A Brief Review of the Status of Plains Bison in North America

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IN 1879, for the first time in the post-glacial history of the Great Plains, the bison hunt failed. It happened first in Canada, and then was repeated two years later in Montana (Foster 1992). Once numbering in the tens of millions, the plains bison (*Bison bison bison*) was driven to near extinction during a brief frenzy of exploitation. Commercial hunting for meat and hides by Native Americans and Euro-Americans was the proximal cause of the decline (Hornaday 1889; Isenberg 2000). Other contributing factors included subsistence hunting, indiscriminate slaughter for sport, transection of the plains by railroads, and political motivations (Hewitt 1919; Mayer and Roth 1958; Dary 1989; Geist 1996; Danz 1997). Environmental factors such as regional drought, introduced bovine diseases, and competition from domestic livestock and domestic and wild horses also played a role (Flores 1991; Isenberg 2000). The early conservation of plains bison was made possible through the independent actions of private citizens combined with protective legislation. Prominent leaders included James McKay and Charles Alloway (Manitoba), Charles Goodnight (Texas), Walking Coyote (Montana), Frederick Dupree (South Dakota), Charles J. "Buffalo" Jones (Kansas), and Michel Pablo and Charles Allard (Montana) (Coder 1975; Dary 1989). Their efforts to establish breeding herds from the few remaining bison resulted in preservation of foundation stock for much of the subsequent recovery of the subspecies.

In the United States, numerous bills to protect bison were introduced by members of Congress between 1871 and 1876, but no laws were enacted (Ogilvie 1979; Dary 1989; Danz 1997). Several state and territorial governments were able to enact legislation to protect bison during the last three decades of the 1800s; however, these laws were largely ineffective and unenforceable (Danz 1997). In 1872, President Grant created Yellowstone National Park (YNP) to protect all natural resources, including bison, within its borders. By 1894, however, poaching had reduced the park bison population from 200 to only 25 animals (Danz 1997). On May 7, 1894, President Cleveland signed the National Park Protective Act (Lacey Act), ameliorating the longstanding problem with jurisdiction and law enforcement in YNP. This was the first U.S. federal law to provide specific protection for bison. It carried a two-year jail term and a $1,000 fine for anyone removing mineral deposits, cutting timber, or killing game in YNP (Dary 1989; Danz 1997).

In Canada, official protection of bison began in 1877 with the passing of An Ordinance for the Protection of Buffalo (Ogilvie 1979; Gates *et al.* 2001). This act was nearly impossible to enforce by the small regiments of Northwest Mounted Police scattered across the plains, and was later repealed (MacEwan 1995). In 1883, the Ordinance for the Protection of Game was passed, but it was also ineffective (Ogilvie 1979). The government of the Dominion of Canada enacted the Unorganized Territories Game Preservation Act in 1894, in part as a response to reports that the wood bison (*B. b. athabascae*) population in northern Canada had declined to 250 (Ogilvie 1979). Enforcement of this legislation was minimal, however, until the Northwest Mounted Police was given an enforcement mandate in 1897 (Soper 1941).

Despite protective legislation, prior to 1907 plains bison in Canada were reduced to a small herd in Rocky Mountains Park (Banff) and a few animals near Winnipeg (Ogilvie 1979). In 1907, the Dominion of Canada purchased the entire Pablo-Allard herd (approximately 716 plains bison) from Michel Pablo of Montana. Four hundred and ten of these bison were temporarily held at Elk Island National Park (EINP) near Edmonton, Alberta until most were transported to Wainwright Buffalo Park in east-central Alberta; forty-eight bison were left at EINP, forming the nucleus of that national park herd (Coder 1975; Fuller 2002). The Pablo-Allard bison were subsequently used to establish herds in other Canadian national parks.

Founded in 1905, the American Bison Society pressed Congress to establish several public bison herds including Wichita Mountains National Wildlife Refuge, the National Bison Range, Sullys Hill National Game Preserve, and Fort Niobrara National Wildlife Refuge (Coder 1975). National parks in both the United States and Canada were also established in part to conserve bison and other large mammal populations (Ogilvie 1979).

