HISTORY AND CURRENT STATUS OF THE NAHANNI WOOD BISON POPULATION

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ABSTRACT

Wood bison (*Bison bison athabascae)* that inhabit the boreal forests of Northern Canada were nearly eliminated during the late 1800s. Only bison populations in the area between the Great Slave Lake and the Peace-Athabasca Delta persisted. Historically, wood bison range included the Southwestern portion of the Northwest Territories. As part of a program to establish a minimum of three free-ranging populations of wood bison in their historical range, the Nahanni wood bison population in southwestern Northwest Territories was established in 1980. Twenty-eight wood bison from Elk Island National Park (EINP) were released into the Nahanni Butte area. Supplemental releases in 1989 and 1998 of 12 and 61 individuals respectively, have bolstered the population. Since the initial reintroduction in 1980 research and monitoring of the population has been inconsistent and sporadic. This lack of population monitoring has been a concern of local residents of Nahanni Butte and Fort Liard. In 2002, a more formal research and monitoring program of the Nahanni wood bison population was initiated. Annual sex and age classification surveys from 2002-2006 show large yearly differences in indices of calf production (20-57 calves per 100 adult females) but overwinter calf survival has been ≥50% regardless of calf production during the previous year and has increased with every year of the survey. An aerial census of the population in March 2004 estimated 399 bison (CV = 0.32). Biological sampling has found no evidence of brucellosis (*Brucella abortus*), tuberculosis (*Mycobacterium bovis*), or the causative agent of Johne's disease (*Mycobacterium avium* subspecies *avium*), nor has anthrax been detected on the range of the population. It is suspected that the range does not provide suitable conditions for spore persistence. Bison are susceptible to collisions with motor vehicles on the Liard Highway (Hwy 77) during September-October when more animals use the road as a travel corridor. In some years at spring break up animals are swept away and drowned. Bison use both sides of the Liard River Valley making swimming across the river an important component of the ecology of this wood bison population. Although sedges, grasses, and willow (*Salix* spp.)

generally predominate the diet of Nahanni wood bison, there is a relatively high *Equisetum* component to the diet.

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HISTORICAL CONTEXT

Wood bison (*Bison bison athabascae*) that inhabit the boreal forests of Northern Canada were nearly eliminated during the late 1800s; this has been attributed to the encroaching fur trade and over harvesting that occurred in the region during this time (Soper 1941; Gates et al. 1992). Bison populations did manage to persist in the area between the Great Slave Lake and the Peace-Athabasca Delta, but wood bison were extirpated in other parts of their range (Ogilvie 1893). A trapper named Poolfield and/or an elder from Trout Lake shot the last known bison around Trout Lake in 1890 (Daniel Allaire pers. comm.). The last confirmed wood bison from the primordial population in northeastern British Columbia was shot at near Fort St. John in 1906 (MacGregor 1952).

Oral narratives obtained from aboriginal people, as well as radiometric data from bison remains indicate that the historical range of wood bison included the Southwestern portion of the Northwest Territories, Northeastern British Columbia, Northern Alberta, Northwestern Saskatchewan and southern portions of the Alaska and Yukon, (Gates et al. 1992; Fig. 1). A well preserved portion of a mature bison skull, including the horn cores, was found on the Liard River three miles above the Blackstone River mouth on the opposite shore in 1967 by Albert Thomas, an Indian friend of Jack Turner of Nahanni Butte, Northwest Territories (Gordon 1970).

Early efforts to reestablish wood bison in the late 1800s were ineffective because of lack of enforcement. It wasn't until the early 1970s that wildlife management agencies began to seriously consider reestablishing wood bison into parts of their historic range. In 1975, representatives from Canadian Wildlife Service (CWS), Parks Canada Agency, and territorial and provincial wildlife management agencies in western Canada established a primary objective of establishing at least three free-ranging herds within the wood bison historical range (Gates et al. 2001). One region for the proposed establishment of a herd of wood bison was in southwest Northwest Territories in the area of the Liard and South Nahanni Rivers based upon a range assessment indicating suitable wood bison habitat (Reynolds et al. 1980).

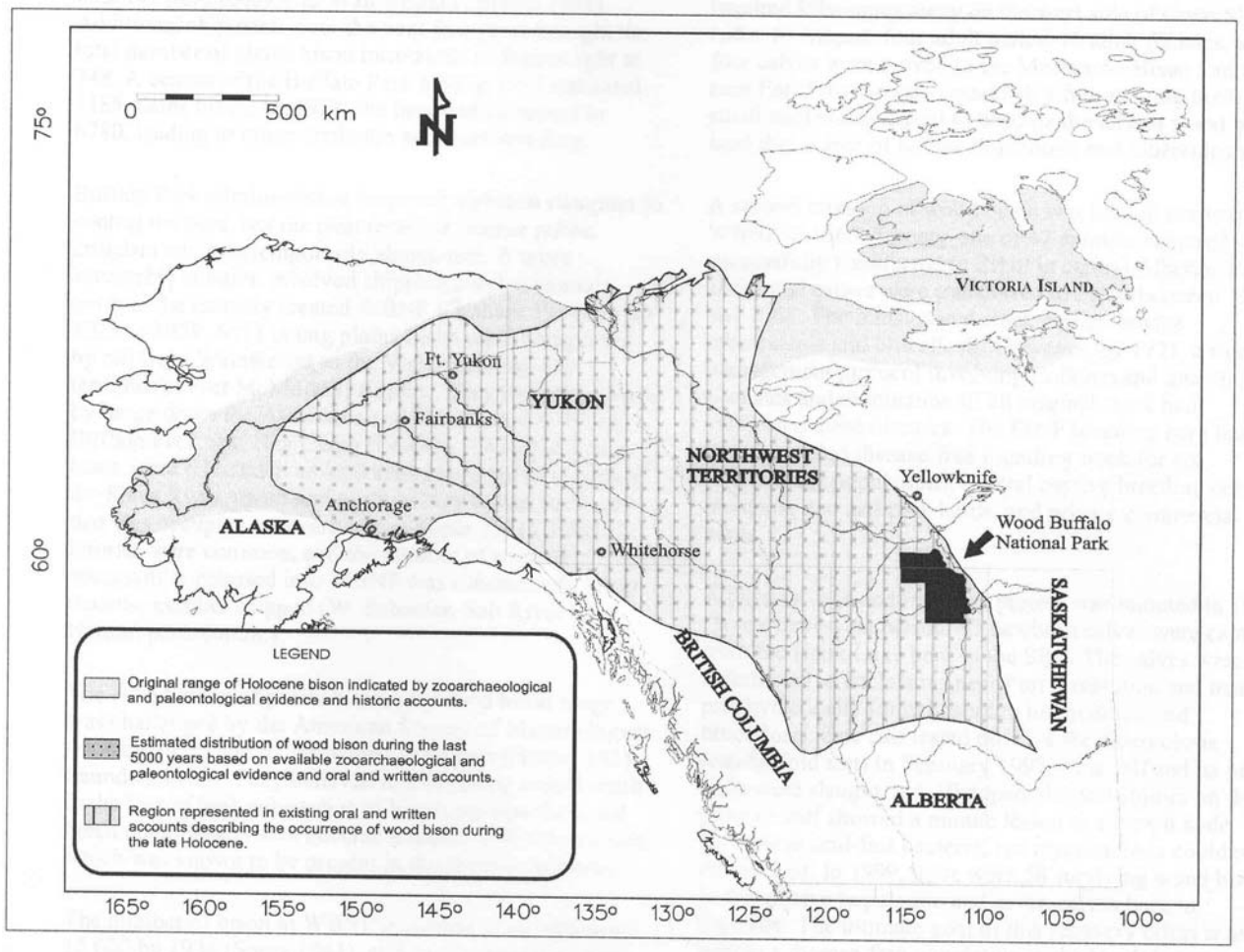

Figure 1. Original and late-Holocene range of wood bison in North America, based upon available zooarchaelogical, paleontological, oral, and written historical documentation (Gates et al. 2001 adapted from Stephenson et al. 2001).

The Nahanni wood bison population was established as a free-ranging population in 1980, with an initial release of 28 wood bison (16 adult females and 12 adult males) from Elk Island National Park (EINP) into the Nahanni Butte area near the Mackenzie Mountains in the southwestern Northwest Territories (Gates et al. 2001; Fig. 2). Unfortunately, this introduced founder population fragmented and by fall 1980, wood bison were found near Fort Nelson, British Columbia, 250 km south of the initial release site. By 1981, wood bison numbers in the Nahanni area had declined to 14 individuals through accidental deaths and dispersal (Gates et al. 2001). In 1985, caribou harvesters from Trout Lake noticed animal tracks they were unfamiliar with at kilometre 45 of the Trout Lake winter road. They followed the tracks southward (moving towards Alberta border) but bad weather made them turn back. It is believed that they were following bison tracks (D. Jumbo pers. comm.).

