BC Environment

MANAGEMENT PLAN FOR WOOD BISON IN BRITISH COLUMBIA

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DISCLAIMER

This management plan has been drafted in consultation with various agencies, organizations, and individuals in order to define conservation actions deemed necessary to protect, recover, and manage wood Bison in British Columbia. The goals, objectives, and recovery actions identified in this document are subject to ministry appropriations, priorities, and budgetary constraints, as well as modifications necessary to accommodate new objectives or findings.

ABSTRACT

Wood Bison were nearly eliminated by uncontrolled hunting during the fur trade in the late 1800s. In British Columbia, the last confirmed wood Bison was shot in 1906. Canadian populations began to recover in the early 1900s, but the introduction of Plains Bison into Wood Buffalo National Park (WBNP) in the late 1920s transgressed the genetic isolation of the original population. Bovine tuberculosis and brucellosis were also introduced with infected Plains Bison. In 1965 Wood Bison salvaged from WBNP were used to establish a disease-free national captive breeding herd (Elk Island National Park) that has since provided stock for six free-roaming populations. Recent studies confirm that these descendant herds resemble Wood Bison, despite the earlier hybridization event. One goal of the Canadian Wood Bison recovery program is to establish a minimum of four herds of over 400 animals each, with at least one of them in British Columbia. Two herds outside of British Columbia have reached the minimum size threshold, and the total in specific disease-free, free-roaming populations is now over 2600. Herds in and around WBNP that are infected with tuberculosis and brucellosis remain a significant threat. An estimated 70 Wood Bison now occur in British Columbia. Large areas of unoccupied historic Wood Bison habitat exist in northeastern British Columbia. In the late 1980s, BC established a "Bison control area" to prevent hybridization between Wood Bison and introduced Plains Bison. Forty-nine Wood Bison were translocated to the Nordquist Flats in the Liard River area in 1995. Eighteen animals were translocated into the Etthithun Lake area in March 1996. They were removed in 1997. The 1998 Etthithun Bison Area Plan included the construction of a 850 ha enclosure that was completed in March 1999. Nineteen animals were added to the facility in March 1999 for eventual release into the area. The goals of the updated Management Plan for Wood Bison in British Columbia are to continue to re-establish herds through translocation (e.g., Etthithun Lake), to maintain their separation from Plains Bison, to keep them disease-free, and to allow populations to increase to a level sufficient to support non-consumptive and consumptive use. The biggest obstacle to successful implementation of the plan is the presence of game-farmed and free-roaming Plains Bison within the historic range of Wood Bison. Developing and maintaining public support for recovery efforts is essential.

Keywords: British Columbia, *Bison bison athabascae*, Etthithun Lake, game-farming, Liard River, management plan, Plains Bison, recovery, reintroduction, translocation, Wood Bison.

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1 INTRODUCTION

1.1 Background

Before European settlement, both subspecies of the American Bison occurred in British Columbia, the Wood Bison (*Bison bison athabascae*) in the northern part of the province and the Plains Bison (*Bison bison bison*) in the southeastern Rocky Mountains (Nagorsen 1990).

Wood Bison once occurred over a large area of the western boreal forest in Canada, although they were unevenly distributed and were never as numerous as Plains Bison (WBRT 1987). Soper (1941) roughly estimated Wood Bison numbers at 168,000 in the early 1800s. Like the Plains Bison, Wood Bison were nearly eliminated by uncontrolled hunting for the fur trade during the late 1800s. Populations declined most rapidly after 1860, and numbers reached an estimated low of 250 between 1896 and 1900 (Soper 1941).

This pattern of population decline also occurred in British Columbia, and the last confirmed Wood Bison from the primordial population was shot at near Fort St. John in 1906 (MacGregor 1952).

Although legislation designed to protect Bison was passed in Canada in 1877 and 1893, enforcement was not effective until after the turn of the century. Only when the Northwest Mounted Police were given responsibility for enforcing the *Buffalo Protection Act* in 1897 and formal patrols began in 1907 did northern Wood Bison populations begin to recover outside of British Columbia (WBRT 1987; Gates et al. 1992). When Wood Buffalo National Park (WBNP) was established in 1922, the total number of Wood Bison in the southern part of their Canadian range was estimated at 1500 to 2000 (Siebert 1925; Soper 1941). The British Columbia population of Wood Bison remained extirpated.

Between 1925 and 1928, over 6000 Plains Bison were translocated to historic Wood Bison range at WBNP in order to relieve overcrowded conditions at Buffalo Park in Wainwright, Alberta (WBRT 1987; Gates et al. 1992). The American Society of Mammalogists (Howell 1925) and other biologists (Harper 1925, Saunders 1925) publicly challenged the translocation program over concerns about interbreeding the two subspecies and infecting Wood Bison with tuberculosis. After the Plains Bison introduction, the total population of Bison in WBNP increased to approximately 12,000 by 1934 (Soper 1941), but Wood Bison "as a race" were rapidly disappearing (Raup 1933). By 1940 it was generally thought that Wood Bison as a subspecies had become extinct as a result of hybridization (WBRT 1987).

In 1959, speculation about the existence of an isolated northern population of relatively pure Wood Bison in WBNP was confirmed when five specimens collected from a herd of about 200 near the Nyarling River were determined to be morphologically representative of Wood Bison (Banfield and Novakowski 1960). A salvage operation began in 1963 when 16 Wood Bison from the Nyarling River area were successfully translocated to the Mackenzie Bison Sanctuary (MBS) near Fort Providence, NWT. A second translocation occurred in 1965 when 21 Wood Bison from Nyarling River were moved to a fenced enclosure at Elk Island National Park (EINP) in central Alberta. Infection of the WBNP stock with both tuberculosis and brucellosis was confirmed with these animals. Most of the world population of Wood Bison is derived from these original 37 animals captured in the early 1960s.

During the 1970s, a large number of agencies and organizations formally recognized the plight of the Wood Bison. In 1970, the United States, under its *Endangered Species Act*, listed the Wood Bison as Endangered in Canada (United State Federal Register 1998). In 1975, a Canadian recovery program was established with representatives from federal, provincial, and territorial wildlife agencies and Parks Canada. Their goal was the establishment of three disease-free, free-roaming herds within the Wood Bison's historic range (WBRT 1987). Although the trading of Wood Bison products was not a threat at the time, the Convention on the International Trade of Endangered Species of Fauna and Flora (CITES) prohibited international commercial trade by listing Wood Bison in its Appendix I in 1977. In 1978, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated Wood Bison as Endangered.

Recovery efforts accelerated through the 1980s with the appointment of the Wood Bison Recovery Team (WBRT) by the Western Wildlife Directors Committee in 1986. The team's mandate was to update the original COSEWIC status report and prepare a national recovery plan. The WBRT revised the recovery goal from three herds to four herds of 200 or more animals each (WBRT 1987).

COSEWIC down-listed Wood Bison to Threatened in 1988, based on a new status report that provided a thorough review of the history and management of Wood Bison to date (WBRT 1987). Also in 1988, the committee for the Recovery of Nationally Endangered Wildlife (RENEW) was established to integrate and direct recovery efforts for threatened and endangered species in Canada.

Recovery efforts up to the end of the 1980s had established one large (1700) and three small (35 to 45) populations of free-roaming, disease-free Wood Bison in the Northwest Territories, Yukon Territory, and Alberta. The most controversial problem then, as now, was the issue of what to do about the Bison in and around WBNP that were infected with brucellosis and tuberculosis. Various actions were proposed in 1990, including the slaughter of all diseased Bison inside and outside of the park (EAP 1990).

In 1996, a project began that was designed to salvage Wood Bison genetic stock from the diseased Slave River lowland herds north of WBNP. This program involves capturing newborn calves from the Hook Lake area, treating them prophylactically for tuberculosis and brucellosis, and keeping the animals in isolation in enclosures near Fort Resolution, NWT. In conjunction with enhancement of Bison habitats, the goal is eventually to restore a disease-free population in the Hook Lake area (Gates et al. in prep.).

A Bison Management Plan for British Columbia (Wildlife Branch 1991) was prepared in the early 1990s. The plan proposed reintroducing Wood Bison north of Fort Nelson, preventing their hybridization with Plains Bison by designating a "Bison free zone," and not permitting commercial operations of game-farmed Plains Bison north of 57° N latitude. Since the initial plan was written, many biological and socio-political parameters have changed that affect Wood Bison conservation efforts and necessitate updating the 1991 plan.

The goals, objectives, strategies, and tasks prescribed in this new management plan are consistent with the principles articulated in the United Nations Convention on Biological Diversity (UNEP 1992). Of particular relevance are sections of Article 8 that stipulate signatory countries shall "rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, inter alia, through the development and implementation of plans or other management strategies" and "promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings."

The new management plan is also designed to support key elements of A Wildlife Policy for Canada, the Canadian Biodiversity Strategy, and BC's Provincial Wildlife Strategy. The Wildlife Policy for Canada states, "it is a matter of priority for all governments to work cooperatively and with each other, aboriginal peoples, nongovernmental organizations, and the public to prevent species extinctions and to conserve as much within-species diversity as possible" (Wildlife Ministers' Council of Canada 1990).

Goal One of the Canadian Biodiversity Strategy is "to conserve biodiversity and sustainably use biological resources" (Biodiversity Working Group 1994). Strategic directions include "determine the ecological requirements of species-at-risk and develop and implement recovery plans for species that are defined as extirpated, endangered or threatened and evaluate recovery success" and "enhance local community and landowner participation in species recovery projects, from early planning phases through implementation."

Goal One of the Provincial Wildlife Strategy is to "maintain the diversity and abundance of native species and their habitats throughout British Columbia" (Wildlife Branch 1994). Strategic objectives include "recovery plans within two years of the species havingbeen designated as threatened or endangered" and "implementation of recommendations contained in approved recovery plans."

Most importantly, the BC Wood Bison Management Plan is a key component of the National Recovery Plan for the Wood Bison (Gates

et al. in prep.). In concert with other provincial and territorial Bison plans and programs (e.g., Reynolds et al. 1985; Government of Northwest Territories 1987; Government of Yukon Territory 1998), the BC Management Plan is designed to support the goals and objectives of the National Recovery Program. The over-all goal of the national program is to re-establish enough viable, healthy, free-roaming populations to remove Wood Bison from Canada's list of species at risk and allow long-term sustainable human use. Specifically, the WBRT calls for establishing four free-roaming populations of at least 400 animals, because 400 is currently thought to represent a minimum viable population (Gates et al. in prep.). One of these populations will be shared between the Northwest Territories and British Columbia.

As part of British Columbia's responsibilities within the RENEW program for the recovery of threatened and endangered species in Canada, this management plan outlines the province's commitment to establish and maintain viable populations of Wood Bison in British Columbia as a component of the overall national Wood Bison recovery plan.

1.2 General Biology

The American Bison (*Bison bison*) is the largest native land animal in North America. A mature adult male weighs between 800 and 900 kg and can exceed 2 m in shoulder height. The heaviest male weighed in the wild was 1031 kg (M. Hoefs, pers. comm.). Adult females weigh about one-half that of adult males and average 1.5 m in shoulder height. Bison have a thick coat that varies across the body from golden to dark brown, with a shaggy mane that covers their forequarters. They have distinctive tasselled tails, and both sexes possess true horns. Wood Bison are slightly larger and darker than Plains Bison; they have relatively shorter hair on their neck mane and leg chaps and a more pronounced shoulder hump than Plains Bison.

American Bison are very well adapted to cold climates. Unlike cattle and yak, the metabolic rate of Bison decreases in response to low ambient temperatures (down to -30° Celsius). However, in very severe thermal environments, when extremely low temperatures and winds are superimposed, Bison respond with a thermoregulatory increase in metabolic rate (Christopherson and Hudson 1978). Although Bison are considered to be a powerful animal and are relatively tolerant of deep snow, snow depths that exceed approximately 65 cm can limit the ability of calves to move and obtain forage (C. Gates, pers. comm.).

Wood Bison are seasonal breeders and are polyestrous, with a mean cycle length of 21 days (Motomura 1994). The breeding season is from July to early September, but the majority of breeding takes place in July. During the rut, older bulls tend to expend more effort and exhibit more aggressive behaviour than younger bulls, but younger bulls still take advantage of any available mating opportunity (Komers et al. 1994a, 1994b). Females first conceive at between one and three years of age, and usually produce one calf in May (WBRT 1987). The gestation period is between 270 and 300 days (around 9.5 months). Wild Bison live an average of 10 years (Eisenberg 1981), but the maximum age of a known animal from EINP was 27 years (E. Morton, pers. comm.). In the wild, fertility usually declines in females over 12 or 13 years of age (WBRT 1987; Shaw and Carter 1989).

Calf production in disease-free translocated herds can be high in the absence of high levels of predation. For example, in the erupting MBS population in 1984, approximately 60% of two-year-old and older females were accompanied by a calf. The captive herd at EINP averaged 61% calf production for two-year-old and older females and 83% calf production for three-year-old and older females (WBRT 1987). First-year survival of calves in the wild is variable but may approach levels as high as the 61% observed in the MBS in 1985 (WBRT 1987).

Bison are very efficient at digesting low protein and high fibre diets (Hawley 1987) due, at least in part, to an efficient rumen nitrogen recycling system (De Liberto and Urness 1994). In the MBS, Bison consume sedges almost exclusively during winter, but willow leaves and grasses become important components of the Bison diet with the onset of new plant growth in spring (WBRT 1987; Larter and Gates 1991). By mid-July Bison use shrubs to a lesser extent, and

sedges again dominate the diet. Fall diets in the MBS consist of nearly equal proportions of grasses and sedges and a minor component of terrestrial lichen (Larter and Gates 1991). Despite the fact that most free-roaming Bison are primarily grazers, some are more cosmopolitan in their food habitats. An introduced Plains Bison herd in northwestern Alaska are known to browse heavily on willow on summer ranges where grasses and shrubs are scarce (Waggoner and Hinkes 1986).

Bison are usually gregarious animals. Throughout much of the year, they form herds composed primarily of adult females, subadults, and young-of-the-year. Mature bulls usually associate in smaller bachelor groups. The size of Wood Bison home ranges in the Mackenzie Bison Sanctuary varied by age, sex, and habitat condition. In areas with less available forage, median values (minimum-convex polygon method) were similar: 712 km^2 for young-of-the-year, 706 km^2 for immature males, and 1240 km^2 for adult females (Larter and Gates 1994). Wood Bison in areas with more available forage had significantly smaller home ranges: 435 km^2 for younger males, 170 km^2 for older males, and 398 km^2 for adult females.

2 STATUS

2.1 Taxonomic Status

Wood Bison (*Bison bison athabascae,* Rhoads 1898) are members of the grand order Ungulata, order Artiodactyla, family Bovidae, subfamily Bovinae, and tribe Bovini (cattle, buffalo, and Bison) (Eisenberg 1981). There is some debate regarding the appropriate genus for the American Bison (*Bison bison*). Some taxonomists favour uniting cattle and Bison within the genus *Bos*, based on similarities of morphology and DNA (e.g., Modi et al. 1996). However, the national WBRT have decided to retain *Bison* as the genus name in order to maintain continuity and avoid confusion (Gates et al. in prep.).