Current Numerical and Geographic Status

Following protection from hunting, bison populations increased rapidly, doubling in number between 1888 and 1902; by 1909, the plains bison was considered safe from extinction (Coder 1975). Initially sparked by

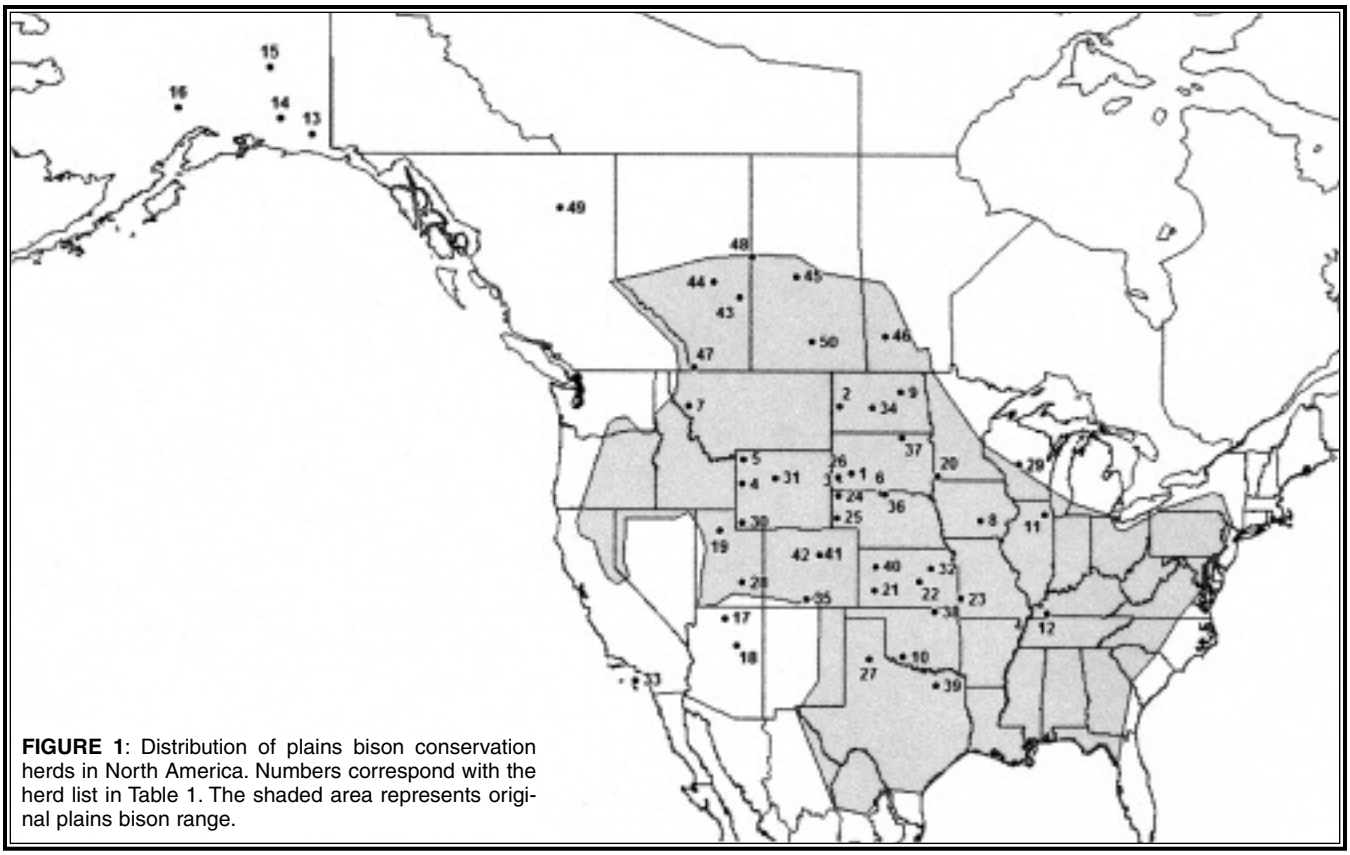

FIGURE 1: Distribution of plains bison conservation herds in North America. Numbers correspond with the herd list in Table 1. The shaded area represents original plains bison range.

reverence for the animal and nostalgia, motivations for bison conservation and recovery became increasingly driven by the animal's commercial value (Yorks and Capels 1998). By 1970, there were 30,000 plains bison in North America; approximately half were in public herds located in national parks, wildlife refuges, and state wildlife areas, and the other half were privately held (Shaw and Meagher 2000).

