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Biogeography Final Paper

A Biogeographic History of the Plains Bison Focusing on Population and Range Dynamics

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General Description and Current Range

There are two subspecies of bison in North America, *Bos bison bison* (plains bison) and *Bos bison athabascae* (wood bison). This paper focuses on the *Bos bison bison* or more commonly referred to as the plains bison (Boyd, 2003). The average adult male bison is approximately 5'8'' tall and 10'2'' in length (Hornaday, 1889, p. 406). Although the plains bison is the smallest of the *Bison* genus adult bulls tend to weigh up to a ton, and cows usually weigh half to two-thirds of that weight (Pickering, 2006, p. 8). The general description of a bison-bison can be summarized by a depiction written by the Spanish historian De Solis in 1724 when he states, "It has crooked shoulders, with a bunch on its back like a camel; its flanks dry, its tail large, and its neck cover'd with hair like a lion. It is cloven footed, its head armed like that of a bull, which it resembles in fierceness, with no less strength and agility." (Hornaday, 1889, p. 373). This is a very comprehensive portrayal of an adult bison, however, the physique of a bison changes throughout its life. The bison calf is a much lighter uniform sandy color and has long wavy hair and it stands approximately 2'8'' tall and 4' in length (Hornaday, 1889, p. 397-398). By the time the calf becomes a yearling its coat darkens and horns start to develop. The legs are also proportionally longer and larger in the joints than those of the full-grown bison (Hornaday, 1889, p. 401). A male bison that is between the "yearling" stage and four years old is called a "spike" bull. A spike bull gets its name as its horns are perfectly straight or have only a slight curve. During this stage a spike bull begins growing tufts of hair on the hump of his back and legs and his beard has lengthened considerably. "He is active, alert, suspicious, and when he makes up his mind to run, the hunter may as well give up the chase." (Hornaday, 1889, p. 402). At four years of age the spike bull fully matures into an adult bull. However, the cow in the third year has similar characteristics to a spike bull, but only with smaller horns that have a well-defined curve. The horns are what immediately distinguishes the sexes. A mature cow has dark hair surrounding its face with no beard, and has lighter colored hair covering the body than that of an adult bull (Hornaday, 1889, p.406-407).

The current range of *Bison* in America is only a fraction of what it has been throughout the last 5,000 years. The factors that led to the reduction of the bison's range varied. 95 percent of extant bison today are part of a commercial operation for producing meat and other byproducts. Only a few thousand animals live in anything resembling a natural habitat

(Pickering, 2006, p.13). A dramatic decline of bison population occurred in the mid-19th century and the population marginally bounced back because of commercial interests. Today an estimated 25,000 bison are in public herds and 250,000 in private herds, compared to an estimated 20-30 million originally (U.S. Fish and Wildlife Service, 2014). Only recently have bison been reintroduced to natural habitats like tallgrass prairie sites. These sites are large enough to assess both the bison's influence on other biota and ecosystem process (Knapp et al., 1999, p. 39). Owing to the geographic limitations, the natural range demographics of plains bison have been difficult to study. Today bison are protected and studied largely within the confines of national parks, the biggest herd residing in the Yellowstone region.

Historical Distribution in North America

Early forms of the bison originated in Asia and slowly dispersed outward. During the Pleistocene, at least 600,000 years ago, the first wave of the bison's ancestors migrated to North America across the Bering Land Bridge (Pickering, 2006, p. 7). The second invasion occurred prior to the Wisconsin glaciation, approximately 90,000 years ago also by way of the Bering Land Bridge (Boyd, 2003, p. 19). The Bering Land Bridge was located at the present day Bering Strait, which is the water way that separates Alaska and Russia. During times of glaciation, sea levels dropped making the Bering Land Bridge a corridor used by a multitude of animals migrating from Asia to the Americas. As ice sheets began to retreat during the Holocene, about 10,000 years ago, it is likely that *B. occidentalis* hybridized with *B. antiquus* and produced the early plains bison (Boyd, 2003, p. 19). *B. antiquus*, the most prominent ancestor of the plains bison had an expansive range over the territory that exists today as the United States of America. In 1970, Frank Gilbert Roe inferred that around 5,000 years ago the migrant bison herds spent the summer in open grasslands and the winter in wooded valleys and hills, or in the lightly wooded to grassy transition zones between open grasslands and adjacent forests, yet movements often were irregular. On the other hand, resident herds likely occupied the lightly wooded valleys, hills, and transition zones the year round (Epp and Dyck, 2002, p. 325). The only main selectivity of a bison's range is having grasses readily available due to dietary habits. Because of this a buffalo's range, can be quite expansive as it was beginning 5,000 years ago and continuing up to the colonization of European settlers. William T. Hornaday in 1889 depicted the historical

