utility values for bison carcass parts.

Table 9: (S)FUI values for identified bison bones from 48YE697

Element	(S)FUI	%MAU
Carpals	9.8	45.5
Caudal Vertebrae	0.7	56.8
Cervical Vertebrae	48.3	9.1
Femur	100	45.5
Humerus	30.2	22.7
Pelvis-Sacrum	36.1	100
Metatarsals	23.3	68.2
Phalanges	8.4	68.2
Radius-Ulna	37.2	45.5
Ribs	67.1	21.4
Scapula	30.6	22.7
Sternum	31.7	45.5
Tibias	96.3	68.2

Tarsals	27.4	45.5
Thoracic Vertebrae	49.8	48.6

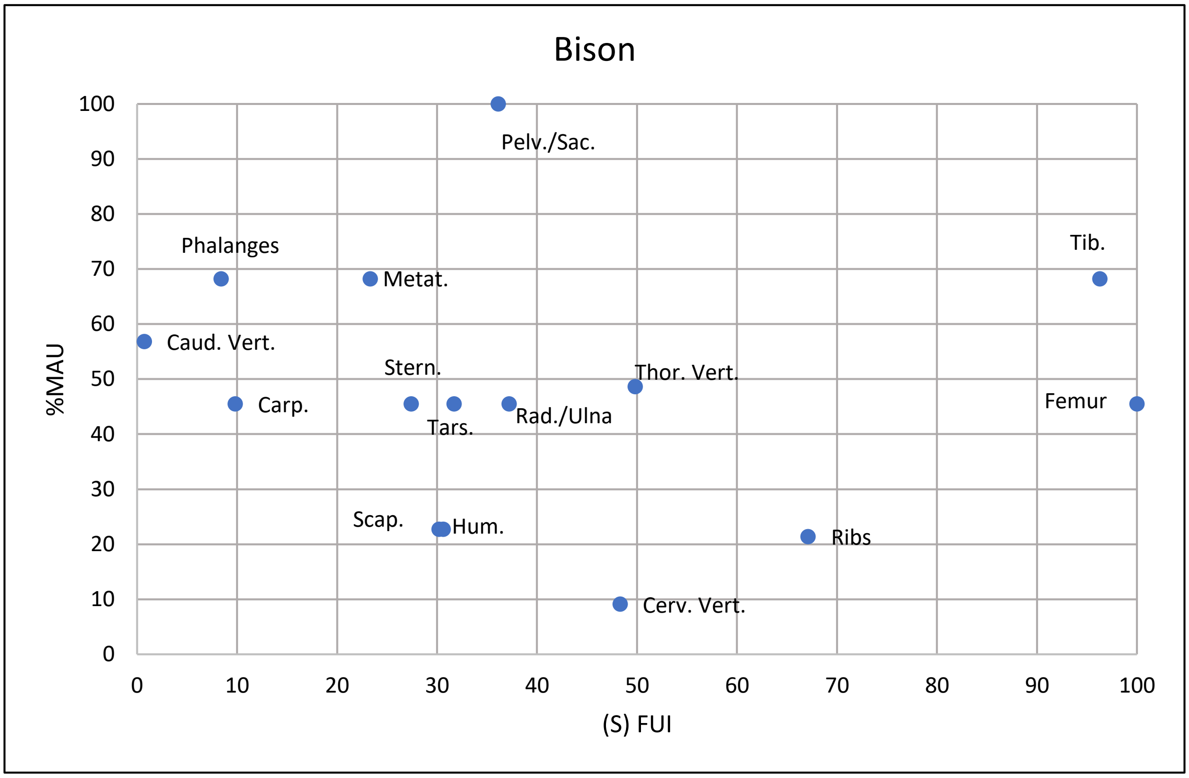

Figure 18: (S) Food Utility Index for bison bones discovered at 48YE697

The bison carcass elements that have the highest %MAU are the pelvis/sacrum, phalanges (feet), metatarsals (smaller leg bone), caudal vertebrae (tail), and tibias. The tibia is the only carcass element out of these five that is considered to be a high-utility element. The other four carcass elements are the elements that are likely to be field processed and left at this site. Furthermore, the femur and ribs are high utility elements with low %MAU values. The elements that have high food utility values and low %MAU value are normally associated with a processing site. These elements are most likely to be butchered and transported back to a residential site.

Additionally, other elements including the scapula, humerus, and the cervical vertebrae also have low %MAU values. The humerus is considered to be a low-utility element, but based on the values displayed in Figures 13 and 16, the grease and marrow may have been used for food or for other uses. The scapula and the cervical vertebrae are also low-utility elements.

Ethnographic and Ethnohistoric Data for Fauna and Faunal Remains

The ethnohistoric data, as shown in Table 10, is presented to show the possible ways in which the bison, elk, and bighorn sheep were utilized by Native Americans. In addition, the data are displayed to provide a determination of why specific parts of these animals were observed at the site, as well as missing from the site. Also, the data in the table do not represent a complete list of all of the tribes that found these faunal species important; it also not a complete list of how these animals were utilized. The tribes and uses presented in this table are based on the research data that was discovered during the research process of this thesis.