A recent survey of the numerical status of plains bison estimated that there are over 500,000 bison in North America including both commercial and conservation populations (Boyd 2003). Of these, 95 percent are under commercial production. Conservation herds enumerated in the survey included those managed by municipal, state, provincial, and federal governments, and private organizations having clear conservation objectives. There are fifty plains bison conservation herds in North America (Table 1), 32 percent of which have less than fifty bison (Boyd 2003). Thirteen herds have populations greater than 400 (Boyd 2003), the number currently estimated as the minimum viable population for bison (Gates *et al.* 2001). The number of plains bison in conservation herds is estimated at 19,200 with 90 percent in the United States, 10 percent in Canada, and none in Mexico (Boyd 2003). Only 22 percent of plains bison conservation herds are increasing in size. Most herds are within original plains bison range (Figure 1). Eight of the fifty herds are distinctly outside plains bison range (Arizona, California, northern British Columbia, and Alaska) (Boyd 2003).

Conservation Issues

The most important conservation-related issues essential to the survival and increase of bison herds are habitat, population genetics, disease, and legal issues.

Habitat

The plains bison was originally a land-intensive, nomadic species that roamed over great distances on the North American landscape. Large-bodied animals are especially vulnerable to the effects of habitat fragmentation because they require a large amount of space (Berger and Cunningham 1994). Fragmented populations can be more susceptible to inbreeding pressures, loss of genetic diversity, and extinction (Berger and Cunningham 1994). Conservation of plains bison is limited because most of the original range has experienced change from competing land uses including cultivation, cattle ranching, commercial bison ranching, natural resource extraction, and urban expansion (Johnson *et al.* 1994). These land uses constrain the potential of preserving or restoring large tracts of habitat for bison conservation.

Current plains bison conservation herds are widely scattered and isolated across the original range of the subspecies (Figure 1). Thirty-eight percent of conservation herds reside on ranges smaller than 10 km^2; 60 percent have ranges smaller than 100 km^2 (Boyd 2003). There is no range expansion potential for 52 percent of plains bison conservation herds. Of herds with expansion potential, only eleven are currently expanding by

