



Before the big dogs : an environmental history of bison and Plains Indians in the Yellowstone River Basin

by Thomas Piper Haynes

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts in History
Montana State University

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Abstract:

Our understanding of the history and ecology of bison in association with the history of Plains Indians has undergone an extensive review during the latter part of the twentieth century. The role Plains Indians played in the demise of bison has been central to many of these studies. These histories are usually associated with horses and the arrival of Europeans. Bison and Indians have, however, a long history of interactions. This thesis attempts to lay the historical background to these pre-horse relationships for one particular region in the Great Plains: the Yellowstone River Basin. Using the interdisciplinary tools of environmental history to explore these relationships, this narrative spans roughly 18,000 years of known bison use and 12,000 years of known human use. Such a narrative is uncommon for the northwestern plains, and specifically for the Yellowstone River Basin it has not been done.

Five major premises underline this story. The first is that the environmental conditions of the Yellowstone River Basin have been in a continual process of change. Second, bison and people have continually adapted and evolved to these changes. Third, the cultural mechanisms for procuring bison were well in place before European ideas and manufactured goods influenced the way people lived in the Basin. Fourth, Indian people were responsible for the deaths of millions of bison before the horse arrived on the northwestern plains. And fifth, far fewer bison roamed over the Basin's grasslands prior to the arrival of the horse than once was thought.

Changing climate conditions resulted in bison and people developing unique strategies for survival. For bison, this meant evolving into a smaller animal. For people it meant adapting to available resources. Through processes of adaptation, bison and people endured dramatic changes in environmental conditions, including complete vegetational transformations of the landscape, the extinction of numerous mammals, and periods of widely fluctuating weather patterns. Around 5,000 years ago bison evolved into the familiar species known today, *Bison bison*. Over time, bison and human populations increased. However, bound by the vegetative productivity of the Basin's landscape, bison numbers were smaller than previous estimates have suggested. The evolution and cultural development of a Plains Indian lifeway was well established by the time horses arrived in the Basin, with these traditions forming the foundations of a horse culture. The increase in human population and procurement of bison implicates Plains Indians as an active contributor in controlling herd size before the arrival of horses to the Basin.

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This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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Date 6 March 2001

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ABSTRACT

Our understanding of the history and ecology of bison in association with the history of Plains Indians has undergone an extensive review during the latter part of the twentieth century. The role Plains Indians played in the demise of bison has been central to many of these studies. These histories are usually associated with horses and the arrival of Europeans. Bison and Indians have, however, a long history of interactions. This thesis attempts to lay the historical background to these pre-horse relationships for one particular region in the Great Plains: the Yellowstone River Basin. Using the interdisciplinary tools of environmental history to explore these relationships, this narrative spans roughly 18,000 years of known bison use and 12,000 years of known human use. Such a narrative is uncommon for the northwestern plains, and specifically for the Yellowstone River Basin it has not been done.

Five major premises underline this story. The first is that the environmental conditions of the Yellowstone River Basin have been in a continual process of change. Second, bison and people have continually adapted and evolved to these changes. Third, the cultural mechanisms for procuring bison were well in place before European ideas and manufactured goods influenced the way people lived in the Basin. Fourth, Indian people were responsible for the deaths of millions of bison before the horse arrived on the northwestern plains. And fifth, far fewer bison roamed over the Basin's grasslands prior to the arrival of the horse than once was thought.

Changing climate conditions resulted in bison and people developing unique strategies for survival. For bison, this meant evolving into a smaller animal. For people it meant adapting to available resources. Through processes of adaptation, bison and people endured dramatic changes in environmental conditions, including complete vegetational transformations of the landscape, the extinction of numerous mammals, and periods of widely fluctuating weather patterns. Around 5,000 years ago bison evolved into the familiar species known today, *Bison bison*. Over time, bison and human populations increased. However, bound by the vegetative productivity of the Basin's landscape, bison numbers were smaller than previous estimates have suggested. The evolution and cultural development of a Plains Indian lifeway was well established by the time horses arrived in the Basin, with these traditions forming the foundations of a horse culture. The increase in human population and procurement of bison implicates Plains Indians as an active contributor in controlling herd size before the arrival of horses to the Basin.

CHAPTER 1

INTRODUCTION

Our understanding of the history and ecology of bison in association with the history of Plains Indians has experienced a bit of tweaking over the latter part of the twentieth century. This review of various aspects of bison and Plains Indian life has come from a wide range of perspectives, and highlights the overall interest, fascination, and appeal that bison and Plains Indians have to a wide range of people. The result of this interest has produced a wealth of studies that offer a broader, fuller story about these enduring creatures and the people who depended on them. The majority of these studies have focused on horse propelled Plains Indians. The goal of this thesis is to tell the story of the history of bison and Plains Indians before the introduction of the horse in one particular region of the Great Plains: the Yellowstone River Basin.¹

There are five major premises in this story. All are fairly straightforward, somewhat broad in scope, and perhaps a bit simplistic on the surface. The first is that the environmental conditions of the Yellowstone River Basin (referred to throughout the text as the Basin) have been in a continual process of change. Second, bison and people have

¹ Buffalo is the most common and familiar name used for this species found in North America. Its scientific name, however, is *Bison*. In the world of science, buffalo is used to describe the African buffalo or the Asian water buffalo. Although buffalo is used periodically in the text, mostly in quotations, bison is the preferred name used in this study.

continually adapted and evolved to these changing environmental conditions. Third, Indian people were responsible for the deaths of millions of bison before the horse arrived in the Basin. Fourth, the adaptive strategies for procuring bison and the cultural characteristics that formed a nomadic horse culture were already in place before European ideas and manufactured goods began influencing the way people lived in the Basin. And fifth, there were far fewer bison roaming the grasslands of the Basin (and entire Great Plains) before Indians became nomadic horsemen than once was thought. The simplistic character of these axioms, however (where someone might easily nod their head in agreement as if they make logical sense), ends here. When delving into why these hypotheses make sense, one quickly sees the many different interwoven relationships that make these seemingly simple premises actually quite complex.

Because bison and Indian people have a long history in the Yellowstone River Basin, it provides a good place for examining the many questions and implications surrounding pedestrian hunter-gatherer life before the horse. The tool kit of environmental history is well suited for the task of exploring these questions. Its interdisciplinary approach tends to link various academic disciplines together to reveal how environmental conditions shaped groups of people and how these groups shaped the environment. Understanding this interplay is crucial when examining pre-horse pedestrian hunter-gatherers. This is not to say that archaeologists and anthropologists do not see or understand these relationships. But they tend to carry their own preconceptions, biases, and other potential baggage, along with concerns about the quality of their evidence and data. An environmental history perspective potentially has the ability to sift through the

mounds of information to present a fresh view, as well as raise relevant issues and questions that archaeologists and anthropologists may lose sight of.

Environmental history studies on bison and Plains Indians have generally focused on larger geographical regions such as the southern, central, northern, and entire Great Plains. Archaeologists examining excavation evidence in and adjacent to the Basin tend to be site-specific. This thesis will differ from these approaches by examining a larger area than an archaeological excavation might cover, but a much smaller area than previous bison studies. Finding middle ground for telling a story that engages the ecological, archaeological, and historical complexities may provide for a more thorough exploration of how the relationship between the environment, bison, and Indian people played out in the Great Plains.²

Over the roughly 18,000 years this thesis explores, geologists, paleontologists, paleoecologists, anthropologists, archaeologists, linguists, geneticists, historians, tribal story tellers, and interested individuals have generated a wealth of data and information about life in the Yellowstone River Basin. This material is generally focused, as alluded to above, on one particular site or aspect of life in the Basin. Combining all this information into one narrative that spans approximately 18,000 years of known bison use and 12,000 years of known human use on the northwestern plains is an uncommon enterprise, and has

² For arguments in favor of regional or "bio-regional" research, see James J. Persons, "On Bioregionalism and Watershed Consciousness," *Professional Geographer* 37(1), 1985, 1-6; and Dan Flores, "Place: An Argument for Bioregional History," *Environmental History Review* 18(4), Winter 1994, 1-18.

not been done specifically for the Yellowstone River Basin.³ Within this wide breath of information, however, are gaps. These gaps, sometimes like the Bighorn Canyon in size, can easily lead to confusion when trying to understand parts of this story's complexity of how Indian people adapted and wildlife species evolved during particular periods of time.

Another part of the story's complexity comes from the study area itself, the Yellowstone River Basin. I define the Basin as the total land area drained by the Yellowstone River in Montana and Wyoming, the Musselshell River, and the land extending north to the Missouri River in Montana (Figure 1). These adjacent areas to the Yellowstone Basin were included because of their many environmental similarities and historic use by bison and people who were not generally restricted by any geographic boundaries. The Basin, referring to the total study area, spans a distinct landscape totaling approximately 96,000 square miles.⁴

The Yellowstone River itself begins its long journey to the Missouri in the Absaroka Mountains just southeast of Yellowstone National Park. For approximately 600 miles the river winds its way through the mountains and parklands of the park, the Paradise Valley, the foothills east of Livingston, Montana, and through the broad open expanse of prairie beginning near Big Timber, Montana. Once past the smaller rivers and

³ George Frison offers of the most encompassing archaeologically review of life on the northwestern plains before the horse, in *Prehistoric Hunters on the High Plains* (San Diego, 1991), second edition. For a smaller regional narrative of pre-horse life on the plains of Alberta and Saskatchewan, see Liz Bryan, *The Buffalo People: Prehistoric Archaeology on the Canadian Plains* (Edmonton, 1991).

⁴ The total land area for this thesis is based on county boundary lines that fit into the described study area. This was done to obtain the size of the area and for determining a bison carrying capacity. Available soil and grass productivity data was based on county areas. See Appendix A for details on the Basin's carrying capacity study.

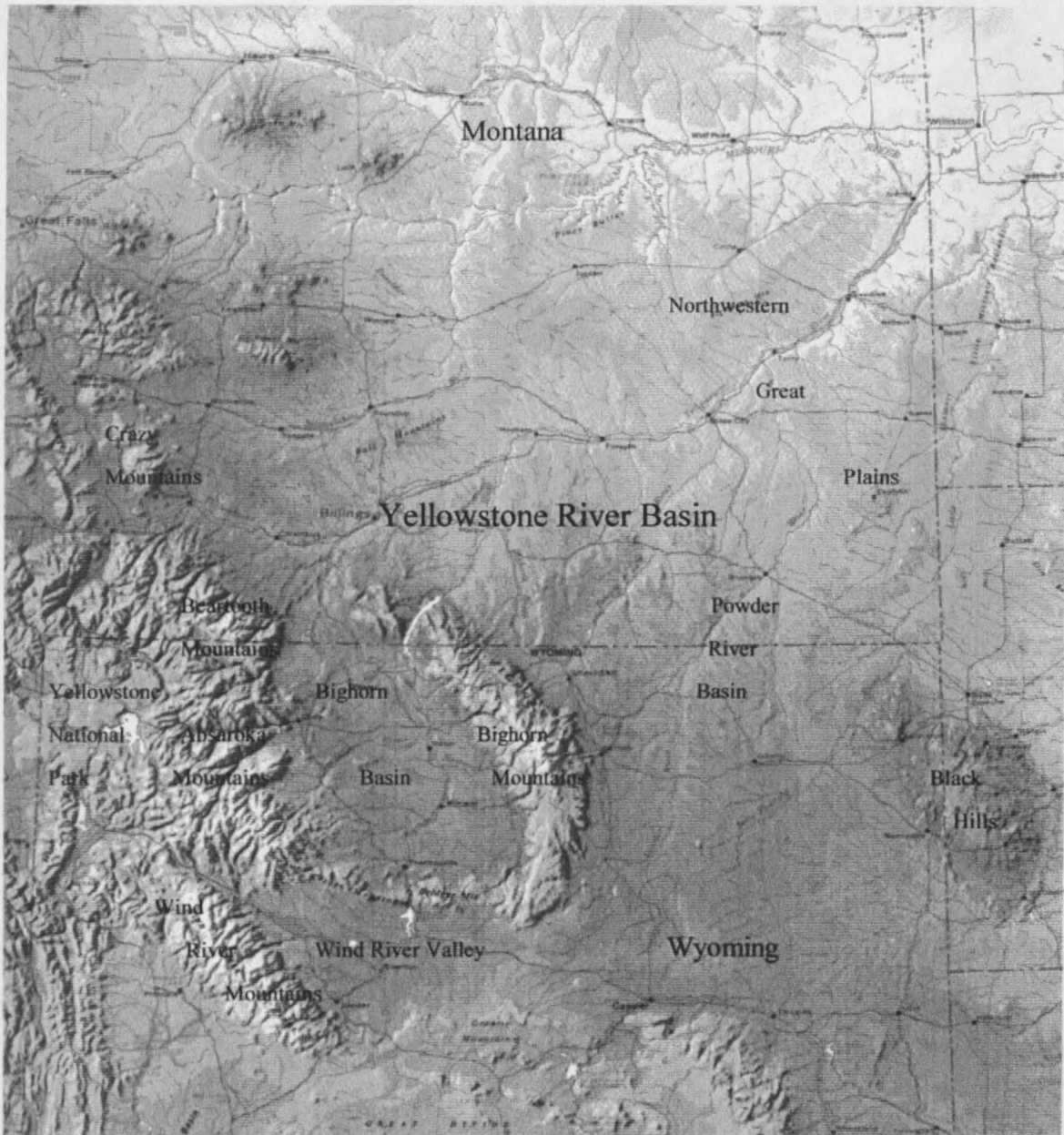


Figure 1. Yellowstone River Basin study area map.

creeks flowing north from the Beartooth range, four major tributaries enter into the Yellowstone before the river blends its waters with the Missouri just over the North Dakota line near Williston. Each of these four major tributaries, the Clarks Fork of the Yellowstone, Bighorn, Tongue, and Powder Rivers, flows north from the mountains surrounding Yellowstone National Park, the Wind River Range, and the Bighorn Mountains.

The Basin's uniqueness can be seen through its broad landscape types. By the sixteenth century the plains area of the Basin consisted mostly of mixed prairie grasses. The Bighorn Basin, situated between the Rocky Mountains on its west and the Bighorn range to the east, was a drier environment of mostly shrubs and grasses. South of the Bighorn Basin, the Wind River valley was dominated by grasses and sagebrush. River valleys and creeks throughout the Yellowstone Basin provided a riparian/woodland type of habitat. Northeast of the Bighorn Mountains and mostly in Montana were savanna forests of ponderosa pine (*Pinus ponderosa*) located on the smaller isolated mountains and along ridges. Throughout the mountains, conifer forests with grassy parklands occupied higher elevations, consisting of about 13 percent of the total land area in the Basin.

This environmental setting, however, was not the same type of landscape that existed 11,000 or even 6,000 years ago. All relationships between bison, people, and the availability of resources revolved around shifting climate conditions. The Basin has experienced a continual process of environmental change. Sometimes this change has been quite dramatic, lasting hundreds and thousands of years. In terms of geologic time, changes have lasted millions of years. At other times environmental change was less

stirring. These varying degrees of change continually affected the way animals and people lived on the land. Unlike today, we know a lot less about these earlier times, when shifting conditions affected water, plant growth, and the movement of bison and people over a diverse and changing landscape.

These relationships between climate, available resources, bison, and people pose several curious questions with interesting implications. Bison are believed to have come from Asia more than 200,000 years ago, but their life history in North America is far from understood. How did herds of bison evolve in the Basin, or for that matter, throughout North America? Indian people are thought to have crossed over a similar land bridge connecting Asia to Alaska 15,000 years ago. Then who were the "first" people to live and hunt bison in the Basin? Where did they come from? Did they pass through the region or did they establish some pattern of occupation or lifeway? How did bison fit into their daily and yearly subsistence needs?

The theory of an Asian migration/s as responsible for the peopling of the Americas remains the dominant archeological view. Connected with this view of these first people, who are generally referred to as Paleoindians, is the concept that they were predominately big-game hunters. Paleoindian arrival also happens to correspond with the extinction of large mammals that once lived in the Basin and elsewhere on the North America continent. One of the most intriguing and puzzling questions is what caused these extinctions: shifting climate conditions or human hunters?⁵

⁵ On the various views of late Pleistocene mammal extinction, see Paul S. Martin and Richard G. Klein, eds., *Quaternary Extinctions: A Prehistoric Revolution* (Tucson, 1984).

Shifting climatic conditions had a continual effect on the landscape of the Basin.

The consequences of these changes have generally been that during dry to drought periods of time bison and people have abandoned drier grassland areas. On the other hand, during cooler, wetter conditions, bison and human populations are said to have increased. On the surface these statements make sense. Dry conditions meant less vegetation, resulting in a decrease in bison herd size and potential abandonment of particular areas. Human groups may have done the same. Cooler temperatures may result in more precipitation, allowing plant growth to increase and bison herds to expand. More bison may have also allowed for an increase in human numbers as well. This almost rule-of-thumb association may not accurately portray the dynamics and conditions of life in the Basin, however.

First, is not known how severe dry conditions may have gotten. Weather patterns, even during cycles of drier years, tend to fluctuate. There is also no consensus on when these drier conditions may have occurred or for how long they lasted. Second, herds of ungulates, including bison, tend to use a landscape at about half its carrying capacity. The size of the herd may fluctuate in response to a decrease in vegetation, but not necessarily to the point of abandonment. Even in years of normal to wet conditions bison populations may not have expanded. A population of bison will only increase if annual births are more than deaths. Natural and human caused mortality appears to have acted as a culling agent that conceivably kept populations from dramatically increasing. And third, because the archaeological record is often silent during proposed periods of dry conditions, we dare not assume that Indian hunters also abandoned areas of the Basin or stopped killing bison and other game. If, for example, subsistence strategies were focused mostly on small kill

events of one to several animals, which was probably the most common way to hunt game, these events are virtually invisible archaeologically.

The hunting of bison is one theme this thesis explores. This relationship between Indian hunters and bison has also been the focus of a number of environmental history studies. These studies strongly suggests that Plains Indians were important factors in the demise of bison in the nineteenth century. Shifting climate conditions, greater opportunities to hunt more often, guns, methods of hunting, selective hunting of cows over bulls, and more bison being killed to supply robes for trade have all been used to support the role Plains Indians played.⁶ Such a conclusion has not been reached for pedestrian hunter-gatherers. Their overall impact on bison populations on the northwestern plains has only recently been explored. Much of this research is based on models and estimations. What this research supports and what numerous bison kill sites reveal, are that pre-horse hunters were capable of killing hundreds of bison at a time.⁷ If one bison was killed each day in the Basin over the roughly 12,000 years of known human occupation, more than four million animals would have died. With kill events procuring a hundred or more bison in one day, and with hundreds if not thousands of people living in

⁶ Dan Flores, "Bison Ecology and Bison Diplomacy: The Southern Plains From 1800 to 1850," *Journal of American History* 78(2), September 1991, 465-485; and "The Great Contraction: Bison and Indians in Northern Plains Environmental History," in: *Legacy: New Perspectives on the Battle of the Little Bighorn*, Charles E. Rankin, ed. (Helena, 1996), 3-22; Elliott West, *The Way to the West: Essays on the Central Plains* (Albuquerque, 1995), 51-83; William A. Dobak, "Killing the Canadian Buffalo, 1821-1881," *Western Historical Quarterly* 27(1), Spring 1996, 33-52; and Thomas Haynes, "Bison Hunting in the Yellowstone River Drainage, 1800 to 1884," in: *International Symposium on Bison Ecology and Management in North America*, L. Irby and J. Knight, eds. (Bozeman, 1998), 303-311.

⁷ John W. Fisher, Jr. and Tom E. Roll, "Prehistoric Human Exploitation of Bison in the Great Plains of Montana (USA) During the Last 3000 Years," in: *LeBison: Gibier Et Moyen De Subsistance Des Hommes Du Paleolithique Aux Paleoindians Des Grandes Plaines*, J.-Ph. Brugal, F. David, J. G. Enloe, J. Jaubert, eds. (Antibes, 1999), 417-436.

the Basin at various times, in all likelihood more than one bison per day died at the hands of Indian hunters. Increasing the number of bison killed to a conservative figure of five animals per day, suggests that more than 20 million animals were killed in the Basin over this time. If ten bison were kill per day, 40 million animals would have died by the hands of pedestrian hunters. This example suggests the potential ability of Indian people to kill large numbers of bison annually and to affect the number of animals in a herd. How the procurement affected the overall bison population is difficult too know, however, without some understanding of how many bison lived in the Basin before horses arrived.

For more than a century researchers have attempted to estimate how many bison once lived on the Great Plains.⁸ These figures cover a wide range of estimates and can go as high as 60 million animals. More recently, some estimates have lowered these totals into the high teens to low twenty million animal range.⁹ Although the way these estimates have been figured varies, the more common methods tend to compare bison use of grasslands to use by other livestock such as cattle, horses, and mules. This study uses a different method to estimate the carrying capacity of the Basin. It is based on soils, native vegetation, climate patterns, biological requirements of bison, and wildlife ecology. While counting bison remains at times simply guesswork, the method used by this study offers a more ecological approach, and conceivably a more realistic one. The data developed in this thesis suggests that there were fewer bison in the Basin, and on the Great Plains, than

⁸ For an overview, see Frank G. Roe, *The North American Buffalo: A Critical Study of the Species in it Wild State* (Toronto, 1970), 334-520.

⁹ Flores, "The Great Contraction," 13; and Haynes, "Bison Hunting," 308.

once was thought. Establishing a bison carrying capacity for the Basin at the turn of the eighteenth century has important implications for how Plains Indians affected bison populations before and after the horse became a part of their culture.¹⁰

The methods pedestrian hunters used to procure bison in association with the Basin's ecology have further implications. How Indian people understood bison ecology was based on their ability to see, comprehend, and interpret even the slightest variations in the animal's habits and environmental surroundings. Simply because they were acutely aware of their surroundings, does not mean they were ecologically sensitive in their thinking or practice, or held a cultural understanding of the need to be ecological. Being aware of their environment allowed these groups of Indian people to "work" the landscape for their betterment and survival. Guiding bison over a cliff or into an arroyo trap and using only 60% of the kill, or only carrying back to camp a portion of an animal from a single kill, was not being ecologically sensitive, but it was highly important to their physical and cultural survival. Perceptions of abundance or the outright need to survive do not necessarily create a situation or desire to be sensitive ecologically.¹¹

After 5,000 years ago the number of known archaeological sites increases dramatically as compared to the previous 7,000 years. In many ways this makes sense, for these newer sites have had less time to be removed through erosion or more deeply buried

¹⁰ The carrying capacity study undertaken in the thesis is a broader, more detailed approach that was used in an early study. See, Haynes, "Bison Hunting," 303-311.

¹¹ Whether or not Native Americans were ecological in their approach toward using the environment remains a sensitive and controversial topic. For recent viewpoints, see Shepard Krech III, *The Ecological Indian: Myth and History* (New York, 1999); and Richard White, "Environmentalism and Indian Peoples," in: *Earth, Air, Fire, Water: Humanistic Studies of the Environment*, Jill Ker Conway, Kenneth Keniston, and Leo Marx, eds. (Amherst, 1999), 125-144.

with sediments. This increase, however, has not always made interpretation easier due to the variedness of the artifacts. What excavation evidence indicates is that human populations progressively increase in the Basin. Because of this increase, groups of people may have used smaller ranges to obtain yearly subsistence needs. But archaeological evidence tells only so much. This is especially true in trying to determine how particular artifacts, such as projectile points, connect with different groups of people. For example, does a new style of a projectile point that was left behind at a camp site represent the cultural influx of a newly arriving group of folks or the adoption of this particular style of point by a resident group who has lived in the Basin for hundreds of years?

Linking ethnic affiliation to artifacts is just as difficult, although extremely tantalizing to attempt. Attempts to do this are highly controversial. The difficulty in making these connections becomes more evident when examining exchange networks. Shells from coastal regions, copper from the Great Lakes, obsidian from Yellowstone National Park, and projectile points from Knife River flint are a few of the objects that have traveled hundreds of miles to be used by someone in the Basin. Less evident forms of exchange are ideas, technology, ceramics, marriage partners, or even slaves. What might appear as an artifact from one tribe, let's say a piece of Shoshone pottery, may simply have been left behind by a completely different ethnic group who adopted Shoshone-style pottery. Or perhaps a Shoshone woman who married into another tribal group and continued to use a familiar style of ceramics. Telling ethnicity through artifacts alone is risky. How known tribes such as the Shoshone, Crow, Kiowa, and Comanche

used the Basin before they adapted to a horse culture, may not be as clear or as simple as once was thought.

Historians tend to leave these types of pedestrian hunter-gatherer questions alone. One explanation might be because this is the world of archaeologists and anthropologists and a period of time generally referred to as prehistory. When historians do write about native peoples before or at the time of European arrival in North America, they generally offer only a summation. These quick overviews are often simple explanations about the lives of people who are quite complex. Even the "New History" of the American West by Richard White says very little about Indian people before the "conquest" by Europeans. The implications of this treatment seems to be that the only meaningful history began with the arrival of Europeans and that the history of American Indian is somehow unimportant.¹²

To particular studies, sometimes a summation might work well enough. But for a study that focuses on the history of a region or place such as the Yellowstone River Basin, and involves the evolution of animals and the lifeways of people over time, describing the process of change with regard to environment, resources, and people offers an important way to explore the impacts of European culture. This thesis attempts that exploration. In doing so it rejects the use of the term prehistory. The geomorphology of landscapes, the bones and artifacts uncovered at archaeological excavations, the growth rings found in trees, the art drawn on rock walls, the architecture of dwellings, and the use of oral

¹² Richard White, *"It's Your Misfortune and None of My Own: A New History of the American West"* (Norman, 1991).

traditions are all valuable evidence to help explore and present the history of a particular place. This study is not the prehistory of the Basin, as if its history began in 1805 when trader and explorer Francis Larocque gave us the first written account of the area. It is instead the history of a place, which was used by animals and people that directly connect in a continuum with the same population of animals and people. Bison and Indian people continued to adapt to environmental changes and the influences of different people, new ideas, and technology as they had for thousands of years. Although the way Indian people lived has often been discounted by whites, their lifeways carried forward the richness of what a history is; the "accumulated knowledge and wisdom that allows a culture to sustain itself and thrive."¹³

One way in which groups of pedestrian hunter-gatherers shared their history was through the use of oral stories. Those historically oriented stories played an important role in connecting their cultural existence with their ancestral past. Such stories still play important roles for millions of Indian and non-Indian people today. To many, American Indian legend and other oral stories seem silly, unreal, or unbelievable. To others, they offer helpful insights into how groups of people valued different attributes of daily life. For many Indian people they embody the roots, the life-blood of their own historical past. The lessons, values, and history each story conveys represents knowledge that people chose to carry forward for future generations. These values cannot be easily ignored in any deeper perspective on the environment and Indian people. Stories, although often

¹³ Paul Schullery, *Searching For Yellowstone: Ecology and Wonder in the Last Wilderness* (New York, 1997), 6-7.

quite complex, offer a glimpse at how groups of Indians perceived their world. To integrate this perspective into the thesis, each chapter begins with an American Indian story.

While there is a wealth of stories from known tribal groups, it is intriguing to contemplate how stories may have been used by hunter-gatherers during those times of environmental change. One, two, or perhaps several generations may not have been aware that a climatic shift was occurring. They might have been aware of how weather patterns affected the lives of plants and animals. Their stories, possibly for the same reasons we tell weather stories today to help us connect with past events, offered Indian people living in the Basin some continuity with and understanding of the people and events from their historical past.

The past in the Yellowstone River Basin is a long history of change and adaption. This thesis offers one interpretation of how this process of change and adaption may have worked in relation to environmental conditions, bison, and American Indians. To do this, the following six chapters are organized chronologically, with a trailing chapter to tie together the study's major findings and implications. There are also two appendices, the studies carrying capacity results and the Basin's climate data based on tree-ring research. Additionally, to help the reader locate archaeological sites, geographic features, and place names used in each chapter, there is a map of the Yellowstone River Basin and surrounding areas.

CHAPTER 2

CREATION



A wind pushes the remaining clouds toward the east, and one by one you see the sparkle of stars fill the night sky. Occasionally a stronger gust of wind whips some of the snow that had lightly fallen throughout the day around the earth lodge and then off the top of the terrace to fall gently into the river below. The terrace is high enough above the river so the sounds of water and ice can only be heard when the winds become still. Wolves, first one and then several, are heard for a brief moment in the far distance. Perhaps the opportunistic animals found that carcass of the recently drowned buffalo on the bank of the river. A voice, soft at first and then growing louder, emanates from the circular lodge. When the deep projecting voice abruptly stops, laughter quickly follows. Stepping into the warm surroundings you see sparks jump up from the fire, as the load of new fuel encourages the flames to remain alive for awhile. Faces glow in the light. Their eyes focus on the elder who sits opposite the entrance. Taking his hands away from his pipe, he lifts his head to look upon each face before beginning his tale.

This story has been told for many generations. In the old times people referred to the Sun as Old Man Coyote, as well as the Supreme Being. Long ago Old Man Coyote

lived where there was no earth, only water. The only creatures in the world were the ducks and Old Man Coyote. One day Old Man Coyote came down to meet the ducks. "My brothers, I believe there is earth below the water. It is not good for us to be alone." He spoke to the large red-headed duck. "Dive beneath and search for earth, and if you can, bring some back. We will use this mud as a means for living." The red-headed duck did what Old Man Coyote wished and dove below. He remained down under the water a long time, but was not able to come up with any mud.

Old Man Coyote spoke next to the smallest duck. "I sent an older duck, but he came back with no mud. It is now your turn to try." The small duck disappeared under the water. He too was gone a long time. When he resurfaced, he said to Old Man Coyote. "My brother, I could not bring you any mud." "How is this," said Old Man Coyote, "I surely thought you would bring some mud back with you." Turning to the blue-feathered duck, Old Man Coyote told this duck to dive for some mud. Under the water the blue-feathered duck went. He too was down a long time. When he returned he was also without any mud. Old Man Coyote exclaimed, "How can we have land to live on if you ducks cannot bring me any mud!"

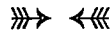
The fourth and largest duck came forward. "My brother, you should have asked me before the others, then you would of had land long ago." Down under the water the large duck went. He was gone even longer then the other ducks. He rolled and patted the mud into a huge cake, but on the way up it slipped away in the water. When he got to the surface he told Old Man Coyote that this task could not be done. Old Man Coyote howled so loud that even the water trembled. All four ducks felt quite unhappy. Then the

first duck pointed at the bill of the largest duck. "There might be a bit of mud under his bill," he said, and there was. Old Man Coyote gathered this very small bit of mud and acknowledged to the ducks that "to every undertaking there are always four trials, but you have achieved it."

With this small bit of mud Old Man Coyote went to the east. He said, "I will make the earth large so that we shall have plenty of room." As he traveled from east to west he spread the mud and this made the earth. From the mud Old Man Coyote took out a little root. In the fertile earth he planted it and things started to grow. There were grasses, flowers, shrubs, trees, and all manner of different food. The elder duck said to Old Man Coyote. "This is indeed a wonderful place you have created, but it is much too flat." "Yes my brother," said Old Man Coyote, "I agree." So upon the earth Old Man Coyote marked out rivers and creeks and formed mountains and hills. He made ponds and streams for the ducks so they would have a place to live and multiply.

Old Man Coyote was not completely happy, however, with his creation. He asked the ducks if they felt anything was missing. The blue-feathered duck replied, "everything is so beautiful my brother, what could be missing?" "Companions are missing," said Old Man Coyote, "we are all alone. It is boring." So Old Man Coyote shaped a bit of mud into a brother that would have great cunning, fast feet, keen eyes, and be very wise. He blew life upon the mud and called it fox. The two of them had great fun. But the fox was always hungry and one day tried to catch the ducks. The fox told Old Man Coyote he could not live on plants and roots. One of the ducks said to Old Man Coyote, "The fox needs meat, so he will not eat us." So Old Man Coyote gathered mud and made it into

balls and placed a feather from the ducks into each one. Then he threw dirt at the balls, and as it struck each one it turned into a different bird. And from the mud Old Man Coyote made all the other animals.¹



On a high river terrace near Glendive, Montana, evidence of a hard packed floor and several post holes were all that remained of an earth lodge that once overlooked the Yellowstone River. Conceivably within the comforts of this dwelling, stories, perhaps creation stories, were once told. The remains of this earth lodge along with an array of scattered bones and artifacts were uncovered in 1938 as part of a Works Project Administration funded archaeological project known as the Hagen site. In addition to the telling signs of the earth lodge, the site contained twenty mud plastered cache pits, human remains in a circular mound burial complex, and numerous hand crafted artifacts that included stone and bone tools, bone beads, thousands of pieces of pottery, and possibly a pair of snow goggles made out of shells. Although no radiocarbon dates were obtained from the site, archaeologists suggest an occupation of sometime in the seventeenth century.²

The artifacts discovered at the Hagen site closely resembled the material culture of

¹ The story of Old Man Coyote was adapted from a number of slightly different versions. See Robert H. Lowie, *Myths and Traditions of the Crow Indians* (New York, 1918), 14-19; Flora Hatheway, *Old Man Coyote: Crow Legends of Creation* (Billings, 1970), 3-11; and Richard Erdoes and Alfonso Ortiz, eds., *American Indian Myths and Legends* (New York, 1984), 88-93.

² William Mulloy, *The Hagen Site: A Prehistoric Village on the Lower Yellowstone*, University of Montana Publications in the Social Science, No. 1 (Missoula, 1942).

the horticulturist Mandan-Hidatsa who lived along the Missouri River and its tributaries in North Dakota. These similarities have led to the suggestion that the site was an early Crow Indian camp. This interpretation was based on Crow tradition of North Dakota being their ancestral homeland, their cultural link to the Hidatsa, time of departure from the Hidatsa, and plausible migration route that followed the Missouri and Yellowstone Rivers. The extent of bison and other animal bones spread throughout the excavation, and the limited evidence of corn horticulture, further imply a transformation toward a lifeway primarily geared to hunting and gathering. However plausible the "powerful circumstantial case" for a historic Crow camp might be, archaeologists have not established a firm tie between the Hagen site and any known ethnic group.³

The Crow creation story that opened this chapter and other Plains Indian creation stories that may have been told at such places as the Hagen site, share threads of similarity with the story geologists or paleoecologists might tell of the Basin's creation. There is water, air, and mud. These elements are then transformed into land, rivers, lakes, and mountains. And over time, the landscape becomes filled with numerous plants and animals. Although these threads of similarity exist, geologists tend to convey this story a bit differently, emphasizing that the Yellowstone River Basin and northwestern plains have undergone continual, dramatic change for more than 2.5 billion years.

As part of this process of dramatic change, at one time during the Paleozoic era, much of the Basin was covered by shallow seas for roughly 355 million years, leaving

³ Frederick E. Hoxie makes this circumstantial case, in *Parading Through History: The Making of the Crow Nation in America, 1805-1935* (Cambridge, 1995), 37-40.

behind a fossil record of varied marine life (Figure 2). Over the next 185 million years, in

Geologic Time Scale

Era	Period	Epoch	Age*	Events in Yellowstone River Basin	
	Quaternary	Holocene	.01	First known occupation by Paleoindians Major glaciation retreat from Basin Glacial maximum	
		Pleistocene	.014		
			.018		
			.2	Bison cross over land bridge from Eurasia	
		.6	Caldera in Yellowstone National Park created		
	Tertiary		2.5	Fluvial process begins to erode the land	
			Pliocene	7	Dry environment -gravels and sediments filling in valleys
			Miocene	18	Savanna/woodland environment
			Oligocene	37	
			Eocene	58	Rocky Mountains still forming
		Paleocene	66	Increase use by mammals	
		Cretaceous	144	Dinosaurs become extinct	
				Rocky Mountains begin forming	
				Age of the dinosaurs	
Jurassic	208	Super-continent of Pangaea splits apart			
Triassic					
Paleozoic			245	Widespread seas repeatedly cover the region leaving a	
			600	fossil record of a variety of marine organisms	
Pre-Cambrian			2500	Formation of basement rock	

Figure 2. Geologic time scale for Yellowstone River Basin. *Ages are in millions of years.

an era referred to as the Mesozoic, dinosaurs dominated the landscape. Near the beginning of the Mesozoic, the supercontinent of Pangaea began splitting apart along the mid-Atlantic ridge. By the end of the era subsurface thrusting and faulting started to

shape the Rocky Mountains, as shifting plates continued to move the North American continent on its westward path.⁴

Over the next 60 million years during the Tertiary period of the Cenozoic era, the Basin experienced several major climatic shifts. These changes transformed the landscape in the early part of the era from a tropical, Caribbean-like condition of hardwoods and lush vegetation to a savanna/woodland environment. Toward the end of the era the Basin's environment was a semi-arid grassland/prairie habitat that was extremely dry. These drier conditions brought about extensive erosion, impeding the fluvial process of carrying sediments, rock, and other materials downstream. This caused valleys in the mountains and plains to fill up with gravel and sediment, transforming the basin into a nearly continuous level topography for 7.5 million years.

Around 2.5 million years ago, climatic conditions again shifted, this time toward a wetter environment. The reestablished fluvial process removed huge volumes of sediments, carving deep valleys but also leaving behind untouched areas of flat uplands. Over time these uplands would provide forage for bison and wheatfields for today's farmers. Increased precipitation also formed lakes that found outlets through mountain ranges instead of around them. The Wind River Canyon through the Owl Creek Mountains and the more widely known Bighorn Canyon to its north are two examples of mountain ranges that were bisected by such down-cutting action. As dramatic as this erosion process appears, what is most often noted about the onset of this wetter climatic

⁴ For two general accounts on geological events that occurred in the Yellowstone River Basin, see David D. Alt and Donald W. Hyndman, *Roadside Geology of Montana* (Missoula, 1986), 1-33; and David R. Lageson and Darwin R. Spearing, *Roadside Geology of Wyoming* (Missoula, 1991), 1-22.

period is the arrival of the ice age.

The period of time during which great ice sheets and mountain glaciers covered portions of the North American continent is called the Pleistocene Epoch. It is during this time of expanding and retreating glaciers that the caldera in Yellowstone National Park was created in a series of three tremendous explosions, the last one occurring about 600,000 years ago.⁵ As global temperatures decreased and more and more water went into forming ice during glacial periods, the amount of water that remained in the oceans abated. At times the drop was significant enough to create a periodic land passage from Asia to North America at the Bering Straits. This land bridge, often referred to as Beringia, allowed for the migration of terrestrial species. Most important to this study is the genus *Bison*, which appears to have crossed over from northern Eurasia to North America around 200,000 years ago.⁶

The Laurentide ice sheet and Pinedale mountain glaciers were the most recent large scale glaciation to have occurred in the Basin. Spreading out from its origin in the Hudson Bay region of Canada, the Laurentide ice sheet reached into the northern area of the Basin below the Missouri River (Figure 3). Terminal moraines generally delineate the farthest extent of glacial ice into northern Montana, which left behind a gently rolling topography. Geologists offer an approximate date for the farthest advance of Laurentide ice into the Basin of around 17,000 to 18,000 years ago. In mountainous environments

⁵ Lageson and Spearing, *Roadside Geology of Wyoming*, 231-236.

⁶ E. L. Lundelius, Jr., T. Downs, E. H. Lindsay, H. A. Semken, R. J. Zakrewski, C. S. Churcher, C. R. Harington, G. E. Schultz, and S. D. Webb, "The North American Quaternary Sequence," in: *Cenozoic Mammals of North America*, Michael O. Woodburne, ed. (Berkeley, 1987), 211-235. This land bridge also allowed for the migration of humans species, which is discussed more fully in Chapter 2.

glaciers formed over most of Yellowstone National Park, adjacent Absaroka, Gallatin, and Beartooth ranges, and over the higher elevations of the Bighorn, Wind River, and Crazy Mountains. The action of mountain glaciers left behind distinct markings on the landscape, such as bowl-shaped cirques, jagged knife-edge ridges, U-shaped valleys, and sizeable moraines.⁷

The climate mechanisms that helped create glaciers, and in turn the warming trends that caused their retreat, were also responsible for the evolving flora and fauna. Paleoecologists have pieced together tidbits of information from pollen samples,⁸ periglacial studies,⁹ and animal bones to help reconstruct how the Basin's

⁷ D. M. Mickelson, Lee Clayton, D. S. Fullerton, and H. W. Borns, Jr., "The Late Wisconsin Glacial Record of the Laurentide Ice Sheet in the United States," in: *Late-Quaternary Environments of the United States: Volume 1 - The Late Pleistocene*, Stephen C. Porter, ed. (Minneapolis, 1983), 3-37; Alastair G. Dawson, *Ice Age Earth: Late Quaternary Geology and Climate* (New York, 1992), 88; and John T. Hollin and David H. Schilling, "Late Wisconsin-Weichselian Mountain Glaciers and Small Ice Caps," in: *The Last Great Ice Sheets*, George H. Denton and Terence J. Hughes, eds. (New York, 1981), 183-186. The overall reshaping of the Basin's topography by the scouring of the Laurentide ice sheet was minimal compared to the fluvial process of erosion.

⁸ The study of pollen for paleoecological reconstruction is called palynology. Most water bodies accumulate layers of sediment over time. Drilling a core into a lake, pond, bog, or marsh reveals microscopic pollen grains and microfossils that tell a history of the type of vegetation that once grew in or nearby the surrounding area of water. Sample cores are put through a series of chemical treatments that destroys most of the sediments, but not the pollen grains or other microfossils. Dating is derived by comparison of sediment layers of known geologic events, such as layers of ash from volcanic eruptions, and radiocarbon testing of microfossils. Determining vegetation from a particular site is often difficult, because of the long distances some pollen species can travel. Lynn Brant, "Pollen Analysis: A Trail Back Through Time," *Montana Outdoors* 13(1), Jan/Feb. 1982, 20-22.

⁹ Periglacial research examines how a landscapes of perennially frozen ground responded to intense frost action in a cold environments, or in other words, the study of permafrost. In studying relict permafrost landscapes, researchers look for particular features such as polygon patterns created in soils by ice or sand-wedge casts, both of which are formed under continual cold windy conditions of low snow cover. Ice wedge casts are formed when ice wedges slowly melt as the permafrost table is lowered, creating their pronounced polygon pattern. Brainerd Mears, Jr., "Periglacial Wedges and the Late Pleistocene Environment of Wyoming's Intermontane Basins," *Quaternary Research* 15(2), March 1981, 171-198.

paleoenvironment might have appeared between 16,000 to 18,000 years ago.¹⁰

In the mountains, glacial ice continued its hold at higher elevations, with rivers of ice flowing down through the valleys to the foothills. Cold temperatures maintained permafrost in soils above 5,000 feet and possibly lower. Vegetation along the mountainous slopes was characteristic of a tundra-like community. Conifers survived in this cold environment in many of the mountain foothills and isolated non-glacial areas, as well as edging into particular river valleys and canyons. Forest communities that occupy higher mountainous elevations today are estimated to have been 2,000 to 3,000 feet lower during these glacial times.¹¹

Away from the mountains and foothills, a dry, cold, and windswept tundra-like or steppe environment with low-growing shrubs and grasses characterizes what is now the open grasslands of the Basin. Mean annual temperatures are estimated to have ranged between 24 to 32° F. Because of these low temperatures, seasonal changes, from spring to summer for example, may have been far less extreme. Under these cold conditions soils experienced at least long periods of permafrost, if not perennially. In this windswept environment glacial meltwater was trapped by dams of ice that formed large glacial lakes.

¹⁰ The study of animal bones, as well as plants and other organisms from geologic time and early human history is referred to as paleontology.

¹¹ Mears, "Periglacial Wedges," 171-198; Tory L. Pewe, "The Periglacial Environment in North America during Wisconsin Time," in: *Late-Quaternary Environments: Late Pleistocene*, Porter, 157-189; T. E. Legg and R. G. Baker, "Palynology of Pinedale Sediments, Devils Park, Boulder County, Colorado," *Arctic and Alpine Research* 12(3), August 1980, 319-333; Jane M. Beiswenger, "Late Quaternary Vegetational History of Grays Lake, Idaho," *Ecological Monographs* 61(2), June 1991, 165-182; and Scott A. Elias and Laurence J. Toolin, "Accelerator Dating of a Mixed Assemblage of Late Pleistocene Insect Fossils from the Lamb Spring Site, Colorado," *Quaternary Research* 33(1), January 1990, 122-126.

The river valleys of Yellowstone, Musselshell, Missouri, and Little Dry Creek all contained these often very large bodies of water (Figure 3).¹²

Over this dry, cold, and windswept environment more than thirty mammalian species are known to have found suitable habitats. Voles, marmots, weasels, lemmings, squirrels, martens, and foxes were some of the smaller critters who shared at least a portion of the Basin with larger grazing animals such as bison, horses (*Equus sp.*), camels (*Camelops sp.*), pronghorn antelope (*Antilocapra americana*) and mountain sheep (*Ovis canadensis catclawensis*). Wolves (*Canis lupus* and *Canis dirus*), lions (*Felis atrox*), and cheetahs (*Miracinonyx trumani*) presumably kept watch over herds of grazing animals in anticipation of making kills or scavenging the dead. Following herds and scavenging dead animals may have been the strategy as well for the giant short-faced bear (*Arctodus simus*). How these various animals used the Basin, their distribution and numbers, or their seasonal movements remain, however, unknown.¹³

How quickly the Laurentide ice sheet departed from Montana on its millenary retreat toward its source in Canada is not entirely clear. Geologists appear to be leaning toward a hypothesis that substantial thinning of the great ice sheet occurred before the

¹² Mears, "Periglacial Wedges," 171-198; and Pewe, "The Periglacial Environment," 157-189. Mean annual temperature for the shrub/grass community has been calculated from 16 to 24° F. below the Basin's late twentieth century average of 48° F. Late twentieth century averages were derived from averaging the annual temperatures of eight sites in Montana and Wyoming. National Oceanic and Atmospheric Administration, *Climatological Data Annual Summary: Wyoming 1995*, Volume 104, No. 13 (Asheville, 1996), 8-10; and National Oceanic and Atmospheric Administration, *Climatological Data Annual Summary: Montana 1990*, Vol. 93, No. 13 (Asheville, 1991), 14-15.

¹³ Stephen A. Chomko and B. Miles Gilbert, "The Late Pleistocene/Holocene Faunal Record in the Northern Bighorn Mountains, Wyoming," in: *Late Quaternary Mammalian Biogeography and Environments of the Great Plains and Prairies*, Russell W. Graham, Holmes A. Semken, Jr., and Mary Ann Graham, eds., Illinois State Museum Scientific Papers, Volume 22 (Springfield, 1987), 394-408.

margins retreated from their maximum positions. During this thinning process, the ice sheet readvanced into South Dakota and Iowa, and possibly reached its former maximum position in the Basin around 14,000 years ago. Estimates suggest that by 13,000 years before present (B. P.) about half of the Laurentide ice had melted, with the margins only reduced by twenty percent, or about 200 miles.¹⁴ A pollen core taken from a kettle depression at the Hafichuk site in south central Saskatchewan reveals that the ice sheet crept over this area prior to 11,650 years ago. The abundant plant microfossils found in the mud contained spruce, poplar, and sixteen taxa of mosses that are indicative of a typical modern boreal forest. This spruce forest plant community appears to have existed throughout southern Saskatchewan and continued west into the mountains of southern Alberta.¹⁵

The 3,200 foot thick ice cap that covered the Yellowstone Plateau melted quicker than many of the valley glaciers in the Basin and northern Rocky Mountains. Pollen records from Yellowstone National Park suggest the ice cap had wasted prior to 14,000 years B. P.¹⁶ In the Bighorn Mountains glaciers were in retreat prior 13,000 years B. P.¹⁷

¹⁴ Lee Clayton, James T. Teller, and John W. Attig, "Surging of the Southwestern Part of the Laurentide Ice Sheet," *Boreas* 14(3), September 1985, 235-241; and James T. Teller, "Proglacial Lakes and the Southern Margin of the Laurentide Ice Sheet," in: *North America and Adjacent Oceans During the Last Deglaciation: The Geology of North America Volume K-3*, W. F. Ruddiman and H. E. Wright, Jr., eds. (Boulder, 1987), 39-69.