The American Bison is the only species in this genus in North America. Van Zyll de Jong (1986) suggested that the palaearctic European Bison, or wisent (*Bison bison bonasus*), is conspecific with American Bison. Gates et al. (in prep.) point out that all living forms of Bison are completely interfertile and lack intrinsic isolating mechanisms, which suggests that they are members of one species.

The Wood Bison is the woodland morph, associated with boreal forests and parklands in northwestern North America. Subspecific taxonomy is controversial, but most taxonomists recognize Wood Bison (*B. b. athabascae*) as a valid taxon separate from Plains Bison (*B. b. bison*) (Nagorsen 1990; Gates et al. in prep.). Geist (1990, 1991) takes the view that North American subspecies are merely "ecotypes" and that morphological differences simply reflect local conditions rather than heritable traits. It is likely that the systematics of existing Wood Bison populations will remain complicated because the original distribution of the two North American races has been altered by range reductions, translocations, and hybridization between the two subspecies (van Zyll de Jong 1986; Nagorsen 1990).

Gates et al. (in prep.) summarizes the existing morphological and genetic evidence that distinguishes Wood Bison as a separate subspecies from Plains Bison. In contrast to the clinal variation in phenotype observed in Plains Bison, a discontinuity was evident between boreal Wood Bison and Plains Bison populations. This discontinuity is genetically based and was reflected in both size and differences in morphology independent of size. Wood Bison from the Nyarling River area of WBNP resemble the original *B. b. athabascae* but show some evidence of interbreeding with *B. b. bison* (van Zyll de Jong 1986). All Wood Bison in disease-free herds outside of WBNP and vicinity are direct descendants of 37 animals captured from the Nyarling River area in the mid-1960s (WBRT 1987). The most recent morphometric work by van Zyll de Jong et al. (1995) found three significantly different groups of American Bison consisting of six populations of Plains Bison, four populations of Wood Bison, and one intermediate morph found in central WBNP near Pine Lake. Van Zyll de Jong et al. (1995) characterized Bison from the Peace-Athabasca Delta, Slave River Lowlands, MBS, and EINP as *B. b. athabascae.*

The chromosome morphology (karyotype) of Wood Bison and Plains Bison is identical, and there is little genetic distance between the two races based on biochemical analysis of blood

protein and enzyme systems (Gates et al. in prep.). Examination of DNA has recently been used to investigate the Bison genome at the molecular level. Early results suggest a recent divergence of Wood and Plains bison, with reproductive isolation perhaps occurring only in the past 5000 to 10,000 years (Gates et al. in prep.). The largest genetic distance between North American Bison herds occurs between Wood Bison and Plains Bison, based on an analysis of microsatellite loci of genomic DNA (Wilson and Strobeck 1998). This confirms that the genetic grouping of Wood Bison remains strong, despite the influx of Plains Bison to WBNP in the 1920s.

2.2 Conservation Status

2.2.1 International

The International Union for the Conservation of Nature (IUCN) includes the American Bison on its list of "Lower Risk – Conservation Dependent" species. These species are the focus of conservation programs, the cessation of which would result in the species qualifying for a higher risk category (Baillie and Groombridge 1996). The Global Ranking under the Nature Conservancy system is the same for Wood Bison and Bison at the species level: G4T4, or apparently secure globally.

The Convention on the International Trade of Endangered Species of Fauna and Flora (CITES) lists Wood Bison in Appendix II. International trade in Appendix II species is regulated but not prohibited. Wood Bison were down-listed from Appendix I in 1997 (Government of Canada 1997).

The United States listed Wood Bison as "Endangered in Canada" under the federal *Endangered Species Act* in 1970 and has not updated that listing (United States Federal Register 1998).

2.2.2 National

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) lists Wood Bison as Threatened. COSEWIC down-listed Wood Bison from Endangered in 1988 (WBRT 1987).

2.2.3 Provincial

The British Columbia Conservation Data Centre categorizes Wood Bison as S1 (critically imperiled because of extreme rarity) under the Nature Conservancy ranking system. The British Columbia Ministry of Environment, Lands and Parks includes Wood Bison on its Red List (Cannings et al. 1999) as a species being evaluated for more formal designation as Extirpated, Endangered, or Threatened.

2.3 Distribution and Abundance

2.3.1 Prehistoric

Gates et al. (in prep.) summarizes the fossil evidence pertaining to prehistoric populations of Bison in North America. From the middle to late Pleistocene epoch, a single species of Bison inhabited Eurasia and North America. During the last glaciation (Wisconsin), two separate races evolved: *B. b. priscus* in Beringia and *B. b. antiquus* south of the continental ice sheet. Starting about 13,000 years before present (YBP), these northern and southern forms dispersed from their respective ranges and intermingled. Modern American Bison are considered to be descendants of these two Pleistocene lines.

The fusion of these two prehistoric subspecies is thought to have produced the early Holocene form, *B. b. occidentalis*, which underwent rapid evolutionary changes leading to the modern Bison (*Bison bison*) by about 5000 YBP. As grasslands and the modern Plains Bison expanded, the Wood Bison, being adapted to open woodlands, became increasingly restricted to the northwestern section of the species range (Gates et al. in prep.). Wood Bison ranged over most of the boreal landscapes of northern British Columbia, and subfossil specimens have been recorded from the mouth of the Kitimat River, Atlin, Cecil Lake, and Ft. St. John (Smith 1977 in WBRT 1987) (Figure 1).

2.3.2 Historic

The historic range of Wood Bison is defined as the probable distribution at the time of European colonization early in the 19th century. It was once

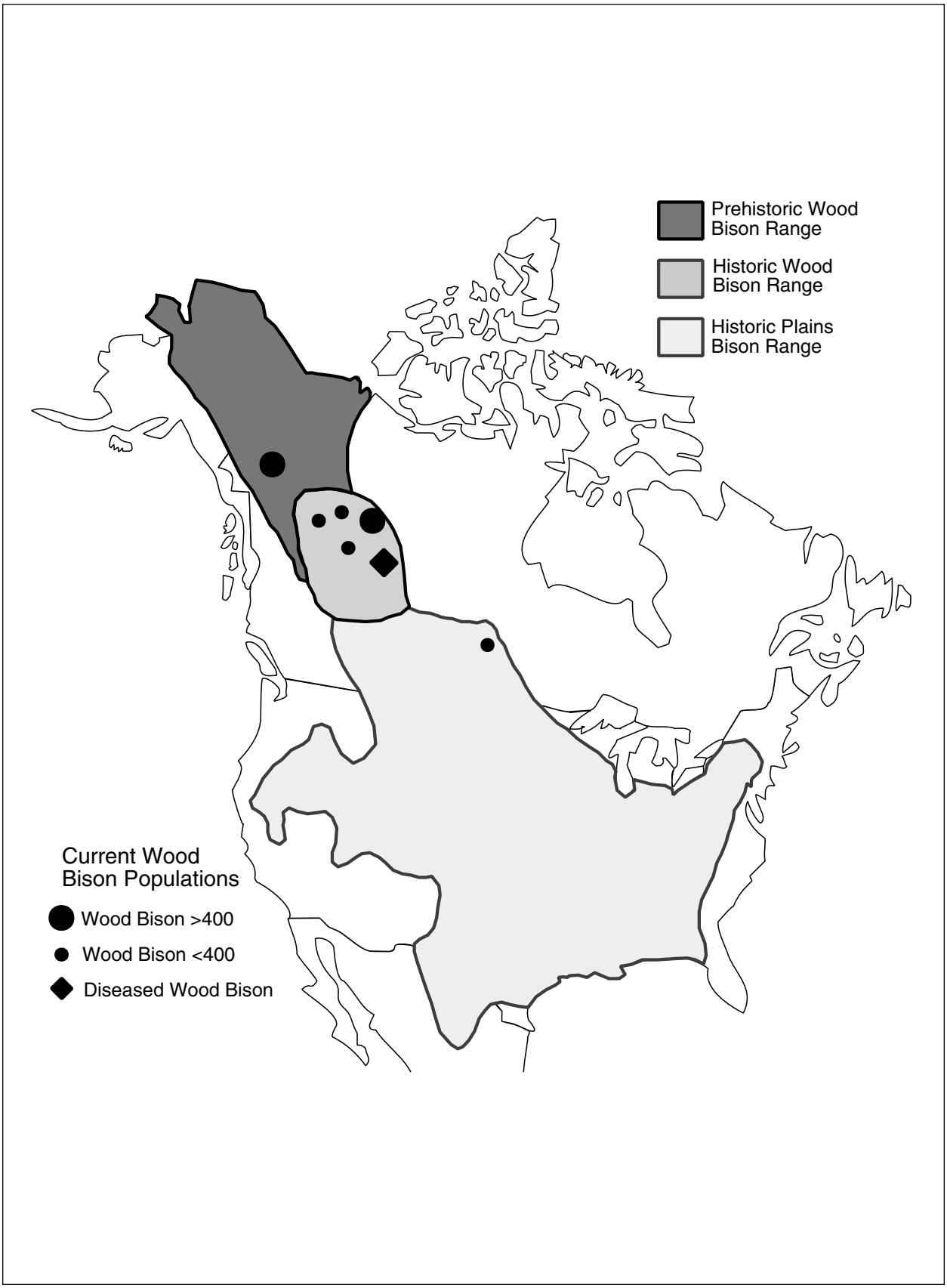

Figure 1. Historical distribution of Bison in North America.

thought to include only northern Alberta, southwestern Northwest Territories, northeastern British Columbia, and a small portion of northwestern Saskatchewan (van Zyll de Jong 1986). Recent radiometric data and oral history accounts (Government of Yukon Territory 1998; Stephenson and Fleener 1998; Gates et al. in prep.) indicate that most of the previously defined prehistoric range in British Columbia, Alaska, and the Yukon should be considered historic Wood Bison range (Figure 1).

Historically, Wood and Plains bison occupied different habitats and different geographic ranges. Along the southern edge of historic Wood Bison range (e.g., the Peace River area of British Columbia) their winter ranges may have overlapped, but they probably did not share a common range during the breeding season (Gates et al. in prep.). However, some skull specimens from this region of overlap have features that are intermediate between the two subspecies, although they most closely resemble *B. b. athabascae* (van Zyll de Jong 1986; Nagorsen 1990).

There is no way of estimating the historic abundance of Wood Bison in British Columbia. A rough estimate for the entire Canadian population was 168,000 in the early 1800s (Soper 1941). Uncontrolled hunting during the fur trade, particularly after 1860, led to a population low estimated at 250 for all of Canada by the turn of the century (Soper 1941). This pattern of population decline also occurred in British Columbia, and the last confirmed Wood Bison from the primordial population was shot near Fort St. John in 1906 (MacGregor 1952).

After the extirpation of Wood Bison from British Columbia, only sporadic and ephemeral sightings of the species occurred. A male Wood Bison was reported shot by natives in the Liard River drainage near Lower Post in 1939 (Clarke 1944; Lotenberg 1996). In the late 1960s Bison were frequently seen adjacent to the BC-Alberta border in the Clear Hills north of Ft. St. John, and in the late 1970s a small herd was observed in the lower Buckinghorse River area, but neither of these herds were ever reported again.

In the 1980s Wood Bison were reported from a number of northeastern localities (e.g., eight at Fort Nelson in 1980; 24 at Kotcho Lake in 1982). The first group, and probably the others as well, originated from 28 animals reintroduced to Nahanni Butte, Northwest Territories in 1980 (WBRT 1987; Nagorsen 1990).

2.3.3 Current

Canada

The 1998 population estimate for free-roaming, disease-free Wood Bison in Canada is at least 2600 animals in six geographically separate herds (Appendix 1), although only two (Mackenzie Bison Sanctuary, NWT and Nisling River, YT) exceed 400 animals (Figure 1). There are also 860 Wood Bison in four co-managed captive-breeding herds and 500 to 700 animals on 45 to 60 private commercial game farms. There is also a population of approximately 2300 Wood Bison infected with bovine tuberculosis and brucellosis in and around WBNP (Figure 2). Two subpopulations totalling approximately 800 animals in central WBNP near Pine Lake are too highly hybridized with Plains Bison to be classified as *B. b. athabascae* (van Zyll de Jong et al. 1995; Gates et al. in prep.).

British Columbia

Wood Bison returned to British Columbia in the 1980s, first as dispersing animals from the Nahanni Butte reintroduction in the NWT and later as the result of direct reintroductions of animals bred at EINP. All the reintroduced Wood Bison in British Columbia are direct descendants of the 21 Nyarling River animals captured near Needle Lake in WBNP in 1965 and relocated to EINP (WBRT 1987). Reintroduced Wood Bison currently occur in two separate locations, Beaver River and the Nordquist Flats area near the Yukon/Northwest Territories border. In 1996 and 1997, a small reintroduced herd also occurred at Etthithun Lake near the Alberta border (Figure 3). This herd was removed in 1997, and a new reintroduction of 19 animals from EINP was made in March 1999.

Beaver River — By the early 1990s, the herd reintroduced at Nahanni Butte had expanded its range upstream along the Liard River to a point approximately 40 km south into British

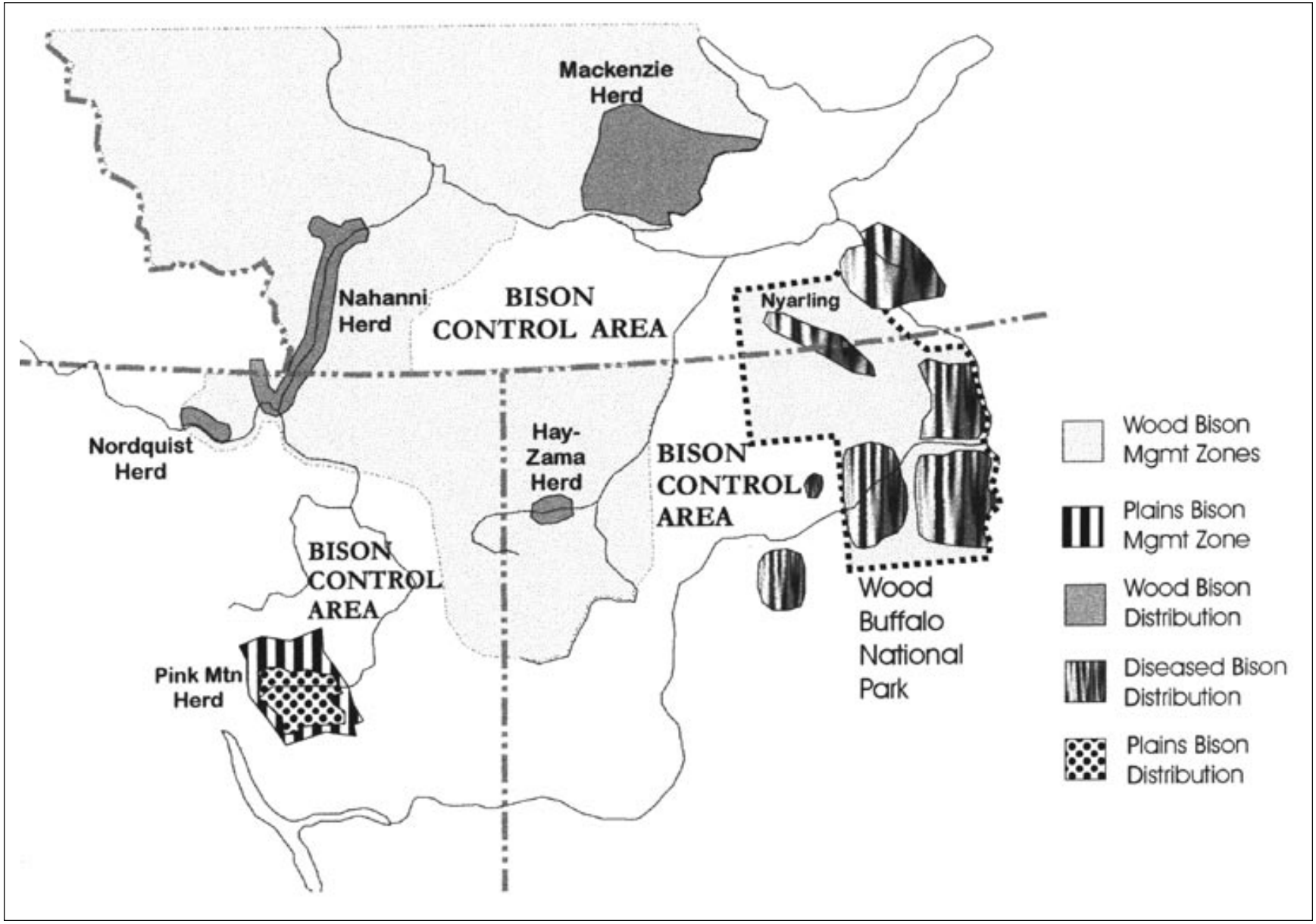

Figure 2. Distribution of management zones and free-roaming herds of Bison.

