Introduction to Plains Bison

Introduction

In 2010, Montana Fish, Wildlife & Parks (FWP) began a process to evaluate the opportunity for establishing a wild plains bison population somewhere within the state. As part of the evaluation process, this public background document was created to compile the current body of knowledge pertaining to bison with an emphasis on Montana. The purpose of this document is not to make management recommendations or decisions, but rather to create the foundation for an informed public dialogue about the future of bison in the state of Montana.

The Montana Comprehensive Fish and Wildlife Conservation Strategy (CFWCS), released in 2005, was developed by FWP to help secure long-term federal funding needed to conserve and manage species. The CFWCS is aimed at ensuring that the citizens of Montana make fish and wildlife management decisions to actively prevent species from becoming threatened or endangered, and public involvement was a critical component of its development (FWP, 2005). The CFWCS identifies bison as a Tier I species, or one in "greatest conservation need" (FWP, 2005).

Should FWP move forward with a formal evaluation of the potential for a bison restoration program, the evaluation would have to progress through the Montana Environmental Policy Act (MEPA) process, which includes extensive public comment opportunity.

Taxonomy and Systematics

The taxonomic relationship between bison and cattle has been a source of debate for several decades. The American Plains Bison was originally classified in 1758 by Linnaeus as a member of the *Bos* genus alongside domestic cattle (Forseman, 2001). It is speculated that bison and cattle both evolved from a common ancestor, *Leptobos,* though it is possible that *Leptobos* was a closely related taxon (McDonald, 1981). The two species are believed to have branched from *Leptobos* in the late Pliocene and continued to evolve to fill separate niches (McDonald, 1981). The two species have distinct adaptations, which indicate that they developed to adapt within separate habitat niches. Bison have adaptations associated with the savanna-steppe habitat, which include less selective feeding, the ability to digest coarse fiber, marked seasonality adaptations, large groups, class hierarchy, non-lethal fighting apparatus and technique, and migratory-nomadic behavior (Guthrie, 1980). Cattle fit woodland adaptations, which include selective feeding strategies, reduced seasonal adaptations, small groups, linear or modified linear hierarchy, territorial fidelity, conservative social organs, and lethal fighting apparatus (Guthrie, 1980).

In 1827 Hamilton Smith determined that the American and European bison were anatomically distinct and should be separated from the other members of the *Bos* genus

into their own subgenus, *Bison* (Skinner and Kaisen, 1974; Shaw and Meagher, 2000). The subgenus *Bison* was elevated to the level of genus in 1849 (Skinner and Kaisen, 1974). Recent advances in DNA analysis indicate that there should not be a distinction between the *Bos* and *Bison* genera (Douglas et al., 2010). Douglas et al. (2010) note that "the recent accumulation of molecular data, together with the fact that members of *Bison* can produce viable offspring with several species of *Bos* (van Gelder, 1977) indicate that the *Bison* and *Bos* genera should be reunited" (pp. 8).

Though recognizing that new DNA findings may have implications as to the taxonomic classification of bison, in keeping with the naming conventions used by the U.S. Fish and Wildlife Service (USFWS) and by the American Bison Specialist Group of the International Union for Conservation of Nature, this document will adhere to the recognition of the separate genus of *Bison*.

Traditionally, within the *Bison* genus there are two recognized subspecies, plains bison (*Bison bison bison*) and wood bison (*Bison bison athabascae*)(Skinner and Kaisen, 1974; van Zyll de Jong, 1986). Plains bison are the subspecies that historically occupied present-day Montana. The two subspecies are believed to have diverged approximately 5,000 years ago during geographical separation (van Zyll de Jong, 1986). Subspecies are defined as having numerous observable morphological differences, genetic divergences, and populations that reproduce in isolation from one another (Winston, 1999). It is possible for natural hybridization between subspecies; however, the hybrid may experience reduced fitness and fertility (Winston, 1999).