	Herd	Location	Jurisdiction	Managing Authority	Population
UNITED STATES					
1	Badlands National Park	SD	Federal	U.S. National Parks Service	750
2	Theodore Roosevelt National Park	ND	Federal	U.S. National Parks Service	850
3	Wind Cave National Park	SD	Federal	U.S. National Parks Service	375
4	Grand Teton National Park/Nat. Elk Refuge	WY	Federal and State	U.S. NPS; U.S. FWS; WY Fish and Game Dept.	700
5	Yellowstone National Park	WY/MT	Federal and State	U.S. NPS, NFS, MT Fish and Parks, and MT Dept. of Livestock	4,000
6	Fort Niobrara National Wildlife Refuge	NE	Federal	U.S. Fish and Wildlife Service	352
7	National Bison Range	MT	Federal	U.S. Fish and Wildlife Service	400
8	Neal Smith National Wildlife Refuge	IA	Federal	U.S. Fish and Wildlife Service	35
9	Sullys Hill National Game Preserve	ND	Federal	U.S. Fish and Wildlife Service	37
10	Wichita Mountains National Wildlife Refuge	OK	Federal	U.S. Fish and Wildlife Service	565
11	Fermilab National Accelerator	IL	Federal	Department of Energy	32
12	Land Between the Lakes National Rec. Area	KY	Federal	USDA Forest Service	130
13	Chitina	AK	State	Alaska Department of Fish and Game	38
14	Copper River	AK	State	Alaska Department of Fish and Game	108
15	Delta Junction	AK	State	Alaska Department of Fish and Game	360
16	Farewell Lake	AK	State	Alaska Department of Fish and Game	400
17	House Rock State Wildlife Area	AZ	State	Arizona Fish and Game Department	217
18	Raymond State Wildlife Area	AZ	State	Arizona Fish and Game Department	72
19	Antelope Island State Park	UT	State	Department of Natural Resources, Division of Parks and Recreation	600
20	Blue Mounds State Park	MN	State	Department of Natural Resources, Division of Parks and Recreation	56
21	Finney Game Refuge	KS	State	Kansas Dept. of Wildlife and Parks	120
22	Maxwell Wildlife Refuge	KS	State	Kansas Dept. of Wildlife and Parks	230
23	Prairie State Park	MO	State	Missouri Dept. of Natural Resources	76
24	Fort Robinson State Park	NE	State	Nebraska Game and Parks	500
25	Wildcat Hills State Recreation Area	NE	State	Nebraska Game and Parks	10
26	Custer State Park	SD	State	South Dakota Game Fish & Parks Dept.	1,100
27	Caprock Canyons State Park	TX	State	Texas Parks and Wildlife Department	40
28	Henry Mountains	UT	State	Utah Division of Wildlife Resources	279
29	Sandhill Wildlife Area	WI	State	Wisconsin Dept. of Natural Resources	15
30	Bear River State Park	WY	State	Wyoming State Parks and Historic Sites	8
31	Hot Springs State Park	WY	State	Wyoming State Parks and Historic Sites	11
32	Konza Prairie Biological Station	KS	State and Foundation	K-State University, Division of Biology; The Nature Conservancy	275
33	Santa Catalina Island	CA	Foundation	Catalina Island Conservancy	225
34	Cross Ranch Nature Preserve	ND	Foundation	The Nature Conservancy	140
35	Medano-Zapata Ranch	CO	Foundation	The Nature Conservancy	1,500
36	Niobrara Valley Preserve	NE	Foundation	The Nature Conservancy	473
37	Ordway Prairie Preserve	SD	Foundation	The Nature Conservancy	255
38	Tallgrass Prairie Preserve	OK	Foundation	The Nature Conservancy	1,500
39	Clymer Meadow Preserve	TX	Foundation and Private	The Nature Conservancy; Private rancher	320
40	Smoky Valley Ranch	KS	Foundation	The Nature Conservancy	45
41	Daniels Park	CO	Municipal	Denver Parks and Recreation	26
42	Genesee Park	CO	Municipal	Denver Parks and Recreation	26
				Subtotal – United States	**17,251**
CANADA					
43	Camp Wainwright	AB	Federal	Department of National Defence	16
44	Elk Island National Park	AB	Federal	Parks Canada Agency	430
45	Prince Albert National Park	SK	Federal	Parks Canada Agency	310
46	Riding Mountain National Park	MB	Federal	Parks Canada Agency	33
47	Waterton Lakes National Park	AB	Federal	Parks Canada Agency	27
48	Primrose Lake Air Weapons Range (Cold Lake)	AB/SK	Federal and Provincial	Dept. of Nat'l Defence; SK Environment, Fish and Wildlife Branch	100
49	Pink Mountain	BC	Provincial	British Columbia Department of Water, Lands and Air Protection	1,000
50	Buffalo Pound Provincial Park	SK	Provincial	Saskatchewan Environment, Parks Branch	33
				Subtotal – Canada	**1,949**
				TOTAL – NORTH AMERICA	**19,200**

TABLE 1. Plains Bison Conservation Herds in North America (Boyd 2003). Numbers refer to locations on the distribution map in Figure 1.

natural dispersal or are being managed actively for expansion (Boyd 2003).

Genetics

Bison experienced a severe population decline in the nineteenth century. Since then, they have undergone artificial hybridization with cattle, been subject to domestication, and have been separated into isolated populations. All these factors could have affected the integrity of the bison genome.

Genetic diversity: At the species level, genetic diversity provides the mechanism for evolutionary change and adaptation (Allendorf and Leary 1986; Meffe and Carroll 1994; Chambers 1998). Reduction in genetic diversity can result in reduced fitness, diminished growth, increased mortality, and shrinking evolutionary flexibility of individuals within a population (Ballou and Ralls 1982; Mitton and Grant 1984; Allendorf and Leary 1986; Berger and Cunningham 1994). North American bison approached extinction in the late 1800s and experienced a severe demographic bottleneck. Consequently, extant bison populations may have lower genetic diversity compared to pre-decline populations. Inventories of genetic diversity held in conservation herds and studies of herd population dynamics are needed to develop genetic management plans for North American bison.

Hybridization: The concept of crossing bison with domestic cattle dates back to Spanish colonizers of the sixteenth century (Dary 1989). Cross-breeding was attempted in Virginia, the Carolinas, and Pennsylvania during the 1700s (Ogilvie 1979). In 1888, C. J. "Buffalo" Jones coined the term *catalo* to refer to hybrids between cattle and bison. Private ranchers involved with salvaging bison had aspirations of combining the hardiness and winter foraging ability of bison with the meat production traits of cattle through hybridization (Ogilvie 1979; Dary 1989). The Canadian government pursued experimental production of crossbred animals from 1916-1964 (Ogilvie 1979; Polziehn *et al.* 1995).

Historical cross-breeding attempts have created a legacy of genetic issues related to the introgression of cattle DNA into bison herds. *Introgression* refers to gene flow between populations caused by hybridization followed by backbreeding of the hybrid offspring to their respective parental populations (Rhymer and Simberloff 1996). The introgressed DNA displaces sections of the original genome, thereby affecting the genetic integrity of a species. Many contemporary bison herds are founded on, and supplemented with, animals from herds with a history of hybridization. Seven of fifty conservation herds currently show evidence of cattle DNA introgression (Ward *et al.* 1999; Ward 2000). There is a high percentage of untested herds (68 percent), creating a large information gap in understanding hybridization prevalence among plains bison conservation herds (Boyd 2003). Plains bison herds with no evidence of hybrids include all five U.S. National Park herds, two of five U.S. National Wildlife Refuge herds, the state-managed Henry Mountains herd in Utah, and the Elk Island National Park herd in Canada. These herds account for approximately 7,984 bison, or 42 percent of the total estimated plains bison in conservation populations (Boyd 2003).

Domestication: The commercial bison population in North America is at least 500,000 and growing. Ranchers continue to enter the bison industry to capitalize on economic opportunities afforded by bison. The increase in commercial bison production may reflect recognition of advantages afforded by the adaptations and ecological efficiency of bison as an indigenous range animal. Bison possess several traits that make them preferable to cattle as a range animal, including greater ability to digest low quality forage (Hawley *et al.* 1981), to defend against predators (Carbyn *et al.* 1993), and lower incidence of calving difficulties (Haigh *et al.* 2001). The primary goal of many commercial bison ranchers is to increase profit by maximizing calf production, feed-to-meat conversion efficiency, and meat quality (Schneider 1998). This requires nonrandom selection for traits that serve this purpose, including conformation, docility, reduced agility, growth performance, and carcass composition. Selection for these traits reduces genetic variation and changes the character of the animal over time (Hodgson 1994). The demand for bison meat cannot currently compete with the much larger scale of the beef production industry. Therefore, many bison producers apply cattle husbandry practices and standards to bison; standards that may be practical for the bison business, but will not maintain the bison genome.

Disease

Only one disease, bovine brucellosis, is of concern for plains bison conservation (Boyd 2003). Bovine brucellosis, also known as Bang's disease, is caused by infection with the bacterium *Brucella abortus* (Tessaro 1992). Current evidence suggests that brucellosis was introduced to North America from Europe during the 1500s (Aguirre and Starkey 1994; Meagher and Mayer 1994). The disease is primarily transmitted through oral contact with aborted fetuses, contaminated placentas, and uterine discharges (Tessaro 1992). The impacts of brucellosis on female bison are abortion, inflammation of the uterus, and retained placenta (Tessaro 1992). Male bison experience inflammation of the seminal vessels, testicles, and epididymis, and in advanced cases, sterility (Tessaro 1992). Both sexes are susceptible to bursitis and arthritis caused by concentrations of the organism in joints, resulting in lameness, and possibly increased vulnerability to predation (Tessaro 1992). There is currently no fully effective vaccine for preventing bovine brucellosis (Cheville *et al.* 1998); however, there is active research testing the efficacy and biosafety of new vaccines (Olsen *et al.* 1998; Roffe *et al*. 1999).

Two of fifty plains bison conservation herds in North

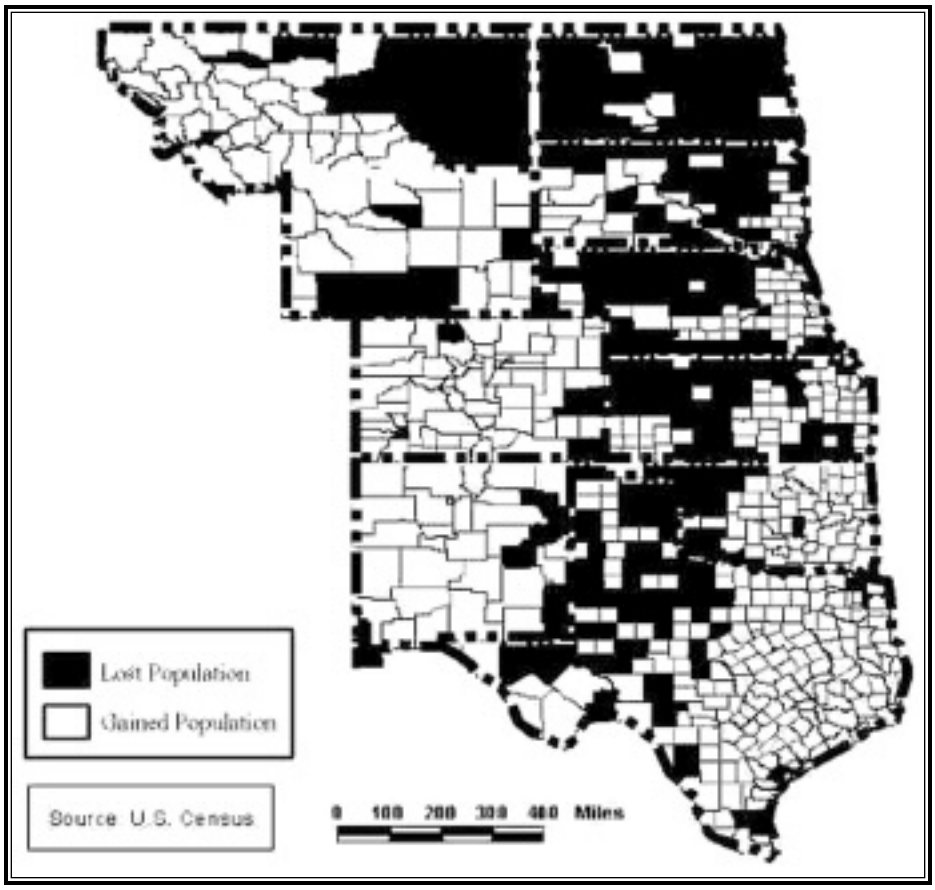

FIGURE 2: Great Plains States Counties that lost population between 1990-2000.

America are chronically infected with brucellosis: YNP and the Jackson herd in Grand Teton National Park/ National Elk Refuge. These populations account for 4,700 bison, or 24 percent of the North American plains bison conservation population (Boyd 2003). Management of these herds is affected by the presence of brucellosis because of the potential risk the disease poses to the livestock industry. Transmission of brucellosis from bison to cattle has been demonstrated in captive studies; however, there are no confirmed cases of transmission in the wild (Cheville *et al.* 1998; Shaw and Meagher 2000; Bienen 2002). Nevertheless, the potential exists and has created a contentious bison management issue in the region.