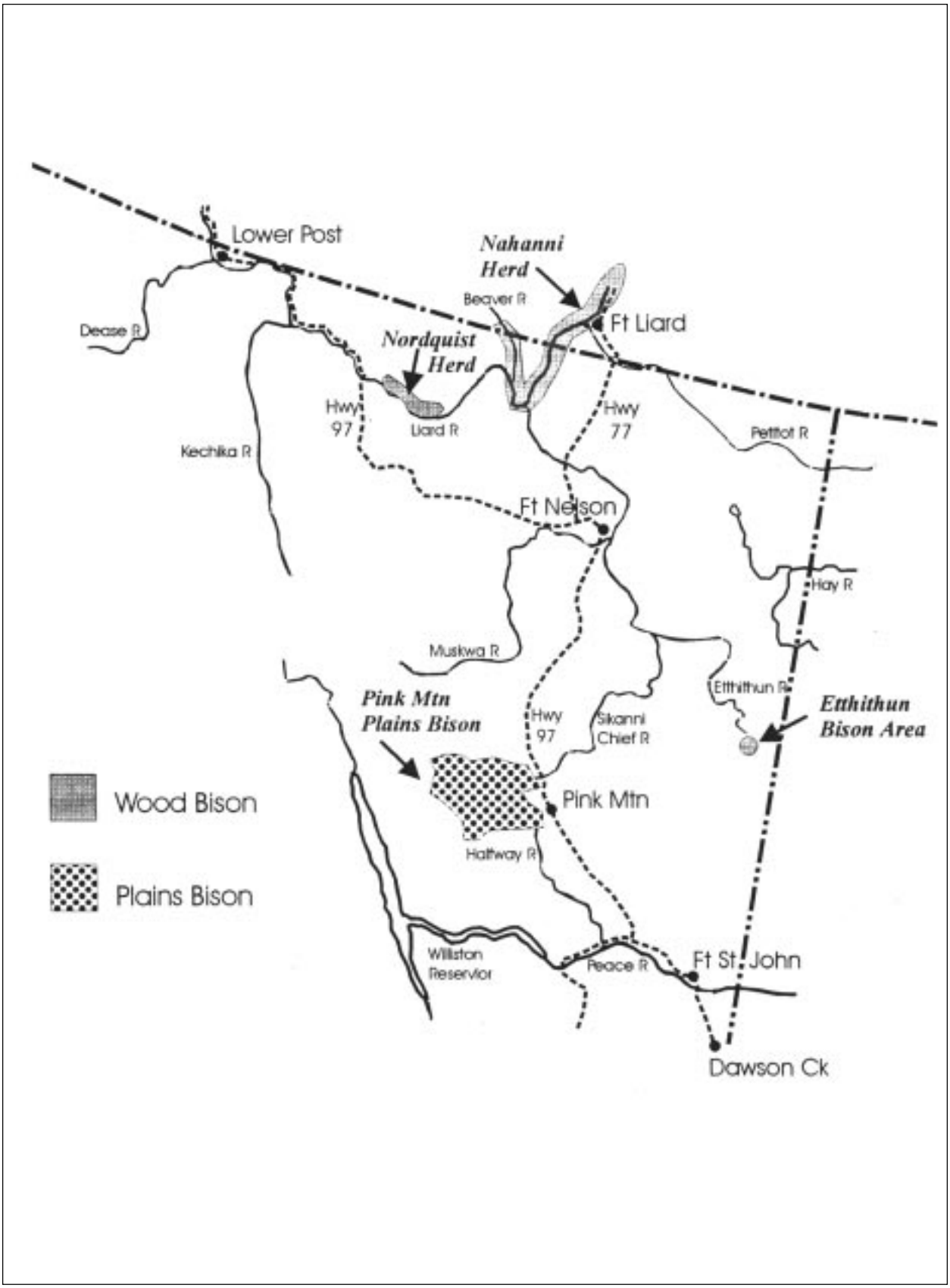

Figure 3. Distribution of free-roaming Bison in British Columbia.

Columbia, near the mouth of the Beaver River (Figure 3). An estimated 30 Wood Bison occur along the Liard River from the mouth of the Beaver River to the border with the Northwest Territories. Approximately half of these are animals that at one point had dispersed as far south as Fort Nelson after being released near Nahanni Butte in April of 1998 (J. Nishi, pers. comm.).

Nordquist Flats — The first reintroduction of Wood Bison to British Columbia took place in March 1995. A total of 49 animals – 4 adult males, 5 adult females, 5 yearling males, 10 yearling females, 10 male calves, and 15 female calves) – were transferred from EINP to Aline Lake in the Nordquist Flats area of the Liard River valley (Figure 3). This translocation site is approximately 80 km from the Nahanni Butte Bison at the mouth of the Beaver River. The translocation employed a "soft release" technique that kept the Bison in a temporary holding facility for two months to allow them to become habituated to the area. A vegetation inventory of the translocation site in 1988 indicated large areas with upland grass production between 500 and 900 kg/ha, and smaller wetland areas with sedge production of approximately 6300 kg/ha (Elliott 1989). Prescribed fire has been used in this area in the past to improve wildlife habitat, and it should be used again to maintain and improve Bison grazing habitat.

The Nordquist Flats herd is estimated at 40 to 50 animals, and surveys in May 1998 indicated that the combined Nahanni and Nordquist populations total approximately 190 animals (Gates et al. in prep.).

Etthithun Lake — In March 1996, 18 Wood Bison that had been maintained for two years at Northern Lights College in Dawson Creek for captive studies were released to the wild in the proximity of Etthithun Lake near the Alberta border (Figure 3). Habitat primarily consists of a mixture of domestic and native grasses that occur on natural meadows, disturbed sites such as clearcut forestry sites, road allowances, seismic lines, pipelines, and well sites. Fifteen Bison were observed in January 1997, and by March 1997 three of the fifteen had been killed in collisions with industrial road traffic (Churchill and Maundrell 1998). In the summer of 1997, the herd spent an increasing amount of time up to 100 km south on the fringe of agricultural development. It eventually joined a small herd of feral commercial Bison that had escaped from a ranch. The mixed herd of 26 commercial plains and wild Wood Bison were captured later that year, quarantined, and disease tested, and 19 Wood Bison, including calves of the year, were sold into private hands. Funding from the Wood Bison sale was allocated to Wood Bison management in northeastern British Columbia.

There were no free-roaming Wood Bison in the Etthithun Lake area in 1998. In March 1999, a total of 19 EINP Wood Bison (14 female calves and 5 yearling+ males) were translocated to a recently constructed 850 ha enclosure, where they will be confined to ensure they habituate to the area, probably until all females have calved at least once (Appendix 2).

Hay River — Wood Bison from the Hay-Zama reintroduction in Alberta occasionally wander into the Hay River drainage in northeastern British Columbia (Figure 2). As the Alberta population grows, eventually it will probably expand to establish a more permanent population in this part of British Columbia.

2.4 Habitat

Wood Bison can be considered a keystone species in boreal forest ecosystems where suitable habitat conditions occur (Gates et al. in prep.). They are capable of exploiting a unique niche of coarse grass and sedge meadows, including industrially disturbed sites, and represent a major component in the dynamics of natural predator-prey systems. Their role in maintaining meadow habitats and ecological diversity, and influencing the abundance and distribution of carnivores and other herbivores, is only now becoming better understood (Gates and Larter 1990; Larter et al. 1994; Zimov et al. 1995; Gates et al. in prep.).

Wood Bison in the SRL and MBS spend spring and early summer foraging in mesic grassy meadows and willow savannas. During late summer and fall, they disperse into small groups for the rut and occupy mixed wood forests in addition to meadows. In winter when Wood Bison feed almost exclusively on sedges, wet sedge

meadows are again heavily used (WBRT 1987; Larter and Gates 1991).

Grazing accounts for the majority of the Bison's food intake, and the meadow habitats that Wood Bison favour are highly productive. In the Slave River lowlands, Wood Bison habitats are characterized by high aboveground plant biomass: 4400 kg/ha for wet meadows dominated by *Carex atherodes* and 2280 kg/ha for dry meadows dominated by *Calamagrostis* spp. (Reynolds et al. 1978). Bison showed a preference for feeding in wet meadows, and *Carex atherodes* and *Calamagrostis* spp. were the most common food items in all seasons (Reynolds et al. 1978). Estimates of aboveground plant biomass on other Bison ranges vary from 2000 to 7000 kg/ha in the MBS (NT), 2450 kg/ha near Nahanni Butte (NT), 3530 kg/ha at Hay-Zama Lakes (AB), 1220 kg/ha at Nisling River (YT), and 900 to 6300 kg/ha in the Nordquist Flats area (BC) (Reynolds et al. 1978; WBRT 1987; Elliott 1989; Larter 1994).

Preferred grass and sedge meadows are rarely contiguous and are usually distributed unevenly over a boreal landscape dominated by spruce and aspen forests and unsuitable bogs, fens, and muskegs. Bison select habitats that maximize their ability to ingest forage items high in crude protein (Larter and Gates 1991), and they appear to prefer meadows on alkaline soils. Preferred habitats usually represent from 5 to 20% of the landscape within occupied ranges (Gates et al. in prep.). Exclosure plots have been successfully used to monitor changes in habitat condition and forage productivity caused by the pressure of Bison grazing (Larter 1994).

Broad scale terrestrial ecosystem mapping identifies areas with moderately suitable habitats through most of the taiga plains of northeastern British Columbia (D.A. Demarchi and B. Krueger 1999; Figure 4). Suitable habitats also occur along the Dease and Blue rivers and near Atlin in northwestern British Columbia, but deep snows may limit their capability as winter habitat. Much of the historic high-quality habitats are no longer available for population recovery due to urban and agricultural development in the Peace River area. In addition, the presence of the Pink Mountain Plains Bison herd and the "Bison control area" surrounding it further alienates a significant proportion of original high-quality Wood Bison range in the Muskwa foothills of the northern Rocky Mountains (Figure 4).

Floods and natural fluctuations in the water table can significantly reduce the amount of suitable Wood Bison habitat, as they did in the MBS in 1988 (Gates et al. in prep.). Similarly, fire suppression activities can reduce the frequency of wildfires and allow aspen and shrubs to encroach on semi-open meadows preferred by grazing Bison (Chowns 1998). Some industrial activity, such as forestry and oil and gas development, can increase available Bison habitat by shifting forested ecosystems to earlier seral states.

2.5 Diseases, Competition, and Predation

2.5.1 Disease and parasites

Three significant infectious diseases (tuberculosis, brucellosis, and anthrax) are present in wild populations of Wood Bison in the Northwest Territories and northern Alberta. Bovine tuberculosis and brucellosis were introduced to WBNP with the introduction of infected Plains Bison in the late 1920s, and these diseases are the greatest obstacle to recovery of Wood Bison populations at the national level. The population of Bison in WBNP has declined to 21% of its former level in the past 27 years (Joly et al. 1998). This decline is attributed to chronic infections and to the loss of productivity and recruitment caused by tuberculosis and brucellosis. At this point, none of these bovine diseases have been diagnosed in wild ungulate populations in British Columbia.

Bovine tuberculosis is caused by *Mycobacterium bovis*, an infectious bacterium with a wide range of hosts, including domestic animals, wild ungulates, and humans (O'Reilly et al. 1995). Infection levels of 50% in WBNP (Joly et al. 1998) are estimated to cause direct mortalities of 4 to 6% annually (Fuller 1966; Tessaro 1989). Rates of wolf predation have also been strongly linked to tuberculosis infection (Tessaro 1989).