The Nahanni population persisted, and by 1989, bison numbers had increased to *ca*. 40 individuals. A supplemental release of 12 wood bison (9 adult females and 3 adult males of EINP stock) in March 1989 was undertaken in the vicinity of Nahanni Butte (Fig. 2). Three years later an aerial survey along the Liard River valley observed 55 bison; one group of 18 was found near Nahanni Butte and the remaining 37 occurred along the Liard River valley as far south as La Jolle Butte in northeastern British Columbia. In the mid-1990s primary bison survey areas were delineated that included meadow areas in the Nahanni Butte and Netla and Kotaneelee River areas, the Liard River Valley and its islands from Flett River to Fort Liard and the cutblocks in the La Biche River area of northeastern British Columbia (C. Gates pers. comm.). Aerial surveys of these areas were conducted in 1995, 1996, and 1997 and resulted in counts of 64, 78, and 107 bison, respectively (Gates et al. 2001; GNWT unpubl. data). In March 1998, a second supplemental release of animals was undertaken near the Muskeg River in the southern part of their range (Fig. 2). Fifty-nine wood bison from EINP: 18 male and 20 female calves of the year (*ca. 9* months old), 4 male and 3 female yearlings (*ca.* 21 months old), and 7 male and 7 female adults were released. Although it is often reported that 61 animals were released in 1998, 2 adult males that were to be included in the shipment were held back and only 59

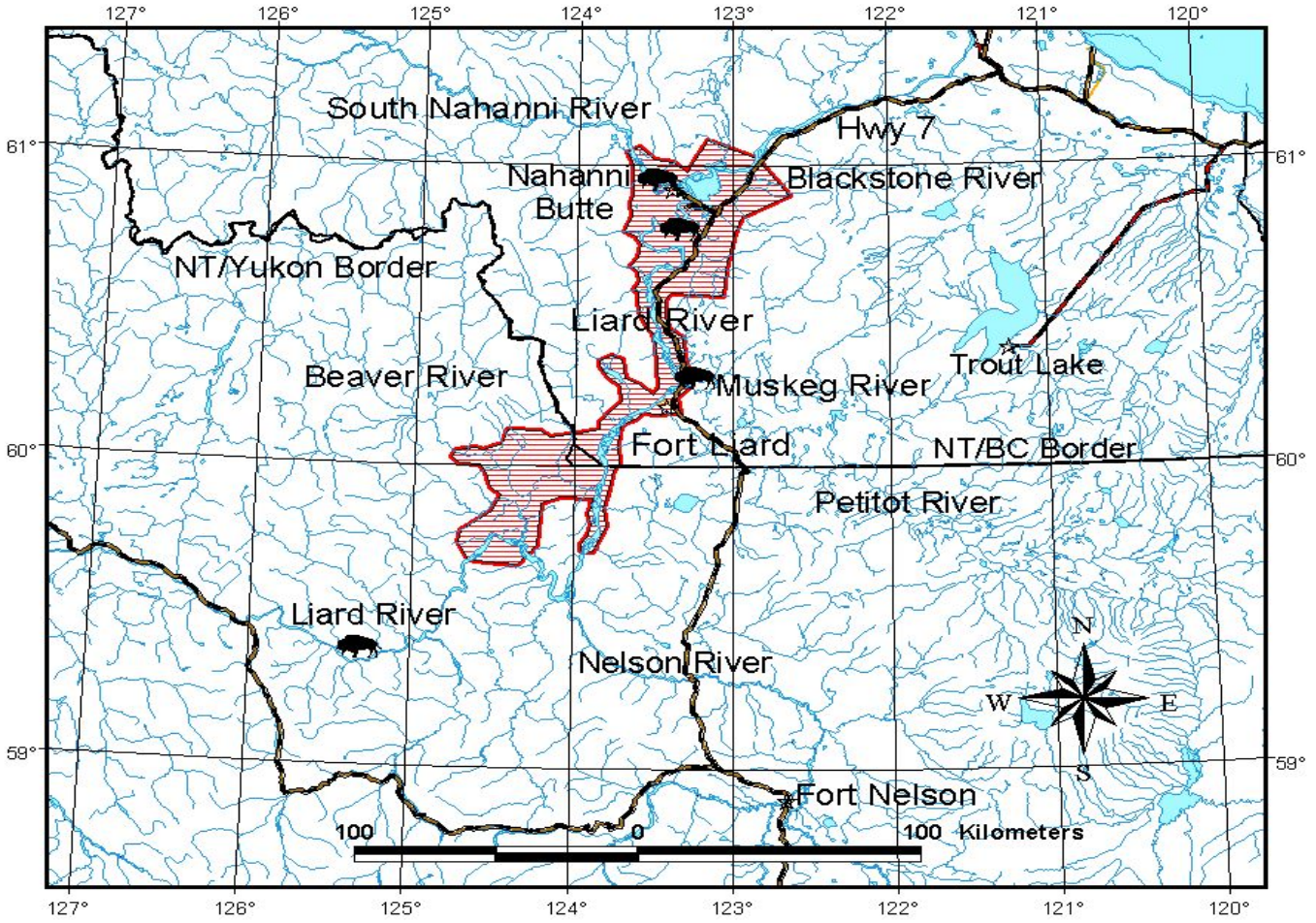

Figure 2. The current range of the Nahanni bison population (hatched area). Release site locations for the Nahanni population (3 north of 60^{o} N latitude) and the Nordquist population (1 in British Columbia) are indicated by bison icons.

animals were shipped (W. Olson pers. comm.). The plan had been to hold the bison in the enclosure for up to 25 days in order to habituate animals to the area. Unfortunately, the animals escaped prematurely and a group of 17 bison dispersed southward in the Fort Nelson area and have established themselves along the Liard River north of the Beaver River in British Columbia (J. Nishi pers. comm.).

An estimated 30 wood bison occur along the Liard River from the mouth of the Beaver River, British Columbia, to the border with the NWT. 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.; Government of British Columbia 2002). Subsequently, the Nahanni wood bison population established itself along both sides of the Liard River valley from the Blackstone River southward to northern British Columbia. In 1998 it was estimated to number *ca*. 160 individuals (Gates et al. 2001).

The Nahanni population is one of a number of free-ranging bison herds, both wood and plains, that are found in the Northwest Territories and northern British Columbia and Alberta (Fig. 3). Another separate population was established further upriver on the Liard in 1995 when the Government of British Columbia reintroduced 49 wood bison (from EINP) to Aline Lake in the Nodrquist Flats area of the Liard River (Figs. 2 and 3) about 80 km SW of the Nahanni bison that dispersed to the Beaver River area (Harper and Gates 2000). It is anticipated that the Nordquist and Nahanni populations will coalesce in future (Gates et al. 2001). Based upon screening of blood and lymph node samples, the Nahanni population is currently designated as a herd that has not been exposed to, or infected with brucellosis (*Brucella arbortus*) or tuberculosis (*Mycobacterium bovis*) (Gates et al. 2001).