Legal Issues

Plains bison are currently not recognized at the subspecific level on any national or international list for species at risk of extinction. A recent survey of plains bison conservation status reveals trends demonstrating that plains bison warrant consideration for listing (Boyd 2003). Although the North American plains bison population is over 500,000 and is growing, more than 95 percent of herds are under commercial production. Of the estimated 19,200 plains bison in conservation herds, only 8,337 are free-ranging (Boyd 2003). Further, free-ranging, brucellosis-free populations within original plains bison range account for only 1,289 plains bison, or 6.7 percent of the total conservation population (Boyd 2003). Conservation issues related to genetic diversity and hybridization with domestic cattle further support consideration of the plains bison for listing.

Potential complications could accompany the process of listing plains bison. First, the presence of cattle DNA in some conservation herds may preclude listing under some legislation, such as the United States Endangered Species Act. Hybrids are exempt from the ESA when propagated in captivity and when they result from one listed parent and one nonlisted parent (O'Brien and Mayr 1991; U.S. Fish and Wildlife Service 2003). Plains bison with hybridization histories could therefore be exempt from the ESA. Second, if all plains bison are considered, then the growing commercial population precludes any arguments for listing based on numerical status. Third, legislation supporting listings may prohibit commercial and captive propagation of a listed species; a situation that the current momentum of the bison industry would not allow. A legal distinction between wild and domesticated populations would be required to support protection of the wild form (Boyd 2003).

Legal recognition of the wild form is impeded by the classification of bison as livestock by many state and provincial governments. In the absence of protection by wildlife legislation, free-ranging plains bison could potentially be sequestered into private herds or hunted without regulation. The only legal protection afforded to free-ranging bison in this situation would be associated with the legal status of their habitat (e.g., a national park). Classification as non-wildlife could have implications for the success of attempts to reintroduce wild bison herds. Existing free-ranging plains bison herds in Alaska, Arizona, Montana, Utah, Wyoming, British Columbia, and Saskatchewan are managed as wildlife under state or provincial legislation. Legislative revisions would be required to provide for reintroductions of free-ranging plains bison in other jurisdictions.

Recovery Initiatives

The ultimate goal of bison conservation is to facilitate recovery of the species and ensure long-term survival of

bison as a wild species (Boyd 2003). Bison recovery should include the maintenance and reintroduction of free-ranging or minimally-managed captive herds in areas within the taxon's original range. To maximize conservation value, these herds should occupy large geographic areas, and should be of sufficient size and demographic composition to maintain population viability. The herds should be subject to forces of natural selection, and effective genetic, disease, and range management. They should also be protected under law and free of the previous causes of extirpation.

In Canada, the national parks played a pivotal role in rescuing the bison from extinction through interventions such as purchasing the Pablo-Allard herd and providing sanctuary for the struggling species (Ogilvie 1979). Today, 50 percent of conservation herds in Canada are found in national parks. Protected public lands offer the best sanctuary for plains bison in Canada at this time. There are also emerging opportunities for bison restoration on additional public lands and lands owned or managed by conservation organizations. In Canada, plains bison reintroductions are being considered for Banff National Park, Waterton Lakes National Park, Grasslands National Park, and the Nature Conservancy of Canada's Old-Man-On-His-Back Conservation Area (Boyd 2003).

Plans to reintroduce plains bison populations in the United States are limited. The USDA Forest Service recently conducted an assessment of its management of national grasslands in Montana, North Dakota, Nebraska, South Dakota, and Wyoming; it dismissed a proposed alternative to restore free-ranging bison (USDA Forest Service 2001). Two appeals to this decision were being considered in 2002 by the Chief of the Forest Service (J. Kessler, Biodiversity Conservation Alliance, personal communication 2002). There are, however, two landscape-level grassland restoration projects being planned that involve reintroducing bison: The Montana Big Open and The Buffalo Commons' Million Acre Project. Although ambitious, these large-scale grassland restoration concepts consider landscape-level processes, and focus on multi-stakeholder networks to facilitate positive economic and environmental rejuvenation of the prairie region, and reestablish free-ranging bison on the North American landscape.

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