Brucellosis is caused by the coccobacillus, *Brucella abortus*, an intracellular parasite (Blood et al. 1983). Infection levels in WBNP are approximately 40% (Choquette 1961; Joly et al. 1998). Over 90% of infected females experience

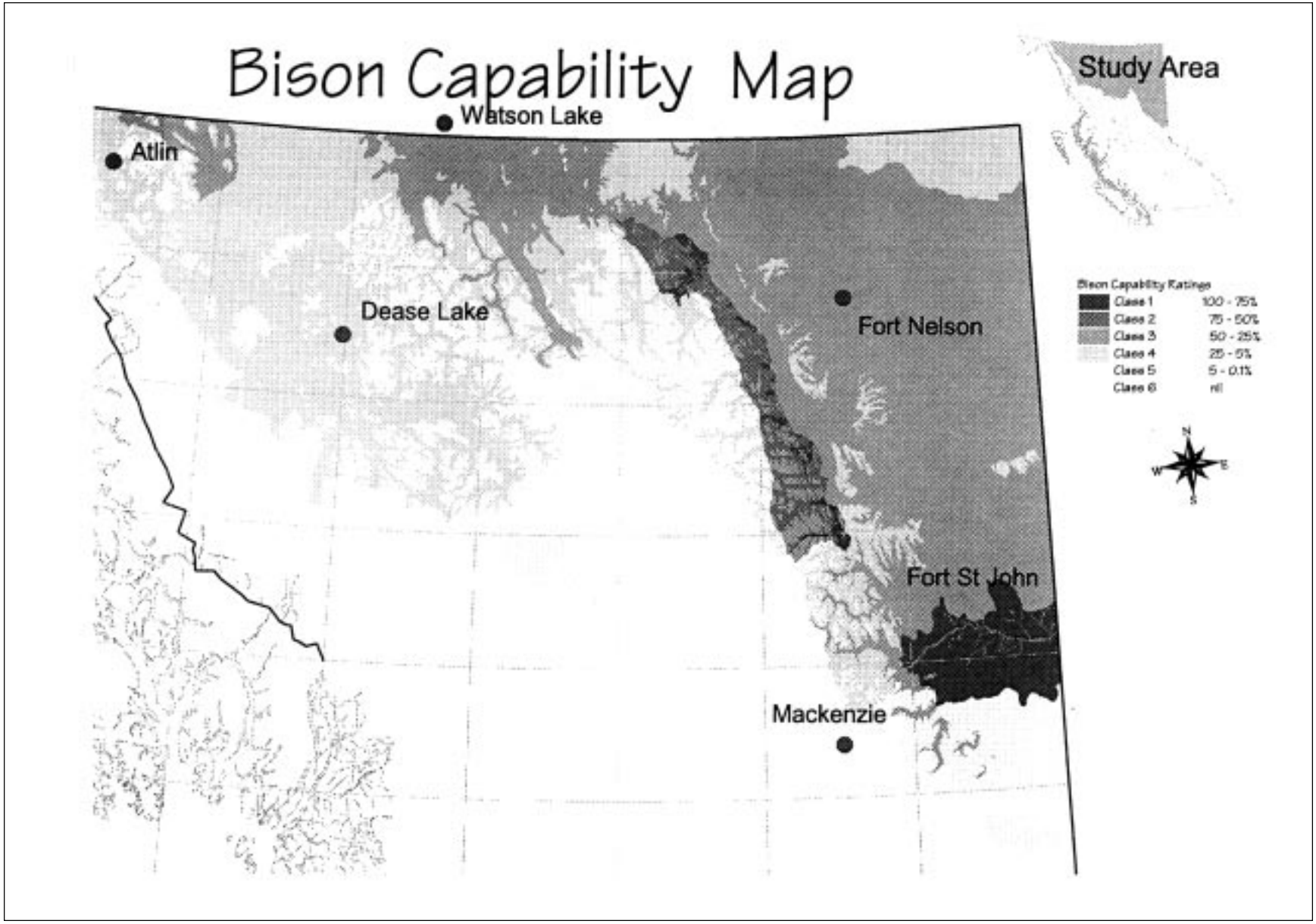

Figure 4. Generalized habitat capability for Wood Bison and Plains Bison in northeastern British Columbia.

spontaneous abortion during their first pregnancy (Davis et al. 1990, 1991), but the abortion rate then declines to near zero after the third pregnancy. Localization of the disease in joints caused arthritis in approximately 2% of adult Bison in WBNP (Fuller 1966). The arthritis may in turn increase susceptibility to predation (Gates et al. in prep.).

Anthrax is caused by *Bacillus anthracis*, a highly infectious and usually lethal bacterium whose spores may lie dormant in the soil for many years (Gates et al. 1995). These spores become exposed under certain environmental conditions (Dragon and Rennie 1995) and can cause epidemic outbreaks in which a substantial proportion of the population may die of infection. Anthrax outbreaks have occurred in WBNP, the SRL, and the MBS (Gates et al. 1995).

Parasites identified in WBNP Bison include lice, *Damalinia (Bovicola) sedecimdecembrii,* and nematodes, *Setaria labiato-papillosa and Setaria cervi,* (Choquette 1961; Fuller 1966). Lungworm infestations (*Dictyocaulus* spp.) were not prevalent in the early 1960s (Choquette 1961).

2.5.2 Competition

Within the historic range of Wood Bison, there is little dietary overlap between Wood Bison and other large ungulates (Gates et al. in prep.). There is some potential for minor components of the Bison diet to result in competition with other species for forage, providing that both species occur in the same area and the forage item is limiting. Fall use of terrestrial lichens may overlap the forage needs of caribou, and spring browsing of willow may overlap the forage needs of moose.

Plains Bison, accidentally introduced in the Pink Mountain-Sikanni Chief River area in 1971, have increased in distribution and abundance, particularly over the past 15 years. The herd is largely confined to grass/sedge meadows in the upper Sikanni River and Halfway River valleys. In 1990, an estimated 500 animals ranged over an area of 500 km^2. The current Pink Mountain population was estimated at 1400 animals in 1998 (R. Woods, pers. comm.). Potential exists for competition for forage between free-roaming Plains Bison and Wood Bison if the ranges of the two should overlap, but the policy of restricting each subspecies to mutually exclusive ranges to prevent hybridization means this should never occur.

2.5.3 Predation

Three carnivore species prey on Bison: the grey wolf (*Canis lupus*), grizzly bear (*Ursus arctos*), and American black bear (*Ursus americanus*) (WBRT 1987). Of these, the wolf is the most effective predator of Wood Bison and, according to the "disease-predation hypothesis" (Messier 1990, Gates et al. 1992), is capable of regulating some populations (e.g., diseased herds in WBNP) at a low density. Populations of healthy herds of Wood Bison (e.g., MBS) are more likely to be limited by intraspecific competition for food resources despite the presence of wolves (Gates et al. in prep.). Small herds are more sensitive to the demographic effects of wolf predation than larger herds. The proportion of Bison in the diet of wolves was approximately 10% in both WBNP (Carbyn et al. 1993) and the Pink Mountain area (Weaver and Haas 1998).

Moose coexist with all free-roaming Wood Bison herds, and large herds of Bison may indirectly influence predation rates on moose by supporting a higher density of wolves than would exist without Bison (Gates and Larter 1990; Larter et al. 1994).

2.6 Human Uses

2.6.1 Non-consumptive

Wood Bison have a special symbolic importance to many Canadians, partly because of their appearance (the classic "charismatic megafauna"), but also because of their conservation status and the fact they are endemic to Canada. Due to their long association, many aboriginal communities in Canada have strong spiritual and cultural connections to the Bison.

Free-roaming Bison are already a major tourist attraction in many parts of Canada and the United States. The potential economic value of viewing Wood Bison is difficult to quantify, but based on experience with other species, it would probably be several orders of magnitude larger

than hunting values. The ecotourist industry could be expected to take advantage of any easily accessible Wood Bison populations, and this would represent a direct annual contribution to the economy of northern communities.

2.6.2 Consumptive

As the largest land animal in North America, the Bison occupies a unique position among North American big game species and is much sought after by hunting enthusiasts. The current economic value of Wood Bison hunting in Canada is low, owing to the small size of most populations. Hunting is permitted only in the MBS and SRL herds in the Northwest Territories, the Nisling River herd in the Yukon, and the "Bison control areas" in Alberta and the Northwest Territories. Approximately 50 males are harvested each year (Gates et al. in prep.).

There are currently no hunting seasons for Wood Bison in British Columbia. The future potential value of Wood Bison hunting could be significant, assuming that the population increases to a level that would support sustainable hunter harvests. In 1998, the Pink Mountain herd of Plains Bison attracted 13,765 applications for 260 limited-entry hunting authorizations (J. Thornton, pers. comm.).

2.6.3 Commercial

Commercial Bison farming is an established agricultural industry, and most Bison in North America are now managed as livestock. Commercial production is expected to increase by at least 25% annually until 2005 (Marchello 1998) and to reach over one-half million behind fence by the year 2000 (Hudson 1998). Plains Bison dominate the commercial production of Bison because commercial production of Wood Bison did not begin until 1989. In Canada in 1996, there were 600 owners of 30,000 commercial Bison (about 20% of North American production) versus an estimated 60 owners of 700 Wood Bison (Gates et al. in prep.). In northeastern British Columbia, there are currently 49 producers of commercial Bison registered under the BC *Game Farm Act* (T.J. Pittman, pers. comm.).

The Canadian Livestock Records Corporation maintains a registry for wood and commercial Bison under the *National Livestock Pedigree Act* (Gates et al. in prep.). The Canadian Bison Association has established standards for certification of stock, developed in cooperation with the WBRT. Similarities between Bison and domestic cattle have made it possible to consider the application of conventional bovine reproductive technologies. Techniques such as pregnancy diagnosis, artificial insemination, estrus synchronization, semen collection, and preservation and embryo transfer are currently being tested for their effectiveness in Bison (Dorn 1995). However, in practice, intensive bovine agricultural techniques are seldom used on Bison ranches (Hudson 1998).

Privately owned Wood Bison do not normally contribute towards conservation of free-roaming populations, unless there are specific agreements designed to link them directly to recovery programs (Gates et al. in prep.). Commercial Bison are selected for agricultural traits and, over time, there is often hybridization, which produces stock of mixed sources, even mixtures of subspecies. These animals would not contribute to conservation projects. Problems can also arise if farmed Bison become diseased or if escaped animals are allowed to mix with free-roaming herds (Hudson 1998).

3 SOCIO-POLITICAL CONSIDERATIONS

3.1 Legal

All references and quotes from legal statutes contained in this section are for information purposes only and are subject to change as legislation and regulations are updated and amended. Persons interested in the specific language of any provincial statute or regulation are encouraged to refer to the latest versions that are available through the British Columbia Ministry of the Attorney General.

3.1.1 British Columbia *Wildlife Act*

Bison are designated as "wildlife" and "big game" under the British Columbia *Wildlife Act* (1982). This designation vests ownership of

all wild Bison with the provincial government and protects them from deliberate killing, capturing, or personal possession, except as authorized by permit. Section 33 of the *Wildlife Act* states:

> (1) A person commits an offence if the person has live wildlife in his or her personal possession except as authorized under a licence or permit or as provided by regulation.
>
> (2) A person commits an offence if the person has dead wildlife or a part of it in his or her possession except as authorized under a licence or permit or as provided by regulation.
>
> (3) Subsections (1) and (2) do not apply to a person acting under a licence under the *Fur Farm Act* or the *Game Farm Act*.

Bison are considered a "domestic animal" under the British Columbia *Wildlife Act* only if they are held in captivity under permit or licence for game farming purposes, and only for the purposes of protecting them from the menaces of other "wildlife." Once a game-farmed Bison escapes captivity, or is released or abandoned, the provincial government acquires ownership of that animal. Section 76 of the *Wildlife Act* states:

> On the escape from captivity or the release or abandonment of an animal that is not a domestic animal, the government acquires the ownership of that animal.

Persons responsible for escaped animals are liable for damages to wildlife and wildlife habitat and any costs associated with recovering or destroying that animal. Section 77 of the *Wildlife Act* states:

> (1) A person who releases or abandons an animal or from whose captivity an animal escapes:
>
> (a) is, despite section 11 (4) of the *Livestock Act*, liable to the government for loss or damage to wildlife or wildlife habitat caused by the animal, and for all costs incurred by the government in pursuing, recovering, holding or destroying it, and
>
> (b) is not entitled to any compensation from the government if the animal is destroyed under section 79.

Wildlife Act permits are required for the movement of nondomesticated Wood Bison across the borders of British Columbia, both to import live animals and to export Bison or Bison products. Wildlife permits are not required for Bison being raised for agricultural purposes under a game farm licence (see below). Provincial wildlife authorities also issue CITES export permits for international movement of any Wood Bison or Wood Bison products (including game-farmed animals).

3.1.2 British Columbia *Game Farm Act*

The British Columbia *Game Farm Act* defines "game" as fallow deer, Bison, and reindeer. Under this act, the Ministry of Agriculture and Food may issue a licence or licence renewal by to a person to raise a type of game for agricultural purposes. Provisions of the *Wildlife Act* with respect to escaped animals do not apply to licensed game if the licensee recaptures the animal within 30 days. Section 6 of the *Game Farm Act* states:

> Section 76 (was 77) of the *Wildlife Act* does not apply to game that escapes from a farm being operated by a person who holds a valid licence issued under this Act, if the licensee recaptures the game within a prescribed period after its escape.

Section 8 of the *Game Farm Act* also includes provisions enabling Cabinet to make regulations "on the recommendation of the Minister of Environment, Lands and Parks specifying regions of British Columbia in which a licence for a specified type of game must not be issued." There are currently no regulations that specify regions where licences for Bison game farms cannot be issued (D. Ireland, pers. comm.). Regulations under this act may also establish different terms and conditions for different licensees based on geographical area and/or the type of game the licensee is licensed to raise.

3.1.3 British Columbia *Livestock Act*

The British Columbia *Livestock Act* includes a definition of "game" that cross-references to the *Game Farm Act*, with an added stipulation that the animals are also being raised for agricultural purposes under a licence issued under the *Game Farm Act*. This means that farmed Bison under licence are considered "livestock" for the purposes of the British Columbia *Livestock Act*.

3.1.4 Federal *Wildlife Trade Act*

The *Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act* (*Wildlife Trade Act*) is the federal statute that covers the issuance of CITES permits, supports the enforcement of provincial wildlife trade legislation in other provinces, and enables provinces to regulate interprovincial trade of wildlife species. Because Wood Bison are a CITES Appendix II species, international export of all Wood Bison (including game-farmed stock) is regulated by CITES permits issued by the province under provisions of the provincial *Wildlife Act* and federal *Wildlife Trade Act.* Export for primarily commercial purposes are permitted. Before 1997, when Wood Bison were listed in Appendix I of CITES, international export of Wood Bison for commercial purposes was prohibited (Government of Canada 1997).

3.1.5 United States *Endangered Species Act*

Listing as "endangered in Canada" under the U.S. *Endangered Species Act* (1973) may have presented a barrier to exports of Wood Bison and Wood Bison products to the United States (Gates et al. in prep.). Until recently, this was also a concern of state officials proposing a translocation of Canadian Wood Bison to Alaska. It has now become apparent that their listing as "endangered in Canada" does not establish a designation for Wood Bison within the United States (Stephenson and Fleener 1998).

3.2 Species Management Issues

3.2.1 Disease management

Bison infected with tuberculosis and brucellosis in and around WBNP threaten the health and potential of reintroduced Wood Bison in northern Alberta, northern British Columbia, and southwestern Northwest Territories (Gates et al. in prep.). Two of these herds (Nahanni and Hay-Zama) are immediately adjacent to British Columbia and are potentially at risk of acquiring brucellosis and tuberculosis because of their proximity to infected Bison in WBNP. Interim "Bison control areas" established by Alberta and the Northwest Territories should help prevent spread of these diseases to Bison in British Columbia. A spatial analysis tool is currently under development that will help quantify the risk of Bison infected with these diseases contacting healthy Bison in northern Canada (Axys Environmental Consulting Ltd. 1998). Restoration of healthy Bison populations in WBNP may be the only long-term solution to prevent eventual spread of these diseases to recovering populations in British Columbia and elsewhere.

Commercial Bison ranches are also a potential threat to the disease-free status of recovering populations of free-roaming Wood Bison. Infectious livestock diseases, if present in game-farmed animals, could spread to wild populations by contact through fences or from escaped animals. Conversely, contact with diseased free-roaming Bison, should it occur, or even contact between Bison of untested status and commercial Bison could change the federal disease-free health status of commercial Bison ranches.

3.2.2 Genetic management

Interbreeding with Plains Bison — Escapes and unauthorized free-roaming herds of commercial Bison are a substantial threat to the genetic integrity and recovery of Wood Bison in Canada (Gates et al. in prep.). In addition, the existence of five free-roaming Plains Bison populations within the historic range of Wood Bison (four in Alaska and one in British Columbia), effectively removes a significant portion of their original range from the recovery program.