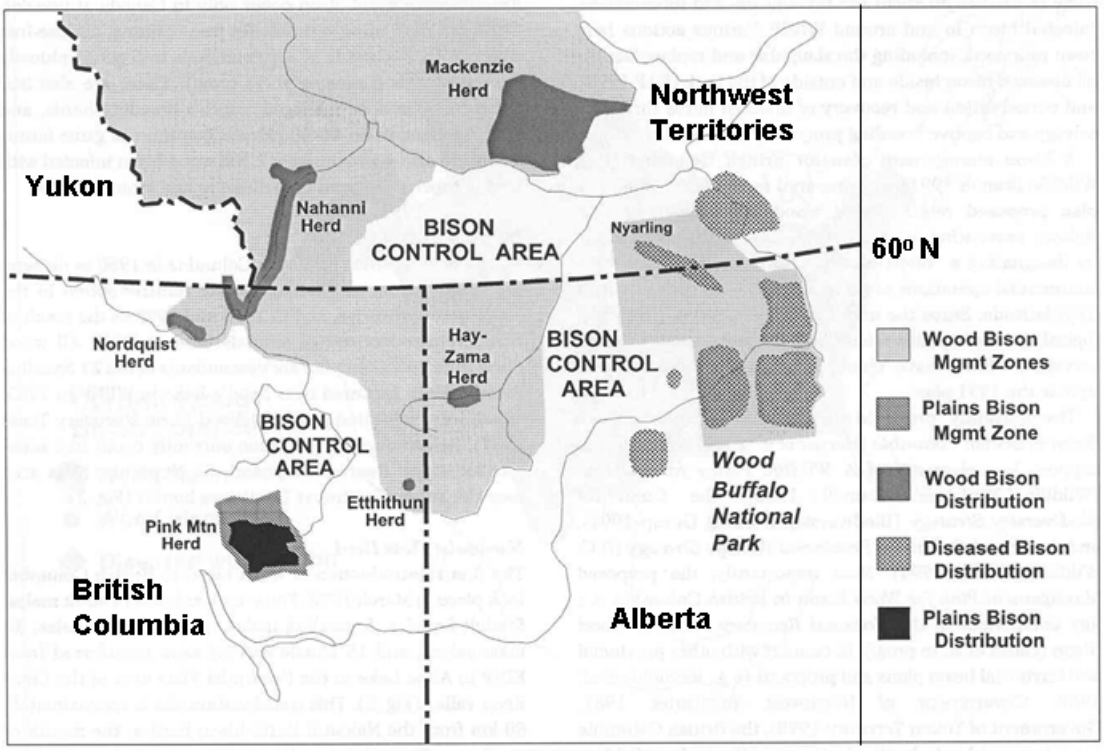

Figure 3. Distribution of management zones and free-ranging herds of bison in NE British Columbia, NW Alberta and the southern Northwest Territories (from Harper and Gates 2000).

INTRODUCTION

Since the initial reintroduction of the Nahanni bison herd in 1980 research and monitoring of the herd has been inconsistent and sporadic. This lack of population monitoring has been a concern of local residents of Nahanni Butte and Fort Liard, especially since there was concern that an increasing bison population may cause declines in moose numbers, the preferred country food source in the region. Part of the limited work on the Nahanni bison population can be attributed to the lack of an established biological program in the Dehcho region of the Northwest Territories at that time, and that all bison work for 3 different populations in the Northwest Territories was covered by one program based out of Fort Smith. A biological program for the Dehcho Region was established in 2002, by the then Department of Resources, Wildlife & Economic Development (DRWED). A regional wildlife workshop held in September 2002 co-hosted by Dehcho First Nations and DRWED brought together resident harvesters, elders, and biologists to discuss regional wildlife issues and concerns and to seek direction for DRWED wildlife programming and research. One of the recommendations from the workshop was for DRWED to identify ways that the Nahanni bison population could be monitored regularly. In response to this recommendation DRWED, continuing as Environment and Natural Resources (ENR), initiated a program which included annual sex and age classification surveys, an aerial survey of the Nahanni population, monitoring bison harvest and mortalities, monitoring bison-vehicle collisions, and collecting biological samples from animals wherever and whenever possible.

In this report we present a brief historical description of the Nahanni wood bison population since its reintroduction and present a compilation of the results of the research initiated in 2002. Where possible we compare our findings with other bison herds or of earlier work on the Nahanni population. The results of the individual surveys have previously been presented in community meetings in both Fort Liard and Nahanni Butte and at the 2004 and 2006 Dehcho Regional Wildlife Workshops.

METHODS

Sex/age Classification Surveys

Historical observations of bison from local residents traveling the rivers and biologists indicated that during the summer animals frequented the riparian areas and gravel/sand bars along the shoreline and on islands in the Liard River (L. Konisenta pers. comm.; J. Nishi and T. Ellsworth pers. obs.). This was presumably because these areas provided relief from heat and insects, and also provided relatively easy access to high-quality forages of newly growing sedges (*Carex* spp.) and willows (*Salix* spp.). The distribution of animals along the river did not provide an ideal situation for either the standard aerial or ground based classification surveys that had been and continue to be used for the Mackenzie bison population (Larter et al. 2000). In summer 1999, DREWD conducted a 1-day boat-based classification survey along the Liard River from Fort Liard to Blackstone as a pilot project (J. Nishi pers. comm.). The survey had favourable results. Not only were 88 animals classified, but it demonstrated that a boat-based survey was cost-effective, repeatable and could provide quantitative data.

River water levels are critical to the success of boat-based surveys because they dictate the amount of shoreline and sand/gravel bars available for bison and also directly affect boat accessibility to river channels and islands. We examined the historical daily discharge and water levels of the Liard River and decided that the most opportune time to conduct surveys starting in 2002 would be during the last half of July. This was when water levels tend to be at their lowest in summer, yet provide adequate river channel accessibility, and when river discharge was relatively low and constant prior to the early August increase in discharge (Fig. 4). This turned out to be 7-10 days later than the 1999 survey. Based on additional observations, we also decided to increase the area of survey coverage in 1999. The survey area would be from at least as far south on the Liard River as the NT/BC border (60^{o} N latitude) and continue upriver to the mouth of the Blackstone River. The survey would also cover the South Nahanni River downriver from where it meets the Liard River to the boundary of the Nahanni National Park Reserve (Fig. 2). Surveys were planned to be of 2-3 days in duration to provide enough time to thoroughly survey as many of the river

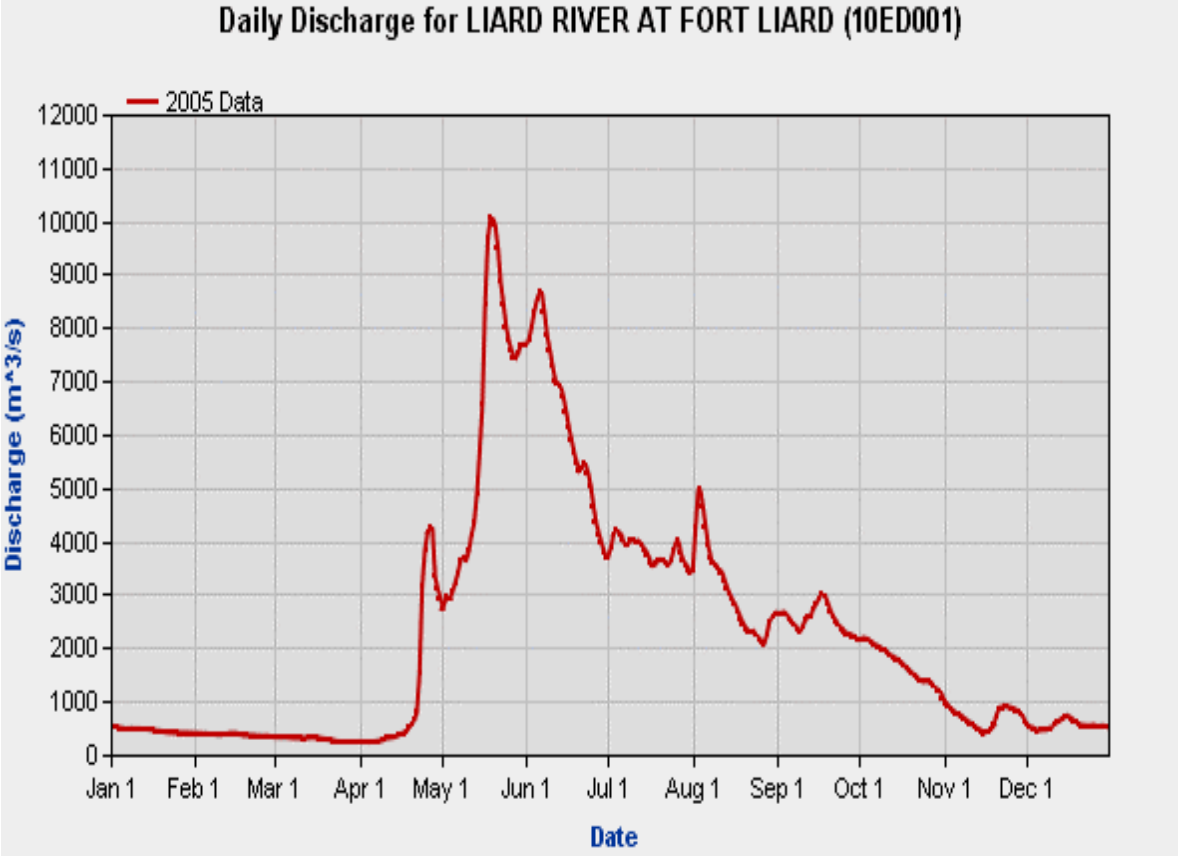

Figure 4. The 2005 daily discharge (m^3/second) of the Liard River at Fort Liard.