The two bison subspecies have a number of phenotypical differences (see Table 1) that support their distinction, and studies of DNA microsatellites by Wilson and Strobeck (1999) indicate that there is a greater genetic distance between the two subspecies than there is within each of the subspecies. However, the recent advances in the analysis of DNA indicating that there should not be separate *Bison* and *Bos* genera have also suggested that there is not a significant difference with respect to the mitochondrial genetic sequences of the plains and wood subspecies (Douglas et al., 2010). Based on these findings Douglas et al. (2010) note that plains bison and wood bison should not be considered separate subspecies. It is unclear as to whether wood bison were ever a genetically separate subspecies, or if it was the introduction of large numbers of plains bison into wood bison herds in the early 1900s that resulted in their similar genetic sequences (Douglas et al., 2010). While scientific debate continues as to whether the two subspecies of bison are unique enough to warrant separation, wood bison are an important source of genetic diversity for the species (Douglas et al., 2010), and therefore it is important to conserve the biodiversity within the species through the distinction of the subspecies. This document addresses the ecology, management, and status of plains bison. The term bison within this document, unless otherwise specified, refers to plains bison, *Bison bison bison*.

Plains bison *Bison bison* ***bison***	Wood bison *Bison bison* ***athabascae***
	
Pelage characteristics	
Dense woolly bonnet of hair between horns	Forelock dark, hanging in strands over forehead
Thick beard and full throat mane, extending below rib cage	Thin beard and rudimentary throat mane
Well-developed chaps	Reduced chaps
Well-demarcated cape, lighter in colour than wood bison	No clear cape demarcation, hair usually darker than plains bison
Structural Characteristics	
Highest point of the hump over front legs	Highest point of the hump forward of front legs
Horns rarely extend above bonnet	Horns usually extend above forelock
Smaller and lighter than the wood bison (within similar age and sex classes)	Larger and heavier than plains bison (within similar age and sex classes)

Table 1. Comparison of Structural and Pelage Characteristics for the Two Bison Subspecies. Originally published in Gates et al. (2010).

Species Description

Male bison. PHOTO CREDIT: S. ADAMS

Bison are the largest terrestrial mammal in North America; however, the weight and measurements of bison differ considerably by age and sex and among different populations (Reynolds et al., 2003). Males, referred to as bulls, average between 1,000 to 2,000 pounds, and females, known as cows, average between 800 and 1,000 pounds (Meagher, 1973; Reynolds et al., 2003; Burde and Feldhamer, 2005; Picton, 2005). Males attain their greatest mass between 10 and 15 years of age (Berger and Cunningham, 1994a). The shoulder height ranges between 5 feet 5 inches and 6 feet 5 inches in males, and between 4 feet 5 inches and 5 feet 5 inches in females (Meagher, 1978). Though similar in appearance, bull and cow bison are sexually dimorphic, and therefore do have observable morphological differences (Meagher, 1973; Reynolds et al., 2003). Birth weight for a free-ranging bison calf averages between 32 and 70 pounds, and on average calves gain 1.2 to 2 pounds per day until they are weaned (Feist, 1999; Burde and Feldhamer, 2005).

Despite their large stature bison are extremely agile, with the ability to reach substantial speeds of approximately 30 to 35 mph, and jump upward of 6 feet high (USFWS, 1997; Lott, 2002). A common misperception is that bison are plodding and cumbersome, though nothing could be further from the truth. The preeminent naturalist John J. Audubon was astonished by the agility of plains bison. Though people associate bison with the flat prairies, they possess remarkable climbing ability. "The activity of Buffaloes is almost beyond belief," Audubon observed, "they can climb the steep defile of the Mauvaises Terres (Bad Lands) in hundreds of places where men cannot follow them" (Brink, 2008, pp. 29).

The unique physical characteristics that cause bison to be easily recognized played an important role in their historic success in North America. The large low-hanging head is equipped with a relatively straight row of incisors on a broad lower jaw. This adaptation allows bison to efficiently gather large amounts of low-growing vegetation (Geist, 1996; Picton, 2005). In order to support the large weight of their head, bison have a prominent rounded hump located above the shoulder, which contains muscles that are attached to neural spines that rise from their vertebrae (Picton, 2005). The forward position of the hump allows bison to utilize quick pivots combined with a disemboweling hooking defense against predatory attacks, and during male competition (Picton, 2005).

The head and the front legs of a mature bison are covered with dense chocolate-colored hair. The hair on the shoulders and hump averages 6 inches in thickness, and the hair on the forehead can be in excess of 8 inches in length (Meagher, 1973; Foresman, 2001). "Bison have about ten times more hair per square inch of hide than do modern

cattle. Bison hair is thinner than that of cattle, but is much denser" (Brink, 2008, pp. 172). This hair plays a crucial role in insulating the bison against extreme environmental conditions, as well as protecting the bison from predatory attacks and injuries that may occur during male competition (Meagher, 1973; Foresman, 2001; Picton, 2005). The remainder of the body is covered in coppery-colored hair that averages an inch in length (Meagher, 1973). Bison calves are a reddish tan at birth and begin to darken around three months (Meagher, 1973; Picton, 2005).