The rapid expansion of the commercial Bison ranching industry in British Columbia and elsewhere in northern Canada has resulted in an increased number of escapes and rising potential for hybridization with free-roaming Wood Bison. Their size and strength make Bison difficult animals to contain permanently behind fencing. If there were a fencing system available that could guarantee to confine commercial Bison, escapes would not be a significant problem.

The B.C. Ministry of Agriculture and Food (MAF) has policies that require the reporting of

escaped animals, which become the property of the government and revert to wildlife status if not recaptured within 30 days. However, it is difficult to enforce these policies regarding the recapture and relocation of free-roaming commercial Bison.

In 1997, the reintroduced Etthithun Lake herd followed a road allowance approximately 100 km south, away from their release site, where they joined a herd of about 12 feral commercial Bison that had escaped from a ranch. The mixed herd of 26 commercial and Wood Bison were later captured, placed in quarantine for disease testing, and sold to a private ranch. The existence of free-roaming or feral commercial Bison in northeastern. British Columbia jeopardizes the current Wood Bison reintroduction program at Etthithun Lake and potentially compromises Wood Bison recovery efforts in Alberta, the Yukon, and the Northwest Territories.

Genetic diversity — Microsatellite DNA analysis indicates that Wood Bison from EINP and MBS animals are less genetically variable than subpopulations from WBNP, confirming suspicions regarding the effect that small founding populations have in reducing genetic diversity (Wilson and Strobeck 1998). The genetic diversity of reintroduced populations originating from EINP could be augmented by introducing available disease-free animals from the MBS or other sources.

3.2.3 Minimum viable population

The estimate of the minimum viable population (MVP) for Wood Bison is not based on precise calculations. The WBRT inferred the MVP for Wood Bison based on a study of artiodactyl populations in western North America parks where the median size of extirpated populations was 241 and the median size of thriving populations was 792 (Gates et al. in prep.). This information, along with incidences of catastrophic mortality events (e.g., drowning), led the WBRT to increase their previously estimated MVP from 200 to 400.

3.2.4 Predator management

Predation is an important part of the process of natural selection that should be unconstrained in most populations of free-roaming Wood Bison. In some cases, however, wolves have the potential to limit or even inhibit the recovery of some populations of Wood Bison. This is particularly the case for small, fragmented populations or herds that are impaired by infectious diseases. It may become necessary in certain circumstances to manage predator populations over a limited time-frame in order to achieve Bison population goals.

The decision as to whether or not to use methods for controlling predators will need to be assessed on a case-by-case basis. Recently reintroduced populations may have the advantage of being somewhat immune from focused predator attacks, at least for the period of time that it takes the predator population to react to the presence of a "new item on the menu." Hopefully by the time predators begin keying in on reintroduced populations, the Bison population will have grown to point where it is able to continue expanding, despite an increase in losses from predation.

3.2.5 Bison-vehicle collisions

Animal-vehicle collisions are a threat to public safety; they can cause considerable property damage (Hughes et al. 1996), and they are an impediment to achieving conservation objectives. Wood Bison in the Yukon Territory have caused traffic hazards along the Alaska Highway, with eight killed in collisions, five killed as "problem" wildlife, and 36 captured and relocated to a game farm. The Yukon government has a "Bison-free" policy in the vicinity of the Alaska Highway that includes deterrence, capture, and ultimately the destruction of "problem" animals (Government of Yukon Territory 1998).

In British Columbia, the first Etthithun Lake reintroduction was potentially compromised when three of fifteen animals were killed in collisions with industrial road traffic during the first winter (Churchill and Maundrell 1998). On occasion, lone bulls and small groups from the Nordquist Flats Bison herd have created traffic hazards on the Alaska Highway, near the Liard Hotsprings.

The rate of animal-vehicle collisions is primarily a function of three factors: the density of animals, traffic volume, and traffic speed. Because fencing that would effectively prevent Bison from entering highway right-of-ways would probably be prohibitively expensive, so the best way to

prevent Bison-vehicle collisions is to establish populations in areas with low traffic volumes and low traffic speeds. In addition, public education and signage is critical. Road access may then further reduce the potential Bison range.

3.2.6 Species movement

Bison have been known to travel hundreds of kilometres in relatively short time-frames. For example, when 28 EINP Wood Bison were transported to the eastern boundary of Jasper National Park in 1978, most of the animals travelled 150 km north in the first 30 days following release from a holding corral (WBRT 1987). This reintroduction attempt failed when the Bison had to be recaptured upon entering an agricultural area near Grande Prairie, AB. A similar situation occurred in 1980 when Wood Bison were released at Nahanni Butte without being maintained in a holding facility, with the result that some animals temporarily dispersed up to 250 km into British Columbia. There are more recent examples of long distance movement of recently translocated Wood Bison. These include animals that dispersed 100 km south from Etthithun Lake in 1997 and those that temporarily dispersed from Nahanni Butte to Fort Nelson in 1998.

3.2.7 Hunting

Hunter harvest may be used to achieve a number of objectives. It may be used to help control the distribution of animals for the purpose of implementing "Bison control areas" and preventing disease transmission or interbreeding with free-roaming plains, captive, or feral commercial Bison. It may also be used to control population size and density when the objective is to reduce the impact of Bison grazing on other components of the ecosystem.

The policy of the British Columbia government is to manage red-listed species, such as the Wood Bison, for recovery and not for hunter harvest. Once populations have built up to a level that supports a harvestable surplus, hunting can also provide a source of food, recreation, and input to the provincial economy.

3.3 Land-Use Issues

3.3.1 Urban and agricultural development

Urban and agricultural development are the least compatible land uses with population goals for Wood Bison. Wood Bison can destroy private property and are rarely tolerated near human habitations. Alienation of habitat for agricultural production is even more of a threat to Bison because of the large areas involved. Agricultural development in the Fort St. John and Fort Nelson areas has greatly reduced Wood Bison habitats, and continuing expansion of agriculture in the north will further limit the ability to meet population recovery objectives. Expansion of the commercial Bison ranching industry may also limit the amount of land available for establishing free-roaming Wood Bison.

3.3.2 Forest development

Forestry is increasingly becoming a resource use within the historic range of Wood Bison. In the short term, because of Wood Bison's preference for open habitats, there are substantial opportunities for maintaining or increasing available habitats for Wood Bison through forest harvesting. An increased use of grasses and forbs to seed landings and skid-trails will also benefit Wood Bison. However, considerable discussion and planning may be required to fully integrate Bison habitat requirements with long-term forest management goals. We also need to find alternatives to the use of herbicides for controlling competing vegetation on clear-cuts in Wood Bison habitat. Intensive grazing by Bison is one such alternative.

3.3.3 Oil and gas development

As with forest development, the preference of Wood Bison for foraging in open grassy areas means they can often benefit from certain alterations in the environment associated with oil and gas exploration. Grasses and forbs used to seed disturbed sites are a potentially significant source of forage for reintroduced Wood Bison populations in some areas.

3.3.4 Ecosystem impacts

Reintroduction of a large herbivore, such as the Wood Bison, is likely to have at least some effect on local plant and animal communities. Depending on the density and duration of seasonal range use, grazing by Wood Bison may alter the species composition of certain plant communities and may reduce forage available for other herbivores. The increase in prey biomass represented by reintroduced Wood Bison may affect the size and behaviour of predator populations. The affect of reintroduced Bison on ecosystem dynamics is complicated and difficult to predict and should be monitored to assess and mitigate any long-term negative impacts (e.g., Clark et al. 1993).

3.3.5 Intensive habitat management

Intensive habitat management can be used to improve foraging opportunities for Wood Bison. Suppression of wildfire has altered natural fire regimes in a manner that encourages shrubs and trees at the expense of Bison meadow habitats (Gates et al. in prep.). Prescribed burning has been used to replace these natural fire regimes in the Northwest Territories, with up to 27,000 ha treated in some years (Chowns 1998). Prescribed fire has also been used in the past on Wood Bison range in the Nordquist Flats area of British Columbia and may be required again.

3.3.6 Provincial planning processes

The Protected Areas Strategy (PAS) is a set of policies that guides the selection and management of protected areas in British Columbia. In 1997, the Muskwa-Kechik Special Management Area was established. It includes most of the range of the Pink Mountain Plains Bison herd and the Nordquist Wood Bison herd.

The Forest Practices Code (FPC) requires forest development and range use plans to include strategies for maintaining wildlife species at risk through the Identified Wildlife Management Strategy. Wood Bison is a candidate for listing as Identified Wildlife. Under the FPC, wildlife habitat areas can be established for Identified Wildlife species with the objective of maintaining, enhancing, or restoring habitats and populations of threatened or endangered wildlife.

3.3.7 Regional and subregional planning processes

The Land and Resource Management Plan (LRMP) for Fort Nelson has been completed (Government of British Columbia 1998) and includes, as an objective, providing for the habitat needs of all wildlife with special attention to red- and blue-listed species. As well, it is the intention of the Fort Nelson LRMP to identify critical winter habitats of ungulates for consideration as wildlife habitat areas under the FPC. Most of the potential Wood Bison recovery area is designated as either general or enhanced resource development. The presence of Wood Bison is unlikely to have any effect on calculations of the Annual Allowable Cut through regional timber supply reviews.

Habitat protection referrals are ongoing, and provisions for revegetation in forest development plans are carefully reviewed for their potential contribution to improving Wood Bison habitat.

3.4 Bison Management in Adjacent Jurisdictions

3.4.1 Wood Buffalo National Park

The core of historic Wood Bison range is located in and around WBNP, and includes some of the highest quality habitat for this subspecies. It also represents the last reservoirs of bovine tuberculosis and brucellosis in Canada. This large area (760,000 km^2) now supports a relatively low number of diseased remnant herds, many of which are declining (Carbyn et al. 1998). In addition, about 800 animals in central WBNP (Pine Lake) were found to be less representative of Wood Bison than other WBNP subpopulations and are not classified as *B. b. athabascae* (van Zyll de Jong et al. 1995).

Eliminating the two bovine diseases from Bison herds in the vicinity of WBNP would remove the single greatest obstacle to the recovery of Wood Bison in Canada (Gates et al. in prep.). In the interim, the Northwest Territories

government has established a "Bison control area" of 39,363 km^2 to help prevent the spread of tuberculosis and brucellosis to the MBS, Hay-Zama, and Nahanni Butte herds. Free-roaming Bison observed in the "Bison control area" are killed and examined for the presence of tuberculosis and brucellosis. Parks Canada initiated a five-year Bison Research and Containment Program in 1995 to gather information for a future plan to manage Bison diseases within WBNP (Chisholm et al. 1998).

3.4.2 Alberta

A reintroduced herd of approximately 100 animals is located near the northeastern British Columbia border in the vicinity of Hay and Zama Lakes. Individual Bison from this herd occasionally wander into British Columbia along the Hay River drainage. It is predicted that the Hay-Zama herd will eventually increase to the national recovery goal of 400 animals, although the current management objective is lower until the disease issue in WBNP is resolved (Gates et al. in prep.).

A Wood Bison management area has been established over 37,000 km^2 in northwestern Alberta, north of the Chinchaga River and west to the British Columbia border (Reynolds et al. 1985). This area is immediately adjacent to the area proposed for Wood Bison recovery in British Columbia. Wood Bison outside of this area can be hunted at any time; this policy provides a "Bison control area" between the healthy Hay-Zama herd and diseased Bison in WBNP (Gates et al. in prep.). Bison within the management area are protected as an endangered species under the Alberta *Wildlife Act*.

British Columbia's reintroduction site near Etthithun Lake is near the Alberta Wood Bison management area and approximately 120 km from the Hay-Zama herd. If the Etthithun Lake reintroduction is successful, it will probably link up with the Hay-Zama herd to form a single population eventually.

A cooperative effort of Syncrude Canada Ltd. and the Fort McKay First Nations has also established a fenced herd of well over 100 Wood Bison near Fort McMurray. This project is designed to determine whether Wood Bison can be successfully raised on reclaimed land as part of efforts to return oil sands leases to a natural grassland ecosystem (Cattaneo 1998).

3.4.3 Northwest Territories

The herd at the Mackenzie Bison Sanctuary was reintroduced in 1963 and increased rapidly until the late 1980s to a peak of around 2000 animals covering an area of 13,000 km^2. Population increases are now limited by wolf predation, anthrax, flooding, and intraspecific forage competition (Gates et al. in prep.). The herd is subject to hunter harvest and is monitored annually for the presence of tuberculosis and brucellosis.

The Northwest Territories government and the Deninu Kue First Nation are cooperating in a program to salvage a healthy herd of Wood Bison from the diseased animals near Hook Lake, northeast of WBNP. With the final capture of Bison calves in 1998, a fenced herd of 59 animals has been established, all from 1 to 10-day-old calves captured in the wild and treated with antibiotics (Gates et al. 1998; J. Nishi, pers. comm.). The genetic makeup of these animals is currently being assessed with a view to confirming that this founding herd sufficiently represents the genetic variability of the wild population (Gates et al. in prep.). Once all females have successfully passed a post-calving brucellosis test (likely in 2002), then disease-free status will be requested for this captive herd (J. Nishi, pers. comm.).

The nearest NWT herd to British Columbia is the Nahanni Butte herd, which is located along the Liard River immediately north of Maxhamish Lake. Reintroduced in 1980, this herd of over 100 animals has expanded its range along the Liard River as far south as the mouth of the Beaver River in British Columbia. By itself, it is unlikely to reach the minimum viable population (MVP) goal of 400 animals. However, it is considered possible that the Nahanni Butte population will eventually link up with British Columbia's Nordquist herd and unite to form a single population that exceeds the population objective of 400 Bison (Gates et al. in prep.). In 1998, there was a combined total of 190 Bison in the Nordquist Flats, Beaver River, and Nahanni Butte herds.

The government of the Northwest Territories controls the introduction or game-farming of commercial Plains Bison by permit, and there are no Plains Bison game farms in the NWT (Gates et al. in prep.; J. Nishi, pers. comm.). Wood Bison are designated as endangered under the *Northwest Territories Act*.

3.4.4 Yukon Territory

The only herd of Wood Bison in the Yukon is the Nisling River herd. Reintroduced between 1986 and 1992, the herd increased by 10 to 20% annually to the current population estimate of approximately 400 animals. They expanded their range southward from the original release site instead of westward as expected and now cover an area of approximately 4000 km^2 north of the Alaska Highway in vicinity of Aishihik Lake (Government of Yukon Territory 1998). The objectives of the Yukon government's five-year plan (1998) are:

- to establish a herd of about 500 in the area currently occupied by Wood Bison.
- to maintain the genetic purity of Wood Bison and possibly enhance their genetic diversity.
- to maintain the disease-free status of the Yukon's Wood Bison.
- to develop habitat management strategies to maintain Wood Bison range.
- to optimize opportunities for hunting as well as non-consumptive human uses of Wood Bison.
- to implement mitigative measures to reduce the impact of Bison on other ecosystem components.

Like the Northwest Territories, the Yukon Territory does not permit game-farming of Bison nor their introduction to the wild (Gates et al. in prep.). The territorial government is maintaining a "Bison control area" to prevent Wood Bison from creating a traffic safety hazard along the Alaska Highway.