channels and islands as possible. Surveys used a 7.5 m welded aluminum riverboat with a 125 hp Mercury outboard motor. The crew consisted of one driver/navigator and 2-5 observers. Driver/navigators were different for each year but all were skilled boaters knowledgeable of the Liard River, its winding channels and hidden gravel/sandbars. The number of observers in the crew varied due to staffing and training opportunities. When bison groups were observed along the shoreline we maneuvered the boat so that it would drift past the group permitting bison to be classified from the boat with binoculars. For small groups accurate classification could be made from the boat. In cases where all bison in a group could not be classified from the boat we landed and found an area where we could classify the animals with binoculars from the shore. When bison were encountered swimming the river (Larter et al. 2003), we

allowed the boat to drift downstream from the animals, beached the craft and waited for the animals to get to the shoreline where they were classified as they came up on shore. All classifications were verified between observers before continuing on with the survey. Digital photographs were taken of most large mixed groups of animals in case there was a classification question. A waypoint of the location of each group was made with a Garmin global positioning system (GPS), either 12XL or 76mapS model. The survey route was documented with a Garmin GPS using the tracking function. All track logs and waypoints were compiled using OziExplorer software. Any bison encountered traveling the road from Fort Simpson to Fort Liard at the start of the river survey, on the return drive after the river survey, or observed in either community during thte course of the river survey were classified and included as survey data.

Bison were classified into 7 different sex and age classes based upon body size, pelage, horn shape and horn wear (following Fuller 1959; Komers et al 1992; Larter and Gates 1994; see Appendix 1):

1) Calves – Young of the year of both sexes, typically being born in April-May with calving largely completed by July. Their reddish-tan coats turn dark chocolate brown at about 3 months of age and by 4-6 months horn nubs may be visible.
2) Yearlings – Animals 12 to 18 months old of both sexes with spike shaped horns of 10-30 cm in length. Body size is smaller than adult females.
3) Cows or adult females – Animals of 2 years and older. Their horns are more slender than those of all males and have a pronounced recurve toward the middle line of the skull resulting in a distinct S-shape in older cows. The front of the skull is narrower than that of adult males.
4) B1 males or juvenile bulls – Animals 2-3 years of age. Body size is similar to or slightly smaller than cows however the horn base is wider than cows. The horns point upward or outwards and always point away from each other.

5) B2 males or sub-adult bulls – Animals 4-6 years of age. Body size ranges between that of cows and adult bulls. Horn base is wider than cows and the horns point straight up or towards the middle line of the skull (Fuller's (1959) "spike-horn" males). The hair on the head and shoulders is shorter than in adult bulls.
6) B3 males or young-mature adult bulls – Animals of 7-12 years of age. Body size is much larger than cows. Horns are curved toward the middle line of the skull and may show the start of wear on the tips. Hair on the chest and head is fully developed leaving no open space between the horns.
7) B4 males or old-mature adult bulls – Animals of at least 10 years of age. The distinction between B3 males is the noticeable wear on the horns, often resulting in wide blunt ends.

We used the ratio of calves per 100 adult females to estimate calf production. We estimated overwinter survival of calves by dividing the ratio of yearlings per 100 adult females determined in a given year by the ratio of calves per 100 adult females from the previous year. We calculated the ratios of male bison per 100 adult females breaking down males into subadult (B1 and B2) and mature (B3 and B4) classes.

Population Surveys

In the mid-1990s the primary bison survey areas were delineated and included meadow areas in the Nahanni Butte and Netla and Kotaneelee River areas, the Liard River Valley and its islands from Flett River to Fort Liard and the cutblocks in the La Biche River area of northeastern British Columbia (C. Gates pers. comm.). Aerial surveys of these areas were made in 1995, 1996, and 1997 to monitor the Nahanni bison population and to generate a minimum population count. However, these were not repeatable systematic aerial surveys of the population.

Subsequent to the September 2002 Dehcho Regional Wildlife Workshop, we compiled and mapped all historical observations of Nahanni bison. We held

community meetings in both Nahanni Butte and Fort Liard in 2003 where harvesters provided additional information on the distribution of the bison population. We also received information from the Governments of British Columbia and Yukon Territory on bison distribution. All data were mapped and circulated before a final map of the winter range of the Nahanni bison population was produced.

In March 2004, an aerial survey was conducted over winter wood bison range in the southwestern Northwest Territories, northeastern British Columbia, and southeastern Yukon Territory, including the current winter range of the Nahanni population (GNWT and YTG unpubl. data). The methods and results of the entire survey are being published elsewhere; here we report the methods and results of that portion of the survey that covered the 5082 km^2 winter range of the Nahanni bison population.

The survey used a Cessna 185 fixed-wing aircraft and a strip-transect technique with the transect being the sample unit (Norton-Griffiths 1978). We flew parallel line transects over the range at *ca*. 4 km intervals at an elevation of 122 m (400 feet) above ground level and attempted to maintain a flight speed of *ca*. 160 km/h. The wing struts of the aircraft were marked so that a 500 m wide strip on both sides of the aircraft could be used as the sample unit. The survey crew consisted of a pilot, a navigator/recorder and two observers. Observers from Nahanni Butte and Fort Simpson and a YTG biologist participated in the survey. We recorded all bison, and any other wildlife, observed whether inside or outside of the 500 m strips. We also recorded animal tracks and feeding sites in order to better describe the winter distribution of wildlife, particularly bison. We estimated population size of non-calf bison following Jolly's (1969) method for unequal sized sampling units (Norton-Griffiths 1978).

Biological Sampling

Mortalities

When bison are harvested legally under quota for subsistence use, sampling and information kits are provided. Hunter(s) are requested to provide information on the age class and general animal condition. If a female is

mistakenly harvested, information on whether she was pregnant or lactating is required. A blood sample and the two first incisor teeth are also collected and provided to ENR. For animals that were euthanized, or after collisions with motor vehicles or where there was a fresh carcass, we collected incisor teeth, whole blood samples and lymph nodes if at all possible. Teeth were forwarded to Matson's Laboratory, Milltown, Montana, for aging, which is determined by counting cementum annuli of the first incisor (Matson 1981). We also investigated bison carcasses that have been reported whenever feasible. Most of these carcasses were located along the riverbanks and were in various stages of decomposition, which limited the type of biological samples available to collect beside teeth.

Disease

Blood samples were spun in a centrifuge, the serum decanted and stored frozen. Frozen serum was shipped to the Canadian Food Inspection Agency's Animal Diseases Research Institute in Lethbridge, Alberta and tested for evidence of exposure to *Brucella abortus*. Lymph node samples were submitted to the Canadian Food Inspection Agency's national Mycobacterial Diseases Centre of Expertise for culture or histological evidence of tuberculosis (*Mycobacterium bovis*) and/or brucellosis (*Brucella abortus*).

Subsamples of fresh fecal samples were frozen and forwarded, with samples from other bison herds in the Northwest Territories, to the Veterinary College, University of Saskatchewan, to determine whether or not animals had been exposed to *Mycobacterium avium* subspecies *paratuberculosis*, the causative agent of Johne's disease.

Diet Composition

Fresh fecal samples (*ca*. 30 g wet weight) were collected during every sex and age classification survey and whenever the opportunity arose during field work at other times of the year. Samples were stored frozen in labeled ziplock bags before being subsampled. Fecal material was thawed and oven-dried at 60^{o}C for 48 h and ground using a coffee grinder. Subsamples of the ground

material (*ca.* 1 g dry weight) were forwarded to the Micro Composition Lab, Fort Collins, Colorado for analysis. Diet composition was determined by analyzing fecal plant fragments (Sparkes and Malechek 1968) following Hansen et al. (1976). Briefly, ground samples were washed with a clearing solution, mounted on a microscope slide, and the cellular plant fragments were identified. Each sample was analyzed at 100 views so it can be reported as percent diet composition via percent relative density. The microhistological technique has inherent limits, such as the inability to separate some species, and a limited percent of identifiable fragments in the slides (Johnson et al. 1983; Barker 1986). However, we deemed the method suitable for this study since we were interested in the proportional dietary contribution of different forage categories not individual plant species. Moreover this method has been used in previous work with the Mackenzie wood bison population, thus permitting for direct comparisons (Larter and Gates 1991; Larter et al. 2000). For the diet analysis we pooled samples of 2-4 individual pats per group. Monthly diet composition was estimated by a weighted average of dietary components from all groups in any month. Group size was used as the weighting factor. We grouped dietary components into the following categories: grasses, sedges, willow, *Equisetum*, legumes, rosaceae, and others. The others category included moss, lichen, and other forbs and woody plants. There was no unidentified material.