PHOTO CREDIT: S. ADAMS

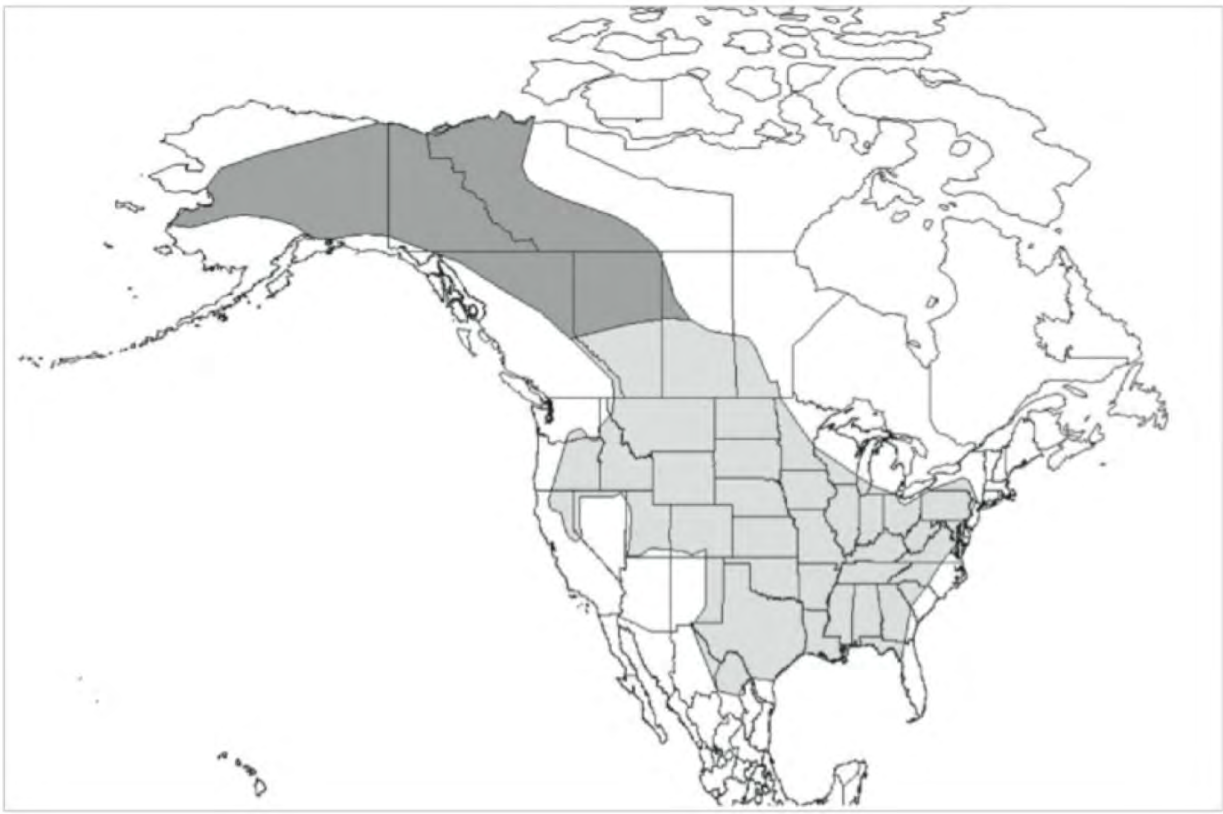
Both the male and female bison have short, upcurved, sharp horns, which are retained throughout their lifetime (Nowak and Paradiso, 1983; Long, 2003). A bull's horns can reach 20 inches in length, while the horns of the cow remain shorter (Burde and Feldhamer, 2005). The horns play an important role in defense against predation, as well as during competition between males over breeding rights during the mating season, referred to as the rut (Picton, 2005).