range of bison as described by Europeans as they explored the new world. Hornaday starts on the east coast and works south. The District of Columbia has no indisputable evidence that bison inhabited it, but some suspicions persist that this area was a part of their range. There is also no evidence of bison ever residing in Maryland, however Hornaday, in 1889, had reason to believe that bison fossils could still possibly be found in Maryland. In 1620, it was reported by Col. William Bryd that bison occupied the state of Virginia, and in high numbers. Also in Virginia, it was noted that the Huguenot settlers in Manikintown had domesticated bison in 1701. In North and South Carolina, C. R. Moore and Professor Allen reported bison being present, but not in high numbers. The southernmost limit of the bison range in the United States was in Georgia. This was recorded in 1744 by Francis Moore. While bison were plentiful in southern Louisiana and Mississippi, they never inhabited Alabama. In Texas in 1530 a group of Spaniards were the first Europeans to discover bison in the New World. Furthermore, in both New Mexico and Idaho there is evidence that bison extensively inhabited these areas. However, bison were only ever present in the northeastern corner of Utah. The whole of the Midwest, including Minnesota, Wisconsin, Illinois, Indiana, and Ohio constituted a large portion of the range of the bison in America. It is also believed that bison occupied the states of New York and Pennsylvania (Hornaday, 1889, p. 378-386). The previous range distribution was also mapped by Hornaday and his work can be seen in Figure 1. Furthermore, the prehistoric migration to the Americas exponentially extended the bison's range, and consequently, made them one of the most common mega fauna in North America during the last 5,000 years.

Evolutionary Changes

Evolutionary changes lead to transformations in the morphology and size of bison. According to Delaney P. Boyd, 2003, the ancestors of all bison in the western hemisphere invaded the Americas twice. The invaders were the Eurasian large-horned steppe bison, *Bison priscus*, which invaded from Asia. They invaded for the first time during the Illinoian glaciation, about 600,000 years ago. After the ice sheets subsided, *B. priscus* moved south and evolved into the larger *Bison latifrons*. During the Wisconsin glaciation *B. latifrons* demonstrated a reduction in size which led to the emergence of a smaller species, *Bison antiquus*. At the same time this occurred, the second invasion of the Eurasian bison, *B. priscus*, again migrated to North America

across the Bering Land Bridge that had re-emerged. Because of this, during the Wisconsin Glaciation two allopatric populations of bison existed in North America. After a gradual reduction in size, *B. priscus* evolved into *Bison occidentalis*. Hybrids of *B. occidentalis* and *B. antiquus* evolved into modern day plains bison. However, *B. occidentalis* became increasingly restricted to northern woodlands and are most similar to wood bison today, while *B. antiquus* are more similar to plains bison (Boyd, 2003, p. 19-20).

Current understanding of bison's morphological traits can be attributed largely to the findings of George McJunkin in 1903. McJunkin was a farm hand in Alaska and one day while he was out breaking horses he spotted a large bone protruding from the side of an erosion gully (Flannery, 2001, p. 219). This discovery McJunkin stumbled upon was an almost completely preserved bison dating back to 36,000 years ago. Because of a chemical reaction on the surface of the skin it caused the bison's skin to turn blue. Scientists then named this mummified bison Blue Babe as a pun regarding Paul Bunyan's blue ox. The following quote is the description of Blue Babe by Gary Selinger in the University of Alaska's campus magazine. "The preservation of this bison carcass was so exceptional coagulated pockets of blood were discovered in the skin at the base of the claw and canine teeth punctured wounds inflicted by the lion. Muscle tissue scavenged by carnivores had a "beef jerky" texture and color. White greasy bone marrow remained in most of the long bones. The skin retained a layer of fat, although most of its hair was gone from slight decomposition. The hooves on all four feet were attached to the carcass, keeping their shape through the millennia." (Selinger, 1986). Furthermore, Dale Guthrie a professor at the University of Alaska explained at the 2002 Alaska Science Forum the morphologic differences between Blue Babe and present day plains bison. The most prominent feature are the horns. Present-day plains bison's horns have been exceptionally reduced and curve up rather than sticking straight out. The horns of Blue Babe also indicate its exact species to be *Bison priscus*. Blue Babe in contrast to plains bison, is a rich dark brown with black points on the face, legs, and tail. Also, Blue Babe lacked the long tufts of fur that give the forelegs of plains bison such a distinctive appearance. Blue Babe is significantly larger than plains bison and has a differently shaped hump that would have allowed it to hold its head up higher to search for predators. Other features including Blue Babe's teeth, his relative size to his female counterpart, and his drab color indicate that *Bison priscus* did not congregate in large crowds, and males foraged for food away from females. It is clear that most of the morphological changes in *Bison*

priscus occurred as the species adjusted to life in a herd. Specifically, shorter horns likely allowed for individuals to be closer while grazing. The change in hump shape allowed for a bison's head, while in a resting position, to hang closer to the ground. Furthermore, teeth and jaw modifications now allow bison to take in more food with each bite which is necessary while living in a crowd. However, the push to a herd lifestyle was likely caused by the introduction of humans as predators which occurred approximately 12,950 years ago (Flannery, 2001). Consequently, prehistoric human hunting shaped the evolutionary adaptations taken by bison as well as their distribution.

19th Century Decline in Population

In recent history humans have drastically influenced the population and distribution of bison in the United States. When the first European settlers came to the new world, many of the Native American groups they saw were sustained by the bison. The hides, hooves, sinews and virtually all other parts of the body were transformed into objects for daily or ritual use. Yet from archeological evidence it is also clear that there were times when many more bison were killed than were consumed (Pickering, 2006, p. 9). Although some may say that Native Americans began the first exploitation of bison, European travelers recorded early proposed population numbers in the tens of millions. Most scientists today estimate the population to have been about 60 million in the United States at that time, (Boyd, 2003, p. 20) making Native American waste of bison insignificant. It was not until the mid-19th century that overhunting of bison became an issue. Demand for bison products and harsh relationships between the U.S. government and plains Native Americans were the two principal factors in the almost extermination of the bison in the 19th century. In the early 1800s, European settlers established trade amongst the Native Americans of the west and they soon realized how profitable bison were. Men out of a job after the civil war saw hide hunting as an opportunity to quickly prosper, and as the demand grew it attracted less-skilled hunters, thus increasing the amount of bison that were wasted (Adams and Dood, 2011). The pull of people to the west because of economic opportunities presented by the buffalo, as well as manifest destiny, was increased by the extension of railroads into buffalo territory. The railroads mangled their range and it split the population into two main herds – the northern and southern herds (U.S. Fish and Wildlife Services, 2014). Using a multitude of

sources, the US Bison Range Wildlife Refuge Complex, a branch of the US Fish and Wildlife Service, created a time line in 2014 examining the destruction of the plains buffalo. In 1844 the Hudson Bay Company traded with the Blackfeet Indians to obtain 75,000 bison robes. In 1870 an estimated two million bison were killed on the southern plains, marking the beginning of the destruction of the southern herd. Just a year later a firm in St. Louis traded 250,000 hides just in 1871. In the next couple of years an estimated 5,000 bison were killed every day. In 1874 it was reported that auctions in Fort Worth, Texas were moving 200,000 hides every day or two. 1874 also marked the end of the southern herd with an estimated four million bison killed off. Hunters then focused their attention on the northern herd and in 1881 one country in Montana shipped 180,000 buffalo skins back east. One hunt in the Dakota Territory killed over 10,000 bison in just a few days. By mid-year in 1883 nearly all bison in the United States were gone (U.S. Fish and Wildlife Services, 2014).

The overhunting of bison on the Great Plains had a purpose. The most logical of these purposes was the economic benefits the animal produced. The luxury goods provided by bison included robes, tongues, fine leather products, and refined sugar, fertilizer, and china made from the bones. The other reason why so many bison were slaughtered was because it was a direct way to rapidly destroy the Native American culture. The U.S. government fully supported the slaughter of the bison as a means to subjugate the Native American tribes. Destroying the bison population meant starvation and destruction of one of the Indians only economical resources (Adams and Dood, 2011). The government's goal to starve out the Native Americans was not a secret as Columbus Delano, the Secretary of Interior for the Grant administration, publically voiced in his office's 1873 annual report. He stated, "I would not seriously regret the total disappearance of the buffalo from our western prairies, in its effect upon Indians. I would regard it rather as a means of hastening their sense of dependence upon the products of the soil and their own labors." (Pickering, 2006, p. 11). The negative connotations the government infused into the American society against Native Americans cannot be overlooked as an explanation for bison extermination. This, along with the short lived economic prosperity of the bison, reduced the population of buffalo in the United States almost to the point where they could not return.

Recovery Efforts

The disastrous turn of events in the 19th century led to a species with only about 1,000 individuals. One of the only positives to come out of the rapid decline in bison population was the haste it provided to conservationists worried about the future of the bison. Referring back to the 2014 time line created by the U.S. Fish and Wildlife Services, they also included the recovery response to the extermination of the bison in their timeline. From the 1860s to the early 1880s, states including Idaho, Arizona, Wyoming, Kansas, Colorado, Texas, New Mexico, the Dakota Territory, and Canada passed laws to protect the bison. However, these laws went unenforced because of the lack of motivation and funding. Change did not come in support of bison until 1905 when the American Bison Society was formed. The American Bison Society helped to reestablish herds and expand herds that had been founded previously. The society also successfully urged the government to host herds in national parks (U.S. Fish and Wildlife Services, 2014). Although bison population numbers have bounced back, the range they once possessed has yet to be reestablished. This is mainly because the majority of bison in the United States are in private herds and are raised only to be slaughtered. Moreover, the minority of bison are limited to the range of the national parks they are protected by, which do not make up their once expansive range. The sad truth is that the recovery of bison, driven by monetary incentives, was only possible by the raising of bison for the slaughter.

However, two modern day plans hope to partially reestablish the range of the bison. The Montana Big Open project, managed by the non-profit organization Montana Big Open, Inc., involves the restoration of approximately 15,000 square miles (38,850km²) of steppe grasslands in eastern Montana. The project's goal is to create and maintain conditions analogous to pre-European settlement, with bison as the focal species (Boyd, 2003, p. 99-100). The main objective for this project is to obtain scientific data. Another area concerned with bison populations with a basis in scientific research is the Konza prairie. The Konza prairie was selected in 1981 for the National Science Foundation's Long Term Ecological Research for a study concerning the effects of fire and climatic variability on the prairie. The researchers wanted to have the grasses on the prairie susceptible to bison grazing, as bison are a keystone species in steppe grasslands (Knapp et al., 1999, p. 49). The other major project focusing on buffalo conservation efforts is the Buffalo Commons' Million Acre Project. This project developed this idea of the Buffalo Commons. The producers of this project believe they could rejuvenate economically declining regions in the Great Plain by encouraging bison-oriented

tourism and a wildlife-based economy through the reintroduction of free-ranging bison to a large expanse of grassland (Boyd, 2003, p. 100). This plan, in contrast to the Montana Big Open plan is trying to revive an economically depressed area by also furthering a species in trouble. These recovery efforts are just the first steps in reacquiring the once extensive range and population the bison first encompassed.

“Plummeting from perhaps 40 million to 1,000 and then rebounding to 300,000 in less than 115 years, bison have gone through a genetic bottleneck that has not only affected their numbers but their genetic diversity and variability.” (Pickering, 2006, p. 12). This quote precisely describes the hardships faced by the bison beginning in the 16th century when the Americas were first explored by Europeans. So much knowledge has been obtained about the prehistoric world as well as human development and interactions with animals because of bison. Examining the historical evolution and distribution dynamic of the North American Bison, one can piece together what the world was like just from looking at the chronology of one species. Even though this species is no longer a dominant environmental feature across the country it has still been a source of valuable scientific information.



Figure 1

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