RESULTS

Sex/age Classification Surveys

Since 2002 we have successfully classified >130 animals annually. In each survey we classified 3-7 mixed sex and age groups of 10 or more individuals (including calves), with most mixed sex and age groups comprising 20 or more individuals. Generally the largest group classified in each survey was *ca.* 40 individuals. Estimated calf production has been highly variable amongst years ranging from 20-57 calves per 100 adult females. Similar annual variation was seen in the number of subadult males per 100 adult females (range 33-57). The number of mature males per 100 females remained relatively constant (range 40-50) until 2006 (72) (see Table 1).

	1999[1]	2002	2003	2004	2005	2006
# bison classified	137	131	154	137	138	167
# groups ≥ 10 bison incl. calves	4	4	7	3	4	4
# groups ≥ 20 bison incl. calves	3	2	2	3	3	4
# bison in largest group	49	42	39	48	27	42
# calves/100 females	29.2	20.4	56.5	41.8	27.8	47.4
# yearlings/100 females	16.9	16.7	9.7	30.9	25.9	24.6
# mature males[2]/100 females	38.5	48.2	50.0	40.0	50.0	71.9
# subadult males[3]/100 females	26.2	57.4	32.6	36.4	51.9	49.1
# all males/100 females	64.6	105.6	82.3	76.4	101.9	121.1

Table 1. The number of bison classified, the number and sizes of mixed groups classified and the number of different sex/age classes per 100 adult female bison. [1] These data include a group of 49 bison classified along the Liard Highway (Hwy 7) after the river survey. [2] Mature males = B3 and B4 classes pooled. [3] Subadult males = B1 and B2 classes pooled.

Estimated overwinter survival of calves has shown a continual increase from 47.5% during the 2002-03 winter, to 88.5% for the 2005-06 winter (Fig. 5).

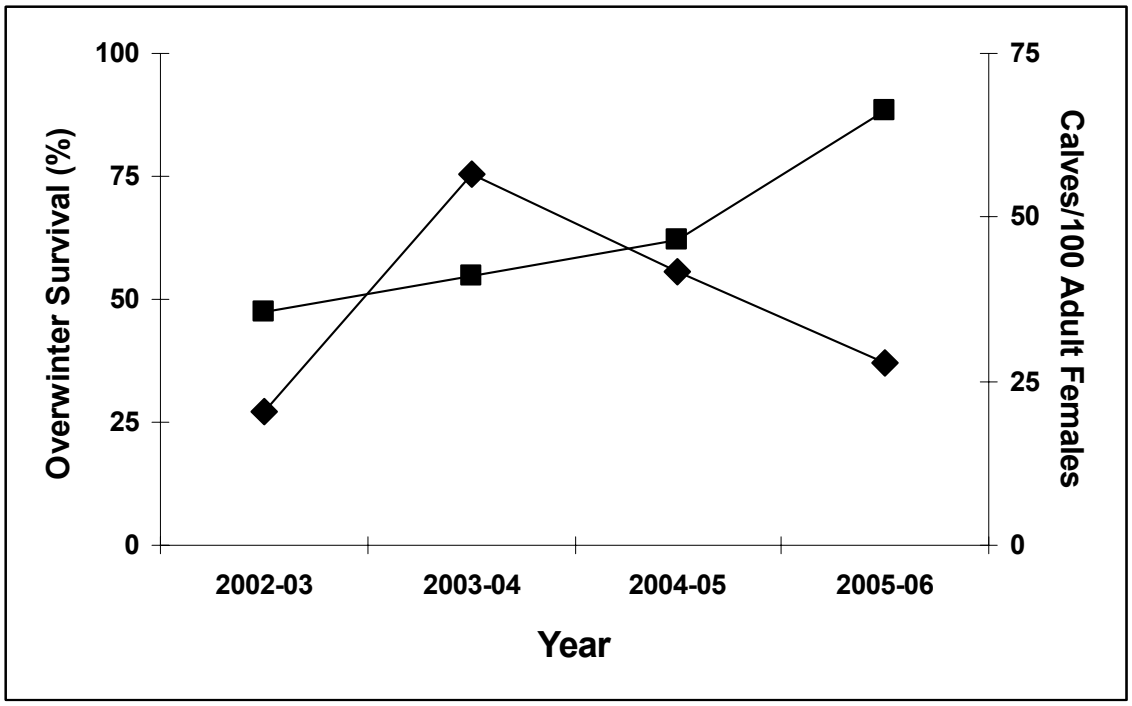

Figure 5. Estimated percent overwinter survival of calves (■) and the number of calves per 100 adult female bison documented during the previous summer (♦) from 2002-03 to 2005-06.

Population Surveys

The winter range survey area mapped was 5082 km^2 in total with 3350 km^2 of the range falling within the Northwest Territories, 1253 km^2 of the range falling within British Columbia, and the remaining 479 km^2 of the range falling within Yukon (see Fig. 2). We flew 1288 km of transect lines over the Nahanni bison winter range, 887 km of transect lines in the Northwest Territories (Fig. 6), 312 km of transect lines in British Columbia, and 89 km of transect lines in Yukon. This translated into percent coverage of 26.5, 24.9 and 18.7 for each area respectively. We counted 101 non-calf bison, all within the Northwest Territories part of the winter range, resulting in a population estimate of 399 bison (CV = 0.32).

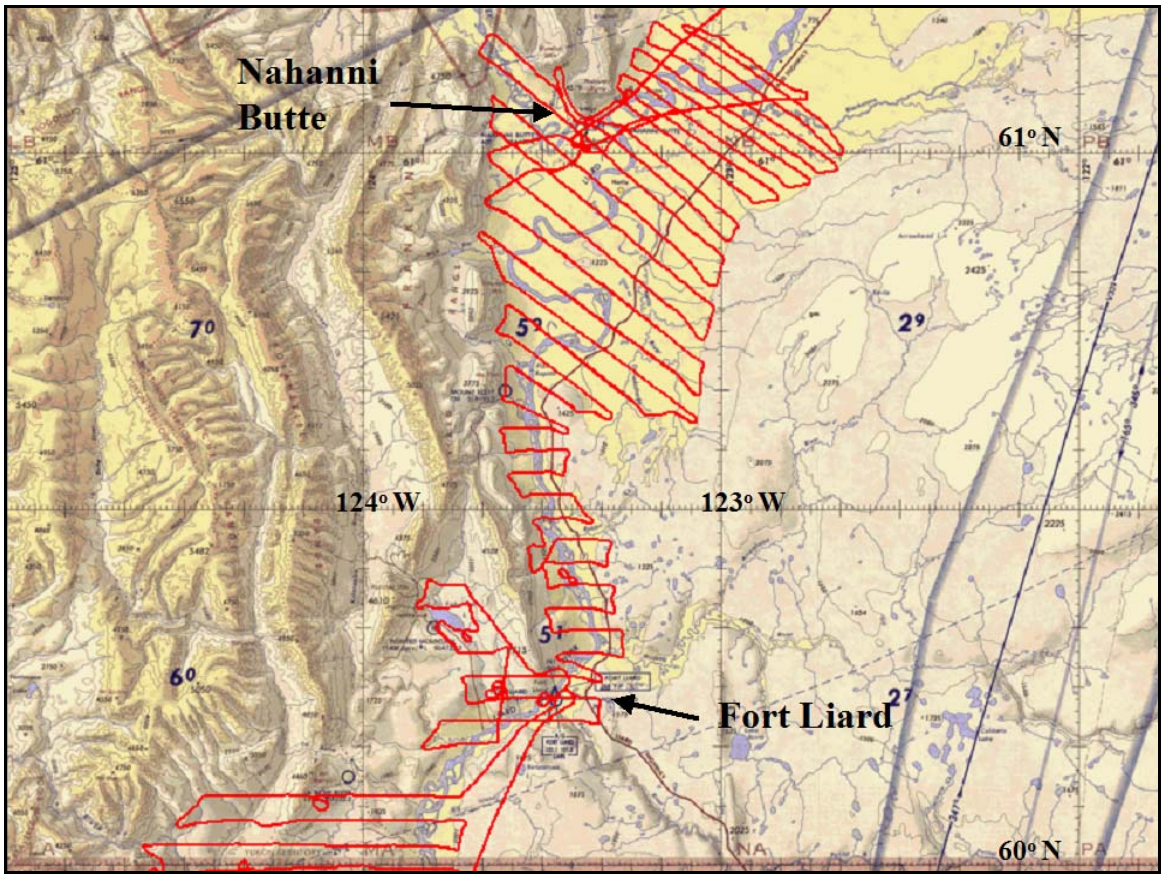

Figure 6. The lines flown over the Northwest Territories portion of the Nahanni bison winter range in March 2004.