Prehistoric and Historic Distribution

The modern American Plains Bison descended from an ancestor that originated in southern Asia approximately two million years ago (Danz, 1997). This early ancestral bison was widely distributed throughout much of Europe and Asia (Shapiro et al., 2004). With the formation of the Bering Land Bridge during the Illinoian Ice Age, the steppe bison, *Bison priscus,* an early predecessor of modern bison, migrated into Alaska between 300,000 and 129,000 years ago (Shapiro et al., 2004; Picton, 2005). Ancestral bison flourished upon reaching the North American continent, and slowly evolved into the present-day forms, plains bison and wood bison.

The historic distribution of bison covered most of the North American continent (Hornaday, 1889; Gates et al., 2010). Guthrie (1980) notes that while historic forms of bison were found throughout North America, the greatest concentration were found along a line from Alberta to Texas, just east of the Rocky Mountains, and in the intermontane basins located just to the west. The largest concentration of bison occupied the Great Plains, which extends east to the Missouri River valley and west to the Front Range of the Rocky Mountains. The Great Plains also extends from Canada to Mexico, and is the largest biome in North America (Isenberg, 2000). Isenberg (2000) notes that the Great Plains consists primarily of short-grass and mixed-grass rolling plains, but also includes wooded river valleys and high, forested hills. Historically bison were also found eastward from the Great Lakes region to the eastern seaboard. Their distribution reached north into New

England and south into northern Florida. Bison also inhabited regions west of the Great Plain in parts of Nevada, Utah, New Mexico, Idaho, and the Cascade and Rocky Mountains. Their distribution extended north to the middle of Alberta, Saskatchewan, and Manitoba and south along the Gulf of Mexico and into Mexico (Hornaday, 1889; Reynolds et al., 1982; Danz, 1997; Picton, 2005; Gates et al., 2010).



Map 1: Original Ranges of Plains (light gray) and Wood (darker gray) Bison. Originally published in Gates et al. (2010); re-created by Boyd (2003) based on van Zyll de Jong (1986) and Stephenson et al. (2001).

Map 1 depicts one estimate of the early historic distribution of *Bison bison bison* (plains bison) and *Bison bison athabascae* (wood bison). There is archeological and historical evidence that bison and/or their ancestors were present in more regions of North America than are represented within this map (J. Fisher Jr. and T. Roll, Montana State University, personal communication).

Though bison were primarily located in the lower elevations of the plains, there are numerous reports of bison seasonally moving to high elevations within the Rocky Mountains, especially along the Front Range. Fryxell (1926) located skulls at approximately 9,500 feet, 10,500 feet, and 11,500 feet within the Snowy and Centennial ranges. Hornaday noted that bison had ranged to an elevation of 11,000 feet, based on a skull that was found at Two Ocean Pass within Yellowstone National Park (Fryxell, 1926).

Prehistoric and Historic Abundance

Historical estimates as to the abundance of bison present at one time on the Great Plains have ranged from 15 to 100 million bison (Dary, 1989; Shaw, 1995). These early estimations were derived by explorers upon seeing large herds of bison congregating during the summer mating season. "It is quite true that summer was the season of the great aggregation of herds on the Plains. Summer is the season when calves are dependent on their mothers and when safety from predators rests in large numbers. Likewise, nursing cows, who are weak and tied to their calves, need the protection of a large herd. Summer is the season when bulls want the company of the cows, to begin courting those they hope to include in their harem. Most importantly, summer is the season when grass is abundant and relatively nutritious, capable of supporting large herds in relatively small spaces" (Brink, 2008, pp. 61). In the summer of 1806, during his exploration of the Marias River, Meriwether Lewis remarked, "we passed immense herds of buffalo on our way; in short, for about 12 miles it appeared as one herd only, the whole plains and valley of this creek being covered with them" (Brandt, 2002, pp. 371).

Summer bison herd. PHOTO CREDIT: GYC

However, "summer was the only season in which massive herds blackened the Plains" (Brink, 2008, pp. 61). In the 1890s, Ernest Thompson Seton proposed the widely accepted estimate that the abundance of bison was actually closer to 60 million (Shaw and Meagher, 2000). Hornaday (1889) critiqued many of the early estimates and noted that "it would have been as easy to count or to estimate the number of leaves in a forest as to calculate the number of buffaloes living at any given time during the history of the species previous to 1870 (pp. 387). Recent studies of the environmental limitations of the semiarid grasslands that make up the Great Plains have lowered the estimated abundance of bison to no more than 30 million (Isenberg, 2000).