3.4.5 Alaska

There are currently no free-roaming populations of Wood Bison in Alaska. The state Department of Fish and Game has proposed reintroducing Wood Bison to the Yukon Flats National Wildlife Refuge in central Alaska (Alaska Dep. of Fish and Game 1994). Despite evidence to the contrary (Stephenson and Fleener 1998), the U.S. Fish and Wildlife Service is currently opposing the reintroduction on the basis that Wood Bison were not indigenous to Alaska (Fairbanks 1998).

There are currently four free-roaming herds of Plains Bison in Alaska, as well as privately owned Bison that are classified as "domestic." Unconfined Bison are classified as "feral" and become the property of the state (Gates et al. in prep.).

4 MANAGEMENT PLAN

In Canada, although Wood Bison are no longer under immediate threat of extinction, further work at the national level is required to ensure their long-term survival (Gates et al. in prep.). The following management plan is designed to recover the species in British Columbia, downlist Wood Bison from the Red List, contribute towards the goals of the national recovery plan, and eventually build up populations to a level that could support sustainable human use. The management plan outlines the goals, objectives, and specific actions required to recover Wood Bison populations in British Columbia, recognizing that it is no longer feasible to restore Wood Bison to their original distribution or abundance.

4.1 Principles

This management plan is based on four basic principles:

1. The recovery of Wood Bison in British Columbia will be based on the establishment and maintenance of wild free-roaming populations in suitable habitats, within their historic geographic range in British Columbia.

2. All efforts will be made to preserve the genetic integrity and diversity of Wood Bison and maintain their genetic distinctiveness from Plains Bison.

3. In order to provide for continued natural evolution of Wood Bison, the normal interaction between free-roaming Wood Bison and their native environment will be maintained.

4. To the greatest extent possible, this management plan will support the goals of the national recovery program and the objectives of Wood Bison management plans in adjacent jurisdictions.

The recovery of Wood Bison in British Columbia will occur primarily through translocation of animals and other intensive population management techniques for maintaining and enhancing populations. Preserving the genetic separation of Wood Bison from commercial and Plains Bison will be of primary concern in all management and conservation decisions. Information and education programs and cooperative action with interested organizations and groups will seek public support for the Wood Bison recovery program. Habitat protection, land-use planning, and habitat enhancement will maintain Wood Bison habitat in optimal condition. Ecological processes that support the normal evolution of Wood Bison will be maintained as much as possible. Scientific research, population surveys, habitat monitoring, local knowledge, and traditional aboriginal knowledge will produce background information to assist managers in decision-making.

4.2 Goals and Objectives

4.2.1 Goals

The management plan for Wood Bison in British Columbia has five goals.

1. Re-establish a viable metapopulation of at least 1200 disease-free, free-roaming Wood Bison within their former range in British Columbia.
   This goal would restore Wood Bison to their approximate historic distribution, within the ability of current habitat conditions to support viable populations. More than one or two subpopulations are required to reduce the risk of random events affecting the entire BC population. At least three populations would be better able to support the national recovery program. A stable or increasing population of 1200 Wood Bison, well distributed across northeastern British Columbia, would probably meet the requirements for down-listing from the provincial Red List (threatened/endangered) to the Blue List (vulnerable). Ultimately, the goal is to have at least three subpopulations of over 400 animals each, genetically interconnected in one metapopulation that exceeds 1200 in total. This goal should be reevaluated once we have acquired more detailed knowledge about the availability of suitable habitat within the recovery area.

2. Maintain the genetic integrity of free-roaming Wood Bison in British Columbia.
   Hybridization with Plains Bison 70 years ago nearly eliminated Wood Bison as a distinct subspecies, and hybridization remains one of the greatest threats to provincial and national recovery programs.

3. Maintain the disease-free status of free-roaming Wood Bison in British Columbia.
   Introduced bovine diseases in the Northwest Territories and northeastern Alberta is the single greatest obstacle to the recovery of Wood Bison in Canada. These diseases can spread to other wild and domestic animals, and all efforts must be made to prevent these diseases from entering British Columbia.

4. Allow free-roaming, disease-free Wood Bison populations to increase to a level that would allow for long-term sustainable human use.
   There is significant potential for ecotourism, wildlife viewing, resident hunting, nonresident guide-outfitting, and native subsistence use. Achieving population levels that allow human use of Wood Bison is consistent with, and supports, conservation objectives.

5. Work with public groups, rural communities, aboriginal peoples, and adjacent jurisdictions to develop cooperative management and fund-raising programs for establishing and maintaining healthy, free-roaming Wood Bison herds in British Columbia.
   Conservation objectives are easier to achieve if local communities have a direct stake in re-establishing and maintaining viable populations of Wood Bison in their area. Native peoples within the historic range of Wood

Bison have a long history and cultural attachment to this species, and they have a proven ability to sponsor and develop Wood Bison conservation programs cooperatively. Translocation programs are expensive. New sources of revenue and fund raising should be developed with various public and private partners to allow implementation of this plan.

4.2.2 Objectives

Each of the five goals in the management plan has a number of objectives that are designed to support its achievement.

Goal 1 Objectives

Goal #1, "Re-establish a viable metapopulation of at least 1200 disease-free, free-roaming Wood Bison within their former range British Columbia," has the following six objectives:

a) Ensure that Wood Bison are re-established within their historic range and in areas with sufficient habitat to support viable populations.

b) Evaluate high priority translocation sites based on an evaluation of habitat suitability and potential land-use conflicts.

c) Establish Wood Bison in at least three geographically separated sites by translocating, as necessary, animals to areas with sufficient suitable habitat to support population goals.

d) Augment free-roaming populations when feasible and necessary to achieve the MVP or improve genetic diversity.

e) Manage at least three subpopulations to increase them to the estimated MVP of 400 animals, in some cases including animals from adjacent jurisdictions when appropriate.

f) Manage habitats of established populations to achieve population recovery objectives.

A number of potential translocation sites exist in northeastern and north-central British Columbia. Etthithun Lake has already been evaluated, and a reintroduction was most recently performed in March 1999 (Appendix 2). Other areas worthy of consideration may include the lower Petitot River, the upper Petitot River (July Lake), Kotcho Lake, Hay River, and the upper Fontas River (Ekwan Lake).

Populations from adjacent jurisdictions that are geographically linked with a BC population may be included within the overall population objective. Once a subpopulation of 400 animals is stable or increasing, it can contribute towards the national recovery goal of down-listing Wood Bison from "Threatened" and the provincial management goal of down-listing Wood Bison from the Red List.

Goal 2 Objectives

Goal #2, "Maintain the genetic integrity of free-roaming Wood Bison in British Columbia," has the following three objectives:

a) Prevent interbreeding between free-roaming Plains Bison at Pink Mountain and populations of reintroduced Wood Bison.

b) Prevent interbreeding between game-farmed commercial Bison and populations of reintroduced Wood Bison.

c) Evaluate the potential for improving the genetic diversity of existing free-roaming populations.

The national WBRT is concerned about the potential for expanding the range of the Pink Mountain Plains Bison herd. Directed native sustenance harvest has been effective to date in preventing eastern movements of Plains Bison across the Alaska Highway. These efforts must remain diligent in order to maintain the physical separation that between reintroduced Wood Bison and the Pink Mountain herd prevents hybridization and contamination of the Wood Bison genome.

A policy restricting captive Plains Bison to south of latitude 57°N was first instituted in 1987 (WBRT 1987), when the Wildlife Branch issued permits to hold Bison in captivity. This was also the policy of the Ministry of Agriculture, Fisheries and Food until the early 1990s (D. Ireland, pers. comm.). As of 1998, a number of Plains Bison farms have been licensed within historic Wood Bison range north of 57°N,

increasing the probability of inadvertent genetic mixing between escaped commercial Bison and free-roaming Wood Bison. Contact between free-roaming Bison and commercial herds also jeopardizes the disease-free status of commercial operations, potentially putting them in a quarantine situation. Existing policies, regulations, and enforcement are inadequate to prevent mixing of commercial Bison and free-roaming Wood Bison.

Existing Wood Bison populations in British Columbia are all descendants of the 21 animals that established EINP in 1965. In the future, surplus animals may be available from the MBS or other herds, and these could be used to augment existing free-roaming populations in British Columbia. The government of Northwest Territories (1987) has indicated that if an agency requested it, Wood Bison from the MBS could be made available for translocation.

Goal 3 Objectives

Goal #3, "Maintain the disease-free status of free-roaming Wood Bison in British Columbia," has the following two objectives:

a) Ensure that all free-roaming and commercial Bison that enter British Columbia are free of serious diseases such as tuberculosis, and brucellosis.

b) Monitor the disease status of free-roaming and commercial Bison.

The most effective method of achieving this goal is to determine that all Bison that enter British Columbia are disease-free. A spatial analysis tool should be available within the next year to assist in assessing the risk of contact between disease-free Bison and infected Bison in northern Canada (Axys Environmental Consulting Ltd. 1998). Periodic testing of commercial and free-roaming populations is also required in order to detect the presence of serious diseases and react accordingly.

Goal 4 Objectives

Goal #4, "Allow free-roaming, disease-free Wood Bison populations to increase to a level that would allow for long term sustainable human use," has the following four objectives:

a) Monitor changes in population distribution, size, and demographics.

b) Manage both habitat and populations to achieve population goals, prevent severe overgrazing, and maintain natural ecosystem function.

c) Optimize opportunities for residents and visitors to view free-roaming Wood Bison.

d) Eventually provide conservative hunting opportunities for native sustenance hunters and resident and nonresident hunters, consistent with the British Columbia Wildlife Harvest Strategy (Wildlife Branch 1995).

Periodic monitoring of the distribution and abundance is required both to determine if conservation objectives have been met, as well as to evaluate the potential for non-consumptive and consumptive human use. Various habitat enhancement techniques, including prescribed fire and mechanical clearing, are available to maintain or improve Bison meadows and help achieve population goals. Integrating Bison habitat objectives with forest management plans and industrial site developments (e.g., seismic lines) can also help achieve population goals.

The restoration of healthy Wood Bison herds to a level that can support long-term sustainable use will contribute to the aesthetic, cultural, economic, and social well being of rural northern communities (Gates et al. in prep.). Re-established Wood Bison populations have the potential to contribute to the economy through ecotourism and through expenditures by resident and nonresident hunters.

Goal 5 Objectives

Goal #5, "Work with public groups, rural communities, aboriginal peoples, and adjacent jurisdictions to develop cooperative management and fund-raising programs for establishing and maintaining healthy, free-roaming Wood Bison herds in British Columbia," has the following four objectives:

a) Involve government agencies, stakeholders, public groups, rural communities, and native groups in developing reintroduction plans.

b) Consult neighbouring jurisdictions during the development of reintroduction plans and Wood Bison policy changes.

c) Continue efforts to increase public awareness through fact sheets, posters, brochures, radio, TV, and print media.

d) Develop new fund-raising capabilities and partnerships involving governments, business, and the public.

Local communities and First Nations should be involved in shaping the management of Wood Bison populations in local areas, and government agencies, public groups, and neighbouring jurisdictions should be involved in shaping management at the provincial level. General consultation and public information on Bison management should be as broad as possible and should include all interested organizations and groups.

4.3 Specific Tasks and Management Actions

To many, the history of Bison in North America symbolizes both failure and success. Over the years, Wood Bison have been subject to excessive hunting, commercial exploitation, habitat destruction, conflicting land use, introduction of disease, genetic mismanagement, and the intentional destruction of populations (Gates et al. in prep.). Wood Bison have also been the focus of a 35-year program of careful captive-breeding and reintroduction to the wild that have brought them back from the brink of extinction.

Continued recovery of Wood Bison populations in British Columbia will require the cooperation of government agencies, aboriginal groups, local communities, and nongovernment organizations. The following section outlines the specific tasks and management actions that are required to achieve recovery goals and objectives.

4.3.1 Goal 1 Actions

Re-establish a viable population of at least 1200 disease-free, free-roaming Wood Bison within their former range in British Columbia.

a) Ensure that Wood Bison are re-established within their historic range and in areas with sufficient habitat to support viable populations.
   i) Identify all potential translocation sites on standard large-scale electronic and paper maps.
   ii) Compare potential translocation sites to the delineated historic and prehistoric range of Wood Bison.
   iii) Determine the general habitat attributes at potential translocation sites using the most recent terrestrial ecosystem mapping, forest cover mapping, satellite imagery, and aerial photography.
   iv) Priorize potential translocation sites based on this general information.

b) Evaluate high priority translocation sites based on a detailed evaluation of habitat suitability and potential land-use conflicts.
   i) Classify and inventory habitat types at potential translocation sites using standard techniques for terrestrial ecosystem classification.
   ii) Measure and estimate the standing biomass of Bison forage available for winter and summer use.
   iii) Measure and predict the maximum expected snow depths on potential winter ranges during severe winters.
   iv) Calculate the theoretical carrying capacity of Bison range using forage biomass estimates, terrestrial ecosystem mapping, and predicted snow depth information to ensure that over 400 Wood Bison can be maintained.
   v) Evaluate the potential for genetic interchange with other Bison herds.
   vi) Evaluate the risk of disease transmission from other free-range Bison and livestock.
   vii) Evaluate the potential for predators to hamper herd establishment.
   viii) Evaluate potential conflicts between a Wood Bison population and other land

uses and other wildlife species at both the translocation site and in adjacent areas.

ix) Evaluate the logistical practicality of transporting Bison and erecting fencing at the translocation site.

x) Finalize potential Wood Bison translocation sites using the detailed information gathered above.

xi) Initiate a program of formal agency and public consultation to obtain feedback on the highest priority Wood Bison reintroduction sites.

c) Establish Wood Bison in at least three geographically separated sites by translocating, as necessary, animals to areas with sufficient suitable habitat to support population goals.

i) For each translocation site, determine the size and location of a Bison enclosure sufficient to support the herd for at least one year without supplemental feeding (i.e., less than 4 adults per km^2 – Appendix 3).

ii) Arrange for future delivery of a minimum 20 adult females and five adult males at the release site. All animals must be confirmed Wood Bison stock and certified disease-free. Surplus animals from EINP are available for conservation initiatives, upon formal agency request.

iii) Construct a Bison enclosure of adequate size and quality for Bison.

iv) Arrange necessary supplies, transportation, and staff support and finalize logistics and timing of animal transport.

v) Transport animals to the translocation site and release them into the Bison enclosure.

vi) Monitor general health and status of captive Wood Bison at the release site and check fencing to detect breaks and weak points.

vii) Repair all breaks and weak points in enclosure fencing and return any escaped animals to the enclosure.

viii) "Soft release" Bison a minimum of 12 to 24 months after initial acquisition, as suitable for site conditions to import animals into the release site.

d) Augment free-roaming populations when feasible and necessary to achieve the MVP or improve genetic diversity.

i) As necessary, obtain an appropriate number of disease-free Wood Bison juveniles for release with an existing population using the same procedures as in Goal 1.c. above.

ii) If the objective is to improve genetic diversity (see Goal 2.c. page 28), obtain young animals of different genetic stock (i.e., MBS), and augment existing populations when they are relatively small to maximize genetic effects.

iii) Release animals in areas where existing animals are concentrated to help habituate animals to the release site.

e) Manage at least three subpopulations to increase them to the estimated MVP of 400 animals, in some cases including animals from adjacent jurisdictions when appropriate.

i) Develop estimates of the optimum density of Wood Bison that habitats can sustainably support in balance with other components of the ecosystem.

ii) Periodically throughout the year determine the size, distribution, and demographics of the reintroduced herd using RIC standards for ungulate inventory (Resource Inventory Branch 1997).

iii) Input Wood Bison population goals into various land-use and land-management planning initiatives (e.g., LRMP, PAS, and FPC).

iv) Initiate intensive population management programs such as predator or disease control as appropriate and necessary to increase subpopulations to optimal levels at or above 400 animals.

f) Manage habitats of established populations to achieve population recovery objectives.

i) Periodically monitor and evaluate seasonal habitats and natural ecosystems for changes associated with Bison use.

ii) Use vegetation sampling techniques employed on Wood Bison range elsewhere in Canada, along with standard methods for ecosystem mapping (Ecosystems

Working Group 1995) and habitat monitoring (Habitat Monitoring Committee 1990) used in British Columbia.

iii) Initiate habitat enhancement programs such as prescribed fire and mechanical clearing as appropriate and necessary.

iv) Monitor response of plant communities and Bison populations to habitat enhancement activities using RIC standards habitat monitoring (Habitat Monitoring Committee 1990).

v) Integrate Wood Bison habitat requirements with forest management plans, oil and gas development, reclamation of industrial sites, and other land uses.

vi) Input habitat objectives for Wood Bison into various land-use and land-management planning initiatives (e.g., LRMP, PAS, etc.).

4.3.2 Goal 2 Actions

Maintain the genetic integrity of free-roaming Wood Bison in British Columbia.

a) Prevent interbreeding between free-roaming Plains Bison at Pink Mountain and populations of reintroduced Wood Bison.

i) Designate the Wood Bison Management Area (Figure 5) through ministry regulations and policy as the area for conservation and recovery of free-roaming Wood Bison.

ii) Ensure that the BC Wood Bison Management Area is contiguous with the Wood Bison management area in Alberta.

iii) Continue to direct native sustenance harvest to any free-roaming Plains Bison that enter the "Bison control area" separating the WWood Bison Management Area from the Plains Bison Management Area (Figure 5).

iv) Communicate the location and purpose of these management areas to other agencies and the general public through standard communication channels (see Goal 5.c. page 32).

v) Periodically determine the size, distribution, and demographics of the Pink Mountain herd inside the Plains Bison Management Area, using RIC standards for ungulate inventory (Resource Inventory Branch 1997).

vi) Develop a contingency plan to deal with population movements toward the "Bison control area," including providing trained ministry staff to move animals and procedures for disposing of animals that enter the "Bison control area."

vii) Prior to achieving Wood Bison population goals, deal with any Wood Bison movements into the "Bison control area" using ministry staff.

viii) Over the long term, control the numbers and distribution of free-roaming Wood Bison at a level that reduces the risk of individuals straying beyond their designated zone.

ix) Control the numbers of free-roaming Plains Bison through regulated hunting, directed native harvest, and other means, at less than 1800 adults.

x) Control the distribution of free-roaming Plains Bison through regulated hunting, directed native harvest, and other means (e.g., salt blocks), to reduce the risk of individuals straying beyond the Plains Bison Management Area (Figure 5).

xi) Regularly monitor the "Bison control area" to ensure that this area remains free of free-roaming Bison.

b) Prevent interbreeding between game-farmed commercial Bison and populations of reintroduced Wood Bison.

i) Develop a cooperative agreement with the Ministry of Agriculture and Food (MAF), the Canadian Bison Association (CBA), and the Peace Country Bison Association (PCBA) to address the respective roles and responsibilities of government agencies and Bison farmers in preventing the inadvertent mixing of free-roaming Wood Bison and commercial Bison.

ii) Work cooperatively with MAF, CBA, PCBA, and Bison farmers to develop regulations under the British Columbia *Game Farm Act* (Section 8) specifying that no commercial Bison game farm

licences be issued within the Wood Bison Management Area (Figures 5 and 6).

iii) Develop standard operating procedures for removing escaped commercial Bison from the wild.

iv) Work cooperatively with MAF, CBA, PCBA, and Bison farmers to develop standards for fencing and gating to prevent the escape of commercial Bison from game farms.

v) Work cooperatively with MAF, CBA, PCBA, and Bison farmers to develop regulations under the British Columbia *Game Farm Act* to make enhanced standards developed under Goal 2.b.iv. mandatory for commercial Bison game farms within a 100-km wide buffer zone adjacent to the Wood Bison Management Area (Figure 6).

vi) Develop a contingency plan as part of the MAF, CBA, and PCBA cooperative agreement that establishes procedures for enforcing regulations for the capture or disposal of abandoned commercial Bison.

vii) Ensure that Wood Bison stock used for commercial game-farming are officially certified as Wood Bison stock by the Canadian Bison Association or the National Wood Bison Recovery Team.

c) Evaluate the potential for improving the genetic diversity of existing free-roaming populations.

i) Determine the feasibility of augmenting herds with disease-free animals from the MBS or other sources as available. This should be done as soon as possible while Wood Bison populations in British Columbia are still relatively small.

4.3.3 Goal 3 Actions

Maintain the disease-free status of free-roaming Wood Bison in British Columbia.

a) Ensure that all free-roaming and commercial Bison that enter British Columbia are free of serious diseases such as tuberculosis and brucellosis.

i) Use only certified disease-free stock for release to the wild.

ii) Work with Bison farmers to confirm that all commercial Bison that enter British Columbia are certified disease-free stock.

iii) Work with adjacent jurisdictions to confirm that all free-roaming and commercial Bison populations near British Columbia are disease-free.

b) Monitor the disease status of free-roaming and commercial Bison.

i) Monitor the disease status of free-roaming populations of both Wood Bison and Plains Bison as appropriate and feasible.

ii) Work with the MAF to ensure that commercial Bison are regularly monitored for diseases.

iii) Work with the Canadian Food Inspection Agency to develop a contingency plan to deal with emergency responses to an outbreak of serious diseases such as anthrax, tuberculosis, or brucellosis in wild or commercial Bison populations.

4.3.4 Goal 4 Actions

Allow free-roaming, disease-free Wood Bison populations to increase to a level that would allow for long-term sustainable human use.

a) Monitor changes in population distribution, size, and demographics.

i) Develop estimates of the optimum density of Wood Bison that habitats can sustainably support in balance with other components of the ecosystem.

ii) Periodically determine the size, seasonal distribution, and demographics of populations, using RIC standards for ungulate inventory (Resource Inventory Branch 1997).

b) Manage both habitat and populations to achieve population goals, prevent severe overgrazing, and maintain natural ecosystem function.

i) Periodically monitor and evaluate seasonal habitats and natural ecosystems for changes associated with Bison use.

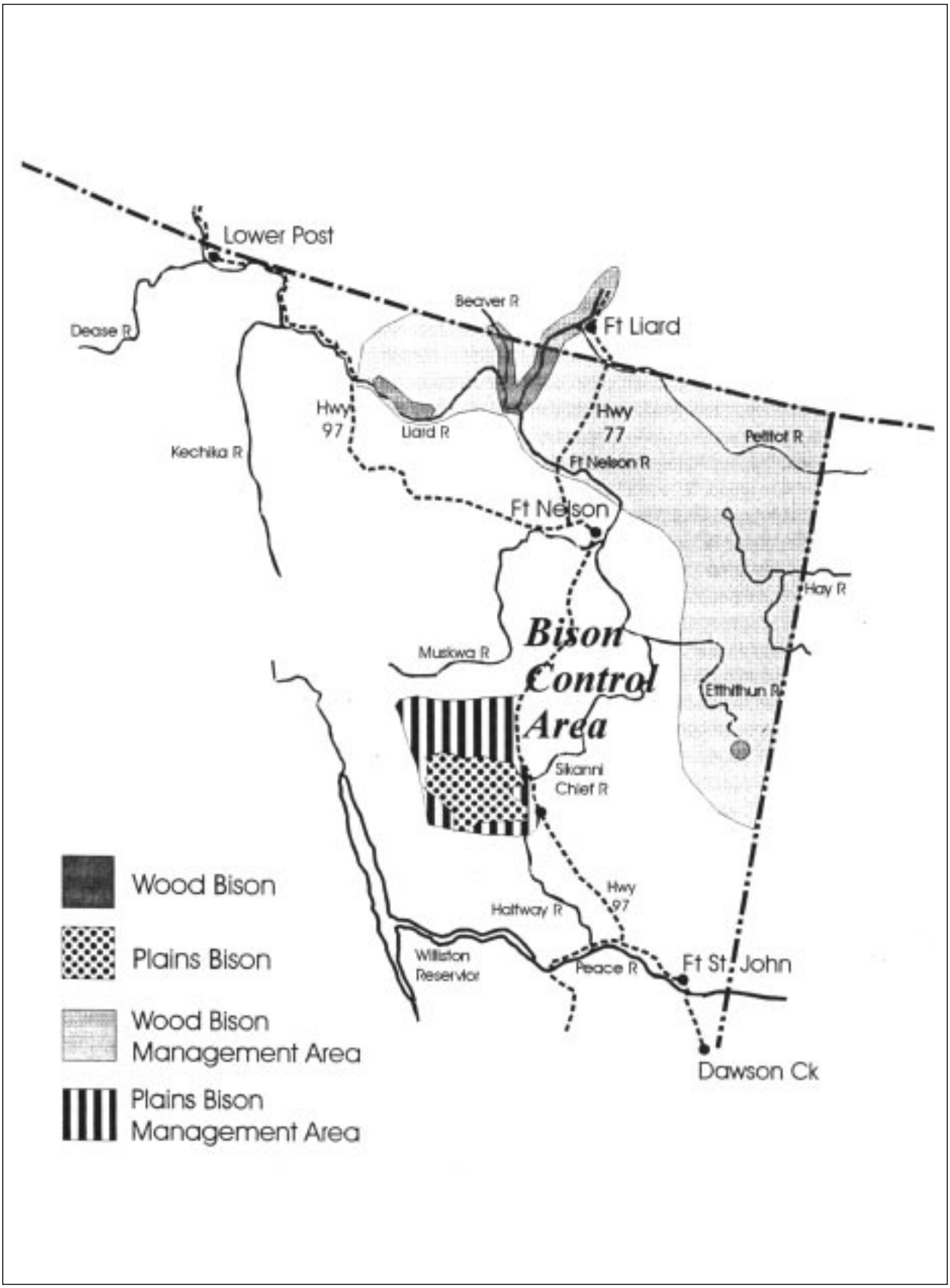

Figure 5. Management areas for free-roaming Bison in British Columbia.

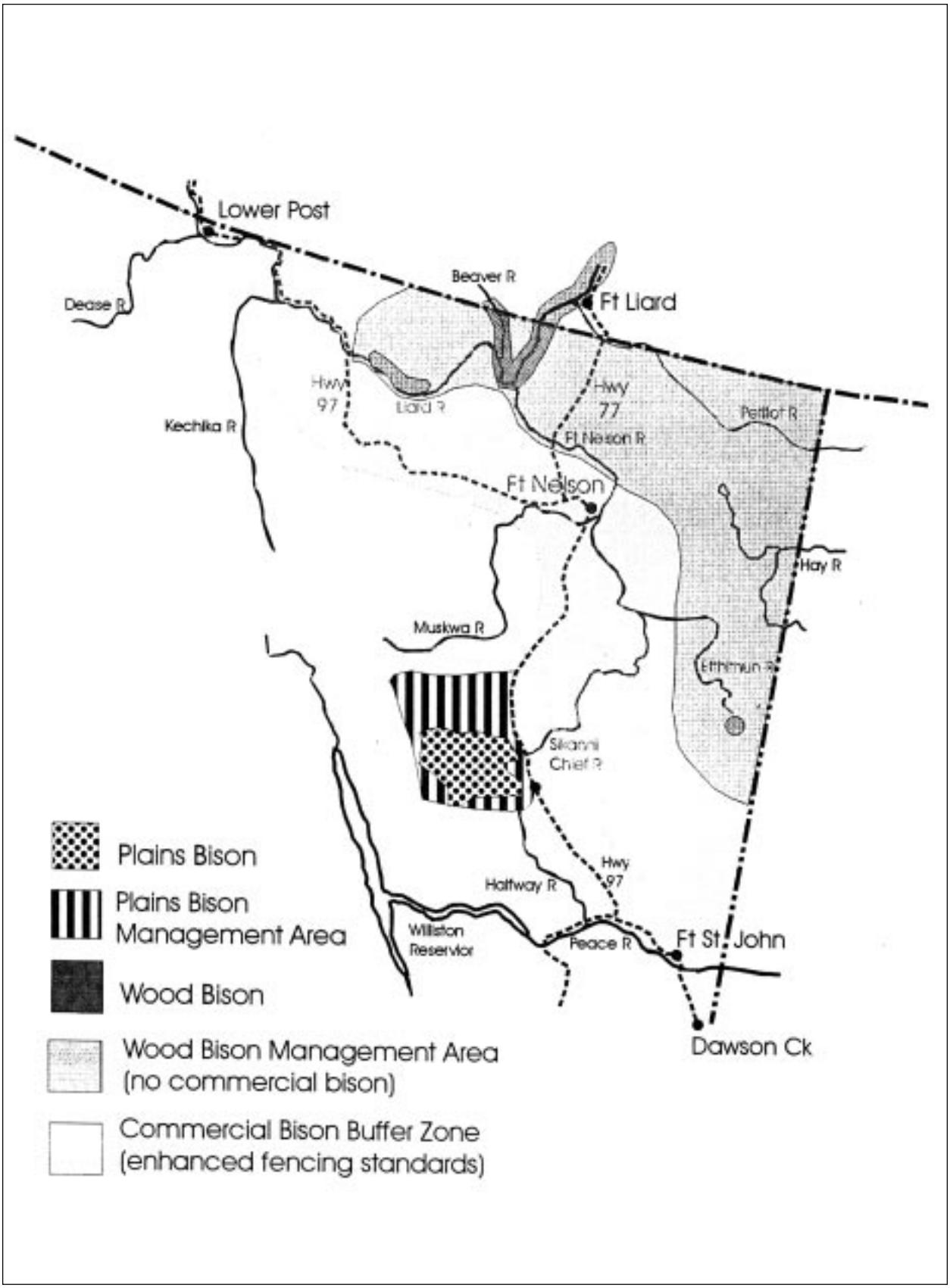

Figure 6. Proposed management zones for commercial Bison in British Columbia.

ii) Integrate Wood Bison habitat requirements with forest management plans, oil and gas development, reclamation of industrial sites, and other land uses.
iii) Input population and habitat objectives for Wood Bison into various land-use and land-management planning initiatives (e.g., LRMP, PAS, and FPC).
iv) Initiate habitat enhancement programs such as prescribed fire and mechanical clearing as appropriate and necessary.
v) Initiate intensive population management programs to maintain or increase populations to optimal levels at or above 400 animals.
vi) Encourage research on re-established Wood Bison herds.

c) Optimize opportunities for residents and visitors to view free-roaming Wood Bison.
i) Monitor the distribution and abundance of re-established herds of Wood Bison.
ii) Evaluate a number of potential viewing sites or corridors where viewers could be relatively safe from direct encounters with Bison.
iii) Evaluate access to the site or corridor, particularly the potential for access development to interfere with established range-use patterns and allow Bison to move out of designated management zones.
iv) Develop a number of safe, accessible viewing sites or corridors that will not disrupt normal Wood Bison range-use patterns.
v) Encourage private entrepreneurs, including guide outfitters, to provide aerial and ground viewing opportunities to the public on a fee-for-service basis.
vi) Increase public awareness and promote wildlife viewing opportunities through standard communication vehicles (see Goal 5.c. page 32).

d) Eventually provide conservative hunting opportunities for native sustenance and resident and nonresident hunters, consistent with the British Columbia Wildlife Harvest Strategy (Wildlife Branch 1995).
i) Evaluate herd-specific data on population size, trend, and distribution.
ii) Down-list Wood Bison to British Columbia's Blue List once population goals are achieved.
iii) Confirm that all herds are well established and that there is a harvestable surplus of animals.
iv) Determine the appropriate level of harvest required to maintain Wood Bison numbers at estimated optimum levels.
v) Allocate the harvest among residents, natives, and nonresidents according to policy.
vi) Manage the native harvest through cooperative agreements with local First Nations.
vii) Manage resident hunting by Limited Entry Hunting with permit authorizations issued on a draw basis.
viii) Manage the nonresident harvest through quotas to guide-outfitters licensed in the areas used by Wood Bison.
ix) Closely monitor the harvest, using hunter surveys, compulsory inspection (Wildlife Branch 1995), and tooth aging (Moffitt 1998).

4.3.5 Goal 5 Actions

Work with public groups, rural communities, aboriginal peoples, and adjacent jurisdictions to develop cooperative management and fund-raising programs for establishing and maintaining healthy, free-roaming Wood Bison herds in British Columbia.

a) Involve government agencies, stakeholders, public groups, rural communities, and native groups in development of reintroduction plans.
i) Ensure that local communities, First Nations, and local industry have input to the management of local Wood Bison populations.
ii) Recognize the special interest of First Nations in the recovery of Wood Bison in the boreal forest region.
iii) Ensure that consultation is broad and includes all public interest groups and affected government agencies.

iv) Consider the development of long-term cooperative management agreements with rural communities and native groups for re-establishing healthy, free-roaming Wood Bison herds.

b) Consult neighbouring jurisdictions during the development of reintroduction plans and Wood Bison policy changes.
   i) Seek comment on and approval of reintroduction plans by the national WBRT and adjacent jurisdictions.
   ii) Seek comment on proposed Wood Bison policy changes (e.g., "Bison control areas") from the national WBRT and neighbouring jurisdictions.

c) Continue efforts to increase public awareness through fact sheets, posters, brochures, radio, TV, and print media.
   i) Periodically review and update fact sheets on Wood Bison recovery efforts for distribution to the public and the media.
   ii) Emphasize the location and purpose of the Wood Bison Management Area, the Plains Bison Management Area, and the "Bison control area" that separates them (see Goal 2.a. above).
   iii) Prepare a brochure on Wood Bison in British Columbia as part of the "Wildlife at Risk" series.
   iv) Continue to supply accurate information promoting Wood Bison and Wood Bison recovery efforts to various media outlets.
   v) Raise public profile by renaming the 90,450-ha Liard River Corridor Protected Area as Wood Bison Provincial Park.

d) Develop new fund-raising capabilities and partnerships involving governments, business, and the public.
   i) Arrange for a minimum of $200,000 to be available to implement each translocation.
   ii) Explore opportunities for financial partnerships with public groups, businesses, and aboriginal peoples.
   iii) Encourage the public to contribute towards and participate in recovery efforts as much possible.

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6 APPENDICES

Appendix 1. Status, trend, and potential of free-roaming Wood Bison populations, free of tuberculosis and brucellosis, in Canada (after Gates et al. in prep.)

Population	Year Established	Current	Potential Size	Pop. Size	Est. year Trend	Initial reach MVP	Size Source
Mackenzie	1963	1900	1500	Stable	Achieved	18	NR
Nahanni	1980	100	100	Stable	N/A	28 + 12	EINP
Liard	1995	50	>400	Incr.	2015	49	EINP
Yukon	1988	400	>400	Incr.	Achieved	142	EINP
Chitek Lake	1991	60	>400	Incr.	?	13 + 9	EINP
Hay-Zama	1993	>100	>400	Incr.	2010	49	EINP

Appendix 2. The Etthithun Bison Area Plan

by John Elliott
Ministry of Environment, Lands and Parks
Fort St. John, BC
March 1998

British Columbia has been part of the national effort to re-establish Wood Bison (*Bison bison athabascae*) across their historic range in northwestern Canada (Wood Bison Recovery Team, 1987). That range included the boreal forest regions of northern Alberta, southwestern Northwest Territories, northeastern British Columbia, and northwestern Saskatchewan. Wood Bison declined across that range from an estimated 168,000 in 1800, to about 250 by 1900, probably largely in response to the severe winters of the late nineteenth century exacerbated by commercial hunting with modern firearms. These had rebuilt to about 2000 by 1925, but then were largely lost as a distinct race as a result of hybridization with transplanted Plains Bison (*Bison bison bison*). About 40 animals that remained as pure Wood Bison were isolated in the mid-sixties. Careful management of these animals and reintroductions have resulted in a present population of at least 2600 animals found in the Northwest territories, Alberta, Manitoba, and the Yukon. Lack of re-establishment within their historic range in British Columbia's northeast remains as the main deficiency in their overall re-establishment.

At present Wood Bison are found at Nordquist Flats (Aline Lake bowl), the Liard River downstream from confluence with the Beaver River, and the Hay River area adjacent to Zama. The next step in re-establishment is to see the Bison returned to their range within the portion undergoing forestry and petroleum extraction south of latitude 59°N. This step is important for several reasons:

- to move towards wider geographic distribution of Bison across northeastern BC (and adjacent NWT and Alberta);
- to allow for greater overall numbers;
- to show that forestry and petroleum extraction need not always result in less ungulate biomass; and
- to allow for greater societal benefits from the Bison; that is, there is limited viewing and consumptive benefit to be had from herds in areas that can only be reached by aircraft. This may be especially important for aboriginal people.

Etthithun Lake at the southern extent of the chosen range for the subspecies in British Columbia, has many advantages.

- Proximity to the Fort St. John office (cheaper)
- Good mix of forestry and petroleum development
- Revegetation of both petroleum and forestry disturbances with domestic cultivars (with higher forage value to Bison)
- Positive interest from Canfor
- High Bison tradition for the local Doig band
- Highlights the southern range of the Wood Bison in modern BC
- Most of the remaining identified range south of latitude 59 is located in a general management LRMP zone (where wildlife objectives may modify resource development) as opposed to an enhanced resource development LRMP zone (where a high priority is designated for extractive resource development).

Etthithun Lake is located in British Columbia's northeast. The nearest town is Fort St. John, situated approximately 200 km to the south.

The area lies at about 700 m above sea level and is predominantly Boreal White and Black Spruce biogeoclimatic type. There are approximately 1050–1250 degree days above 5 degrees Celsius annually (Environment Canada AES station summary). Mean maximum snow depths for the general area/elevation are 40 to 50 cm, with a 22-year maximum of 91 cm (BC Water Management Year).

The Etthithun Bison Area (EBA) of some 375 km^2 is located in the Clear Hills ecosection of the Alberta Plateau of the Boreal Plains. This is an area of smoothly rolling upland that gradually rises in elevation towards the north and east. The upland is interspersed with wetlands.

A good mosaic of cover types exists, with extensive areas of trembling aspen forest indicative of the fire history of the area. These upland burned sites would have been the mainstay of

historical Bison populations in the area. The present policy of fire suppression can be expected to reduce the incidence of these naturally created pasturages, though there is some small potential to conduct controlled burns to rejuvenate sites. However, in its present state the 7300 hectares of aspen woodland in the area would be expected to support only 182 adult Bison for the six months of summer (DDMI=16.4 kg, 50% utilization) at standard BCFS fair quality site productivity rates for that vegetation type (largest biomass of graze would be hairy wild rye, *Elymus hirsutus*).

The present attractiveness of the site, though, is in the contribution to forage production from the disturbed sites. In 1997 there were approximately 3300 hectares of clear cut. The predominant grass response on these sites is bluejoint, which is a low quality grass forage species used, however, as a winter mainstay of the Beaver herd of Wood Bison. This would in theory support 990 AUMs (83 animals annually) at standard BCFS rates for only fair quality sites. Additionally, other grass communities are the result of logging activity, including approximately 300 hectares of domestic seeded grassland on access roads, skid trails, and landings. At standard BCFS fair quality site rates, these 300 hectares of domestic grassland would be expected to support 36 adult Bison year round. The area also contains some 385 ha of domestic cultivar seeded pipelines and petroleum leases, which at standard BCFS fair quality site rates would support another 46 Bison year round.

Additionally, this area contains over 1200 km of seismic line, most of it seeded to domestic cultivars, for over 960 ha, which if assumed on average to have only half the annual AUM capacity of pipeline hectares (that is, conservatively assuming that only 50% has good grass coverage), would support another 58 Bison year round. There are also 540 ha of high volume forage production sedge wetland (and lots more beyond the EBA boundaries), which theoretically may support 118 Bison year round. Further there are some 200 km of petroleum development roads which (at 30 m width and 4 m road surface) provide another 600 hectares of reseeded domestic grassland capable of supporting another 77 Bison year round. There remain over 25,000 additional ha of land, which would supply additional forage and other needs.

In summary, the EBA domestic grassland disturbed sites alone would very conservatively support some 217 adult Bison per year while additional animals could be supported at least seasonally by aspen woodland (1092 AUMs), sedge wetland (1416 AUMs), clearcuts (990 AUMs), and other woodland. The immediately adjacent area to the south (so called South Fontas) is rather similar in disturbance and would provide probably at least 50% of the AUMs of the EBA in somewhat similar proportions. To the north and west, there is lots of sedge wetland and some enhanced disturbed sites. Modest expansion of the EBA boundary or even refinement of the present very conservative carrying capacities should allow for a population of 400 Bison if that is deemed appropriate. Alternatively, establishment of other subpopulations to the north could allow a cumulative achievement of a 400 objective.

DISCUSSION

The EBA is an area that would historically have attracted Bison due to high-volume forage grasslands following wildfires. In the absence of wildfires, the present and future ability of the area to attract and hold Bison is based on high volume forage grasslands following industrial disturbance.

The forage base in the EBA area alone appears, as of 1997, to be adequately dense over many hectares sufficiently widespread and of suitable quality to sustain a substantial Bison herd. However, additional forage evaluation can provide valuable insight into this aspect.

In the interim there is merit in containing Bison on site in a large enclosure for several years. This would:

1. meet the WBRT objective of establishing a geographically distinct fledgling herd as a species buffer to catastrophic events elsewhere.

2. meet the WBRT and B.C. MELP objective of local community involvement in Wood Bison re-establishment.

3. provide an incentive for resolving the feral domestic Bison issue.

4. provide an opportunity for detailed vegetation analyses.

5. provide an opportunity for refinement/updating of the BC Bison plan.

6. provide source animals for a future BC release back to the wild.

7. allow the opportunity for local industry to display their environmental consciousness in a very positive way through participation.

8. condition some Wood Bison very strongly to the Etthithun area.

Only items 4, 5, and 6 could be met without this project.

Careful location and design of the enclosure site to include some industrially disturbed sites would provide a microcosm of the larger EBA. Considerable planning and cooperator input will be required to choose a specific enclosure plan boundary.

It is proposed to proceed in June–July 1998 with construction of a large approximately 2500 ha game wire fenced enclosure to contain an initial reintroduction in February 1999 of 25 calves consisting of 20 heifers and 5 bulls. The 25 animals should be trucked to the EBA in a straight liner style unit. To facilitate settling and combat travel stress, there will be modest supplemental feeding of grain for the remainder of the 98–99 winter.

It is expected that with appropriate site selection, it will not be necessary to provide any artificial food for the Bison beyond the winter of release in their large enclosure over a five-year containment period. Should highly unusual winter weather conditions arise, it should be possible to provide supplemental grain at minimal cost and with minimal disturbance to natural feeding regimes.

While it is likely that the EBA would remain the priority release site, the option exists to evaluate any or all other possible sites over the five-year enclosure period and define new priorities.

BUDGET/ACTIVITIES (to March 99)

Activity	Timing	Cost ($,000)
Trucking of 25 calves to EBA	Feb 99	5.0
Grain	Feb–Mar 99	2.0
Salt	Mar 98– Mar 99	0.2
Enclosure boundary resolution	Apr 98	2.0
Enclosure fence construction (one year option)[1]	Jun–Jul 98	150.0

[1]The fence construction cost is based on one company's preliminary quote only.

Subsequent year costs for enclosure fence repair and general monitoring would be on the order of $5000 per annum, barring major problems.

Various funding sources will be explored. These would include regional funds (staff time, proceeds from Bison disposal, possible other), HCTF, FRBC through Canfor, Rod and Gun Club, Doig First Nation, and possible industry contributions.

Appendix 3. Characteristics of enclosures used in "soft release" of Wood Bison in the 1980s (after WBRT 1987).

Location	Size of Enclosure (km^2)	Number of Adults	Max. Density to 1987 (No. km^2)	Comments
Waterhen, MB	23	34 to 102	4.4	Low calf production
Hay-Zama, AB	3	29 to 34	11.3	Supplemental feeding required (high mortality, low calf production)
Nisling River, YT	6	34 to 44	7.3	Low calf production
EINP, AB	59	21 to 222	3.8	Calf production somewhat reduced

Appendix 4. List of acronyms used in the management plan.

Organizations and Committees

BCFS	British Columbia Forest Service
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CITES	Convention on the International Trade of Endangered Species of Fauna and Flora
FPC	Forest Practices Code of British Columbia Act
LRMP	Land and Resource Management Plan, Government of British Columbia
MAF	British Columbia Ministry of Agriculture and Food
MELP	British Columbia Ministry of Environment, Lands and Parks
PAS	Protected Areas Strategy, Government of British Columbia
RIC	Resource Inventory Committee, Government of British Columbia
RENEW	Recovery of Nationally Endangered Wildlife Committee
UNEP	United Nations Environment Program
WBRT	Wood Bison Recovery Team

Wood Bison Herds

EBA	Etthithun Bison Area
EINP	Elk Island National Park
MBS	Mackenzie Bison Sanctuary
NR	Nyarling River
SLR	Slave River Lowlands
WBNP	Wood Buffalo National Park

Provinces and Territories

AB	Alberta
BC	British Columbia
NWT	Northwest Territories
YT	Yukon Territory

Measurements

AUM	Animal Unit Month
DDMI	Digestible Dry Matter Ingested
MVP	Minimum Viable Population
YBP	Years Before Present

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