Biological Samples

In total we investigated and collected at minimum an I1 tooth from 16 different bison (11 male and 5 female) that have died since May 2002. Samples were collected from 2 male bison that were legally harvested (aged 8 and 6 years); neither tested positive for brucellosis (*Brucella abortus*) or tuberculosis (*Mycobacterium bovis*), 7 bison (4 male and 3 female) that were involved in accidents with motor vehicles, 6 bison carcasses (4 male and 2 female) that were discovered and reported, and 1 male bison that appeared to be incapacitated and was euthanized. This latter male was 16 years old, with an arthritic hip. All of his molariform teeth were worn to the gum line and all incisors were small,

peglike and widely separated (Fig 7). He tested negative for brucellosis and tuberculosis.

Figure 7. The incisor bar of a 16-year old adult male bison.

Carcasses

A 12-year old male found along the banks of the Liard River *ca*. 25 km up river from Fort Liard was presumed to have drowned in the spring breakup and washed up against some driftwood. An 8-year old female was located near the banks of the Muskeg River not too far from the Liard Highway (Highway 7), but the carcass had decomposed to the extent that we could not determine the cause of death. A 10-year old male was found on a trail *ca*. 2 km east of Nahanni Butte in late May 2002. This animal appeared to have died sometime in the previous winter. It was in a resting position and had been covered with snow because the carcass was completely intact and still quite frozen on the inside

when it was discovered. This bison was diagnosed as having emphysema and we presume it died of associated breathing complications; it did not test positive for diseases. A 14-year old female was discovered on a small island on the Liard River *ca.* 10 km east of Nahanni Butte. Bone evidence at the site indicated she had died from complications with a breach birth. A 5-year old male was found near the Flett River crossing. It appeared to have died from complications related to a puncture wound that had ruptured the rumen. A 2-year old male was found partially submerged on the shores of the Liard River *ca*. 10 km upriver from Fort Liard. This animal was suspected to have succumbed to internal injuries possibly from a fall from the steep west side river bank. It was tested for anthrax with a field ELISA test provided by the United States Navy. The results from the ELISA field test and from lab analyses of nasal swabs were all negative.

Motor Vehicle Collisions

Prior to fall 2004 there had only been one reported collision involving Nahanni bison on the Liard Highway; an impaired driver in a pickup truck killed 4 bison in May 2000. A territorial fire crew was in the vicinity at the time of the accident and they salvaged as much of the meat as possible and distributed it to residents in Fort Liard (D. Allaire pers. comm.). In fall 2004, 3 young animals (a 1-year old male, 2-year old male, and a 1-year old female) died as a result of motor vehicle collisions on the Liard Highway. In January 2005 an adult female died from a motor vehicle accident on the access road to Fort Liard and an adult male died from a motor vehicle accident on the K-29 road. All 5 of these animals tested negative for brucellosis and tuberculosis. In October 2005 an adult female died from an accident on the Liard Highway. The ages are currently unavailable for these 3 animals that died after 2004. A 7-year old male was accidentally struck and killed by a vehicle in Nahanni Butte in September 2003. We are also aware of an adult male bison being struck and killed by a motor vehicle in January 2005 near or about km 120 Highway 77 (British Columbia section of the Liard Highway) (Shawn Brinsky pers comm.), but we were unable to collect samples from this animal.

Diet Composition

Diet composition was determined for the months of January (1 group representing 12 animals), February (1 group representing 8 animals), July (4 groups representing 145 animals), September (2 groups representing 17 animals) and December (3 groups representing 25 animals). The diet in January and February is sedge-dominated with sedge being ≥20% of the diet in all months reported. *Equisetum* is a major component of the December diet and comprises ≥10% of the diet in all months except February. Willow (*Salix* spp) and grasses make up varying proportions of the diet (5-25%) in January, July and September (Fig 8).

All fecal samples were collected within the Liard River valley, no more than 7km away from the river with the majority collected either within the community limits of Fort Liard and Nahanni Butte or adjacent to the river. The only exception being the January samples which were collected from Fish Lake.

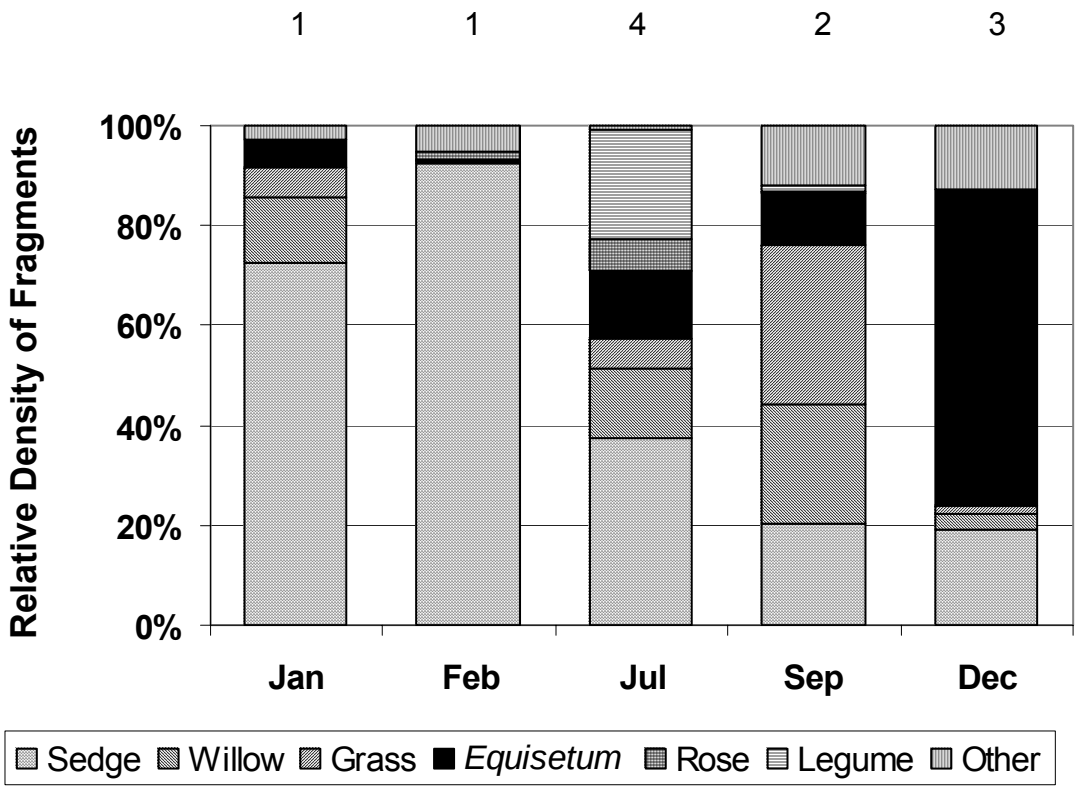

Figure 8. The composition of the diet broken into major forage classes during different months. Composition based up the analysis of fecal plant fragments. Numbers above each histobar indicate the number of groups the analysis is based upon.

DISCUSSION

General

The ability of bison to swim across the Liard River is important in the ecology of the Nahanni population. Open water crossings allow bison to access forage in riparian habitats throughout the river valley and may play a role in insect and predator avoidance. Based upon our observations (at least one group of animals observed swimming the river during each sex and age classification survey) and reports from residents of Nahanni Butte and Fort Liard, who use the river for travel during the ice-free period, swimming back and forth across the river is a relatively common occurrence. Bison are frequently seen crossing the river near Swan Point near Netla and near the confluences of the Muskeg and Kotaneelee Rivers (see Larter et al. 2003). All sex and age classes appear to be quite capable of swimming even in current speed of 14-16km/h, however calves and mature males may be more vulnerable to wave action and disturbance from river traffic. Both calves and mature males sit low in the water.