Table 10: Ethnohistoric Data for fauna discovered at 48YE697

Ethnohistorical Data of the Fauna Discovered at 48YE697 (Bison, Elk, and Bighorn Sheep)
***Tribes associated with Yellowstone National Park (information within table is limited to the research data discovered):** Arapaho; Arickaras; Assiniboines; Blackfeet; Crow; Cheyenne; Gros Ventre; Kiowa; Kootenai; Lakota; Salish; Shoshone; Salish
Bison (*Bison bison)*
Food: Pemmican (all tribes); (Arapaho) redistribution of meat depends on the social status within a community (Campbell 2004a: 91); Tongue (Assiniboine) - great delicacy served at special events, feasts, and in guest lodges (Long 1961: 81); (Blackfeet) – ceremonial (greatest delicacy of the entire animal (Kidd 1986: 180); (Cheyenne/Lakota) – the tongue and gristle around the nostrils of the bison were viewed as great delicacies often served at ceremonial feasts (Albers 2003a:355); (Crow) – used as a fee for tribesmen during the Sun Dance; eaten raw (Lowie 1935:297, and Yarlott 1999:45); Pancreas and Tripe (Cheyenne/Lakota) – considered one of their favorite food dishes (Albers 2003a:356); Brains (Cheyenne/Lakota) - used as a soup thickener (Albers 2003a:356); (Crow) – eaten raw; Small Intestines (Cheyenne/Lakota) – formed into sausages (Albers 2003a:356); Lungs (Cheyenne/Lakota) – eaten by slicing open, and drying and roasting over coals (Albers 2003a: 356); Meat (Crow) – meat from the bison hump was considered a delicacy (Yarlott 1999:45); Liver (Crow) – eaten raw (Yarlott 1999:45) **Utensils:** Paunch (Assiniboine) – used as a kettle; (Blackfeet) – constructed into buckets, cups, basins, and dishes (Kidd 1986: 144; and Wissler 1910: 30,47); Horns (Blackfeet) – used as spoons and cups (Kidd 1986:117; and Wissler 1910:30); (Cheyenne/Lakota) – used as dishes, spoons, and ladles (Albers 2003b:705); (Crow) - bowls, cups, and spoons (Lowie 1935:92); Bladder (Gros Ventre) – used as a water pail (Wissler 1910:47) **Accessories:** Tongue (Cheyenne) - the rough skin on the tip of the tongue was used as combs (Albers 2003b:706); Hide (Arapaho) – shields (bull hide) (Campbell 2004a:95), snowshoes (woven by strings of hide), sacks, men's shirts, leggings, breech-clothes, moccasins (Kroeber 1902: 23,28); (Arickaras) – robes (Denig 1961a:48); (Assiniboine) - lodge covers, robes, shields (hide taken from the hump of the bison), ropes, dried meat sacks (Long 1961: 86, 88, 92-93); (Blackfeet) – bow grip, robes, blankets, parfleche, leggings, shields (bull hide), halters, hobbles, lines (produced from strips of rawhide) (Kidd 1986: 59,75,76,129,134; and Wissler 1910: 53,79,155); (Cheyenne) – dresses, leggings, moccasins, loincloths, bedding material (Albers 2003b: 707); (Crow) – robes (warm robes were produced from female bison) (Yarlott 1999: 43), straps, saddles, bridles, and war shields (bull bison hide) (Yarlott 1999: 47), parfleche bags (hides taken from young bulls) (Yarlott:1999: 47); (Gros Ventre) – rattles

(used in the Star and War Dances), robes (worn in the Crazy Dance) (Kroeber 1908: 236, 241); (Kootenai) – lodge covers, blankets, and clothing (Manning 1983: 55) Skins (Arickaras) – lodge covers (Denig 1961a: 48); (Blackfeet) – breech-clothes, tipi covers, summer moccasins, robes, moccasins (Kidd 1986: 73,76; and Wissler 1910: 100,118,129); (Cheyenne) – Headdress (Sacred Medicine Hat) (Campbell 2004b: 242); (Crow) – shirts, leggings, and moccasins (Yarlott 1999: 43); (Gros Ventre) – ceremonial lodge covers (Sun Dance), caps and mittens (worn in winter), and sacks (Kroeber 1908: 149,150, 261); (Shoshone) – robes (Loendorf and Stone 2006: 99); (Sioux) – used as clothing, and lodge covers (Denig 1961d: 13) **Tools and Weapons:** Bone (Arapaho) – knives (constructed from the bosse rib) (Campbell 2004a: 95), handles used on hide scrapers (constructed from the spine of bison vertebrae), chisel-shaped flesher (leg bone), needles and awls (used for sewing) (Kroeber 1902: 24, 26, 28); (Assiniboine) – knives (formed from the hump rib), and awls (Denig 1961b: 69); (Blackfeet) – needles (formed from the tarsal bone) (Kidd 1986:82); (Cheyenne/Lakota) – scrapers, needles, awls, hoes, arrowpoints, arrow-straighteners, knives (shoulder blades), runners (made from the rib and jaw) for sleds, toys and game parts (Albers 2003b: 705); (Cheyenne) – used the proximal end of the humerus to produce tools for abrading hide (Albers 2003b:705); (Crow) – produced fleshers (made from leg bones), beaming tools (made from the ribs), and scraping tools (made from shoulder blades) (Yarlott 1999: 48); (Gros Ventre) – buzzer (made from a bison foot bone), sleds (constructed from ribs), and chisel-like fleshers (leg bones) (Kroeber 1908: 150,190,191); Horns (Cheyenne/Lakota) – used to manufacture bows (Albers 2003b: 705); (Crow) – used as bows (Lowie 1935: 85); (Shoshone) – used as bows (Loendorf and Stone 2006: 118) **Other:** Sinew (Arapaho) – used as thread (Kroeber 1902: 28); (Blackfeet) – used as thread for sewing (Wissler 1910:53); (Cheyenne/Lakota) – used as string/thread (taken from the dorsal spine) for constructing handles, knives, and pipes (Albers 2003b: 706); (Crow) – used to make bowstrings, and glue (boiling sinew and gristle) (Lowie 1935: 85); (Sioux) – bowstrings (Denig 1961d: 13); Dew-Claws (Arapaho) – used as ornaments (Kroeber 1902: 29); Dung (Arapaho) – used to start fires (fuel) (Kroeber 1902: 24); (Blackfeet) – used as a fuel source to start fires (Kidd 1986:123); (Crow) – used as a fuel to start fires (Yarlott 1999: 47); Hair (Assiniboine) – rope (Long 1961:93); (Crow) – used as rope (bison beard) (Yarlott 1999: 114); Hooves (Assinibione) – hoof tendons were used as an element for making glue (Long 1961: 97); (Cheyenne/Lakota) – used for butchering, glue, arrow-making, pendants, rattles, and decorative cylinders (Albers 2003b:705); Heart lining or pericardium (Cheyenne) – used as a water container for children and infants (Albers 2003b:706); Tendons (Arapaho) – used to wrap handles and blades together (Kroeber 1902:24); Dried aorta (Cheyenne) – used as a smoking pipe (Albers 2003b:706); Horns (Lakota) – used medicinally for the treatment of blood disease (Albers 2003b:705); Tails (Blackfeet) – used as a decoration that is attached to the exterior of tipi covers (Kidd 1986:121); (Lakota) – tied to many objects (i.e. war clubs, and rods) as way to support *Tatanka* (Albers 2003b:706); (Crow) – used as whips (Yarlott 1999: 47); (Gros Ventre) – tied to ceremonial objects; and used to beat the body during a sweat (Kroeber 1908: 264,275); Skulls (Lakota) – spiritually important and used during ceremonial events (i.e. *Hunka*) (Tarka 2007:45); (Gros Ventre) – used as a ceremonial object in the Sun Dance (Kroeber 1908:264)
Elk (*Cervus canadensis)*
Accessories: Skins (Blackfeet) – summer blankets (Kidd 1986:51); (Lakota) – used for moccasins, breech-clothes, shirts, leggings, belts, gowns, garments (worn during ceremonial events), drumheads, and sashes (worn by officers of the *Miwatani* society) (Albers 2003b:721); Hides (Kiowa) – used for shields (associated with the Taime Shield Society) (Campbell 2004c:719); (Lakota) – used for saddle skirts (tanned hides), shield covers (tanned hides), and receptacles (tanned hides) (Albers 2003b:721); (Shoshone) – used for shirts (tanned hides), and robes (tanned hides) (Loendorf and Stone 2006: 99)

Tools and Weapons: Antlers (Arapaho) – used as a scraper (Kroeber 1902: 26); (Assiniboine) – used as whipstocks and scrapers (remove the hair from hides) (Long 1961:92); (Cheyenne) - used antlers to knap flint (Albers 2003b:721); (Lakota) - constructed the porus portion of an antler into a tool that helps apply paints; and constructed saddle pommels from antlers (Albers 2003b:722); (Crow) – used as bows, and drills (produced from heated prongs of the antler) (Yarlott 1999:47); (Salish) – used as bows (Cross 1996:54); (Shoshone) – used a bows (Loendorf and Stone 2006:118); Bone (Cheyenne) – produced fleshers from leg bones to scrape hides (Albers 2003b: 721); (Shoshone) – used an elk astragalus (heel bone) as an awl for scraping hides (Loendorf and Stone 2006: 97) **Other:** Teeth (Assiniboine) – used as ornaments for women's dresses (Kidd 1986: 93), and bracelets (Karklins 1992:99); (Cheyenne) – used to ornament leggings, and necklaces (Albers 2003b:721); (Crow) – used as decorative ornaments on dresses (Lowie 1935:82); (Kiowa) – used as a decoration on women's clothing (Campbell 2004c:716); (Lakota) – used as decorative ornaments for women's dresses (Albers 2003b:721); Grease (Lakota) – used as a mixer with skunk musk to treat colds and other respiratory disorders (Albers 2003b:722)
Bighorn Sheep (Ovis canadensis)
Utensils: Horns (Arapaho) – used as spoons and cups (Campbell 2004a:94); (Blackfeet) – used as spoons, large ladles and dippers (Wissler 1910: 29); (Crow) – used as spoons, cups, and other small dishes (Lowie 1935: 92); (Cheyenne/Lakota) – used as spoons and ladles (Albers 2003b:719); (Salish) – used as spoons (Cross 1996:51) **Accessories:** Skins (Blackfeet) – used as shirts (Wissler 1910:118); (Crow) – used for dresses (Lowie 1935: 82); (Cheyenne) – used for garments (men and women), dresses and leggings (women), and war shirts (men) (Albers 2003b:718); the fleece was used to stuff pillows (Albers 2003b:718); (Salish) – used for women's dresses (Cross 1996:51); (Shoshone) – used as breech-clothes, loincloths, robes (tanned skins), and boots (Loendorf and Stone 2006: 98-100) **Tools and Weapons:** Horns (Arickaras) – used as bows (Albers 2003b:719); (Crow) – used as bows (Yarlott 1999:47); (Cheyenne) – used as bows, and arrow-straighteners (Albers 2003b: 719); (Salish) – used as bows (Cross 1996:51); (Shoshone) – used as arrow-straighteners (Loendorf and Stone 2006: 129-130); Bone (Shoshone) – used as awls (from tibias and ulnas) (Loendorf and Stone 2006: 97)

In summary, the economic utility tables and indices (meat, marrow, grease, and (S)FUI) were developed to determine which faunal elements were of low-utility and high-utility. The determination of the high or low-utility elements leads to possible understanding of why there specific elements present at 48YE697, and why there specific elements missing. The ethnohistoric data table adds to the determination and understanding by providing information of the how these animals were potentially used by Native Americans occupying the area.

For instance, there were score marks on the hyoid bone which is associated with the tongue and mandible. The tongue could have been used for food or for other uses. The Cheyenne used the rough skin on the tip of the tongue as a comb (Albers 2003b:706). The Assiniboine used the tongue for food as special events and feasts (Long 1961:81). Another example reflects on the idea that if the second bison, or the elk, and/or bighorn sheep carcasses were transported back to a residential site, both the high-utility and low-utility elements could be used. For instance, the Arapaho used bison femur for food, as well as a chisel-shaped flesher (Kroeber 1902:24, 26, 28). The phalanges (hooves), which are low-utility elements, were used by the Cheyenne and Lakota for making glue, and using as decorative ornaments (Albers 2003b:705).

Chapter Six

Interpretation and Discussion

This thesis focuses on identifying the Native American subsistence strategies at the Windy Bison Site (48YE697). The faunal remains that were discovered from 48YE697 were analyzed in Chapter 5 (analysis and results) to determine: 1) if 48YE697 is a kill or a processing site; and 2) the economic utility of the documented remains, as well as the missing remains from the site. The goal for this chapter is to provide a summary and interpretation of the results from Chapter 5 as a way to understand the carcass part selection and transportation decisions conducted by hunters.

Part One: Processing Site or Kill Site

The Windy Bison Site has characteristics that reflect both a processing site and a kill site. This site has the potential to be both based on two lines of evidence including: 1) the combination of high-utility and low-utility carcass elements; and 2) the location of the site. According to Byerly et al. (2007:138), a processing site can be expected to contain primarily broken, high-utility faunal elements, and few articulated skeletons. A kill site primarily contains a low species diversity, and a large number of whole bones, usually low-utility elements, and articulated skeletons.

The Windy Bison Site reflects a processing site because there were a number of high-utility bison elements that were recorded at the site. The high-utility elements included: both femurs, one humerus, ribs, thoracic vertebrae (1-14), one radius, and three tibias. In addition, the site had a low number of articulated skeletons; the four-year old bull bison was the only articulated skeleton. The elk and bighorn sheep that were recorded were not articulated skeletons. The only elk elements observed were one metatarsal, one ulna, and the illium portion of the pelvis; and the only bighorn sheep element to be documented was the fifth cervical vertebrae.

Furthermore, 48YE697 resembles a kill site for three reasons. One, there was a low species diversity that included two bison, one elk, and one bighorn sheep. The vole, fish, and raptor that were observed at the site were not included in the species diversity due to the deaths of these species most likely being caused by natural occurrences. Secondly, the site had a large number of low-utility whole bones. The low-utility whole bones included: tarsals (bison), metatarsals (bison and elk), phalanges (bison), caudal vertebrae (bison), carpals (bison), and the calcaneus (bison). The last reason is that the site contained an articulated skeleton (bison).

Also, the Windy Bison Site reflects both a processing site and a kill site because of the location of the site. As Figures 7-10 display in Chapter 3, 48YE697 lies within the migration ranges for bison and elk.

The migration ranges for bighorn sheep were not presented in this research due to a range map not being able to be discovered during the research process of this study. Furthermore, with 48YE697 being located within the migration ranges of bison and elk, hunters would have potentially had the knowledge of when these animals migrated into the area. Also, if hunters did have knowledge of the migration patterns, they would have possibly been able to develop ambush strategies, construct traps, or use natural landscape formations as a strategy for obtaining these resources as they migrated into the region.

Part Two: Carcass Element Selection and Transportation Decisions

The carcass elements that were present, and missing from 48YE697, provides an indication of the type of selection and transportation decisions that were conducted by hunters. In addition, the documented and missing carcass elements can also reflect if a hunter, or hunters had to transport the remains a long or short distance back to a residential site. However, one of the challenges with understanding the decisions that were performed, is the fact that there was almost all the elements (high-utility and low-utility) of an entire bison skeleton documented at the site. One question that is addressed with this challenge is, if this site is a processing and a kill site, why were both high-utility and low-utility elements present at the site?

The carcass elements that were missing from the articulated bison included the metacarpals, lumbar veterbrae, and the mandibles. These elements are considered to be low-utility parts, so it is unclear why these carcass elements would have been missing from the site. The high-utility elements that were documented at the site included the femur, ribs, humerus, tibia, and possibly the hyoid. The humerus, tibia, and hyoid are important elements because they contained evidence of score marks, which possibly indicates a person or persons, were trying to remove meat, or obtain marrow from these elements. The humerus and the tibia both contain a large amount marrow and bone grease, but not a large amount of meat, which may reflect that whoever was field processing the bison was attempting to remove the marrow from the bones. The hyoid bone potentially had score marks on it because it is usually handled during the removal of the tongue (Bubel 2014).

In addition, one interpretation of why an almost entire bison skeleton was present at this site is that this bison was possibly killed during a time of season when the meat was not good to eat. A second interpretation is that this bison was already dead and was encountered by hunters who were moving through the area shortly after its death, and found the meat spoiled, and decided to remove and butcher any good meat or marrow still left on the bison.

The last interpretation is that the bison wasn't primarily used for food. For instance, if the food components (meat, marrow, and grease) were no longer edible, hunters could have butchered the bison to collect the hide, skin, and organs. The hide could have been used for clothing (Kroeber 1902:23,28), and shield covers (Campbell 2004a:95). The skins may have been used for lodge covers (Denig 1961a:48), and/or moccasins and clothing (Kidd 1986: 73,76; and Wissler 1910: 100,118,129). Organs such as the paunch and the bladder may have been obtained and used as a kettle (Wissler 1910:47), and a water pail (Wissler 1910:47).

In regard to the second documented bison, the carcass elements that were discovered at 48YE697 included the fifth or sixth thoracic vertebrae, and a right tibia. According to the meat utility index in Chapter 5, the thoracic vertebrae has a moderate amount of meat value, which reflects the possible idea that a hunter/hunters field processed the thoracic vertebrae, leaving a small portion of it behind due to breakage during the butchering process, and transported the rest of the vertebrae back to a residential location. In addition, the thoracic vertebrae may have been selected and transported because the meat from the hump of the bison was sought to be a delicacy for some Native American tribes (Yarlott 1999:45). The right tibia that was identified at the site is considered to be a high-utility element, based on the large amount of marrow and bone grease that is associated with it. The tibia was possibly documented at the site because it was it was left behind accidently during the transportation process, or that it was simply not needed at the time, based on hunters not having to carry more weight than they needed to.

Additionally, with only a couple of carcass parts of the second bison being observed, it presents the question of why were there not more carcass elements of the second bison at 48YE697? One interpretation is that scavengers or carnivores visited the site and collected the remaining carcass elements, transporting them to another location. A second interpretation is that the remaining carcass elements were washed into the lake. Third, this bison was killed elsewhere and some of the bison was transported to this site and processed. Lastly, the fourth interpretation is that both high-utility and low-utility were transported back to a residential site.

The first interpretation is possible due to wolves, coyotes, and bears inhabiting the region. The second interpretation is also possible, considering the bone bed was discovered in a cutbank along Yellowstone Lake. The third interpretation could be possible based on hunters potentially killing this bison in a second location and transporting the tibia and thoracic vertebrae to this site where they stumble across the articulated bison (bison #1). As the hunter(s) encountered the natural kill, they possibly dropped and left these elements behind due to trying to field process the articulated bison.

The last interpretation, however, reflects the idea that a residential site is potentially located in close proximity to the processing/kill site. The close proximity would allow for a person, or persons to transport the remaining high and low-utility carcass elements back to the residential site.

Also, if the remaining bison carcass was transported back to the residential site, both the low-utility and high-utility elements may have been used for food and/or for other uses. For example, the humerus, which is high-utility element missing from the site, could have been processed for food and used to produce abrading tools (Albers 2003b:705). Another element that may have had multiple uses is the tibia. As mentioned previously, there were three tibias (2 right and 1 left) documented at 48YE697. The other left tibia was missing from the site, indicating that it was possibly butchered and transported to a residential location. Also, the tibia is considered to be a high-utility food element, based on the marrow and bone grease associated with the tibia, but it may also have been used as a chisel-shaped flesher (Kroeber 1902:24,26,28).

A couple of low-utility elements that would have been transported are the scapula and the phalanges (hooves). There was one scapula observed at 48YE697, which means there was at least three other scapula's that were transported from the site. The scapula contains very little meat, marrow, and bone grease value, but they were possibly used as a tool such as a scraper, awl, hoe, or arrow-straighteners (Albers 2003b:705). The phalanges are also low-utility elements that contain low amounts of food value, but they are associated with the feet (hooves), which were used as an element to make glue, and used as decorative ornaments (Albers 2003b:705).

The elk elements to be documented at 48YE697 include an unsided metatarsal, a portion of a right illium (pelvis region), and a left ulna. The unsided metatarsal and the portion of the right illium were documented to be in the cutbank below the actual bone bed. The left ulna was recorded in the bone bed with the bison elements. The two carcass elements that were discovered below the bone bed possibly suggests that they were washed out from the bank. Another possibility is that the bone bed may have been larger at one period. Although, it is unknown if other elements were washed out into the lake.

In addition, if these were the only three elements to be in the bone bed previous of the washout, then it presents an interpretation that the remaining elk elements were potentially scavenged by predators (i.e. bears, wolves, etc.). Another interpretation is that the elk was killed in a different location and these elements were transported to this site to be further processed. A fourth interpretation is that the elk was killed/field processed here, and these three carcass elements were left behind while the remaining carcass was transported to a possible nearby residential site.

The elk's pelvis (illium portion), ulna, and metatarsal are considered low-utility elements, according to the meat utility index in Chapter 5. This presents the idea that these elements were left at this site due not much meat value and not needing to be used for food. However, the metatarsal does contain a large amount of useful grease. This presents an interpretation that the other elk metatarsal that was missing from the site was potentially transported back to a residential location to be used for food or for other uses. For instance, the Lakota tribe used the grease from elk bones to mix with skunk musk as a way to treat colds and other respiratory disorders (Albers2003b:722). Lastly, the remaining elements that were missing from the site may have also been used in other ways. As previously mentioned, the fact that only a few elements were documented at the site, possibly reflects that a residential site was located in close proximity where the remaining carcass elements (high and low utility) were able to be transported from the processing/kill site.

The person or persons may have been able to transport the remaining carcass elements if the residential site and kill/processing site were in close proximity to one another. Also, if the two sites were in short distances from each other, both the low-utility and high-utility carcass elements would be able to be obtained and used. For instance, the astragalus, which is a low-utility element located on the hind leg, would have been able to transported along with rest of the leg to be potentially used as an awl for scraping hides (Loendorf and Stone 2006:97). The leg bones that were transported would have provided a group with food, as well as a tool. For example, fleshers were produced from leg bones to scrape hides (Albers 2003b:721).

In addition, if the remaining elk carcass was transported back to the residential site, the skin may have also been used for possible shield covers (Campbell 2004c:719), summer blankets (Kidd 1986:51), and/or for shirts and leggings (Albers 2003b:721). Furthermore, another element that was not recorded at the site, but possibly transported were the antlers. However, it is unknown if the elk that was at the site was a bull or cow. If the elk was a bull, the antlers may have been transported and used as bows (Cross 1996:54), and/or drills (Yarlott 1999:47). The teeth of an elk were another element that were possibly valuable. For instance, elk teeth were used as decorative ornaments on women's clothing (i.e. dresses) (Campbell2004c:716).

In regard to the bighorn sheep that was identified at 48YE697, the only element to be observed was a fifth cervical vertebrae. This single carcass element provides an indication that the remaining carcass possibly eroded into the lake, similar to the other elk elements. A second interpretation is that the bighorn sheep was killed somewhere else and this element was transported to 48YE697 to be further field processed along with the elk and/or second bison. A third interpretation is that the rest of the carcass was transported from the kill/processing site to a residential site. The cervical vertebrae of the sheep is considered to be a moderate-utility element, meaning the element could have provided a hunter or a group of hunters with food, or was obtained for other uses. Also, the single element presents the idea that the hunter(s) possibly butchered the bighorn sheep into sections, broke off the fifth vertebrae during the butchering process, and transported the rest of the vertebrae back to the residential site.

The remaining elements such as the femur, pelvis and sacrum, ribs, sternum, and thoracic vertebrae are high-utility elements. These bones are considered to be high-utility elements based on the amount of meat associated with each part. Also, according to Figure 17, the leg bones, and the low-utility elements (calcaneus, astragalus, carpals, and phalanges) that are associated with the leg bones, have highest grease utility. Overall, a large number of elements that are associated with the bighorn sheep make this animal a valuable species to obtain. The entire carcass of the sheep may provide a group of hunter-gatherers with plenty of food, as well as uses. Other uses may include the horns of the sheep being used as bows (Cross 1996:51), or as spoons and cups (Campbell 2004a:94). In addition, the tibia and the ulna could have possibly been used as awls (Loendorf and Stone 2006:97). Skins of a bighorn sheep may have also been useful by providing hunter-gatherers with clothing such as dresses (Lowie 1935:82), or as breech-clothes, robes, loincloths, and/or boots (Loendorf and Stone 2006:98-100).

Future Research

Further research that could be conducted from this thesis is to determine if a residential site is located in the area. The discovery of a residential site in the area would contribute to the understanding of the subsistence and mobility strategies that occurred on the northeast shore of Yellowstone Lake. In addition, based on the analysis of the faunal elements that were identified from 48YE697, as well as missing, it is possible a residential site is located in close proximity to the kill/processing site. A possible research direction for determining if a residential site is located near 48YE697, is to study the lithic artifacts (i.e. debitage and tools) that were documented at other archaeological sites in the area.

According to Stevenson (1985), artifact assemblages can contribute towards understanding the development, and function processes of a campsite. Stevenson (1985:64), also addresses that sites that are used for hunting and gathering of seasonally available resources (i.e. residential sites), experience three different phases: 1) initial settling phase; 2) occupational or exploitational phase; and 3) a final or abandonment phase. These three phases can be described through the debitage (primary, secondary, and tertiary) that is produced during each phase.

The first phase, initial settling, is identified through tool production (Stevenson 1985). Primary debitage is to be the majority of the debitage that is expected to be present during the initial phase, with secondary debitage following primary, and tertiary be the least present. Primary debitage is defined by (Francis and Larson 1996:88) as an "unmodified flake having between 75% and 100% cortex the dorsal surface and no intentional dorsal flake scars." Secondary debitage is defined as "unmodified flake having between 1% and 75% cortex on dorsal surface and one or two dorsal flake scars." (Francis and Larson 1996:88). Lastly, tertiary debitage is defined as "unmodified flake having less than 1% cortex on the dorsal surface and three or more dorsal flake scars." (Francis and Larson 1996:88).

In addition, a residential site that is in the initial phase would expect to have discarded primary and secondary debitage from produced site-specific tools; the tertiary debitage that associated with non-local raw materials; and curated tools that were no longer used. Lastly, artifact assemblages that are produced during this early phase would be displaced near features (i.e. hearths) and activity areas (i.e. butchering) (Stevenson 1985).

A residential site that is in the second development phase, exploitation, would continue to produce tools as other tools become worn or are discarded (Stevenson 1985). In addition, distribution between primary, secondary, and tertiary debitage would be even. The debitage would be evenly distributed because it is more cost-effective to reshape tools (i.e. projectile points, knives, etc.) that may be worn. Also, the tertiary debitage that is produced during reshaping of tools may possibly be from a local or nonlocal material source (Stevenson 1985). Lastly, a residential site within this phase would contain evidence (i.e. blood protein and bones) of faunal remains, and tools (i.e. scrapers) that are associated with faunal activities (Stevenson 1985).

The last phase to be associated with a possible residential site is the abandonment phase. This phase is identified based on early-stage reduction debitage (Stevenson 1985). Tools may be discarded as refuse, especially if they were left behind during their production stage. Also, any tools that are discarded are likely to be produced from local materials. However, it is possible that tools produced from non-local raw materials were transported into the residential site during initial development (Stevenson 1985).

In summary, further research that could be conducted from this thesis is to analyze the debitage that was observed and/or collected from documented archaeological sites, and try to understand what type of site is in the Steamboat Point area. Furthermore, future researchers could also separate the documented and/or collected debitage into primary, secondary, and tertiary, and determine what type of raw material is primarily being used. For instance, if there is more of a non-local lithic source present at the site, it could possibly indicate that people were living at the site for a long length of time, and knew that it was worth traveling further to obtain a higher-quality source that could be transported back, and used for hunting and/or butchering of animals.

Conclusion

This thesis attempted to identify the subsistence strategies that occurred on the northeast shore of Yellowstone Lake. In doing so, the faunal elements of bison, elk, and bighorn sheep that were discovered at 48YE697 were analyzed through the construction of economic utility tables, indices, and ethnohistoric data. The goal for these three tools were to present the economic utility of the documented, as well the missing, carcass elements from 48YE697. The economic utility was determined based on the amount of meat, marrow, and/or grease that was associated with each carcass element. If a carcass element contained a large value of meat, marrow, and/or grease, it was considered to be a high-utility carcass element. On the other hand, if the carcass element contained a low value of meat, marrow, and/or grease, then the element was presented as a low-utility carcass element. The determination of which carcass elements were of high-utility or low-utility contributed towards understanding which carcass elements were likely to be field processed and transported from the kill/processing site (48YE697) to a possible residential site.

Additionally, the development of economic utility tables, indices, and ethnohistoric data contributed to the understanding of what type of site 48YE697 represents. According to the data that was presented in chapter 5, the combination of low-utility and high-utility elements, number of whole bones, and the number of different fauna species determined that 48YE697 reflected being both a processing site and a kill site. Furthermore, the determination of the economic utility of the different carcass elements that were present and missing from the site, as well as the site type of 48YE697 reflects, provides further research for attempting to locate a possible residential site in the area.

The combination of different theoretical perspectives used in this thesis research allowed for a 'broader picture' to be developed. The broader picture involves why hunter-gatherers may have settled in this specific area (Seasonal Transhumance); the type of food resources that were obtained in the area (Migration Patterns); and the type of decisions that were conducted once a food resource was obtained (Central Place Foraging). The theoretical perspective of seasonal transhumance was useful in this study, and potentially useful for future studies because it focuses on hunter-gatherers scheduling their movements to other locations as a way for intercepting food resources as they become available throughout the season. Yellowstone Lake would have been a region where seasonal transhumance was possibly conducted because the Yellowstone Lake region is cold for most of the year, and most food resources don't become available until May.

However, it is possible that hunter-gatherers continued to occupy the Yellowstone Lake region during the cold seasons (winter through early spring), as a way to take advantage of other resources that were easier to obtain. For instance, according to MacDonald (2018), bears may have been a possible food resource for Native Americans to obtain at Yellowstone Lake during the cold seasons. Bear hunting is a common activity for numerous hunter-gatherers living in the northern-latitude, including the Cree who occupy the northwestern Great Plains (MacDonald et al. 2012b). During the spring, when bears are emerging from hibernation, they would have been easier prey to target as hunters waited outside the dens (MacDonald 2018). Bear dens were usually marked by hunters in the fall and winter, and later returned to in the early spring (MacDonald 2018).

MacDonald (2018) discusses that bears were likely present at Yellowstone Lake during the time when the lake was covered with enough ice for them to walk on. Yellowstone Lake is normally iced over between January and early May (MacDonald 2018). Also, according to a bear management officer in YNP, there have been bears observed on three different islands, all of which consists of archaeological sites, and one island containing a bear den (MacDonald 2018). Hibernating bears on the islands would have allowed Native Americans to also walk across the ice in the early spring to hunt bears as they emerge from their dens (MacDonald 2018).

In addition, migration patterns of food resources (i.e. bison and elk) play role in understanding seasonal transhumance because they present when a seasonal food resource will become available to intercept. Also, displaying the migration patterns of bison and elk in this study, allowed for the understanding of why these fauna species were initially documented at 48YE697. For instance, based on the Figures 7-10 in chapter 5, bison and elk herds migrate through the Steamboat Point area. According to a bison migration study (discussed in Chapter 3), bison normally migrate out of the Pelican Creek Valley and Steamboat Point area around the first week of June (Meagher 1973). According to two elk migration studies, also discussed in Chapter 3), elk herds arrived to their summer grounds (i.e. Steamboat Point area) around the June 14th and July 20th (Cunningham et al. 2008).

Furthermore, if hunters had the knowledge of when these animals migrated into an area, they would have been able to schedule their movements to the area, and intercept these animals before, or as they move into the region. However, similar to the bear hunting discussion, Native Americans may have continued to occupy the Yellowstone Lake area during the winter and early spring. According to the bison migration study, bison continue to occupy the Yellowstone Lake area during the winter and early spring; this would have allowed Native Americans to also continue to occupy the area and hunt bison during the cold seasons. As discussed in Chapter 2 (Late Prehistoric section), Dot Island (48YE475) contained Late Prehistoric bison remains, which possibly indicates that bison were walking across the ice to access the island. If bison were present during the winter at Yellowstone Lake, and also on Dot Island, Native Americans could have walked across the ice to hunt bison that were present. In addition to bison occupying Yellowstone Lake in winter, and bison carcass elements being present on Dot Island, it possible that the articulated bison that was recovered in the bone bed at 48YE697 was killed/processed during the winter. Also, the evidence of there not being any insect carcasses recovered from the soil samples possibly indicates that the bison was killed during winter or early spring when insects were not present.

Lastly, central place foraging theory was a useful for this study because it reflected the type of decisions hunter-gatherers possibly conducted, as well as the type of decisions that may still occur with modern-day people. The decisions that are focused on are carcass element selection, and transportation. The assumption that is built from this theoretical perspective is that when a game animal is killed further away from a residential site, the hunter(s) should field process the animal at the point of capture, leaving behind the low-utility carcass elements at the processing site, or kill site, and transporting the high-utility carcass elements back to a residential site (Cannon 2003). Again, the analysis of the faunal elements that were observed, and missing from 48YE697 allowed for the understanding of the possible subsistence strategies that were conducted by hunters who occupied the area of 48YE697. Also, the faunal analysis sets for further research that expands on the subsistence and mobility strategies in the area by attempting to discover a possible residential site that is located near 48YE697. This future study will allow other researchers to understand the lifeways and activities that occurred within a residential site, and how they are associated with processing sites and kill sites.

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