¹⁵ James C. Ritchie, *Postglacial Vegetation in Canada* (New York, 1987), 99-100; and J. C. Ritchie and S. P. Harrison, "Vegetation, Lake Levels, and Climate in Western Canada during the Holocene," in: *Global Climates Since the Last Glacial Maximum*, H. E. Wright, Jr., J. E. Kutzbach, T. Webb, III, W. F. Ruddiman, F. A. Street-Perrott, and P. J. Bartlein, eds. (Minneapolis, 1993), 401-414.

¹⁶ Kenneth L. Pierce, *History and Dynamics of Glaciation in the Northern Yellowstone National Park Area*, U. S. Geological Survey Professional Paper 729-F (Washington, 1979); Richard G. Baker, *Late Quaternary Vegetation History of the Yellowstone Lake Basin, Wyoming*, U. S. Geological Survey Professional Paper 729-E (Washington, 1976); and Judith A. Gennett and Richard G. Baker, "A Late

By 11,500 years ago, geologists suggest that Pinedale glaciers in the Basin had probably disappeared or were as small as current mountain glaciers are today.¹⁸

As warmer climate conditions melted the Laurentide ice sheet and Pinedale mountain glaciers, the Basin's flora and fauna was also undergoing its own dramatic changes. Initially replacing mountain glaciers was a tundra-like vegetation. In time, spruce communities replaced much of the tundra. This mountainous environment with its cool and moist conditions may have resembled a patchy or parkland landscape, with drier places perhaps evolving to a steppe-like habitat.¹⁹ Following the retreat of the Laurentide ice sheet, tundra-like vegetation appears to have initially reestablished itself on the bare soils. By about 12,000 years ago, the tundra-like vegetation had evolved into a grassland, or a grass, forb, sagebrush, and shrub-type landscape with elements of tundra-like vegetation and areas of wetland habitat.²⁰

Quaternary Pollen Sequence from Blacktail Pond, Yellowstone National Park, Wyoming, U.S.A.," *Palynology* 10, 1986, 61-71.

¹⁷ Michael R. Burkart, *Pollen Biostratigraphy and Late Quaternary Vegetation History of the Bighorn Mountains, Wyoming*, Ph.D. dissertation, University of Iowa, 1976, 43-47.

¹⁸ Stephen C. Porter, Kenneth L. Pierce, and Thomas D. Hamilton, "Late Wisconsin Mountain Glaciation in the Western United States," in: *Late-Quaternary Environments: Late Pleistocene*, Porter, 71-111.

¹⁹ A parkland landscape consists of a mix of forested and grassland environments. Gennett and Baker, "Late Quaternary Pollen Sequence from Blacktail Pond," 61-71; Burkart, *Pollen Biostratigraphy*, 43-47; Robert S. Thompson, Cathy Whitlock, Patrick J. Bartlein, Sandy P. Harrison, and W. Geoffrey Spaulding, "Climatic Changes in the Western United States since 18,000 years B. P.," in: *Global Climates Since the Last Glacial Maximum*, Wright, et al., 468-513.

²⁰ Vera Margraf and Tom Lennon, "Paleoenvironmental History of the Last 13,000 years of the Eastern Powder River Basin, Wyoming, and Its Implications for Prehistoric Cultural Patterns," *Plains Anthropologist* 31(111), February 1986, 1-12; and Cathy W. Barnosky, "Postglacial Vegetation and Climate in the Northwestern Great Plains of Montana," *Quaternary Research* 31(1), January 1989, 57-73.

Where the boreal forests in southern Saskatchewan and Alberta changed into a grassland-shrub community in northern Montana is not clear. East of the Yellowstone River Basin there is strong evidence to suggest that a spruce dominated forest covered much of the central plains when glaciers reached their maximum extension south into the continent. Spruce forests then followed the retreating ice sheet north back into Canada. Through pollen records, white spruce (*Picea glauca*) forests are known to have survived in the Nebraska Sand Hills and southern South Dakota region around 12,600 years ago. White spruce still occupies areas of the Black Hills today and may represent a relict population. After 12,500 years B. P., spruce habitat was mostly replaced by a type of pine community with a mix of grasses and flowering plants. Over the next 500 years the region around the Nebraska Sand Hills changed again, this time to a drier prairie landscape. The plains area of the Yellowstone River Basin and adjacent land appears to have remained a pocket on the northern plains that did not undergo a spruce transition during post-glacial time.²¹

Animal populations also responded to the changing climate conditions. The number of known grassland species appears to have increased, whereas the number of tundra or tundra edge species seems to have decreased. Accenting this transformation are three species that no longer live in the Basin but continue to live in cold, arctic tundra environments: the collared lemming (*Dicrostonyx torquatus*), caribou (*Rangifer tarandus*),

²¹ J. Platt Bradbury, *Late Quaternary Vegetation History of the Central Great Plains and its Relationship to Eolian Processes in the Nebraska Sand Hills*, U. S. Geological Survey Professional Paper 1120-C (Washington, 1980), 29-36; W. A. Watts, "Vegetation History of the Eastern United States 25,000 to 10,000 Years Ago," in: *Late-Quaternary Environments: Late Pleistocene*, Porter, 294-310; and H. E. Wright, Jr., "Vegetational History of the Central Plains," in: *Pleistocene and Recent Environments of the Central Great Plains*, Wakefield Dort, Jr. and J. Knox Jones, Jr., eds. (Lawrence, 1970), 157-172.

and barren-ground muskox (*Ovibos moschatus*). As warming occurred and vegetation changed, the collared lemming, caribou, and muskox drop out of the paleontological record.²² Shifting climates and a change in vegetation may also be why the number of large mammals began to decline beginning around 15,000 years ago. Eventually eighteen mammalian species that once lived in the Basin will go extinct (see Chapter 3 for an overview on the Pleistocene extinctions). Bones of mammoth, bison, camel, coyote, gray wolf, red fox, and pronghorn have been recovered from a few paleontological and archaeological sites in and near the borders of the Basin after 12,000 years B. P.²³

The bison that foraged over the grasslands of the Yellowstone River Basin during late Pleistocene times were not the species that currently live in parks, refuges, or on private ranches. Although the origin and evolution of bison in North America remains controversial, zoologists generally agree that the link to Eurasia is through *Bison priscus*. This Eurasian species is suggested to have evolved into a communal grassland forager before crossing Beringia. During non-glacial periods this large bison dispersed from

²² Emilee M. Mead and Jim I. Mead, "Quaternary Zoogeography of the Nearctic *Dicrostonyx* Lemmings," *Boreas* 18(4), December 1989, 323-332; Danny N. Walker, "Late Pleistocene/Holocene Environmental Changes in Wyoming: The Mammalian Record," 334-392; and Mary Ann Graham, Michael C. Wilson, and Russell W. Graham, "Paleoenvironments and Mammalian Faunas of Montana, Southern Alberta, and Southern Saskatchewan," 410-459, both found in: *Late Quaternary Mammalian Biogeography*, Graham, et al. A quick and easy assumption when examining these three species is to say they are obligated to live in tundra conditions. While suggestive, the assumption is not necessarily accurate, because the environment that existed 16,000 to 18,000 years ago in the Basin may not have any modern analogues. It therefore remains difficult to know how species adapted to changing conditions. Current ecological thought suggests that individual species, not communities of species, respond to the dynamics of a changing environment. Varying individual response to environmental change may explain why some species from the paleontological record still live in the Basin, while some do not, and others who once shared a cold and tundra-like Basin environment live in different types of habitats today. It may also be why eighteen mammalian species that once lived in the Basin eventually became extinct.

²³ Chomko and Gilbert, "The Late Pleistocene/Holocene Faunal Record," 394-408; and Walker, "Late Pleistocene/Holocene Environmental," 334-392.

Alaska into mid-latitude areas of North America and as far south as northern Mexico. *B. priscus* was larger than the bison of today, yet an even larger bison evolved from populations of *B. priscus*. *Bison latifrons*, with its high hump and five to seven-foot horn spread, roamed throughout most of the United States and possibly southern areas of Canada.²⁴

How *B. priscus* and *B. latifrons* may, or may not have shared the landscape or lived in pockets of isolation is not known. What the fossil record does show is that the overall size of bison after *B. priscus* and *latifrons* are smaller, an evolutionary process that continues with modern bison today. The how's and why's of this evolutionary process are open to speculation, with limited resources, competition over resources, and high predation all plausible parts to the answer. With the possibility of multiple waves immigrating from Alaska and with an always changing environment, it is conceivable that the individual size of bison may have fluctuated in response to environmental conditions. One, two, or perhaps more sub-species may have co-existed at one time in different areas of North America.²⁵

However this evolutionary process worked out, *B. priscus* and *B. latifrons* faded from the paleontological record prior to glacial ice leaving the Basin. What appears to

²⁴ For greater details on the various views of bison evolution during the late Pleistocene, see R. D. Guthrie, "Bison and Man in North America, *Canadian Journal of Anthropology* 1(1), Spring 1980, 55-73; Jerry N. McDonald, *North American Bison* (Berkeley, 1981), 40-75; Valerius Geist, *Buffalo Nation: History and Legend of the North American Bison* (Stillwater, 1996), 17-30; and Michael Wilson, "Archaeological Kill Site Populations and the Holocene Evolution of the Genus *Bison*," *Plains Anthropologist* 23(82, Part 2), Memoir 14, November 1978, 9-22.

²⁵ Michael C. Wilson, "Late Quaternary Vertebrates and the Opening of the Ice-Free Corridor, with Special Reference to the Genus *Bison*," *Quaternary International* 32, 1996, 97-105.

have replaced these larger bison was a smaller animal with shorter horns called *Bison antiquus*. A shift in climatic conditions, landscape change to perhaps a more open grassland environment, decrease in vegetation, and competition for forage were perhaps all forces that influenced this reduction in size. A smaller body is more efficient in gathering limited resources. Individuals who reduced daily maintenance were more likely to be reproductively successful.²⁶

During the retreat of glacial ice, *Bison antiquus*, or perhaps an even smaller subspecies, *Bison antiquus antiquus*, are known to have lived in the Basin. In far northern latitudes of Alaska and Canada, *B. priscus* appears to have evolved into the smaller *B. occidentalis*, perhaps for similar environmental reasons that caused the morphosis to the smaller *B. antiquus*. Blocked by connecting ice from mountain glaciers and the Laurentide ice sheet along the east front of the Rocky Mountains, movement south by *B. occidentalis* does not appear to have occurred until after 14,000 years ago when these huge forms of ice melted.²⁷

The herds of *Bison antiquus* (or subspecies) that roamed the Yellowstone River Basin during the retreat of glacial ice lived through a period of dramatic environmental change. By around 11,000 to 12,000 years B. P., the trend toward a warmer climate continued, with a possible increase of 8 to 10° F. in mean annual temperature from conditions three thousand years earlier. The Laurentide ice sheet still covered parts of North Dakota, but had left Montana, inching its way back toward Hudson Bay. Only

²⁶ McDonald, *North American Bison*, 65-85; and Geist, *Buffalo Nation*, 17-30.

²⁷ McDonald, *North American Bison*, 85-95; and Wilson, "Late Quaternary Vertebrates," 97-105.

remnant mountain glaciers existed in isolated areas of the Beartooth, Wind River, and Bighorn Mountains. Tundra-like plant communities and boreal forests continued in many canyons, river valleys, and on cooler north-facing slopes. But with warmer temperatures treeline elevations increased, with grasses and shrubs claiming drier foothill environments. Lodgepole pine (*Pinus contorta*), which requires drier soil conditions, became more abundant, occupying areas that were once boreal forests.

Extending out from the foothills into the Bighorn Basin, mid-size grasses may have followed the transition from the colder periglacial condition. On the east side of the Bighorn Mountains expanses of shorter grasses and shrubs with areas of wetland habitat and ponds dominated the landscape in the upper Powder River Basin. North of the Yellowstone River, grasslands occupied a treeless region with assemblages of forbs and shrub. Diverse communities of small and large mammals used these various habitats throughout the Basin. Bison, mammoths, horses, camels, wolves, and pronghorn antelope were some of the larger animals that were active in the more open grassland and shrub habitats. In its smaller size, *Bison antiquus* out-competed larger animals. Around 11,000 to 12,000 years ago, bison may have also represented the largest population of large mammals in the Basin. To this environmental setting of changing climate, vegetation, and composition of animals, the first known American Indians walked into the Yellowstone River Basin.

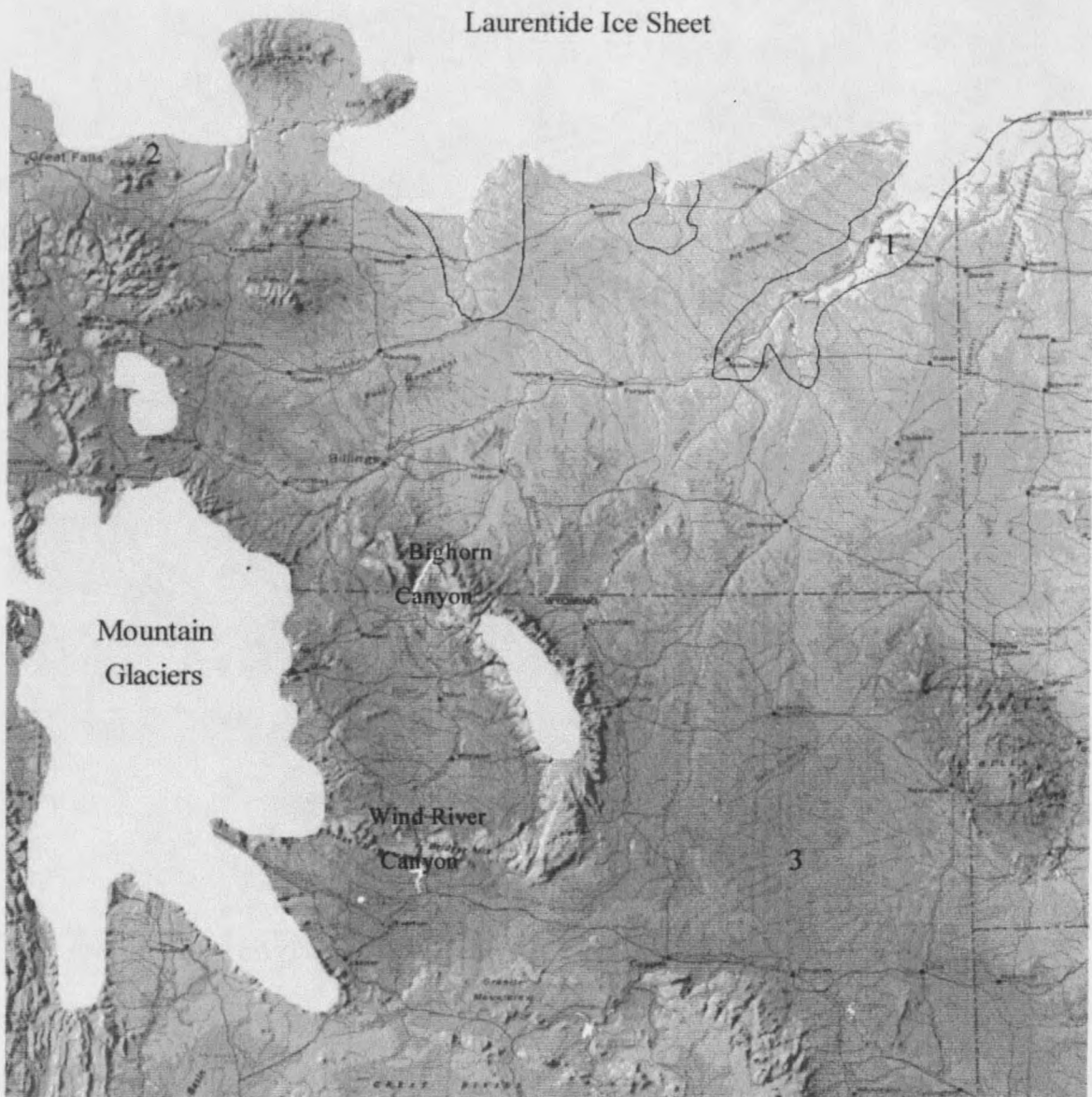


Figure 3. Approximate extent of glacial ice and glacial lakes, and location of geological features, archaeological site, and pollen core drill sites discussed in Chapter 2.

----- Approximate area of glacial lakes

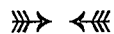
1. Hagen

2. Lost Lake

3. Antelope Playa

CHAPTER 3

A WALK INTO A NEW COUNTRY



There is a beginning for everything. Out of the darkness Saynday came upon the sunless earth. He was alone and felt both lonely and curious in a world with no people. Stumbling along, he stretched out his arms and felt something. Probing carefully with his hands and fingers he recognized the rough surface as the bark of a cottonwood tree. Feeling tired and discouraged, Saynday stopped to rest.

As he relaxed, Saynday began hearing strange sounds coming from beneath the hollow cottonwood tree. Rapping on the bark, he called out, "Who is there? Who are you?"

"We are people," faintly came the reply. "We want to come out into your world. Can you help us?" Surprised and excited, Saynday slowly reached into the hollow cottonwood tree through the opening made by an owl. Into the underground darkness he reached until suddenly another hand clasped his. Saynday instructed everyone to hold hands to form a long chain of people.

When everyone had clasped hands, Saynday began pulling the first person out of the hole, and he watched in amazement as the people poured out. After some had

emerged, a pregnant female became stuck in the opening and could go neither forward nor backwards. She blocked the way for those behind her, and no more people came out.

Those who had crawled from the underground darkness gathered together and looked up at Saynday. Bending down, smiling with excitement, he said, "I am Saynday, and I am very happy to see you! As your friend I will teach you how to live on this world, how to find food to eat, and how to be happy. The people from underground felt glad to be on the earth. They called themselves *Kwuda*, "coming out."

Those who came from the hollow cottonwood tree became the Principal People known as the Kiowa. Because the pregnant female prevented all the people from coming out into the world, the Kiowa have always been a small tribe.¹



On a portion of the earth that was sunless, the Kiowa entered into this world. Saynday, with help from fox, deer, and Swift-hawk, would take the sun that was being held on the other side of the world and return it to the sky where the Kiowa lived. In this way the earth became divided into day and night. As the story goes, they devised their plan to capture the sun around a prairie dog hole.²

Kiowa legend has this prairie dog hole somewhere between the headwaters of the

¹ The story was adapted mostly from Maurice Boyd, *Kiowa Voices: Myths, Legends and Folktales* (Fort Worth, 1983), Volume II, 13-14; and in part by N. Scott Momaday, *The Way to Rainy Mountain* (Albuquerque, 1993), 16-17. Saynday is a mythical Kiowa folk hero who arrived upon the earth in the shape of a person from the Great Mystery. From the heroic to the humorous, Saynday often represents the many aspects of the Kiowa's tribal personality.

² Boyd, *Kiowa Voices*, 15-18.

Missouri and Yellowstone Rivers. It is where the Kiowa begin their migration story.

Tribal storytellers describe aspects of early nomadic life in western Montana as consisting of travel by foot and dog travois, trading with people from the Pacific Northwest coast, and communal hunting. How long the Kiowa lived in Montana is unknown. But sometime in the late seventeenth century they left their homeland. Traveling east, they came upon the Devil's Tower, and shaped a story of how the 5,117 foot tall column of rock received its distinct columnar joints.

Eight Children were at play, seven sisters and their brother. Suddenly the boy was struck dumb; he trembled and began to run upon his hands and feet. His fingers became claws, and his body was covered with fur. Directly there was a bear where the boy had been. The sisters were terrified; they ran, and the bear after them. They came to the stump of a great tree, and the tree spoke to them. It bade them climb upon it, and as they did so it began to rise into the air. The bear came to kill them, but they were just beyond its reach. It reared against the tree and scored the bark all around with its claws. The seven sisters were borne into the sky, and they became the stars of the Big Dipper.³

As long as the legend lives the Kiowa have kinsmen in the northern night sky.

Living near the Devil's Tower in northeastern Wyoming brought about many changes for the Kiowa. Possibly the most important was a cultural switch or adaptation toward a Plains Indian lifeway. For the Kiowa, this meant gathering new geographic knowledge and adapting to a mixed grass prairie landscape with different edible plants, game, and hunting strategies. The move away from the mountains and valleys of western Montana meant establishing new cultural relationships with different people, integrating or adapting to new rituals, ceremonies, moral values, and religious ideas. Befriended by the Crow, the Kiowa transformed themselves into a nomadic horse culture dependent on

³ N. Scott Momaday recalls this story as told by his grandmother, in *Way to Rainy Mountain*, 8.

bison. Their time living near the Devil's Tower and the Black Hills of South Dakota ended around 1775, as pressure from the Lakota forced the Kiowa to move south of the Platte River.⁴

The stories, legends, and history of the people and events from the Kiowa's past represent one of many intriguing narratives about the peopling of the Yellowstone River Basin. These stories begin with Paleoindians, and like the Kiowa they are tales of people who have moved into the Basin and their ability to adapt to new situations and environments. They are also tales that leave many unanswered questions.

The most generally accepted theory of where Paleoindians originated from points to northeastern Asia. Crossing over the Bering Strait via the land bridge, Paleoindians reached the Alaska mainland as bison had done. This land bridge, possibly 600 to 900 miles wide, would not have been perceived as any type of bridge by these early migrants, but a continuation of a cold, arid, and windswept environment that supported a steppe/tundra-like vegetation and animals with which they were already intimately familiar.⁵ A consensus beyond an Asian origin, however, ends here. When initial populations reached North America, their travel route, and in how many waves of migration, remain controversial. The Kiowa, or any other American Indian group that

⁴ One way to understand the Kiowa's transformation from a mountainous to a plains culture is through their oral stories. See, Boyd, *Kiowa Voices*, 47-111, 131-144.

⁵ Steven B. Young offers an overview on the vegetative conditions in Beringia, see "The Vegetation of Land-Bridge Beringia," in: *Paleoecology of Beringia*, David M. Hopkins, John V. Matthews, Jr., Charles E. Schweger, and Steven B. Young, eds. (New York, 1982), 179-191. For a geologists overview of environmental conditions around the Pacific Northwest, see Stephen C. Porter, "Landscapes of the Last Ice Age in North America," in: *America Before Columbus: Ice-Age Origins*, Ronald C. Carlisle, ed. (Pittsburgh, 1988), 1-24.

carries forward an origin story of how they came to be on the land, may indeed have an easier time reconciling their origins than the array of researchers studying Paleoindians.⁶

The best supported archaeological hypothesis is that Asian people crossed into North America between 14,000 and 15,000 years ago. As ice from the mountains and the Laurentide ice sheet melted, it created corridors that allowed people to move south. One proposed route was along the east side of the Canadian Rocky Mountains. The movement of these "first" people away from Alaska and onto the rest of North American occurred around 12,000 years ago. Archaeologists call this group of Paleoindians Clovis, after the site in Clovis, New Mexico. Clovis is culturally represented by a long fluted style projectile point. Clovis sites are scattered throughout non-glaciated North America, and have been placed in a period of occupation between 11,200 and 10,900 radiocarbon years B. P. (Figure 4).⁷

⁶ For a historical overview on the peopling of the Americas and a wide range of articles supporting a Northeast Asia origin, see Robson Bonnicksen and D. Gentry Steele, eds., *Method and Theory for Investigating the Peopling of the Americas* (Corvallis, 1994). This consensus of an Asian origin may crumble, however, if a proposed theory of the first Americans came from Polynesia or Europe finds evidence and support. On these highly controversial conclusions, see Sharon Begley and Andrew Murr, "The First Americans," *Newsweek*, April 26, 1999, 50-57. Wherever the first Americans may have come from, anthropologists may still retain the belief that the ancestors of contemporary Native Americans still came from northeast Asia. Jack Fisher, Montana State University archaeologist, personal communications, 13 November 2000.

⁷ This overview of Paleoindian migration is from, Dean R. Snow, "The First Americans and the Differentiation of Hunter-Gatherer Cultures," in: *The Cambridge History of the Native Peoples of the Americas*, Bruce G. Trigger and Wolcomb E. Washburn, eds. (Cambridge, 1996), 125-138. The placement of Clovis into this time period follows, C. Vance Haynes, Jr., "Clovis-Folsom Geochronology and Climatic Change," in: *From Kostenki to Clovis: Upper Paleolithic—Paleo-Indian Adaptions*, Olga Soffer and N. D. Praslov, eds. (New York, 1993), 219-236. Archaeologists refer to groups like Clovis as cultural complexes. Based mostly on the different styles of projectiles points in association with radiocarbon dates, as many as fifteen complexes have been identified for the northwestern plains over the past 12,000 years. Cultural complexes have been furthered categorized into broader periods of time, such as Paleoindians or Early Plains Indian Period as this study prefers to use. These terms are not uniformly use by all archaeologists, however. While cultural complexes have been labeled separately as if representing one ethnic group of people, they may in fact be adaptations made by several or the same

Cultural Chronological Chart		
Years Ago	Cultural Complexes	Period
12,000	Pre-Clovis ?	Paleoindians or Early Plains Indian
11,000	Clovis	
10,000	Folson	
9,000	Agate Basin	
8,000	Hell Gap	
7,000	Foothills/Mountains	Middle Plains Indian
6,000	Cody	
5,000		
4,000	Oxbow	
3,000	McKean	
2,000	Pelican Lake	Late Plains Indian
1,000	Besant	
500	Avonlea	

Figure 4. Yellowstone River Basin chronological chart of cultural complexes that are mentioned in the text.

Most of the archaeological evidence supports a Clovis-first migration theory. Additional support has come from dental analysis conducted on specimens from the Americas and Eurasia. This research indicates that all American Indians possess a single dental pattern, with most Indians from North and South America related to an ancestral population that migrated from northeast Asia in the first of three waves beginning after 15,000 years ago. The second wave of Eurasians immigrants occurred around 9,000 years ago, establishing a Paleoarctic culture throughout the interior of Alaska and down the Pacific Coast. A final wave of people arrived by at least 8,000 years ago, representing

group of people who lived within a particular region for centuries. A complex may also represent two or more ethnic groups that happen to use the same type of technology.

descendants of the Aleut-Eskimo of northern Alaska and Canada.⁸

Some linguistic research also supports this theory of a three-wave migration. Amerind speakers migrated to North America from Eurasia in a wave that eventually populated almost all of the Americas. The second wave brought the Na-Dene dialect of the Haida, Tlingit, and Athabaskan peoples who disbursed themselves along the northern Pacific coast, central Alaska and northwestern Canada, and the American southwest. The final migration brought Eskimo-Aleut speakers of northern Alaska and Canada.⁹

Not all archaeologists or linguists accept a Clovis migration scenario, however. There is also "substantial skepticism" among archaeologists for a three wave migration from northeast Asia to North America. A few archaeological sites in North and South America have produced artifacts dating to and before the Clovis period. Archaeologists who support a pre-Clovis migration, point out that hunter-gatherer communities would not have had sufficient time to reach South America with a Clovis migration after 12,000 years ago, implying an earlier group or groups of people migrated south from Alaska.¹⁰

⁸ Christy G. Turner II, "New World Origins: New Research from the Americas and the Soviet Union, in: *Ice Age Hunters of the Rockies*, Dennis J. Stanford and Jane S. Day, eds. (Niwt, 1992), 7-50.

⁹ Joseph Greenberg, *Language in the Americas* (Stanford, 1987); Merrit Ruhlen, "Linguistic Evidence for the Peopling of the Americas," in: *Method and Theory*, Boonichsen and Steele, 177-188; and Joseph H. Greenberg, Christy G. Turner II, and Stephen L. Zegura, "The Settlement of the Americas: A Comparison of the Linguistic, Dental, and Genetic Evidence," *Current Anthropology* 27(5), December 1986, 477-497.

¹⁰ Two of the best documented and dated sites for a pre-Clovis occupation are Monte Verde in Chile and Meadowcroft Rockshelter in Pennsylvania. See, Tom D. Dillehay, *Monte Verde: A Late Pleistocene Settlement in Chile* (Washington, 1997), 41-52, 789-796; and J. M. Adovasio, J. Donahue, and R. Stuckenrath, "The Meadowcroft Rockshelter Radiocarbon Chronology 1975-1990," *American Antiquity* 55(2), April 1990, 348-354. Three additional articles that support a pre-Clovis migration to the Americas, are David S. Whitley and Ronald I. Dorn, "New Perspectives on the Clovis vs. Pre-Clovis Controversy," *American Antiquity* 58(4), October 1993, 626-647; J. M. Adovasio, "The Ones That Will Not Go Away: A Biased View of Pre-Clovis Populations in the New World," in: *From Kostenki to Clovis*,

Some linguists echo similar conclusions as to how a wave of people were able to transform a single language into a wealth of linguistic diversity in a relatively short time. It is estimated that at least 375 separate American Indian languages were spoken in North America alone by the time Columbus arrived in 1492. To create such diversity conceivably required a habitation for "tens of millennia." One curious question linguists pose is why there is more language diversity in the Americas than in Eurasia, despite the relatively recent proposed occupation?¹¹

If the peopling of the Americas happened before a Clovis migration, one proposed route is along the Pacific coast. A window of opportunity to travel south from Alaska occurred around 30,000 to 35,000 years ago, and it is speculated that these hearty people possessed the ability and technology to navigate through the various glacial and non-glacial terrain either by foot, some type of water craft, or a combination of both.¹²

Soffer and Praslov, 199-218; and J. M. Adovasio and D. R. Pedler, "Monte Verde and the Antiquity of Humankind in the Americas," *Antiquity* 71(273), September 1997, 573-80. Jack Fisher suggests that the three wave migration theory is currently being viewed with more and more skepticism. Personal communication, 13 November 2000.

¹¹ For arguments against the three wave migration theory and with alternative views, see Lyle Campbell "Review Article of Language in the Americas," *Language* 64(3), September 1988, 591-615; Ives Goddard and Lyle Campbell, "The History and Classification of American Indian Languages: What are the Implications for the Peopling of the Americas?" in: *Method and Theory*, Bonnicksen and Steele, 189-207; and Johanna Nichols, "Linguistic Diversity and the First Settlement of the New World," *Language* 66(3), September 1990, 475-521. The quote is from the Nichols article. In 1995, approximately 209 Native American languages were still spoken in North America. This is thought to be about half the number of languages spoken in 1492. Ives Goddard, ed., *Handbook of North American Indians - Languages*, Volume 17 (Washington, 1996), 3.

¹² Knut R. Fladmark, *A Paleoecological Model for Northwest Coast Prehistory*, Archaeological Survey of Canada Paper No. 43 (Ottawa, 1975), 280-281; and "Times and Places: Environmental Correlates of Mid-to-Late Wisconsinan Human Population Expansion in North America," in: *Early Man in the New World*, Richard Shutler, Jr., ed. (Beverly Hills, 1983), 13-41. Also see, Ruth Gruhn, "The Pacific Coast Route of Initial Entry: An Overview," in: *Method and Theory*, Bonnicksen and Steele, 249-256. The data for a coastal entry theory is limited due to the fact that most of the area became submerged as glacial melting raised ocean levels. On the use of watercrafts by Paleoindians, see William E.

Another argument for an earlier migration suggests that people crossed into Alaska around 30,000 years ago and traveled south along the east side of the Canadian Rocky Mountains before great amounts of ice converged around 25,000 years ago to block the corridor. It is plausible that both passages may have brought the founding populations to the Americas.¹³

Offering their interpretations of the origin of Paleoindians, DNA researchers working with mitochondrial DNA haplogroups have shown that all American Indians are descended from four maternal Asian lineages.¹⁴ Results and conclusions, however, vary considerably. Some test results link all Indians from North and South America into one wave of migration, while others support two distinct waves. There are indications that haplogroups may be tribally specific, meaning tribalization began early in the history of these people, with different tribes branching out and developing with relatively little intertribal genetic exchange.¹⁵ Even the time of the first migration proposed by geneticists

Engelbrecht and Carl K. Seyfert, "Paleoindian Watercraft: Evidence and Implications," *North American Archaeologist* 15(3), 1994, 221-234.

¹³Sandro L. Bonatto and Francisco M. Salzano, "Diversity and Age of the Four Major mtDNA Haplogroups, and Their Implications for the Peopling of the New World," *American Journal of Human Genetics* 61(5), November 1997, 1423-1423.

¹⁴Douglas C. Wallace and Antonio Torroni, "American Indian Prehistory as Written in Mitochondrial DNA: A Review," *Human Biology* 64(3), June 1992, 403-416; Antonio Torroni, Theodore G. Schurr, Margaret F. Cabell, Michael D. Brown, James V. Neel, Merethe Larsen, David G. Smith, Carlos M. Vullo, and Douglas C. Wallace, "Asian Affinities and Continental Radiation of the Four Founding Native American mtDNAs," *American Journal of Human Genetics* 53(3), September 1993, 563-590; and Antonio Torroni, Rem I. Sukernik, Theodore G. Schurr, Yelena B. Starikovskaya, Margaret F. Cabell, Michael H. Crawford, Anthony G. Comuzzie, and Douglas C. Wallace, "mtDNA Variation of Aboriginal Siberians Reveals Distinct Genetic Affinities with Native Americans," *American Journal of Human Genetics* 53(3), September 1993, 591-608.

¹⁵Antonio Torroni, et al., "Asian Affinities and Continental Radiation," 563-590; D. A. Merriwether, F. Rothhammer, and R. E. Ferrell, "Genetic Variation in the New World: Ancient Teeth, Bone, and Tissue as Sources of DNA," *Experientia* 50(6), 15 June 1994, 592-601; and Joseph G. Lorenz

has resulted in a wide range of variable dates from 11,000 to more than 30,000 years ago.¹⁶

What becomes evident from briefly outlining some of the different arguments is that answers to who the first Americans were, when they arrived, what route they traveled, and whether it was in one, two, three, or more waves remain elusive.¹⁷ Perhaps complicating the picture even more are theories that the first arrivals came from Europe or Polynesia and not Asia.¹⁸ While these questions remain important in the larger context of how Paleoindians arrived in the Americas, and in turn, their arrival in the Yellowstone River Basin, it is not crucial to have conclusive answers here. Notwithstanding the possibility that a pre-Clovis occupation site may be unearthed in the Basin, this story follows the hypotheses that people, most likely from the Clovis culture, walked into an unoccupied Basin landscape sometime after 12,000 years B.P.¹⁹

Whichever route Paleoindians traveled to enter the Yellowstone River Basin, most

and David Glenn Smith, "Distribution of Four Founding mtDNA Haplogroups Among Native North Americans," *American Journal of Physical Anthropology* 101(3), November 1996, 307-323.

¹⁶ Gerald F. Shields, Andrea M. Schmiechen, Barbara L. Frazier, Alan Redd, Mikhail I. Voevoda, Judy K. Reed, and R. H. Ward, "MtDNA Sequences Suggest a Recent Evolutionary Divergence for Beringian and Northern North American Populations," *American Journal of Human Genetics* 53(1), July 1993, 549-562; Antonio Torroni, James V. Neel, Ramiro Barrantes, Theodore G. Schurr, and Douglas C. Wallace, "Mitochondrial DNA "Clock" for the Amerinds and its Implications for Timing Their Entry into North America," *Proceedings of the National Academy of Sciences* 91(3), 1 February 1994, 1158-1162; Bonatto and Salzano, "Diversity and Age of the Four Major mtDNA Haplogroups," 1421; and Anne C. Stone and Mark Stoneking, "MtDNA Analysis of a Prehistoric Oneota Population: Implications for the Peopling of the New World," *American Journal of Human Genetics* 62(5), May 1998, 1153-1170.

¹⁷ For a good overview of the origin question from an archaeological perspective, see David J. Meltzer, "Clocking The First Americans," *Annual Review of Anthropology* 24, 1995, 21-45.

¹⁸ Begley and Murr, "First Americans," 49-57.

¹⁹ There are no known archaeological sites in the Basin that date to before 12,000 years ago.

anthropologists and archaeologists would probably agree that their walk into a new country would have occurred slowly. The fastest known migration by a group of pedestrian hunter and gatherers into a region void of people is by the ancestral Thule Eskimos. About 900 years ago the Thule moved from Alaska across more or less familiar, homogeneous northern maritime habitats to Greenland, a journey that took approximately three to four centuries.²⁰

One conceptual tool to help us understand how the Thule and early Paleoindians occupied the landscape is with the theory of adaptive radiation. Derived from the study of biological evolution and ecology, an anthropological interpretation of the theory suggests that when favorable environmental conditions converge with the cultural development and technological capabilities of a group of people, it allows such a group to adapt to new surroundings. For example, such change might be as dramatic as climate warming and the melting of great ice sheets in relationship to human population pressures or the availability of new resources. The change might be as small as the development of a new type of projectile point for the killing of a particular animal or the discovery of a new edible plant. Adaptation to a new region expands relatively rapidly within the resource limits of the landscape and capabilities of the new inhabitants. In time, and as environmental, cultural, and technological factors again converge, the whole group or a portion of the group will again migrate, radiating out from its former range. Such a pattern of connected ranges can be envisioned by a series of adjacent or overlapping rings placed upon the landscape.

²⁰ Robert McGhee, "Thule Prehistory of Canada," in: *Handbook of North American Indians - Arctic*, Volume 5, David Damas, ed. (Washington: 1984), 369-376.

What becomes intriguing and quite complicated is how these rings of human movement overlap and expand in a temporal and spacial scale to develop into individual tribal groups and languages. Equally intriguing is how the rings of particular plant and animal species, that are also adapting to environmental changes, fit among the patterns of human settlement.²¹

Anthropologists refer to groups of hunter-gatherers as bands. In order to provide for the basic needs of its individuals, bands needed to remain small, typically between 20 and 50 individuals and consisting of a multigenerational single nuclear family. Their yearly movement over the landscape was guided by environmental factors of temperature, aridity, and the availability of plants, animals, water, fuel, and lithic materials for tools. Social constraints affecting movement were limited to the number of people in the band and distance from other kinship groups. An average size band of about 25 to 30 individuals might have required a range of 310 square miles, with an absolute upper limit of 1,000 square miles. A band of Paleoindians in the Yellowstone River Basin would have then required a range the size of the Paradise Valley, located directly north of Yellowstone National Park in Montana, or one of the smaller counties in Eastern Montana.²²

One band of Paleoindians, however, moving through the landscape without any

²¹ This interpretation of adapted radiation is from Snow, "The First Americans," 125-127; and Tom Roll, Montana State University archaeologist, personal communications, 10 June 1999.

²² Fekri A. Hassan, *Demographic Archaeology* (New York, 1981), 51-62; Brian Hayden, "Subsistence and Ecological Adaptations of Modern Hunter-Gatherers," in: *Omnivorous Primates: Gathering and Hunting in Human Evolution*, Robert S. O. Harding and Geza Teleki, eds. (New York, 1981), 344-421. The 310 square mile range size is determined by the estimated round-trip distance that a group of hunter/gatherers could cover in a day over a years time. The maximum size area is based on known territory size of contemporary hunter-gatherers.

interaction with other groups, would eventually become extinct. Exchanging knowledge, food, lithic materials, and, most important, marriage partners, was essential for survival. Gatherings may have focused on communal hunting, the collecting of plants, and possibly ceremonies or rituals. Computer modeling of paleolithic hunter-gatherer kinship groups suggests a network of seven to nineteen bands, or 175 to 475 individuals were needed to maintain a viable population. If these population figures were accurate for Paleoindians, an overall population of nineteen bands of 25 or more members may have occupied a quarter of the Basin in any given year.²³

Unlike the northern Thule Eskimo moving through mostly familiar maritime habitats, the Basin's environmental setting may have been relatively new to these first known migrants upon the northwestern plains. If for example, bands of Paleoindians did indeed travel south from Canada, perhaps staying close to the foothills and river valleys, they may have emerged onto the open plains near Livingston, Montana. Working their way east around the Absaroka and Beartooth ranges, subsistence needs possibly guided some bands to follow the Yellowstone River. Slowly radiating out upon the entire length of the valley to the Missouri River, a distance of about 400 miles, might have taken fifty to seventy-five years and possibly even longer. How quickly early Paleoindians radiated out to adapt and occupy the Basin's landscape is not well understood. Artifacts suggest their

²³ For an discussion on social interactions between Paleoindians, see Jack L. Hofman, "Paleoindian Aggregations on the Great Plains," *Journal of Anthropological Archaeology* 13(4), December 1994, 341-370; and Robert L. Kelly, *The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways* (Washington, 1995), 161-203. Computer modeling focused on paleolithic kinship communities and may not be applicable for Paleoindians. See, H. Martin Wobst, "Boundary Conditions for Paleolithic Social Systems: A Simulation Approach," *American Antiquity* 29(2), April 1974, 147-178. Archaeologist Robert Kelly points out in the *Foraging Spectrum* that caution is needed when determining tribal size due to the "variance in prehistoric breeding populations" may be considerable, 209-210.

cultural adaptation lasted in the Basin between roughly 8,000 and 11,500 years ago.

There is also insufficient evidence to truly understand how they went about hunting and gathering on a landscape undergoing relatively rapid environmental change. Their newness to the Basin perhaps restricted their knowledge of wild plants and focused their attention on the continual pursuit of game.

A band's need for resources and social interaction in conjunction with environmental conditions would have guided yearly movement. Those kinship communities that were more widely dispersed over a varied topography that offered limited or seasonal resources, greater fluctuation in seasonal temperatures, and low rates of annual precipitation are thought to have been highly mobile.²⁴

Environmentally, the warming trend that started the melting of North America's great ice sheets continued into the Holocene. Overall mean annual temperatures are estimated to have continued to increase, perhaps in the range of 3 to 5° F. above present temperatures. The conditions that existed around 12,000 years ago when bands of Paleoindians started their inhabitation were virtually gone by 10,000 years ago. Forests of spruce were being invaded by species of pine in the mountains, implying drier soil conditions and a decrease in overall precipitation levels. As warmer and drier conditions prevailed, treeline elevations became higher on mountainous slopes, leaving behind a

²⁴ Three studies that discuss various aspects of mobility among hunter-gatherers, are Robert L. Kelly, "Hunter-Gatherer Mobility Strategies," *Journal of Anthropological Research* 39(3), Fall 1983, 277-306; Stephen M. Perlman, "Group Size and Mobility Costs," in: *The Archaeology of Frontiers and Boundaries*, Stanton W. Green and Stephen M. Perlman, eds. (Orlando, 1985), 33-50; and Robert L. Kelly and Lawrence C. Todd, "Coming into the Country: Early Paleoindian Hunting and Mobility," *American Antiquity* 53(2), April 1988, 231-244.

foothill environment that was generally dominated by grasses and sagebrush.²⁵

Northern and eastern areas of the Basin also felt the effects of warmer and drier conditions. The rise in sagebrush and xerophyte plant pollen, and perhaps accelerated soil erosion, suggest an environment moving toward increased aridity. Such arid conditions may not have dominated in the upper Powder River Basin of Wyoming, as the region maintained more of a grass and sagebrush community, with scattered ponds and wetlands.²⁶ Mammoths, bison, pronghorn antelope, camels, horses, and other game and small mammals continued to live in the Basin. Bison appear to have been procured in relatively small numbers. But to what degree of reliability or predictability these animals were available for hunting and how they affected human movement patterns and mobility is difficult to know. Changing climatic conditions may have reduced animal population levels or limited particular animals to certain ranges. Clearly, by 10,000 years ago some of the animals these initial Paleoindians saw or became familiar with had gone extinct.²⁷

Hunting animals for meat, hides, and bone tools was unquestionably a major focus for these initial Paleoindians. Plants presumably played an important role, but are not well

²⁵ Thompson, et al, "Climatic Changes," 488; Gennett and Baker, "Late Quaternary Pollen Sequence," 61-71; Burkart, *Pollen Biostratigraphy*, 43-57; and Baker, *Late Quaternary Vegetation History*, E37-E41.

²⁶ Barnosky, "Postglacial Vegetation and Climate," 57-73; Markgraf and Lennon, "Paleoenvironmental History," 1-12; and Linda Scott Cummings, "Paleoenvironmental Interpretations for the Mill Iron Site: Stratigraphic Pollen and Phytolith Analysis," in: *The Mill Iron Site*, George C. Frison, ed. (Albuquerque, 1996), 177-193.

²⁷ The spectacular bison kills of 100 to 200 animals do not appear in the archaeological record until after 10,000 years B.P. See, Jack L. Hofman and Eric Ingbar, "A Folsom Hunting Overlook in Eastern Wyoming," *Plains Anthropologist* 33(121), August 1988, 337-350; and Kelly and Todd, "Coming Into the Country," 238. Because of its environmental conditions, the region between the Yellowstone and Missouri Rivers is an area that may not have seen a lot of use by Plains Indians throughout its history. It may also be an area where erosion has eliminated much of the archaeological evidence.

documented in the archaeological record for this time. Literally walking into an unoccupied environment required time to gather knowledge about which plants were edible, useful, harmful, and where they might be located. The challenges of such a search were possibly compounded by the vegetational change that was occurring throughout the Basin. Plants once found in a particular habitat may have vanished from an area as the landscape became warmer and drier.

Depending on the availability of plants, animals, and other resources, the mobility of a band might have required as many as forty to sixty campsites within a particular area during one year alone. Movement over the various topographical features allowed each band to become geographically educated and knowledgeable in the ways of animal behavior and the harvest-ability of particular edible and medicinal plants. This process of becoming aware and intimate with a particular area of the Basin, or that sense of place so often referred to today, would have developed slowly, perhaps taking a number of decades to accumulate if resources allowed a kinship community to remain in one region.²⁸

Establishing base camps was another adaptive strategy Paleoindians might have used. Bands would have employed the use of base camps if resources proved predictable and reliable, making forays to procure game, harvest plants, or visit other kinship groups. If a band remained in the general vicinity over several years or decades, specific camps

²⁸ The term "mapping on" has been used to describe this process of hunter-gatherers learning about a particular area. On how this might have been done, see Lewis R. Binford, "Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation," *American Antiquity* 45(1), January 1980, 4-20; Kelly, *Foraging Spectrum*, 111-160. From an archaeologist perspective, Lewis Binford explores the organizational relationship among places and how hunter-gatherers learn to differentiate one place from another. See, "The Archaeology of Place," *Journal of Anthropological Archaeology* 1(1), March 1982, 5-31.

were possibly used several times. The number of known stratified excavation sites from the Basin before 10,000 years ago is small, however, implying that early Paleoindians were focused more on mobility than establishing permanent or seasonal base camps. Although archaeologists lean toward a theory of greater mobility, in all likelihood Paleoindians integrated a mix of movement strategies in response to yearly weather conditions and its effect on plants and animals, and their need for social interaction. Anthropologist Richard Lee states this understanding more simply by saying "there is no such thing as a typical year for a hunter-gatherer."²⁹

How campsites were chosen and what camp life may have been like for bands of initial Paleoindians is not clearly revealed from the few archaeological excavations found in the Basin. Staying close to water by following rivers and creeks may have been one strategy. Flood plains often supply greener, more abundant forage than upland terraces, offering greater potential toward attracting game throughout the year. Away from foothill environments, trees tend to grow more prolifically in flood plains, offering fuel for fires, although animal chips may have been used extensively. The type of light-weight, easily built, and transportable shelters these initial people used is also not known. The earliest known use of caves and rockshelters does not begin until around 10,000 years B.P. Small

²⁹ On the use of base camps, see Binford, "Willow Smoke and Dogs' Tails," 4-20. The Colby and Agate Basin sites in Wyoming are both suggested to be in part frozen meat caches from late season kills. See, George C. Frison and Lawrence C. Todd, *The Colby Mammoth Site: Taphonomy and Archaeology of a Clovis Kill in Northern Wyoming* (Albuquerque, 1986), 60-61; George C. Frison and Dennis J. Stanford, *The Agate Basin Site: A Record of the Paleoindian Occupation of the Northwestern High Plains* (New York, 1982), 79. On the likelihood that hunter-gatherers used a variety of movement strategies during a years times, see Richard Lee, "What Hunters Do for a Living, or, How to Make Out on Scarce Resources," in: *Man the Hunter*, Richard B. Lee and Irven DeVore, eds. (Chicago, 1968), 30-48. Richard Lee's quote is from, "Kung Spatial Organization: An Ecological and Historical Perspective," in: *Kalahari Hunter-Gatherers*, Richard B. Lee and Irven DeVore, eds. (Cambridge, 1976), 95.

structures similar to the conical skin tipi may have provided shelter for individuals at the Hanson bison kill site along the western foothills of the Bighorn Mountains, and at the Agate Basin sites near the Cheyenne River in eastern Wyoming.³⁰

To help carry the materials used to construct a shelter or other needed goods, domesticated dogs were possibly used by Paleoindians. Although no archaeological site from the Basin have yielded evidence of a domestic dog until more modern times, two sites near the borders of the Basin have. A domesticated dog bone, which had received a series of cut marks, was recovered at the Agate Basin site and dated to between 10,500 and 10,800 radiocarbon years ago. Evidence from Jaguar Cave in northwestern Idaho revealed canine bones more closely resembling domestic dog than wolves or coyotes, and dated to about 10,300 years ago.³¹

Presumably, dogs helped relieve some of the burden of transporting materials and goods. Their use, however, was simply one component of everyday Paleoindian life. Packing, moving, establishing camp, harvesting plants, killing game, butchering animals, preparing food, and making tools, were a few of the many aspects of daily life. Ethnographic studies suggest that the tasks in and around camp were probably segregated along gender lines. Because bands were most likely multigenerational family units, caring

³⁰ On the use of skin shelters, see George C. Frison, "Paleoindian Subsistence and Settlement During Post-Clovis Times on the Northwestern Plains, the Adjacent Mountain Ranges, and Intermontane Basins," in: *Americans Before Columbus*, Carlisle, 83-106. Shelter and firewood considerations conceivably limited the use of some areas of the Basin. This may have been especially true, possibly catastrophic, for a band walking through an area that was struck by a long, cold, severe period of winter-like weather.

³¹ Stanley J. Olsen, *Origins of the Domestic Dog: The Fossil Record* (Tucson, 1985), 31-40; and Danny N. Walker and George C. Frison, "Studies on Amerindian Dogs, 3: Prehistoric Wolf/Dog Hybrids from the Northwestern Plains," *Journal of Archaeological Science* 9(2), June 1982, 125-172.

for children and maybe elders, gathering plants, food preparation, tanning hides, and making clothes can easily be envisioned as tasks done by women. Such life supporting work required enormous energy and blocks of time, creating a need for a band to remain relatively sedentary at least occasionally. Hunting, scouting, protection, tool making, and perhaps the butchering of animals and the moving of camp can easily be seen as jobs done by men. As easy as it is to envision gender roles, who actually completed these numerous daily tasks remains completely speculative. This is true as well regarding how Paleoindians used religion, rituals, or ceremonies. Although the prolific use of red ochre occurs at a number of sites, including a burial near Wilsall, Montana, its cultural significance remains unclear.³²

The preparation of food was another major component of camp life. Meat was probably the mainstay for most bands. A diet of mostly meat, fat, and seasonal plants provided a sufficient nutritional diet through most of the year. Yet in late winter and spring when animals had lost their fat reserves and no fresh plants were available, a diet of strictly lean meat could have led to protein poisoning if carbohydrates or fats were not added. To avoid inadequate nutrition during this time of year, bands needed to consume carbohydrate rich stored plants, stored fat, or fat-rich meat from such animals as bear, beaver, certain species of fish, and migratory waterfowl. Eating the ruminating contents found in the stomachs of bison perhaps offered another option, although one that does not

³² For views on interpreting gender at archaeological sites, see Julie E. Francis, "Gender Studies in Plains Anthropology : A Commentary to the 1987 Symposium," *Plains Anthropologist* 36(134), Memoir 26, April 1991, 77-80. Donna C. Roper describes the various uses of red ochre and its potential importance to Paleoindians, in: "A Comparison of Contexts of Red Ochre Use in Paleoindians and upper Paleolithic Sites," *North American Archaeologist* 12(4), 1991, 289-301.

seem appealing by current taste standards. Another source of fat was marrow. There is, however, no clear evidence from the Basin that initial Paleoindians broke open large leg bones to scoop out the fat rich marrow.³³

Initial Paleoindians who lived in the Basin are generally portrayed as specialists in big-game hunting. The use of optimal forage theory has also bolstered the notion of a hunting specialist. Because of the amount of energy it took to hunt, hunters attempted to optimize their time by returning with the most meat that was available. Killing one bison would appear to have been easier than killing five or six deer, or perhaps seventy-fifty rabbits to obtain the same amount of meat. Bison and mammoth make up the majority of animal bones excavated from a limited number of sites. Mixed within their bones, however, are small game animals, suggestive of resource exploitation on a much wider scale. Bands faced restrictions in their mobility due to size, composition, daily walking ability, and other survival needs. If large animals were not in the band's range, they would have needed knowledge and proficiency in securing smaller game such as deer (*Odocoileus hemious*), elk (*Cervus elaphus*), mountain sheep (*Ovis canadensis*), and jackrabbits (*Lepus* sp.) to augment their subsistence meat supply.³⁴

³³ Limited knowledge of plant resources has been used as one reason why Paleoindians were big-game hunting specialists. See, Kelly and Todd, "Coming into the Country," 231-244. On the need for protein in the diet, see John D. Speth and Katherine A. Spielmann, "Energy Source, Protein Metabolism, and Hunter-Gatherer Subsistence Strategies," *Journal of Anthropological Archaeology* 2(1), March 1983, 1-31.

³⁴ The support for Paleoindians as big-game hunters is widespread. For archaeologists who combine this argument with aspects of optimal foraging theory, see Kelly and Todd, "Coming into the Country," 231-244. For an discussion that questions Paleoindians as big-game specialist, see David J. Meltzer, "Is There a Clovis Adaptation?" in: *From Kostenki to Clovis*, Soffer and Praslov, 293-310. On Paleoindian hunting on the northwest plains, see Frison, *Prehistoric Hunters*, 139-186.

The actual number of known Paleoindian kill sites in the Basin during their initial occupation is small, less than twelve, and may not reflect conclusively all of the animal species that were hunted. What these kill sites do reveal is an ingenious use of weaponry, natural features, and detailed knowledge of animal behavior for successful procurement. Stone weapons were lightweight and portable. The fluted projectile points are difficult to manufacture, indicative of careful precise craftsmanship. For a skilled flint knapper to produce one point may have taken as long as two hours, not including the time it took to get to and from the quarry or to produce the blanks for transport. Different sizes and styles of projectile points found throughout the Basin may reflect the specific animal that hunters hoped to kill or the type of weapon the point was attached to. Points are known to have been placed on spears or throwing sticks such as the atlatl. The stone used to make these finely crafted points often came from quarries that were located many miles away. Obsidian flakes found at the Hanson site provide one example. Visual comparison strongly suggests that the source for the obsidian was from the Obsidian Cliff in Yellowstone National Park, about two hundred miles west of the Hanson site. Access to quality stone, whether through actual quarry visits or by exchange, was essential for survival, and needed to be integrated into each band's movement strategies. In addition to projectile points, tool kits also consisted of stone end scrapers and knives, along with tools made from bone. Paleoindian tool kits appear to reflect a band's ability to have lived frequently on the move.³⁵

³⁵ George C. Frison, "North American High Plains Paleo-Indian Hunting Strategies and Weaponry Assemblages," in: *From Kostenki to Clovis*, Soffer and Praslov, 237-249; Brian M. Fagan, *Ancient North America: The Archaeology of a Continent*, (London, 1995), 83-84. On the sources of lithic

To increase the odds of procuring sufficient quantities of game with the use of stone weaponry, Paleoindians successfully integrated the use of natural features into their hunting strategies. The arroyo represents the most widely known feature used by bands of early hunters. Dendritic-like erosional patterns on the open plains produce a variably wide steep sided channel. These geologic features can end abruptly, acting as a natural trap for animals who may have wandered into the feature for forage or have been gently guided into the channel by hunters. Bison appear to have been the most sought after species to be trapped, but the bones of mammoth, horses, pronghorn antelope, camels, musk-ox, mountain sheep, elk, and jackrabbits have also been found in arroyos. Several mammoths are known to have been killed in an arroyo at the Colby site in the Bighorn Basin. Bison were trapped during several kill events at the Carter/Kerr-McGee site in Wyoming's Powder River Basin and at the Agate Basin sites. Each of these excavations suggests a late fall to winter procurement, as a band or possibly several bands gathered together to form a communal hunt to supply meat for the coming winter.³⁶

Behavioral knowledge of game and the use of parabolic sand dunes provided another method to procure bison. The ecological character of a dune area often provided for a year-round water supply and potentially lush grasses. Bison feeding around the dune area may have been easily guided into the deep sand, where their split hooves would

artifacts found at the Hanson site, see George C. Frison and Bruce A. Bradley, *Folsom Tools and Technology at the Hanson Site, Wyoming* (Albuquerque, 1980), 11-16. Blanks are a small block of rock which has been worked into a shape for easier transport. The flakes or debitage left at most quarry sites suggest that projectile points were manufactured at another location.

³⁶ Frison, "North American High Plains," 244-246. Placing the time of year on a procurement event is done by analyzing teeth and their relationship to the age of young bison.

readily sink. Once bison were bogged down in the sand, hunters could dispatch as many animals as possible before the bison could have fought their way free. At the Casper site, situated north of Casper, Wyoming, 75 to 100 bison were killed and butchered in what may have been a series of late fall to early winter procurement events.³⁷

How representative the use of arroyos or parabolic sand dunes were to the overall hunting strategies of initial Paleoindians is far from conclusive. These skilled hunters undoubtedly could kill bison and other animals opportunistically without the need of natural features. In fact, the Horner site, located near the Shoshone River and the town of Cody, Wyoming, offers some evidence that Paleoindians had the ingenuity to construct drive lanes and possibly a holding pen as another method to procure bison.³⁸

How bison and Paleoindians adapted or had overlapping ranges during this period of vegetational change remains unclear. If Paleoindians occupied the landscape in dispersed ranges, but close enough to form social networks of needed exchange, their contact with bison would appear to have been relatively frequent, especially if bison herds were spread over the Basin. But if bison were not as widely dispersed or occupied only particular ranges, then Paleoindians would have needed to be skilled at procuring other animal species for subsistence. This latter scenario implies that these early hunter-gatherers were not big-game specialists, but more likely generalists, taking advantage of a variety of game when hunting opportunities became available.

³⁷ George C. Frison, *The Casper Site: A Hell Gap Bison Kill on the High Plains* (New York, 1974), 21-24, 103-104.

³⁸ A summary of the Horner site is found in, George C. Frison and Lawrence C. Todd, *The Horner Site: The Type Site of the Cody Cultural Complex* (Orlando, 1987), 361-369.

Although there remain numerous gaps in the archaeological record to fully grasp how initial Paleoindian and bison adapted to the environmental conditions of the Basin 10,000 years ago, through anthropological research we can infer that bands, small in numbers and made up of a multigenerational family, were probably dispersed throughout most of the Basin. Each band remained connected to and interacting with at least a few other bands that occupied shared or adjacent ranges. The extent of mobility depended on environmental conditions, leadership, topography, resource richness, animal and plant knowledge, and social kinship connections. Yearly patterns of movement may have led to general wandering, chasing game, following river courses, planned strategies to seasonally locate near particular resources, use of seasonal base camps, or in all likelihood some combination. Yearly movement, however, had limitations due to each band's ability to travel. Kinship groups that first came to the Basin may have needed to be more mobile until knowledge of particular areas became better known. Depending on location and animal densities, bands may or may not have been big-game hunters. Social interactions and communal hunting played a role in the lifeways of each band, but to what degree remains unknown.

Bands conceivably faced periods of population pressures, whereby resources proved limited in relationship to the size of the group. Interactions may have led to dissension, or perhaps the vying for power as a new leader emerged. Catastrophic death of male or female members through accidents, conflict, hunting mishaps, or crossing rivers were perhaps daily concerns. Any of these possibilities, and there were probably many more, may have divided a group or forced it to join a different band. With a new leader, a

band or a number of bands might venture off to explore an entirely new region or develop a new social relationship with a different regional/cultural group of people. The Kiowa may provide a more modern example of how this process worked for a group of people reestablishing themselves in a new environment and cultural framework. The branching off of various bands conceivably led to the formation of different tribal groups, regional identities, and languages.

To these various possibilities of movement over the Basin's landscape we can envision the lifeways of mobile hunter-gatherers. How these initial Paleoindians indeed adapted, still remains mostly suggestive through the conceptual tools of anthropological theory and limited archaeological data. It may be that the lifeways that initial Paleoindians used have no modern analogy. Whatever fate these people endured, the strategies they developed in order to survive in the Yellowstone River Basin and elsewhere for two thousand years worked, and they worked quite well. This initial formation of a Plains Indian Culture with its adaptive form of living would flourish relatively unchanged until the arrival of Europeans, diseases, and the horse.

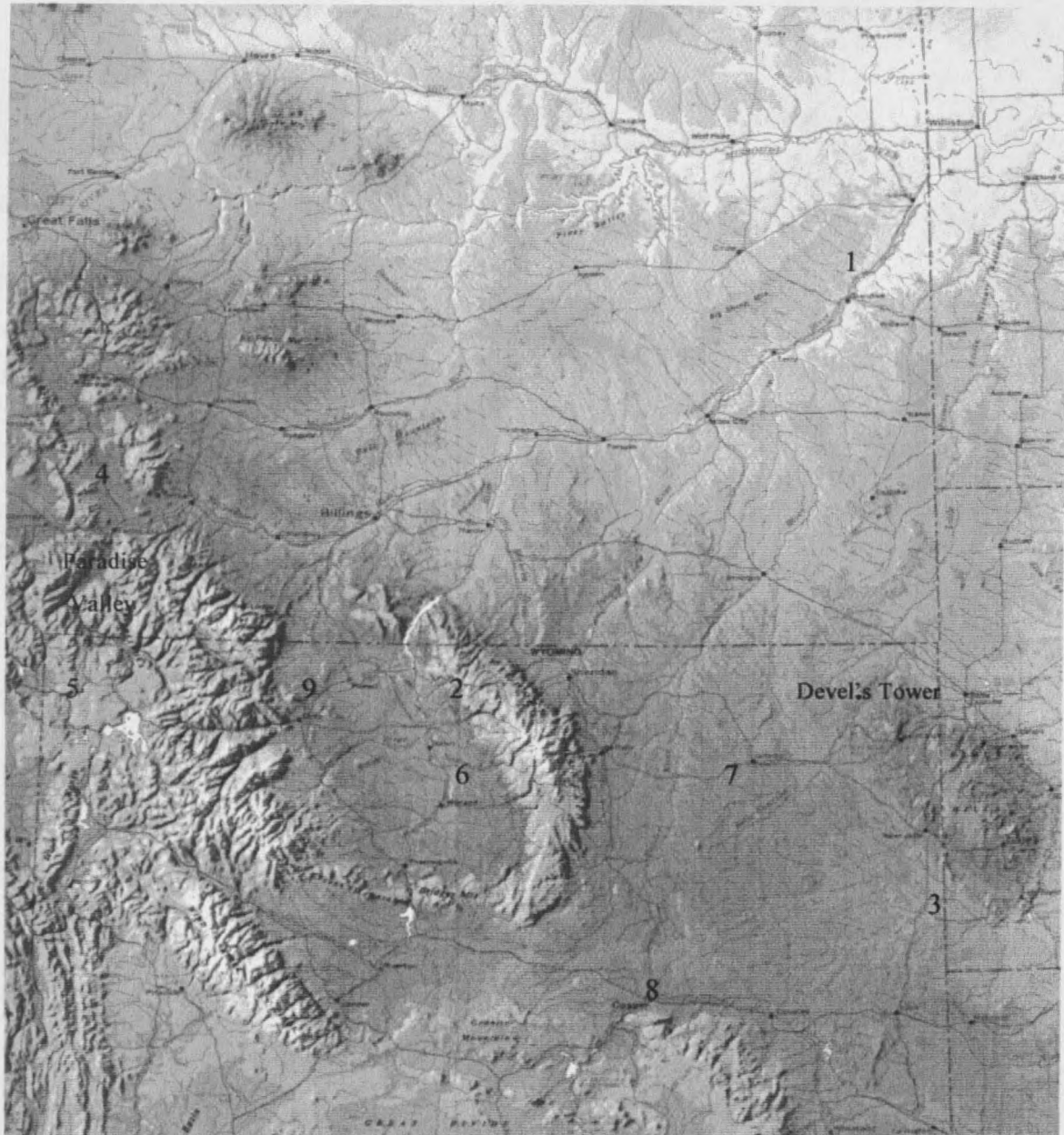


Figure 5. Approximate location of Paleoindian archaeological sites discussed in Chapter 3.

- | | |
|----------------------|-----------------------------------|
| 1. Lindsay Mammoth | 2. Hanson |
| 3. Agate Basin | 4. Anzick - near Wilsall, Montana |
| 5. Obsidian Cliffs | 6. Colby |
| 7. Carter/Kerr-McGee | 8. Casper |
| 9. Horner | |

CHAPTER 4

EXTINCTION, DROUGHT, AND ADAPTATION



They say a long time ago that fifty young men went out to hunt buffalo. These men traveled on foot and carried with them their stone tools and spears, along with additional sets of moccasins. When the group came down from the mountains, they began to cross the dry and barren plains. As far as the eye could see, the rolling topography spanned the horizon. There were a few places, however, where coulees and canyons had formed, and looking down into these breaks in the landscape one would often see mirages of shining water. That is why when the men saw something shining ahead of them on the trail they were not surprised.

As the men walked nearer to the shining object, they realized it was not a mirage but something different. The object grew larger and larger as the group got closer, shining and glowing as it reflected the sun like a mirror. They all stopped to look at the wonderful sight. "Let us go over and see what this is," said some of the men. Others said "no!" suggesting that they should travel the other way and avoid this mysterious and perhaps dangerous object. The leader of the group pointed out that "we must stay on the trail in order to find water. If this shining object is something wonderful and meant for us, it will

be right on the trail.”

For the rest of the morning they followed the trail. Around midday they caught up to the object to see that it was a great water turtle with a shining shell walking slowly along the trail to the water hole as if it were a person. “I’m going to ride on its back,” said one of the young men. Foolishly he climbed onto the turtle’s back, and the turtle carried him slowly along the trail.

Seeing how strong the turtle was, another young man climbed onto the turtle’s back. The turtle continued forward carrying the two men steadily to the east. Slowly, one after another, forty-nine of the young men climbed onto the turtle’s back, with only the leader of the group left on the ground to walk beside the great creature.

“I wonder what makes him so strong,” said the first young man to climb onto the turtles back. “I’m going to see his muscles if I can,” he said. Taking his spear, he tried to pry the shell off of the turtle’s back. Others tried to do the same, but the shell held together. The turtle gave no sign that this prying hurt, and the great creature continued to carry its load forward.

“Get down,” the chief ordered his friends. “We can walk beside him and keep him company as long as he stays on the trail, but he is much too powerful to play with or to hurt. Get down and walk with me.”

The forty-nine young men began to argue among themselves about whether or not the great turtle was a mystery sent to them and they should stay with him, or leave him alone for he possessed dangerous powers. Those who felt the turtle was dangerous decided to get off of the creature’s back and walk beside it. When they tried, they found

they were stuck to its shell. The other young men also found that they were stuck. They began to attack the turtle with their weapons, but they were useless against the thick shell.

The forty-nine young men cried out to their chief. "Save us! Help us! You are our leader and it is up to you to save us from this creature."

"Stop, please stop," the chief said to the turtle. "Please let my brothers get down, and we will wait here and not bother you again. They are sorry they tried to hurt you. Forgive them and be merciful, because you are so much stronger than they are. Let these poor young men go free, and they will honor you forever." The turtle crawled steadily forward, and the young men could not get off his back.

Weeping and pleading the chief continued to walk alongside the turtle. But the turtle did not stop. Daylight was beginning to fade, and ahead the chief could see a pool of water. The water was not shining, and the turtle was heading straight for it. The young men also saw the water and they became truly frightened. They all began to cry and pray for mercy. The turtle ignored their pleas, and continued toward the water. "Stop!" the chief begged. "Let my foolish friends get down. Show us your strength through your mercy." The turtle showed no signs of slowing down as it crawled forward nearing the water.

"I have done all that I can," the chief said to his friends. "Something wonderful was shown to you and you did not respect it. Now you will be punished because you thought wrong in your hearts. I cannot change anything."

"Go home," said the young men as the turtle stepped into the water, "it is all that you can do. Tell the people what happened and let them know that we love them and we

will mourn for them. They should mourn for us too. And bring the people here this time next spring, so they can mourn for us on this spot.”

The chief raised his arm in farewell. “I will tell the people what has happened and we will return next spring to mourn for you.”

To the last minute, as the turtle carried the young men down, down into the water, they waved to their chief. Weeping and sighing the chief promised his friends that he would do what they asked. When the chief came home, all the people came out to meet him. “Where are our sons and brothers,” they asked? Sorrowfully the chief retold the story of the mysterious and powerful turtle. The people wept and mourned. When he finished, the people all agreed to return to the lake to mourn for their sons and brothers.

In spring, when the grass was high and standing water was everywhere, the chief lead the whole village west to the lake where his friends were lost. The chief did not find the lake. Instead, he came to a place where a great lake once had been. In the middle of the old lake bed there was a deep hole. Going down, down into the earth, the people found the hole filled with bones. The people removed their heavy loads and began to mourn, for they knew that the bones were from the forty-nine young men the turtle had carried into the water.¹



Most Plains Indian tribes have water-monster stories. The Cheyenne carry

¹ This Cheyenne story, “The Waters Beneath: Fifty Young Men and a Turtle,” was adapted from a version told to Alice Marriott by Mary Little Bear Inkanish. In, Alice Marriott and Carol K. Rachlin, *American Indian Mythology* (New York, 1968), 41-45.

forward a number of stories about water-monsters set on the plains of Montana and Wyoming, but this account comes from the high plains of Oklahoma. Near Canton, archaeologists have recovered bones from a pit that they suggest are from animals. From the story, the Cheyenne offer a much different interpretation of how these particular bones arrived in this pit. These two different interpretations highlight the polarities of two contrasting approaches toward reconstructing past events. Archaeology, along with other disciplines, often pulls at the very fabric of Plains Indian Culture by not only giving alternative or opposing views of past events, but also by imposing a history upon a culture that may see it's world quite differently. The contrast between an oral story and a reconstructed archaeological interpretation often reveals how little is truly known about the bones of humans and animals that have been left behind.²

The Cheyenne, like numerous generations of people who lived in the Yellowstone River Basin before them, integrated stories to help them learn, create, accept, and adapt to the various cultural and environmental changes that confronted each generation. Images of a great turtle who can support forty-nine men, the ability of a place to become dry and barren, the quest and need for water, staying on a trail, a lake becoming dry even in spring, and the lack of respect toward other creatures are a few of the historical, cultural, and environmental expressions that radiate from the tale.

Initial bands of Paleoindians who lived and flourished in the Basin 10,000 years

² For an overview toward ways of perceiving and understanding Native American history, see Peter Nabokov, "Native Views of History," in: *Cambridge History of Native Peoples*, Trigger and Washburn, 1-59. The author acknowledges that this study also imposes at various times a history on Native people who have lived in the Yellowstone River Basin.

ago most likely did not understand the phenomenon of climate warming that was occurring all around them. They were, however, probably keenly aware that populations of particular animals and plants were no longer being found upon the landscape. Stories may have offered some explanation that helped them understand and adapt to these changes. But unlike the Cheyenne who have a story that tells how certain bones came to be in a particular place, how Paleoindians interpreted the disappearance of various species, particularly animal species, is unknown, and it also forms one of the great mysteries of vertebrate paleontology. Generally referred to as the megafauna extinction, the vanishing of numerous species of mammals and birds coincided with the initial occupation of Paleoindians. In the 1960s, archaeologist Paul Martin strongly suggested that these two factors were not simply a coincidence.

Martin argued that the extinction of megafauna was a direct result of an "overkill" by well-adapted big-game hunters. Linked to the hypothesis of a Clovis first migration along the ice-free corridor on the east side of the Canadian Rocky Mountains, these Clovis people happened onto a vast supply of large animals who had no experience with human hunters and were unequipped with any defensive behaviors. Taking complete advantage of the wealth and accessibility of naive large game, Paleoindians multiplied and spread quickly in a southward direction to populate all of the Americas. In their wake only the bones of thirty-three genera of megamammals remained. Of these species that went extinct, nine are known to have resided in the Yellowstone River Basin.³

³ Paul S. Martin's 1960s extinction theory can be found in, "Prehistoric Overkill," in: *Pleistocene Extinctions: The Search for a Cause*, P. S. Martin and H. E. Wright, Jr., eds. (New Haven, 1967), 75-120. A 1980s version is in, "Prehistoric Overkill: The Global Model," in: *Quaternary Extinctions*, Martin and

Martin's provocative hypothesis has not been met with universal acceptance. Critics point out that large scale fauna extinction has been occurring for more than ten million years, with the end of the Pleistocene but one of many extinction events. They also suggest that several species were possibly already extinct prior to the arrival of Clovis hunters and that Paleoindians procured a variety of animals and were not simply single-minded big-game hunters. Most of the major arguments against Martin's hypothesis, however, revolve around aspects of climate change and its effect on animal ecology. As seen in the Yellowstone River Basin, a major vegetational transformation occurred in a relatively short period of time. Animals in turn were forced to adapt to these changes, leave the area to find suitable habitats, or perish. Large animals are perhaps more vulnerable to extinction in the face of dramatic environmental change than smaller animals because they require more food, more space for fewer numbers, and reproduce at a much slower rate. Although several genera of small mammals also went extinct at the end of the Pleistocene, they survived at a much higher rate than their larger kindred. One adaptation strategy for larger mammals living in an environment heading toward limited resources is reducing body size. As bison evolved from *Bison latifrons* (or perhaps *B. priscus*) to *B. antiquus* as a result of environmental change 15,000 to 20,000 years ago, the species is thought to have continued evolving into the smaller *B. antiquus antiquus* as the landscape in the Yellowstone River Basin and elsewhere on the northern plains continued to inch its

Klein, 354-403. Martin's division between small and large mammals is around 95 pounds. Of those genera and species that have gone extinct in the Basin, see Walker, "Late Pleistocene/Holocene Environmental Changes," 342-345.

way toward drier conditions.⁴

Paleoindians in the Basin killed large game that went extinct. But whether they wiped out megafauna populations as Martin's hypothesis implies seems less likely as archaeological findings increase and our understanding of animal ecology and behavior improves. An extinct species of camel, for example, was recovered at the 10,000-year-old Casper site, a date younger than Martin's overkill theory argues.⁵ In light of the existing evidence, it seems reasonable to envision Paleoindians playing a role of some degree in the extinction process. One interpretation for the extinction of mammoth species is derived from evidence excavated at the Colby site.

Most of the mammoth bones uncovered were of younger animals, suggesting Paleoindians may have focused on smaller, relatively easier to kill juveniles. If mammoth reproduction physiology was similar to that of today's elephant, females would have produced young at about fifteen years of age, had a gestation period of less than two years, and calved about every six years. The combination of slow population renewal, deteriorating habitat caused by climate warming, and an unstable population due to a

⁴ Opposing views of Martin's theory and the biological requirements of mammals in the context of Pleistocene extinction can be found in, Donald K. Grayson, "Late Pleistocene Mammalian Extinctions in North America: Taxonomy, Chronology, and Explanations," *Journal of World Prehistory* 5(3), September 1991, 193-231; John E. Guilday, "Pleistocene Extinction and Environmental Change," in: *Quaternary Extinctions*, Martin and Klein, 250-258; and Anthony D. Barnosky, "The Late Pleistocene Event as a Paradigm for Widespread Mammal Extinction," in: *Mass Extinctions: Processes and Evidence*, Stephen K. Donovan, ed. (New York, 1989), 235-254.

⁵ George C. Frison, Danny N. Walker, S. David Webb, and George M. Zeimens, "Paleo-Indian Procurement of Camelops on the Northwestern Plains," *Quaternary Research* 10(3), November 1978, 385-400; Frison, "North American High Plains," 240. Archaeologists have not established unequivocally that Paleoindians hunted camels on any regular basis. Also see, Gary Haynes and D. Stanford, "On the Possible Utilization of Camelops by Early Man in North America," *Quaternary Research* 22(2), September 1984, 216-230.

potentially higher death rate of young animals and subadults may have worked against mammoth survival.⁶

On the other hand, changing vegetative conditions may have been highly suitable for horses, as it is today, and there is no reliable evidence that Paleoindians hunted either horses or for that matter camels in any systematic fashion. Bison and pronghorn antelope, however, the two most heavily hunted animals as indicated by excavation evidence, managed to escape extinction.⁷

With populations of mammoth, horse, and camel disappearing, along with large predators such as lion, cheetah, and short-faced bear, the Basin's population of bison may have had an opportunity to increase. Reduced species diversity offers less competition for available forage, resulting in fewer predators. Yet bison themselves may have helped seal the fate of larger herbivores who grazed in the Basin. As the region changed toward a more open grassland and shrub environment, the smaller evolving bison may have overcome being regulated by predators and adopted a migratory strategy. Due to their lack of territoriality, increasing numbers of bison moved into areas of other species and simply out-competed resident animals for available resources. Ungulates forced to marginal or woodland habitats slowly went extinct, perhaps with the help of predators and Paleoindian hunters. The increase in bison numbers also had repercussions for predators. Because most predators were territorial and generally did not follow migrant prey, they

⁶ Frison and Todd, *Colby Mammoth Site*, 111-114; Frison, *Prehistoric Hunters*, 153-155; and Gary Haynes, "Age Profiles in Elephant and Mammoth Bone Assemblages," *Quaternary Research* 24(3), November 1985, 333-345.

⁷ Haynes and Stanford, "Possible Utilization of Camelops," 216-230; and Frison, *Prehistoric Hunters*, 155.

would have experienced severe shortages in prey once large ungulates were gone and bison migrated away from particular territories.⁸

As new evidence appears to weaken Martin's overkill conclusions, it makes one ponder the human element in megafauna extinction if Paleoindians were living in North America before 12,000 years ago. How much of an impact could these even earlier inhabitants have had on animal populations if they were killing large game for a couple of thousand or more years prior to Clovis? Whatever role Paleoindians had in the extinction of species who once lived in the Basin is probably untraceable. What can be said about these creative, knowledgeable, and highly adaptable people is that they possessed the ability to survive dramatic environmental change and mammal extinction to develop an intimate familiarity with the landscape to produce food, shelter, and tools. This knowledge and adaptability appears to have developed into two distinct subsistence strategies around 10,000 years ago. One focused on the Basin's grassland environments and the other on foothill and mountainous habitats.⁹

This apparent difference in adaptation was probably well underway prior to 10,000 years ago. Initial Paleoindians are known to have visited the foothills and mountains to

⁸ R. Dale Guthrie suggests that bison populations increased as species diversity decreased, in *Frozen Fauna of the Mammoth Steppe: The Story of Blue Babe* (Chicago, 1990), 285. Henry Epp counters his idea by arguing that bison were the cause of ungulate extinction in his review of Guthrie's book. See, "Reviews," *Saskatchewan Archaeology* 11 & 12, 1990-91, 74-76. For a discussion on the migratory lifeways of ungulates in which Epp supports his argument, see John M. Fryxell, John Greever, and A. R. E. Sinclair, "Why Are Migratory Ungulates So Abundant," *The American Naturalist* 131(6), June 1988, 781-798.

⁹ George C. Frison outlines his concepts toward this separation of lifeways, in "Paleoindian Subsistence and Settlement," 83-106; *Prehistoric Hunters*, 67-79; and "The Foothills-Mountains and Open Plains: The Dichotomy in Paleoindian Subsistence Strategies Between Two Ecosystems," in: *Ice Age Hunters*, Stanford and Day, 323-342.

obtain resources, such as lithic materials and demonstrated by the many fluted projectile points they left behind. But why some bands appear to have turned to the foothills and mountains to live is not entirely clear. Curiosity, population pressures, human desire for exploration, an easier subsistence, trade, changing environmental conditions, and the disappearance of various animals and plants may offer some explanations. Regional pollen samples support a continuation of a warmer climate throughout the Basin (warmer even than current temperatures), except in the upper Powder River area where the vegetative landscape appears to have remained relatively consistent throughout Paleoindians times.¹⁰

Archaeologists support this idea of a distinct adaptation to the foothills and mountains with evidence from caves and rockshelters located in the Absaroka and Bighorn Mountains. A number of excavation sites have stratified deposits of artifacts and animal bone that reveal a much different faunal record and style of projectile points than from known grasslands sites. This dichotomy is highlighted in part by the Mummy Cave site, which is located well within the mountains of the Absaroka Range and next to the North Fork of the Shoshone River in northwest Wyoming, and the Horner site, situated farther downstream near the main trunk of the Shoshone River in open country of the Bighorn Basin. The two sites are about 50 miles apart. Mummy Cave held a remarkable history that covered roughly 8,800 years of use, from 400 to 9,200 years ago. Radiocarbon dates from the Horner site span approximately 2,100 years beginning around 10,060 years ago. Occupation at the two sites overlapped during the cultural time period

¹⁰ Barnosky, "Postglacial Vegetation and Climate," 63-78; Baker, *Late Quaternary Vegetation History*, E39-E40; Burkart, *Pollen Biostratigraphy*, 49; Cummings, "Paleoenvironmental Interpretations," 188; and Markgraf and Lennon, "Paleoenvironmental History," 7-8.

referred to as Cody, or from 8,800 to 9,200 years ago. Neither the artifacts nor types of animal bone recovered matched each others findings.¹¹

Several sites located in the Bighorn Mountains provide a similar example. The stratified rockshelters of Medicine Lodge Creek, Little Canyon Creek Cave, and Bush Shelter, along with the Paint Rock V and Southsider Caves all have radiocarbon dates spanning from 8,000 to 10,000 years ago. Three stratified bison kill sites located on the open grasslands, Hell Gap, Carter/Kerr-McGee, and Agate Basin, also span this time. A comparison of the style of projectile points found at the foothill and mountain sites show that they are quite different than those recovered from the three bison kill sites.¹²

These differences are also evident in how bands used the open grasslands for communal hunting of bison. Large communal hunts required hunters to maintain a sizeable number of well-designed projectile points to successfully carry out the killing of numerous animals. Known communal kill events appear to have occurred mostly during the late fall to early winter, presumably providing bands a winter supply of meat. Such an event may have led to bands spending part of the winter near these kill sites to use and protect their surpluses. Because no two years were exactly alike, communal hunting may not have occurred on a yearly basis. In all likelihood, the mainstay of meat came from small kills of one, two, or three animals at a time.¹³

¹¹ Frison, "Foothills-Mountains and Open Plains," 325; and *Prehistoric Hunters*, 26. A stratified deposit is a layering of artifacts and animal bone that represents different periods of time.

¹² Frison, *Prehistoric Hunters*, 69-71; and "Foothills-Mountains and Open Plains," 327, 331.

¹³ Frison, "Paleoindian Subsistence and Settlement," 98-101. The difficulty in knowing how Paleoindians, or for that matter all pre-horse Plains Indians, procured bison is that hunts involving a single kill are virtually invisible archaeologically. Communal hunts have a high archaeological visibility,

Mountain sheep, mule deer, and other smaller mammals dominate the faunal record in the foothills and mountains. Hunting smaller game required a much different strategy than hunting bison that was not necessarily communal. A reinforced net made of twisted juniper cordage and designed to trap medium-size animals was recovered in a cave at the Sheep Mountain site in the Absaroka Mountains of northwest Wyoming. Clubs rather than stone tipped projectile points would have provided a more efficient way to dispatch such medium-size animals as sheep. At nearby Mummy Cave, skeletal remains of sheep were recovered at all levels of the stratified site, with evidence of some type of ritualistic treatment of a sheep skull around 9,000 years ago. The limited number of known projectile points may reflect in part the absence of large communal hunts or their infrequent use in killing smaller game. The lithic sources used to make projectile points also portrays differences in the two adaptations. In the foothills and mountains the material comes from sites near excavations, whereas distant sources commonly supplied the points found at grassland sites.¹⁴

In addition to the differences in the dwellings bands used, methods and type of game hunted, and types of projectile points manufactured, people adapting to the foothills and mountains also used caches for the storage of dried foods. Ecologically, foothills and mountains provide a wider range of roots, tubers, seeds, berries, greens, and fruit than

but might skew the picture of how bison were hunted on a daily or yearly bases. Jack Fisher, personal communications, 21 April 2000. The use of wild plants also has a low archaeological visibility.

¹⁴ Frison, "Foothills-Mountains and Open Plains," 329; George C. Frison, R. L. Andrews, J. M. Adovasio, R. C. Carlisle, and Robert Edgar, "A Late Paleoindian Animal Trapping Net From Northern Wyoming," *American Antiquity* 51(2), April 1986, 352-361. The limited number of projectile points recovered at Mummy Cave may also reflect in part the type of domestic activities that took place at the site.

grassland environments. The gathering of edible plants and the storage of grains and seeds may have offset the need for greater quantities of meat, as well as prevented nutritional inadequacies in their diet throughout the year. The storage pits at Schiffer Cave, for example, located on the east side of the Bighorn Mountains, contained a variety of seeds including sunflowers (*Helianthus annuus*), prickly pear (*Opuntia polyacantha*), amaranth (*Amaranthus retroflexus*), wild rye (*Elymus canadensis*), and limber pine (*Pinus flexilis*). People living in the foothills and mountains may have retained more of a focus on gathering plants as part of their settlement patterns than on hunting game.¹⁵

The differences between settlement patterns, hunting styles, and artifacts of foothill and mountain groups compared to bands using the plains remains striking. The time needed to successfully hunt and gather on either landscape has led to the suggestion that neither group could have exploited both effectively. If so, interactions along common boundaries may have developed into well established networks of exchange. As Paleoindians developed two different adaptations to live in the Basin, they were also savvy, creative, and flexible folks who may have had no trouble moving to and from different types of landscapes to hunt and gather different resources.

The warmer and drier climate conditions that occurred during Paleoindian times continued long past the time when their artifacts disappeared from the archaeological record. Not only did the landscape become even drier around 8,000 years ago, but a significant cultural transformation occurred as evidenced by side-notched points replacing

¹⁵ George C. Frison, "Early Period Marginal Cultural Groups in Northern Wyoming," *Plains Anthropologist* 18(62, Parts 1 and 2), November 1973, 300-312. The use of plant foods in all likelihood is under-represented archaeologically due to their low visibility.

the various styles of lanceolate points. Whether this change resulted from new groups of people moving into the Basin in response to environmental conditions, an influx of a new idea, or a manifestation by resident bands is not known. Whichever way this new technology developed, its timing nonetheless corresponds to the longest known period of dry to drought conditions that Indian people have ever faced in the Yellowstone River Basin.¹⁶

In 1955, geologist Ernst Antevs presented an outline documenting the various climatic events that have occurred in the western part of North America since the last great glaciation. As one of several geologists who helped establish a basis and method for geochronological dating in North America archaeology, Antevs proposed that the climate conditions between 4,000 and 7,500 years B.P. had reached maximum warmth and dryness since post-glacial times. Antevs referred to this period of time as the altithermal, although hypsithermal is a term often used today. Estimations of altithermal temperatures range between 3 and 5° F higher than modern averages, implying a landscape undergoing dramatic changes affecting plants, animals, and people. Taking Antevs' climate information and the lack of any archaeological evidence of human use on the grasslands of the northwestern plains, archaeologist William Mulloy in 1957 speculated that the region became "uninhabited" by Plains Indians during this prolonged period of drought.¹⁷

¹⁶ This transformation of point types distinguishes for most archaeologists the end of the Paleoindian period. This arbitrary division of time is referred to in this study as the beginning of the Middle Plains Indian Period, but is also referred to as Early Plains Archaic or Early Middle Prehistoric Period.

¹⁷ Ernst Antevs, "Geologic-Climatic Dating in the West," *American Antiquity* 20(4), April 1955, 317-335. In 1957, the term hypsithermal was proposed by Edward S. Deevey and Richard F. Flint to cover climatic events that occurred between approximately 8,000 to 2,500 years ago, in "Postglacial

Archaeological excavations have shown that Mulloy's assumptions of a hiatus are not completely accurate. While most archaeologists would agree that a warmer and drier period of time occurred, the extent and overall affect the altithermal had on all aspects of life in the Basin are not entirely clear. The evidence of utilization by people and animals is slim. Faced with an environment becoming more and more arid, Plains Indians were thought to have abandoned the open grasslands for better conditions elsewhere as one way to survive. The foothills and mountains have been suggested as possible refuges. Bands may have also established seasonal patterns that focused on living near major waterways. Because archaeological evidence is slim, it remains difficult to know how individual bands adjusted to various landscapes of plants and animals undergoing dramatic environmental change.¹⁸

This dramatic shift toward an even warmer and drier environment can be identified throughout most of the Basin. In the mountainous area surrounding Yellowstone National Park, a parkland landscape of spruce, subalpine fir, and whitebark pine slowly gave way to an environment dominated by lodgepole pine and increases in Douglas fir, *Populus*

Hypsithermal Interval," *Science* 125(3236), 4 January 1957, 182-184. Deevey and Flint also suggested that temperatures may have been 3 to 5° F higher than 20th century temperatures. William Mulloy presented his brief "uninhabited" idea in, *A Preliminary Historical Outline for the Northwest Plains*, University of Wyoming Publication 22(1), July 1958, 208-209.

¹⁸ Archaeologist David J. Meltzer discusses the various responses Plains Indians may have had during the altithermal, in "Altithermal Archaeology and Paleoecology at Mustang Springs, on the Southern High Plains of Texas," *American Antiquity* 56(2), April 1991, 236-267. Michael S. Sheehan examines the role water may have played during the altithermal and how Plains Indians appear to have responded, in "Cultural Responses to the Altithermal or Inadequate Sampling?," *Plains Anthropology* 40(153), August 1995, 261-270; and "Cultural Responses to the Altithermal or Inadequate Sampling Reconsidered," *Plains Anthropology* 41(158), November 1996, 395-397. Archaeologist Brian Reeves argues that a limited archaeological sampling is the problem toward understanding how Plains Indians and bison responded to warmer and drier conditions, in "The Concept of an Altithermal Cultural Hiatus in Northern Plains Prehistory," *American Anthropologist* 75(5), October 1973, 1221-1253.

(aspen), and sagebrush. Lodgepole pine, Douglas fir, and *Populus* are species that are fire adapted, implying that fires may have occurred frequently and at higher intervals than in modern times. This change established a mosaic of different aged stands with more openings of sagebrush and grass as tree lines receded due to drier conditions and perhaps fire. Mesic plants appear to have filled in around small ponds and lakes as water levels dropped. Macrofossils from the Buckbean fen drill site near Yellowstone Lake further magnify our view of the altithermal's intensity with a core sample indicative of a plant life that occurs around small, warm-water ponds. With such dry conditions lake levels were estimated to have been approximately 15 feet below present shorelines.¹⁹

Forest of lodgepole pine evolved to dominate throughout the Bighorn Mountains, also implying a change toward much drier conditions as in the mountains around Yellowstone National Park. Such dryness may not have prevailed throughout the range, however. The Laddie Creek archaeological site suggests an environment that was warmer with wetter conditions. Situated along the western foothills the site may represent a microclimate. A place like Laddie Creek during the altithermal, whether in the Bighorn Mountains or elsewhere in the Basin, may have been an attractive place for people and wildlife.²⁰

No matter how warm and dry environmental conditions may have gotten, people

¹⁹ Baker, *Late Quaternary Vegetation History*, E-37-E38; Baker, et al., "Holocene Vegetation History," 114-116; Gennett and Baker, "Late Quaternary Pollen Sequence," 68; Cathy Whitlock, "Postglacial Vegetation and Climate of Grand Teton National Park and Southern Yellowstone National Park, Wyoming," *Ecological Monographs* 63(2), May 1993, 173-198.

²⁰ Burkart, *Pollen Biostratigraphy*, 57; Mary Lou Larson, "Site Formation Processes in the Cody and Early Plains Archaic Levels at the Laddie Creek Site, Wyoming," *Geoarchaeology* 7(2), April 1992, 103-120.

worked out a subsistence adaptation that allowed them to live in the foothills and mountains throughout the altithermal years. Seasonal hunting and gathering in association with drier conditions conceivably kept the number of people in a band small. The need for water may have dictated movement since many smaller rivers and creeks could run dry during periods of drought. Caves and rockshelters continued to be used for temporary or seasonal shelter. Hunting focused on smaller game such as mule deer, mountain sheep, jackrabbits, and occasionally elk. The number of grinding stones found at excavation sites also suggests that the use of wild plants had increased from Paleoindians times.²¹

Another adaptation that developed by at least 6,000 years ago in the Basin to help endure warm summers and cold winters was the construction of pit houses. Most of these dwellings have been uncovered south of the Basin in south-central Wyoming. Two houses, one at Dead Indian Creek in the Absaroka Range and the other at Grass Creek in the southern portion of the Bighorn Basin, have been found in the Basin. Pit houses were generally dug into sandy soils and located next to or near permanent water sources.

²¹ George C. Frison, David Schwab, L. Adrien Hammus, Peter Winham, David Walter, and Robert C. Mainfort, "Archeology of the Northwestern Plains," in: *Archeological and Bioarcheological Resources of the Northern Plains*, George C. Frison and Robert C. Mainfort, eds., Arkansas Archeological Survey Research Series No. 47 (Fayetteville, 1996), 8-40. One indication of a higher use of plant foods than meat comes from dental studies of Indian remains. Higher levels of tooth decay, or caries, are recorded from diets higher in plant foods. The frequencies of caries decreases over time from the altithermal to late Middle Plains Indians period, suggesting plants were perhaps consumed more than meat during altithermal times. See, Laura L. Scheiber and George W. Gill, "Bioarcheology in the Northwestern Plains," in: *Archeological and Bioarcheological*, Frison and Mainfort, 91-119. Archaeologist Michael S. Sheehan suggests that water played a role in movement strategies based on his spacial relationships study between archaeological sites and water sources during the Middle Plains Indian Period. See, "Cultural Responses to the Altithermal: The Role of Aquifer-Related Water Resources," *Geoarchaeology* 9(2), April 1994, 113-137. Also see his "Cultural Responses" articles. In a study of 115 archaeological sites found on the central and northern plains during the early Middle Plains Indian Period, Ernest Walker has noted that "virtually all the sites are very close to reliable water sources." See, *The Gowen Sites: Cultural Responses to Climatic Warming on the Northern Plains (7500-5000 B.P.)*, Archaeological Survey of Canada Mercury Series Paper 145 (Hull, 1992), 128.

Typically the habitat around a house was also rich in edible plants. Houses were generally circular in shape, with some form of a supporting post system that held a conical or oval-shaped roof. Fire pits, caches or storage pits, grinding stones, stone flakes or debitage from tool manufacturing, and highly fragmented mammal bones are common remains found at these sites. Because of the energy required to construct a pit house, these dwellings may have provided a seasonal base camp that was often reused. The large number of storage pits may reflect a mobility strategy that was compensating for drier conditions by storing plant foods for long term occupation. As a whole, pit houses found in Wyoming have a wide distribution, with their known common use spanning a period between 4,000 and 6,000 years ago.²²

Although archaeological evidence of how people lived in the foothills and mountains during the altithermal is limited, for the open grasslands of the Basin it is almost non-existent. The warmer and drier conditions may have actually played an important role in hiding such evidence. North of the Crazy and Bighorn Mountains between 6,000 and 8,300 years ago, the landscape was dominated by xeric type plants. Conifer forests also appear greatly reduced on nearby mountain slopes in much the same way thinning occurred around Yellowstone National Park. Dry to drought conditions tend to decrease vegetative cover and increase the likelihood of erosion, perhaps extensive in places. The lack of any bison kill sites or direct evidence of use by people may be the result of

²² Mary Lou Larson, "Housepits and Mobile Hunter-Gatherers: A Consideration of the Wyoming Evidence," *Plains Anthropologist* 42(161), August 1997, 353-369; Frison, *Prehistoric*, 83-86. A small number of pit houses dating between 250 and 4,000 years ago have also been uncovered, suggesting the use of this architectural form persisted for nearly 6,000 years.

intensive weathering and erosion, with the evidence of an Indian occupation either eroded away or deeply buried.²³

Dry to drought conditions may not have been the situation east of the Bighorn Mountains in the upper Powder River region of Wyoming. As throughout the Paleoindian period, the pollen record indicates a continuation of a grass and sagebrush landscape that was perhaps even more mesic than today. Like the Laddie Creek site, this area of the Basin may have been a microclimate. Regional differences in climate conditions may not have been unusual in an area the size of the Basin, as dynamic, mid-Holocene weather patterns appear to have fluctuated rapidly between intervals of dry and moist conditions.²⁴

During those periods of dry to drought conditions, herds of bison and possibly other animals may have responded by migrating away from drought-stricken areas, starved, or reduced their herd size in order to survive on limited resources. Throughout the two to three thousand years that altithermal conditions persisted, extended periods of cooler, wetter weather probably occurred, directly affecting vegetation and animal

²³ Barnosky, "Postglacial Vegetation and Climate," 67-70. Barnosky's data is from the Lost Lake site, located southeast of Fort Benton and north of the Highwood Mountains in Montana. In southeastern Alberta at Chappice Lake, pollen core samples nearly mimic the results found at Lost Lake, with a warmer and drier environment occurring during the same period of time and also ending around 6,000 years ago. Walker, *The Gowen Sites*, 13. Brian Reeves has argued that without a systematic archaeological research program to investigate large areas of the Basin, our understanding of animal and human use remains limited and possibly "skewed." See, "Concept of an Altithermal Cultural Hiatus," 1231.

²⁴ J. P. Bradbury, W. E. Dean, and R. Y. Anderson, "Holocene Climatic and Limnologic History of the North-Central United States as Recorded in the Varied Sediments of Elk Lake, Minnesota: A Synthesis," in: *Elk Lake, Minnesota: Evidence for Rapid Climatic Change in the North-Central United States*, J. P. Bradbury and W. E. Dean, eds., Geological Society of America Special Paper 276 (Boulder, 1993), 309-328.

behavior. Such climate patterns, along with microclimates, may have allowed animals, and in turn people, to occupy portions of the landscape at least periodically.

Evidence of periodical use by bison and human groups has surfaced near the eastern edge of the Basin and the western mountains of the Black Hills in Wyoming. The excavations are known as the Hawken site, and represents two different arroyo traps. The older of the two, dates to around 6,470 years ago, and reflects a series of early to midwinter communal hunts. The younger site, which dates to about 6,270 years ago, represents the killing of a small herd of mostly bulls during the spring. Aside from resembling a Paleoindian kill site, the evidence implies that smaller herds of bison probably continued to live throughout areas of the Basin that offered suitable habitat. The ecologically different Black Hills may have had optimal altithermal conditions, "an oasis-like feature," for bison and other animals to persist. Simply because archaeological evidence remains limited, does not mean areas of the Basin were abandoned by bison or people. It may have been that the size of herds were not suitable for large communal procurement. Small kill events of one to several, conceivably the most common form of hunting bison, are virtually invisible archaeologically.²⁵

In addition to offering evidence of occupation on at least a portion of the northwestern plains, the skulls and bones found at the Hawken site also revealed a form of bison known as *Bison occidentalis*. This intermediate size bison was smaller than the *B.*

²⁵ George C. Frison, Michael Wilson, and Diane J. Wilson, "Fossil Bison and Artifacts From an Early Altithermal Period Arroyo Trap in Wyoming," *American Antiquity* 41(1), January 1976, 28-57; Frison, *Prehistoric Hunters*, 187-191. Archaeologist Ernest Walker interprets the evidence of occupation on the plains during the altithermal as being at least sporadic, possibly interspersed between short periods of drought. For an overview, see *The Gowen Site*, 122-128.

antiquus that Paleoindians hunted. *Bison occidentalis* were, however, larger than the modern species of bison. Migrating south from the far north, *B. occidentalis* was foraging on the plains of southern Canada and northern Montana by 10,000 years B.P. At some point during these generally drier conditions of the altithermal, between 6,000 and 7,000 years ago, the smaller *B. occidentalis* replaced *B. antiquus* or *B. antiquus antiquus* throughout the northwestern plains. The importance of the Hawken site, whether it was an "oasis," microclimate, or an area exploited by bison and humans during a cooler, wetter period of time, is that it documents one of only a handful of bison kill sites known throughout the plains to have occurred during the early part of the Middle Plains Indian Period. The recovered bones also provide an important link in understanding the natural selection process in bison evolution.²⁶

The transformation of bison into a smaller species reflects only one of the many changes that occurred in the Basin during roughly three thousand years of history. New styles of projectile points, increased use of grinding stones, and the construction of pit houses are all known adaptations of Plains Indians during this time. As sketchy and uncertain as much of the archaeological evidence is, one aspect remains clear; that people and animals somehow persisted during these warmer and drier times. Between 5,000 and

²⁶ Frison, et al., "Fossil Bison and Artifacts," 28-57; Wilson, "Archaeological Kill Site Populations," 9-22, and "Late Quaternary Vertebrates," 97-105. Jerry McDonald suggests that *B. occidentalis* evolved from *B. antiquus antiquus* in mid-latitude grasslands of North America. *North American Bison*, 94. One important cultural development toward bison procurement was the bison jump, which appears to have begun during the early part of the Middle Plains Indian Period. The first known site on the northern plains is located in southern Alberta at the Head-Smashed-In site, perhaps the largest documented jump site in North America. The earliest radiocarbon dates suggest the site was first used around 5,700 years ago. For more on the Head-Smashed-In site, see Brian O. K. Reeves, "Head-Smashed-In: 5500 Years of Bison Jumping in the Alberta Plains," *Plains Anthropologist* 23(82, Part 2), Memoir 14, November 1978, 151-174.

6,000 years ago the altithermal no longer dominated climatic conditions, as a cooler and moister weather pattern slowly settled in over the Basin's landscape.

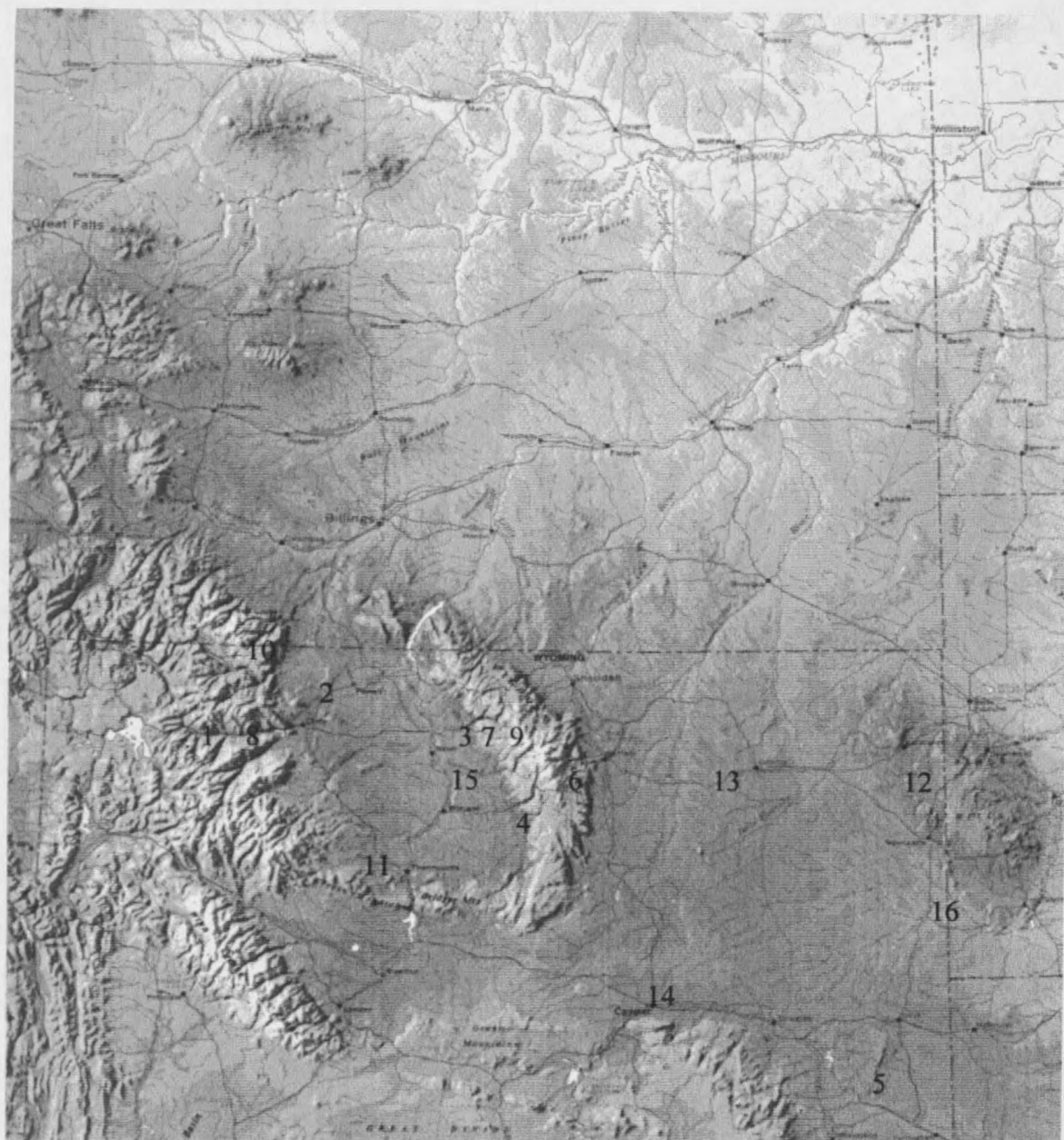


Figure 6. Approximate location of archaeological sites discussed in Chapter 4.

- | | | | |
|-----------------------|-----------------------|-----------------------------------|---------------------------------------|
| 1. Mummy Cave | 2. Horner | 3. Medicine Lodge Creek | 4. Little Canyon Creek & Bush Shelter |
| 5. Hell Gap | 6. Schiffer Cave | 7. Southsider Cave & Paint Rock V | 8. Sheep Mountain |
| 9. Laddie Creek | 10. Dead Indian Creek | 11. Grass Creek | 12. Hawkins |
| 13. Carter/Kerr-McGee | 14. Casper | 15. Colby | 16. Agate Basin |

CHAPTER 5

THE FLOURISHING OF CULTURE



When the people came from the underworld, they traveled southward for four days. During this time they became very hungry, for all they had to eat were seeds and some wild plants. The women made a kind of flour by grinding these seeds between two flat rocks. Stirring water into the flour made a kind of gruel, but the people remained hungry and grew tired and weak.

On the fourth evening one family set their lodge apart from the rest of the camp. As the parents went out to look for seeds and wild plants, the children remained inside the lodge to tend the fire. Soon, the children heard somebody approach the lodge. "May I come in," he said. "Yes," replied the children, "but we have nothing to offer you." "That is okay," said the stranger, as he stepped into the lodge. At that moment the children could see that the stranger was a raven. Once inside, he hung his bow and quiver on a lodge pole as if he lived there. Turning, the raven left the lodge, with the children wondering who he was and why he left his bow and quiver in their parent's lodge.

After a time the children's curiosity got the best of them, so they took the bow and quiver down to examine them. Looking inside the quiver they saw arrows and what

appeared as a lump of meat and fat. So the oldest boy reached into the quiver, pulled out the lump of meat and fat, and tasted it. "It's good," he exclaimed. The other children also ate some meat, and they all began to get fat and healthy.

When the parents came home after collecting seeds and plants, they could see that their children looked different and their mouths were smeared with grease. "What has happened to you?" the mother cried. The children showed their parents the lump of meat. "Taste it," they said. The mother did, and at once she began to grow fat and healthy. Word quickly spread around the camp, and people came to see the healthy mother and children. They all agreed to wait to see if the raven came back with more food.

The raven did not return to the camp, for he knew that his food had been stolen from his quiver. Instead, he flew away to the east, to a mountain that was too far away for the people to find. A bat, however, saw the raven fly away and followed him. When she returned, she told the people where the raven had gone. The people held a council and decided to go find the raven's home to learn where he acquired this wonderful food.

The people traveled at night, for it was the only way the bat could guide them. On the fourth night the people came to the mountain where the raven had flown to. There they saw many ravens cawing, crying, and swooping around in great circles. But they did not recognize the raven who had come to their camp. Their search for the raven led them to a place where a great fire had been. It was a place where all the ravens cooked together. The people decided to hide, hoping to learn where the ravens got their food. Hiding and waiting produced no results, however.

One of the chiefs suggested that they ask their medicine man to help. When he

was before the people, he asked for the first person who had tasted the meat. The young boy stepped forward, and as he did, the medicine man used his power and turned the boy into a puppy. The medicine man then instructed all the people to leave.

In the morning, the circling ravens came down to inspect the people's camp to see what was left behind. One small raven boy found the puppy. Taking the puppy to his parents, the boy asked if he could keep it. The parents said no. The boy begged, cried, and pleaded with his parents until his father finally said. "I will pass a blazing stick in front of the puppies eyes, if he does not cry or turn away, you may keep him." Of course the puppy heard all this and knew what to do. That night the boy and the puppy snuggled down under the warmth of his buffalo robe.

The boy and the puppy played together all the next day. That evening, the raven mother called to her husband that it was suppertime. "All right," he answered, and he brushed away the ashes from the fireplace. A great flat stone lay under the ashes. Lifting the stone, the father disappeared beneath it. Presently he came back, driving a buffalo before him. Killing the animal with his stone knife, all the ravens gathered for a feast.

For three days the puppy watched this happen. On the fourth, he decided that he could do the same thing. So when the sun was high in the sky and all the ravens were busy away from camp, he turned himself back into a boy. Taking a white eagle feather, he pushed away the fireplace stone and descended into the hole.

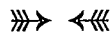
Below was a beautiful world, with green grass and blue lakes and many animals grazing everywhere. There were many great herds of buffalo. The boy took the eagle feather to the great white buffalo. Placing the feather in his mouth the boy said, "I know

your power. You are chief of all the animals, and the most sacred of them all." Holding the white feather in his mouth, the great white buffalo followed the boy to the surface of the earth, with all the other animals following him.

One of the ravens heard the sounds of the animals passing through the hole and tried to push back the stone. But he was too late. The raven said that the animals now belong to the people. "But whenever you kill any game," he said to the boy, "remember to leave the eyes for the ravens."

The boy found the tracks of his people, and for four days he traveled with all the animals following him. When he came upon their camp on the fifth day, the animals scattered out to find food wherever they could. One deer began to nibble on the brush that covered the shelter of an old woman. She became angry, for it took her a long time to build her small brush shelter. Taking a stick from the fire, she left her lodge and hit the deer over the nose. "Stay away from the people," the old woman ordered.

The deer left the camp with all the other animals following him, for they would not stay in a place where their brother was mistreated. From that day to this, the people and animals were no longer friends. The animals only come near camp at night, and the people must search far and wide for game during the day.¹



For the Jicarilla Apache to make themselves healthy, they needed to bring bison

¹ This Jicarilla Apache story entitled "The Origin of the Animals," was adapted from, Frank Russell, "Myths of the Jicarilla Apache," *Journal of American Folk-Lore* 11(40), January-March 1898, 253-271; and Marriott and Rachlin, *American Indian Mythology*, 112-119.

and other animals to the surface from underground so they could have meat. This was accomplished at some mountainous place that was far away from their present homeland in northern New Mexico. Where this mountain stood was not clearly revealed in the story. But with the help of a bat, ravens, and a young boy, the Jicarilla Apache would live upon a landscape filled with animals.

The Jicarilla Apache are Athabaskan speaking people from an ancestral homeland in northwestern Canada. For unknown reasons their ancestors left the Pacific Northwest and began a journey that covered more than a thousand miles. Their route to the American Southwest is not clearly known, but archaeologists have proposed a number of possibilities. The most intriguing route in regard to this study, was along the east side of the Rocky Mountains and entering onto the northern Great Plains in Montana. Being able to hunt for meat to regain their health as a tribe in a different place that was filled with bison and other game is maybe reflected in the story, as the Jicarilla Apache walked away from their old lifeway to begin a new one living as Plains Indians. The Yellowstone River Basin may have been this place.²

An Athabaskan migration from Canada with a possible route through the Basin to the Southwest has theoretical merit. Linking particular artifacts to ethnic groups (and never mind to a story) remains extremely difficult to do, however. Whether or not the Jicarilla Apache story speaks of their transition years ago, it does reflect the importance of

² The migration route for the Jicarilla Apache to the southwest remains unsubstantiated. For two possible explanations, see Dolores A. Gunnerson, *The Jicarilla Apaches: A Study in Survival* (DeKalb, 1974), 126-133; and David R. Wilcox, "Avonlea and Southern Athapaskan Migrations," in: *Avonlea Yesterday and Today: Archaeology and Prehistory*, Leslie B. Davis, ed. (Saskatoon, 1988), 273-280.

bison to a group of people moving over a different or changing landscape. The people who made the Basin their home after the altithermal may have faced a similar situation. Archaeological evidence supports the continuation of adaptive living strategies by people through their use of hunting and gathering as Paleoindians had done. But over the next forty-five hundred years, excavation evidence begins to display a growing dependence on bison and a flourishing of cultural characteristics that are not known to have occurred earlier in the Basin. To these slowly evolving changes, the underpinning of a seventeenth and eighteenth century northwestern Plains Indian culture was formed.³

The arrival of a cooler and generally moister climate after the altithermal years has led many archaeologists to propose that bison once again "returned" to the plains in great numbers. With the larger *Bison antiquus* being displaced by the smaller *B. occidentalis* sometime after 7,000 years ago, it would seem that the overall bison population would not have increased during this time of morphological change and generally drier conditions. In fact, overall numbers may have decreased as the selection processes intensified in favor of an even smaller animal. How this process actually worked itself out remains unknown, but sometime between 4,500 and 5,000 years ago a smaller *Bison bison* replaced *B. occidentalis* in the Basin. This smaller, better adapted bison may have slowly expanded its numbers with the advent of increased moisture and improved vegetative conditions.⁴

³ This interpretation is based on an increase in the number of known archaeological sites that date between 500 and 5,000 years ago, and may not reflect cultural or technological advances that occurred prior to 5,000 that remain unknown.

⁴ Using the term "returned" implies that herds of bison vanished from the region. Where is not always indicated. Bison probably did not leave the Basin during the altithermal. Such statements appear to make simple what was most likely a complex evolutionary relationship between bison and changing climate conditions. The time frame for the emersion of *Bison bison* is based on the three earliest known

Archaeologists have also suggested that with the prospects of a growing bison population people once again returned to the Basin's grasslands. As discussed earlier, bison and bands of hunter-gatherers probably never completely left. Whether people abandoned areas of the Basin or not, the arrival of improved climate conditions corresponds with archaeological evidence of a broader utilization of the Basin's landscape.⁵

Between approximately 3,000 to 5,000 years ago, two broadly defined and apparently different cultures are found in excavation sites throughout most of the Basin: Oxbow and McKean.⁶ They are divided into separate cultural groups because of the different types of projectile points they left behind. Representing Oxbow are side-notched points similar to those used by people during altithermal years. McKean are associated with a variety of lanceolate type points similar to the ones used by Paleoindians. Between the two, Oxbow appears older. These oldest known sites are located in the foothills and

dates where *B. bison* bones have been recovered. The Head-Smashed-In bison jump in southern Alberta, dates to about 5,080 years ago. Northeast of the Basin in southeast Saskatchewan, the Long Creek site near the Souris River dates *B. bison* to about 4,635 years ago. And south of the Basin along the North Platte River in south-central Wyoming, *B. bison* bones were recovered from the 4,540 year old Scoggin site. McDonald, *North American Bison*, 95-108.

⁵ David Meltzer summarizes a number of subsistence strategies used on the Great Plains during the altithermal, in "Altithermal Archaeology and Paleoecology," 261-262.

⁶ The period of time between the end of the altithermal and about 1,800 years B.P., is referred to in this study as the middle and late portions of the Middle Plains Indian Period, or the middle and late portions of the Middle Prehistoric Period or Plains Archaic. Establishing dates for when middle and late periods begin and end remains arbitrary. Dates associated with projectile points and other artifacts do not present a neat and tidy chronology of when different groups of people may have occupied the Basin. The names Oxbow and McKean, as well as the other names of cultural groups mentioned in this and proceeding chapters, are not ethnic groups. They are a names placed upon groups of people who apparently shared a similar technology and possibly other cultural traits as interpreted from archaeological evidence. Using the name Oxbow or Oxbow hunters, for example, represents the cultural group as a whole and not any ethnic affiliations that may have made up the overall group.

mountains of the Absaroka and Bighorn ranges. The younger sites, which make up the majority of known excavations, are found north of the Yellowstone River. This age difference from south to north has led some archaeologists to speculate that Oxbow followed a northern migration into Montana and southern Canada. Excavation evidence further implies, although far from conclusively, that they were a people primarily focused on small-scale bison hunting and gathering.⁷

McKean artifacts are generally more widely dispersed over the entire Basin. Movement into the Yellowstone region is thought to have derived from the Great Basin or from the mountainous areas of Wyoming and Colorado. Because McKean sites tend to postdate Oxbow sites in the Basin, they may have replaced the Oxbow culture in areas south of the Yellowstone, and perhaps over time in some areas north of the river. Although Oxbow and McKean movement patterns remain speculative, along with how much interaction and exchange they may have shared, both groups appear to have occupied at least a portion of the Basin and northwestern plains together, presumably amicably, for roughly 1,000 years.⁸

⁷ For a discussion of Oxbow settlement patterns and chronology, see Stephen A. Aaberg, William P. Eckerle, and Kenneth P. Cannon, *Cree Crossing (24PH3396): The Cultural and Paleoenvironmental Record of a Mid-Holocene to Historic Ford of the Milk River in Northcentral Montana*, report prepared for the Montana Department of Transportation by Aaberg Cultural Resource Consulting Service (Billings, 1999), 72-73, 144-145.

⁸ For theories on the origin of McKean, see James D. Keyser and Carl M. Davis, "Lightning Springs: 4000 Years of Pine Parkland Prehistory," *Archaeology in Montana* 25(2 and 3), May-December 1984, 1-64. Connecting McKean to the Great Basin as one possible origin comes from the appearance that they relied on gathering plants and possessed the technology and knowledge associated with their processing. Due to the environmental conditions in the Great Basin, a desert culture was conceivably more knowledgeable and skilled in the harvesting and usage of a wider array of plants. Two articles that discuss the continued use of mountainous landscapes by groups of people, and who may of have an influence or were part of groups who moved into the Basin, are Kevin D. Black, "Archaic Continuity in the Colorado Rockies: The Mountain Tradition," *Plains Anthropologist* 36(133), February 1991, 1-29;

Subsistence strategies north of the Yellowstone River by both groups appears focused on small-scale bison hunting and gathering, although little is known about how they may have used wild plants. South of the Yellowstone, especially in the foothills, bordering grasslands, and the drier Bighorn Basin, subsistence appears equally divided on hunting a variety of game and gathering plants. At least 19 species of plants are known to have been used. Of these plants, 14 were edible seeds, bulbs, and fruits, and five were used to construct cordage, netting, and coiled baskets. In association with this use of plants, numerous stone manos and metates have also been uncovered. These were used as a mortar and pestle-like grinding tool. Paleoindians were known to have used similar tools, but manos and metates, especially from McKean sites, become commonly found and begin to take on clearly identifiable forms.⁹

As excavation evidence begins to reveal a much broader usage of plants than from previous cultural groups, Oxbow and McKean sites also begin to demonstrate a much fuller use of bison carcasses. This interpretation is based mostly on the fragmentation of bison bones. Cracking open larger bones to scoop out the rich marrow was one technique that Paleoindians are thought to have used as a source of fat in their diet. At some point

and Susan J. Bender and Gary A. Wright, "High-Altitude Occupations, Cultural Process, and High Plains Prehistory: Retrospect and Prospect," *American Anthropologist* 90(3), September 1988, 619-639. On McKean in association with other cultural groups such as Oxbow, see John H. Brumley, *The Cactus Flower Site in Southeastern Alberta: 1972-1974 Excavations*, Archaeological Survey of Canada Paper No. 46 (Ottawa, 1975), 97-102.

⁹ James D. Keyser, "The Evidence For McKean Complex Plant Utilization," *Plains Anthropologist* 31(113), August 1986, 225-235. At least 37 manos and 50 metates have been recovered from eight sites located in or adjacent to the Basin. Also see, George C. Frison, "The Northwestern and Northern Plains Archaic," in: *Archaeology on the Great Plains*, W. Raymond Wood, ed., (Lawrence, 1998), 147-157.

this knowledge was taken a step further. The bison bones that were rich in marrow were broken up using a hammerstone. A pit was dug and lined with the hide (hair side down) of a bison. Water was poured into the skin. Stones were heated by an adjacent fire and placed into the water. Once the water started to boil, the broken bones were added. The boiling process removed the marrow from the bones, with the fat floating to the surface to be skimmed off. This process of extracting bone grease was hard work, perhaps requiring several days and only after the meat had already been removed and processed from the bones. What bone grease provided, however, was a storable fat to be used in a variety of ways. Perhaps the most ingenious and important use was mixing the grease with pounded dried meat and berries to make pemmican. Sealed in a skin bag with liquid bone grease, this long lasting and highly nutritional source of protein and fat was widely used by eighteenth and nineteenth century Plains Indians, fur traders, and trappers. The first known pits of this highly creative adaptation are associated with Oxbow sites.¹⁰

The ability to process and store bone grease solved any problems bands may have had with a lack of fat in their diets. Pemmican also provided a highly nutritional food source that was easily transported by scouts, hunters, and other individuals on long expeditions, or stored for times when fresh meat was not available. It also furnished bands

¹⁰ Brian O. K. Reeves, "Communal Bison Hunters of the Northern Plains," in: *Hunters of the Recent Past*, Leslie B. Davis and Brian O. K. Reeves, eds. (London, 1990), 169-194. Reeves makes note of the work involved in extracting grease and making pemmican. The dried meat from one bison and the grease from two to three bison produce approximately 80 to 100 pounds of pemmican. One pound of pemmican was equal to about three pounds of fresh meat. Bone grease extraction pits are not common in the Basin until after 3,000 years B.P. Archaeologist Jack Fisher stresses, however, that the processing of bone grease may have occurred more frequently than excavation sites suggest, since such pits were not necessarily located near or next to bison kill sites or in the middle of camps. Personal communication, 21 July, 1999.

with a valuable trade item, as seen during the eighteenth and nineteenth centuries. Shells from the Pacific Coast and copper from the Great Lakes are artifacts that have been uncovered at Oxbow sites, implying that people living in the Basin between 3,000 and 5,000 years ago were participating in an extended network of exchange that may have involved lithic material, edible plants, and pemmican.

Less speculative than whether or not pemmican was used as a trade item was the construction of stone circles. More commonly referred to as tipi rings, known sites have been located north of the Yellowstone River. These circles of stones held down the bottom edge of the tipi cover, and varied in size from 10 to 22-foot in diameter. Contemporary figures on the number of people a Plains Indian tipi housed ranged between six and eight individuals. If this was true three to four thousand years ago, than bands of 25 to 30 people might have required four to six tipis. Bison hides are the most notable and functional material to cover a tipi frame. Increased use of the open grasslands by bison and people after the altithermal may have led to the development or expansion of tipis as year-round dwellings.¹¹

The bison hides used to cover a tipi frame were heavy no matter how small the structure was. Besides the hides, as many as twelve wood poles were also needed. A sewn-together tipi cover may have weighed as much as 300 pounds, and each pole 20 to 30 pounds. To carry and move a tipi, additional bedding, and other supplies and goods

¹¹ Frison, *Prehistoric Hunter*, 92-97. The proceedings of the Eleventh Annual Chacmool Conference presents a number of papers on tipis and the use of stone structures on the northwestern plains. Michael Wilson, Kathie L. Road, and Kenneth J. Hardy, eds., *Megaliths To Medicine Wheels: Boulder Structures in Archaeology* (Calgary, 1981). Leslie B. Davis edits another collection of articles on tipi rings, in: "From Microcosm to Macrocosm: Advances in Tipi Ring Investigation and Interpretation," *Plains Anthropologist* 28(102, Part 2), Memoir 19, November 1983.

each family needed, required many strong backs or a large supply of dogs. Estimates to move one family with a tipi and additional supplies range from ten to fifteen dogs. A family unit traveling with five or six tipis might have formed a caravan of 25 people and 70 dogs. As part of a band's adaptation to the use of a tipi, dogs conceivably played a vital role, for without these beasts of burden the use of tipis may have been limited or not even possible. An additional consideration was how much food dogs required. Seventy animals, for example, may have needed the meat and bones equivalent of one bison every few days.¹²

In addition to their use of stone circles, wild plants, long distance exchange, and grease extraction, the Oxbow culture is also linked to the building of stone structures known as medicine wheels. A few archaeologists have suggested that these often large structures, which were not always in the shape of a circle, were used for astronomy. Oxbow folks also carved effigies out of river stone and had some leisure time to create purely decorative artistic objects out of shells and bones. They buried their dead. An estimated 500 people were buried in a mass grave site located in southwestern Saskatchewan. First used around 5,000 years B.P., the Gray burial site reveals the internment of people for more than 2,000 years.¹³

¹² Reeves, "Communal Bison Hunters," 170; Bryan, *The Buffalo People*, 81-84; and Norman Henderson, "Replicating Dog Travois Travel on the Northern Plains," *Plains Anthropology* 39(148), May 1994, 145-159.

¹³ For additional information on the Oxbow culture, see Bryan, *The Buffalo People*, 54-84; Richard E. Morlan, "Oxbow Bison Procurement As Seen from the Harder Site, Saskatchewan," *Journal of Archaeological Science* 21(6), November 1994, 757-777; Sally T. Greiser, T. Weber Greiser, and Susan M. Vetter, "Middle Prehistoric Period Adaptations and Paleoenvironment in the Northwestern Plains: The Sun River Site," *American Antiquity* 50(4), October 1985, 849-877; and selected papers presented at the 13th Annual Meeting of the Canadian Archaeological Association, "The Oxbow Complex In Time And

One question about Oxbow and McKean that puzzles archaeologists was how these people procured the newly evolved *Bison bison* and other game. Individual methods were certainly used since bison bones have been recovered from most camp sites. Yet no communal kill sites have been uncovered in the Basin. The closest known communal kill site is the Scoggin trap in south central Wyoming. Situated on the downhill side of a talus slope, a series of postholes are presumed to have supported a reinforced fence that formed an enclosure. Bison appear to have been driven down the slope and into the enclosure. Once they were temporarily trapped, hunters stationed above the crowded animals could begin the kill. These animals died about 4,540 years ago with McKean type projectile points by a thoughtful, highly organized, and well planned communal event.¹⁴

Around 3,000 years ago the artifacts characterizing the Oxbow or McKean cultures simply disappear from the archaeological record. What surfaces in their place are artifacts that represent another set of cultural groups: Yonkee and Pelican Lake. Projectile points and geographic location generally distinguishes the differences between each group. Yonkee appears to represent resident bands that developed around the Powder and Tongue River drainages in Montana and Wyoming. The origins of Pelican Lake remain unknown, but these people appear to have moved into the Basin carrying their own cultural traits and traditions.¹⁵

Space," J. F. V. Millar, ed., *Canadian Journal of Archaeology* 5, 1981, 79-177.

¹⁴ Frison, *Prehistoric Hunters*, 193; Reeves, "Communal Bison Hunters," 180. This lack of bison kill sites is also the apparent reason no early *B. bison* remains have been identified from the Basin. A bone grease boiling pit was also uncovered at the Scoggin site.

¹⁵ On Yonkee archaeological sites found in the Basin, see Frison, *Prehistoric Hunters*, 194-199.

The hunting and gathering subsistence strategies used by bands of Yonkee and Pelican Lake appear similar to those of Oxbow and McKean with one noticeable difference: communal hunting. Mass communal bison kills sites in and adjacent to the Basin begin to become much more common, with many sites being used more than once. Yonkee and Pelican Lake hunters used arroyos, traps, and other natural features such as driving bison over cliffs. More commonly referred to as buffalo jumps, the first known site on the northwestern plains was Head-Smashed-In in southeast Alberta. The site was used during the altithermal, but was deserted throughout the Oxbow and McKean occupation years. Pelican Lake hunters resurrected the site to once again drive bison over its sandstone cliffs.¹⁶

Of the bison jumps in the Basin, the Kobold remains the oldest known site. Situated on upper Rosebud Creek in south central Montana, Yonkee were the first known hunters to use the site as a jump. Similar to other communal methods of hunting, the work and decisions involved in forcing bison over a cliff were no simple feats. Probably in most cases communal hunts were well organized, prearranged, and highly disciplined events. Herd size was one important consideration. A small number of bison were almost impossible to drive over a cliff, for they have the ability to change their direction immediately when they perceive any danger. Larger herds of stampeding bison formed a mass of animals so great that it did not allow the leaders enough time to change direction. When a sufficient number of bison were available to employ a jump, hunters needed to wait or coax the animals into the right position, a practice that would have taken patience,

¹⁶ Reeves, "Head-Smashed-In," 151-174.

skill, and perhaps several days to accomplish. At the Kobold site and elsewhere, hunters constructed drive lines using rocks and possibly wood to further help guide the stampeding animals to their death. To obtain spiritual help, Yonkee and Pelican Lake hunters may have also used rituals and ceremonies.¹⁷

The evidence of the Yonkee culture hunting and living in the Basin disappears around 2,500 years ago. At the Kobold site, for example, Pelican Lake artifacts lie stratigraphically above Yonkee, as they do at several kill sites in the Powder and Tongue River area.¹⁸ With Yonkee archaeologically disappearing, the influence of a Pelican Lake culture throughout most of the Basin remained active over roughly the next 1,000 years. Their subsistence appears focused on bison, except in foothill and grasslands environments near mountainous areas and in the Bighorn Basin. In these areas south of the Yellowstone River a wider spectrum of wild plants and animals continued to be gathered and hunted. Caves and rockshelters were being used as temporary short term camp, but the number of stone circle sites increases dramatically. Networks of exchange were perhaps even more extensive than those established by Oxbow and McKean peoples. Copper from the Great Lakes, shells from the Pacific and Gulf coasts, and lithic material from Obsidian Cliff and Knife River were all items that worked their way through an exchange system that may have included pemmican as a byproduct from the communal hunting of bison. Their tool kits, at least at one location on the northern plains, contained arrow points, tentatively

¹⁷ George Frison, "The Kobold Site 24BH406: A Post-Altithermal Record of Buffalo Jumping for the Northwestern Plains," *Plains Anthropologist* 15(47), February 1970, 1-35; and Frison, *Prehistoric Hunters*, 156-157, 197-199.

¹⁸ Frison, *Prehistoric Hunters*, 199; Frison, "The Kobold Site," 1-35. Tom Roll suggests this approximate time period of occupation by Yonkee. Personal communication, 19 August 1999.

suggesting that people may have been using bows and arrows regionally a thousand years earlier than was previously thought. The subtle refinements of procuring game and gathering plants on a diverse landscape, while engaged in wide-reaching exchange, are hallmarks of the Pelican Lake cultural adaptation.¹⁹

Before the cultural artifacts from the Pelican Lake occupation completely vanished from the archaeological record, different groups of people appear (mostly based on style of projectile point) to have already migrated onto the northwestern plains around 2,000 years ago. The movement or the influence of these new groups in the Basin seems to have come from different geographical directions, creating a complicated pattern of overlapping cultural adaptations that are not well understood by archaeologists.²⁰ One of the groups is called Besant. Their affiliation appears connected to Northeastern Plains Woodland tradition. Migrating west from the Dakotas, the location and distribution of Besant sites suggest their movement into the Basin followed the Missouri and its major tributaries, such as the Milk, Yellowstone, Powder, Middle Missouri, and Belle Fourche Rivers. Adaptation appears to have revolved around a settlement pattern that used the open

¹⁹ For more on Pelican Lake adaptation, see Frison, et al., "Archeology of the Northwestern Plains," 23; Bryan, *Buffalo People*, 96-103; Brian O. K. Reaves, *Culture Change in the Northern Plains: 1000 B. C. - A. D. 1000*, Archaeological Survey of Alberta Occasional Paper No. 20 (Edmonton, 1983), 76-91; and Jack Brink and Stuart J. Baldwin, "The Highwood River Site: A Pelican Lake Phase Burial from the Alberta Plains," *Canadian Journal of Archaeology* 12, 1988, 109-136. Ian Dyck and Richard E. Morlan suggest the earlier use of the bow and arrow from evidence excavated at, *The Sjovald Site: A River Crossing Campsite in the Northern Plains*, Mercury Series Archaeological Survey of Canada Paper 151 (Hull, 1995), 537.

²⁰ Frison, et al., "Archeology of the Northwestern Plains," 23-24. Two articles that discuss the occupation of the Basin and the speculative nature of interpreting archaeological data during the first millennium, are J. Roderick Vickers, "Cultures of the Northwestern Plains: From the Boreal Forest Edge to Milk River," 3-33; and Sally T. Greiser, "Late Prehistoric Cultures on the Montana Plains," 34-55, both found in: *Plains Indians, A.D. 500-1500: The Archaeological Past of Historic Groups*, Karl H. Schlesier, ed. (Norman, 1994).

grasslands during warmer months and the more protected valleys in winter. Their subsistence seems to have been mostly dependent on bison, with the use of wild plants, manos, and metates rarely uncovered at excavation sites. Hunters used a distinct, larger side-notched, dart-type projectile point that was used with an atlatl.²¹

The methods used by Besant hunters to procure bison were much like their predecessors, but they also employed a new twist to the use of natural features by constructing large, corral-like structures to trap animals. Generally referred to as bison pounds, variations of this procurement method are found scattered throughout the northwestern plains. The Ruby site, located in the upper reaches of the Powder River drainage, perhaps represents the most revealing evidence. Situated in an arroyo, posts were placed in deep holes, with horizontal poles presumably stacked alternatively to create a post and rail type of enclosure capable of holding thirty to forty animals. Post and pole fences may have also formed the wings and a portion of the drive lanes leading up to the corral. Construction estimates suggest that 20 men would have needed ten days to two weeks to build the Ruby corral.²²

The amount of time and energy required to build such an enclosure suggests an organized work force with intentions of long-term use. It also indicates that the builders

²¹ For an overview on the Besant culture and connections to a Plains Woodland tradition, see Ann Mary Johnson and Alfred E. Johnson, "The Plains Woodland," in: *Archaeology on the Great Plains*, Wood, 201-234; Greiser, "Late Prehistoric Cultures," 36-38; Reeves, *Culture Change*, 92-100; and Frison, et al., "Archeology of the Northwestern Plains," 24-26. Most of the archaeological evidence supporting a dependence on bison and a marginal use of plants comes from bison kill or processing sites only. Few camp site are known, which can easily skew the overall picture of how the Besant culture may have adapted to the Basin's environment.

²² George C. Frison, "The Buffalo Pound in Northwestern Plains Prehistory: Site 48CA302, Wyoming," *American Antiquity* 36(1), January 1971, 77-91; and Frison, *Prehistoric Hunters*, 199-208.

were highly experienced and knowledgeable of bison behavior. A deliberate bend in the drive lane before it reached the corral obscured the pen from the bison's view until the last possible moment to help prevent the animals from balking and turning around. The appearance of a ceremonial arrangement of eight male bison skulls at the site may also indicate these people relied on spiritual helpers. Radiocarbon dates suggest the site was used for several years about 1,670 years ago. Bison were processed on both sides of the corral and as far away as 900 feet. Within the contiguous processing area, smaller, possibly family groups worked on carcasses about 30 to 50 feet apart. Users of each individual group site operated one or two fire hearths, with several sites extracting bone grease.²³

Although the use of stone circles were not discovered at the Ruby site, a number of camp and kill sites in and adjacent to the Basin strongly suggest that Besant used tipis. About 100 stone circles represent one feature at the Beaucoup bison kill site near Malta, Montana. If only a quarter of these rings were used at one time, 150 or more people were possibly camped at the site for one communal event. The large number of rings also suggest that as many as 150 dogs were present to help transport tipi hide covers, poles, and other supplies. At the Muddy Creek bison pound in Wyoming, numerous stone circles have also been discovered, giving it an appearance of a tipi ring village. Such large communal gatherings represents a relatively complex social structure that enabled

²³ Ibid.

successful communal killing and distribution of bison to individual band members.²⁴

The ability of several bands to strategically plan and position themselves for a large communal hunt implies that bison herds were large enough to support these events. Band members, it would seem, would not intentionally walk and prepare a bison pound or drive lanes for a bison jump without believing that this investment of time would pay off. The ability of several bands to congregate for a fall hunt, for example, and then disperse to establish winter camps in relatively close proximity to each other, further suggests that bands were using smaller ranges at least regionally in response to sizeable herds of bison. A higher density of bands using the Basin's landscape may reflect a human population that had increased.²⁵

In addition to documenting their skill as hunters, archaeologists also believe that ceramic technology was brought to the northwestern plains by Besant bands. Although the initial use and distribution of pottery may have been limited, its introduction to the Basin can easily be interpreted as revolutionary from a culinary perspective. The use of pottery opened up an array of cooking and storage possibilities that people living in the Basin subsequently improved upon. Clays and other material used to make these horizontal cording style pots appear to have been gathered from local sources near

²⁴ Frison, et al, "Archeology of the Northwestern Plains," 26. Charles Reher points out the village aspect of the Muddy Creek site, in "Analysis of Spatial Structures in Stone Circle Sites," *Plains Anthropologist* 28(102, Part 2), Memoir 19, November 1983, 193-222. W. Raymond Wood and Ann M. Johnson highlight the social complexity of Besant, in "High Butte, 32ME13: A Missouri Valley Woodland Besant Site," *Archaeology in Montana* 14(3), September-December 1973, 35-83.

²⁵ A limited number of pollen samples within and adjacent to the Basin suggest that overall climatic conditions were generally cooler and moister during the first millennium, perhaps allowing bison and human populations to increase. Beiswenger, "Late Quaternary Vegetation History," 176-177; and Gennett and Baker, "Late Quaternary Pollen Sequence," 68-69.

excavation sites. Pot making was perhaps a seasonal activity, however, due to the difficulty in collecting and working clay under cold winter conditions. Transporting pots safely may have also been a problem for people living a mobile hunter-gatherer lifeway.²⁶

Around 1,800 years ago with the Besant culture apparently flourishing, a technological advancement was working its way into the Basin that proved to be extremely innovative if not revolutionary: the bow and arrow. Presumably spreading out from Africa around 13,000 years ago, the bow reached northern North America about eight thousand years later. Working its way through arctic and then subarctic peoples, the bow with its small arrow points was being used by people in the northern Rocky Mountains and plains by as early as 2,550 years ago. Near the end of the Pelican Lake occupation, the first known bows and arrows are thought to have reached the Basin via the foothills along the Rocky Mountain front around 2,000 years ago.²⁷

The first people who exclusively used bow and arrow technology in and adjacent to the Basin have been broadly referred to as Avonlea. This cultural group is generally characterized by a small type of arrow point that was used with the bow. These Avonlea

²⁶ Reeves, *Culture Change*, 98-100; and Ann M. Johnson, "Woodland and Besant in the Northern Plains: A Perspective," *Archaeology in Montana* 18(1), January-April 1977, 27-41.

²⁷ For an overview on the spread of the bow and arrow and a technological comparison with the atlatl, see John H. Blitz, "Adoption of the Bow in Prehistoric North America," *North American Archaeologist* 9(2), 1988, 123-145. There is some evidence that the bow and arrow reached North America earlier than 5,000 years ago, but this remains speculative. Blitz indicates that this new technology reached the northern Rocky Mountains and plains about 1,800 years ago. The arrow points found at the Sjøvold site suggest a date between 2,400 to 2,700 years B.P. See, Dyck and Morlan, *Sjøvold Site*, 485. Although the route from Africa appears traceable, it is conceivable that the invention of the bow and arrow may have happened simultaneously by Plains or other Indian groups. On the first known arrow points located in and near the Basin, see Sally T. Greiser, "Artifact Collections from Ten Sites at Canon Ferry Reservoir," *Archaeology in Montana* 27(1 and 2), January - December 1986, 187; and "Late Prehistoric Cultures," 38; and Vickers, "Cultures of the Northwestern Plains," 14-20.

type points have been found throughout most of the northwestern plains. Because of the wide variations in point types, not all archaeologists agree that these similar points represent all Avonlea groups. The difficulty of one cultural group to maintain a uniform lifeway over a large and varied landscape suggests that bow and arrow technology was probably adopted by several different groups of people. This idea, however, remains controversial.²⁸

One intriguing theory about the arrival of the Avonlea culture with the bow and arrow is that these people represent the migration of Athapaskan's moving through the Basin on their way to the southwest. Possibly the ancestors of the Jicarilla Apache were part of this movement south through the Basin? Connected to subarctic cultures, Athapaskan speaking people probably used the bow and arrow and carried them south. This new technology appears to have preceded their arrival (if at all) to the Basin, however. Resident Pelican Lake bands that lived in the valleys and mountains bordering the Basin may have learned about the bow by exchanging with people living north of the plains in the boreal forests of Canada or from the upper Columbia River plateau region. Stratigraphically, Pelican Lake artifacts with an arrow style point predate Avonlea type arrow points at several sites, suggesting resident Pelican Lake bands had obtained the bow

²⁸ The advent of the bow and arrow marks the end of the Middle Plains Indian Period and the beginning of the Late Plains Indian or Late Prehistoric Period for many archaeologist. Avonlea is named after the bison drive and kill site located in the Avonlea Creek valley of south-central Saskatchewan. In support of Avonlea representing a number of cultural groups, see Tom E. Roll, "Focus on a Phase: Expanded Geographical Distribution and Resultant Taxonomic Implications for Avonlea," in: Davis, 237-250.

before Athapaskan or Avonlea groups moved into the region.²⁹

North of the Yellowstone River, bands associated with the "true" Avonlea point appear to have initially occupied the northern plains of Canada and its river valleys in smaller numbers. Slowly radiating south and east, the greatest concentration of sites in relation to the Basin are located on the glacial plains north of the Missouri River. These sites reflect a mix of small and large scale communal hunts by people who used stone circles, had extensive tool kits that included local and exotic lithic material, and extracted bone grease. Similarly to Besant people, Avonlea hunters used arroyos, bison jumps, and pounds to communally hunt bison as well as other game. There is also some evidence they used fish. Their use of bison and other game appears extensive, as seen by the overall size of sites, processing pits, and piles of crushed bones for making grease.³⁰

Another style of the Avonlea type of point has been found south of the Yellowstone River in the area surrounding the Bighorn Mountains. These folks are generally referred to as Beehive, named after the camp that is located along the central foothills on the west side of the Bighorn Mountains. Beehive sites have dates contemporary with those of Avonlea sites north of the Yellowstone River. Their subsistence strategies seems to have continued in much the same way as Pelican Lake groups had, hunting and gathering a variety of game and wild plants. Beehive sites are not

²⁹ Wilcox, "Avonlea and Southern Athapaskan Migrations," 273-280; and Greiser, "Artifact Collections," 187; and "Late Prehistoric Cultures," 38.

³⁰ Vickers, "Cultures of the Northwest Plains," 14-20; and Greiser, "Late Prehistoric Cultures," 38-39. For a review of Avonlea hunting, see Frison, et al., "Archeology of the Northwestern Plains," 24-28. On the hunting of different game such as antelope, see Leslie B. Davis and John W. Fisher, Jr., "A Late Prehistoric Model for Communal Utilization of Pronghorn Antelope in the Northwestern Plains Region, North America," in: *Hunters of the Recent Past*, Davis and Reeves, 241-276.

associated with the use of tipis, however. Rockshelters seem to have been much more commonly used. They also constructed a type of stonewalled dwelling, such as the one found on the top of Benson Butte near the Tongue River and the Montana and Wyoming state line. Beehive people appear to have located their shelters and dwellings in secluded or easily defensible places, such as in canyons or on buttes. Occupation also appears to have been by individual bands, with many sites used regularly over a period of years.³¹

Avonlea type arrow points are also found throughout the mountainous areas of Montana and Wyoming adjacent to the Basin. These sites tend to reflect a different subsistence strategy and settlement pattern than the sites north and south of the Yellowstone River. One area of the Basin where Avonlea type points are not well represented are the plains of eastern Montana and northeastern Wyoming. This area appears to have remained the territory of people using Besant type projectile points. Exchanging bow and arrow technology required several centuries to fully integrate into the daily lives of people living in the Basin. Why some people continued to use the atlatl when bows were available is intriguing. Their skills as hunters may not have warranted a change, or bison and other resources may have been plentiful, and the skills and tools they had worked well enough. Perhaps holding on to their use of the atlatl reflected some inner-cultural pride that placed a high value on retaining traditional tools. Yet something changed, and the larger, dart-type projectile point disappears from the archaeological

³¹ For a comparison of northern and southern Avonlea dates, see Richard E. Morlan, "Avonlea and Radiocarbon Dating," in: *Avonlea Yesterday and Today*, Davis, 291-309. On Avonlea sites south of the Yellowstone, see Lynn B. Fredlund, "Distribution and Characteristics of Avonlea South to the Yellowstone River in Montana," 171-182; and George C. Frison, "Avonlea and Contemporaries in Wyoming," 155-170, both found in: *Avonlea Yesterday and Today*, Davis. Beehive is also referred to as the Benson's Butte-Beehive Complex.

record about 1,200 years ago.³²

How groups of people may have responded to changing technology and the presence of different people remains difficult to know. One theory suggests that beginning around 1,500 years ago and lasting roughly three or four hundred years, a warmer and drier landscape may have caused significant stress to bison populations, thereby decreasing dramatically the number of bison in the Basin. This decline forced Besant bands to disperse. Because of fewer people, Avonlea groups, who were once kept at bay by large numbers of Besant people, were able to move into the region and successfully hunt smaller herds of bison with their bow and arrow technology. Fewer bison and better technology may have led Besant hunters to change their tool kits.³³

Another component that might have been occurring during this period of change revolves around tension. The hidden or defensible locations of Beehive sites surrounding the Bighorn Mountains gives an impression that these people were not always at ease living in this area. Whether these potential intruders or unwelcome visitors were resident Besant groups, Athabaskan speaking people, or another group is not known.³⁴ If

³² On the distribution of mountainous sites, see Roll, "Focus on a Phase," 237-250. David C. Fraley discusses the limited number of Avonlea sites, in "Avonlea and Besant in Eastern Montana: Archaeological Distributions in the Lower Yellowstone Region," in: *Avonlea Yesterday and Today*, Davis, 129-136. Also see, Greiser, "Late Prehistoric Cultures," 39-42.

³³ Sally T. Greiser offers this tentative suggestion of a drier environment, or a period she refers to as the Scandic episode, in "Late Prehistoric Cultures," 39-42. Also see, Wayne M. Wendland, "Holocene Man in North America: The Ecological Setting and Climatic Background," *Plains Anthropologist* 23(82, Part 2), November 1978, 273-287; and P. G. Duke, "Models of Cultural Process During the Avonlea Phase," in: *Avonlea Yesterday and Today*, Davis, 265-271. On bison stress in response to climate change, see Michael C. Wilson, "Bison Dentitions from the Henry Smith Site, Montana: Evidence for Seasonality and Paleoenvironments at an Avonlea Bison Kill," in: *Avonlea Yesterday and Today*, Davis, 203-225.

³⁴ Fredlund, "Distribution and Characteristics of Avonlea," 175; Frison, "Avonlea and Contemporaries," 167-168.

resources were becoming scarcer in response to climate change or if human population were instead increasing, there may have been movement by some bands toward the foothills and mountains. In response, people may have felt the need to defend particular territories. Conflict may have been a part of these changes. The remains of a 30 to 35 year old male with extensive trauma inflicted to the head and upper torso has been uncovered at the Bairoil site in central Wyoming. His injuries date to about 1,430 years ago.³⁵

The climate events that may have triggered such a warmer and drier trend are far from conclusive, especially any major shift toward a four hundred-year dry condition. Areas of the Basin probably experienced periods of drought or prolonged dry spells during this time. In response, utilization of particular areas by bison and people may have been limited.³⁶ Dental anomalies found on bison at the Henry Smith kill site near Malta, Montana, may simply reflect a particular dry spell which lasted through several generations of animals.³⁷

The transition from the use of the atlatl to the bow and arrow marked a major cultural evolution in the Basin during the first millennium. So, too, did the expressions left on rocks. Although rock art appears to have been less significant than the overall impact

³⁵ Susan Guise Sheridan, Jeannette L. Mobley-Tanaka, Dennis P. Van Gerven, and William Lane Shields, "A Case of Late Prehistoric Mutilation on the Northwest Plains," *Plains Anthropologist* 37(141), November 1992, 289-298.

³⁶ L. D. Williams and T. M. L. Wigley, "A Comparison of Evidence for Late Holocene Summer Temperature Variations in the Northern Hemisphere," *Quaternary Research* 20(3), November 1983, 286-307; and Beiswenger, "Late Quaternary Vegetational History," 177. Questioning the soundness of this drier environmental argument are Markgraf and Lennon, "Paleoenvironmental History," 8-9.

³⁷ Wilson, "Bison Dentitions," 221-223.

the bow and arrow had on people, it was nonetheless important for individuals and their bands. In the western end of the Wind River Valley, eleven major rock art sites are situated in the upper reaches of Dinwoody Canyon at about 7,000 feet. Known as Dinwoody style or tradition, engravings are created by a distinct pecked rock method that outlines individual human and animal figures. Generally rectangular in shape and large, sometimes close to life size, elaborate human figures exhibit a wide array of bodily orientations, with descriptive pecked lines patterned throughout the torso and attached regalia. Animals depicted on the panels are often connected to these human-like figures. Additional Dinwoody sites are located in the Wind River Canyon and the southwest quarter of the Bighorn Basin. At the Legend Rock site in the Bighorn Basin, these kinds of petroglyphs were being created by at least 2,000 years ago.³⁸

Another distinct style of pecked rock art was also being used in the Pryor Mountains of south central Montana and in the Bighorn Basin. This form of art is called *en toto*, with the inside of human and animal forms being completely pecked out. Engravings are generally small and simple compared to the Dinwoody style. At several sites *en toto* and Dinwoody share the same rock walls. Radiocarbon dates indicate that people were pecking *en toto* style art onto rock by at least 1,200 to 1,500 years ago and possibly earlier. Who these people may have been or which cultural group they represented remains unknown. The strong difference in style between Dinwoody and *en*

³⁸ David Gebhard, *The Rock Art of Dinwoody Wyoming* (Santa Barbara, 1969). Experimental dating of rock art varnish has pushed the development of the Dinwoody style back to as early as 3,000 years ago or older. If this method of dating proves accurate, it further suggests that people continued to use this form of art throughout the first millennium. Julie E. Francis, Lawrence L. Loendorf, and Ronald I. Dorn, "AMS Radiocarbon and Cation-Ratio Dating of Rock Art in the Bighorn Basin of Wyoming and Montana," *American Antiquity* 58(4), October 1993, 711-737.

toto and their contemporaneous dates suggest that at least two distinct cultural groups inhabited this area of the Basin at about the same time.³⁹

Beginning around 900 years ago, the use of Dinwoody and en toto pecked style of rock art appears to end. What emerged are two very different forms of art. One method is called incised. Grooves, often rounded and deep, were cut into the rock by artists that created motifs such as V-necked and stick figures, rectangular-bodied humans, animals, and shield-bearing warriors. The other method simply used paints, depicting humans and animals similar to those used in incised motifs. Considered "hallmarks" of Plains Indian rock art, V-neck figures and shield-bearing warriors are nonexistent in either of the pecked methods. An emphasis in the type of animals depicted also appears different. Large animals such as bison, bear, and elk displayed in hunting scenes and often much larger than the human hunter were common motifs incised or painted onto rocks. Pecked methods, especially the Dinwoody style, tend to display smaller animals such as mountain sheep, pronghorn antelope, and dogs, with humans much larger than animals. These differences imply that the inhabitants throughout and adjacent to the Bighorn Basin experienced a major cultural shift in the way they were expressing themselves. Such evidence has led some archaeologists to suggest that incised and painted art represented the movement of a different cultural or ethnic group into the Basin.⁴⁰

³⁹ Francis, et al., "AMS Radiocarbon and Cation-Ratio Dating," 711-737; Julie E. Francis, "Rock Art of the Northwestern Plains," in: *Archeological and Bioarcheological*, Frison and Mainfort, 50-55.

⁴⁰ Julie E. Francis, "An Overview of Wyoming Rock Art," in: Frison, *Prehistoric Hunters*, 397-430; and Lawrence L. Loendorf, "A Dated Rock Art Panel of Shield Bearing Warriors in South Central Montana," *Plains Anthropologist* 35(127), February 1990, 45-54. Loendorf offers Athapaskan speaking folks, represented as Avonlea, as candidates who used incised and painted rock art in the Basin 900 years ago.

Whether the meanings and techniques of rock art were shared with neighbors is really not known. Archaeological evidence, however, suggests that networks of exchange were quite extensive during the first millennium and there after. At sites with Avonlea type arrow points, for example, the relatively consistent and wide spread styles and forms of pottery implies that people were sharing their methods for making ceramic pots.⁴¹ In addition to pottery, bow and arrow technology, sea shells, bison robes, pemmican, marriage partners, wild plants, lithic materials, and designs of shelters were conceivably all part of a large system that linked people, ideas, and material goods together in the Basin and northwestern plains.

One notable item that was part of this broad exchange network was obsidian. At several Hopewell cultural sites in Ohio and Illinois, archaeologists have uncovered sizeable deposits. Most of this obsidian has been traced to Obsidian Cliff in Yellowstone National Park, a distance between the two areas of roughly 1,500 miles. Hydration dating suggests that Yellowstone obsidian arrived in Ohio and Illinois between 1,600 and 2,100 years ago, and possibly at different times. Obsidian Cliff has also been identified as the main source for obsidian found at a number of sites in the upper Mississippi Valley as well, with dates spanning throughout most of the first millennium. Whether Hopewellian people traveled from Ohio to Wyoming to quarry and transport more than 600 pounds of obsidian during one or several trips remains undetermined. Most archaeologists speculate, however, that the transporting of obsidian to the mid-west was carried out by a network of trading

⁴¹ On the various styles of Avonlea pottery, see Ann M. Johnson, "Parallel Grooved Ceramics: An Addition to Avonlea Material Culture," 137-143; and J. Michael Quigg, "A New Avonlea Ceramic Style Form North-Central Montana," 145-153, both found in: *Avonlea Yesterday and Today*, Davis.

partners.⁴²

Avonlea associated artifacts disappear from the Basin's archaeological record around 900 years ago, about three hundred years after the Besant artifacts. What generally replaces Avonlea type points are a variety of side-notched points that were being used north of the Yellowstone River even before Avonlea artifacts disappeared archaeologically. These side-notched points are generally linked together under the cultural group of Old Women's.⁴³ Variations of Old Women's type points occurred throughout the first 700 years of the second millennium in the Basin, and were used by such known tribal groups as the Crow, Blackfeet, and Shoshone. During this period of time, the number of archaeological sites also tends to increase, perhaps as a result of weathering and erosion having had less time to remove or bury evidence of human use. This increase of archaeological information tends to blur, however, more than help provide a clearer overall picture of what life was possibly like in the Basin. The various types of arrow points and associated artifacts also make it difficult to identify particular characteristics that may distinguish individual cultural groups.⁴⁴

⁴² On aspects of obsidian in Yellowstone National Park, see Leslie B. Davis, Stephen A. Aaberg, and James G. Schmitt, *The Obsidian Cliff Plateau Prehistoric Lithic Source, Yellowstone National Park, Wyoming* (Denver, 1995). For contrasting studies on how Yellowstone obsidian reached Ohio, see J. B. Griffin, "Hopewell and the Dark Black Glass," *Michigan Archaeologist* 11, 1965, 115-155; and James W. Hatch, Joseph W. Michels, Christopher M. Stevenson, Barry E. Scheetz, and Richard A. Geidel, "Hopewell Obsidian Studies: Behavioral Implications of Recent Sourcing and Dating Research," *American Antiquity* 55(3), July 1990, 461-479. On the finding of obsidian in the upper Mississippi Valley, see Duane C. Anderson, Joseph A. Tiffany, and Fred W. Nelson, "Recent Research on Obsidian From Iowa Archaeological Sites," *American Antiquity* 55(4), October 1986, 837-852.

⁴³ Old Women's takes its name from the Old Women's Bison Jump site in Southern Alberta.

⁴⁴ Karl H. Schlesier offers one attempt at interpreting archaeological evidence to designate cultural affiliation and ethnicity, see "Commentary: A History of Ethnic Groups in the Great Plains," in: *Plains Indian*, Schlesier, 308-381.

The initial occupation by people who used Old Women's type of arrow points may have lived in the Basin during a period of favorable environmental conditions. Between approximately 700 and 1,100 years ago, climatic and archaeologic studies tend to suggest a swing toward cooler and moister conditions, leading to an expansion of bison in the Basin.⁴⁵ These suggestions remain tentative, however, if not a little speculative. There is little in the way of evidence to suggest that such weather conditions were the norm in the Basin. Weather patterns, as has been shown, can fluctuate from region to region. And although archaeological evidence suggests that bison were being procured throughout the Basin in large numbers, they tend not to imply direct clues to climate conditions.

As a cooler, moister environment, with increased numbers of bison has been proposed, so has a 300 year dry to drought period beginning around the middle of the thirteenth century. It was during this time that such cultures as the Anasazi, Hohokam, and Sinagua abandoned their horticultural lifeway in the American Southwest and Middle Missouri River residents constructed fortifications around their villages. In both regions, drier environmental conditions are thought to have played a major role. The Crow Creek site, located above the Missouri River floodplain in central South Dakota, represents one example of people who felt the need to construct defenses around their village. Thought by archaeologists to have been ancestors of the Arikara, who were moving into the middle Missouri River area from the central plains, these folks dug a 20 foot wide by 6 foot deep ditch that was backed by a wooden palisade to protect their village. A second ditch was

⁴⁵ Wendland, "Holocene Man in North America," 281; and Flores, "The Great Contraction," 10-12.

also dug farther outside the initial defensive perimeter as the village grew. These measures proved inadequate as more than 450 men, women, and children were killed and mutilated at the site sometime in the mid fourteenth century. Competition for resources, possibly in response to crop loss and scarcity of game due to drier conditions, has been proposed as one explanation as to why this village was attacked by ancestors of the Mandan. Archaeologists offer further evidence of a drier environment through the examination of the victims bones. They revealed extensive signs of malnutrition that was often sever and occurred at different times over the course of their lives. Even at the time of their death, the villagers at Crow Creek appear to have been malnourished.⁴⁶

It remains unclear what the motives were for the attack on the village at Crow Creek. Competition for resources, territorial threats, and revenge killings are all possible explanations. If this drier period of time occurred in the Basin as well, the archaeological record is muddled as to how bison and people may have adjusted. The number of archaeological sites tends to decrease over these three hundred years to suggest that something ecological was occurring in the Basin. This change toward drier conditions does not appear, however, to have reached the dramatic proportions of the altithermal years. Bison, it would then seem, would not have disappeared from the Basin, but possibly moved in smaller herds and periodically used particular areas if conditions became extremely dry. Human groups may have responded in a similar fashion by becoming more dispersed, living closer to river courses, using foothill environments more frequently, or

⁴⁶ Douglas B. Bamforth, "Indigenous People, Indigenous Violence: Precontact Warfare on the North American Great Plains," *Man* 29(1), March 1994, 95-115.

expanding their networks of exchange to supply needed resources. If herds were smaller, communal hunting was maybe impractical as bands focused more on small kill events. Because smaller kill sites are more difficult to detect, may explain why there are fewer archaeological sites during this time, with evidence of occupation having been removed or simply hidden from view.

What has not been hidden from the view of archaeologists during the centuries that preceded the arrival of known tribal groups tends to suggest a number of broadly framed characterizations of life in the Basin and northwestern plains that are different than those of earlier cultures. Bands continued to hunt and gather, but the number of people in a band may have increased. Human population levels as a whole appear to have become larger. An estimated population of 34,000 people may have lived in the Basin in any given year. These figures are based on a comparison of available resources between hunting and gathering groups living in the Basin and hunter-gatherer Bushmen of the Kalahari Desert in Africa. Bushmen live in densities of about 41 people per 100 square miles. The people in the Basin appear to have lived a similar lifeway to that of Bushmen. Comparing the two environments, the Yellowstone River Basin would appear to have matched or even exceeded the productivity of plant and animal resources of the Kalahari Desert.⁴⁷ The increase in the number of people suggests that bands were using smaller territories. More

⁴⁷ This model of human population figures follows, John W. Fisher, Jr. and Tom E. Roll, "Ecological Relationships Between Bison and Native Americans During Late Prehistory and the Early Historic Period," in: *International Symposium on Bison Ecology*, Irby and Knight, eds., 283-302. Fisher and Roll's model is derived from observation made by Roll and Ken Deaver from excavations conducted at *The Bootlegger Trail Site, A Late Prehistoric Spring Bison Kill*, Interagency Archeological Services Investigation Reports (Denver, 1980), 98. The 34,000 figure is based on square miles of suitable bison habitat. If the forested area of the Basin were included, this population figure would obviously be higher.

people and smaller territories gives the impression that bands had more contact with each other, implying that exchange networks were probably extensive and the flow of material goods, food items, and information traveled through the Basin and elsewhere at a relatively quick speed.⁴⁸

Bands who used the foothills and bordering grasslands in and adjacent to the Bighorn Basin appear to have continued to use a subsistence strategy that was less focused on bison. The generally drier conditions in the Bighorn Basin and the limited evidence of large scale bison hunting and usage suggests that this area was never heavily populated with bison. Elsewhere in the Basin, bison populations appear to have slowly increased after the drier times of the altithermal years, with vegetative productivity guiding any population growth and the Basin's overall carrying capacity abilities.

How *Bison bison* populations may have fluctuated during climatic shifts remains difficult to know. The methods hunters used to procure bison with Old Women's type points appears the same as those techniques that were developed and used for centuries before. What tends to be different in the procurement of bison is the scale. Communal kill sites are generally larger in the total area people used and contain more animals. Kill events occurred throughout the year. Sites were often reused multiple times, with bison and other game being killed in successive years, over decades, and centuries.

Archaeologist have also identified spatial differences within sites, with the kill, process, and sometimes camp areas clearly evident. Process areas tend to display the most diversity of artifact types, including arrow points, knives, scrapers, bone awls, pottery, and

⁴⁸ Fisher and Roll, "Prehistoric Human Exploitation," 417-436.

a variety of ornaments. Process areas also reveal extensive use of animal bone. Boiling pits for extracting grease are common, with whole bones rarely found. The combination of more people, smaller territories, larger kill sites, frequency at which kill sites were used, spatial arrangement of the site, and the overall use of carcasses implies that the hunting and processing of bison had intensified.⁴⁹

To process numerous animals required a large supply of lithic materials. By the beginning of the sixteenth century every known lithic source in the Basin had been exploited to make the projectile points, knives, and other stone tools. Such tools were probably used on a daily basis, generating the need for a relatively constant supply of raw material. Quarrying rock required a great amount of physical labor using hammerstones, elk, and bison bone tools. It also required a well-planned expedition and time depending on how far away particular quarries were, or a reliable network of exchange.⁵⁰

The seasonal settlement patterns bands employed to collect lithic material, engage in a communal hunt, or another subsistence task enhances the perception that these people knew the landscape intimately. In their movement over the landscape, tipis appear to have become the choice of dwelling by people living throughout the grassland areas of the Basin. Settlement patterns also suggest that Plains Indian life held well-defined social structures that allowed bands, perhaps some from different ethnic groups, to work together to obtain the resources they needed or possibly for defensive purposes. Shield-

⁴⁹ Fisher and Roll, "Prehistoric Human Exploitation," 426-434.

⁵⁰ Frison, *Prehistoric Hunters*, 290-292; and "Northwestern and Northern Plains Archaic," 150-151; and Reher and Frison, "The Vore Site," 52.

bearing rock art warriors suggest that some level of conflict was occurring. But unlike the Crow Creek site in South Dakota, there is no known direct evidence of conflict in the Basin prior to the seventeenth century. Ritualized treatment of animal skulls and other artifacts further suggest that religion or ceremonies were also important cultural components. How people ultimately interacted with each other, whether in regard to etiquette for trading goods, during religious moments and ceremonies, in their division of labor, in conflict, or following daily social structure or customs remains conjectural.⁵¹

From the end of the altithermal to the movement of known tribal groups working their way toward the Basin, archaeological evidence has revealed a wealth of information about various cultural groups and how these people adapted to new influences, technology, and changing environments. Known and yet to be found archaeological sites still have more stories to tell about these people's lives, hopefully filling in some of the gaps that currently exist. What can be interpreted about the flourishing of a Plains Indian culture since the drier times of the altithermal suggests a growing dependence on bison, trade, and increased interactions between people. Each cultural group had their own characteristics, some unique, some acquired, and some let go of over time as they were no longer useful. Lifeways evolved and expanded through the development and exchange of technology, techniques in hunting and gathering, ideas, partners, and material goods that were carried on or discarded by preceding groups. This process of adaptation forms the cultural underpinning for the Crow, Shoshone, Kiowa, and other known tribal groups who will use and make the Yellowstone River Basin their home.

⁵¹ The ideas and meanings of shield-bearing warriors is more fully discussed in Chapter 6.

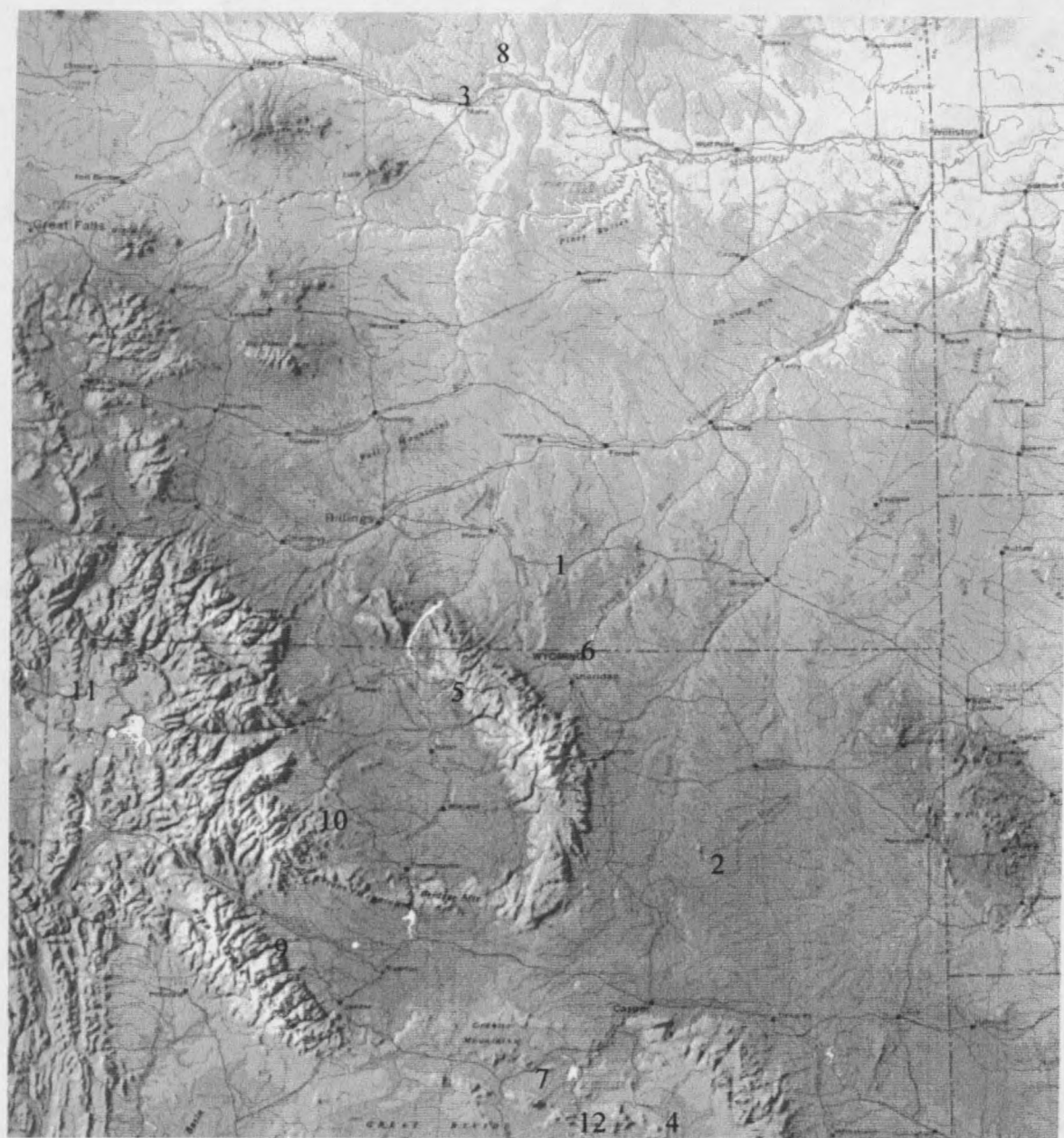


Figure 7. Approximate location of archaeological sites discussed in Chapter 5.

- | | | |
|-----------------|---------------------|-----------------|
| 1. Kobold | 2. Ruby | 3. Beaucoup |
| 4. Muddy Creek | 5. Beehive | 6. Benson Butte |
| 7. Bairoil | 8. Henry Smith | 9. Dinwoody |
| 10. Legend Rock | 11. Obsidian Cliffs | 12. Scoggin |

CHAPTER 6

HOME



The Crow country is a good country. The Great Spirit has put it exactly in the right place. Wherever you are in Crow country you fare well, and whenever you leave Crow country you fare worse.

If you go to the south, you have to wander over great barren plains. The water is bad and there is ague. To the north it is cold. Winters are long and bitter. There is no grass, so you cannot keep horses, and must depend on dogs. What is a country without horses?

To the west on the mighty Columbia they are poor and dirty, paddle about in canoes, and eat fish. Their teeth are worn out, and they are always taking fish bones out of their mouths. Fish is such poor food. To the east they dwell in villages. They live well, but must drink the muddy water of the Missouri. Crow dogs would not drink such bad water.

Around the forks of the Missouri it is a fine country. There is good water and good grass, and there are plenty of buffalo. In the summer it is almost as good as Crow country. But in the winter it is cold, with no grass and only salt weed for the horses.

The Crow country is exactly in the right place. It has snowy mountains and sunny plains, with all kinds of climates and good things for every season. When the summer heat scorches the prairies, you can draw up under the mountains where the air is sweet and cool, the grass is fresh, and the bright streams come tumbling out of the snow banks. There you can hunt the elk, deer, and antelope when their skins are fit for dressing. You can also find plenty of white bears and mountain sheep.

In the autumn when the horses are fat and strong from foraging on mountain pastures, you can go down onto the plains and hunt buffalo or trap beaver in the streams. When winter comes on, you can find shelter in the woody bottoms along the rivers, where you can find plenty of buffalo for yourselves and cottonwood bark for the horses. Or you can winter in the Wind River valley where salt weed is in abundance.

The Crow country is exactly in the right place. Everything good is to be found there. There is no country like Crow country.¹



Along the banks of the upper Green River, with the snow-capped Wind River Mountains in full view to the northeast, a year's worth of pent-up energy was being let loose. Mountain men were trading their season's catch of furs for the necessary supplies they would need to get them through another year. When most of the trading was completed, the spree could begin. For three weeks under warm and pleasant July skies,

¹ Washington Irving, *The Adventures of Captain Bonneville* (London, 1837), Vol. II, 59-63. Irving was hired by Bonneville to write his narrative.

the traders and trappers renewed old friendships, told stories and tall tales, competed in games of skill and chance, and gulped lots of alcohol.

The rendezvous of 1833, with its various camps of traders, trappers, and Shoshone Indians, spread along the Green River for about ten miles. At the north end of the encampments stood Fort Bonneville. Built the previous year by Captain Benjamin Bonneville, the trading post was generally referred to as Fort Nonsense, even by his own men. Bonneville was not that successful as a trader. During the 1833 rendezvous, he was outmatched by the company of William Sublette and Robert Campbell, and the American Fur Company. Although the competition for trade was fierce among the traders, it did not spoil the comradery among all the men involved. At some point during the celebrations and mayhem, Bonneville and Robert Campbell talked. From this interaction, Campbell appears to have told Bonneville the story about the Crow country.²

As a trapper and brigade leader, Campbell, with the help of veteran mountain man Jim Bridger, worked the creeks and rivers in Crow country during the 1828-29 season. That winter Campbell presumably heard this story while camped with the Crow near the junction of the Wind and Bighorn Rivers. Campbell traveled through Crow country after the 1833 rendezvous to meet up with his partner Sublette at the confluence of the Missouri and Yellowstone Rivers. The day after Campbell left the rendezvous, Bonneville also traveled east to Crow country, leading fifty-six men around the southern end of the

² Fred R. Gowans edited a number of personal accounts of the 1833 rendezvous in his, *Rocky Mountain Rendezvous: A History of the Fur Trade Rendezvous 1825-1840* (Provo, 1977), 102-122. Washington Irving credited the story of the Crow country to Arapooish, as told to Robert Campbell, see *ibid.* The 1833 rendezvous appears to have been the only place that Campbell and Bonneville met. It may have been, however, that Bonneville heard the story from another source who heard it from Campbell. There are no known accounts of Campbell and Irving ever meeting.

Wind River Mountains, presumably crossing over South Pass before striking the Popo Agie River. Bonneville's interest in exploring and trapping in Crow country may in part have been spurred by Campbell's positive picture of the Yellowstone River Basin.³

By the time Bridger, Campbell, Bonneville, and the other fur traders and trappers were exploring and exploiting the Basin's resources, the Crow had lived along its many river valleys, mountainous foothills, and open prairies since the mid-to late-1600s. The Crow, like most of the cultural groups that have made the Basin their home, began their history somewhere else. In their migration toward the Basin the Crow and other tribal groups carried with them their own characteristics and customs while incorporating and letting-go of ideas, technology, and people along the way. While artifacts, written accounts, and tribal stories provide the first clear evidence of ethnicity in the Basin, their routes and the area they occupied are not necessarily as clear a picture as some archaeologists and historians have proposed. What the evidence does suggest, aside from their individual migrations, is aspects of a Plains Indian lifeway that resembled life in Crow country in the early eighteen hundreds.

Crow tribal legends tell of a migration that began in the woodlands near Lake Superior and Lake Michigan. Severe droughts, along with reports of sufficient game, are believed to have initiated a move westward. The journey west led them to the Sacred

³ Robert Campbell gives a short narrative of his time during the fur trade, in Drew Alan Holloway, ed., *A Narrative of Colonel Robert Campbell's Experiences in the Rocky Mountain Fur Trade From 1825 to 1835* (Fairfield, 1991), 17-47. For more on Campbell's life in the west, also see, William R. Nester, *From Mountain Man to Millionaire: The "Bold and Dashing Life" of Robert Campbell* (Columbia, 1999), 13-109. For Bonneville's summer in Crow country, see Irving's *Adventures of Captain Bonneville*, 76-128; and James R. Wolf, "Bonneville's Foray: Exploring the Wind Rivers in 1833," *Annals of Wyoming* 63(3), Summer 1991, 93-104.

Waters, the Devils Lake area in northeast North Dakota. It was while living along the shores of the Sacred Waters that two chiefs fasted and received spiritual guidance. Red Scout was given an ear of corn and told to plant the seeds for their sustenance. No Vitals was given a pod of sacred seeds and told to go west and plant them in the high mountains. Along with receiving seeds, No Vitals was told that someday the proper way to use the seeds would be revealed to his people, they would increase in numbers, become powerful and rich, and live in a beautiful land.⁴

From the Devils Lake area the tribe continued on a westward path. They lived for a time with the Mandan along the Missouri River and then with the Hidatsa further upstream, with whom they share a similar Siouan language. Holding onto his visions, No Vitals and those willing to follow him, left their hunting and horticultural life along the Missouri to pursue a nomadic lifeway. To find their promised land they headed first in a northwesterly direction, most likely to the area north of the Milk River in southern Alberta. From there the tribe traveled south, and settled for a time along the Great Salt Lake. When conditions along the lake proved unfavorable, they journeyed east over the Rocky Mountains, getting perhaps as far as Oklahoma. The land east of the mountains was also not suitable, so once again the tribe switched directions and came north and west, possibly by way of the Platte River to find their promised land in the heart of the Yellowstone River Basin.⁵

⁴ Joseph Medicine Crow, *From the Heart of Crow Country: The Crow Indians' Own Stories* (New York, 1992), 16-19.

⁵ *Ibid.*, 20-24.

When the descendants of No Vitals and his followers were finally able to plant the sacred pod of seeds, they solidified themselves as a tribe. The feasibility of such a long pedestrian migration over a relatively short period of time, tribal historians say around 100 years, remains debatable. A more seasoned explanation, which often includes the Hagen site as evidence (see Chapter 1), suggests the Crow migration followed a more direct path to the Basin. Separation from the Hidatsa and the move west was initiated by a squabble over the sharing of some meat. It has also been hypothesized that the movement west occurred in two separate waves, with the tribe developing into bands known as the Mountain and River Crow. Whichever route the Crow took, their migration story, whether real or symbolic, nonetheless demonstrates how one group of pedestrian hunters-gatherers traveled over a vast and varied landscape while developing their own unique cultural characteristics. For the Crow, their migration journey is dramatized through a ceremony known as the Tobacco Society.⁶

On one level, the Tobacco Society ceremony is a process of bringing someone into the Crow tribe, an adoption. On another level, the ceremony is a reenactment of the tribe's historical origins, an actual experience, which all tribal members share as a common bond. Seeing themselves as orphans seeking to solidify their homeland by planting sacred seeds, reflects not only their horticultural past but a means to hold together their genetic survival as a tribe. Weaving together their history along with strongly held tribal values, the pageant instructs and promotes the continuation of life and fertility of the Crow

⁶ Peter Nabokov offers a thorough overview of the various ideas on the Crow migration, in *Cultivating Themselves: The Inter-play of Crow Indian Religion and History*, Ph.D. dissertation, University of California at Berkeley, 1988, 81-86.

people. Solidifying their cultural base of existence also supports the Crow's territorial claims to much of the Yellowstone River Basin. The Crow country story told to Robert Campbell during the winter of 1828-29, was simply another way for the Crow to reveal aspects of their historical origins, while proclaiming their territorial rights to live in the Basin.⁷

The Crow were clearly not the first tribal group to call the Basin their home, as ten thousand years of known human use reveals. Nor would they be the last. Their migration into the Basin, whether it occurred as their migration story reveals or a more gradual adaptation to a nomadic lifeway, cannot be clearly corroborated by archaeological findings. Ceramic artifacts, for example, found at excavation sites on both sides of the Bighorn Mountains in Wyoming, have been proposed as Crow. They may represent, however, a completely different ethnic group who adapted a Missouri River style of pottery or had individual Missouri River potters living among them. There are, nonetheless, a few historical accounts, tribal stories, linguistic evidence, and archaeological findings from within and adjacent to the Basin to cautiously propose ancestral links to known tribal groups such as the Crow.⁸

Around the time that No Vitals was leading his followers west, a Numic speaking language group had migrated north from the Great Basin to occupy portions of eastern

⁷ The complexity of the Tobacco Society and its relationship with the Crow migration, history, and culture is extensively developed and discussed in Peter Nabokov's Ph. D. dissertation, *Cultivating Themselves*.

⁸ George Frison, "Crow Pottery in Northern Wyoming," *Plains Anthropologist* 21(71), February 1976, 29-44. Discussing the difficulty of linking archaeological sites to ethnic groups such as the Crow, see Ann M. Johnson, "The Problem of Crow Pottery," *Archaeology in Montana* 20(3), September-December 1979, 17-29.

Idaho and western Wyoming. Their Numic roots suggest that they originated in southeastern California, and formed the middle or central branch of Numic distribution referred to as Shoshonean. Their migration into the central and northern areas of the Great Basin replaced a mostly sedentary and horticulturally based group of people called the Fremont Culture.⁹

Fremont people lived in scattered farmsteads and small villages, constructed substantial pit house style dwellings and storage units, raised a drought-resistant strain of corn for a short growing season, made pottery, coiled baskets, and developed a unique artistic tradition through their rock art and clay figurines. Nine hundred years of Fremont adaption throughout the eastern Great Basin, however, disappeared during the late thirteenth and early fourteenth century, with remnant groups in northern Idaho perhaps surviving into the middle of the sixteenth century. What ultimately caused their collapse and disappearance remains a mystery, although the timing corresponds with people abandoning areas of the Southwest and fortifications being built in the middle Missouri River region. Drier environmental conditions conceivably played a role, creating a more competitive situation for fewer resources. Whether or not this potential competition occurred when Numic people were moving through the landscape is not known. Nor is it clear if Fremont people were absorbed by various Numic groups or if they left the region

⁹ Current discourse about the Numic migration theory was initiated by S. M. Lamb, "Linguistic Prehistory in the Great Basin," *International Journal of American Linguistics* 24, 1958, 95-100. For a number of article that discuss the wide breath of Numic origin and expansion ideas, see David B. Madsen and David Rhode, eds., *Across the West: Human Population Movement and the Expansion of the Numa* (Salt Lake, 1994).

peacefully or by force.¹⁰

The Numic people who walked north from the Great Basin are generally thought to be the descendants of Shoshone Indians. Unlike the Crow, the Shoshone do not have a narrative for their migration. Instead, they have stories symbolic of their movement into new regions and the changes it created as people responded to different environmental and social conditions.¹¹ Numerous archaeological sites in Montana and Wyoming have been identified as Shoshone, with many pre-horse sites found in the Basin. Shoshonean intermountain ware pottery provides the connecting artifact at most sites, with the Myers-Hindman excavation near Livingston, Montana, representing the oldest at 750 years ago. Early dates such as Myers-Hindman and widespread distribution of sites throughout eastern Idaho, most of Wyoming, and parts of Montana, have led to the suggestion that the Shoshone were a dominant force throughout much of the northwestern plains for several centuries. To tell the Shoshone migration story and their occupation in the Basin through the use of archaeological evidence remains problematic, however. This is due to the inability to truly know if such artifacts as flat-bottom (Intermountain ware) pottery, tri-notched projectile points, carved steatite vessels, knives, rock art, and various styles of

¹⁰ For an overview on the Fremont Culture, see John P. Marwitt, "Fremont Cultures," in: *Handbook of North American Indians, Volume 11 - Great Basin*, Warren L. D'Azevedo, ed. (Washington, 1986), 98-106. On the longevity of the Fremont culture in southern Idaho, see B. Robert Butler, *When Did the Shoshoni Begin to Occupy Southern Idaho?: Essays on Late Prehistoric Cultural Remains from the Upper Snake and Salmon River Country*, Occasional Papers of the Idaho Museum of Natural History, No. 32 (Pocatello, 1981), 14-18.

¹¹ Anthropologist Robert H. Lowie makes this point of a lack of a migration legend in, *The Northern Shoshone*, Anthropological Papers of the American Museum of Natural History, Vol. II, Part II (New York, 1909), 233. Toward an understanding of how to interpret a migration through Shoshone stories, see Gary A. Wright and Jane D. Dirks, "Myth as Environmental Message," *Ethnos* 48(3-4), 1983, 160-176; and Mark Q. Sutton, "The Numic Expansion in Great Basin Oral Tradition," *Journal of California and Great Basin Anthropology* 15(1), 1993, 111-128.

structures are Shoshonean or an adoption of a particular aspect of Shoshone material culture by a different group of people.¹²

Aside from the difficulty of interpreting ethnicity from artifacts, the picture of a widespread Shoshonean occupation has additional complications. The Comanche, known as a southern Plains tribe, are linked linguistically to the Shoshonean branch of the Numic language. Following known linguistic boundaries between the central Shoshonean and southern Ute Numic speakers, the route taken by ancestral Comanche most likely took them through Wyoming. Several archaeological sites, such as Firehole Basin, Big Goose Creek, Vore, and T-W Diamond, have uncovered Shoshonean associated artifacts that radiocarbon date to before the arrival of the horse in the region. Bands that lived along the eastern edges of Shoshonean expansion in Wyoming and northeastern Colorado may represent these ancestral groups of Comanche.

It is not known when the Comanche identified themselves as different from their Shoshonean relatives. Like the Shoshone, the Comanche lack a migration story. Tribal mythology does allude to a time long ago when the people were hungry and access to bison was denied them. Once this barrier was removed and bison were liberated, the Comanche were able to begin the process of establishing their own distinct traditions. Movement by the Comanche to the plains was perhaps encouraged by another tribal group

¹² On the difficulties of distinguishing Shoshone artifacts from archaeological sites in the Yellowstone River Basin, see Mary Lou Larson and Marcel Kornfeld, "Betwixt and between the Basin and the Plains: The Limits of Numic Expansion," in: *Across the West*, Madsen and Rhode, 200-210; and Frison, *Prehistoric Hunters*, 116-122. The idea of a dominant Shoshonean occupation is discussed in, George E. Hyde, *Indians of the High Plains: From the Prehistoric Periods to the Coming of Europeans* (Norman, 1959), 117-145; and Colin C. Calloway, "Snake Frontiers: The Eastern Shoshones in the Eighteenth Century," *Annals of Wyoming* 63(3), Summer 1991, 83-92.

moving away from the region, thereby providing the Comanche with access to bison herds that were once denied them. Access to bison may have also been acquired through the use of force. By 1706, most Comanche bands had transformed themselves into a nomadic horse culture, with various groups interacting, trading, and raiding within the Spanish sphere of economic influence in the southwest.¹³

One possible component that assisted the Comanche in gaining access to the plains revolves around weather. Beginning in the 1500s, global weather patterns appear to have shifted toward a cooler and possibly moister environment. This shift, generally referred to as the Little Ice Age, caused glaciers to advance and devastated agricultural productivity throughout much of Europe. Some Rocky Mountain glaciers as well experienced some levels of advancement. In the Basin, it appears that vegetative conditions were possibly favorable for bison, conceivably allowing for numbers to increase, but not necessarily exponentially. Bison or any wildlife population can only grow if the number of annual births outpaces the rate of deaths. If such a population increase occurred, Comanche bands may have found it possible to make the full transition to a plains economy.¹⁴

The movements of the Kiowa also further complicate the picture. Their tribal

¹³ Morris W. Foster offers a discussion on when the Comanche may have split from their Shoshonean roots, in *Being Comanche: A Social History of an American Indian Community* (Tucson, 1991), 31-35. On the archaeological aspects, see Larson and Kornfield, "Betwixt and between," 207. For stories regarding the liberation of bison, see H. H. St. Clair, "Shoshone and Comanche Tales," *Journal of American Folk-Lore* 22(85), July-September 1909, 265-282; Herwanna Becker Barnard, *The Comanche and His Literature*, master's thesis, University of Oklahoma, 1941, 202-211; and Galen M. Buller, *Comanche Oral Narratives*, Ph. D. dissertation, University of Nebraska, 1977, 87-90. The year 1706 produced the first known Spanish document that refers to the Comanche.

¹⁴ On the global effects of the Little Ice Age, see Jean M. Grove, *The Little Ice Age* (New York, 1988). On the suggestion that there was a "bison boom" as a result of cooler temperatures on the northern Great Plains, see Flores, "The Great Contraction," 12-13. The potential effects the Little Ice Age may of had on vegetation, bison, and Indians is more fully discussed in Chapter 7.

history indicates they were unacquainted with the Crow when they left the region around the headwaters of the Missouri River. If the Crow had been well established in the Basin, trading networks, it would seem, would have delivered this knowledge to the Kiowa. This suggests that the Crow were recent arrivals themselves. A dispute over an antelope, severities of the climate, and the scarcity of game are all reasons given why the Kiowa left western Montana and their Salish speaking friends the Flathead Indians. This stage of their migration is thought to have begun around 1600.¹⁵

A curious question about the Kiowa, however, is where were they before arriving in western Montana? Their language is part of a Kiowa-Tanoan family, with Tanoan generally associated with Anasazi traditions in the southwest. Splitting away and heading north, ancestral Kiowa may have formed a part of the Fremont Culture, or perhaps they maintained their hunter-gatherer lifeway as they continued on a northerly migration in front of Numic groups. It is conceivable that the ancestral Kiowa may have adopted aspects of Shoshonean culture or even absorbed individuals from various Shoshone bands. If that were true, and the Kiowa were in the headwaters of the Missouri River before the Shoshone, then sites such as the Myers-Hindman may represent a Kiowa occupation and not Shoshonean.¹⁶

For the ancestral Kiowa, as well as the Shoshone/Comanche and Crow, one important cultural formation that may have played a strong role in their migration

¹⁵ James Mooney, *Calendar History of the Kiowa Indians* (Washington, 1979), 152-156. This is a reprint from the Seventeenth Annual Report of the Bureau of American Ethnology, 1895-1896. Mooney also suggest that occasional quarrels emerged between the two tribes. Perhaps the quarrel over the antelope was with the Flathead.

¹⁶ *Ibid.*, 153; Foster, "Language and the Culture History," 95-96.

decisions was conflict. As human populations increased in the Basin, access to resources may have become more competitive. Comanche stories seem to make this suggestion as they were denied access to bison. Small and large-scale acts of conflict, including mutilation, scalping, and torture, have occurred for at least a thousand years on the northern plains as evident by the Bairoil and Crow Creek sites. Such violence, some archaeologists argue, was not simply opportunistic inventions used by a particular group, but rather an identifiable, persistent, and complex cultural tradition. Part of the strategies for the Crow, Kiowa, and Shoshone/Comanche to gain new territory and possibly access to herds of bison may have involved conflict.¹⁷

Not all interactions between the various tribal groups was violent. The relationship between the Crow and Kiowa apparently materialized into a lasting friendship. Kiowa traditions also suggest they developed a strong bond of friendship among the Missouri River Mandan, Hidatsa, and especially the Arikara. Being related, it seems logical that the Crow maintained a close relationship with the Hidatsa and most likely the Mandan. Occasional quarrels "more or less serious" were suggested as part of the Kiowa's relationship with the Shoshone and Flathead, yet friendship appears to have mostly prevailed.¹⁸ What kind of relationship the Crow established with the Shoshone/Comanche is not clear. Yet quarrels and violence occurred in and adjacent to

¹⁷ On the evidence of Plains Indian warfare, see Douglas H. Ubelaker, "An Overview of Great Plains Human Skeletal Biology," in: *Skeletal Biology in the Great Plains: Migration, Warfare, Health, and Subsistence*, Douglas W. Owsley and Richard L. Jantz, eds. (Washington, 1994), 391-395; Sheridan, et al., "Case of Late Prehistoric Mutilation," 289-298; and Bamforth, "Indigenous People, Indigenous Violence," 102-108.

¹⁸ Mooney, *Calendar History*, 160.

the Basin prior to the arrival of the horse.

About one-third of the known human burials found in Wyoming and Montana contain projectile points found within the individuals body cavity, embedded in bone, or in the grave site. Both males and females contained arrow points within their bodies. Perhaps the most revealing act of conflict comes from the Robber's Gulch site. Located in south central Wyoming, an adult and two juveniles were unearthed in an arroyo, with the adult thrown faced down. The mid-thirty year-old male had been shot with fourteen arrows, two from the front and twelve into his back.¹⁹

Shedding additional light onto the characteristics of pre-horse conflict comes from the only known account of pedestrian battles. It was told to the explorer and trader David Thompson by a Cree Indian named Saukamappee (Young Man), and pitted the Snake Indians against the Algonquin speaking Piegan in western Saskatchewan.²⁰ Saukamappee participated in the fight and had lived among the Piegan since a young man. Thompson stayed in his tipi along the Bow River while visiting the Piegan in the winter of 1787-88 while employed by the Hudson Bay Company. His host, then 75 to 80 years old, recounted for Thompson that the Piegan were always the leading tribe in their expansion south. As a result of this expansion the attacks by the Snake Indians had become "very numerous." Because of the attacks, the Piegan would come to the Cree for help. For this particular fight, Saukamappee recalled that about 350 Piegan, Cree, and allied warriors

¹⁹ Laura L. Scheiber and George W. Gill, "Bioarcheology in the Northwestern Plain," in: *Archeological and Bioarcheological*, Frison and Mainfort, eds., 105-106; Frison, *Prehistoric Hunters*, 433-434, 443-445.

²⁰ The Piegan, Blackfoot, and Blood are often referred to as a whole as the Blackfeet or Siksika.

came together to fight the Snakes. Both sides made a "great show of their numbers," in which he felt his side was outnumbered. After the Snakes displayed the size of their force, along with more singing and dancing,

they sat down on the ground, and placed their large shields before them, which covered them: We did the same, but our shields were not so many, and some of our shields had to shelter two men. Theirs were all placed touching each other; their Bows were not so long as ours, but of better wood, and the back covered with the sinews of the Bisons which made them very elastic, and their arrows went a long way and whizzed about us as balls do from guns. They were all headed with a sharp, smooth, black stone which broke when it struck anything. Our iron headed arrows did not go through their shields, but stuck in them; On both sides several were wounded, but none lay on the ground; and night put an end to the battle, without a scalp being taken on either side, and in those days such was the result, unless one party was more numerous than the other. The great mischief of war then, was as now, by attacking and destroying small camps of ten to thirty tents, which are obliged to separate for hunting.²¹

This engagement between the Snakes and the Piegan occurred around 1730. The picture of warriors hiding behind their shields draws a striking resemblance of characters that have been carved and painted on rocks throughout Basin for more than 700 years. Fighting enemies with the use of large protective shields, however, was soon to become obsolete. The Cree, for example, had already acquired a few guns through trade with the Hudson Bay Company when Saukamappee walked off to fight the Snakes. With powder and shot in short supply, these weapons were left behind, being seen as more valuable for hunting game. Within a few years the Snakes had obtained a few horses, and used them to charge through Piegan lines wielding death blows with stone clubs. Although the use of horses and guns was about to change the character of warfare, Saukamappee participated

²¹ J. B. Tyrrell, ed., *David Thompson's Narrative of His Explorations in Western America, 1784-1812* (Toronto, 1916), 326-330.

in one more battle using large shields. This time, with help from the Cree and their allies the Assiniboine, along with their 10 flintlock muskets, the Piegan routed the Snakes.²²

Throughout Saukamappee's account, which continued into the 1780s, the Snakes and "their allies" were the people the Piegan were fighting, and they were clearly the aggressor. Yet who were these "Snakes?" The name was generally applied to various groupings of Shoshonean people, such as the Northern and Eastern Shoshone, Bannock, and Paiute. It has also been used to identify the Ute, Nez Perce, Kiowa, Comanche, Flathead, and other Salish speaking groups. In addition, the name Snake has been used to simply indicate an enemy. Different Shoshonean groups, however, were also known as Grass Lodges, presumably based on the material used for constructing dwellings prior to their adoption of the tipi. Through the use of sign language, the moving of hands to indicate the weaving of a grass lodge may have been interpreted as a snake.²³

Taking Saukamappee's tale at face value, Shoshonean occupation north of the Basin was extensive, and their expansion was perhaps based on warfare. The interpretation of an aggressive pre-horse Shoshonean occupation throughout the northwestern plains rests strongly on Thompson's account and its reference to the Snakes. There is currently, however, little archaeological evidence to support an extensive Shoshonean occupation this far north. The artifacts of Siouan speaking people found in

²² Ibid., 330-334.

²³ The Kiowa are known to have referred to the Shoshone as Grass Lodges, perhaps suggesting they interacted and knew the Shoshone before they moved onto the plains and adapted to tipis. Mooney, *Calendar History*, 160. For a discussion of the name Snake, see David D. Fowler, *Cultural Ecology and Culture History of the Eastern Shoshoni Indians*, Ph. D. dissertation, University of Pittsburgh, 1965, 46-50; Calloway, "Snake Frontiers," 84; and Virginia C. Trenholm and Maurine Carley, *The Shoshonis: Sentinels of the Rockies* (Norman, 1964), 3-4.

southern Alberta tends to corroborate these findings, further complicating the picture of tribal migration on the northwestern plains.²⁴

East of Calgary and along the Bow River at a place called Blackfoot Crossing, archaeologists have uncovered an earth lodge village with fortified trenches, palisade walls, tools, and numerous pieces of pottery typical of a Middle Missouri River settlement. Known as the Cluny site, the village was constructed at a strategic location next to a historic river crossing and meeting place. Use of an earth lodge village are generally associated with Siouan speaking people related to the Hidatsa or Mandan. By the number of artifacts recovered, the lifespan of the village appears short lived, and dates to around the time when Saukamappee joined his Piegan allies to fight the Snakes. Outside of the artifacts recovered, very little is known about the site. Its location poses several intriguing questions, however. Could this have been a settlement built by ancestral Crow, who may have lived in the area as their migration story suggests? What was the relationship between the builders of the Cluny site and the Snake Indians, especially with the village being located farther south than on the battlefields in which Saukamappee fought? Could the Snakes that Saukamappee fought be these Siouan people, or a combination of different

²⁴ In support of conflict as a means for Shoshonean expansion, see Mark Q. Sutton, "Warfare and Expansion: An Ethnohistoric Perspective on the Numic Spread," *Journal of California and Great Basin Anthropology* 8(1), 1986, 65-82. Writing-On-Stone rock art site in southern Alberta with its shield-bearing warrior motif has been argued by archaeologist James D. Keyser to have originated from the Great Basin and thereby created by Shoshonean people. Keyser's argument supports a Shoshone occupation this far north. See, "A Shoshonean Origin for the Plains Shield Bearing Warrior Motif," *Plains Anthropologist* 20(69), August 1975, 207-215; and "Writing-On-Stone: Rock Art on the Northwestern Plains," *Canadian Journal of Archaeology* 1, 1977, 15-80. Suggesting that the Shoshone may have had a limited role at best in creating the rock art in southern Alberta and elsewhere on the northwestern Plains, are Martin P. R. Magne and Michael A. Klassen, "A Multivariate Study of Rock Art Anthropomorphs at Writing-On-Stone, Southern Alberta," *American Antiquity* 56(3), July 1991, 389-418. For a discussion on the rock art at Writing-On-Stone, see P. S. Barry, *Mystical Themes in Milk River Rock Art* (Edmonton, 1991).

ethnic groups that included the Snakes, as the Piegan forces included the Cree and additional allies?²⁵

David Thompson's narrative remains one important piece in a complicated weaving of history, archaeology, oral tradition, linguistics, and conjectural ideas about how tribal groups migrated in and around the Basin. Thompson's narrative also provides a sense of where known tribal groups were located just prior to the arrival of the horse, along with an early account of the culture of Plains Indian life. Such a peek into the past illuminates cultural aspects that were potentially in place during the Old Women's period of occupation and possibly earlier, and how these characteristics may or may not have changed once the horse arrived on the northwestern plains.

In his winter conversations with Saukamaptee, Thompson recounted a number of cultural characteristics that surrounded conflict. When the animosity between the Snakes and the Piegan is not known. Even at an early age it appears that Saukamaptee despised the Snakes. Ingrained into his seventy-five plus years, and mostly likely into all of the Piegan and their relatives, was the feeling that the Snakes were simply "bad people." Killing an enemy received high praise, as did taking a scalp or some other part of the dead warrior's weapons, clothes, and body. Singing, music, and dancing greeted successful warriors, as battle stories were shared and retold. Saukamaptee was even encouraged by his Cree wife to go and fight. She said "that her father's medicine bag

²⁵ Richard G. Forbis, *Cluny: An Ancient Fortified Village in Alberta*, University of Calgary Department of Archaeology Occasional Paper No. 4 (Calgary, 1977), 1-17; and Vickers, "Cultures of the Northwestern Plains," 24-26. For a larger discussion on ceramic in southern Alberta and possible ethnic connections, see William J. Byrne, *The Archaeology and Prehistory of Southern Alberta as Reflected by Ceramics*, Archaeological Survey of Canada Paper No. 14 (Ottawa, 1973), 531-554.

would be honored by the scalp of a Snake.” Hatred and the many ensuing cultural aspects of warfare, such as a war tent, war chiefs, obtaining power and status, possessing the soul of a dead enemy by taking their scalp, and revenge killing were powerful forces that were probably not exclusive traits of the Piegan or Cree, but more of a cultural reality for tribes on the northwestern plains that had a long history of use.²⁶

If Thompson interpreted Saukamapsee hand signals accurately, there were 350 Piegan and at least that many Snake warriors. The ability of war chiefs to enlist hundreds of fighting men indicates a well organized and established tradition that viewed conflict as culturally and socially important. When the sixteen year-old Saukamapsee arrived at the Piegan camp with his father and 18 other Cree warriors for his first fight against the Snakes, they joined a force that consisted of other “allies.” Most likely these additional warriors were the Piegan’s Blackfoot and Blood relatives, and men from other tribes such as the Cree. Understanding the cultural importance of alliances, the social rewards of being a warrior, methods of fighting, and the numerous pitfalls that were part of warfare, the Cree and others could choose to participate knowing their role and place within Piegan culture, tradition, and society. Preparations for this battle alone may have taken many days or more likely weeks.²⁷

On the other side of the line, the Snakes and their allies probably possessed a similar organizational ability, since they may have outnumbered the Piegan forces. Thompson described the Kootenai, Flathead, and “their allies the Snake Indians” as being

²⁶ Tyrrell, *Thompson's Narrative*, 330-334.

²⁷ *Ibid.*, 328-329.

"in full possession" of the plains east of the Rocky Mountains in Alberta and northern Montana prior to the Piegan, Blackfoot, and Blood expansion south.²⁸ A legend tells of a people known by the name of Tunaxa, who were related to the Kootenai and once lived east of the mountains as Plains Indians. Flathead migration stories indicate a cultural link to the Pacific Northwest, as they represent the most eastern advance of Salish-speaking people. An alliance between the Kootenai, Flathead, and Shoshone, which may have included Siouan warriors as well, may have been the Snakes who fought against Saukamaptee and his Piegan allies. To Saukamaptee the Snakes were clearly the enemy and the aggressor. It may have been that the Kootenai, Shoshone, Flathead, or Siouan groups were simply trying to defend their territories from the expansion minded Piegan.²⁹

Conflict may have also affected the size of a band. By the early 1700s they appear to have gotten larger. A small band might have included 70 or more people. To outnumber your opponent was clearly an advantage, particularly in surprise attacks and hand-to-hand combat. A need to respond to these concerns may have forced some bands to increase in size for defensive reasons. Larger bands also tend to create more concentrated pressure on resources. The hunting of bison in particular areas may have diminished overall numbers to the point that larger or new territory was required.

²⁸ Ibid., 327-328.

²⁹ On the Tonaxa legend, see James A. Teit, "Traditions and Information Regarding the Tonaxa," *American Anthropologist* 32, 1930, 625-632; Harry Holbert Turney-High, *Ethnography of the Kutenai*, Memoirs of the American Anthropological Association, No. 56 (Menasha, 1941), 18-19; and Bill B. Brunton, "Kootenai," in: *Handbook of North American Indians: Volume 12 - Plateau*, Deward E. Walker, Jr., ed. (Washington, 1998), 223-237. On the Flathead migration, see Harry Holbert Turney-High, *The Flathead Indians of Montana*, Memoirs of the American Anthropological Association No. 48 (Menasha, 1937), 11-13.

Increasing the range needed to hunt game and gather plants could force one band into the range of another, creating a higher degree of competition for available resources. This would have been especially true if overall northwestern Plains human populations were increasing. One tribal group moving into an area consuming resources typically used by resident bands would not be appreciated. The fights between the Snakes (whoever they were) and Piegan may have reflected such a situation.³⁰

Although the competition for resources leading to some level of conflict in the Basin is suggestive, it remains inconclusive. This appears true as well for competition over the control of trading networks, with European manufactured goods being exchanged adjacent to the Basin by 1700. The Cree, for example, were in possession of guns and metal arrowheads, and southern bands of Comanche and Shoshone were moving horses and other Spanish goods north.³¹

The process and importance of exchange (including the ability of individuals to move among different bands) that has occurred for hundreds of years on the northwestern plains, also comes to life with real people in Thompson's narrative. Saukamappee's Cree wife left him while he was away fighting the Snakes to live with another husband and band. Upset and "disheartened" upon hearing this news when he returned, he was counseled by friends who said that she was "a worthless woman," and it was "beneath a warrior" to hold such anger. They continued, as a friend might say today, "there is no

³⁰ Saukamappee alludes to a small band might contain as few as 10 lodges, and that "small camps ... are obliged to separate for hunting." Tyrrell, *David Thompson's Narrative*, 330.

³¹ It remains inconclusive how European diseases affected Plains Indians prior to the 1700s. For more on how European diseases affected Indian peoples, see Ann F. Ramenofsky, *Vectors of Death: The Archaeology of European Contact* (Albuquerque, 1987).

want of women ... and a better wife could be got." As in all relationships there are two sides. Others told Saukamappee that it was his fault his wife left because he was away too long. In the end Saukamappee renounced his people and left to join the Piegan band he fought with. Warmly welcomed by the Piegan chief, and in remembrance of his deeds on the battle field, the chief presented to Saukamappee his oldest daughter to be his new wife.³²

Thompson's narrative offers glimpses into the characteristics of Plains Indian life around the early 1700s. These characteristics and traditions that Thompson reveals probably had a long history of use on the northwestern plains that may go back for hundreds if not thousands of years. Corroborating at least one characteristic of Plains Indian life that Thompson learned from Saukamappee, is a Hidatsa battle account that included the use of shields. This Hidatsa story, however, is based on legend. The tale comes from the grizzly bear ceremony, and tells of a vision received by Crow Bull from the Grizzly Bear informing him that he was about to meet the enemy near Sentinel Butte in western North Dakota, and that none of his men would be killed in this battle.

He went to the place where he was instructed to go and sent out scouts to look around. The scouts returned to tell him that they saw the enemies coming. They waited for the enemies until they were nearer. When the enemies saw them, they climbed one of the high buttes. The men with shields were told to go ahead and all the others would follow closely behind them in a compact group. Each man, using his bow and arrows, was supported by a shield carrier who walked in front to deflect the arrows with his shield, thus protecting the man in back of him. In this way the shields protected them and in a short time they had killed all 30 enemies. At that time there were a few horses but no guns. These people were the Snake Indians so after the battle the people named the butte Snake Indian Butte.

³² Tyrrell, *Thompson's Narrative*, 334-335.

If not based on a real account, this Hidatsa legend was probably based on an informed portrayal of fighting methods that were used about the time horses were being introduced into the Basin. It also suggests that the Snake Indians roamed as far east as the Dakotas.³³

Forming alliances between kinship groups and other tribes conceivably played a vital role in the decisions of the Hidatsa, Crow, Shoshone, Comanche, Piegan, Kootenay, Flathead, and Kiowa. Competing for territory and resources appears to have been factors in the lifeways of northwestern Plains Indians leading up to the arrival of the horse. These factors pose a curious question as to how the Crow completed their migration following the route indicated by their migration story. Their movement south from Alberta to the Great Salt Lake and over the Rocky Mountains to reach the central plains and back into Wyoming and Montana took them through land already occupied by various people almost every step of the way.

Were Shoshonean groups warlike in their expansion into the Yellowstone River Basin? Perhaps. Certainly David Thompson's narrative indicates that conflict was occurring among various tribes and with a cultural tradition well established. Considering that little archaeological evidence supports the use of warfare in the Great Basin, the Shoshone may have embraced the use of conflict as part of a Plains Indian tradition. The use of shields, as depicted in rock art, further suggests that some level of conflict had a

³³ Alfred W. Bowers, *Hidatsa Social and Ceremonial Organization* (Lincoln, 1992), 351. The legend does not indicate how large these shields were, although they appear to have been big enough to protect the shield carrier and the men shooting the arrows since no Hidatsa was killed. In 1742, while trying to develop trading networks with Indians along the Missouri, the Verendrye's explored areas east of the Black Hills and cite the Snakes as being in that region and attacking other tribes. See Lawrence J. Burpee, ed., *Journals and Letters of Pierre Gaultier De Varennes De La Verendrye and His Sons* (Toronto, 1927), 411-421.

long history of use in the Basin. Did the Crow have to fight various Shoshonean groups in order to establish themselves? Perhaps. Yet there is no evidence to clearly indicate any pre-horse violence between the Crow and Shoshone. It may mean that Shoshonean expansion did not include most of the Basin, and that archaeological sites containing Shoshonean-associated artifacts represent other people. A seasonal or limited occupation may explain why the Shoshone lack bison and other Plains Indian type stories within their mythology. Maybe, since the number of warriors was an important component for a successful fight, an alliance between the Crow and Kiowa put pressure on the Shoshone to force them to leave, or prevented them from advancing into areas of the Basin.³⁴

Interpreting the ancestral movement of Plains Indians on the northwestern plains prior to 1700 is difficult and at times simply conjectural. It is questionable whether a Cree camp or kill site can be distinguished from a Piegan, a Comanche from a Shoshone, or even a Shoshone from a Crow. Like any aspect of pre-horse life in the Basin, such issues remain open to reinterpretation as new evidence becomes known. What can be comfortably interpreted prior to the arrival of the horse on the northwestern plains is that the central portion of the Yellowstone River Basin slowly became the territory of the Crow. Using the eastern edges of the Basin and probably connected to the Crow through trading networks, Missouri River tribes at least occasionally hunted for bison and other game to augment their horticultural lifeway. As friends with the Crow, bands of Kiowa lived on the southeast flanks of the Basin and into the Black Hills of South Dakota.

³⁴ On a lack of bison and prairie stories in their mythology, see Lowie, *Northern Shoshone*, 233-236.

Bands of Numic speaking Comanche/Shoshone probably remained scattered in southern Wyoming and possibly in the Black Hills, with some bands continuing south to become the Comanche, while others remained connected to Shoshone groups to the west. The cultural link between the Comanche and Shoshone appears to have provided a connection that brought horses to the northwestern plains. Throughout the Green River Valley, eastern Idaho, the mountains around Yellowstone National Park, southwestern Montana, and perhaps as far north as southern Alberta, various Shoshone bands occupied a wide geographical area. Toward the northwest, Piegan, Blood, and Blackfoot groups were expanding south toward Montana, with the Kootenai and Flathead living along both fronts of the continental divide. Directly north of the Basin, it may have been that Siouan groups occupied this region, possibly developing into River Crow. The Gros Ventre moving south toward the Milk River and the Assiniboiné migrating toward the Basin from the northeast, may have applied some pressure on these Siouan groups.³⁵

What each of these tribes shared in common was an ability to adapt to numerous changes, whether environmental, cultural, or physical, carrying on 12,000 years of known pre-horse human history. Throughout the Basin and northwestern plains, the process of exchange by countless numbers of people created a unique pre-horse Plains Indian Culture, as well as unique individual tribal traditions. Certainly the one aspect of cumulative knowledge that nearly all people living in the Basin shared was an understanding of how natural landscape worked, and especially the relationship with

³⁵ Clark Wissler proposed a similar location for the Kiowa, Comanche, and Shoshone in 1912, although with few details. See, *Indians of the United States* (Garden City, 1966), revised edition, 226-227.

perhaps the landscape's most valuable resource: Bison.

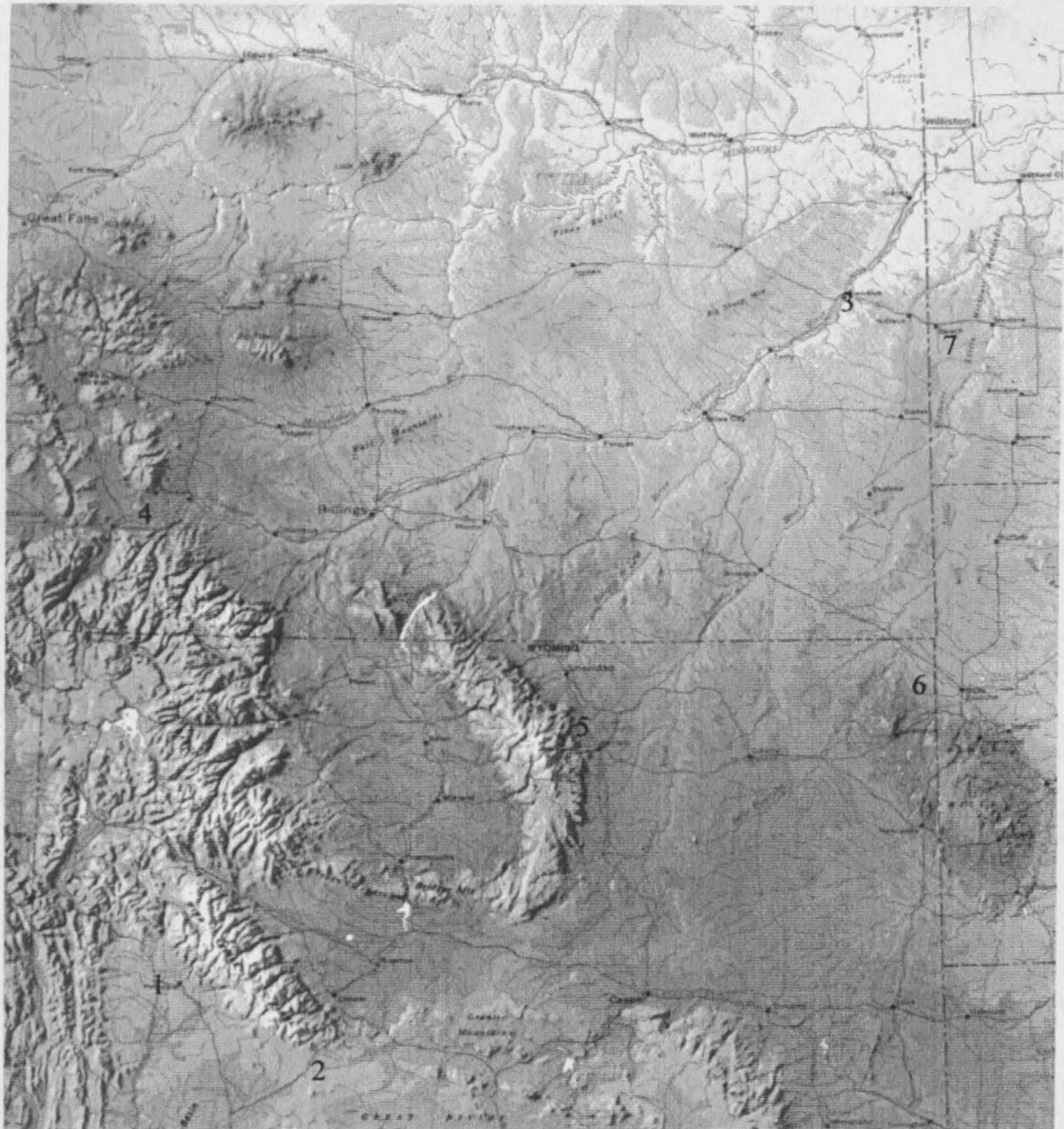


Figure 8. Approximate location of archaeological and historical sites discussed in Chapter 6.

- | | |
|--------------------|------------------|
| 1. 1832 Rendezvous | 2. South Pass |
| 3. Hagen | 4. Myers-Hindman |
| 5. Big Goose Creek | 6. Vore |
| 7. Sentinel Butte | |

CHAPTER 7

THE BASIN'S ECOLOGY



By morning the temperature was already quite warm, promising to bake the ground for yet another day. Grasses throughout the area were turning to a golden hue in response to the arrival of dry summer weather, except in those moister places in the coulees and along the river. Spring and early summer rains were plentiful, however, as they had been for many years, so the grasses were once again more than adequate to supply the needs of the grazing animals. As warm as the day was becoming, the small camp that was situated on a terrace overlooking a coulee and near the Great River was busy with activity. Late last night, right before the sun went down, the hunters returned with fresh buffalo meat.

The herd was close by. Bellowing bulls could be heard day and night as the mid-summer congregation of animals moved in a northeasterly direction that mostly paralleled the Great River. By mid-morning much of the meat had already been processed into strips for drying and the two hides were being prepared for staking and scraping. With their stomachs full from a big meal, the hunters worked on their tool kits in the shade of the tipis and strategized for their next attack on the herd. They were thankful that the herds

had been plentiful for many years now, for they knew this was not always true. As their plan started to take shape, some of the hunters began to reminisce about past hunting adventures. There was even a story told about a time when the animals lived in fear for their own survival because the hunters were so skilled in catching many animals.

As the story goes, a long time ago, the great Buffalo Bull invited all the large animals over to his house. "A terrible misfortune has come over us large animals," he said, "for these hunting people are always pursuing us, even when we are asleep in our winter dens. I suggest we ask the Great Spirit, who made us all, to give us more cold and longer winters to keep these people in their own homes. All the large animals agreed, for they had felt the impact of these hunting people. Wolf said, "we should invite all the small animals too so we might increase our strength when we go to ask the Great Spirit." They all agreed.

On the following day all the animals, even the smallest of insects, assembled on the wide prairie near the Great River. Before the animals mighty Buffalo Bull rose. "Friends," he said, "we all know how the people hunt us on the prairie, in the valleys, on the hillsides, and in the forests. Therefore, my brothers the large animals have agreed to ask the Great Spirit to give us colder and longer winters so these people will have more difficulty in hunting us." To this all the large animals joined in to agree. Buffalo Bull then spoke to the small animals to ask them what they thought about this matter.

At first none of the small animals replied. Then, after a while, the silence was broken by Badger. He said, "your strategy is good for you. You have plenty of warm fur, but for some of us, especially the insects who have no fur at all, how will they stay warm?"

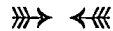
And if winters are colder and longer, how will we all obtain enough food? Therefore, do not ask the Great Spirit for more cold and a longer winter."

"Pay no attention to Badger's words," shouted Buffalo Bull to the large animals.

But Badger once more spoke up and this time full of rage. "If winters are colder and longer," he said, "will not the roots of berries and other edible plants freeze and wither away on the prairie? How will grasses get enough sunlight and warmth to grow? How will you larger animals get enough food, or will you all die from starvation with no spring and fall? But we smaller animals will survive better, for we can live on the bark and gum of trees and food found in the earth." Badger angrily sat down.

The large animals were speechless at Badger's words. Finally Buffalo Bull admitted that Badger was right, and all the other animals agreed. Seeing his wisdom the animals asked Badger to speak again. "In winter," he said, "we will have ice, snow, and cold winds. For those who wish to sleep through the winter, you can go into your dens. For others, be thankful that winter is not as long as up north, and that snow is not so deep to prevent you from finding grass to eat. In spring we will have rain, and the prairie will once again become green. During the summer we will have warm weather and lots of food to eat. And in the fall when the air begins to turn cool, we can continue to eat and put on fat while finding protected places to live for the long stretch of winter." All the animals agreed to Badger's seasonal cycle of life on the prairie. They were reconciled to the fate that they must share the land and of themselves with the hunting people. When the council was over, all the animals once again returned to their homes, content that

winter was not going to be colder and longer.¹



About three miles upstream from Terry, Montana, a small partly submerged and seasonally flowing stream known as Ash Coulee enters into the Yellowstone River. Heading up into the coulee approximately nine miles from its mouth, and on a low terrace just west of the coulee's bottom, a small camp was established by pre-horse people presumably in the latter part of the 1600s. The site, named after the coulee, was excavated in the 1940s. Of interest to archaeologists was the close resemblance of the artifacts to those found at the Hagen site about 40 miles downriver. Of particular interest was the discovery of a bison scapula fragment. A scapula was used as a hoe by Indian horticulturists, perhaps suggesting that crops were planted at the site and they were culturally linked to Missouri River tribes. Such similarities have led to the suggestion that Ash Coulee, like the Hagen site, represents the migration of the Crow into the Basin.²

As tantalizing as it is to try to ascribe a tribal affiliation to those people who established a camp at Ash Coulee, the evidence is conjectural at best. The artifacts do indicate the hunters made arrow points out of jasper, flint, chert, and obsidian. They used pottery, deer and elk scrapers, bison rib knife handles, awls, and bone beads. Evidence

¹ The story is adapted to a plains setting from a Tsimshian myth, a tribe of people from the Skeena River area of the central coastal region of British Columbia. The story, entitled "The Meeting of the Wild Animals," was collected by Franz Boas, *Tsimshian Mythology*, Bureau of American Ethnology Annual Report No. 31 (Washington, 1916). Reprinted by Johnson Reprint Corporation, New York, 1970, 106-108.

²William Mulloy, "The Ash Coulee Site," *American Antiquity* 19(1), July 1953, 73-75.

from the site does not indicate what time of year and for how long it was used. By its placement on a terrace the location seems to suggest a summer encampment. Working in the warm days of summer, these hunter-gatherers were following the seasonal cycle of life in the Basin as groups of Indian people had for thousands of years. Elk, deer, pronghorn antelope, bear, sheep, other smaller mammals, and wild plants continued to provide valuable resources. Bison, however, remained the most sought after animal resource in the Basin except in the more mountainous areas. Favorable weather and a stable forage base for bison and other animals were certainly helpful, as the story implies. Even more important than favorable environmental conditions for these "hunting people," was their deep knowledge of bison biology, behavior, and the animal's relationship to the Basin's environment.³

Maybe only a little more than one hundred years after people camped at Ash Coulee, 11 men, one woman, a small child, and 50 horses followed an "old buffalo road" to reach the top of a 6,000 foot ridge. What lay to the east for William Clark and his party while on top of what is now called Bozeman Pass, was blocked from view by a number of ridges, hills, and trees. Yet soon, as they followed the contours down along the well-used trail, they were presented with the expansive view of the Yellowstone River valley. They reached the river near the present site of Livingston, Montana, on the 15 of July 1806. Over the next 20 days Clark traveled down the Yellowstone, mostly by dugout canoe, to

³ Ibid, 73-75. The archaeological record strongly suggests that bison was the most sought after animal in the Basin. What is understood about bison ecology comes from nineteenth century accounts of explorers, trappers, and traders, and 20th century scientific data mostly from wildlife refuges. This information may not reflect with complete accuracy the ecology of bison before the arrival of the horse.

rendevous with the expedition's co-commander Meriwether Lewis along the Missouri River.⁴

William Clark and his party were not, however, the first non-Indians to travel in the Basin. Canadian explorer and trader Francois Larocque spent the previous summer traveling with the Crow from the Mandan villages along the Missouri in North Dakota to the Yellowstone, reaching the river at about Pryor Creek near Billings, Montana. Like Clark, Larocque wasted little time in proceeding overland down the Yellowstone Valley to the Missouri, reaching the confluence on the 30th of September after 17 days of often difficult traveling. Larocque also recorded his experiences in a journal, and it is from his and Clark's accounts that we get our first detailed written descriptions of life in the Yellowstone River Basin.⁵

Their landscape descriptions portray a vast and dynamic environment. Guiding his two strapped-together cottonwood canoes through the Yellowstone's swift current, Clark passed the occasional rapid, many small islands and gravel bars, a few towering limestone cliffs, numerous groves of cottonwood trees, and spacious areas of open grassland in the valley's generally broad flood plain. In his overland journey, Larocque observed that many of the Yellowstone's major tributaries displayed a similar topography, smaller in overall scale and with their own unique characteristics and features. From the number of river valleys they crossed or passed by, the two explorers could bear witness to a time

⁴ Reuben Gold Thwaites, ed., *Original Journals of the Lewis and Clark Expedition, 1804-1806* (New York, 1959), vol. V, 261-316. Four men took several days longer to reach the Missouri due to their unsuccessful attempt to take the horses overland.

⁵ The journal of Francois Larocque was edited by, L. J. Burpee, *The Journal of Larocque: From the Assiniboine to the Yellowstone, 1805* (Ottawa, 1910), 25-50.

when these rivers were even mightier and wider, with bench-like terraces connecting the river valleys with the prairie uplands. As Larocque learned while traveling with the Crow, the expansive sweep of prairie uplands was occasionally interrupted by a deep ravine, eroding badland, towering butte, pine forested ridge, or small isolated mountains.⁶

The two explorers also witnessed "immense" numbers of animals. In awe of such abundance, Clark noted near the mouth of the river that bears his name, the Clarks Fork of the Yellowstone, that "for me to mention or give an estimate of the different specie's of wild animals on this river particularly Buffalow, Elk Antelopes & Wolves would be incredible." Larocque echoed a similar thought with variations of his often used phrase of "Buffaloes and Elk we found in great plenty."⁷

Along with the many descriptions of various landscapes and large herds of animals, Clark and Larocque observed a number of other characteristics about life in the Basin. Each explorer made comments on the number of old Indian camps they saw along the Yellowstone River. They both noticed that the grasses had changed or were changing to a golden hue under the heat of the northern plains summer. There were several days for Larocque, when there was "no grass to feed horses," it having already been eaten by herds of bison. Bison were not the only herbivores eating grass, however. Below the mouth of the Stillwater River, Clark noted that "grasshoppers had distroyed every sprig of Grass for money miles on this side (north) of the river." "Fire," Larix exclaimed two days after

⁶ Burpee, *Journal of Larocque*, 44-50; Thwaites, *Journals of Lewis and Clark*, vol. V, 262-316; Alt and Hyndman, *Roadside Geology of Montana*, 357-386, 399-407; and Lageson and Spearing, *Roadside Geology of Wyoming*, 85-190.

⁷ Thwaites, *Journals of Lewis and Clark*, vol. V, 290, 294, 302, 316; Burpee, *Journal of Larocque*, 29-30, 47-50.

crossing the Powder River on his way back to the Mandan villages, "is in the plains from which the wind brought columns of thick smoke in abundance so that we could barely see." Stopping to allow a large herd of bison to cross the lower Yellowstone, Clark observed that a number of animals had drowned trying to swim across the river. Clark also wrote about the disagreeable bellowing of bison bulls during annual rut.⁸

The array of life and activities that Clark and Larix witnessed while quickly traveling down the valley in 1805 and 1806, was quite conceivably the same basic ecological community the small band at Ash Coulee knew even more intimately. This knowledge, as represented by the skill of the hunters in the beginning story, included an understanding of the relationships between climate, grasses, and animals of which Clark and Larix were probably completely unaware. Topography, precipitation, and temperature guided these relationships as it had for thousands of years. The image of Indian people sitting around a campfire talking about the weather in the same way we might today is intriguing.

How people at such sites as Ash Coulee may have explained climatic patterns and environmental conditions is really not known, but they probably retained stories or tales that expressed such time-based knowledge. To help tell the Basin's summertime climate story are the growth rings preserved in trees. Dendroclimatology research indicates that from the mid-1600s to about 1705 produced a steady period of normal to slightly wet conditions (Appendix B). With the Rocky Mountains intercepting most of the moisture

⁸ Thwaites, *Journals of Lewis and Clark*, vol. V, 269, 276, 289, 314, 324; Burpee, *Journal of Larocque*, 28-32, 49-50.

from the prevailing west winds, average precipitation for most of the Basin was limited to about 10 to 18 inches annually. Caught in the effects of a rainshadow, the Bighorn Basin and parts of the Wind River valley received even less moisture. Precipitation in higher-elevation foothill environments increased to around 20 inches annually. Most of the moisture in non-mountainous areas arrived as rain during the spring and early summer. Summers were generally dry and extremely warm, with mean July temperatures ranging more than 70° F. As summer land surface temperatures increased, heat rose and mixed with warm unstable air, resulting in a high percentage of thunderstorms with abundant lightning. These storms may have produced hundreds of lightning started wildfires each year, with the majority occurring in July and August.⁹

What resulted from warm summer temperatures baking a landscape that received little rainfall were water deficient soils. This was especially true for south-facing hillsides, as they absorbed more radiant heat than did north facing slopes. Depending on the location, slope, moisture content, and use, each soil type throughout the Basin had the ability to support certain vegetation. Although there are more than a hundred different

⁹ Tree ring data is from Edward R. Cook, David M. Meko, David W. Stahle, and Malcolm K. Cleaveland, *Reconstruction of Past Drought Across the Conterminous United States from a Network of Climatically Sensitive Tree-Ring Data*, National Oceanic and Atmospheric Administration's (NOAA) World Data Center for Paleoclimatology in Boulder, Colorado, and available from NOAA's web site at www.ngdc.noaa.gov/paleo. For how these authors developed and compiled this data, see "Drought Reconstructions for the Continental United States," *Journal of Climate* 12(4), April 1999, 1145-1162. For additional climate information, see *Soils of Montana*, Montana Agricultural Experiment Station, Bulletin 744 (Bozeman, 1982), 9-14; and *Wyoming General Soil Map*, Agricultural Experiment Station, Research Journal 117 (Laramie, 1977), 1-3. Fire frequency data from Kenneth F. Higgins, "Lightning Fires in North Dakota Grasslands and in Pine-Savanna Lands of South Dakota and Montana," *Journal of Range Management* 37(2), March 1984, 100-103. Higgins' data suggests that an average of 24.7 lightning strike fires per 3900 square miles occurred annually in western North Dakota's mixed grass prairie over a 41 year period. For the same time period, pine-savanna lands experienced 91.7 fires per year. For the Basin's 83,633 square miles of grasslands and pine-savanna habitat, these data suggest that hundreds of fires may have occurred annually.

types of soil, as well as grasses, forbs, shrubs, and trees in the Basin, the entire Basin was dominated by only five broad types of landscapes: riparian/woodland habitat generally found along rivers and creeks; savanna forests of ponderosa pine (*Pinus ponderosa*) located mostly in Montana and northeast of the Bighorn Mountains; open grasslands of the northwestern plains and Wind River valley; shrublands and grasses in the central area of the Bighorn Basin; and conifer forests with grassy parklands at higher elevations in the foothills and mountains.¹⁰

Native grasses that were short (in height) to mid-size formed the foremost association on the open grasslands of the Basin. Referred to as the mixed grass prairie, the dominant species consisted of western wheatgrass (*Agropyron smithii*), blue grama (*Bouteloua gracillis*), and needle-and-thread (*Stip. comate*). This association tended to form a land cover that was generally more open and less dense. On the eastern fringe of the Basin, the same association of grasses occupied the landscape, but with blue grama less dominant and the overall plant cover more dense. Along the slopes of the mountainous foothills, a moderately dense and rather short grass community of Idaho and rough fescue (*Festuca idahoensis* and *scabrella*), bluebunch wheatgrass (*Agropyron spicatum*), and needle-and-thread had adapted to cooler temperatures and greater moisture. Throughout the Wind River valley and the periphery of the Bighorn Basin, western wheatgrass, needle-and-thread, and sagebrush (*Artemisia tridentata*) formed an

¹⁰ For a general description of the various vegetation types in the Basin and northern plains, see William T. Barker and Warren C. Whitman, "Vegetation of the Northern Great Plains," *Rangelands* 10(6), December 1988, 266-272; and A. W. Kuchler, *Potential Natural Vegetation of the Conterminous United States*, American Geographical Society Special Publication No. 36 (New York, 1964), legend numbers 12, 15, 16, 40, 55, 56, 63, 64, 66, 98. A sixth landscape category would include alpine meadows at higher mountainous elevations. Since bison rarely used these areas, they are not included in this study.

open mixed community of grasses and shrubs.¹¹

Native grasses evolved uniquely to the northwestern plains environment in association with grazing animals. Each species developed a particular photosynthetic pathway that facilitated the plant's growth. Western and bluebunch wheatgrass, needle-and-thread, and Idaho and rough fescue have been categorized as cool season (C3) plants. These species generally sprouted earlier in spring, favored moister conditions, and matured or reached maximum primary production in early summer. Overall yearly growth depended on the amount of moisture the soil had in spring. Blue grama on the other hand, has been identified as a warm season (C4) grass that sprouted a bit later, favored drier soils, matured later in summer, and was better adapted to grazing. The difference between cool and warm season grasses created a more diversified landscape with minimal competition between the various species. Topography, precipitation, and grazing modified the overall composition of these and other grasses over time and to particular environments. Cool season species generally dominated on north facing slopes, river valleys, and riparian habitat. Warm season plants favored terraces, uplands, and the drier conditions in the Bighorn Basin.¹²

¹¹ Ibid. On grasses in the Basin, see Robert T. Coupland, "Mixed Prairie," 151-182; and "Fescue Prairie," 291-295, both found in: *Natural Grasslands: Introduction and Western Hemisphere*, Robert T. Coupland, ed. (Amsterdam, 1992), 151-182; and J. S. Singh, W. K. Lauenroth, R. K. Heitschmidt, and J. L. Dodd, "Structural and Functional Attributes of the Vegetation of the Northern Mixed Prairie of North America," *The Botanical Review* 49(1), January-March 1983, 117-149. In the central area of the Bighorn Basin low growing shrubs of saltbush (*Atriplex confertifolia*) and greasewood (*Sarcobatus vermiculatus*) overshadow a mix of short growing grasses adapted to much drier conditions. This type of environment resembles areas found in the much drier Great Basin.

¹² On the ecology of the dominant grasses in the mixed grass prairie, see Singh, et al., "Structural and Functional Attributes," 117-149; Thomas W. Boutton, A. Tyrone Harrison, and Bruce N. Smith, "Distribution of Biomass of Species Differing in Photosynthetic Pathway Along an Altitudinal Transect in Southeastern Wyoming Grassland," *Oecologia* 45(3), June 1980, 287-298; O. E. Sala, W. K. Lauenroth,

Directly associated with the annual growth of vegetation in each of these landscapes was the level of moisture found in the soil. Tree ring data indicates a relatively consistent level of precipitation occurred for the growth and productivity of vegetation in the Basin for nearly sixty years. These conditions would have allowed plant and perhaps animal populations to remain stable, and in some cases increase. Consistent levels of moisture in turn provided hunter-gatherers working the landscape from such sites as Ash Coulee an important stabilizer in their ability to maintain the physical and cultural health of their bands. At least two generations of leaders knew how plants and animals might respond to these steady climate conditions. For those tribal groups who would become the Crow, Kiowa, and Shoshone/Comanche, this period of favorable climatic stability may have formed the underpinning for their movement into the Basin. It may have also allowed for the experimenting or growing of crops at such places as Ash Coulee.

and C. P. P. Reid, "Water Relations: A New Dimension For Niche Separation Between *Bouteloua Gracilis* and *Agropyron Smithii* in North American Semi-Arid Grasslands," *Journal of Applied Ecology* 19(2), August 1982, 647-657; and Jose M. Paruelo and W. K. Lauenroth, "Relative Abundance of Plant Functional Types in Grasslands and Shrublands of North America," *Ecological Applications* 6(4), November 1996, 1212-1224. Through the process of photosynthesis, plants use light and carbon dioxide from the air to produce simple sugars for growth, a conversion known as carbon fixation. Cool (C3) and warm (C4) season plants, based on their environmental adaptations, produce these simple sugars a bit differently. Any college botany textbook can explain this difference and process in their chapter on photosynthesis. Blue grama is perhaps the grass best adapted to the Basin's extensive plains upland environment. After spring rains, soils begin to dry out with the heat of summer, limiting available moisture and nutrients. Depending on the year, soils may dry out to depths of two feet or greater. In response to these dry conditions, eighty-five percent of blue grama's roots are within the first 8 to 12 inches of soil, enabling the plant to hold and utilize limited summer rainfall before it evaporates under the hot sun. When moisture is unavailable, plants become dormant while concentrating 85 percent of their net photosynthetic gains, transformed into carbohydrates (simple sugars), to belowground organs. This keeps the aboveground leaf area small and limits water loss through transpiration. Blue grama's shallow root system contrasts with the deeper roots and higher moisture needs of western wheatgrass and needle-and-thread on the mixed grass prairie. O.E. Sala and W. K. Lauenroth, "Small Rainfall Events: An Ecological Role in Semiarid Regions," *Oecologia* 53(30), 1982, 301-304; and James K. Detling, "Processes Controlling Blue Grama Production on the Shortgrass Prairie," in: *Perspectives in Grassland Ecology*, Norman R. French, ed. (New York, 1979), 25-42.

There is no tree ring data available for the period prior to 1652, so it is not clearly known when this favorable period began in the Basin or how plant and animal populations may have responded. Individuals who support the Little Ice Age theory would probably concur that these favorable conditions began around the sixteenth century and that wildlife populations would have most likely increased. The Basin's tree ring data offers some limited supporting evidence for this cooler and moister period. This evidence, however, is slight because 60 percent of the years between 1652 and 1705 received normal amounts of precipitation, with 12 wetter and 6 slightly drier years interspersed over these 53 years (Appendix B). While forage productivity was an important component for the ability of a population of animals such as bison to have increased, it was only one of several factors.¹³

The folks at Ash Coulee did not have the models wildlife ecologists use to understand the population dynamics of animals. Their time-tested field knowledge of bison biology and behavior was vast and complete for their needs, and went beyond anything Clark and Larocque seemed to have acquired during their short stay in the Basin. What the hunters at Ash Coulee understood, and what current research supports, was that bison generally formed two distinct types of groups. Mature bulls composed one group. These males tended to live among themselves, in pairs, or alone during most of the year.

¹³ On the Little Ice Age, see Grove, *The Little Ice Age*, 1-2. In support of a generally cooler and moister period after 1600, see James S. Clark, "Fire and Climate Change During the Last 750 Yr in Northwestern Minnesota," *Ecological Monographs* 60(2), June 1990, 135-159; Williams and Wigley, "Comparison of Evidence," 286-307. Two articles that partially support aspects of the Little Ice Age from an archaeological perspective, are Douglas B. Bamforth, "An Empirical Perspective on Little Ice Age Climatic Change on the Great Plains," *Plains Anthropologist* 35(132), November 1990, 359-366; and Lawrence Loendorf, "The Chilling Effects of the Little Ice Age on North Dakota," *North Dakota Quarterly* 59(4), Fall 1991, 192-199. For an environmental history perspective, see Flores, "The Great Contraction," 10-14.

Females, calves, young males under three years old, and the occasional bull formed a second group referred to as a mixed herd or a cow group. Mixed herds were highly fluid and variable in size, with some members moving about from one herd to another. Mixed herds displayed the most cohesion as a group, although the bonding between cows and calves appears to have been the only stable relationship in the herd.¹⁴

The various herds the residents of Ash Coulee observed and hunted had probably lived in and around the Yellowstone River valley for many generations. Herd movement tended to follow relatively predictable patterns, a trait of North American caribou and other large ungulates of grassland environments in Africa.¹⁵ In their use of the landscape, bison attempted to maximize their movement in order to obtain sufficient grass and water, find shelter in winter, and possibly to avoid predation.¹⁶ Helping bison guide this movement was their spatial memory. Such a memory allowed bison to return to known sites that offered higher-nutrient forage, water, and shelter rather than simply wandering over the landscape to sites that offered less value.¹⁷ Such use of a particular landscape

¹⁴ Mary Meagher, "Bison bison," *Mammalian Species* 266, 16 June 1986, 1-8.

¹⁵ Joseph A. Chapman and George A. Feldhamer, eds., *Wild Mammals of North America: Biology, Management, and Economics*, (Baltimore, 1982), 928-930; Walter Leuthold, *African Ungulates* (New York, 1977) 41-53; A. R. E. Sinclair, *African Buffalo: A Study of Resource Limitation of Populations* (Chicago, 1977), 126-155; and Mark J. Mloszewski, *The Behavior and Ecology of the African Buffalo* (Cambridge, 1983), 63-78.

¹⁶ The idea of maximizing their movements derives from aspects of optimal forage theory. See, G. H. Pyke, H. R. Pulliam, and E. L. Charnov, "Optimal Foraging: A Selective Review of Theory and Tests," *The Quarterly Review of Biology* 52(2), June 1977, 137-154; and David W. Stephens and John R. Krebs, *Foraging Theory* (Princeton, 1986), 3-12.

¹⁷ On the use of memory by animals, see Derek W. Bailey, John E. Gross, Emilio A. Laca, Larry R. Rittenhouse, Michael B. Coughenour, David M. Swift, and Phillip L. Sims, "Mechanisms That Result in Large Herbivore Grazing Distribution Patterns," *Journal of Range Management* 49(5), September 1996, 386-400; Frederick D. Provenza and Richard P. Cincotta, "Foraging as a Self-Organizational

suggests that bison used some form of a home range, an area in which daily, seasonal, and annual travel occurred with relatively predictable patterns.¹⁸

The northern grasslands of Yellowstone National Park provide an example of how mixed herds exhibit an adhesion for specific ranges. An average home range area in the park consists of about 14 to 15 square miles. Yearly movement appears to be guided by the amount of snowfall the area receives. Herds use the lower valleys in winter and spring. As snow melts away from the hillsides at higher elevations, bison climb to forage on the new grasses. In fall or early winter, herds move back toward the lower valleys. Older females generally lead this movement, possibly helping teach younger members of the herd how to maximize the available resources in their particular home range.¹⁹

The actual size of a home range for a herd of bison outside the mountain and foothill areas of the Basin is much more difficult to know. Such data is based on years of observations, and there are no "true" free ranging herds currently on the Great Plains.

Learning Process: Accepting Adaptability at the Expense of Predictability," in: *Diet Selection: An Interdisciplinary Approach to Foraging Behaviour*, R. N. Hughes, ed. (Oxford, 1993), 78-101; and Frederick D. Provenza, James A. Pfister, and Carl D. Cheney, "Mechanisms of Learning in Diet Selection with Reference to Phytotoxicosis in Herbivores," *Journal of Range Management* 45(1), January 1992, 36-45.

¹⁸ On the use of a home range by bison, see Dirk Van Vuren, "Group Dynamics and Summer Home Range of Bison in Southern Utah," *Journal of Mammalogy* 64(2), May 1983, 329-332; Mary Meagher, "Range Expansion by Bison of Yellowstone National Park," *Journal of Mammalogy* 70(3), August 1989, 670-675; and Nicholas C. Later and C. Karmic Gates, "Home-Range Size of Wood Buffalo: Effects of Age, Sex, and Forage Availability," *Journal of Mammalogy* 71(1), February 1994, 142-149.

¹⁹ Keith Aune, Tom Roffe, Jack Rhyen, John Mack, and Wendy Clark, "Preliminary Results on Home Range, Movements, Reproduction and Behavior of Female Bison in Northern Yellowstone National Park," in: *International Symposium on Bison Ecology*, Irby and Knight, 61-70; and Meagher, "Bison bison," 6. This yearly cycle of movement in Yellowstone National Park may in part be guided by the animal's memory of particular forage sites or other important landscape features. L. L. Wallace, M. G. Turner, W. H. Romme, R. V. O'Neill, and Yegang Wu, "Scale of Heterogeneity of Forage Production and Winter Foraging by Elk and Bison," *Landscape Ecology* 10(2), April 1995, 75-83.

Nor is there even a herd that may reflect the size of the herds that the people at Ash Coulee saw. On the grasslands of the Basin, snowfall appears to have played a lesser role in herd movement than it did in foothill environments. Bison migration appears to have been guided more by the animal's ability to know where the most favorable locations were each season.

Clark and Larocque traveled through the Basin much too quickly to acquire an understanding of how far and wide bison migrated over the landscape. The Crow did indicate to Larocque prior to his departure that seasonally they could be found camped in particular areas of the Basin. Being dependent on bison, the Crow presumably held some understanding of herd movement, and thereby situated their camps in convenient locations. They were able to convey to Larocque their settlement pattern if he were to return and establish further trade relations. Grant Bulltail, a Crow storyteller, also echoes this knowledge of migratory patterns and how the Crow used traditional winter camps in the mountain valleys bordering the Bighorn Basin because of the number of bison that used these protected valleys each winter.²⁰

The migratory habits of bison that the Crow seemed to have understood worked in conjunction with seasonal changes.²¹ In spring, bison foraged on the succulent new leaves of cool season grasses that generally emerged first in the river valleys and riparian habitat,

²⁰ Burpee, *Journal of Larocque*, 45. Bulltail's stories were told as part of the Buffalo Bill Historical Center summer institute program in Cody, Wyoming, June 1997. Personal notes. There are numerous accounts of bison following particular patterns of movement from the early fur trade to the commercial hide hunters.

²¹ Wildlife data also indicates that bison follow patterns of movement in response to seasonal changes. Changes in environmental conditions generally guides ungulate movement and migration as well in Africa. See, Leuthold, *African Ungulates*, 51.

and then on the terraces and uplands. The later sprouting blue grama and other warm-season grasses attracted bison to particular areas by supplying sprigs of green leaves into the summer months. Young grass leaves supplied the highest proportion of protein and carbohydrates during the year. Bison, especially calf bearing females, coming through a winter of eating only dried grasses were eager for nutritional forage. In the Bighorn Basin and uplands areas where the soils were drier and overall plant cover was less dense, bison dispersed into smaller groups. These smaller groups were more efficient and successful as foragers, expending less energy gathering resources and required a smaller home range.²²

Spring was also calving season. After a gestation period of about 285 days, cows (who were at least 2 years old) gave birth to brightly reddish to tan colored calves between mid-April and the end of May. Cows sought out cover and isolation if possible when they gave birth, suggesting that river valleys and shrub/grassland habitat were used more often for birthing than open grasslands. Severity and the length of winter on the northern plains effected yearly pregnancy percentages, with an estimated rate of around 60 to 65 percent. Males calves would have generally outnumbered females at birth, with newborns staying close to their mother. Cows with calves tended to cluster during the spring calving season, shying away from the rest of the mixed herd. When threatened, cows commonly stepped in to defend or protect their young. By the end of spring a

²² For a discussion on the relationship between the warm season grasses, uplands, and bison, see Floyd Larson, "The Role of the Bison in Maintaining the Short Grass Plains," *Ecology* 21(2), April 1940, 113-121; and Glenn E. Plumb and Jerrold L. Dodd, "Foraging Ecology of Bison and Cattle on a Mixed Prairie: Implications for Natural Area Management," *Ecological Applications* 3(4), November 1993, 631-643. Trapper Osborne Russell offers one of the first accounts from the Basin of spring movement away from the valley and toward the plains in the upper Powder River in 1838, in *Journal of a Trapper*, Aubrey L. Haines, ed. (Lincoln, 1965), 81-82.

herd's calf population averaged around 18 to 20 percent.²³

In summer, bison on the mixed grass prairie tended to maintain their foraging patterns in upland areas. At least 90 percent of their summer diet consisted of these grasses, of which they needed to consume about 2 percent of their body weight each day. An average size bison of 1,100 pounds would have consumed 22 pounds of forage daily. Because of their size and daily forage requirements, bison, like most large herbivores, evolved as foraging generalists. Less selective than other ungulates who lived in the Basin, bison consumed all the various parts of grasses, including dead plant material. Nutritionally, one-seventh of their daily diet required protein. The carbohydrates in grass were not nutritionally available if not balanced with enough protein. Although generalists, bison needed to consume enough quality grass to maintain this balance. Of the grasses in the Basin, blue grama offered the highest protein to carbohydrate ratio.²⁴

To obtain their nutritional needs, bison foraged several times during a typical day and mostly during daylight hours. When grazing, herds tended to fan out into a loose grouping or wave-like pattern. At least once a day, herds traveled to the nearest river or watering hole to drink. Interspersed between intervals of feeding and drinking were

²³ Meagher, "Bison bison," 4-6; Chapman and Feldhamer, *Wild Mammals*, 980-983; Aune, et al., "Preliminary Results on Home Range," 68-69; and Flores, "Bison Ecology and Bison Diplomacy," 476-477. On refuges today, between 35 and 88 percent of breeding age cows give birth each year. In a previous study I used a pregnancy rate of 53%. Although it is difficult to know if modern rates represent the pregnancy rate in the late 1600s, in light of current data this study will use these higher figures. Haynes, "Bison Hunting," 303-311.

²⁴ Chapman and Feldhamer, *Wild Mammals*, 985-986; Meagher, "Bison bison," 4-5; Jerry L. Holechek, "An Approach for Setting the Stocking Rate," *Rangelands* 10(1), February 1988, 10-14; and Charles W. Johnson, "Protein as a Factor in Distribution of the American Bison," *Geographical Review* 41(2), April 1951, 330-331. When sufficient protein is not available, bison can in extreme cases, literally starve to death with a full stomach of roughage.

periods of resting and ruminating. Like all ungulates bison required plenty of time to ruminate. Depending on the availability of water and grass, and the size of the herd, daily movement between foraging sites, drinking, resting, and ruminating may have covered a distance of one to several miles. Older cows generally led the herd through their day, and when traveling, the rest of the herd followed more or less in a line. A mixed herd may have stayed at a particular foraging area up to two days if conditions remained favorable.²⁵

As herds slowly moved over the landscape their foraging influenced the production of each of the various grasses they fed on. In years of normal precipitation low levels of grazing maintained annual productivity, increasing the proportion of new growth over the growing season and the period of time when forage conditions were best. Cool season grasses such as western wheatgrass, needle-and-thread, Idaho and rough fescue tended to decrease productivity during the summer (by varying degrees depending on the species) when grazing approached fifty percent of the available plant. Warm season grasses on the other hand tended to increase their forage yields when grazing was less than fifty percent. Heavy grazing, where fifty percent or more of the plant was removed, generally decreased productivity for all grasses in the Basin.²⁶

²⁵ Meagher, "Bison bison," 5-6. Bison obtain nutrients by breaking down grasses through a four-compartment stomach.

²⁶ Coupland, "Mixed Prairie," 177-178; and "Fescue Prairie," 294; Johan F. Dormaar, Barry W. Adams, and Walter D. Willms, "Impacts of Rotational Grazing on Mixed Prairie Soils and Vegetation," *Journal of Range Management* 50(6), November 1997, 647-651; and H. V. Eck, W.G. McGully, and J. Stubbendieck, "Response of Shortgrass Plains Vegetation to Clippings, Precipitation, and Soil Water," *Journal of Range Management* 28 (1975), 194-197. It is assumed that bison did not eat more than 50% of available forage. An increased percentage of blue grama within associations of grasses suggests heavy grazing, a climatic switch to a more arid condition, or a period drought. See, A. B. Frank, D. L. Tanaka, L. Hofmann, and R. F. Follett, "Soil Carbon and Nitrogen of Northern Great Plains Grasslands as Influenced By Long-Term Grazing," *Journal of Range Management* 48(5), September 1995, 470-474; and Mario E. Biondini and Llewellyn Manske, "Grazing Frequency and Ecosystem Processes in a

To optimize their foraging time on the highest nutritional grasses available during the summer, bison appear to have frequented the many prairie dog colonies that were scattered over the Basin's grasslands. Continuous nibbling of grasses and forbs by prairie dogs not only modified the landscape around the colony, but facilitated a steady growth of fresh leaves. Because grass leaves were eaten low to the ground and often, very little dead plant material or litter accumulated. This modified the prairie by creating a patch of selective vegetation (such as blue grama) that was well adapted to continuous clipping and by increasing the amount of area with more bare soil. The grasses around a colony provided bison with a higher live-to-dead ratio of forage, more digestible young leaves, and greater nutrients compared to non-colonized prairie vegetation. Bison also used the colonies for resting, ruminating, and wallowing, perhaps due to the increase in bare soil.²⁷

Neither Clark or Larix said anything about prairie dog colonies in their journals. Both explorers did, however, write about the evidence of fire.²⁸ A common thread between cool and warm season grasses was their relationship to fire. The expansive nature of the Basin's grasslands was caused in part by fire controlling the encroachment of shrubs and trees. Depending on the time of year (spring, summer, or fall burns) and

Northern Mixed Prairie, USA," *Ecological Applications* 61(1), February 1996, 239-256.

²⁷ D. L. Coppock, J. W. Ellis, J. K. Detling, and M. I. Dyer, "Plant-Herbivore Interactions in a North American Mixed-Grass Prairie: II. Responses of Bison to Modification of Vegetation by Prairie Dogs," *Oecologia* 56(1), 1983, 10-15; April D. Whicker and James K. Detling, "Control of Grassland Ecosystem Processes by Prairie Dogs," in: *Proceedings of the Symposium on the Management of Prairie Dog Complexes for the Reintroduction of the Black-footed Ferret*, John L. Oldemeyer, Dean E. Biggins, Brian J. Miller, and Ronald Crete, eds., U. S. Fish and Wildlife Service Biological Report 13 (Washington, 1993), 18-27; and Kirsten Krueger, "Feeding Relationships Among Bison, Pronghorn, and Prairie Dogs: An Experimental Analysis," *Ecology* 67(3), June 1986, 760-770.

²⁸ Burpee, *Journal of Larocque*, 49-50; Thwaites, *Journals of Lewis and Clark*, vol. II, 296, 350.

intensity, fires would have reduced overall productivity. For some grass species this decrease was as much as 30 to 50 percent in the first year alone. For grass associations in the Basin, full recovery to pre-fire conditions generally occurred in one to three years. Where grasses were grazed after a fire, full recovery may have taken as long as three to five years.²⁹

The new growth that generally occurred with grasses after a fire was highly attractive forage to bison in much the same way they were attracted to the new leaves around prairie dog colonies. These fires were not always lightning started. Clark, shortly before departing from the expedition's winter quarters among the Mandan in 1805, wrote that the

Plains are on fire in View of the fort on both Sides of the River, it is Said to be common for the Indians to burn the Plains near their Villages every Spring for the benefit of their hors, and to induce the Buffalow to come near to them.³⁰

Nineteenth century Plains Indians were also known to use fire as a way to concentrate or herd animals into particular areas; to deprive hostile neighbors access to herds; and as a weapon in times of conflict, whether as an aid in helping to escape or to help in the defeat of an enemy.³¹

²⁹ On the impact of fire in grassland environments, see two publications by Henry A. Wright and Arthur W. Bailey, *Fire Ecology and Prescribed Burning in the Great Plains — A Research Review*, U.S. Forest Service General Technical Report INT-77 (Ogden, 1980), 21-28, 30-33; and *Fire Ecology* (New York, 1982), 108-109, 113-121. Also see, J. L. Launchbaugh, "Effects of Early Spring Burning on Yields of Native Vegetation," *Journal of Range Management* 17(1), January 1964, 5-6; and Henry A. Wright, "Effects of Fire on Grasses and Forbs in Sagebrush-Grass Communities," in: *Rangeland Fire Effects: A Symposium*, Ken Sanders and Jack Durham, eds. (Boise, 1985), 12-21.

³⁰ Thwaites, *Journals of Lewis and Clark*, vol. 1, 279.

³¹ Roe, *North American Buffalo*, 158-160; Stephen J. Pyne, *Fire in America: A Cultural History of Wildland and Rural Fire* (Seattle, 1997), 71-83; and Kenneth F. Higgins, *Interpretation and Compendium of Historical Fire Accounts in the Northern Great Plains*, U. S. Fish and Wildlife Service

The ability to hunt bison close to their camps with the aid of fire would have certainly been an advantage for pedestrian hunters. Plains Indian on the northwestern plains appear to have a long history (perhaps hundreds to thousands of years) of using fire to alter habitat and attract or manipulate bison and other game, although the full extent remains uncertain. Fire, whether started by human hands or lightning, occurred annually with some frequency.³²

At the height of summer, bull and mixed herds congregated as mature males displayed and fought for the right to mate with cows. Interaction between bulls during the annual rut was intense. Fights generally ended without serious injuries, although deaths would occur. Most of the fighting consisted of stylized threats with one bull eventually backing down with signals of submission. The distraction the rut may have temporarily caused the herd, possibly allowed pedestrian hunters additional opportunity to procure bison. William Clark's small party of hunters were able to kill from one to four bison on 11 of the 20 days they quickly traveled down the Yellowstone valley. But for Clark, the sounds of the bellowing bulls during the rut were simply "very loud and disagreeable." And on one occasion his men fired several shots at bulls to scare them away before they could feel safe enough to fall asleep.³³

The "immense numbers" of bison that Clark and Larix witnessed, and that many

Resource Publication 161 (Washington, 1986).

³² Pyne, *Fire in America*, 66-83.

³³ Tom McHugh, *The Time of the Buffalo* (New York, 1972), 191-205; Meagher, "Bison bison," 6; Chapman and Feldhamer, *Wild Mammals*, 980-981; Thwaites, *Journals of Lewis and Clark*, vol. V, 302, 294. The annual rut can also carry on into September.

others would see and write about for the next seventy years, were often engaged in the annual rut. Most of the explorers and visitors were traveling in the Basin during the warmest time of year and not through the six to eight months of winter. Herds during the rut probably got quite large, yet they were not necessarily characteristic of herd size throughout the year. With the end of the mating season, mixed herds once again tended to disperse into smaller groups.

During the shorter and cooler days of autumn, bulls who have exerted enormous energy during the rut, turned their attention toward gaining fat and weight for winter. Leaving the mixed herd, bulls once again foraged alone or in smaller bull groups. Members of the mixed herd, as they had done all summer, continued to store reserves as well, reaching their prime condition in terms of meat, fat, and quality of hide. With the approach of winter herds generally moved toward the timbered valleys around the foothills, in coulees, and along river bottoms in order to gain shelter from the coming onslaught of a cold plains winter. Although bison tended to seek shelter during the coldest parts of winter, they were hardy creatures who were well adapted to cold environments. When weather and snow conditions permitted, bison foraged on dried upland grasses or in other more exposed areas. In winter, blue grama was especially important, for even when dried it maintained a higher percent of protein and carbohydrates than taller grasses.³⁴

³⁴ On bison foraging on fescue grasses and in foothill environments in winter, see A. Johnson and M. D. MacDonald, "Floral Initiation and Seed Production in *Festuca Scabrella* Torr.," *Canadian Journal of Plant Science* 47(5), September 1967, 577-583; and Thomas R. Baumeister, "The Rocky Mountain Front: Home To Bison - A Case Study on the Coevolution of Bison and Fescue Prairie," in: *Symposium on Bison Ecology*, Irby and Knight, 351-359. For a few early descriptions of bison wintering along river valleys and sheltered areas, see Russell, *Journal of a Trapper*, 51, 81; Maurice S. Sullivan, ed., *The*

Plains Indians also needed to find shelter during the cold winter months. The availability of wood and water guided their placement of a winter encampment. Hunting seemingly would not have stopped, but cold winds, drifting snow, frozen conditions, and winter temperatures that were at times well below 0° F. would have made it more difficult to remain outside for extended periods of time. Harsh winter conditions could have easily lasted through March before the warmer Chinook winds signaled the coming of spring. As new shoots of grasses emerged in the valleys and then on the uplands, the seasonal cycle of life on the Basin's grasslands began again.

The yearly cycle of life in the Basin was clearly a shared existence. Large animals such as bison, elk, deer, pronghorn antelope, grizzly bears, wolves, and coyotes all had established niches that worked in conjunction with the multitude of smaller mammals, reptiles, birds, fish, insects, fungi, and bacteria. Prairie dogs, for example, were an integral part of the grassland community. Their industrious burrowing and herbivory provided not only improved forage for bison, but habitat and food for approximately 170 other species that relied on the colonies for some part of their survival. Carnivores such as the black-footed ferret (*Mustela nigripes*), Ferruginous hawk (*Buteo regalis*), and badgers (*Taxidea taxus*) fed on the busy rodent. Their burrows, cooler in summer and warmer in winter, provided shelter for a diverse array of creatures, including burrowing owls (*Athene cunicularia*), prairie rattlesnakes (*Crotalus viridis viridis*), tiger salamanders (*Ambystoma*

Travels of Jeremiah Smith (Santa Ana, 1934), 8-10; and John C. Ewers, ed., *Adventures of Zena Leonard Fur Trader* (Norman, 1959), 156-159. George W. Arthur offers a contrasting view suggesting bison herds were largest during the winter, in *An Introduction to the Ecology of Early Historic Communal Bison Hunting Among the Northern Plains Indians* (Ottawa, 1975), 53-60. On blue grama, see C. Johnson, "Protein as a Factor in Distribution," 330-331.

tigrinum), and black widow spiders (*Latrodectus hesperus*).³⁵

In taking care of their needs, bison for the most part had minimal competition from other herbivores. Elk were "estonishingly noumerous on the banks of the river," wrote William Clark the day after passing by the Bighorn River, "which lay on almost every point in large gangs." Form his descriptions, elk herds appear to have stayed close to the Yellowstone River or in the immediate valley. Bison on the other hand, were located "at a greater distance from the river." Francois Larix did the same, describing bison on the uplands and the river "bottoms full of elk." Larix also noted, while traveling south along the Powder River with the Crow, that the grass was "entirely eat up by the Buffaloes and Elk." Less of a feeding generalist and more restricted in their movement than bison, elk appear to have competed some with bison for fresh spring grasses in the river valleys, as well as for winter forage. Although the number of elk must have been large (Clark described herds in the low hundreds), they do not appear to have reached the population size of bison.³⁶

Clark and Larix also witnessed sizeable populations of deer and pronghorn antelope. Both of these herbivores are even more selective in their diet than elk, and posed little competition for grasses with bison. Possibly the one mammal that did compete significantly with the large grazers was the prairie dog. While they helped stimulate new

³⁵ William Stolzenburg, "Town Meeting," *Nature Conservancy* 50(4), July/August 2000, 8-9.

³⁶ Thwaites, *Journals of Lewis and Clark*, vol. V, 265, 290, 302, 305-307; and Burpee, *Journal of Larocque*, 30, 32. Two subspecies of elk appear to have used areas of the Basin: the Manitoban elk on the plains and the Rocky Mountain elk in foothills and mountainous environments. See Jack Ward Thomas and Dale E. Toweill, eds., *Elk of North America: Ecology and Management* (Harrisburg, 1982), 15-24, 360-366. Also see, Chapman and Feldhamer, *Wild Mammals*, 983-984.

leaf growth and nutritional forage, they were also consuming as much as 4 to 7 percent of the total productivity. Grasshoppers as Clark noted, and perhaps locusts, were additional herbivores munching on the Basin's grasses. These hungry insects appear to have consumed the most vegetation in years that were drier or during droughts.³⁷

Carnivores were also important members of the food chain. Grizzly bears, who roamed the river valleys, assuredly pounced on a calf or two in spring, especially if bison cows tended to use these areas for birthing. The large "white bear" as Clark often called them, were capable of taking down even larger animals in the right situation. Predation on bison by these feared creatures, however, does not appear to have been too extensive. The "emence numbers" of wolves that Clark noted on several occasions, were, on the other hand, quite capable of killing large numbers of bison.³⁸

Wolves are known to have killed bison and other ungulates of any age. They are also known to be selective when they targeted prey. When hunting, avoiding debilitating or fatal wounds from horns or hooves would have been vital. Calves, older, sick, or injured animals were relatively easier to bring down. Calves may have represented 30 to

³⁷ Adrian P. Wydeven and Robert B. Dahlgren, "Ungulate Habitat Relationships in Wind Cave National Park," *Journal of Wildlife Management* 49(3), July 1985, 805-813. On prairie dog competition for forage, see John L. Oldemeyer, Dean E. Biggins, Brian J. Miller, and Ronald Crete, eds., *Management of Prairie Dog Complexes for the Reintroduction of the Black-footed Ferret*, U. S. Fish and Wildlife Service Biological Report 13 (Washington, 1993), 1; and D. W. Uresk and D. D. Paulson, "Estimated Carrying Capacity for Cattle Competing with Prairie Dogs and Forage Utilization in South Dakota," in: *Management of Amphibians, Reptiles, and Small Mammals in North America*, R. C. Szaro, K. E. Severson, and D. R. Patton, eds., U. S. Forest Service General Technical Report RM-166 (Washington, 1988), 387-390. On the consumption of grasses by grasshoppers and locust, see J. E. Weaver and F. W. Albertson, *Grasslands of the Great Plains* (Lincoln, 1956), 93.

³⁸ Thwaites, *Journals of Lewis and Clark*, vol. V, 292, 302, 312, 316. Naturalist John James Audubon felt predation by grizzly bears was greater than by wolves. See, John James Audubon and Rev. John Bachman, *The Quadrupeds of North America* (New York, 1854), 50.

40 percent of the number of bison killed by wolves in one year. Bison were not in short supply around the end of the 1600s, and by all accounts wolves were not either. Those packs of wolves that followed particular bison herds tended to use them for 60 to 80 percent of their yearly diet.³⁹

Wolf population estimates have varied widely depending on the setting, habitat, and prey, from 9 to more than 50 individuals per 400 square miles. Potential densities of wolves that lived in the Basin may have averaged around 25 to 30 animals per 400 square miles. This suggests an estimated population of roughly 5,700 animals. If each wolf consumed five bison per year (as predation studies suggest), wolves conceivably took down an estimated 28,000 bison annually. Even into the mid-eighteen hundreds wolf populations appear to have been numerous. According to Upper Missouri Indian Agent Alexander H. Redfield, predation by wolves "next to Indians and white men, are the greatest destroyers of buffalo."⁴⁰

There were other forces at work besides wolves and humans culling herds of bison. Old age, starvation, severe winters, and fire all caused mortality. Drownings, which Clark witnessed, of animals trying to cross rivers, or breaking through ice in winter or spring, also had the potential to produce sizable numbers of deaths. Clark did not mention any

³⁹ L. D. Mech, *The Wolf: The Ecology and Behavior of an Endangered Species* (New York, 1970), 246-263; and L. N. Carbyn, S. M. Oosenbrug, and D. W. Anions, *Wolves, Bison ... and the Dynamics Related to the Peace-Athabasca Delta in Canada's Wood Buffalo National Park*, Circumpolar Research Service Number 4 (Alberta, 1993), 222-223.

⁴⁰ The method used to determine the number of bison killed by wolves comes from, Fisher and Roll, "Ecological Relationships," 283-302. Wolf predation figures come from Carbyn, et al., *Wolves, Bison ...*, 230. Alexander H. Redfield, *Report of the Commissioner of Indian Affairs* (Washington, 1858), 91. For additional accounts of wolf predation on the Great Plains, see Bruce Hampton, *The Great American Wolf* (New York, 1997), 80-101; and Roe, *The North American Buffalo*, 62-64, 155-157.

large sightings of drowned bison, but he did witness the "extrodanary dexterity" of the Mandan to jump from one ice cake to another to secure drowned floating bison from the Missouri in spring. Apparently the softened flesh was highly desired to eat. Twenty-seven years later Prussian adventurer Alexander Maximilian was informed by the staff of the American Fur Company's trading post at Fort Union that whole herds of bison have drowned in the Missouri and other rivers. "I have been assured," Maximilian wrote, "that in some rivers, 1,800 and more of their dead bodies are found in one place." At one place on the Peace-Athabasca River delta in northern Alberta, an estimated 3,000 bison drowned in the spring of 1974 in Wood Buffalo National Park.⁴¹

On refuges today, natural bison mortality can range between 1 and 9 percent, with the greatest percentage occurring within the first two years of an animal's life. With predators present, higher rates of annual mortality probably occurred during the time of Ash Coulee, perhaps around 12 percent. Wolf predation alone, depending on the size of the bison herd and year, had the potential to limit overall population growth. Add to predation drownings and human hunting, or even a major decrease in vegetation due to drought, then the number of bison in a particular herd may have actually been reduced.⁴²

⁴¹ On natural causes that took the lives of bison, see J. E. Cole, "Buffalo (Bison bison) Killed by Fire," *Journal of Mammalogy* 35(3), August 1954, 453-454; and Roe, *North American Buffalo*, 154-203. On drownings, see Thwaites, *Journals of Lewis and Clark*, vol. I, 278-279; Hal W. Reynolds and Alexander Hawley, *Bison Ecology in Relation to Agricultural Development in the Slave River Lowlands*, N. W. T., Occasional Paper Number 63, Canadian Wildlife Service, 1987, 11; and Maximilian, Prince of Wied, *Travels in the Interior of North America*, Reuben Gold Thwaites, ed. (Cleveland, 1905), vol. 1, 382.

⁴² Natural mortality figures from Thomas Haynes, *Bison Hunting in the Yellowstone River Drainage, 1800 to 1885: A Comparative of Native and EuroAmerican Impacts on Bison Ecology*, undergraduate thesis, Montana State University, Bozeman, 1996; and Flores, "Bison Ecology and Bison Diplomacy," 477-478. On herd recruitment, see Carbyn, et al., *Wolves, Bison ...*, 222-223.

Hunters at Ash Coulee may have cloaked themselves in a wolf skin as one method to approach and procure bison. These hunters made up a small part of an estimated population of 34,000 people who may have been lived in the Basin near the end of the seventeenth century.⁴³ How these pre-horse Plains Indians fully used the Basin to hunt game, especially bison, and gather wild plants remains difficult to know. Their methods of hunting may have resulted in the death of one, several, many, or even hundreds of bison. As keen observers, they used the landscape creatively to trap animals in canyons, arroyos, or sandy soils. They constructed enclosures or pounds, and used cliffs (bison jumps) to kill and maim small and large numbers of bison. Other methods, such as hiding under a wolf skin or bison calf hide ("making a calf"), bogging bison in snow drifts, and using fire to help procure bison are known nineteenth-century techniques, and were conceivably used by hunters for hundreds if not thousands of years.⁴⁴

The hunting pressure placed on bison by the people camped at Ash Coulee and elsewhere in the Basin can be calculated by the daily intake of calories that each person required. Estimates of caloric requirements and written accounts by fur traders suggest that Plains Indians consumed approximately 5 to 6½ bison per person each year. These estimates indicate that near the end of the 1600s, 170,000 to 221,000 bison were being

⁴³ The model used for human population figures is from, Fisher and Roll, "Ecological Relationships," 286-287.

⁴⁴ Whether we know how bison were procured by pedestrian hunters, and if Plains Indians manipulated or "managed" bison and the landscape through such use of fire, castration, or taming are developed in, Fisher and Roll, "Ecological Relationships," 290-298.

killed on a yearly basis.⁴⁵

Natural mortality and Plains Indian hunting may easily have accounted for the deaths of more than 200,000 bison annually. These figures are a "guestimation." They nonetheless highlight the potential and sizable mortality that may have occurred, especially at the hands of Plains Indians. How this mortality affected bison populations remains difficult to know without some understanding or estimate of how many bison once roamed over the Basin's grasslands during this time of favorable climatic conditions.

There were approximately 53.5 million acres of habitat suitable for bison in the Basin. The many different soil types in the Basin produced a measurable amount of vegetation that was used to determine a carrying capacity, or how many bison (and other animals) the land supported without depleting the resource. Herds of bison that foraged on the landscape did so at about the Basin's carrying capacity median point in order to ebb and flow with the dynamics of an ever-changing environment or situation. Calculating the productivity of native vegetation for each soil type under normal precipitation (minus the effects of competition, fire, and grazing), and dividing these figures by the ecological requirements of bison (feeding requirements, waste, and use), produced a bison carrying capacity of approximately 1,800,000 animals at the time when the hunters at Ash Coulee

⁴⁵ For accounts and ways to calculate the yearly intake of bison by Plains Indians, see Bill Brown, "Comancheria Demography, 1805-1830," *Panhandle-Plans Historical Review* 59, 1986, 1-17; Jacob Fowler, *The Journals of Jacob Fowler*, Elliott Coues, ed. (New York, 1898), 61, 63; Flores, "Bison Ecology and Bison Diplomacy," 479; Elliott Coues, ed., *New Light on the Early History of the Greater Northwest: Manuscript Journals of Alexander Henry and David Thompson* (Minneapolis, 1897), vol. I, 444; and Fisher and Roll, "Ecological Relationships," 287.

were preparing their tool kits and sharing animal stories (Appendix A).⁴⁶

To subtract an estimated annual mortality of 200,000 bison from a relatively consistent population of 1.8 million animals would not have caused much of a dent if the population was one large herd. There were, however, numerous herds of various sizes that lived in the Basin. Each herd followed their seasonal and cyclical patterns of movement, while exchanging members with other herds, adapting to changing conditions, and learning about particular habitats. A "walk" among the folks at Ash Coulee provides an example of how these relationships may have worked.

The site itself is located in Prairie County, Montana, with the Yellowstone River completely dividing the county approximately in half. If 435 square miles of the county (one-half of half the acres in the county) produces 1,225 pounds of forage per acre with normal precipitation, we have a bison carrying capacity of about 8,325 animals. An area of this size, which includes portions of the Yellowstone valley, would have supplied a home range to herd/s of bison and other herbivores with plenty of grass, water, and shelter. In spring approximately 2,425 calves would be born from 62 percent of the

⁴⁶Calculating bison populations is not an exact science. Variables, such as accuracy of data, inclusion or exclusion of particular habitats, different ways to calculate a carrying capacity or stocking rate, and differences in delineating the size of the research area all have the potential to change numbers considerably. For details in how this study determined a bison population for the Yellowstone River Basin, see Appendix A. On population ecology and carrying capacity, see Eric G. Bolen and William L. Robinson, *Wildlife Ecology and Management* (Englewood Cliffs, 1995), 3rd Edition, 46-65; Graeme Caughley and Anthony R. E. Sinclair, *Wildlife Ecology and Management* (Cambridge, 1994), 110-130; and William J. Sutherland, *From Individual Behaviour to Population Ecology* (Oxford, 1996), 111-113. Wildlife ecologists indicate that the growth rate of an animal population declines once it reaches half its carrying capacity abilities. The simple use of a logistic equation graph shows how populations decline once they reach half the area's carrying capacity. Using Department of Agriculture census data from 1910 has been another method used to calculate for a bison carrying capacity. On the use of this method, see Brown, "Comancheria Demography," 9-11; Flores, "Bison Ecology and Bison Diplomacy," 470; and Dobak, "Killing the Canadian Buffalo," 33-52.

female population. Estimating a natural mortality for the year at a conservative 12 percent, would cull the herd by about 1,300 animals.⁴⁷

The 40 or so people who temporarily camped at Ash Coulee probably used an area of roughly 100 square miles (10 miles square) to obtain most of their yearly needs, with forays out of the area to obtain particular resources. The area around Ash Coulee could support no more than four bands, with these neighbors bound by similar physical and cultural constraints.. Procuring bison at an annual rate of 5 per person, the band at Ash Coulee harvested about 200 animals. Including neighboring bands, then, the number of bison needed increased to 800 animals. With a total mortality (natural and human) of about 2050 bison, or 19 percent for the year, the population of these various herds would have experienced an increase of about 430 animals. In comparison, if bands harvested 6 bison per person each year, killing roughly 960 animals, then the total mortality for the year would reach 2,260 bison, or 20 percent. With this slight increase in human consumption, the overall population would have experienced a small increase of 220 animals. If there was bad ice on the Yellowstone River and an additional 500 bison drowned while trying to cross during the winter, then the population for the area would have declined for the year. A mortality rate of only 23 percent maintains a stable bison population for this area of the Basin.⁴⁸

⁴⁷ Bison tend to have more males in a herd than females. This study uses a sex-ratio of 53 males to 47 females. See Chapman and Feldhamer, *Wild Mammals*, 982. In this example, the herd consists of 4,412 males to 3,913 females. The number of births are based on 62% of the female population being pregnant.

⁴⁸ The 40 people and square mile area use in this example represent a population similar to the Bushmen of the Kalahari Desert. For Prairie County data, see Appendix A. The rate of annual mortality is based on $a = h + n - hn$, whereas a = annual mortality, h = hunting mortality, and n = natural mortality.

As the example implies, the extent of annual mortality fluctuated the size of the herd from year to year. Higher numbers of bison killed through hunting, drownings, fire, wolf predation, and other natural factors had the potential to reduce a population below the carrying capacity in particular years, and even in years of favorable weather conditions that produced sufficient amounts forage. Communal hunting that used, let's say, a bison jump, could have contributed to an even greater amount of annual deaths. If the members forming the communal hunt desired a large kill, or even a procurement of 50 animals, their focus would have been on the mixed herd, except during the annual rut. If they succeeded, and killed, for example, 200 bison in the fall of the year, potentially half these animals could have been breeding-age females. Removing 100 females in one quick kill may have placed limits on a herds ability to maintain its population. This would have been especially true if the herd had experienced more than one large communal hunting event in a year. Archaeological excavations on communal kill sites tend to uncover bone beds dominated by females.⁴⁹

On the other hand, there were certainly herds that did not experience high mortality for perhaps several years. Their populations would have increased. In order to live in a variable carrying capacity range, some members would have emigrated to less populated areas or to other herds who may have had their numbers reduced by drowning,

This simple calculation implies that hunting and natural mortality added together will not support annual mortality because hunting removes some bison that would have died from natural causes. Thereby the percentage of annual mortality will be smaller then simply totaling up hunting and natural mortality figures. The formula for crude annual mortality comes from, Bolen and Robinson, *Wildlife Ecology*, 56-57.

⁴⁹ Fisher and Roll, "Ecological Relationships," 289. Fisher and Roll also point out that wolves may have also killed a higher percentage of females than males.

fire, predation, or hunting.

How this dynamic system of numerous herds within particular home ranges fluctuated between annual births and mortality is difficult to know with any certainty. Calculating a realistic carrying capacity based on the productivity of soils and native vegetation forms an important underpinning. Layering the many complex ecological and cultural variables surrounding bison and Plains Indians on top of these soil and grass data creates one interpretation of how numerous herds of bison and bands of Indian people coexisted on the Basin's grasslands at the end of the seventeenth century. To this dynamic relationship a new ingredient, "big dogs" as Saukamappee called them, was about to influence and dramatically change the relationship between bison and people in the Basin.⁵⁰

⁵⁰Tyrrell, *David Thompson's Narrative*, 330.

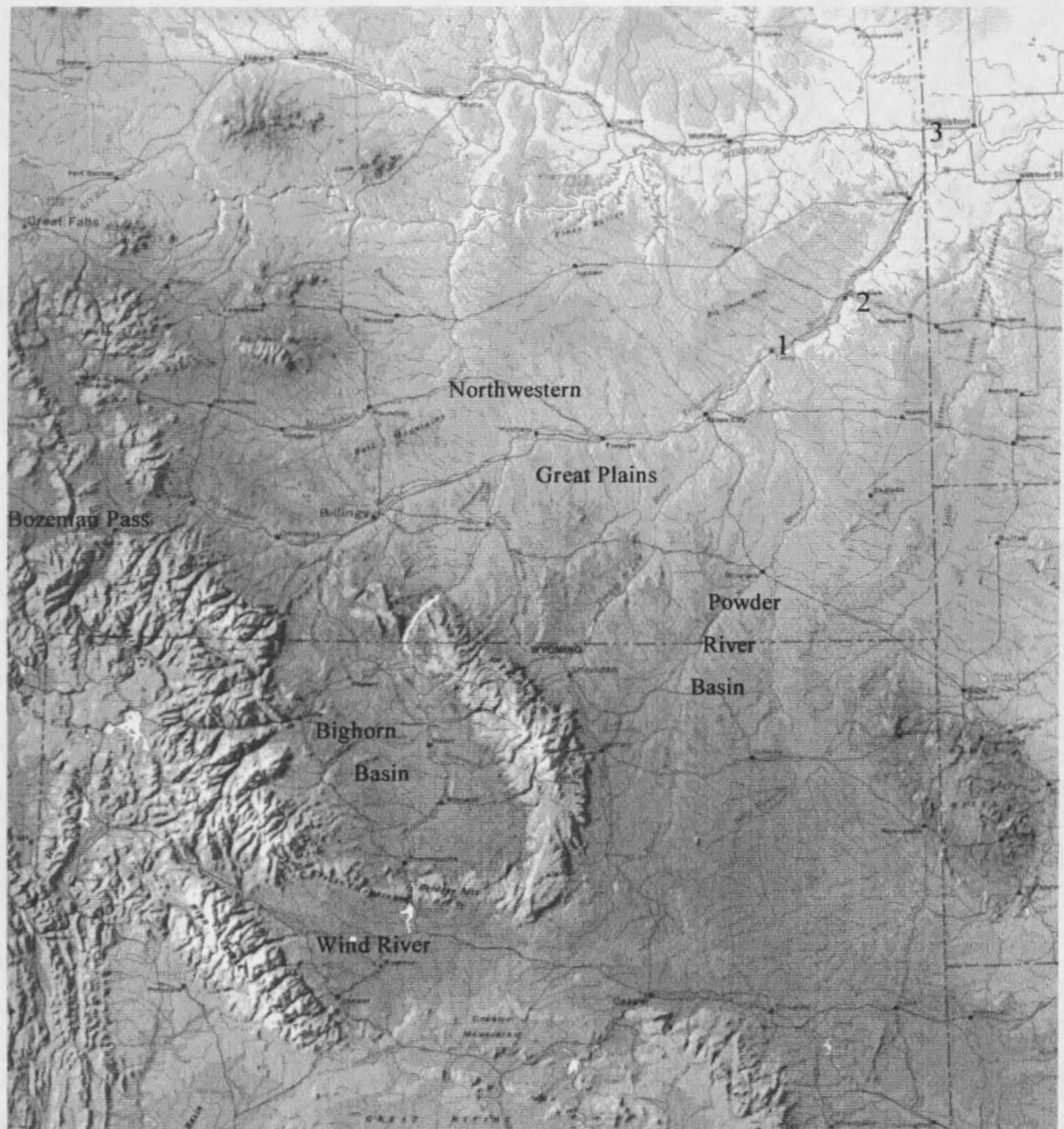


Figure 9. Approximate location of archaeological and historic sites discussed in Chapter 7.

1. Ash Coulee
2. Hagen
3. Fort Union

CHAPTER 8

CONCLUSION

Somewhere around the 1730s, horses, who had gone extinct approximately 10,000 years earlier, once again galloped over the Basin's landscape. With no word in their language associated with a horse, Saukamaptee and his Cree and Piegan relations called these large four-legged creatures "big dogs." It may have been a term other tribal groups used as well to describe an animal that was much more than simply a big dog. The versatility of the horse was quickly realized and was probably highly desired. Through networks of exchange, horses became a part of Plains Indian life relatively swiftly, igniting a transformation from pedestrian hunter-gatherers to horse propelled nomadic hunters. Within two to three generations such tribal groups as the Shoshone, Crow, Kiowa, and Blackfeet had fully adopted the horse into their Plains Indian life.

The details of this transformation remain a second part to this history of bison and people in the Yellowstone River Basin, and not told here. There are, however, a number of important implications this study suggests about pre-horse life in the Basin that has potential ramifications for horse propelled Indian hunters. First, the apparent consistency of weather patterns for sixty to seventy years beginning in the mid-1600s (and perhaps earlier) allowed bison populations to remain relatively stable. If the Basin's tree-ring data

reflects typically the climate during the period referred to as the Little Ice Age, than the normal to slightly wet weather patterns may have provided optimal conditions for a slow growth in overall bison numbers. Potential growth and carrying capacity densities, however, because 60 percent of these years received only normal amounts of rainfall, would have placed restrictions on any major population explosion.

A second implication is that in combining natural and human mortality on a landscape producing normal to slightly better vegetative conditions, had the potential to limit population growth for particular herds in certain years. Of these natural factors, wolf predation and drownings probably caused the greatest mortality to bison on an annual basis. The archaeological record attests to the knowledge and skill pedestrian hunters had in procuring large numbers of bison. These methods were well in place before the arrival of horses, as were the cultural foundations that surrounded hunting.

Third, these stable weather patterns provide an optimal time to establish not only a potential carrying capacity estimate for the Basin, but also a base estimate for the northern and entire Great Plains as well. In years of normal precipitation the Basin's 83,633 square miles provided for approximately 1.8 million bison. The land area of the northern mixed grass prairie was roughly 200,000 square miles, suggesting a pre-horse northern plains bison population of around 4.3 million animals. Extrapolating carrying capacity figures from the Basin into the mixed and shortgrass Great Plains environments of roughly 775,000 square miles, implies a population of 17 million bison. These numbers do not necessarily reflect all of the environmental conditions and potential productivity for the northern and entire Great Plains. They do suggest that former estimates of bison are

conceivably too high.

Finally, the climate pattern of the 1700s compared to the second half of the 1600s fluctuated much more widely between extreme moisture conditions and drought. Although there were 32 years with above normal moisture, the remaining 68 years experienced normal to dry conditions. Such weather patterns would not have allowed bison herds to expand rapidly, if at all. Mixing together the climate patterns of the eighteenth century with the development of trade for European manufactured goods, natural and human caused bison mortality, and the advantage the horse provided in hunting bison, implies a culling effect on herds that would have limited any population growth. Such population growth would have been further curtailed between 1781 and 1824. Of these 44 years, 37 experienced normal to dry conditions, with 6 of these years in extreme drought (Appendix B). The herds of bison that Francois Larocque and William Clark saw while they traveled through the Basin may have already been teetering at their population thresholds.¹

These implications have a more important bearing on how Plains Indians hunted bison with horses and their role in the animal's demise. What these implications emphasize, however, along with the thousands of years of known human hunting, is that Plains Indians killed millions of bison. In looking back 12,000 years, Paul Martin's megafauna extinction theory perhaps takes on new meaning. The possibility that Paleoindians arrived in the Basin earlier than 12,000 years ago adds an interesting twist

¹ This idea of the demise of bison herds beginning by the early 1800s is more fully developed, in Haynes, "Bison Hunting," 303-311.

into how these earlier relationships may have been between game and human hunters. Yet even if Paleoindians were in the Americas before 15,000 years ago they may not have used the northwestern plains because of its cold environment. The first people to live in the Yellowstone River Basin may indeed have traveled down the ice-free corridor on the east side of the Canadian Rocky Mountains about 12,000 years ago.

As debate over the peopling of the Americas awaits further evidence, so does the evolutionary development of bison and the reconstruction of Paleoindian life in the Basin. People and bison nonetheless adapted. Bison became smaller and human groups developed a Plains Indian and mountain lifeway. These two types of human adaptation were not necessary exclusive of each other. But the knowledge, skill, tools, and adaptive strategies required to exploit these two dissimilar environments were clearly different.

These differences in adaptive strategies were especially pronounced during altithermal years. Plains Indians were creative and savvy folks, and do not appear to have abandoned the Basin's grasslands. Instead, they seem to have found ways to adapt to drier conditions. So did bison, becoming an even smaller animal in order to better compete for available resources. It was during the altithermal that the familiar animal we know today, *Bison bison*, took its shape.

Cooler and moister climate conditions generally returned to the Basin around 5,000 years ago. From the end of the altithermal to the arrival of the horse, many different cultural groups made the Basin their home. Over these four-and-a-half to five thousand years each of these groups left behind its own unique characteristics. Over time particular characteristics became a part of the cultural traditions of northwestern Plains Indians. The

use of the bow and arrow, tipis, rock art, pemmican, and conflict, which are generally associated with aspects of a horse propelled Plains Indian life, were instead, several of the many characteristics that had a much longer history of use in the Basin. This as well was true for bison hunting. Although new procurement techniques, such as buffalo running and surrounds, were developed to use horses, much of the horse propelled hunting tradition followed or incorporated procurement methods that had been in use for thousands of years.

As culture developed and flourished in the Basin after the altithermal, human populations appear to have increased. By 1,500 years ago, as many as 34,000 people may have lived in the Basin at any one time. Bison also appear to have responded to the Basin's improved climate situation by increasing their numbers when vegetative conditions provided favorable. How much of an increase or how numbers may have fluctuated remains difficult to know, as well as if human populations fluctuated in proportion to bison numbers. The Basin's vegetative productivity provided for only a certain number of animals. Bison herds probably maintained a population that was close to the Basin's carrying capacity abilities. In the late 1600s, that was roughly 1.8 million animals.

More people placed more pressure on available resources. The number of members in a band appears to have increased, along with the size of a communal kill site and the number of bison procured. Such increases suggest that the overall size of a band's territory decreased. These factors, along with competition for available resources and changing climatic conditions, may have initiated the culture of conflict in the Basin.

Interpreting the social structure of how bands and tribal groups were organized

and functioned over these 12,000 years of history is clearly a most difficult task. Who did what in everyday life has been easily shaped by our understanding of how known ethnic groups lived. Division of labor probably occurred. Stories were certainly told. Religion and ceremonies conceivably played an important role in daily life. Political structures presumably existed, along with issues of power and control. Social and exchange networks assuredly tied people together. But just how all these factors may have worked to form complex relationships known as a Plains Indian Culture or a Mountain Cultural Tradition remains difficult to accurately portray. One aspect remains fairly clear, however. Bison, for most of these people, played a pivotal role in their lives. This evolving relationship between animal and pedestrian hunter-gatherer created a long and rich history of life in the Yellowstone River Basin that is slowly becoming better known and more fully appreciated.

APPENDICES

APPENDIX A
CARRYING CAPACITY

The Basin consists of 31 counties in Montana and Wyoming, covering an area of more than 61 million acres or 95,809 square miles. Because bison generally refrained from using densely forested habitat and higher mountainous elevations, the overall area used to determine the Basin's carrying capacity was smaller; 53,532,824 million acres or 83,633 square miles (Table 1). For the total acreage and square miles for each county in the Basin, see Table 5 and Table 6 on pages 199 and 200.

Acreage Totals					
States	Acres	Square Miles	Grassland Acres	Grassland Square Miles	Forested Acres
Montana	35486097	55447	33373197	52137	2112900
Wyoming	25831792	40362	20159627	31496	5672117
Totals	61317889	95809	53532824	83633	7941817

Table 1. Total acreage and square miles for Montana and Wyoming.

The term carrying capacity has many meanings. In this study it is used to describe the maximum number of bison the Basin's grasslands could sustain over a period of time without causing degradation of soils and vegetation or an overall adverse environmental impact. To determine such a population requires knowing how much vegetation was available. Because vegetative growth is directly linked to soil composition and moisture content, soil data from the Natural Resource Conservation Service (NRCS) in Montana and Wyoming was used. NRCS soil data was arranged by county or county area. The number of soil types for the 31 counties examined ranged between 49 to 275. For each

soil type per county, NRCS data contained the soil name; a brief description of the site's environmental conditions; native vegetation; potential productivity of vegetation; percent of composition for each species; number of acres in the county; and percent of acres within the county. Productivity figures, calculated in pounds/acre for a dried weight, were arranged into three soil moisture groups - wet, normal, and dry - reflecting the variability of climatic conditions. Identical soil types that had exactly the same productivity were lumped together. The number of acres of each of the 3,533 soil types examined was then multiplied by the potential productivity for each soil moisture group. This resulted in the number of pounds of forage each soil type potentially produced in a year. The data from Richland County, Montana (Table 4, page 198-199), provides an example of how NRCS data was organized and calculated for the 31 counties in the study area.¹

Vegetative productivity totals for Montana and Wyoming are displayed in Table 2, and include total grassland acres; number of soil types examined; county average for potential productivity for each soil moisture group; and the number of pounds per acre for each moisture group. Five of the thirty-one counties lacked useable NRCS soil data. Average potential productivity from the surrounding counties with similar soil types was used instead. Some counties had larger or smaller total acres than some state statistics. This was due to NRCS contract work done by area and not necessarily by county boundaries.²

¹Grassland productivity data was supplied by the state offices of the Natural Resource Conservation Service. In Bozeman, Montana, Chuck Gordon and Jim Hansen provided soil data in July 1995, February 1997, and January 2000. In Wyoming, Darrell Schroeder provided data in July 1995 and March 2000. Data and calculations from all 31 counties examined are in the author's possession.

² Personal communications with Chuck Gordon, 26 January 2000.

Productivity Totals

States	Grassland Acres	No. Soil Types	Average Potential Production			Productivity Pounds/Acre		
			Wet	Normal	Dry	Wet	Normal	Dry
Montana	33373197	2111	1603	1272	902	50931229183	39936996538	27763743238
Wyoming	20159627	1422	1469	1144	775	26253410030	20323476205	13364725670
Totals	53532824	3533	1536	1208	839	77184639213	60260472743	41128468908

Table 2. Combined average and total productivity for Montana and Wyoming.

With the establishment of each soil type's potential productivity, a stocking rate was determined. There are various ways to calculate a stocking rate, but the standard formula is:

$$\frac{\text{Total Available Forage in lbs./acre}}{\text{Total Bison Forage Requirements for One Year}}$$

The standard method used to determine total forage was calculated by multiplying the number of acres per soil type by its potential productivity, producing pounds of forage per acre for each soil moisture group. These pounds were then multiplied by an allowable use figure of 50%. Because grazing more than 50% reduces productivity, it was assumed that bison would not have overgrazed the Basin's resources.

$$\text{Acres} \times \text{Potential Productivity} \times \text{Allowable Use (.5)} = \text{Total Forage}$$

Bison need to eat about 2% of their body weight each day. An average bison weighs around 1100 pounds, thereby needing a daily intake of 22 lbs of forage per day. Multiply this intake by 365 days, and one bison requires 8,030 pounds of forage annually.

$$\text{Daily Intake (2\%)} \times \text{Average Weight (1100 lbs.)} \times \text{365 Days} = \text{Bison Requirement of 8,030 Pounds Per Year}$$

Using this calculation for each soil moisture group produced the number of bison each soil

type could provide for. These numbers were then added together for each county. Table 7 and 8 on pages 200 and 201, provide totals for each county. To stock the maximum number of bison from the available vegetation under the standard method without considering any other factors, the Basin's grasslands could support 3,750,620 bison in years of normal precipitation.³

Carrying Capacity Totals							
States	Grassland Acres	Wet	Standard Normal	Dry	Wet	Ecological Normal	Dry
Montana	33373197	3170415	2485812	1727822	2851690	2235919	1554085
Wyoming	20159627	1634064	1264808	831521	1469769	1137635	747866
Totals	53532824	4804479	3750620	2559343	4321459	3373554	2301951

Table 3. Carrying capacity totals for Montan and Wyoming.

Another approach that reflected more of the Basin's environmental relationships was called, for no better words, the ecological method. This method integrated two additional variables into the standard equation. The first variable takes into account that bison were not the only herbivore foraging on the Basin's vegetation. Including the needs of these other hungry creatures, such as prairie dogs, elk, and grasshoppers, reduced the overall available forage to bison between 4 to 8 percent. The extent of fires and resulting grazing also reduced the total amount of annual forage in the range of 1 to 5 percent. The consumption of vegetation by other herbivores and the effects of fire on vegetation had the potential to reduce the total amount of forage to bison by about 8 percent annually.

³ On a standard stocking rate, see Jerry L. Holechek, Rex D. Pieper, and Carlton H. Herbel, *Range Management: Principles and Practices* (Englewood Cliffs, 1995), second edition, 198-200.

$$\text{Acres} \times \text{Potential Productivity} \times \text{Unavailable Forage (.92)} \times \\ \text{Allowable Use (.5)} = \text{Total Forage}$$

As herds of bison walked, ran, foraged, defecated, and wallowed during their daily activities, they wasted or decreased the amount of vegetation potentially available for consumption. How much waste grazers produce appears dependent on the density of the herd, removing from 1 to as much as 15 percent. How much waste each bison may have produced remains difficult to predict. In their daily movement it is conceivable they wasted about one-half of a pound per day of vegetation by such means as trampling, defecating, pulling up plants by their roots when grazing, and by creating or expanding wallows. This indicates that bison required 22½ pounds of forage per day. Over one year the total amount of forage needed by one bison calculated to 8,213 pounds.⁴

$$\text{Daily Intake (2\%)} \times \text{Average Weight (1100)} + \text{Waste (}\frac{1}{2}\text{ lb.)} \times 365 \text{ Days} = \\ \text{Bison Requirement of 8,213 Pounds Per Year}$$

As with the standard method, the ecological calculation was used for each soil type and moisture group. Using the ecological approach to stock the grasslands of the Basin for a year with normal precipitation and no restrictions equals 3,373,554 animals. The two ways used here to calculate a carrying capacity resulted in a sizeable difference in overall numbers, as shown in Table 3. The difference between the two implies that 377,066 less bison utilized the Basin's grasslands under the ecological method. Averaging the two methods considering no other factors suggests that the Basin's landscape could

⁴ James A. Quinn and Donald F. Harvey, "Trampling Loss and Travel by Cattle on Sandhills Range," *Journal of Range Management* 23(1), January 1970, 50-55; B. H. Koerth, W. M. Webb, F. C. Bryant, and F. S. Guthery, "Cattle Trampling of Simulated Ground Nests Under Short Duration and Continuous Grazing," *Journal of Range Management* 36(3), May 1983, 385-386.

feed 3,562,000 bison annual during normal years of precipitation.

Herds of large ungulates do not generally maximize their numbers on the landscape, however. Wildlife ecologists indicate that herds attempt to find a medium point between the number of animals and the available resources. Once at this median, the population goes from an increasing rate to a decreasing rate as a simple logistic equation points out. In order to ebb and flow with the changes that may occur in the environment, migrating ungulate populations tend to use the landscape somewhere at about half of the overall carrying capacity. Taking the average number of bison from the standard and ecological methods, and reducing by half suggests that the Basin's overall bison population in the late 1600s was 1,781,000 animals. Divided by the 83,633 square miles of grasslands in the Basin, indicates that $21\frac{1}{4}$ bison required one square mile each year, or each bison that roamed the Basin required 30 acres.⁵



Vegetative Productivity - Richland County, Montana

Soil Name	Acres	Potential Vegetation			Totals Pounds/Acre		
		Wet	Normal	Dry	Wet	Normal	Dry
ADGER	2129	800	600	400	1703200	1277400	851600
BADLANDS	19682	0	0	0	0	0	0
BANKS	11113	3000	2600	2200	33339000	28893800	24448600
BENZ	4615	500	300	200	2307500	1384500	923000
BENZ-TREMBLES	2388	1250	950	700	2985000	2268600	1671600
BOWBELLS	3438	2600	2300	1900	8938800	7907400	6532200

⁵ Bolen and Robinson, *Wildlife Ecology*, 548-51; Caughley and Sinclair, *Wildlife Ecology*, 110-119; Sutherland, *From Individual Behaviour*, 111-113.

CHERRY	47844	1700	1500	1300	81334800	71766000	62197200
CHERRY COMPLEX	26164	1975	1575	1100	51673900	41208300	28780400
DAST-BLANCHARD	1336	1700	1350	900	2271200	1803600	1202400
DIMYAW	3336	1200	900	700	4003200	3002400	2335200
DOOLEY	1401	2000	1600	1000	2802000	2241600	1401000
FARNUF	10804	2000	1500	1000	21608000	16206000	10804000
HAVRELON	22551	1900	1500	1000	42846900	33826500	22551000
HAVRELON	9043	2000	1600	1200	18086000	14468800	10851600
HOFFMANVILLE	2363	1800	1300	1000	4253400	3071900	2363000
LAMBERT	6200	1800	1400	1000	11160000	8680000	6200000
LAMBERT	99590	1900	1500	1000	189221000	149385000	99590000
LAMBERT-BADLAND	81596	900	650	400	73436400	53037400	32638400
LAMBERT-BLANCHARD	9210	1250	925	600	11512500	8519250	5526000
LAMBERT-DIMYAW	110302	1050	775	550	115817100	85484050	60666100
LAMBERT-RINGLING	14034	900	925	400	12630600	12981450	5613600
LIHEN	5493	2600	2200	1800	14281800	12084600	9887400
LOHLER	16955	2000	1500	1000	33910000	25432500	16955000
LOHLER	820	5600	4000	1500	4592000	3280000	1230000
MARIAS	1471	1600	1400	900	2353600	2059400	1323900
RIDGELAWN	6957	2600	2200	1500	18088200	15305400	10435500
RIVERWASH	2365	0	0	0	0	0	0
SAVAGE	10233	1700	1300	900	17396100	13302900	9209700
SHAMBO	72351	1900	1500	1000	137466900	108526500	72351000
SHAMBO-LAMBERT	112039	1900	1500	1000	212874100	168058500	112039000
RECLAIMED LAND	505	0	0	0	0	0	0
TALLY	9091	1800	1400	900	16363800	12727400	8181900
TINSLEY	24751	800	600	400	19800800	14850600	9900400
TREMBLES	7759	2000	1600	1200	15518000	12414400	9310800
TURNER-BEAVERTON	15077	1500	1200	800	22615500	18092400	12061600
TYPIC HAPLAQUENT	18917	3500	3000	2000	66209500	56751000	37834000
VANDA	2428	1100	900	600	2670800	2185200	1456800
VIDA	203883	1500	1200	800	305824500	244659600	163106400
VIDA-ZAHILL	103800	1650	1300	900	171270000	134940000	93420000
WATER	12121	0	0	0	0	0	0
WILLIAMS	42650	1800	1500	1000	76770000	63975000	42650000
ZAHILL	94294	1200	1000	800	113152800	94294000	75435200
ZAHILL-LAMBERT	94001	1050	825	600	98701050	77550825	56400600
Totals	1347100	1628	1299	887	2041789950	1627904175	1130336100

Table 4. Sample of how soil data was organized and calculated for Richland County, Montana.

Montana Acreage

Counties	County Acres	Square Miles	Grassland Acres	Grassland Square Miles	Froested Acres
Bighorn	3209600	5015	3007400	4699	202200
Carbon	1321000	2064	1067000	1667	254000
Carter	2139300	3342	2139300	3342	
Custer	2428497	3794	2428497	3794	
Dawson	1525800	2384	1525800	2384	
Fallon	1039100	1623	1039100	1623	
Garfield	3102900	4848	3102900	4848	
Golden Valley	752200	1175	728500	1138	23700
McCone	1716500	2682	1716500	2682	
Musselshell	1197200	1870	1197200	1870	
Park	1708700	2669	757800	1184	950900
Petroleum	1071500	1674	1071500	1674	
Powder River	2212500	3457	2212500	3457	
Prairie	1114300	1741	1114300	1741	
Richland	1347100	2104	1347100	2104	
Rosebud	3418500	5341	3316600	5182	101900
Stillwater	1151800	1799	962200	1503	189600
Sweet Grass	1224200	1912	904100	1412	320100
Treasure	630300	984	630300	984	
Wheatland	911400	1424	840900	1313	70500
Wibaux	568900	888	568900	888	
Yellowstone	1694800	2648	1694800	2648	
Totals	35486097	55438	33373197	52137	2112900

Table 5. Acreage and square mile totals for Montana counties.

Wyoming Acreage

Counties	County Acres	Square Miles	Grassland Acres	Grassland Square Miles	Forested Acres
Big Horn	2007680	3137	1672972	2614	334708
Campbell	3074632	4804	3074632	4804	
Fremont	5877120	9183	4407840	6887	1469280
Hot Springs	1282560	2004	955486	1492	327074
Johnson	2666240	4166	2346751	3666	319489
Natrona	3431080	5361	3431080	5361	
Park	4443520	6943	1627182	2542	2816338

Sheridan	1615360	2524	1225230	1914	390082
Washakie	1433600	2240	1418454	2216	15146
Totals	25831792	40362	20159627	31496	5672117

Table 6. Acreage and square mile totals for Wyoming counties.

Montana Vegetative Production

Counties	County Acres	No. Soil Types	Average Potential Production			Productivity Pounds/Acre		
			Wet	Normal	Dry	Wet	Normal	Dry
Bighorn	3007400	265	2022	1499	926	5380060160	4047289235	2525590895
Carbon	1067000	117	1701	1386	1001	1568574060	1304920075	909749535
Carter	2139300	167	1453	1111	767	2823327910	2126148700	1463929505
Custer	2428497	224	1758	1368	907	3845839300	2950729700	1883520375
Dawson	1525800	55	1615	1288	922	2399835575	1899493800	1356693450
Fallon	1039100	138	1720	1407	984	1651648400	1336532925	928829350
Garfield	3102900	N/D	1525	1225	875	4731922500	3801052500	2715037500
Golden Valley	728500	N/D	1750	1400	1000	1274875000	1019900000	728500000
McCone	1716500	145	1683	1355	990	2703760125	2177592150	1561030425
Musselshell	1197200	N/D	1550	1225	850	1855660000	1466570000	1017620000
Park	757800	N/D	1975	1575	1150	1496655000	1193535000	871470000
Petroleum	1071500	102	1456	1165	821	1459633225	1156767150	812216075
Powder River	2212500	61	1296	1059	787	2332661600	1828074800	1295176400
Prairie	1114300	125	1585	1226	910	1654651450	1279835700	951074800
Richland	1347100	50	1628	1299	887	2041789950	1627904175	1130336100
Rosebud	3316600	175	1444	1123	780	4653877925	3490762400	2447626150
Stillwater	962200	61	1834	1476	1098	1499762800	1190303300	848418750
Sweet Grass	904100	166	1972	1580	1157	1782465828	1428586928	1046114503
Treasure	630300	103	1678	1315	930	857016725	677792300	478124600
Wheatland	840900	N/D	1850	1475	1075	1555665000	1240327500	903967500
Wibaux	568900	49	1654	1338	945	917841650	745470525	513221775
Yellowstone	1694800	108	1716	1358	980	2443705000	1947407675	1375495550
Totals	33373197	2111	1603	1272	902	50931229183	39936996538	27763743238

Table 7. Average and total vegetative production for each Montana county.

Wyoming Vegetative Production

Counties	County Acres	No. Soil Types	Average Potential Production			Productivity Pounds/Acre		
			Wet	Normal	Dry	Wet	Normal	Dry
Big Horn	1672972	94	1156	901	625	1553979950	1188147850	814117600
Campbell	3074632	210	1787	1432	1014	5441967235	4310129900	2964791200
Fremont	4407840	237	1250	999	695	5006326400	3858147625	2534921400
Hot Springs	955486	41	1405	1073	722	1348662275	1035375450	698149250
Johnson	2346751	275	1666	1294	834	3356478850	2594789800	1646067800
Natrona	3431080	201	1265	989	634	4017458000	3146121540	1942334495
Park	1627182	120	1029	776	520	1550364950	1169540200	780855350
Sheridan	1225230	167	2300	1754	1181	2519142820	1902508790	1245662550
Washakie	1418454	77	1360	1079	749	1459029550	1118715050	737826025
Totals	20159627	1422	1469	1144	775	26253410030	20323476205	13364725670

Table 8. Average and total vegetative production for each Wyoming county.

Wyoming Carrying Capacity

Counties	Grassland Acres	Standard Carrying Capacity			Ecological Carrying Capacity		
		Wet	Normal	Dry	Wet	Normal	Dry
Big Horn	1672972	96712	73931	50644	86990	66505	45550
Campbell	3074632	338749	268270	184498	304696	241303	165950
Fremont	4407840	311622	240123	157738	280293	215985	141863
Hot Springs	955486	83957	64449	43453	75517	57970	39081
Johnson	2346751	208895	161464	102393	187888	145229	92093
Natrona	3431080	250054	195799	120846	224916	176108	108683
Park	1627182	96484	72765	48561	86778	65446	43677
Sheridan	1225230	156776	118379	77477	141016	106473	69685
Washakie	1418454	90815	69628	45911	81675	62616	41284
Totals	20159627	1634064	1264808	831521	1469769	1137635	747866

Table 9. Carrying capacity for Wyoming counties.

Montana Carrying Capacity

Counties	Grassland Acres	Standard Carrying Capacity			Ecological Carrying Capacity		
		Wet	Normal	Dry	Wet	Normal	Dry
Bighorn	3007400	334872	251880	157133	301198	226551	141321
Carbon	1067000	97614	81197	56589	87798	73033	50899

Carter	2139300	175715	132303	91067	158054	119005	81910
Custer	2428497	239369	183622	117175	215297	165162	105388
Dawson	1525800	149407	118250	84455	134386	106364	75964
Fallon	1039100	102776	83155	57772	92445	74795	51960
Garfield	3102900	294640	236678	169055	265029	212892	152065
Golden Valley	728500	79382	63505	45361	71404	57123	40802
McCone	1716500	168284	135525	97132	151370	121898	87362
Musselshell	1197200	115545	91318	63363	103933	82140	56995
Park	757800	93191	74317	54263	83825	66848	48809
Petroleum	1071500	90840	71982	50527	81712	64744	45442
Powder River	2212500	145223	113805	80616	130623	102364	72513
Prairie	1114300	102974	79631	59159	92615	71626	53213
Richland	1347100	127114	101347	70365	114341	91160	63289
Rosebud	3316600	289696	217273	152312	260572	195426	137003
Stillwater	962200	93360	74092	52803	83973	66642	47494
Sweet Grass	904100	110987	88953	65137	99833	80013	58591
Treasure	630300	53315	42153	29718	47951	37912	26731
Wheatland	840900	96865	77230	56286	87130	69469	50630
Wibaux	568900	57133	46391	31934	51383	41732	28724
Yellowstone	1694800	152113	121205	85600	136818	109020	76980
Totals	33373197	3170415	2485812	1727822	2851690	2235919	1554085

Table 10. Carrying capacity for Montana counties.

APPENDIX B
TREE-RING DATA

Tree-ring data is from the National Oceanic and Atmospheric Administration's World Data Center for Paleoclimatology in Boulder, Colorado.¹ They have developed a 2° latitude by 3° longitude grid system for summer drought reconstruction for the continental United States based on established tree-ring chronologies. Each grid point spans a 150-km (93 mile) radius and is considered one cell (Figure 10). All tree-ring chronology data stations from within each radius were used. If the minimal of five stations were not in the radius, the next closest were used.

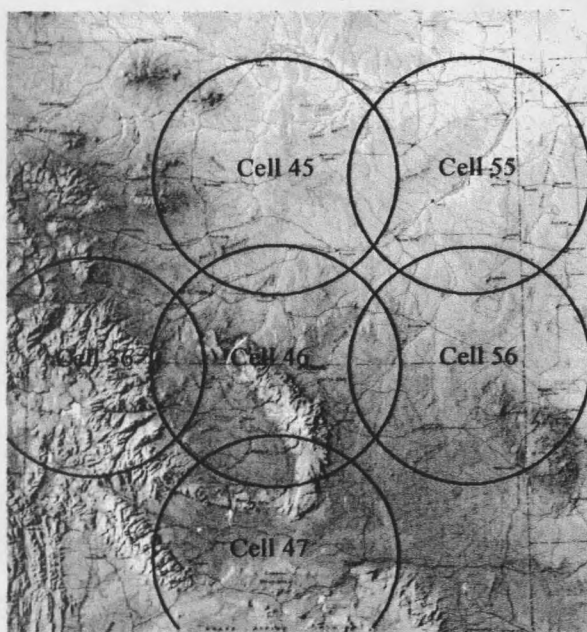


Figure 10. Location of the six cell radii grid points used in this study.

Yearly tree-ring chronologies were based on the Palmer Drought Severity Index (PDSI), a widely used measure of drought and wetness. Based on the chronologies, each year has a corresponding PDSI number. Of the six grid points that covered the study area, cells 45 and 46 in the middle of the Basin had tree-ring chronologies beginning in 1652.

Chronologies for Cell 55 started in 1677

¹ Tree-ring data from Cook, et al., *Reconstruction of Past Drought*, and available on the web at: www.ngdc.noaa.gov/paleo. Method used to reconstruct data is from, Cook, et al., "Drought Reconstructions," 1145-1162. Co-author David M. Meko from the Tree-Ring Laboratory at the University of Arizona, advised in the reconstruction of PDSI data for the Yellowstone River Basin.

and Cell 56 in 1692. The remaining two Cells, 36 and 47 had chronologies beginning in 1701. Yearly cell data was listed chronologically with years averaged together (Table 11). This average reflects the moisture condition for that year, and was used to determine the level of vegetative productivity — wet, normal, and dry — for the Basin's carrying capacity. Yearly figures spanned between five and negative five, with zero the median point and positive numbers representing moister conditions and negative numbers drier. Between 1.1 and -1.1 indicates normal summer precipitation. From 1.1 to 2 and -1.1 to -2 represents slightly moister and drier conditions, respectively. PDSI numbers more than 2 and -2 were considered more extreme conditions (Figure 11).

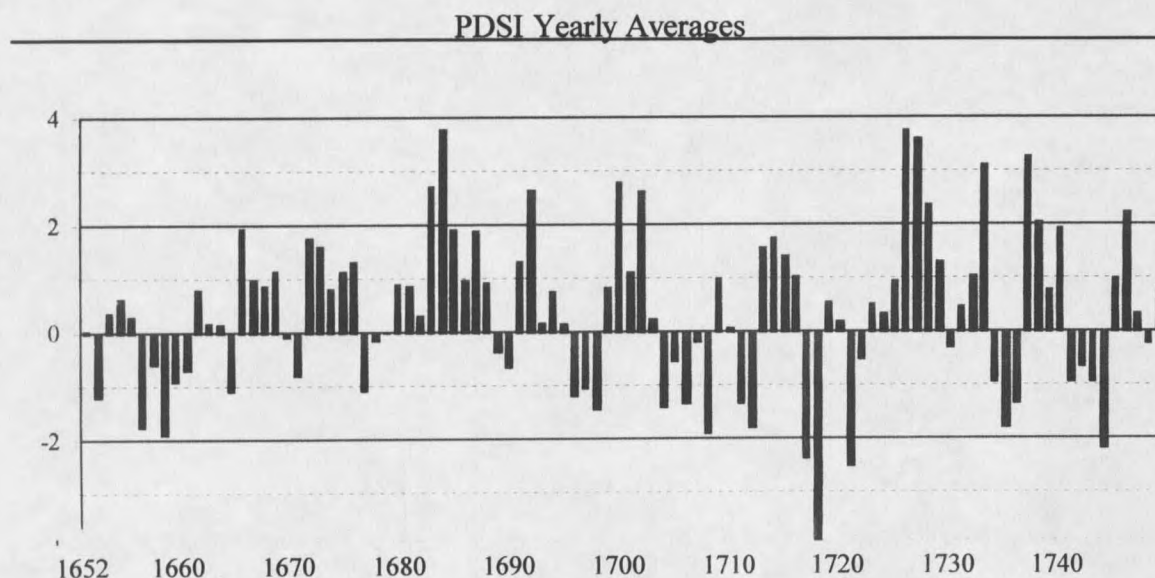


Figure 11. Average yearly PDSI cell data for Yellowstone River Basin.

Cell Data: 1652-1750

Year	Cell 36	Cell 45	Cell 46	Cell 47	Cell 55	Cell 56	Environmental Condition			
							Yearly Average	Wet	Normal	Extremely Dry Wet Dry
1652		-0.207	0.299				0.05		x	
1653		-1.728	-0.671				-1.20			x
1654		0.336	0.433				0.38		x	
1655		0.799	0.505				0.65		x	
1656		1.06	-0.442				0.31		x	
1657		-1.603	-1.876				-1.74			x
1658		-0.39	-0.753				-0.57		x	
1659		-1.861	-1.927				-1.89			x
1660		-1.011	-0.785				-0.90		x	
1661		-1.145	-0.255				-0.70		x	
1662		1.226	0.401				0.81		x	
1663		-0.293	0.678				0.19		x	
1664		0.417	-0.09				0.16		x	
1665		-1.492	-0.666				-1.08		x	
1666		2.059	1.832				1.95	x		
1667		0.798	1.209				1.00		x	
1668		1.101	0.665				0.88		x	
1669		1.285	1.042				1.16	x		
1670		-0.435	0.267				-0.08		x	
1671		-1.566	0.01				-0.78		x	
1672		2.133	1.416				1.77	x		
1673		1.587	1.638				1.61	x		
1674		0.224	1.438				0.83		x	
1675		1.32	0.972				1.15	x		
1676		0.976	1.69				1.33	x		
1677		-1.418	-0.773		-1.045		-1.08		x	
1678		-0.212	0.71		-0.911		-0.14		x	
1679		0.398	-0.77		0.435		0.02		x	
1680		0.559	1.039		1.127		0.91		x	
1681		0.913	0.859		0.827		0.87		x	
1682		-0.03	-0.158		1.138		0.32		x	
1683		2.528	2.825		2.851		2.73	x		x
1684		3.613	3.439		4.319		3.79	x		x
1685		1.105	1.766		2.899		1.92	x		
1686		1.185	-0.121		1.882		0.98		x	
1687		1.854	1.986		1.861		1.90	x		
1688		-0.295	1.735		1.359		0.93		x	
1689		-0.867	0.052		-0.283		-0.37		x	

Year	Cells						Yearly					
	36	45	46	47	55	56	Ave.	W	N	D	W	D
1690		-0.86	-0.59		-0.48		-0.64		x			
1691		0.699	1.48		1.798		1.33	x				
1692		2.423	2.627		3.279	2.274	2.65	x			x	
1693		0.209	-0.359		1.337	-0.468	0.18		x			
1694		0.653	0.957		0.782	0.647	0.76		x			
1695		-0.391	-0.783		0.647	1.156	0.16		x			
1696		-1.53	-0.775		-1.219	-1.144	-1.17			x		
1697		-1.086	-0.142		-1.023	-1.956	-1.05		x			
1698		-1.659	0.08		-1.276	-2.857	-1.43			x		
1699		1.145	1.58		1.057	-0.44	0.84		x			
1700		2.608	3.453		4.084	1.037	2.80	x			x	
1701	2.141	0.059	1.316	1.195	1.918	0.165	1.13	x				
1702	3.355	2.68	3.211	1.42	3.001	2.127	2.63	x			x	
1703	1.194	0.337	-0.218	-1.101	1.065	0.207	0.25		x			
1704	-0.755	-1.388	-1.919	-1.177	-1.398	-1.851	-1.41			x		
1705	0.258	-0.597	-1.17	0.217	-0.288	-1.802	-0.56		x			
1706	-0.015	-0.946	-1.675	-0.814	-1.251	-3.367	-1.34			x		
1707	-0.157	0.169	-0.121	-0.12	-0.131	-0.787	-0.19		x			
1708	-2.214	-1.781	-1.873	-1.288	-1.706	-2.544	-1.90			x		
1709	0.961	1.802	1.454	-1.252	2.476	0.581	1.00		x			
1710	-0.314	0.151	-0.152	0.102	0.183	0.517	0.08		x			
1711	-0.815	-0.968	-1.418	-1.162	-1.894	-1.806	-1.34			x		
1712	-1.581	-1.926	-1.18	-0.814	-2.216	-3.028	-1.79			x		
1713	1.633	2.258	2.532	0.035	2.559	0.437	1.58	x				
1714	0.765	2.681	1.836	0.543	3.097	1.597	1.75	x				
1715	1.148	1.843	1.407	0.584	2.644	0.902	1.42	x				
1716	0.872	1.086	0.778	0.094	2.107	1.317	1.04		x			
1717	-2.39	-2.68	-3.14	-1.65	-1.61	-2.8	-2.38			x		x
1718	-3.72	-5.46	-4.04	-0.59	-5.57	-5.78	-4.19			x		x
1719	0.395	0.457	1.296	2.635	-0.84	-0.6	0.56		x			
1720	-0.48	-0.17	-0.1	2.212	-0.67	0.369	0.20		x			
1721	-2.63	-3.37	-2.77	-0.69	-2.85	-2.82	-2.52			x		x
1722	-1.4	0.18	-0.192	0.208	-0.841	-0.95	-0.50		x			
1723	0.002	0.678	0.733	0.392	0.362	1.041	0.53		x			
1724	0.557	1.164	0.177	-0.273	0.945	-0.447	0.35		x			
1725	1.696	0.418	0.976	1.401	1.721	-0.517	0.95		x			
1726	4.349	2.604	4.028	3.883	4.308	3.42	3.77	x			x	
1727	4.567	2.516	4.128	2.129	4.369	4.021	3.62	x			x	
1728	3.042	3.043	1.977	-0.764	4.28	2.705	2.38	x			x	
1729	0.694	1.804	0.484	-0.5	2.644	2.742	1.31	x				
1730	-0.353	-0.003	-0.138	-1.388	0.485	-0.303	-0.28		x			

	Cells						Yearly					
Year	36	45	46	47	55	56	Ave.	W	N	D	W	D
1731	0.33	0.479	0.945	0.156	1.736	-0.773	0.48		x			
1732	1.099	1.219	1.661	0.772	1.945	-0.409	1.05		x			
1733	3.118	3.401	3.286	0.943	5.099	2.877	3.12	x			x	
1734	-0.374	-1.116	-1.575	-0.495	-0.574	-1.461	-0.93		x			
1735	-1.569	-1.75	-2.451	-1.558	-0.687	-2.741	-1.79			x		
1736	0.137	-0.87	-0.372	-1.4	-1.381	-4.022	-1.32			x		
1737	3.37	4.539	3.943	1.192	4.714	1.951	3.28	x			x	
1738	1.304	2.27	2.214	0.923	2.84	2.776	2.05	x			x	
1739	0.341	-0.094	0.172	-0.261	2.642	1.945	0.79		x			
1740	-0.15	2.249	1.292	0.063	4.014	4.187	1.94	x				
1741	-0.045	-1.569	-1.154	-1.062	-0.181	-1.503	-0.92		x			
1742	0.489	-0.561	-0.481	-1.5	0.27	-2.06	-0.64		x			
1743	-0.62	-0.078	-1.165	-1.727	0.02	-1.942	-0.92		x			
1744	-4.068	-1.885	-2.661	-1.297	-1.991	-1.237	-2.19			x		
1745	-0.423	2.341	1.004	0.341	2.104	0.65	1.00		x			
1746	2.349	2.199	2.811	1.245	3.069	1.692	2.23	x			x	
1747	0.692	-0.335	0.081	0.655	0.526	0.47	0.35		x			
1748	-0.003	-1.87	0.059	0.516	-0.492	0.447	-0.22		x			
1749	1.699	0.167	1.943	1.508	0.55	-0.814	0.84		x			
1750	3.909	3.957	4.03	1.253	4.377	1.934	3.24	x			x	
1751	1.645	-0.023	0.563	0.515	1.26	0.647	0.77		x			
1752	-1.552	-0.85	-0.454	-0.33	-0.711	0.329	-0.59		x			
1753	-1.331	0.275	-0.28	-0.159	0.481	-0.239	-0.21		x			
1754	-0.03	2.213	1.635	0.917	2.789	2.224	1.62	x				
1755	-0.953	-0.461	-0.48	-0.13	-0.339	-0.133	-0.42		x			
1756	-2.902	-4.283	-3.179	-2.157	-3.604	-4.48	-3.43			x		x
1757	-2.423	-2.03	-2.483	-2.48	-2.763	-5.697	-2.98			x		x
1758	-1.047	-0.099	-0.425	-1.384	-0.004	-4.574	-1.26			x		
1759	-2.239	-1.579	-2.473	-1.25	-1.326	-4.66	-2.25			x		x
1760	-0.877	-1.852	-1.135	-0.07	-1.089	-3.644	-1.44			x		
1761	1.891	2.192	2.806	2.484	2.31	1.207	2.15	x			x	
1762	0.88	0.712	0.728	-0.119	1.745	0.529	0.75		x			
1763	-0.155	0.031	0.005	-0.036	0.907	0.836	0.26		x			
1764	0.552	1.023	0.729	1.102	0.903	1.332	0.94		x			
1765	0.5	0.274	0.344	0.34	1.321	0.879	0.61		x			
1766	1.494	0.83	2.411	2.034	2.083	2.675	1.92	x				
1767	3.45	4.119	4.373	0.747	5.409	4.127	3.70	x			x	
1768	2.08	1.42	1.592	1.069	4.312	3.205	2.28	x			x	
1769	0.56	-1.518	-0.837	-0.124	0.241	-0.413	-0.35		x			
1770	0.571	-0.162	0.047	-0.004	1.078	-0.158	0.23		x			
1771	2.063	2.268	2.392	1.207	2.635	1.889	2.08	x			x	

Year	Cells						Yearly					
	36	45	46	47	55	56	Ave.	W	N	D	W	D
1772	2.326	-0.07	0.942	0.25	2.224	0.813	1.08		x			
1773	1.761	0.755	1.103	0.569	2.923	1.821	1.49	x				
1774	0.41	-0.076	0.766	1.575	1.25	1.303	0.87		x			
1775	3.878	3.724	3.796	1.766	4.814	3.513	3.58	x			x	
1776	3.306	1.012	2.123	1.139	2.275	1.758	1.94	x				
1777	3.379	1.234	2.335	1.423	2.866	2.657	2.32	x			x	
1778	4.099	3.772	2.963	1.347	5.639	5.721	3.92	x			x	
1779	2.083	0.728	0.767	0.351	2.805	2.67	1.57	x				
1780	2.293	1.538	1.489	0.587	2.217	2.065	1.70	x				
1781	0.165	0.385	-1.034	-1.956	1.406	-0.7	-0.29		x			
1782	-2.424	-1.919	-2.275	-1.386	-1.62	-2.48	-2.02			x		x
1783	-2.274	-1.478	-1.727	0.145	-1.804	-0.962	-1.35			x		
1784	-1.562	-0.667	-0.94	0.513	-1.305	-0.634	-0.77		x			
1785	-1.794	-1.957	-1.702	-0.043	-2.296	-2.728	-1.75			x		
1786	0.525	1.764	0.826	-0.533	1.105	0.307	0.67		x			
1787	1.526	1.508	1.475	0.944	2.877	1.392	1.62	x				
1788	2.391	0.982	1.655	0.358	2.797	0.77	1.49	x				
1789	1.775	-0.026	0.764	-2.038	1.959	-1.529	0.15		x			
1790	0.318	-0.007	0.292	0.663	0.451	-0.723	0.17		x			
1791	0.693	-0.547	0.14	0.668	-0.82	-1.597	-0.24		x			
1792	1.328	-0.016	0.503	1.642	0.159	0.433	0.67		x			
1793	0.425	0.838	0.381	1.243	1.291	2.384	1.09		x			
1794	-0.471	-2.194	-0.736	0.863	-0.848	0.071	-0.55		x			
1795	-1.214	0.289	-0.447	0.558	1.486	0.993	0.28		x			
1796	-0.362	-1.289	-0.053	1.122	-0.556	0.537	-0.10		x			
1797	0.783	1.474	0.96	0.371	1.561	1.7	1.14	x				
1798	-1.177	-2.21	-1.782	-1.273	-1.151	-1.996	-1.60			x		
1799	0.566	-0.015	0.931	0.731	0.26	-0.718	0.29		x			
1800	-3.038	-3.707	-2.803	-0.624	-3.674	-3.761	-2.93			x		x
1801	-1.461	0.142	-0.306	0.061	-0.336	-0.988	-0.48		x			
1802	-0.322	0.459	-0.249	0.898	0.59	-0.089	0.21		x			
1803	0.911	0.883	1.208	1.419	1.928	1.899	1.37	x				
1804	0.816	1.408	0.501	-0.902	2.862	2.06	1.12	x				
1805	-1.167	-0.19	-1.216	-2.18	-0.075	-0.302	-0.86		x			
1806	-1.319	1.157	-0.195	-0.863	0.594	0.429	-0.03		x			
1807	-1.561	0.47	-0.989	-1.689	-0.171	-1.308	-0.87		x			
1808	-3.263	-4	-3.478	-0.927	-4.479	-4.957	-3.52			x		x
1809	-1.53	-0.411	-1.124	-1.631	-1.766	-3.825	-1.71			x		
1810	0.714	1.701	1.764	0.769	1.616	-0.857	0.95		x			
1811	1.804	1.217	2.195	1.417	2.532	1.118	1.71	x				
1812	0.316	-0.004	-0.289	-0.286	0.996	0.516	0.21		x			

Year	Cells						Yearly					
	36	45	46	47	55	56	Ave.	W	N	D	W	D
1813	0.444	1.094	0.662	-0.349	1.822	1.121	0.80		x			
1814	-0.295	0.457	-0.228	0.34	0.958	1.098	0.39		x			
1815	-0.675	-2.062	-0.877	0.578	-1.901	-1.221	-1.03		x			
1816	-1.484	-1.443	-0.669	0.685	-1.789	-1.255	-0.99		x			
1817	-1.7	-2.983	-2.346	-0.806	-3.701	-4.965	-2.75			x		x
1818	-1.301	-2.232	-1.466	-0.572	-2.8	-3.927	-2.05			x		x
1819	-1.282	-1.06	-0.677	0.119	-1.639	-2.162	-1.12			x		
1820	-0.014	0.057	0.495	-0.669	0.069	-1.289	-0.23		x			
1821	0.97	1.963	1.985	0.538	2.322	1.538	1.55	x				
1822	-1.316	-1.946	-1.026	-0.382	-1.068	-1.44	-1.20			x		
1823	-2.113	-3.059	-1.9	-1.296	-3.157	-4.444	-2.66			x		x
1824	-0.818	0.847	-0.453	-2.27	0.579	-2.823	-0.82		x			
1825	0.718	1.267	1.685	1.493	2.342	0.745	1.38	x				
1826	1.9	1.938	2.603	1.324	2.127	1.419	1.89	x				
1827	1.282	0.605	1.797	1.719	0.488	1.028	1.15	x				
1828	3.068	3.273	4.268	2.74	3.137	4.02	3.42	x			x	
1829	2.113	2.94	3.003	0.873	2.765	4.502	2.70	x			x	
1830	2.698	3.263	3.062	1.706	4.334	6.182	3.54	x			x	
1831	0.266	-0.975	-0.268	0.25	0.99	1.861	0.35		x			
1832	3.005	3.558	4.099	2.052	4.83	3.971	3.59	x			x	
1833	4.637	4.217	5.14	1.669	5.323	4.758	4.29	x			x	
1834	0.316	-0.648	0.561	-0.056	0.818	1.265	0.38		x			
1835	-0.25	1.476	0.758	0.864	2.108	1.207	1.03		x			
1836	0.728	0.316	1.488	2.463	0.723	0.992	1.12	x				
1837	2.3	1.449	2.15	2.297	1.863	2.02	2.01	x			x	
1838	2.51	1.014	2.477	2.989	0.887	1.021	1.82	x				
1839	4.525	2.61	3.95	2.026	2.27	1.32	2.78	x			x	
1840	1.116	-0.413	1.333	1.78	0.517	1.373	0.95		x			
1841	0.208	0.044	0.154	0.232	-0.367	-0.359	-0.01		x			
1842	-1.867	-1.458	-1.774	-2.834	-0.385	-0.828	-1.52			x		
1843	-0.956	0.761	-0.022	0.95	0.761	0.638	0.36		x			
1844	0.746	2.378	1.614	1.177	2.876	3.191	2.00	x			x	
1845	-1.512	-0.24	-1.716	-2.686	0.124	-0.56	-1.10			x		
1846	-2.933	-0.888	-2.759	-2.214	-0.429	-1.404	-1.77			x		
1847	-1.618	-0.324	-1	-1.818	-0.863	-1.704	-1.22			x		
1848	-2.453	-2.488	-2.289	-2.249	-2.96	-5.06	-2.92			x		x
1849	0.355	1.409	1.431	1.281	1.733	0.541	1.13	x				
1850	-0.032	-0.139	-0.398	-0.029	0.997	0.122	0.09		x			

Table 11. PDSI cell data, yearly average, and environmental conditions.

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