Drowning is a source of mortality for other bison populations like Wood Buffalo National Park and Yellowstone National Park (Carbyn et al. 1993; Meagher 1973) and can have a substantial impact on the population. Before the damming of the Peace River 3000 animals were lost in one year when the Peace/Athabasca delta flooded (Fuller 1966; Carbyn et al. 1993). Drowning mortalities for the Nahanni population are generally reported during spring breakup or after peak river discharge related to mountain snowmelt and early summer rains (as in June 2006). Animals caught along the river banks or on the riverine islands at this time are swept away and drowned. Unlike for other bison populations, where mass “accidental deaths” occur when large groups of animals are lost at once (Meagher 1973), there have only been reports of individual animals being drowned and washed ashore; no drownings of groups have been reported (Larter et al. 2003). Boat traffic, especially barge traffic, poses a potential threat to crossing bison. Collisions, disturbances that change crossing locations and increase the crossing time and distance, and increased wave and wake action could all contribute to an increase in mortalities.

The Liard River has many channels and riverine islands which historically have been transient in nature as evidenced by the abundance of oxbow lakes and channels that are found throughout the valley. These riparian and oxbow habitats provide a variety of forage and are frequented by bison. The limited information we have on the diet of Nahanni bison shows similarities to the diet of the Mackenzie wood bison population in that sedges dominate the winter diet and during summer and fall there is a more diverse mix of sedges, grasses, willow and forbs. However, noticeable differences were the lack of lichen and the inclusion of *Equisetum* in the diet of Nahanni bison. There was a substantial amount of *Equisetum* in the diet during early winter (December). These differences in diet likely reflect differences in forage availability but there have been no detailed habitat assessments done in the Nahanni area. Although *Equisetum* plants are generally considered to be forages of limited nutritional value, in cold temperate shrub wetlands they acquire and cycle nutrients more efficiently than other members of the plant community (Marsh et al. 2000). In December, before increased snow cover and snow hardness reduce the availability of *Equisetum*, bison may seek this more nutritious forage hence its substantial component of the diet. However, *Equisetum* also has a high silica content which must affect bison teeth as evidenced by Figure 7.

There remains concern from local residents that the presence of bison in the Liard Valley has altered the patterns of use of riparian areas by moose because bison have chased moose from the river. We have observed moose during 3 of our 5 sex and age classification surveys conducted since 2002. The summer diet of moose generally includes aquatic vegetation (MacCracken 1992), which would be found in ponds or oxbow lakes away from the main river channels. Moose inhabit areas also occupied by free-roaming bison herds like Wood Buffalo National Park, the Mackenzie Bison Sanctuary, Elk Island National Park and the Aishihik. Studies addressing the interspecific relationships between bison and other ungulates are lacking and limited to diet and habitat studies which point towards selective habitat use by different ungulates (Cairns and Telfer 1980). Whether similar interspecific relationships hold following re-introductions of bison is unknown. Bison may indirectly influence predation rates

on moose by supporting a higher density of wolves than would exist without bison as an alternate prey source (Larter et al. 1994).

Sex/age Classification Surveys

There are wide annual fluctuations in the number of calves per 100 adult females, similar to that reported for the Mackenzie population. However, absolute numbers are lower. Rarely were there fewer than 30 calves per 100 adult females in the Mackenzie population between 1984 and 1998 (Larter et al. 2000), but in 3 of the 6 surveys of the Nahanni population fewer than 30 calves per 100 adult females have been recorded. During 1984-1998, overwinter survival of calves in the Mackenzie population ranged 26-97%, averaging 54%. This is higher than the overwinter survival reported for the Nahanni population over the past 4 years. During 1984-1998, the Mackenzie population was undergoing an increase in numbers (Larter et al. 2000). We suspect the Nahanni population is slowly increasing in number but future population surveys are required in order to determine the population trend.

The survey results indicate that overwinter survival of calves has been increasing. This is conditional on the assumption that the number of females in the population has remained relatively constant over time (Caughley 1974). It is unlikely that we are missing many late born calves by conducting the surveys at almost the same date in mid-July. It is also unlikely that there has been inconsistent classification of females because it has been the same group of observers classifying for each survey. There is the possibility that more adult females died this past summer with the high water levels and flooding. At least three bison carcasses washed up in the Mackenzie River in the Sahtu following this year's flooding. The percent of subadult males that are B1 versus B2 increased from 13% in 2002 to ranging from 32-45% in subsequent years. This provides further indication that there has been increasing number of young animals in the population over the past 5 years and would be consistent with an increasing trend in overwinter survival of calves. A further population survey is required in order to corroborate increased overwinter calf survival.

Even if overwinter survival of calves has been increasing recently, it is highly unlikely that the Nahanni population would go through the same kind of eruptive population growth that was observed with the Mackenzie population. The Nahanni population has lower calf production, its highest estimated overwinter calf survival is 20% lower than that reported for the Mackenzie population and it is most likely that the lifespan of Nahanni animals is significantly shorter due to the high silica intake in the diet which rapidly wears down the teeth (see Fig. 7).

We saw more groups of bison during the 2006 survey than in other years, including more male only groups than other years. This explains why we had a higher mature male per 100 female ratio in 2006 than in other years. Generally we are able to classify 1 or 2 large mixed sex/age groups, which we believe provides a fairly accurate assessment of the female, calf, and immature (yearling, B1 and B2 males) component. Because fewer mature males are associated with these mixed sex/age groups during summer we likely underestimate the mature male (B3 and B4) component of the population (Komers et al. 1992).

Population Surveys

The population estimate of 399 non-calf bison for March 2004 has a high coefficient of variation, which is not surprising. The shape of the study area, which is close to the current distribution of animals, has a very narrow section with much wider sections at the ends (see Figure 2). This increases the likelihood of having zero animal counts on transects which is exacerbated by the fact that bison tend to be clumped in large groups dispersed over the range.

We feel that the estimate is relatively accurate for a number of reasons. We have consistently observed a minimum of 130-160 bison over the past 5 years when we have conducted sex/age classification surveys in a 2-3 day period traveling the river. The overwinter survival of calves has been increasing over the past 5 years. In 1997, 107 bison were counted in the third consecutive year that a reconnaissance survey was conducted in parts of the bison range known to be frequented by bison. An instantaneous growth rate per year of approximately r=0.19 would result in an estimate of approximately 399 bison in

2004. This is likely a liberal estimate of *r* since some bison were most likely inhabiting parts of the range that were not surveyed. Bison have been dispersed into British Columbia, but there is no reason to believe that dispersal is only out of the Northwest Territories.

We conducted the population survey in late-winter because tracks in the snow permit the opportunity to find animals that may not be seen, whether on or off transect, and this can provide information useful in formulating sightability correction factors. A strict line transect survey method may not be the most appropriate for providing a population estimate with a relatively tight coefficient of variation. We are exploring other options based upon the current survey area shape. The Nahanni bison distribution is bounded by the Liard Range to the west and we do not anticipate animals dispersing to the east out of the river valley because of the lack of meadow habitat and oxbow lakes. Hence there will continue to be an awkwardly shaped survey area within which the survey must be conducted. Maybe a tighter coefficient of variation is not as critical as being able to do repeatable surveys of the area on a more timely rotation.

Biological Samples

Motor Vehicle Collisions

The Departments of Transportation (DOT) and Environment and Natural Resources (ENR) take the subject of motor vehicle collisions very seriously, and try to gather as much information from these unfortunate incidents as possible (see Appendix 2). Although the number of collisions along the Liard Highway (Hwy 7) pales in comparison to those occurring on the Mackenzie Highway (Hwy 1) between the Mackenzie River crossing and Yellowknife, accidents still occur. Collisions to date have not caused any loss of human life but have caused significant damage to property and the loss of life of a number of bison.

Bison seem to frequent the road corridor more during August-October in association with the rut. Well worn trails are often seen along the side of the road between Flett crossing and Muskeg River (kms 90 and 45 on Hwy 7). Still, an alarming number of local residents are oblivious to the fact that bison inhabit the area and can often be seen along the road corridor and interestingly, most

collisions on Hwy 7 are between bison and vehicles driven by local residents, not visiting tourists or truck drivers. Most collisions occurred between dusk and dawn and near a dip or rise in the road. All collisions occurred in areas of known high use by bison. Each fall DOT and ENR conduct a media campaign on the radio and in the newspapers reminding people that bison may be encountered on the highways and to be especially alert during low light conditions. Posters are also circulated. Even with the media blitz fall 2004 was especially bad for motor vehicle collisions on the Hwy 7. In response to the number of collisions in fall 2004, DOT and ENR erected an additional 8 highway signs over a 200 km stretch of Hwy 7 in spring 2005. These signs reminded motorists to be aware of bison presence in the area.

Disease

Wood bison in and around Wood Buffalo National Park (WBNP) are infected with two introduced cattle diseases, bovine tuberculosis and bovine brucellosis. The presence of these two diseases is considered the largest single obstacle to wood bison conservation and recovery in Canada (Gates et al. 2001), and is also a real concern to the commercial livestock industry and to those people who hunt animals from infected populations. For this reason, it is very important to prevent the spread of these diseases to currently disease-free wood bison populations like the Nahanni, and to have adequate surveillance programs in place to remain confident in the health status of these populations. The national Wood Bison Recovery Team has highlighted the need to maintain adequate ongoing surveillance of all free-roaming herds. Testing to date suggests that the Nahanni population remains free of both diseases.

Johne's Disease is a chronic disease of domestic ruminants that causes significant loss of body condition and diarrhea. While reported in a number of wildlife species, it has seldom been recognized as a significant disease-causing problem in free-ranging wildlife populations with several exceptions where there are predisposing management issues. A unique strain of *Mycobacterium avium* subspecies *paratuberculosis*, the causative agent of Johne's Disease, was recently identified in a number of free-ranging and captive bison populations in

Canada. While no clinical disease has been recognized in these populations, the significance of this organism for wood bison populations is not currently known. As part of ongoing efforts to monitor for the organism in herds across Canada, sampling of the Nahanni population has not found any evidence of *M*. *a*. *paratuberclosis*.

Anthrax, the other major disease of wood bison in northern Canada, has not been detected in the range of the Nahanni bison population. *Bacillus anthracis*, the causative agent of anthrax, forms long-lived spores that persist in the environment and can cause disease under certain environmental factors. Anthrax is endemic in bison in northern Canada, with 10 outbreaks documented in WBNP, the Slave River Lowlands and the Mackenzie populations between 1962 and 2006. The suitable conditions for spore persistence and disease outbreaks may not exist within the range of the Nahanni bison population, which may explain the absence of disease in this population.

Legal Harvest

In 1998 a legal harvest was established for the Nahanni bison population. Two tags are issued annually for male bison, one each for a resident of Nahanni Butte and a resident of Fort Liard. Hunting can take place from 1 July to 15 March and from 15-30 June. Complete biological sampling kits are issued with each tag and every effort is made to have an ENR staff member (wildlife officer, biologist, technician) accompany the hunt to assist with the collection of biological samples. To date only 2 bison have been taken, one by each community. A wildlife officer accompanied the hunts and collected the required biological samples (K. Davidge, pers. comm.). Because there has been little interest from the communities of Fort Liard and Nahanni Butte to legally harvest bison, we get limited information on the presence and incidence of diseases in the bison population, and have relied on opportunistic collections of biological samples from reported animal carcasses and animals involved in motor vehicle collisions to bolster our sample size. If the legal quotas were filled annually we would certainly have a more consistent collection of samples over time from which to detect disease presence and incidence in this population.

Nuisance Bison

Bison, that frequent the communities of Fort Liard and Nahanni Butte regularly, have been considered a nuisance by some local residents. Beyond their physical presence within the community, bison have been known to damage gardens, yards, fences, and planted trees. They make use of unfenced sandy and dusty areas because they provide ideal wallow sites for dust baths which relieve them of insect harassment. Bison often frequent community airstrips and their vicinity likely attracted by the good quality of forage available adjacent to the airstrips from seeding and regrowth of disturbed areas. Bison, as a nuisance, are more commonly reported by residents of Fort Liard than by residents of Nahanni Butte with most complaints occurring during June to September.

Mitigating measures that make things less attractive to bison and reduce bison damage include fencing draped with flagging around planted trees and gardens, regularly cutting grass and lawns to reduce the amount of feed, and brushing out under story vegetation around the community. Wallows that have been created by bison could be covered in gravel. Any sand pits associated with playgrounds should be fenced off before bison have discovered them. Tags to harvest bison could be used to remove bison that have become habituated to the community. A public education campaign would go a long way to reducing bison interactions in communities. The Department of Environment and Natural Resources and the Fort Providence Resource Management Board are pioneering a poster information campaign for Fort Providence, another Dehcho community that has been experiencing challenges with bison frequenting the community. A similar campaign should be considered for Fort Liard and Nahanni Butte.

RECOMMENDATIONS

1) Sex and age classification surveys should continue to be conducted annually during July.
2) A population survey, covering a similar area and with a comparable methodology to the March 2004 survey, should be conducted in March 2008 or 2009 in order to get another population estimate and to put into context the calf production and overwinter calf survival data estimated from the sex and age classification surveys.
3) A public education campaign heightening public awareness of bison, describing bison behaviour, ways to reduce bison presence within the community, and actions to avoid when bison are present should be initiated in Fort Liard and Nahanni Butte.
4) Additional fecal samples need to be collected, especially during months where data are lacking, in order to better address the seasonal changes in bison diet composition.
5) Biological samples should continue to be collected on an opportunistic basis.
6) Government of the Northwest Territories staff should continue to assist with any legal bison harvest in order to ensure biological samples are collected.
7) There should continue to be a detailed collection of data from any motor vehicle collisions and continued coordination of the data collection and information sharing between law enforcement agencies and GNWT Departments (DOT, ENR).
8) There should continue to be a public education campaign during fall to remind and alert residents about bison presence on highways.

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PERSONAL COMMUNICATIONS

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Appendix 1. Plates showing the 7 different sex and age classes of wood bison. See methods for detailed descriptions.

Cow, Cow, Calf

B4 (see broomed horn), B3

Cow, Yearling

Cow, B3, Cow, Yearling

B3, B2, Yearling, Cow, Cow, Calf

Yearling, B1

Cow, Calf, Cow

B3, B3, B1, B3, B3, B2

B2, B3

Appendix 2. A copy of the information sheet completed for bison-vehicle collisions.

NWT Wildlife - Vehicle Collision Report Form

Station:	RCMP File #:	Occurrence #:	Date:	Time:
Location of Incident (Hwy #):			Km Post:	
Latitude / Longitude (Use GPS & fill out on scene):			Officer Responding:	
Informant Name:		Phone #:	Address:	

Occupant Information

Name of Driver:	Licence #:	Age:	Sex:
Address:	Phone #:	Occupants: Y / N	Number of Occupants:
Occupant(s) Name:	Address:		Phone #:
Occupant(s) Name:	Address:		Phone #:
Describe any Injuries to Driver or Occupants:			

Vehicle / Weather Information

Vehicle Description (Licence Plate #):		Date:	Time of Accident (24h):
☐ Passenger Car ☐ Light or Heavy duty Truck ☐ Bus ☐ RV ☐ Semi -Trailer ☐ Other:			Ambient Temperature (°C):
Estimate of Damage: ☐ Minimal ☐ Extensive ☐ Wrecked		Light Conditions: ☐ Dawn ☐ Day ☐ Dusk ☐ Night	
Road Surface Type: ☐ Asphalt ☐ Gravel ☐ Dirt		Surface Conditions: ☐ Dry ☐ Wet ☐ Icy ☐ Loose Snow ☐ Packed Snow	
Weather Conditions: ☐ Raining ☐ Cloudy ☐ Clear ☐ Snowing ☐ Fog ☐ Sunny ☐ Windy ☐ Other			
Road Description: ☐ Turn ☐ Dip ☐ Rise ☐ Straight - Away		Photos of Vehicle Taken: Y / N	

Wildlife Information

Wildlife Species:	Was Animal(s) Killed on Impact: Y / N	Did Animal(s) Have To Be Destroyed: Y / N Number:
Total Number of Animals Involved:	Males: _____ Calf _____ Yearling _____ Sub-Adult _____ Adult _____ Unknown	
	Females: _____ Calf _____ Yearling _____ Sub-Adult _____ Adult _____ Unknown	
Dominant Vegetation along Roadside Right-of Way:		Photos taken: Y / N
Describe any Injuries to Wildlife:		
Method of Carcass Disposal:		

Hide Salvaged: Y /N	Skull Salvaged: Y /N	Meat Salvaged: Y /N	Biological Samples Collected: Y / N	Sample ID#
Lymph Nodes: Y /N	Fecal: Y /N	Teeth(Middle Incisors): Y / N	Ear(DNA): Y / N	Blood: Y / N
Full Girth (CM):	Half Girth (CM):	Nose - Tail Length (CM):		

Date:	Time:	Other Comments: