Reintroducing Wood Bison to the Upper Yukon Valley, Alaska: A Feasibility Assessment

Photo by Lu Carbyn

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EXECUTIVE SUMMARY

Various species of bison inhabited interior Alaska for more than 500,000 years. Wood bison were the last subspecies of bison to live in Alaska, occupying the state for 5,000 years or more. The reasons for their disappearance a few hundred years ago are not well known, but changes in weather, vegetation, and hunting by man may have been involved. Some Athabascan elders relate stories about bison being hunted in the Yukon Flats area long ago.

This document examines the feasibility of reintroducing wood bison to the Yukon Flats area in northeast Alaska. In terms of habitat suitability and effects on other wildlife, the environment, and human activities, a reintroduction appears to be feasible. Additional habitat studies in summer 1994 should reveal the full extent of potential habitat.

Establishing a self-sustaining herd of wood bison in Alaska would be a major step in the recovery and conservation of this subspecies and would significantly enhance Alaska's wildlife resources. Reintroducing wood bison to Alaska appears to be consistent with state and federal laws and policies, including the Endangered Species Act. It would be appropriate to classify a reintroduced population as experimental/nonessential, allowing long-term management to be compatible with the concerns of local landowners and other land uses, especially on non-refuge lands.

Discussions with local residents, other Alaskans and agencies have revealed substantial interest in the idea of reestablishing wood bison in the Yukon Flats; however, there are a number of public and agency concerns that need to be addressed. To go forward, this project will require that local residents, other Alaskans, state and federal agencies, and landowners work together to develop a plan that addresses these concerns and outlines a cooperative management approach for a reintroduced wood bison herd.

INTRODUCTION

Wood bison (*Bison bison athabascae*) were formerly widespread in Alaska and northwestern Canada, but by the late 1800s were found only in a limited area centered in northern Alberta. Conservation efforts since that time have allowed wood bison in Canada to recover from a low of about 250 animals in 1900 to about 3,000 at present, allowing them to be reclassified in Canada from "endangered" to "threatened" in 1988. In recent years wood bison have been successfully reestablished in parts of their former range, with a herd of 1,700 in the Mackenzie population in the Northwest Territories and a recently established herd approaching 150 animals in the Yukon.

In the United States bison conservation has involved only the plains bison (*B. bison bison*). The International Union for the Conservation of Nature, Bison Specialist Group

(IUCN/BSG) recently reviewed the status of bison in North America and prepared an action plan for their conservation. They recommend U.S.-Canadian cooperation in assessing the feasibility of reintroducing wood bison to Alaska. The Canadian Wood Bison Recovery Team has also recommended examining the potential for reintroducing wood bison to Alaska. The wood bison is classified as an endangered species in the United States and is listed on Appendix I of the Convention on International Trade in Endangered Species in Wild Flora and Fauna.

The possibility of reintroducing wood bison to the upper Yukon River valley in Alaska has been discussed with a variety of Alaska residents and biologists, and with Canadian biologists involved in wood bison conservation, since fall 1991. The response in Alaska has been generally favorable, and Canadian biologists have expressed a strong interest in helping to reestablish a free-ranging wood bison herd in Alaska. Such an effort would require the cooperation of state and federal resource agencies, Alaska residents and private landowners, and the Canadian government. There is little grazing by herbivores on the Yukon Flats, and an important ecological niche appears to be unoccupied. This document outlines historical, ecological, socioeconomic, legal and practical considerations associated with reintroducing wood bison. The preparation of this feasibility assessment was supported by Federal Aid in Wildlife Restoration and specifically by funds provided through a cooperative agreement between the U.S. Fish and Wildlife Service (FWS) and the Alaska Department of Fish and Game (ADF&G) (COOP-94-035).

HISTORICAL BACKGROUND

Bison originated in Eurasia and probably entered North America by the Bering Land Bridge about 1 million years ago. Large-horned bison similar to steppe bison *(Bison priscus*) probably prevailed until about 10,000 years ago, when many large mammals characteristic of the ice age died out. Northern small-horned or western bison apparently evolved from large-horned bison in Siberia, Alaska, and the Yukon and, in turn, gave rise to wood bison about 5,000 years ago (Harington 1977). Bison were the dominant large mammal in Alaska during most of the last 100,000 years (Guthrie 1968). The genus persisted into the modern (Holocene) era which encompasses the past 10,000 years. Wood bison were the last type of bison to occupy Alaska and adjacent regions under natural conditions (Harington 1977). The previously designated prehistoric range of wood bison included much of Interior Alaska, the Yukon Territory, Northwest Territories, and northern British Columbia and Alberta (van Zyll de Jong 1986). Plains bison predominated south of this area (Fig. 1).

Although bison were thought to have disappeared from Alaska prior to historic time, recent evidence indicates they were present in small numbers at least as recently as 400-500 years ago. Alaska bison remains have been radiometrically dated at 470 years

before present (B.P.) (Chester Creek, Anchorage), about 2,000-3,000 years B.P. (Delta Junction), 2,460 years B.P. (Tanana), 5,340 years B.P. (Goldstream Valley, Fairbanks) (Holmes and Bacon 1982), and 1,730, 4,495, and 11,900 years B.P. (Yukon Flats) (Fig. 2). Numerous other bison skulls have been found over the years but are not in museum collections. In the upper Yukon valley, local residents have found bison skulls and other remains in the Chandalar River, Porcupine River, Black River, and Birch Creek drainages.

The prehistoric range of wood bison, as estimated prior to the emergence of Athabascan oral history detailed below, is shown in Fig. 1. The location and age of subfossil specimens are shown in Fig. 2. Wood bison have been identified from unfossilized and relatively intact skulls found near Circle, the Black River, Anchorage, the mouth of the Tanana River, and St. Michael. In adjacent Canada, wood bison remains have been identified in the Yukon near Dawson, the mouth of the Pelly River, the Peel River, near Atlin, British Columbia, at three sites on the arctic coast of the Northwest Territories near the mouth of the Horton River, and on Victoria Island (van Zyll de Jong 1986, Harington 1977 and pers. commun.). Radiocarbon dates of 1,350 and 1,465 years B.P. (Dawson specimens), and 420, 1,800, 5,230 and 8,000 years B.P. (arctic coast specimens) have been obtained from Canadian specimens (Harington 1977, 1980; van Zyll de Jong, pers. commun.).

Alaskan bison were probably hunted by man until the time of their demise, a few hundred years before the present, shortly before Europeans and firearms entered the Far North (Skinner and Kaisen 1947, Guthrie 1990), and are thought to have been a major food resource for early man (Jennings 1968, Holmes and Bacon 1982). The causes for the disappearance of wood bison from Alaska are not known, but it has been suggested that changes in weather, vegetation, and hunting by man from late postglacial to historic times were involved (Harington 1977, Guthrie 1990).

Bison in Athabascan Oral History

In the course of discussing the possible reintroduction of wood bison with residents of Yukon Flats villages, ADF&G's area biologist was made aware that some Athabascan elders were told stories about bison being hunted by native people in the past. An effort was made to contact elders in Fort Yukon, Chalkyitsik, Beaver, Venetie, Arctic Village, and Minto.

Detailed discussions with several elders showed that they were aware that bison were hunted fairly recently in the Mackenzie River - Lake Athabasca region in Canada, based on accounts from relatives who traveled to and from this region via the Porcupine River in the late 1800s and early 1900s. In addition, some elders were told that bison were once abundant in the Yukon Flats region and were an important source of food for people. The most important details of these accounts are summarized below because

they are a significant, and as yet unpublished, part of the oral history of the upper Yukon region.

Mr. David Salmon of Chalkyitsik, Mr. Moses Cruikshank of Beaver, and Ms. Annie James of Fort Yukon, provided the most detailed accounts of bison in the region. Their accounts indicate that bison were abundant back in the "skin clothes days." They were hunted with bow and arrow and with spears and were a "main food" of Gwitch'in Athabascan people before moose inhabited the country. Bison were hunted in summer and fall when hunters could shoot arrows from cover. Hunters would climb trees to escape wounded bison if necessary. The meat was often dried in the fall and used throughout the winter. David Salmon described a detachable arrowhead that was used to hunt bison and other large animals and showed one he had made from moose antler. The barbed design caused it to continue to penetrate as the animal moved after being hit. Moses Cruikshank provided a more specific account involving an influx of bison in the "Sheenjek country" that was related to him years ago by Chief Christian. A large number of bison were said to have covered a mountain like a shirt (the place was afterward referred to as "Buffalo Shirt" mountain) and were hunted for several years before they disappeared. Drive fences were said to have been used to guide bison to an area where they were driven over an escarpment.

These elders differentiated bison from muskox and were clear about the fact that bison once occurred in the Yukon Flats area. While the time when bison disappeared is not known, David Salmon thought it could not have been more than a few hundred years ago. He doubted that earlier events could have been passed along in oral tradition. This estimate is in general agreement with the most recent radiocarbon dates from Alaska and northern Canada.

In addition, an elder in the village of Eagle recently reported that a small herd of bison moved into that area about 1917. These animals were seen by many residents and got into snares set for moose (Sarah Malcolm as told to Bill Goebels, pers. commun.). This suggests that small numbers of bison may have occurred in Alaska fairly recently, but their occurrence has gone unrecorded.

WOOD BISON CONSERVATION AND STATUS IN CANADA

Written records indicate that prior to the 1800s, wood bison were widespread and abundant in northern Alberta, southwestern Northwest Territories, and parts of northern British Columbia and Saskatchewan (Gates *et al.* 1992). Wood bison, like plains bison, were nearly eliminated during the late 1800s as a result of overhunting following the advent of the fur trade (Reynolds and Gates 1991). By 1900, less than 300 wood bison remained near the Peace-Athabasca delta. A series of early conservation measures, including the establishment of Wood Buffalo National Park (WBNP) in 1922, fostered an increase in numbers. Recent conservation efforts, including reestablishing wood bison

in parts of their former range, have further improved the status of the subspecies. By 1992, there were approximately 2,900 wood bison.

One of the major controversies in bison conservation resulted from transplanting over 6,000 excess plains bison from Alberta to WBNP between 1925 and 1928. This action resulted in some hybridization with wood bison and also introduced two diseases (bovine brucellosis and tuberculosis) to bison in the area. Although subpopulations of bison in WBNP still show strong wood bison characteristics (van Zyll de Jong *et al.*, in press) their taxonomic status is unclear and diseases continue to affect bison and their management.

The Mackenzie Bison Sanctuary (MBS) supports the largest free-ranging herd of about 1,700 wood bison, resulting from the reintroduction of 18 bison in 1963. Other free-roaming herds include approximately 80 near Nahanni Butte, Northwest Territories; 200 in the southern Yukon Territory; small, recently-reestablished populations in central Manitoba (Chitek Lake herd - 25 bison) and northern Alberta (Hay-Zama - 40 bison); and segments of a herd of about 2,600 bison inhabiting the WBNP-Slave River lowlands area.

There are also a few captive wood bison populations, the most important of which is the semi-wild herd of about 300 at Elk Island National Park (EINP), Alberta. This herd was subjected to a 4-year intensive disease eradication program and has been free of reportable diseases (notably bovine brucellosis and tuberculosis) since 1971. A major purpose for maintaining this herd is to provide healthy founding stock for reestablishing free-roaming as well as captive wood bison populations. Other captive herds occur in central Manitoba (Waterhen population - 200 bison) and Northwest Territories (Hanging Ice Bison Ranch - 150 bison).

The primary factors limiting the recovery of wood bison in Canada are the risk of infection by bovine brucellosis and tuberculosis, habitat limitations imposed by the occurrence of human population, agriculture and domestic livestock, and the presence of transplanted plains bison. About 34% of historic wood bison range in Canada is unavailable because of development. The existence of diseased herds of bison in and around WBNP is the greatest single factor limiting the potential for recovery of additional healthy herds of wood bison, with 42% of historic wood bison range (primarily in northern Alberta and southern Northwest Territories, including WBNP) being unavailable because of disease (National Recovery Plan for Wood Bison, draft 1992). In 1987, the government of the Northwest Territories established a policy of eradicating bison in an area between WBNP and the MBS to reduce the risk of transmitting diseases to wood bison in the MBS.

ECOLOGY OF WOOD BISON

The ecology and behavior of wood bison has been described in numerous studies of both free-ranging and captive herds in Canada. Wood bison are the largest terrestrial mammal native to North America. Bull wood bison average nearly 2,000 pounds in weight, with cows averaging about 1,200 pounds. Wood bison are well adapted to northern habitats, having a high digestive efficiency and ability to sustain themselves on a variety of common grasses and sedges found in northern meadows and successional habitat (Reynolds and Hawley 1987, Reynolds *et al.* 1978, Larter and Gates 1991). Wood bison often show seasonal changes in diet, with sedges predominating during winter and a more diverse diet of grasses, sedges, and browse during summer and fall. Food habits are somewhat variable depending on forage availability in various areas. Wood bison are typical generalist herbivores that encounter seasonal scarcities of high quality forage. They appear to maximize foraging efficiency by selecting habitats that provide the most available crude protein. Wood bison are highly mobile animals and use a wide variety of both open and forested habitats at various times of year. During most of the year, they forage primarily in wet and mesic meadows. However, their diet is flexible allowing them to use other habitats so that nutritional needs can be met throughout the year, and temporary changes in climatic and other factors can be accommodated (Larter and Gates 1991).

Food availability and access to mates are important factors determining the size of wood bison home ranges. Adult female and yearling bison live in larger groups and have larger home ranges than adult male bison (Larter and Gates 1994). Home ranges tend to be largest where food is less abundant.

The wood bison reproductive cycle is similar to other northern ungulates. Breeding occurs primarily from late July and mid-August. Most cows first breed as 2- or 3-year-olds, and pregnancy rates are generally high, ranging from 70% to 90% depending on nutritional status. Twinning is extremely rare, with most adult cows producing one calf each year during May or June. Wood bison sometimes live as long as 20 years in the wild, but most show signs of old age when 12-15 years old (Reynolds *et al.* 1978, Gates and Larter 1990).

Wood bison are gregarious animals that exist in three types of groups during the course of the year. Cows, calves and yearlings usually remain in matriarchal groups ranging up to a few dozen animals or so. Mature bulls seldom form groups of more than a few animals, and solitary bulls are common. Breeding groups, including both bulls and cows, occur primarily during the rut, but bulls generally remain separate during other seasons (Reynolds *et al.* 1978).

The social behavior of wood bison appears to be adapted to northern forests where major forage occurs in relatively small and scattered meadows separated by woodlands. Group size is generally smaller than is the case for plains bison in more open habitats,

but there appears to be a linear dominance hierarchy among male wood bison similar to that observed in plains bison. Wood bison occur in small, mixed herds during the rut, apparently as an adaptation to resource availability in forested terrain (Melton *et al.* 1989).

Wood bison have been recognized as a subspecies based on a number of distinct morphological characteristics (van Zyll de Jong 1986). The subspecific designation was recently questioned by Geist (1991), who hypothesized that phenotypic differences between wood and plains bison are induced by environmental factors and are non-genetic. However, a recent study of eight external characters in six herds of plains bison and five bison herds with wood bison ancestry showed the characters are genetically based and that the subspecific status of the original wood and plains bison is well founded (van Zyll de Jong *et al.*, in press). This study relied on morphometric analysis of the anterior slope of the hump, location of the highest point on the hump, angle of the hump, cape variegation and demarcation, upper front leg hair, frontal display hair, ventral neck mane, and beard. The results demonstrate that variation within plains bison populations is much less than between plains and wood bison, reflecting the separation between wood and plains bison in the past.

The evolutionary history of North American bison has been described in detail (Skinner and Kaisen 1947; Harington 1977, van Zyll de Jong 1986, 1993; McDonald 1981, Guthrie 1990). These studies are in general agreement regarding the pattern of evolutionary divergence and geographic discontinuity that developed within the last 10,000 years and led to the existence of two morphologically distinct types of bison. While morphological and evolutionary evidence supports the formal recognition of contemporary plains and wood bison as subspecies, any debate about the taxonomic validity of this designation should not affect their conservation as separate entities (van Zyll de Jong *et al.*, in press).

THE UPPER YUKON BASIN - GEOGRAPHY, HABITAT AND HUMAN POPULATION

Geologic History and Geography

The long-term geologic history of the Yukon Flats region is summarized by Heinsohn *et al.* (1964). A detailed review is beyond the scope of this document. However, the geologic history of the area reflects a complex interplay of volcanism, glaciation, uplifting and alluvial action.

The Yukon River flats is a vast wetland basin lying in a level plain through which the Yukon and Porcupine Rivers and nine major tributaries flow. The active floodplain lies slightly below a floodplain formed during the early Holocene. The old flood plain consists of 16-20 feet of horizontally interbedded calcareous sands and silts with redeposited organic layers underlain in some areas by river gravels (Farjon and Bogaers

1985). The area is characterized by numerous thermokarst and oxbow lakes. Shallow lake beds support a variety of marsh, and wet and dry meadow plant communities. Streams and rivers impose a continuing influence on the flat landscape as shown by a complex network of terraces, depressions, meander scars, oxbow lakes and sloughs. Areas adjacent to rivers are periodically flooded during spring.

Soils are mainly of recent origin and are generally alkaline with a PH above 7. Because rainfall is scant, no leaching occurs. Soils are generally mixtures of silt and sand with varying organic content, except on lake bottoms where clay occurs. Permafrost is discontinuous but can occur to a considerable depth in poorly drained areas (Heinsohn *et al.* 1964).

The Yukon Flats lies near the northern edge of the boreal forest and is characterized by diverse vegetation mosaics, including mixed spruce-poplar and spruce-hardwood forests, spruce muskeg, extensive successional and climax stands of willow and alder, and wet and dry meadows comprised of sedges (*Carex* sp.), grasses and a variety of forbes.

Climate

The climate in the upper Yukon valley is generally classified as Continental Subarctic. Temperatures range from as high as 100° F in summer to -60° F or colder in winter. Daily minimum temperatures during winter are summarized in Table 1 (p. 12). There are about 108 frost-free days on average. Long summer days provide about 2,000 growing hours for plants, a relatively large number compared to lower latitudes (Johnson and Vogel 1966). The climate is dry with annual precipitation ranging from 7-11 inches. The low precipitation, high summer temperatures, and an abundance of thunderstorms create the most extreme fire climate in Alaska (Trigg 1971, Yarie 1981) resulting in extensive stands of grass and low shrubs.

Snow accumulation rarely exceeds 30 inches. Late winter snow accumulation data collected since 1965 at four sites are given in Appendix A. The maximum snow depth recorded at the Black River, Fort Yukon, and Venetie sites was 28 inches, with average depth for all years ranging from 17 to 23 inches. Snow accumulation is somewhat greater at Circle at the southern edge of the area, with a maximum depth of 38 inches and an average of 24 inches (Soil Conservation Service, Anchorage, Alaska).

Present Fauna

Large mammals currently inhabiting the Yukon Flats area include moose (*Alces alces*), wolves (*Canis lupus*), grizzly bears (*Ursus arctos*), and black bears (*Ursus americanus*), with Dall sheep (*Ovis dalli*) and caribou (*Rangifer tarandus*) occurring at higher elevations.

Although the area includes extensive high quality moose habitat, moose density is generally low compared to most other areas in Interior Alaska. Population density is lowest in the western portion of the Yukon Flats where recent estimates range from one moose per 8-10 mi^2. Moose density is slightly higher to the east, at one moose per 2-5 mi^2 (ADF&G and FWS, unpubl. data). Moose have historically been at a chronically low density relative to habitat carrying capacity, although they have been more abundant in recent decades than earlier in the century (H. Petersen, F. Thomas, pers. commun.). Predation by bears, wolves, and human harvest are probably the major factors limiting moose population growth.

The area supports a moderate number of wolves. A census conducted in Subunit 25D by ADF&G and FWS in March 1992 resulted in a fall population estimate of 200-244 wolves, or 1 wolf per 72-88 mi^2. This is relatively low compared to most other areas in Interior Alaska, but is similar to wolf population density in the northern Yukon where large prey are also at low density (B. Hayes, pers. commun.). Field observations suggest that wolves rely primarily on moose but also on beaver, snowshoe hares and miscellaneous foods, including salmon carcasses in local areas.

Both black bears and grizzly bears are common. Observations by local residents, pilots, and guides generally indicate that numbers have increased somewhat in recent years. Black bear population density has not been estimated by field studies but, based on densities determined in similar habitat, is probably on the order of one bear per 5-10 mi^2 (Hechtel 1991). Based on knowledge of populations in similar habitat, the number of grizzly bears is estimated at approximately 380 in all of GMU 25D, an area of 17,569 mi^2, or a density of 1 bear per 46 mi^2 (ADF&G, unpubl. data).

Dall sheep occur in limited numbers in the White Mountains south of the Yukon Flats and in larger numbers in the Brooks Range to the north. Caribou are commonly found in the hills surrounding the Yukon Flats, but have not occurred in low elevation habitat for many years.

Human Population

The human population in the Yukon Flats includes about 1,400 people in the villages of Fort Yukon, Chalkyitsik, Arctic Village, Birch Creek, Beaver, Stevens Village, Venetie, and Circle. Landholders in the area include the U.S. Fish and Wildlife Service-Yukon Flats National Wildlife Refuge, Doyon Ltd. Regional Corporation, native village corporations, Venetie Tribal Government, and the State of Alaska (Fig. 3).

Residents of the area are largely Gwitch'in Athabascan, but the villages of Beaver and Stevens Village also include Koyukon Athabascan people. The human history and resource use in the region have been summarized by Caulfield (1983). The present socioeconomic system is generally characterized as a mixed, subsistence-based system with a general preference for combining both subsistence and market sectors of the

economy. Harvests of fish, furbearers, and big game animals have historically been important both physically and culturally to local residents.

SUITABILITY OF THE YUKON FLATS AS WOOD BISON RANGE

A preliminary assessment of habitat suitability for wood bison was conducted 4-7 August 1992 with the help of Dr. Cormack Gates, a bison ecologist working with wood bison in the MBS. Aerial and ground reconnaissance provided a general assessment of grass and sedge standing crop biomass, suitability of dominant forage species, size and distribution of key habitat patches, and the potential for seasonal flooding of meadow habitat. Results suggested the Yukon Flats has substantial potential as wood bison range with habitat quality and quantity exceeding that in the MBS, and being at least comparable to the Slave River lowlands, where wood bison have prospered. The assessment suggested the area could support in excess of 500 bison.

Major meadow systems that would provide key winter range for wood bison are limited primarily to the flats adjacent to the Yukon River between Fort Yukon and Beaver, and the lower Porcupine and Black Rivers. The area with the greatest potential to support significant numbers of bison is, in broad terms, encompassed by an area of approximately 3,800 mi^2 (Fig. 4).

Plans for Additional Range Studies

During summer 1994, ADF&G will carry out a more extensive inventory of the distribution and characteristics of meadows that could provide key summer and winter range for wood bison. This effort will be designed to provide information on the distribution and abundance of suitable bison forage relative to 1) the potential to sustain a free-ranging herd of at least 500 bison, and 2) the occurrence of potentially suitable release sites.

The details of this effort are currently being planned, but the general approach will be as follows:

1. Land-sat and color IR aerial photographs will be used to identify meadows larger than 5 acres, and calculate their aerial extent, and stratify the sample into a) acidific fens/*Carex aquatilus* meadows and b) mesic and dry meadows, the latter being the habitat most important as winter forage for bison.

2. Potential bison range will be divided into several range units based on physiography, using obvious geographic boundaries to the extent possible. These units will be sampled to provide an indication of the carrying capacity of various areas north and south of the Yukon River.

3. Meadows within individual range units will be sampled to determine whether species composition and forage abundance is suitable for bison.

4. Annual biomass production (for 1994) will be measured in a subsample of meadows. These data will provide the basis for carrying capacity of the various range units based on knowledge of bison forage requirements and a conservative estimate of allowable grazing rates.

5. Standard nutritional assays will be performed on samples of key forage species to determine their suitability for bison based on comparisons with similar data from areas known to be suitable bison range and knowledge of bison forage requirements in general.

Flooding

Excessive spring runoff, ice jams on larger rivers, or heavy rains in surrounding uplands during summer result in occasional flooding of areas of low elevation habitat adjacent to rivers. A review of stream flow records for the Yukon and Porcupine Rivers (U.S. Geological Survey), discussions with local residents and pilots familiar with the area, and observations of water levels in lakes and ponds indicate that, while flooding is common, high water rarely persists for more than a few hours or days, or affects areas extensive enough to hinder large, mobile animals such as moose or bison.

Floods are most common between about 20 May and 10 June. One of the longest periods of flooding occurred in spring 1992, when high water persisted for about 1 week in late May and early June. In this case, high water extended back from the Yukon, Porcupine, and Black Rivers for a few miles in some areas and restored water levels in many lakes and ponds that had been drying for several years. However, there are still vast areas where water levels were unaffected, demonstrating that even severe floods are limited in extent, with many areas remaining above water.

Bison are highly mobile animals and should easily avoid periodic and localized flooding. It is unlikely that floods will have important or long-term detrimental effects on wood bison.

Wildland Fires

Habitat changes associated with fires generally benefit bison, and fire appears to be a potential tool for managing northern bison populations (Campbell and Hinkes 1983, Shaw and Carter 1990, C. Gates, pers commun.). The existing relatively natural fire regime and fire management plans aimed at perpetuating it on the Yukon Flats National Wildlife Refuge should benefit a wood bison herd. The reintroduction of wood bison would not require modifying fire management policies or activities.

Existing Plains Bison Herds

In 1928, 19 plains bison were released near Delta Junction, Alaska after being obtained from the national bison range at Moiese, Montana. This herd grew rapidly and is presently maintained at a fall population level of about 400 animals. Between 1950 and 1968, bison from the Delta herd were introduced to the Copper River, Chitina, and Farewell areas. Bison herds continue to exist in these areas, with the Delta herd being the largest.

There has been a renewed interest in the taxonomic relationship of wood and plains bison (Geist 1991). As detailed above, a recent study has confirmed the validity of subspecific status of wood bison, demonstrating very little overlap in several morphological characteristics (van Zyll de Jong *et al.*, in press). Members of the IUCN/BSG, the Canadian Wood Bison Recovery Team, and most other bison authorities consider it essential to maintain genetic separation of wood and plains bison.

Potential reintroduction sites in the upper Yukon River basin are about 170 miles from the closest herd of plains bison (Delta), and 320-400 miles from other Alaska herds of plains bison. Existing plains bison show a strong fidelity to their range. There have been no long-range dispersals from these herds. Mature male bison initially colonize new habitat (Gates and Larter 1990). There are relatively few mature males in the Delta herd because of selective hunting, and this herd remains year-round in an area of about 400 mi^2.

The lack of suitable grassland habitat in the upland terrain separating existing plains bison herds and the area being considered for a wood bison reintroduction makes it unlikely that plains bison will disperse northward and mix with wood bison. If reintroduced wood bison were allowed to increase to a high population level, dispersal could conceivably occur to the south. The possibility of eventual mixing would be guarded against through provisions to monitor bison movements and remove or relocate bison that are likely to join other herds.

Climate

Bison can withstand relatively severe snow conditions compared to other ungulates, but snow depth and density can influence winter foraging behavior (Larter and Gates 1991, Carbyn 1993). Bison clear snow from forage by swinging their heads sideways and pulling and pushing with their muzzle. Van Camp (1975) indicated that snow depths of about 20-24 inches hindered feeding by bison calves, while depths of 26-30 inches could affect adults in EINP. However, in WBNP and MBS, bison appear to tolerate comparable snow depths with little discernable effect on mortality or productivity, perhaps because snow density is lower, or winter forage biomass is higher, than in EINP. Effects of snow depth would depend largely on duration, and prolonged periods of deep snow should

have the greatest effect. Maximum snow depths are generally not reached until mid- or late winter in northern environments.

Snow depth on the Yukon Flats is similar to WBNP and the WBS. Late winter snow depth in WBNP generally ranges from 16 inches to 24 inches, but sometimes exceeds 30 inches in late winter (Carbyn 1993). Snow depth and duration is similar in the MBS (Larter and Gates 1991). Late winter snow depths on the Yukon Flats during 1965-91 are summarized in Table 1 below. Snow depths at three sites adjacent to potential wood bison winter range are similar to, but in general somewhat lower than, those in bison range in northern Canada.

Table 1. Summary of late winter (about 1 March) snow depth (in) at four measuring sites, 1965-71, Yukon Flats, Alaska.

Site	Range	Mean
Fort Yukon	12 - 26	19
Black River	15 - 27	21
Venetie	9 - 24	17
Circle	15 - 38	23

Other characteristics of snow cover on the Yukon Flats are that thaws and resultant icing are rare, snow density is generally low, and wind-packed snow occurs only on large lakes and meadows. The Yukon Flats is not often subject to persistent winter winds, but northeast winds sometimes affect snow cover in large openings. Wind effects in most areas are minimized by dense vegetation.

Temperature and wind chill can also influence bison behavior. The metabolic rate of bison calves was found to be stable, or actually lower, at -30° F than at 32° F in calm air, but increased at -20° F with a 3 mph wind (Christopherson *et al.* 1978). The critical temperature for the metabolic rate of adult bison would be considerably lower than that of calves. Bison are commonly seen grazing in open meadows at temperatures of -48° F on calm days in WBNP (Fuller 1962).

Based on a comparison of average daily minimum and maximum and average monthly temperatures, midwinter temperatures on the Yukon Flats are somewhat lower than those in WBNP and MBS (National Weather Service, Alaska Region; Arctic Environmental Information Center, Univ. of AK). However, wind is characteristically less frequent and of lower velocity on the Yukon Flats than in Canadian wood bison ranges (R. Thoman, Natl. Weather Service, Fairbanks, pers. commun.). A comparison of long-term average and extreme minimum temperatures during the five coldest months (Nov,

Dec, Jan, Feb, Mar) is given below. Fort Providence is close to the MBS, while Fort Smith is near WBNP.

Table 2. Average daily minimum and extreme temperatures (Fahrenheit) in the Northwest Territories and Yukon Flats areas.

Location	Avg. Daily Minimum (° F) Nov	Dec	Jan	Feb	Mar	Extreme Low (° F)
Northwest Territories						
Fort Providence (26 years of record)	+2	-17	-26	-18	-9	-58
Fort Smith (26 years of record)	+3	-16	-26	-17	-8	-65
Alaska						
Fort Yukon (61 years of record)	-12	-28	-28	-24	-12	-71

These data suggest that Fort Yukon minimum temperatures are 4-15° F lower, except in January when the difference is only about 2° F. It is likely that greater wind chill at the Northwest Territories' sites compensates for some or all of the difference in temperature. The fact that plains bison have prospered at Delta Junction and Farewell, Alaska, in environments that are slightly warmer but substantially windier than the Yukon Flats, also suggests the climate in the upper Yukon Basin is suitable for wood bison. In addition, the fact that wood bison are as large or larger than moose of comparable sex and age also suggests the area's climate is suitable in view of the positive relationship between thermal efficiency and body size.

WILDLIFE DISEASE CONSIDERATIONS

A major concern in moving wild or domestic stock from one region to another is that precautions must be taken to prevent the spread of diseases that could pose a threat to other wildlife, livestock, or humans. In the case of wood bison, it is well established that two diseases originally acquired from domestic cattle, bovine tuberculosis and bovine brucellosis (*Brucella abortus*), can have chronic debilitating effects on bison, other ungulates and can infect man. In addition, anthrax (*Bacillus anthracis*) can periodically affect bison, primarily bulls, when environmental conditions are suitable.

Serologic surveys for *B. abortus* show this disease is not found in Alaska wildlife (Zarnke 1991). Evidence from both scientific studies and empirical observation demonstrate that bovine tuberculosis is not present in Alaska. There are no records of anthrax in Alaskan wildlife, but it is possible the organism is present in soils. Anthrax has apparently been carried to various regions in North America by carrion eating birds or other means after being introduced from Europe. This disease is not generally transmitted by bison to each other or to other animals, but is usually acquired by individual animals ingesting or inhaling spores while feeding, drinking or wallowing. Scavengers and biting flies can apparently also spread the disease. Anthrax could not be introduced to Alaska by reintroduction stock. The anthrax organism may be present in soils on the Yukon Flats, but there is no way to determine whether it is present or to predict the effects it might have in causing mortality among bison.

The occurrence of anthrax is influenced by conditions affecting soil moisture, surface temperature, and plant growth. The conditions necessary for the concentration of spores appear to be variable among areas and difficult to predict (Choquette *et al.* 1972). The advisability of vaccinating reintroduction stock against anthrax should be explored.

The stringent disease control and monitoring programs at EINP ensure that Alaska could safely import bison from this herd. Bison and other ungulates at EINP have been free of tuberculosis and brucellosis since 1971, following an intensive 4 year disease eradication program. In addition to routine monitoring for serological and clinical signs of disease, it is the park's policy to test each animal for bovine tuberculosis and brucellosis before it is moved to another area. This program has been very successful in preventing disease in any of the four wild herds or seven captive herds established elsewhere in Canada with stock from EINP. Anthrax is not known to occur at EINP.

Although wood bison are not known to harbor parasites that would be a concern for Alaska plains bison or other Alaska wildlife, the EINP staff has offered to treat bison with a broad spectrum anti-parasite medicine (Ivermectin) before shipment as a precaution.

While Alaska can obtain wood bison that are free of serious diseases, the possibility of them being affected by diseases indigenous to Alaska should be considered. The disease that is of greatest concern is *Brucella suis* IV, which occurs in various caribou herds and sometimes in other ungulates. This disease is most prevalent in arctic caribou and reindeer herds (Zarnke 1991). Because of the historic distribution of caribou relative to the location of potential wood bison habitat, transmission of *B. suis* to bison is unlikely. A preliminary study of the effects of the disease in bison suggested it may not be pathogenic in this species and cannot be maintained in a bison herd independent of another source of infection. This contrasts with *B. abortus* which causes reproductive disease, mammary gland infections, and debilitating arthritis and can be maintained in a bison population (Bevins and Blake 1993). However, there is some disagreement

regarding the indication that B. *suis* IV is relatively benign in bison (R. Zarnke, pers commun.), since bison can become infected.

EFFECTS ON OTHER SPECIES AND THE ENVIRONMENT

In considering the effects a wood bison population might have on other wildlife on the Yukon Flats, it is important to keep in mind the history of bison in North America. Bison were one of the most abundant large mammals in North America during both prehistoric and historic times. It is clear that bison evolved with other North American fauna over a period of at least 500,000 years. Historic accounts from western and northern Canada and the central and western United States indicate that wood and plains bison generally coexisted with an abundance of other wildlife including waterfowl (ducks, geese, cranes and shorebirds), other ungulates (deer, elk, moose, bighorn sheep, antelope), carnivores (including wolves, black bears, and grizzly bears), and a variety of small mammals.

Knowledge of existing bison herds in the United States and Canada also suggests that bison coexist with a variety of wildlife without negative effects. This is apparent from the summaries provided by Canadian ecologists (Appendix B) and from comments of biologists familiar with plains bison herds in the western United States.

The effect of wood bison on other species and habitat will depend largely on the number of bison relative to the amount of suitable meadow habitat and total land area. While the total extent of potential key winter range on the Yukon Flats has yet to be calculated, preliminary calculations based on IR photographs suggest that major meadow systems comprise at least 200 mi^2 of habitat, and that potential bison range encompasses an area of approximately 3,800 mi^2. A population of 500 bison (currently thought to approximate the minimum viable population for large ungulates and a logical management goal) would constitute a density on the order of one bison per 16 mi^2 of total habitat, and 2.5 bison per mi^2 of winter range (assuming 200 mi^2 of winter range).

Waterfowl

The Yukon Flats' extensive wetlands encompass an estimated 40,000 lakes and ponds and are one of Alaska's principal waterfowl breeding grounds with from 0.5 to 1.5 million ducks, geese, and swans nesting there annually (Conant and Dau 1989, Platte and Butler 1992), representing over 27 species (Heglund 1988). Approximately 1.6 million ducks, geese, and swans are produced annually. Studies of waterfowl nesting ecology show that the distribution of breeding waterfowl is determined primarily by behavioral spacing, while habitat use during brood rearing, molt, and premigratory periods is strongly related to energy requirements and, thus, wetland productivity (Heglund 1988). The size of waterbodies and shoreline length also affect waterfowl use, with larger lakes and ponds being used more heavily. Nine wetland types have been identified on the

Yukon Flats and their relative level of use by waterfowl has been evaluated. Freshwater herb, freshwater sedge, and brackish water sedge marshes, and brackish water sedge-grass wet meadow wetlands appear to be most important to waterfowl (Heglund 1992).

The actual distribution of nests of various waterfowl species on the Yukon Flats has not been closely studied. However, it is clear from numerous studies of waterfowl ecology that most waterfowl nest near water bodies. Diving ducks such as canvasbacks, scaup, and goldeneyes are especially limited in their ability to travel overland and nest close to open water. Dabbling ducks may range farther from water to nest, but nests are usually located less than 200 yards from water systems (Sowls 1955).

The potential effects of wood bison on waterfowl could include 1) alteration of nesting cover through grazing and trampling, 2) disturbance or trampling of nests and 3) effects on nutrient cycling, water quality, and habitat diversity.

We base the following assessment of interrelationships between bison and waterfowl on 1) a review of major studies on the effects of grazing ungulates (primarily bison or cattle) on waterfowl nesting success, nesting vegetation, and nutrient cycling, 2) consultation with wildlife biologists familiar with the ecology of waterfowl and bison where these animals presently coexist, and 3) the density and patterns of habitat use that would likely characterize a wood bison herd on the Yukon Flats.

It appears that bison population density will be comparable to other areas where bison coexist with waterfowl and other species, and vastly lower than the densities at which some negative effects by grazing ungulates on waterfowl have been noted. For example, Kirsch (1969) observed a moderate, but not significant, decline in pair numbers, nesting density, and nest success of upland nesting waterfowl (including teal, gadwall, mallard, shoveler, and pintail) related to grazing by cattle at densities of 43-320 cattle per mi^2. Heavily grazed range was characterized by removal of more than two-thirds of annual vegetative growth. In contrast, ongoing studies in the MBS and Slave River lowlands show that at a density of one bison per square mile of key winter range (Slave River lowlands) the effects of grazing on forage species are undetectable. At 10 bison per square mile of winter range (Mackenzie Sanctuary) summer grazing has caused a reduction in winter forage availability, but there have been no retrogressive effects on plant communities. Evidence from these areas indicates that moderate grazing pressure by wood bison at densities of up to 10 per square mile of key meadow habitat results in greater floristic diversity (Appendix B).

There is a substantial body of literature on the effects of grazing on breeding waterfowl in the United States, Canada, and Europe. Although there is relatively little information regarding the effects of grazing by wild ungulates in boreal forests, there is no reason to believe that basic principles developed elsewhere are not applicable to other systems in which large grazing herbivores have a long and continuing history. An excellent review of the effects of vegetation manipulation on breeding waterfowl in prairie wetlands was

conducted by Kantrud (1986), a waterfowl ecologist with the USFWS Northern Prairie Wildlife Research Center. Kantrud's detailed review of 181 studies pertinent to the effects of grazing and fire led him to the following conclusions, as stated in his abstract:

> "Both dabbling and diving ducks and their broods prefer wetlands with openings in the marsh canopy. Decreased use is commonly associated with decreased habitat heterogeneity caused by tall robust hydrophytes such as *Typha* spp. and other species adapted to form monotypes in the absence of disturbance. Nearly all previous studies indicate that reductions in height and density of tall, emergent hydrophytes by fire and grazing (unless very intensive) generally benefit breeding waterfowl. Such benefits are an increase in pair density, probably related to increased interspersion of cover and open water which decreases visibility among conspecific pairs, and improvements in their invertebrate food resources that result from increased habitat heterogeneity."

Kantrud (1986) recognized that climate, grazing, and fire were once the major factors controlling the abundance and species composition of vegetation, and that wetland birds evolved successfully under these influences as indicated by the abundance of water birds in pristine environments. He pointed out that natural fluctuation of water levels is probably the most important cause of vegetative change in prairie wetlands.

Kantrud (1986) cites numerous studies describing a variety of factors resulting in decreased use by aquatic birds that accompanies a reduction in natural ecological processes and resultant decreased habitat heterogeneity. The diversity and richness of avian communities generally benefits from natural processes, including light to moderate grazing, through decreased susceptibility to predation, more abundant food supplies, increased availability of open sites for preening, resting, and waiting, better access to nest sites, improved habitat for broods, increased nesting pair density, and better isolation of conspecific pairs (Kantrud 1986). Except where unusually severe, grazing results in greater plant species diversity and the development of more intricate patterns and sharper boundaries among plant communities. Both dabbling and diving ducks have been shown to benefit from grazing. Species for which positive effects have been noted include mallard, green-winged teal, blue-winged teal, northern pintail, northern shoveler, gadwall, lesser scaup, and canvasback (Kantrud 1986). The likelihood that grazing by wood bison could have beneficial effects on canvasback ducks is of special interest since the Yukon Flats is a principal nesting area for this species. The highest concentrations of breeding canvasbacks and broods in Manitoba were associated with pastured wetlands (Stoudt 1982).

Many of the studies cited by Kantrud (1986) occurred in areas where dense stands of plants such as *Typha* spp., *Scirpus* spp., and *Phragmites* spp. are common. However, beneficial effects were also noted in habitats characterized by sedges and grasses, which are more typical of the Yukon Flats.

The timing and duration of grazing in wetlands is an important factor determining its effect on waterfowl. Rest-rotation grazing, for example, has been shown to be more compatible with waterfowl (Mundinger 1976), while sustained, high intensity grazing is more likely to be detrimental (Kirsch 1969). Heavy grazing in early spring, during nesting and incubation, is more likely to hinder waterfowl production than grazing at other times of the year (Glover 1956, Mundinger 1976).

The nature of wood bison grazing in an area such as the Yukon Flats could be described as low to moderate intensity rest-rotation, in view of the mobility, seasonal shifts in food habits, and behavior of free-ranging wood bison populations (Larter and Gates 1991). In addition, bison avoid wet meadows except in winter, after freeze up. This characteristic would further minimize the likelihood of negative effects on waterfowl during spring and early summer.

As indicated in the letters from bison ecologists (Appendix B) there is no indication of negative effects on waterfowl due to the presence of bison in Canada. To the contrary, it appears that bison have a generally positive effect on waterfowl populations by increasing habitat diversity, nutrient cycling, and contributing to the maintenance of meadow habitat by reducing encroachment by shrubs and trees.

The knowledge gained at EINP provides valuable insight into the ecological relationships between bison and waterfowl. This 75.5 mi^2 park has been intensively studied and managed. Elk Island National Park encompasses hummocky topography which, together with beaver activity, has resulted in hundreds of ponds and small lakes. There are also several large, shallow, eutrophic lakes. Open water comprises about 8% of the surface area. Vegetation is predominantly (about 60%) aspen parkland with some birch, spruce, and tamarack, and an understory of hazel, prickly rose, willow, saskatoon, dogwood, cranberry, gooseberry, raspberry, honeysuckle, and buckbrush. Other cover types include grassland, sedge meadows, and shrubland (Blyth and Hudson 1987, Blyth *et al.* 1993).

The main park area (52.5 mi^2) supports precalving populations of about 550 plains bison, 1,000 elk, 270 moose, and 275 deer. In the wood bison area (23 mi^2) there are about 300 wood bison, 400 elk, 120 moose, and 150 deer. The overall density of ungulates is approximately 40/mi^2. Bison density is 10-12/mi^2 relative to the total park area, including water, and in excess of 30/mi^2 of grassland, sedge meadow, and shrubland (non-forest habitat).

Annual forage biomass production in upland grasslands and sedge meadows subject to grazing has averaged approximately 3,700 kg/ha and 5,900 kg/ha, respectively, in the main park and 4,400 kg/ha and 7,400 kg/ha, respectively, in the wood bison area in recent years. Annual forage utilization rates by grazing ungulates vary considerably from site to site, but average about 50% (B. McDougall, EINP 1993 Forage Biomass Productivity and Utilization Report, unpublished; Blyth *et al.* 1993). Except in spring and

fall when ungulate grazing reduces above-ground biomass, sedge meadows present a "virtually ungrazed appearance" (Blyth and Hudson 1987).

Surveys have identified 227 species of birds in EINP including about 50 wetland species. Studies of avian use of seven wetland habitat types have found total numbers of birds ranging from about 500-10,500 per 100 ha. Total numbers of ducks, herons, and swans are in the tens of thousands. Common species of waterfowl include lesser scaup, bufflehead, ring-necked duck, blue-winged teal, gadwall, mallard, and American wigeon. Red-necked grebes are also common and have increased since power boats were banned from the park. Because there is no indication that waterfowl are adversely affected by the high densities of bison and other ungulates, no studies of possible effects have been attempted. In the opinion of park biologists, the presence of bison has a beneficial effect on waterfowl populations by maintaining or increasing productivity and diversity of meadow vegetation (Appendix B).

The status of bison and waterfowl in the MBS and Wood Buffalo Park also suggest a lack of any negative effect by bison on waterfowl. Both areas support substantial populations of waterfowl similar in species composition to the Yukon Flats. Biologists familiar with the ecology of these areas see no indication of adverse effects (Appendix B).

As described earlier, the density of wood bison at or near a minimum viable population of about 500 would be fairly low relative to both total and winter range. This further diminishes the likelihood of adverse effects on waterfowl and their habitat, since negative effects have been observed only under conditions of sustained grazing by extremely high densities of cattle in confined areas.

Based on a review of historical conditions, published studies, and experience with existing bison populations, it is clear that bison and waterfowl can coexist, even at fairly high densities. The evidence suggests that even minor or temporary negative effects are unlikely while some long-term positive effects may occur. The absence of a grazing herbivore, and the ecological processes that accompany grazing, is an unusual and, in a sense, unnatural situation (Savory 1988). The return of a native grazing animal to the Yukon Flats should have beneficial effects on habitat diversity, productivity, and nutrient cycling.

Upland Birds and Small Mammals

The projected effects of wood bison on upland birds are generally similar to those indicated for waterfowl. This conclusion is based on studies of the relationship between grazing and upland bird species diversity and richness elsewhere in North America. Kantrud and Kologiski (1982) studied the effects of grazing on upland birds in a 600,000 km^2 area on the Great Plains and reviewed 241 related articles in the scientific literature. Their study showed that light to moderate grazing resulted in increased species richness for 19 upland species studied. Various effects ranging from no change

or increases in bird density with increased grazing intensity to declines in density and richness with heavy grazing have been reported in other studies. The favorable status of the 227 bird species recorded in EINP, despite the high densities of bison and other ungulates, also indicate that healthy upland bird populations will not be threatened by the presence of bison.

There are few specific studies on the relationship between large ungulates and small mammals such as microtines, ground squirrels, beavers, and snowshoe hares. However, these species occur at levels of abundance typical of northern environments in EINP, WBNP, and MBS. It is difficult to foresee a mechanism by which bison would adversely affect small mammals, and it would appear that any increase in habitat diversity and productivity would benefit small mammals such as microtine rodents.

Moose and Predator-Prey Relationships

Moose are the only ungulate species that occur regularly on the Yukon Flats. Although population density is generally low, moose are an important source of food for local residents. The relationships between moose and a reintroduced herd of wood bison are a concern to both local people and wildlife managers.

There is abundant evidence that moose and bison are behaviorally and ecologically compatible, even at high densities. The evolutionary history of these species in both Eurasia and North America shows they are basically compatible, having coexisted in a variety of situations. A major reason for the high level of compatibility is that moose are primarily browsers, relying on woody vegetation (willow, birch, aspen), while both wood and plains bison are primarily grazers, consuming mainly grasses and sedges. Because moose and bison rely on different forage types, there is little competition between them for food.

Wood bison are known to browse on willow leaves and twigs for a short period in spring and early summer in areas where willows are available close to preferred sedge meadows. However, the importance of willows in the diet is small, with willows comprising from 10% to 30% of the summer diet in the Slave River lowlands and MBS (Reynolds *et al*. 1978, Larter and Gates 1991). In view of the low density of moose on the Yukon Flats and consequently low browse utilization rates (ADF&G, unpubl. data), a small amount of browsing by bison in scattered areas during summer would not be detrimental to moose.

Studies at EINP show that while there is extensive overlap in the distribution of moose and bison, there is only a small overlap in food habits. During winter, for example, indices reflecting overlap in habitat use and food were 0.64 and 0.04, respectively (Blyth and Hudson 1987). As described earlier, EINP sustains high densities of moose, bison, elk, and deer with overall densities of moose and bison (wood and plains bison combined) of approximately 5 moose and 10-12 bison per mi^2. Bison and moose are

commonly observed feeding and resting in close proximity, suggesting a high degree of behavioral tolerance. The Delta and Farewell bison herds in Alaska also have a history of coexistence with high density moose populations. In both areas, overall densities of both moose and bison are on the order of 1-2 per mi^2 in the areas used by bison (about 300-400 mi^2 in each case).

Evidence from Canada and Alaska shows clearly that bison and moose can coexist at high densities. However, empirical evidence from some areas in Canada indicates the presence of large herds of bison can indirectly exacerbate problems where chronically low moose populations exist.

In the MBS, wood bison increased from 18 to about 1,700 during a 24-year period. Two strip transect surveys for moose in 1965 and 1971 indicated moose density was approximately 0.15 moose per mi^2 (0.059 to 0.066 moose per km^2) during the early years following the reintroduction of wood bison. In 1987, a similar survey, as well as incidental observations, indicated that moose numbers had declined substantially. Although little is known about changes in wolf and bear numbers, hunting pressure, habitat suitability, or weather-related mortality of moose, it has been suggested that the relatively large number of bison that existed by the early 1980s supported an increase in wolf numbers and increased predation on moose (Gates and Larter 1990). It appears wolf predation on bison during this period was initially low, then increased when bison became numerous and widespread and were sufficiently available to support more wolves than existed when the total prey base was lower. The rate of bison population growth declined from over 25% to about 18% annually between 1975 and 1985, and reached a low of 10.3% in 1987. Bison calves have been the most common cohort killed by wolves, and an increase in total calf mortality to 45% is believed to be the primary cause of the observed decline in growth rate.

A comparison of moose numbers in the different areas in Canada and Alaska suggests that moose can continue to be abundant indefinitely in the presence of moderate bison populations (250-500 bison), as in the Delta and Farewell areas in Alaska, even with predator populations that are for the most part naturally regulated. The knowledge gained at EINP shows that moose and bison can coexist at high densities, in this case, in an area where wolves and bears are absent.

The history of moose and bison in WBNP and MBS suggests that large populations of more than 1,000 bison may result in increased wolf numbers and contribute to maintaining chronically low moose populations, especially where hunting mortality of moose, including cows, is not carefully managed and/or predation is unregulated.

In view of the generally low density of moose on the Yukon Flats, an initial population objective of about 500 bison would seem to be prudent. A population of this size would be expected to remain within an area of about 500 mi^2 based on population behavior in MBS (Gates and Larter 1990). The total area used, however, could be smaller if habitat

for wood bison on the Yukon Flats is more abundant than in the MBS, as indicated by the preliminary range assessment. A bison population of this size and distribution would potentially affect wolf numbers in only one or two pack territories and have little or no effect in terms of altering the dynamics of wolf-moose relationships. Long-term population objectives could be established based on the results of population monitoring of other species and habitat as bison become established and approach the interim objective of 500 bison.

The growth and dispersal characteristics of a Yukon Flats wood bison population would probably be similar to those observed in the Mackenzie population, suggesting that an annual harvest of between 10% and 25% would be necessary to regulate the population after it reached a desired level.

Establishing a population of about 500 wood bison in Alaska would be a major contribution toward meeting recovery plan goals for bison conservation and survival and restoring the natural diversity of Alaska's wildlife. In addition, it would be a significant resource in terms of Alaska's culture and economy. A population management objective of 500 bison would appear to represent a biologically sound compromise, with little potential to adversely affect other wildlife or human interests.

Caribou

Because there is little history of caribou using the Yukon Flats, there appears to be little chance that bison could have adverse effects on this species. Although the White Mountains, Fortymile, Porcupine, and Western Arctic herds use the uplands surrounding the flats, caribou are rarely found within about 50 miles of the area where potential wood bison habitat occurs. Skoog (1968) reported that some caribou were killed near Fort Yukon in 1925, and caribou sometimes wintered in the area during the 1930s. The presence of caribou during these years was unusual, according to local residents. In 1982, caribou from the Porcupine herd traveled directly north from a wintering area near Circle, passing along the eastern edge of the Yukon Flats enroute to calving grounds on the north slope. The use of the Yukon Flats by caribou during summer has never been recorded and is highly unlikely in the future.

If caribou should occasionally winter on the Yukon Flats, the small overlap in food habits and behavioral compatibility between caribou and bison suggest that bison would not interfere with caribou using the area. During winter, caribou have a preference for lichens which occur mainly in forest and upland habitat, while bison feed almost exclusively on sedges and grasses. Although the ranges of bison and caribou presently overlap in only a few areas in North America, the Big River caribou herd often winters in the range of the Farewell bison herd in Alaska. Large numbers of bison and caribou are commonly observed mixed together in the same general areas, but concentrating on different foods (P. Valkenburg, pers. commun.). This indicates that bison and caribou are tolerant of each other and can coexist where their ranges overlap.

Furbearers

Bison appear to coexist with a variety of furbearers without detrimental effects. Where bison are abundant, the remains of bison killed by predators or dying of other causes are a source of food for small predators and scavengers such as wolverines, foxes, and weasels. There is no reason to anticipate detrimental effects on furbearers, and an increase in biological diversity and productivity associated with the presence of wood bison should have a generally positive effect on furbearers.

Vegetation

The probable effects of wood bison on habitat on the Yukon Flats have been to a large extent discussed previously in the assessment of potential effects of bison on waterfowl. Experience with bison herds in other areas (Appendix B) and the knowledge of the effects of grazing on plant diversity and productivity (Kantrud and Kologiski 1982, Kantrud 1986, Savory 1988) indicate the effects of grazing by wood bison on the Yukon Flats sedge meadows and grasslands would range from virtually undetectable with light grazing (up to about one bison per square mile of key winter range) to increased plant diversity and productivity with moderate grazing (3-5 bison per square mile). The nature of bison foraging behavior and habitat use indicates that plant communities dominated by grasses and/or sedges will be most affected by bison, with minimal effects to other habitats which are used primarily for travelling or resting. Another probable long-term effect of bison activity would be a tendency to retard the encroachment of shrubs and conifers into openings. This effect will likely occur slowly over a period of years and depend on the number of bison using the area.

The Yukon Flats appears to have been subject to a long-term drying trend, and many lakes, ponds, and meadow systems have diminished and been partly or completely invaded by shrubs. Although this trend is periodically reversed in some areas by recharging of some water bodies during spring floods, such as occurred in 1992, the long-term contribution of bison toward maintaining habitat diversity should be positive.

Bluffs along the upper Yukon River 100-175 miles southeast of Fort Yukon support some of the few remaining steppe plant communities in Alaska. Four species (*Cryptantha shackletteana, Oraba murrayi, Eriogonum flavum, Podistera yukonensis*) are on the Category II Candidate Species List in Alaska, meaning they may qualify for protection under the Endangered Species Act. About 75 miles of primarily upland terrain lies between the eastern edge of wood bison habitat and the closest known steppe community (Woodchopper Bluff). In view of the lack of suitable bison range in this area, and the limited movements of existing bison herds in Alaska and Canada, it is unlikely that even a few members of a moderate wood bison population on the Yukon Flats would venture this far from suitable habitat. In the event that bison dispersed to the bluffs along the upper Yukon some measures may be required to protect steppe plant communities.

Water Quality

The effects bison might have on water quality can only be evaluated based on evidence from other areas where bison inhabit wetlands. The Yukon Flats is characterized by a diversity of river systems, dry mesic and wet meadows, and lakes and ponds, some of which are eutrophic. Concern has been expressed that bison activity could cause hypereutrophy or increased water turbidity.

Information relevant to this concern is provided by previously cited studies in EINP, where high densities of bison and other ungulates inhabit an area with hundreds of lakes and ponds that are naturally eutrophic or hypereutrophic. Park biologists have seen no indication that bison have increased the level of eutrophy, noting that lakes outside the park are identical in terms of their trophic status and that eutrophication is a natural characteristic of lakes in the region. In addition, water quality in this park has been monitored for several years with no indication that fecal coliform levels are higher than normal, even in wetlands adjacent to bison holding facilities (Appendix B).

It is unlikely that wood bison could detrimentally affect water quality on the Yukon Flats. Here again the evolutionary history of bison would indicate their presence would not cause a deterioration in water quality. In view of the major roles played by droughts, flooding, siltation, and beaver and waterfowl activity in the dynamic wetlands on the Yukon Flats, the impact of 500 bison would likely be overshadowed by other forces.

Other Land Uses and Resource Development

Based on historical and recent experiences with wood bison populations in the north, it appears that, in a practical sense, the presence of bison is compatible with the variety of activities that characterize human use of northern environments. Common activities on existing bison ranges include hunting for both small and big game species, trapping, wood cutting, berry picking, fishing, camping and other forms of recreation. The EINP, for example, is used by thousands of visitors each year who camp, hike, and picnic in an area where they routinely encounter bison and other ungulates. Bison generally avoid people, but should be treated with the same respect as other large animals.

One minor effect on the Yukon Flats is that bison may occasionally cross or travel on snow machine trails during winter, temporarily resulting in a rougher surface. Any effect that wood bison might have on other land uses is more likely to occur because of legal and political ramifications of their present status as an endangered species. As outlined below, Section 7 of the Endangered Species Act requires the USFWS to review resource development projects that involve federal permits, and request modifications of activities as necessary to avoid jeopardizing endangered species.

Section 7 consultations are routinely done for species such as peregrine falcons in Alaska. Given the adaptability and mobility of wood bison and their high level of

tolerance for human activity, it is highly unlikely that other resource developments would be hindered by their presence.

LOGISTIC CONSIDERATIONS IN REINTRODUCING WOOD BISON

Source of Wood Bison Stock

The best source of wood bison stock for a reintroduction is EINP in Alberta, which maintains a herd of about 300 disease-free bison with a primary goal of providing bison to reestablish free-ranging herds in their former range. From 30 to 50 surplus wood bison are available each year. Reintroduction stock would include young adult females, a majority of which would be pregnant, and young (1-3 year old) male bison.

Transport and Handling Methods

The details of handling and transporting wood bison to Alaska have been worked out in cooperation with the staff at EINP based on their extensive experience in transporting bison and other large ungulates long distances. The handling facility at EINP is designed to handle hundreds of bison annually. Bison can be separated, ear-tagged, disease tested, and otherwise handled in this modern facility. Wood bison stock destined for Alaska would be selected in January during the annual wood bison round-up. After being ear-tagged, sexed, aged, and disease tested, bison would be held separate until being transported to Alaska in late February. A few adult cows would be radio-collared to allow monitoring of herd movements. Bison would be loaded in appropriate shipping containers, trucked to Edmonton International Airport, and loaded into C-130 aircraft for a 5-hour flight to a temporary release facility on the Yukon Flats. These flights would be accompanied by personnel experienced in handling bison.

Release Site

There are several sites on the Yukon Flats that may be suitable in terms of habitat and logistics. The final selection of a site will also depend on land ownership and preferences expressed during an extensive public involvement process.

The basic features that will be necessary include a partly wooded area to provide shelter, a nearby source of water such as a lake or pond, a gravel airstrip or lake large enough to accommodate C-130 aircraft, sufficient remoteness from human activity that disturbance is minimal or absent, and proximity to suitable bison range.

Previous experience with bison reintroductions has shown that unless animals are held in an enclosure and allowed to habituate for 2-3 months after being moved, they are likely to wander long distances into areas where there is less suitable habitat. To assure that bison will establish themselves in the desired area, a temporary enclosure about 10-

20 acres in size would be constructed using commercially available high-tensile game fencing. Bison would be released into this enclosure and provided with hay and water until their release at the beginning of the calving season in May.

A temporary camp would be built near the enclosure and two attendants experienced in large animal handling would feed and tend the bison during their confinement. It would be important to limit human activities in order to avoid alarming the bison and causing them to break out of their enclosure. This would jeopardize the success of the reintroduction and likely result in some animals being injured. However, it should be possible to accommodate visits by interested people, including school children, under controlled conditions after bison settle into the enclosure. This would certainly be desirable in terms of education and increasing public interest in the program.

Bison would be allowed to leave the enclosure in May. This would be accomplished by simply leaving the gate open, but not changing the daily routine, or forcing the bison to leave the enclosure. Hay would continue to be available at the release site until the animals had located and were using local forage. Bison would be expected to rapidly establish a pattern of using meadows and would develop trails connecting important habitats. Range expansion would likely occur in direct relation to population size as reported in the MBS (Gates and Larter 1990).

Following their release, bison movements would be monitored by aerial radio telemetry on a weekly basis, and an effort would be made to obtain fecal samples for forage analysis every 2-4 weeks to obtain insight into seasonal food habits. Annual changes in numbers, calf production, and survival would be determined by an annual spring census and annual fall composition counts.

The possibility of augmenting the growth of the herd by releasing an additional 30-50 animals in one or more subsequent years has been considered. If additional wood bison stock and funding are available, this would be a wise investment as it would reduce the length of time necessary to reach the minimum goal of 500 bison, shorten the time until the herd should be self-sustaining and able to withstand unforeseen accidents or severe weather, and provide nonconsumptive and consumptive benefits. A rapid growth rate will also increase genetic heterogeneity (M. Kronin, pers. commun.).

Projected Population Growth, Long-term Monitoring and Management

Based on experience with reintroduced populations elsewhere, a wood bison population on the Yukon Flats could be expected to increase at a rate of 15%-25% annually after becoming established (Gates and Larter 1990, ADF&G, unpubl. data).

With an average annual growth rate of 20%, an initial precalving population of 50 bison would increase to 500 in approximately 13 years. If the population were augmented with an additional 50 bison in the year following the initial release, it would take about 10

years to reach 500. A third introduction of 50 bison would shorten this period by 2-3 years. Variation in the rate of growth could lengthen or reduce the period necessary to reach 500. For example, if the average growth rate were 25%, a herd of 50 would increase to 500 in only 11 years.

Basic biological data necessary for long-term management of a herd of about 500 bison will be obtained from an annual spring census, fall composition counts, and monthly monitoring of herd movements. Based on experience with similar sized herds in Alaska and on logistics for the Yukon Flats area, long-term monitoring would require approximately $10,000 in operating funds annually. Bison populations are relatively easy to monitor because of the animal's visibility, gregarious nature, and fidelity to seasonal ranges.

GOALS OF A WOOD BISON REINTRODUCTION

The goals and objectives of a reintroduction will be formally established and refined following extensive public involvement and comment. The following are preliminary goals inherent in the concept of reintroducing wood bison to Alaska.

1. To contribute to restoring and maintaining natural ecological processes and biological diversity by reestablishing and maintaining a self-sustaining, healthy, free-ranging wood bison population in part of their former range.

2. To contribute to wood bison recovery and removal of the subspecies from endangered species lists.

3. To establish a healthy wood bison herd capable of sustaining a variety of consumptive and nonconsumptive uses and contributing to the cultural, aesthetic, economic and social well-being of Alaskans.

4. To ensure the genetic integrity of wood bison by maintaining a herd subject to natural selection, and protected from hybridization with other bison subspecies.

5. To involve the Alaskan public and resource agencies in the management and use of a wood bison herd.

BENEFITS OF REESTABLISHING WOOD BISON IN ALASKA

Conservation and Biodiversity

The establishment of a self-sustaining herd of wood bison in Alaska would represent a major step forward in the conservation and recovery of a once abundant North American mammal, increasing the likelihood of removing wood bison from lists of endangered

species. The Wood Bison Recovery Plan assigns a high value to this program and suggests that it be a priority use of wood bison stock, second only to additional reintroductions in Canada. The potential for additional free-ranging herds in Canada is limited pending resolution of disease problems and other issues. An Alaska herd would be especially significant in terms of ensuring the future of the subspecies because it would be remote from the threat of bovine tuberculosis and brucellosis.

The diversity of Alaska's wildlife would be enhanced by restoring a native herbivore to part of its former range. An important ecological process would be reestablished on the Yukon Flats, where there is presently little grazing by large herbivores.

Conservation of Genetic Diversity

The near extinction of North American bison during the 19th century is one of the most tragic stories of the abuse of wildlife in North America (Gates *et al*. 1992). The chronology of depletion was similar for both wood and plains bison, and by the turn of the century only a few hundred wood bison remained near Lake Athabasca and Great Slave Lake. Since that time, wood bison have undergone a modest recovery. The argument for the restoration of free-ranging wood bison populations is compelling, and has been carefully outlined by van Zyll de Jong *et al*. (in press) as follows:

> "After their devastating impact on the species in the past, humans continue to virtually control the evolutionary destiny of the bison. There is thus an implicit responsibility to preserve as much of the within species diversity as possible, to allow for continued adaptation and evolution, as well as for utilitarian purposes. Geographic variation should be preserved in populations where natural processes and factors operate most freely. Accidental crossbreeding of northern and southern forms of bison resulting from escapes of privately owned commercial bison or the willful introduction of one form into the range occupied by the other will lead to further loss of within species diversity and thus conflicts with one of the central objectives of conservation biology. Phylogeny is a time dependent process in part resulting from accumulated genetic differences in the absence of gene flow. The possibility that geographic variants possess unique adaptations and have the potential to evolve into new species are compelling reasons for conserving them (O'Brien and Mayr 1991).
>
> Managers of public and private bison herds cannot afford to be complacent about conservation of geographic variability. Erosion of genetic variability tends to advance rapidly under domestication. Domestication places the species in a state of total dependence, where natural selection is replaced largely by artificial selection based on economic and husbandry considerations. Experience with several traditional domestic animals indicates that recovery of original genetic

diversity is difficult or impossible once domestication has progressed to a stage where existing breeds and wild stocks have become extinct (Crawford 1984). Artificial selection and hybridization to obtain certain traits dictated by economic and animal husbandry considerations make good business sense, but rapidly diminish the genetic resource. Wild stocks, therefore, serve as a genetic bank that can be drawn from to improve domestic breeds when the need arises.

It takes but little reflection to conclude that the responsibility for conserving within species diversity rests primarily with public agencies and not private interests. Only public agencies can provide the continuity and long-term protection of intact ecosystems large enough for all natural forces to act on a large species such as the bison. A conservative approach to the conservation of within species diversity in bison would be to manage geographic variants separately in large, viable populations under conditions as close as possible to those of primeval times. Aldo Leopold implored 'to keep every cog and wheel is the first precaution of intelligent tinkering' (Noss 1989). We would be wise to bear this analogy in mind as we forge plans for the conservation of remnant bison populations for present and future generations."

Historic and Aesthetic

Wood bison and their ancestors are an integral part of Alaska's history. Reestablishing wood bison in the state would provide a focus for an enhanced appreciation of Alaska's natural history and the history of Native Alaskans.

Resource Enhancement

A self-sustaining herd of wood bison on the Yukon Flats would significantly enhance local resources as well as Alaska's wildlife resources in general. The chronically low abundance of large ungulates on the Yukon Flats would be to some extent alleviated by reestablishing a species that relies on a presently unused forage base and would not compete with the areas relatively low, but valuable, moose population. The economic benefits associated with a wood bison population include:

1. Contributing to a more diverse and abundant source of high quality food.

2. Providing a source of other potentially valuable raw materials such as leather and skulls.

3. Providing a base for an expanded tourism industry. Wood bison are impressive, visible, and photogenic animals. This would be the only wild population of wood

bison in the United States. As such, it would be of interest to tourists, naturalists, and photographers.

4. Creating a basis for a modest guiding industry that could provide stable employment for residents of the Yukon Flats and the interior in general.

5. Providing direct economic benefit to private landholders in the area who could charge fees for access to view or hunt bison.

Social and Political Considerations

A benefit of successfully pursuing a wood bison reintroduction would be that the cooperative efforts of local and other Alaska residents, agencies, and various entities in Canada could serve as a model for other programs. It would also demonstrate how careful wildlife management can benefit wildlife, local and regional economies, and quality of life. This program appears to have a minimal chance of negatively affecting the environment or the values and interests of diverse constituencies, while providing substantial benefits to bison conservation and Alaska's people and economy. As such, it is an undertaking that could bring together various segments of society in support of a common cause.

INITIAL PUBLIC CONTACT AND RESPONSE

The ADF&G staff have discussed the possibility of reintroducing wood bison with a variety of individuals and groups in Alaska since late 1991 when the possible merits of the idea became apparent. Initial discussions involved primarily residents of the Yukon Flats and Fairbanks, as well as Yukon National Wildlife Refuge staff. In 1993 and early 1994, presentations ranging from 15 minutes to 1 hour were made to various groups, including the Alaska Outdoor Council and Wildlife Safeguard Board of Directors in Fairbanks, the Yukon Flats Fish and Game Advisory Committee in Fort Yukon, the Alaska Board of Game (joint slide presentation by ADF&G and Dr. Dale Guthrie, University of Alaska), College Rotary Club in Fairbanks, the Anchorage Fish and Game Advisory Committee, and ADF&G staff in Juneau, Anchorage, and Fairbanks. Staff and upper level managers from the FWS (including divisions of Refuges, Endangered Species, and Federal Aid) and ADF&G met in Anchorage in March 1993, and in Fairbanks in August 1993, to discuss various aspects of a reintroduction.

In general, residents of Beaver, Fort Yukon, and Chalkyitsik have expressed a positive interest ranging from cautious interest to strong support and expressions of impatience about beginning the program. Some individuals, however, either have strong concerns or tend to oppose a bison reintroduction. Major concerns are: that bison might have a negative effect on the moose population, that a bison herd would be used by hunters from outside the Yukon Flats and not be available to local residents, or that the presence

of bison in the region would be new or artificial. These concerns are not surprising since a comprehensive program to inform local residents about the history of bison in the region or other aspects has not yet been carried out. It seems that most people are receptive to more information and take a more supportive position once they understand the reasons for considering a reintroduction. A slide talk was given to representatives of the Council of Athabascan Tribal Governments, Native American Fish and Wildlife Society, FWS, and Fort Yukon residents on 26 April 1994. A lengthy discussion followed and indicated general interest in the possibility. Much of the discussion focused on developing a process that would provide for local participation in evaluating the possibility, and in preparing a cooperative management plan and assisting with the project, should it be undertaken. Village councils have not been formally consulted, but various representatives have expressed interest in the idea and want to learn more about the possibilities. The primary concern of some leaders seems to be assuring a high level of local involvement or, in some cases, control of the program. Managing a wood bison herd for benefits to the local subsistence and cash economy will continue to be a focus of concern among local residents. Long-term economic development has become a major focus of local government. The economic benefits associated with the development of a substantial herd of wood bison, including a local guiding and tourism industry, are appealing to at least some local leaders.

Elsewhere in Alaska, the possibility of reintroducing wood bison has been generally well received. Most outdoor-oriented groups and individuals have expressed genuine enthusiasm about the opportunity for Alaska to contribute to the conservation of wood bison and to reestablish a free-ranging population of an interesting and valuable animal. People also seem to welcome an opportunity for various interests to work together toward a goal that would directly or indirectly benefit everyone.

Positive interest is, however, accompanied by some concerns, the most prevalent being that a wood bison herd could end up benefitting only a small segment of Alaskan society as a result of the legal and political controversy over subsistence, rural versus urban residency, and tribal sovereignty. Investing substantial public funds to develop a resource, the use of which could potentially be limited by race or residency, is disturbing to many Alaskans. People expressing these sentiments appreciate and support the various and substantial benefits that wood bison could provide to local residents, but hope benefits could be realized by other Alaskans as well. The possibility that wood bison could remain on the U.S. Endangered Species List, even though they may be thriving in Alaska, is also a concern.

The status of wildlife law in Alaska a decade or more in the future is impossible to predict. Despite their concerns, a number of people expressed the view that uncertainty about future laws and politics should not preclude reestablishing wood bison. If a reintroduction is biologically feasible, appropriate in terms of wood bison conservation, and will enhance Alaska's wildlife resource, people generally seem to believe it should be

carried out. While they see some potential obstacles, they do not believe they are insurmountable. Preliminary contact with these interests revealed a uniform desire to learn more about this possibility and to be kept apprised of ADF&G's progress in pursuing it.

To date, only limited and informal discussions have occurred involving organizations such as the National Wildlife Federation, National Audubon Society, The Wildlife Society, International Association of Fish and Wildlife Agencies, and Safari Club International. As is the case with most Alaska residents, representatives of these groups are interested in learning more about the possibility and have requested presentations and other information.

The only international organization whose position is known is the International Union for the Conservation of Nature - North American Bison Specialist Group. This entity has recommended reintroducing wood bison to Alaska if it is biologically feasible.

PERTINENT STATE AND FEDERAL POLICIES, MANDATES AND AGREEMENTS

This section attempts to consolidate various state and federal laws and policies that pertain to the reestablishment or management of wildlife species in general, and endangered or threatened species in particular.

State of Alaska

Constitution:

Article VIII, Section 4. Sustained Yield. "Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the state shall be utilized, developed, and maintained on the sustained yield principle, subject to preference among beneficial uses."

Section 5. Facilities and Improvements. "The legislature may provide for facilities, improvements, and services to assure greater utilization, development, reclamation, and settlement of lands, and to assure fuller utilization and development of the fisheries, wildlife and waters.

Alaska Statutes:

Title 16. Section 05.020. Functions of Commissioner. (2) manage, protect, maintain, improve, and extend the fish, game and aquatic plant resources of the state in the interest of the economy and general well-being of the state.

ADF&G Mission Statement:

The ADF&G's mission is to manage, protect, maintain, improve and extend the fish, game and aquatic plant resources of Alaska. Its primary goal is to ensure that Alaska's renewable fish and wildlife resources and their habitat are used, developed, and maintained on the sustained yield principle in the best interest of the economy and general well-being of the state.

ADF&G Policy on Wildlife Transplants and Reintroductions:

(Note: this policy is being revised) In 1959 with the dawn of statehood, Alaska's transplant program was inherited by ADF&G. Ultimately, the department established a policy similar to but stronger than that of the Bureau of Sport Fisheries and Wildlife. This policy states:

> "The department recognizes that transplanting game species for restocking former ranges or stocking vacant habitat may be a useful management tool. Because transplants often have unforeseen detrimental effects, importing and transplanting of game will be generally opposed but may be approved if substantial public benefit can be shown. Proposed transplants will be reviewed by the department and must meet the following minimum requirements to be approved: 1) The proposed transplant site must provide sufficient and suitable habitat to support a viable population of the transplanted species, as determined by comprehensive study; 2) Prior study must establish that the introduction of a species will not adversely affect the numbers, health, or utilization of resident species."

A revised policy will be completed by fall 1994 and will likely include more stringent standards, particularly regarding protection against disease transmission. These standards will be congruent with the level of review and disease precautions inherent in a wood bison reintroduction.

In 1970, during the second session of the Sixth Alaska Legislature, the statutes (Sec. 16.25.010) dealing with wildlife stocking of public lands were amended to read as follows:

> "There is adopted a program of stocking lands in the state with valuable game and fur-bearing animals which do not at present occur on those lands. The department is responsible for establishing priorities on the species of animals to be stocked and the area of the stocking. Priorities shall be based on the habitat requirements of the species, the population of native game animals present, and other factors that will effect the successful establishment of the species."

ADF&G Endangered Species Program:

Alaska Statutes 16.20.190. This program seeks to identify species whose numbers have declined to the extent that their continued existence is threatened. Wood bison are not included on the state's endangered list, which is oriented toward identifying wildlife species already existing in Alaska that need special conservation measures to assure their survival.

State Laws Affecting Importation of Animals:

The Alaska state veterinarian (Dept. of Environmental Conservation) would request health certificates for wood bison intended for shipment to Alaska and would list the diseases which would need be tested for and which must not be present. The disease testing techniques and policies at EINP should meet these requirements without difficulty.

Master Memorandum of Understanding Between ADF&G and FWS:

This document outlines general areas of agreement. ADF&G acknowledges the responsibility of FWS to manage endangered species and certain other classes of wildlife, and agrees to manage resident wildlife in their natural species diversity on service lands, and to consult with the service and comply with appropriate federal laws and regulations before embarking on enhancement activities on service lands. Among other things, FWS agrees to cooperate with the department in planning for enhancement or development activities on service lands which require permits, environmental assessments, compatibility assessments, or similar regulatory documents by responding to the department in a timely manner with requirements, time tables, and any other necessary input.

Cooperative Agreement between USDI and ADF&G for Conservation of Endangered and Threatened Animals:

This 1979 agreement details the relationship between ADF&G and FWS regarding endangered species management. The parts of this agreement pertinent to reintroducing wood bison include the determination that ADF&G "...has established an acceptable conservation program, consistent with the purposes and polices of the Act, for all resident fish or wildlife in the state which are deemed by the secretary to be endangered or threatened..." and "...has the authority to establish programs ... for the conservation of resident endangered or threatened fish or Wildlife "...and that FWS may agree with the state to provide financial assistance for the implementation of an acceptable project for the conservation of endangered and threatened fish or wildlife." The agreement states that ADF&G will not authorize the taking of resident federally listed endangered or threatened species without obtaining a permit from the Director of FWS. Taking can also be done by department employees or agents in connection with

conservation programs, or pursuant to a special rule in 50 CFR-17 (as described in section 10 (V) of the ESA).

The department is required to inform FWS of changes in the status of threatened and endangered species resident in the state, changes in threatened and endangered species conservation programs, and specimens taken by state employees or agents under 50 CFR-17.

Department of the Interior

Refuge Policies:

The U.S. Fish and Wildlife Refuge Manual outlines the mission, goals, and policies for the National Wildlife Refuge System. The following material is excerpted from pertinent sections of the Refuge Manual, NWRS Objectives - 2 RM 1.1.

Sec. 1.3. Mission - To provide, preserve, restore, and manage a national network of lands and waters sufficient in size, diversity and location to meet society's needs for areas where the widest possible spectrum of benefits associated with wildlife and wildlands is enhanced and made available.

Sec. 1.4. Goals - The following broad goals of the National Wildlife Refuge System describe a level of responsibility and concern for the Nation's wildlife resources for the ultimate benefit of people.

A. To preserve, restore, and enhance in their natural ecosystems (when practicable) all species of animals and plants that are endangered or threatened with becoming endangered.

B. To perpetuate the migratory bird resource.

C. To preserve a natural diversity and abundance of fauna and flora on refuge lands.

D. To provide an understanding and appreciation of fish and wildlife ecology and man's role in his environment, and to provide refuge visitors with high quality, safe, wholesome, and enjoyable recreational experiences oriented toward wildlife to the extent these activities are compatible with the purposes for which the refuge was established.

Exotic Species Introduction and Management, 7 RM 8.

8.1 Policy - The National Wildlife Refuge System exists for the protection and management of plants and animals native to the United States. The policy of the service is to prevent further introduction of exotic species on national wildlife refuges except

where an exotic species would have value as a biological control agent and would be compatible with objectives of the refuge.

8.4 Definitions -

A. Exotic species. All species of plants and animals (including fish) not native to the United States and not presently or historically occurring in the United States except through the intervention of man, intentional or otherwise. A non-indigenous species.

B. Native species. All species of plants or animals (including fish) having originated in and being produced, growing, or living in a particular region or environment of the United States. An indigenous species.

C. Introduction. Release, escape or establishment of an exotic species into a natural ecosystem.

Propagation and Stocking 7 RM 12.1.

12.1 Policy - The propagation and stocking of fish and wildlife on refuge lands will be permitted when such activities are in accordance with the wildlife management objectives of the refuge.

1. The species introduced or stocked will be indigenous to the area.

2. Consideration will be given to endangered species where a "Recovery Plan" has been developed and approved by the director.

3. Data on the life history, population dynamics, behavior, habitat requirements, and general ecology of a species must be available before reintroductions are attempted. This includes disease studies, analysis of available habitat, population trends and dynamics, lack of response to previous habitat restoration, natural predators, inter- and intra-specific competition and management practices along with any needed base information.

Policies for specific groups of wildlife are as follows:

B. Upland birds and mammals. The policy "...is the same as for migratory birds except that introductions from any source of stock must be approved by the director of the state wildlife agency concerned and the regional director." The policy for waterfowl stresses that stock be disease free based upon examinations conducted by qualified professionals approved by the director.

D. Threatened and endangered species. "A restoration or restocking program for threatened and endangered species may be undertaken in accordance with Section 7 Consultation Procedures and an approved 'Recovery Plan'."

12.3 Definitions - (Definitions of exotic and native species under this section are as detailed under section 8.4 above, except that under native species the following is added: For purposes of this chapter, any United States species outside of its contiguous recognized range as a viable, self sustaining population, without assistance of man, is considered an introduced native species and must be addressed on a case by case basis.)

In addition, definitions for reintroduction and reestablish are given:

E. Reintroduction. Releasing a species into a natural area in which it had previously existed in a viable population but has since disappeared or become greatly diminished.

F. Reestablish. To restore a breeding population or to restore use of historic habitat of a species.

Section 7 RM 12 goes on to outline the internal process for approval of "stocking" (which includes introduction, reintroduction and augmentation) programs on refuges. This section is attached (Appendix C).

Endangered Species Management - 7 RM 2.

This section details FWS policy and procedures for listed species. It is fairly lengthy and is attached (Appendix D). There are some sections which are especially pertinent to the potential reintroduction of wood bison, which are currently listed as an endangered species, including:

2.1 Policy - The protection, enhancement and recovery of endangered and/or threatened species will receive priority consideration in the establishment of refuge objectives and the management of national wildlife refuges. Consideration will also be given to the protection of species identified by the state as endangered or threatened.

2.2 Objective -

A. To prevent any species of fish, wildlife or plant from becoming extinct;

B. To restore endangered or threatened fish, wildlife or plant species to a viable, non-endangered status;

C. To protect ecosystems upon which endangered and threatened species depend; and

D. To ensure that conflicts between endangered species and other wildlife management or public use programs are resolved in favor of endangered species.

This section outlines the requirements of Section 7, the purpose of which is to ensure that planned actions do not jeopardize listed species or their critical habitat. The effects of Section 7 are reviewed below in connection with a discussion on ramifications of endangered species status.

Public Law 96-487, Dec. 2, 1980. Title III:

This section of the Alaska National Interest Lands Conservation Act established several new national wildlife refuges in Alaska. The purposes for which the Yukon Flats National Wildlife Refuge was established include:

1. To conserve fish and wildlife populations and habitats in their natural diversity including, but not limited to, canvasbacks and other migratory birds, Dall sheep, bears, moose, wolves, wolverines, and other furbearers, caribou...and salmon;

2. To fulfill the international treaty obligations of the United States with respect to fish and wildlife and their habitats;

3. To provide, in a manner consistent with the purposes set forth in subparagraphs (1) and (2), the opportunity for continued subsistence uses by local residents; and

4. To ensure, to the maximum extent practicable and in a manner consistent with the purposes set forth in paragraph (1), water quality and necessary water quantity within the refuge.

Compatibility with Refuge Purposes:

It is the responsibility of the refuge manager to determine whether various activities are compatible with the primary purposes for which a refuge was established. The manager of the Yukon Flats National Wildlife Refuge would evaluate the reintroduction of wood bison as to whether it is compatible with the purposes listed above, based on a thorough analysis of environmental impacts.

Section 810 Determination:

This section of Public Law 96-487 requires that federal agencies shall evaluate the effect of various uses of land or changes in land disposition on subsistence uses and needs. If a "withdrawal, reservation, lease, permit, or other use, occupancy or disposition of such lands" would significantly restrict subsistence uses, the agency is required to give notice to the appropriate state agency and local committees and regional councils, hold

hearings in the area involved, and attempt to minimize adverse impacts on subsistence uses and resources resulting from such action.

Yukon Flats National Wildlife Refuge Comprehensive Conservation Plan:

This 422 page document is the final conservation plan, Environmental Impact Statement (EIS), and wilderness review for the Yukon Flats National Wildlife Refuge. It describes five alternatives for managing the refuge and the possible consequences of implementing these alternatives. The service selected Alternative D, involving minimal management as the preferred alternative. The specific management directions involved in the plan are detailed in the document.

Perhaps most relevant to this feasibility assessment is the statement (p. 127) under Wildlife Management. "It is the intent of the service to maintain wildlife population on the Yukon Flats Refuge at levels near the carrying capacity of refuge habitats, subject to naturally occurring fluctuations in populations. The service will focus its efforts on maintaining existing fish and wildlife populations and productive habitats on the refuge, ensuring that the full complement of native flora and fauna continue to exist on the refuge. Introduction of exotic species (species not native to North America) will not be permitted, although introduction of native species (species native to North America outside their original range) and wildlife stocking (reestablishing, augmenting, or maintaining native species within their original breeding range) will be permitted." Table 13 (p. 117) indicates that introduction of native wildlife species "may be permitted on a case-by-case basis," while wildlife stocking (including "reestablishing" native species within their original breeding range) "may be permitted."

Refuges 2003 - A Plan for the Future of the National Wildlife Refuge System:

This draft EIS and management plan reviews the status of the refuge system and describes seven alternative approaches to management of the system during the next decade. Current policy includes a priority for protection and recovery of threatened and endangered species and wetland management for waterfowl and related species. Under the "Conservation Alternative" (proposed action), pertinent statements include the following: "Refuges will become nationally recognized areas where techniques to conserve and restore natural biological diversity will be explored and demonstrated." "Where appropriate, refuges will pursue opportunities to reintroduce native game species (e.g., bison, elk) as part of cooperative ecosystem management initiatives." "The refuge system will play a significantly more important role in the recovery of T&E species than under the No Action Alternative." "Refuges involved in propagation and release of T&E species will increase as refuges play a more active role in restoration of native species..."

Endangered Species Act of 1973:

This act (ESA) and subsequent amendments provided additional protection to endangered species and mandated all federal departments and agencies to use their authorities in furtherance of the act. Among other things, the ESA provides for cooperative agreements with states and funding of conservation efforts for threatened and endangered species.

Wood bison were listed as endangered in Canada only in 1970 (35 FR 8495). Prior to the 1973 ESA, the FWS maintained two lists of threatened and endangered species, one for domestic and one for foreign species. Wood bison were included on the foreign list. These lists were combined in 1973, placing wood bison on the U.S. Endangered Species List. Wood bison were recognized by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as an endangered subspecies of Canadian wildlife in 1978. This status was changed to threatened in June 1988 by COSEWIC based on a status report prepared by the Wood Bison Recovery Team.

Several provisions of the ESA that would have significant implications for the reintroduction of wood bison are discussed below.

a. The ESA was amended in 1982 (P.L. 97-304) to include a new section, 10 (j), providing for the designation of specific populations of listed species as "experimental populations." Under previous authorities the FWS was permitted to reintroduce populations into unoccupied portions of a listed species' historical range when it would foster the conservation and recovery of the species. However, local opposition to reintroduction efforts, stemming from concerns about the restrictions and prohibitions on federal and private activities contained in Sections 7 and 9 of the ESA, severely handicapped the effectiveness of the ESA as a management tool (Federal Register 56, No. 182, 1991, Final rule on nonessential experimental status of black footed ferrets in Wyoming, USFWS).

b. Under section 10 (j) the FWS may designate reintroduced populations established outside the current range but within the species historical range as "experimental." This allows more flexibility in managing reintroduced populations because experimental populations of endangered species may be treated as threatened species.

   If the loss of an experimental population would not jeopardize the continued existence of the species in question, an experimental population can be classified as "nonessential." This provides additional management flexibility for populations outside of National Wildlife Refuge or National Park lands, where nonessential experimental populations are treated as if they were only proposed for listing. Two provisions of Section 7 would still apply: Section 7(a)(1) would require all federal agencies to establish conservation programs and Section 7(a)(4) would

require federal agencies to confer informally with FWS on actions that are likely to jeopardize the continued existence of the species. Section 7 (a)(2), requiring federal agencies to ensure their activities are not likely to jeopardize the continued existence of a listed species, would not apply except on national wildlife refuge or national park lands. Activities undertaken on private lands are not affected by Section 7 of the Act unless they are funded, authorized, or carried out by a federal agency.

Congress intended that most experimental populations be considered nonessential (Parker and Phillips 1991), and it appears that a reintroduced wood bison population would appropriately be designated as such. A Yukon Flats population would be clearly separated from other wood bison populations, and stock for a reintroduction would be comprised of bison that are not necessary to populations elsewhere. However, the level of management flexibility would be different on private and refuge lands, primarily due to different Section 7 requirements.

c. Section 10 (e) states that Alaska Natives residing in Alaska and any non-Native permanent resident of an Alaskan native village may be allowed to take endangered or threatened species if such taking is primarily for subsistence purposes. However, if such taking materially and negatively affects the threatened or endangered species the Secretary of Interior may prescribe regulations restricting the taking of such species. The success of a reintroduction of wood bison to Alaska would be seriously jeopardized if bison were hunted prematurely or without careful regulation. This issue could be addressed in a special rule establishing experimental/nonessential status. However, one goal of a reintroduction would be to establish a huntable population. Hunting regulations would be promulgated when the population is removed from the list of threatened and endangered species.

d. Progress in wood bison conservation has brought the subspecies to the point that delisting can be contemplated depending on the success of recently reestablished populations and the outcome of decisions on the future management of diseased populations in Northern Canada (C. Gates, Chairman, WBRT, pers. commun.). The establishment of a viable population in Alaska would be a major step toward meeting the goals set forth in the Wood Bison Recovery Plan, and allow for delisting to be seriously considered. This would require the Director General of the Canadian Wildlife Service to request delisting in Canada and the United States. Delisting would simplify the management of wood bison on the Yukon Flats by reducing the amount of permitting and review associated with management and by clarifying the management authority, which would then lie with the State of Alaska, which manages resident wildlife.

e. The harvest of wood bison could be legally provided after the subspecies is delisted. The Wood Bison Recovery Plan is presently being finalized, but it is likely the recovery goal will include the existence of four separate, free-ranging, healthy herds with a minimum of approximately 400 animals in each. The herd size regarded as the minimum size necessary to be self-sustaining may change somewhat depending on the results of a minimum viable population analysis that will be completed in 1994 (C. Gates, pers. commun.).

The MBS herd presently exceeds the minimum goal and the Yukon herd numbers approximately 200 and is expected to reach the management goal of 400 animals. A reintroduction planned for the Liard River Valley in northeastern British Columbia is expected to eventually result in a third herd of 400 wood bison. A successful reintroduction in Alaska would be the fourth herd with the clear potential to meet or exceed the minimum goal of 400 bison, making delisting possible. Delisting in Alaska could be pursued independently of recovery in Canada depending on how the special rule and recovery plan are written. Delisting could occur range-wide if recovery goals are met either within Canada or in Canada and Alaska combined.

f. Practical considerations related to the endangered species status of wood bison include: (1) limiting the flexibility of management agencies in terms of eventually providing for a harvest of bison on refuge lands; (2) potentially creating two types of management regimes based on land ownership when management would be simplest and most coherent if management were uniform across the herd's range; (3) making it necessary for FWS to undertake a Section 7 consultation for resource developments on refuge land that require federal permits and might have the potential to adversely affect wood bison. It is unlikely that this requirement would constrain foreseeable resource developments. Bison are mobile, have broad habitat requirements, and can tolerate and adapt to considerable human activity and development. Resource developments involving construction activities that would directly affect meadows that were key bison winter range are the only foreseeable situation in which a Section 7 review might result in adjusting development plans to accommodate the presence of wood bison.

National Environmental Policy Act:

This law (NEPA) requires that federally funded projects, including Federal Aid in Wildlife Restoration programs, be examined relative to their effects on the environment. The handbook titled "NEPA in Federal Aid Proposals - Guidance to the States" (USDI-FWS 1980) draws together portions of existing directives which apply to the states as applicants for Federal Aid Funding. The steps involved in project evaluation under NEPA are summarized in Figure 5, taken from the NEPA handbook.

Based on existing criteria, a bison reintroduction would not be categorically excluded from the NEPA process, and would require either an EA or EIS. An EIS is required for actions which "significantly affect the environment" and "broad actions having extensive geographical scope, major cumulative impacts, or far-reaching technological developments which...could significantly affect the quality of the human environment. Also, actions associated with substantial and long-term alteration to the physical environment or those involving intense controversy may evoke EIS procedures. All such actions with the potential for exceptionally disrupting soil, water, air, and nontangible components of the human environment are candidates."

"The need for an EIS depends on a judgement of significant impact on the quality of the human environment. There are no hard and fast rules...reasonable professional judgement must be exercised."

An EA is usually prepared to judge whether an EIS is required. In some cases a state, in consultation with the FWS regional office, may choose to prepare an EIS. This course is considered when it appears the proposed action will:

1. Jeopardize public health or safety (i.e., introduce hazardous substances into an aquifer or domestic water supply, increase air pollution above standards, cause a flood hazard).

2. Adversely affect the unique characteristics of a geographic area (i.e., loss of cultural, historic, or scientific resource, convert parklands to non-recreational uses, remove prime farmlands from agricultural production causing irretrievable loss as opposed to a change in vegetative type, loss of wetland values, alter the characteristics of wild or scenic rivers or an ecologically critical area).

3. Generate strong public opposition (i.e., condemnation of property rights, large scale relocation of people, property or facilities).

4. Involve high uncertainty or involve unique or unknown risks (i.e., introducing a species of animal into an ecosystem where it has never occurred and which it could not have reached through natural dispersion and where it has potential for unintentional establishment beyond the project area, development of a new technology that would adversely affect the quality of the human environment).

Application of the Experimental Population Designation:

The provision for experimental population status has been applied to only a few endangered vertebrates since its establishment in 1972. These include the red wolf (North Carolina), gray wolf (proposed-Yellowstone), Delmarva fox squirrel, Colorado squawfish, Colorado wound fin, yellowfin, madtom, Guam rail, and Black-footed ferret (Wyoming).

The case history of the introduction of red wolves to the Alligator River NWR has been summarized by Parker and Phillips (1991). This case, as well as that of the black-footed ferret, provide valuable examples for the reintroduction of wood bison because refuge or other federal land was involved to a large extent. These successful programs point out the value of "nonessential" status on other than NWR or NPS lands, where federal agencies are required only to confer informally with the FWS on activities that may affect the populations. However, regardless of the finding of essential or nonessential, individuals of an experimental population are treated as threatened for purposes of taking (Section 9, Prohibited Acts). This provides that prohibited acts can be identified on a case by case basis, with FWS defining them in ways that do not disrupt activities of local citizens or unnecessarily jeopardize public support for recovery programs. Based on a review of congressional intent and the application of Section 10 (j) elsewhere, it is not clear whether language in a cooperative management plan for wood bison and in the special rule establishing the law governing the reintroduction could provide for the harvest of wood bison on private lands at the appropriate time. However, previous applications have not involved species with the high utilitarian value of bison in an area where reliance on local resources is as important as in many parts of Alaska. This issue requires clarification.

Parker and Phillips (1991) concluded Section 10 (j) of the ESA was helpful for the introduction of red wolves, and would be beneficial for wide-ranging species introduced into areas not designated critical habitat, or where a species may expand into nonpublic land not designated critical habitat. They also describe the process used to brief national and local organizations, governments and individuals about the proposed introduction and ways in which their concerns were addressed.

Precedents for NEPA Documentation in Reintroductions:

The reintroductions cited above, as well as other reintroductions in Alaska, provide an indication of the level of NEPA documentation and process that would be appropriate in connection with a wood bison reintroduction. Pertinent examples include the following:

1. Introduction of red wolves as experimental/nonessential to the Alligator River National Wildlife Refuge, North Carolina. An environmental assessment (EA), accomplished in accordance with NEPA, concluded the introduction would not significantly affect the quality of the human environment within the meaning of Section 102 (2)(c) of NEPA, and an EIS was not required. The initial reintroduction occurred in 1987.

2. Reintroduction of black-footed ferrets in Wyoming and in north central Montana. These programs involved the preparation of an EA, state cooperative management plans developed in cooperation with FWS or BLM, and preparation of a special rule by FWS establishing reintroduced populations as

experimental/nonessential. The state management plan is referenced in the special rule as the document which will guide management of ferret populations.

3. Reintroduction of wolves to Yellowstone. This prospective program has required the preparation of an EIS because of substantial opposition from livestock owners and other resource users in areas adjacent to the park. It is likely that if the reintroduction is carried out, a special rule establishing it as an experimental population will be established.

4. Reintroduction of caribou to the Kenai National Wildlife Refuge. This reintroduction occurred in 1985-86 after the preparation of an informal EA and proposal and a cooperative agreement between ADF&G and FWS.

5. Reintroduction of caribou to the Togiak National Wildlife Refuge. Caribou were successfully reintroduced on the Togiak Refuge in 1988 following an informal EA and proposal, and the development of a cooperative agreement between ADF&G, FWS and village councils in three communities in the area. A cooperative management plan developed by ADF&G and FWS is in the final draft stage.

6. Introduction of elk to southeast Alaska. Elk were transplanted to Etolin Island in the Tongass National Forest in 1987 following an EA and a Memorandum of Understanding between the U.S. Forest Service and ADF&G to confine any resulting herd to certain islands in southeast Alaska. Elk are not native to southeast Alaska.

7. Introduction of Canada geese to Kodiak. Vancouver Canada geese were introduced to Kodiak and Shuyak Islands on Kodiak National Wildlife Refuge and Alaska State Park Lands in 1986. There was no evidence of prior occurrence of resident Canada geese. An Environmental Assessment (EA) was prepared by ADF&G with cooperation from FWS, which published the EA and obtained public comment. The introduction was determined to be consistent with refuge policies, and the process resulted in a Finding of No Significant Impact, allowing the program to proceed.

The criteria and precedents reviewed above, indicate an EA would be the appropriate NEPA document for a wood bison reintroduction. Such a program does not fit the EIS criteria reviewed above, even with reference to introductions. Establishment beyond the project area is very unlikely because the Yukon Flats is surrounded by extensive uplands that are not suitable habitat for bison. It is well established that wood bison inhabited the Yukon Flats for several thousand years. Regarding the level of uncertainty or unique or unknown risks, the experience gained with wood bison in similar habitat and their long coexistence with people and the environment indicates the possibility of unforeseen negative effects is virtually nonexistent.

The only development that could eventually create the need for an EIS would be the existence of substantial public opposition.

Despite fairly widespread public awareness of the fact that ADF&G is considering the possibility of reintroducing wood bison, there is little evidence of opposition. To the contrary, people representing a variety of lifestyles and persuasions have expressed interest in the possibility, a desire to remain apprised of progress in outlining possibilities and technical problems, and some concerns about potential ramifications of such a program. The level of concern expressed to date, or likely to occur in the future, is certainly minor in comparison with controversy surrounding the reintroduction of wolves to Yellowstone. As was the case with the reintroduction of red wolves to North Carolina and Black-footed ferrets in Wyoming, a thorough EA concerning the reintroduction of wood bison to the Yukon Flats should result in a Finding of No Significant Impact (FONSI), allowing the program to go forward without on EIS.

Convention on International Trade in Endangered Species and Wild Flora and Fauna:

Wood bison are included on Appendix I of CITES. This means the State of Alaska will be required to obtain a CITES import, and Canada will have to obtain a CITES export permit. Obtaining CITES permits can be a time consuming process and it appears that several months or more will be required to obtain the necessary permits. Classification on Appendix I means that commercial trade is restricted.

Under Appendix I it is possible to arrange for legally taken trophies or animal parts to be transported from the "range state" to the recipient CITES party. This requires an agreement between these parties and the preparation of matched import and export permits. For example, a recent agreement between Canada and the European Economic Community - CITES Working Group allows for the export to European countries of up to 60 trophies from wood bison taken in Canada by foreign hunters.

MAJOR STEPS NECESSARY TO ACCOMPLISH A REINTRODUCTION

A number of steps would be required to accommodate social, legal and technical needs associated with reintroducing wood bison. These are listed below in the general order in which they would occur, but several activities would often be ongoing at the same time.

1. Feasibility Assessment: The present document is intended to serve as a source of information for agencies, other government decision-makers, and members of the public in evaluating the potential reintroduction of wood bison.

2. The FWS and ADF&G will assess the possibility in terms of various legal and policy mandates, their responsibilities relative to the management of Alaska's wildlife endangered species, and conservation benefits.

3. These agencies would prepare an EA or an EIS and conduct a public process as outlined in NEPA. A final document would follow public comment.

4. An extensive public information effort would be required to inform local, state, and national interests of the potential for a reintroduction, obtain public comment, and address concerns. This would include both formal and informal discussions with residents of the Yukon Flats villages, local governments, and land owners.

5. A citizens working group could be established to prepare a cooperative management plan to guide the long-term management of wood bison on the Yukon Flats. This group would include representatives of local governments and communities as well as other Alaskan interests. Cooperative management plans recently prepared for Seward Peninsula muskox and the Kilbuck caribou herd could serve as models for a wood bison management plan.

6. The FWS would prepare a special rule classifying wood bison on the Yukon Flats as an experimental/nonessential population, referencing Alaska's cooperative management plan as the managing document for the population. The final rule would be published after public review and comment.

7. The state of Alaska and the Canadian government would obtain the necessary CITES permits.

8. Arrangements for transportation of wood bison to Alaska would be made with the U.S. State Department, U.S. Customs, and Alaska Department of Environmental Conservation.

9. A release site would be selected and temporary enclosure and camp constructed.

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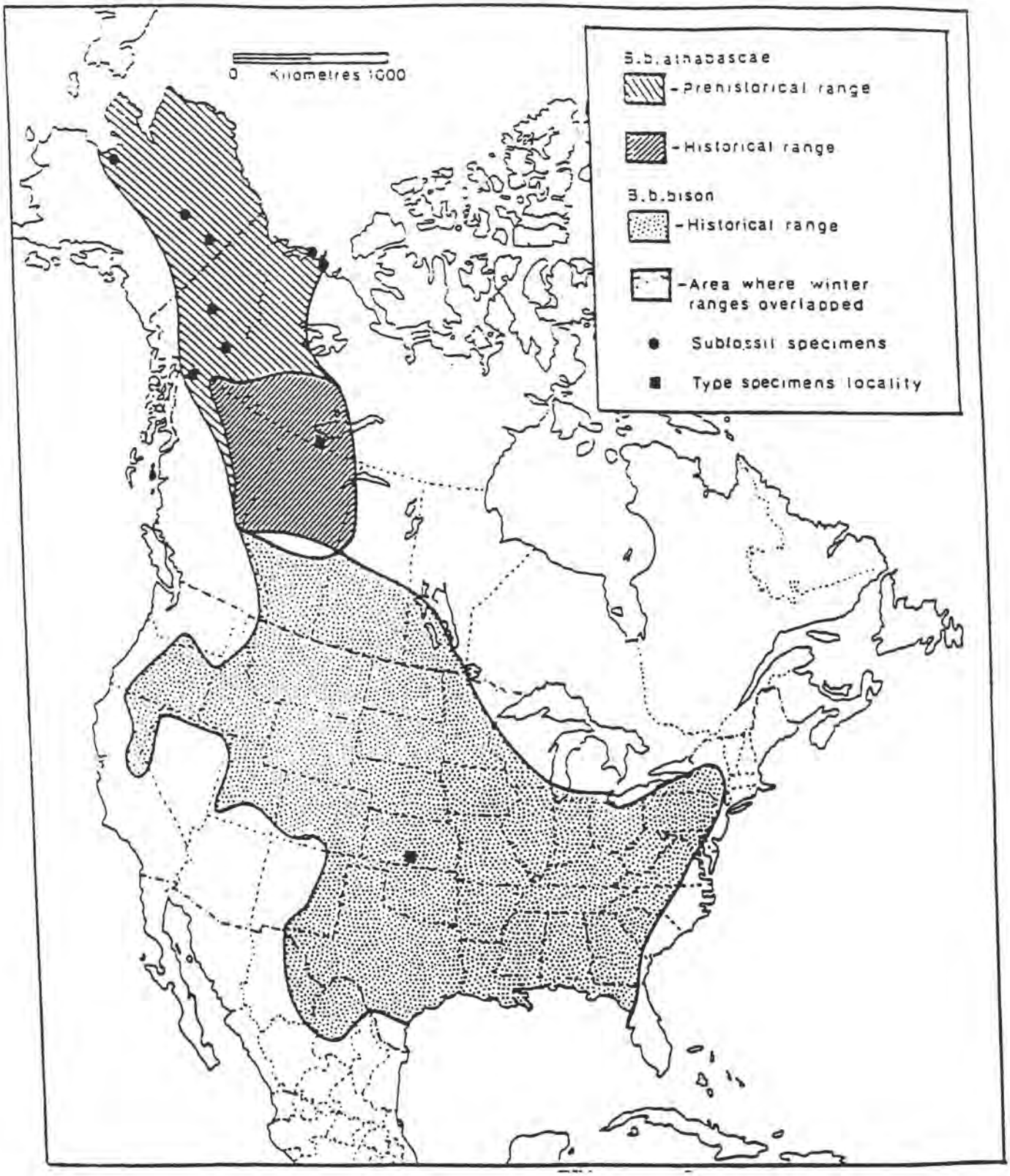


Fig. 1. Historic and prehistoric distribution of wood bison (*Bison bison athabascae*) and historic range of plains bison (*Bison bison bison*), after van Zyll de Jong (1986).

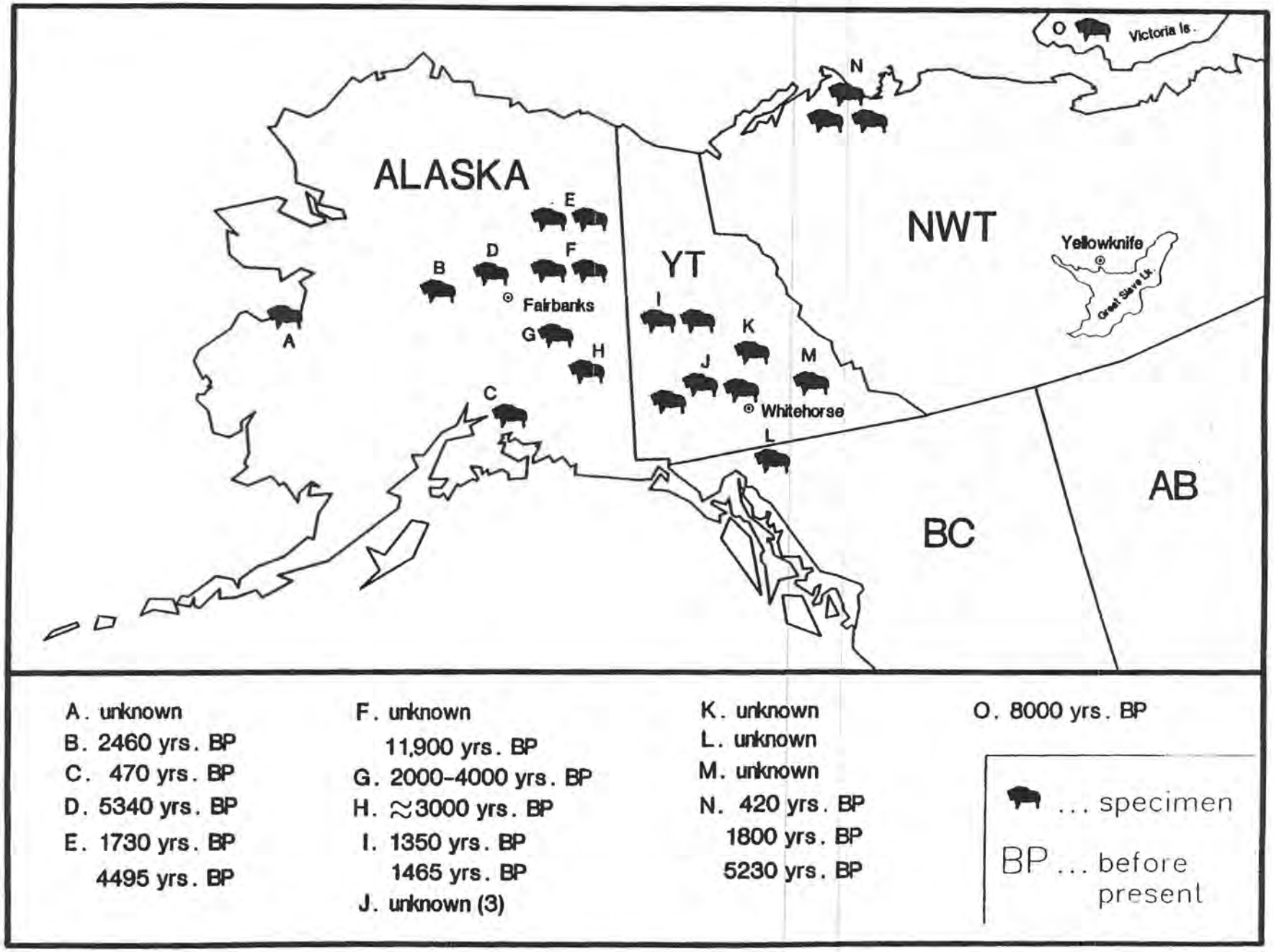


Fig. 2. Location and radio-carbon dates for specimens of recent bison in Alaska and adjacent Canada.

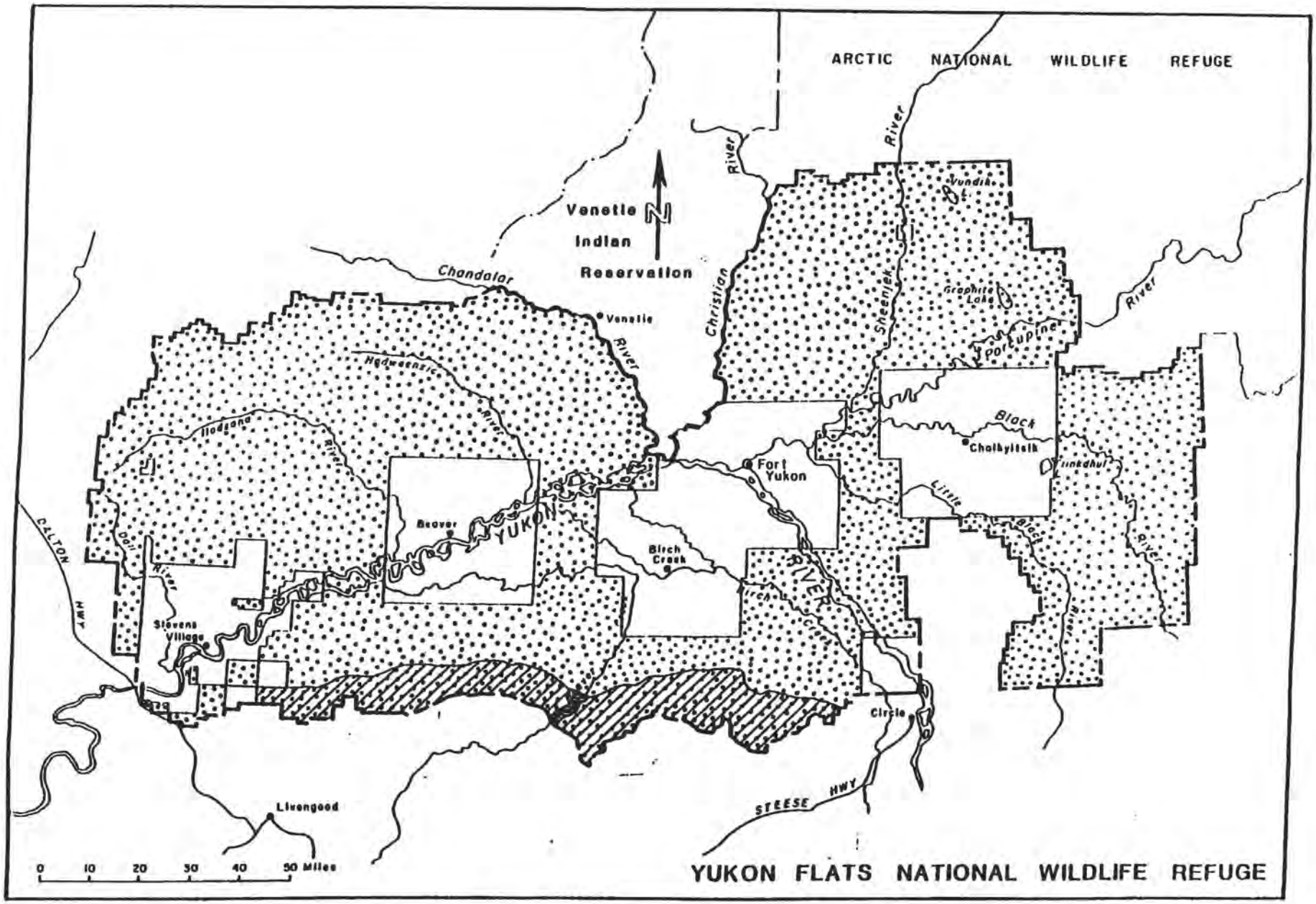


Fig. 3. Land ownership in the Upper Yukon Basin. Native selected or conveyed lands within refuge boundaries are shown in white.

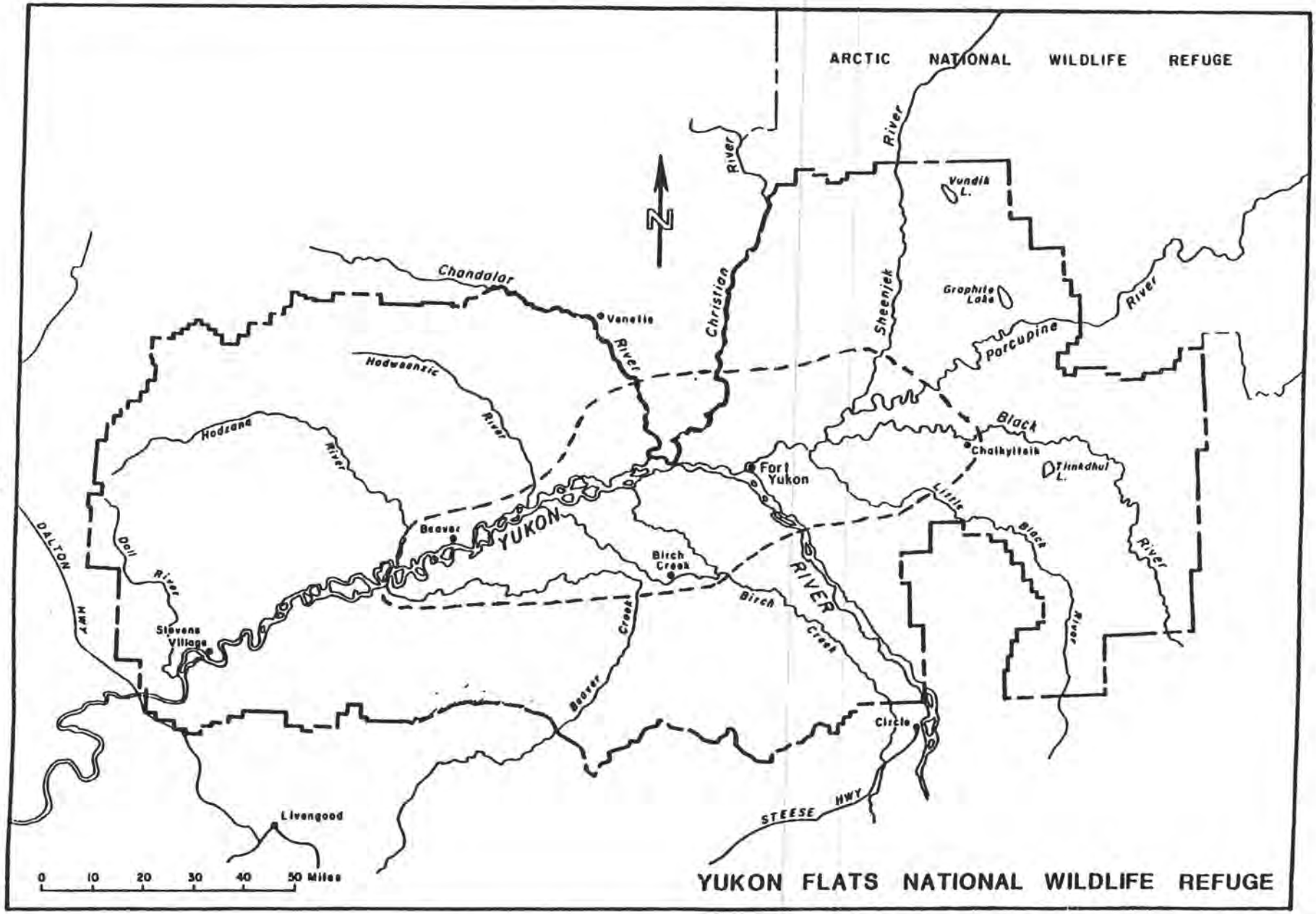
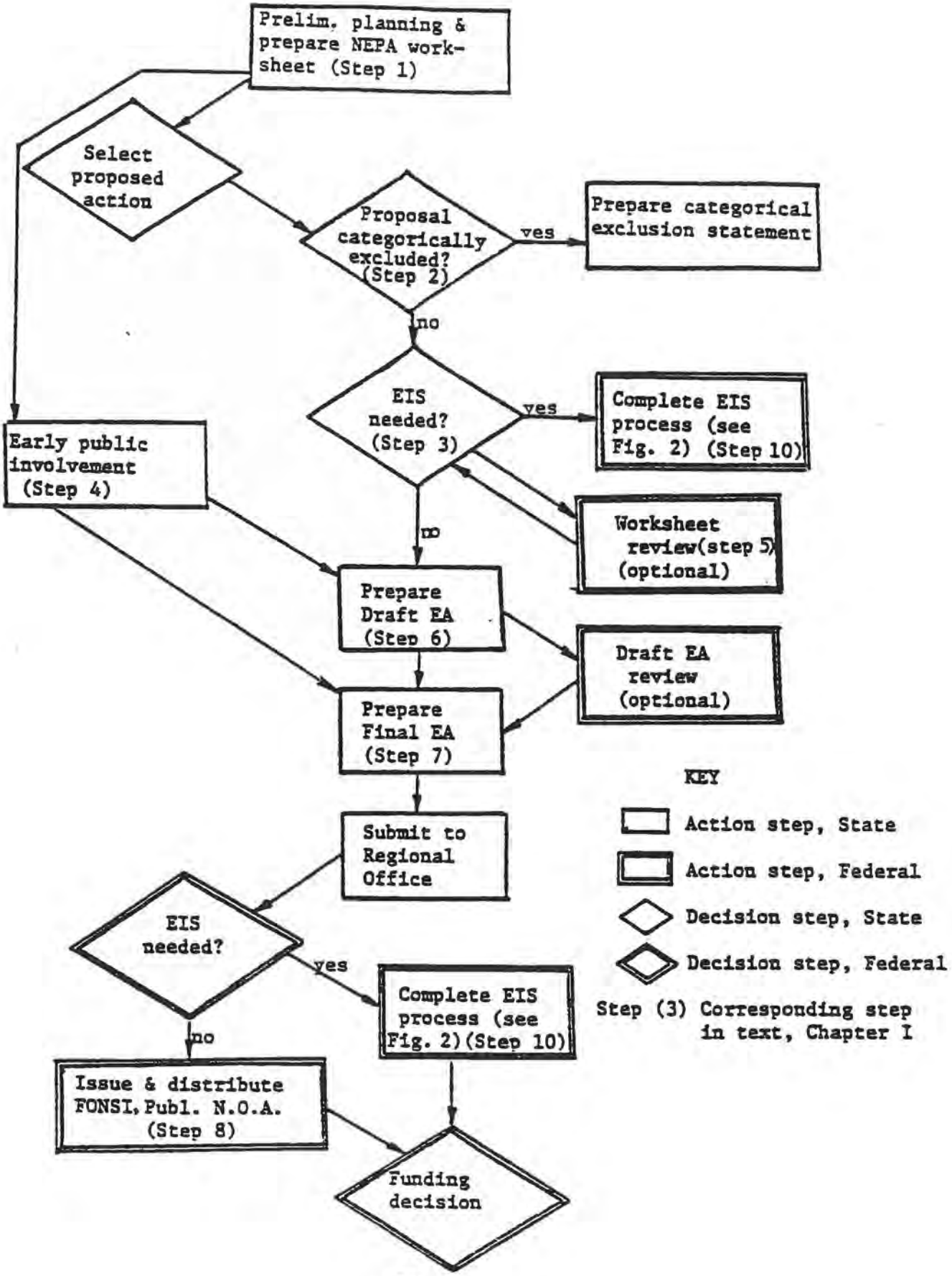


Fig. 4. Approximate boundary (- - -) of area including potential wood bison range on the Yukon Flats and boundaries of the Yukon Flats National Wildlife Refuge.

Fig. 5. Incorporating NEPA into project planning.



Appendix A. Historical snow accumulation (in inches) data in interior Alaska during March and April (Soil Conservation Service, Anchorage, Alaska).

SNOW COURSE: BLACK RIVER (DISCONTINUED)

ID NUMBER = 42R01
ELEVATION = ft.
LATITUDE = deg. min.
LONGITUDE = deg. min.

REMARKS -

year/	January			February			March			April			May		
	date	dep	swe	date	dep	swe	date	dep	swe	date	dep	swe	date	dep	swe
65							3/09	21	3.4	EST	21	4.0			
66							3/11	23	3.0	4/07	21	3.8			
67							3/07	23	3.8	4/08	26	4.8			
68							3/04	27	5.4	4/02	21	4.7			
69							3/04	15	2.4	4/02	16	2.7			
70							3/04	16	2.3	4/06	15	2.9			
71							3/06	28	4.9	4/03	29	5.5			
72							3/02	27	5.5	4/06	30	6.0			
73							2/28	22	4.3	3/28	25	5.2			
74							2/26	17	2.0	3/28	15	2.5			
75							2/26	27	5.3	3/28	26	5.2			
76							2/25	19	2.9	3/29	22	3.9			
77							2/25	25	3.8	3/30	29	7.3			
78							2/28	17	2.4	3/29	17	3.0			
79							2/27	19	3.4	3/27	24	4.1			
80							2/26	18	3.0	3/26	17	3.0			
81							EST	16	2.8	3/31	20	3.3			
82							2/25	16	2.9	3/26	16	3.3			
83							2/23	18	2.5	3/29	16	3.3			
84							3/02	19	2.6	3/26	19	3.4			
85							2/25	20	2.9	3/25	20	3.9			
86							3/05	21	2.5	4/01	19	2.9			
FIRST OF MONTH MEASUREMENTS															
average depth and swe :								21	3.4		21	4.0			
years	0	0		0	0			22	22		22	22		0	0
1961-1985 average :								21	3.4		21	4.1			
years	0	0		0	0			21	21		21	21		0	0

Appendix A. Continued. SNOW COURSE: FORT YUKON

ID NUMBER = 45R01
ELEVATION = 430 ft.
LATITUDE = 66 deg. 35 min.
LONGITUDE = 145 deg. 12 min.

REMARKS - IN SMALL OPENING WITHIN DENSE ASPEN AND WILLOW GROVE. NO WIND EFFECTS.

year/	January			February			March			April			May		
	date	dep	swe	date	dep	swe	date	dep	swe	date	dep	swe	date	dep	swe
64							EST	17	2.8	EST	17	3.0			
65							3/11	24	3.6	EST	24	4.4			
66							3/12	19	2.5	4/ 8	18	3.1			
67							3/ 7	21	3.2	4/ 8	27	4.9			
68							3/04	17	3.1	4/02	16	3.1			
69							3/04	12	1.6	4/02	13	2.0			
70							3/03	15	2.5	4/06	16	3.1			
71							3/05	26	4.4	4/03	25	5.4			
72							3/02	23	4.2	4/06	25	4.7			
73							2/28	20	3.2	3/28	22	4.7			
74							2/25	15	2.0	3/28	15	2.5			
75							2/26	25	4.9	3/28	24	4.9			
76							2/25	19	2.6	3/28	17	3.0			
77							2/24	24	3.4	3/30	24	5.5			
78							2/27	17	2.9	3/28	19	3.3			
79							2/27	18	3.3	3/27	26	4.1			
80							2/25	16	3.0	3/26	14	3.0			
81							EST	17	2.7	3/30	17	3.3			
82							2/26	18	3.0	3/26	19	3.6			
83							2/24	20	3.1	3/28	18	3.2			
84							3/03	22	3.3	3/27	22	3.6			
85							2/27	20	2.7	3/26	19	3.6			
86							3/06	14	2.0	4/02	16	2.6			
87							3/08	16	2.4	3/31	16	3.0			
88							EST	18	3.0	3/29	20	3.8			
89							EST	14	2.2	3/21	14	2.2	4/19	8	2.0
90							EST	26	4.4	4/05	24	4.9			
91							2/27	20	3.6	EST	23	4.6			
92											22	4.8			
FIRST OF MONTH MEASUREMENTS															
average depth and swe :								19	3.0		20	3.6		8	2.0
years	0	0	0	0				26	26		27	27		1	1
1961-1985 average :								19	3.1		20	3.7			
years	0	0	0	0				22	22		22	22		0	0

Appendix A. Continued.

SNOW COURSE: CIRCLE CITY

ID NUMBER = 44Q03
ELEVATION = 600 ft.
LATITUDE = 65 deg. 50 min.
LONGITUDE = 144 deg. 4 min.

REMARKS - POORLY DRAINED SEMI-OPEN AREA ADJACENT TO BLACK SPRUCE FOREST. NO WIND EFFECTS.

year/	January			February			March			April			May		
	date	dep	swe	date	dep	swe	date	dep	swe	date	dep	swe	date	dep	swe
65							3/09	21	3.3	EST	21	3.8			
66							3/10	21	2.7	4/07	19	3.0			
67							3/08	28	4.4	4/09	25	5.2			
68							3/04	24	4.7	4/02	24	4.5			
69							3/05	15	2.1	4/03	19	2.9			
70							3/05	16	2.3	4/03	14	2.7			
71							3/06	38	6.5	4/03	36	7.1			
72							3/02	26	5.1	4/05	27	5.5			
73							2/28	20	3.3	3/28	24	4.6			
74							2/26	20	2.5	3/27	19	2.8			
75							2/26	31	6.5	3/27	32	6.4			
76							2/26	18	2.7	3/29	22	4.0			
77							2/27	30	3.6	3/30	29	5.1			
78							2/28	22	3.3	3/29	23	4.1			
79							2/27	26	4.4	3/27	35	5.9			
80							2/26	21	3.4	3/27	21	3.7			
81							EST	17	2.8	3/31	20	3.3			
82							2/25	26	4.1	3/26	26	4.4			
83							2/23	25	3.6	3/27	25	4.2			
84							3/ 2	25	3.2	3/26	25	3.8			
85							2/26	28	4.0	3/25	28	5.0			
86							3/05	22	2.3	4/02	20	3.0			
87							EST	20	2.7	EST	20	3.2			
88							2/29	26	3.9	3/29	28	4.7			
89							EST	21	3.5	4/01	21	3.5			
90							3/03	35	5.9	3/31	31	6.6			
91							2/28	29	5.0	4/01	32	6.1			
92							2/27	30	9.3	3/29	29	4.7			
FIRST OF MONTH MEASUREMENTS average depth and swe :								24	3.7		24	4.3		21	3.5
years	0	0	0	0				26	26		26	26		1	1
1961-1985 average :								24	3.7		24	4.4			
years	0	0	0	0				21	21		21	21		0	0

Appendix A. Continued.

SNOW COURSE: VENETIE

ID NUMBER = 46S01
ELEVATION = 610 ft.
LATITUDE = 67 deg. 3 min.
LONGITUDE = 146 deg. 25 min.

REMARKS - AERIAL MARKER: ADJACENT TO WINTER TRAIL AMONG SCATTERED SPRUCE FOREST. LITTLE TO NO WIND EFFECTS. GROUND SURVEYED IN EARLY YEARS.

year/	January		February		March			April			May		
	date	dep	swe	date	dep	swe	date	dep	swe	date	dep	swe	date	dep	swe
64							EST	12	2.2	EST	12	2.2			
65							3/10	17	2.7	EST	17	3.1			
66							3/12	18	2.6	4/08	18	3.2			
67							3/06	18	2.6	4/07	20	3.4			
68							3/05	17	3.1	4/03	16	3.1			
69							3/03	12	1.8	4/01	11	2.1			
70							3/03	9	1.3	4/03	9	1.5			
71							3/05	22	3.6	4/02	18	3.5			
72							3/01	17	2.6	4/05	19	3.3			
73							2/27	20	3.2	3/27	20	3.7			
74							2/25	16	2.3	3/27	15	2.6			
75							2/25	17	2.6	3/27	18	2.9			
76							2/24	19	2.6	3/27	17	3.0			
77							2/24	24	3.2	3/29	22	4.4			
78							2/27	19	2.9	3/28	21	3.4			
79							2/25	18	2.9	EST	20	3.3			
80							EST	18	2.9	3/27	16	2.9			
81							EST	16	2.9	3/30	15	2.7			
85							2/27	19	2.7	3/29	18	3.4			
86							3/06	10	1.2	4/02	15	2.1			
87							3/08	21	3.3	3/31	19	3.5			
88							EST	18	2.8	3/29	20	3.9			
89							EST	18	2.5	3/22	18	2.5	4/19	8	2.0
90							EST	20	3.2	3/27	19	3.6			
91							EST	18	3.2	EST	20	4.0			
FIRST OF MONTH MEASUREMENTS average depth and swe :								17	2.6		17	3.1		8	2.0
years	0		0	0		0	0	23	23		24	24		1	1
1961-1985 average :								17	2.7		17	3.0			
years	0		0	0		0	0	19	19		19	19		0	0

Appendix B. Letter sent by ADF&G and responses from U.S. and Canadian biologists regarding the reintroduction of wood bison to Alaska.

DEPARTMENT OF FISH AND GAME

1300 COLLEGE ROAD
FAIRBANKS, ALASKA 99701-1599

July 28, 1993

Dr. C. G. van Zyll de Jong
Canadian Museum of Nature
PO Box 3443, Station D
Ottawa, Ontario
Canada K1P 6P4

Dear Dr. van Zyll de Jong:

In recent months I have discussed with you the idea of reintroducing wood bison to the Yukon Flats area in Alaska. The Alaska Department of Fish and Game, members of the public, and other agencies continue to study this possibility, and there is a growing level of interest. However, questions continue to be raised about certain issues, and I would like to ask you to respond, at whatever length you feel appropriate, to what seem to be the most important concerns. Your opinions will be helpful here because of your knowledge and experience. There are 3 general areas where your comments would be especially helpful.

1. While it is accepted the wood bison once occurred on the Yukon Flats, there will probably be some debate as to whether they should be regarded as a native or an exotic species. At present only one radiometric date for a local specimen is available (1,730 $\pm$ 60), but other dates of 400-500 years in Alaska and adjacent Canada and recently obtained oral histories suggest bison persisted until more recently. Alaska was not originally included in the map of "historic" range for the subspecies. For obvious reasons there are no contemporaneous written accounts referring to bison, but there are now oral accounts of their being present and hunted by native people.

What are your thoughts as to whether wood bison have a legitimate place in Alaska's fauna as a reintroduced species. While recognizing the semantic difficulties, how do you regard the idea of reestablishing wood bison relative to the issues of naturalness, natural diversity, historic versus protohistoric occurrence, and ecological appropriateness in general.

2. At present there is virtually no grazing by ungulates on the Yukon Flats, although grasses and sedges are relatively abundant. The area supports substantial numbers of breeding waterfowl (see attached table) as well as beaver, muskrats, and other furbearers such as lynx, marten, and red fox. Moose are widespread but, despite excellent range and low snowfall, exist at chronically low densities ranging from 1 moose per 5-10 square miles in most of the area.

There is a concern that wood bison could have a negative impact on (1) waterfowl nesting (see attached letter from USFWS biologist P. Heglund) by

disturbing nests, altering nesting cover, or affecting water quality and (2) moose through indirect effects on predator populations.

Can you respond to these concerns, particularly the likelihood of adverse effects on waterfowl.

3. In terms of its contribution to the conservation of bison, genetic diversity, and North American fauna in general, how do you regard the establishment of at least a minimum viable population (roughly 500 animals) of free-ranging wood bison in Alaska .

I thank you in advance for any information you can provide that will shed light on these issues. Your response can be forwarded to me at the above address.

Sincerely,

Robert O. Stephenson
Wildlife Biologist
Division of Wildlife Conservation
(907) 456-5156

Enclosures

Zoology Division *
P.O. Box 3443, Station D
Ottawa, Ontario, Canada
K1P 6P4

Division de la Zoologie *
C.P. 3443, Succursale D
Ottawa, Ontario, Canada
K1P 6P4

Canadian Museum of Nature
Musée canadien de la nature

30 November 1993

Robert O. Stephenson
Wildlife Biologist
Division of Wildlife Conservation
Department of Fish and Game
1300 College Road
Fairbanks, Alaska
99701-1599

Dear Mr. Stephenson:

I apologize for the delay in responding to your letter of July 28, regarding the idea of reintroducing wood bison to Alaska. Personal circumstances prevented me from attending to this matter earlier.

As you know, the IUCN Bison Specialist Group recommended the reintroduction of the wood bison to Alaska in its Action Plan, which will be published next year. The rationale for the recommendation was based on subfossil evidence that this northern bison, until recently, had a distributional range extending much farther west and north than at present. It included most of Alaska, the Yukon and the western part of the Northwest Territories as far west as the Bering Strait and as far north as southern Victoria Island. In view of the absence of written reports from the area, the distribution is technically referred to as prehistoric, but radiocarbon dates indicate that bison were present in this general as recently as between eleven and twelve human generations ago. A second consideration that led to the recommendation was that significant portions of the historic range of the wood bison further south are compromised by anthropogenic factors or disease and are therefore not available for reestablishment of wood bison.

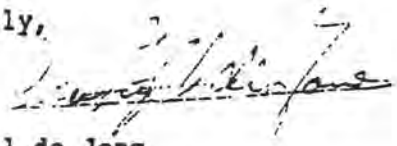
In my opinion the reintroduction of the wood bison to Alaska would be entirely appropriate and would reestablish a form indigenous to the area for most of the Holocene. The wood bison's temporary absence from Alaska, in my view does not make it an exotic.

From an ecological perspective, it can further be argued that the extensive areas of sedge/grass meadows of the Yukon Flats lack a grazing ungulate and thus represent an unoccupied niche. The reintroduction of wood bison to the area would enhance biological diversity and in view of the above considerations, restore it to a former level. As to the possible negative impact of the reintroduction on waterfowl in the area, I would suspect that this would be minimal. In this respect it might be useful to consider the situation in the Peace/Athabaska Delta in Wood Buffalo National Park. This delta supports a large population of bison and is at the same time one of the most productive nesting areas for waterfowl.

In conclusion, I would say that the reintroduction of wood bison to Alaska would be a positive contribution to the conservation of this magnificent northern subspecies, it would restore an indigenous form to the fauna and it would be an asset for Alaska.

I enclose a recent publication and a copy of a manuscript dealing with different aspects of bison, that may be of interest to you.

Yours sincerely,



C. G. van Zyll de Jong

2 encl.

Northwest Territories RENEWABLE RESOURCES

C. Cormack Gates, Ph.D.
Wildlife Management Division
P.O. Box 390, Fort Smith
NWT, Canada, X0E 0P0

29 April 1994

R.O. Stephenson
Wildlife Biologist
Alaska Department of Fish and Game
1300 College Road
Fairbanks, AK
99701-1599, U.S.A.

Fax: (907)452-6410

Dear Bob;

It is very encouraging to witness the large amount of interest in the reintroduction of wood bison into former range in Alaska. In addition to working with you and others in Alaska F&G during the past two years, I have become aware of support from the Lieutenant Governor of the State of Alaska, faculty member at the University of Alaska, the Canadian Parks Service and the Canadian Wildlife Service. It should be evident from my field trip to Alaska in August 1992 and from your meeting with the Canadian Wood Bison Recovery Team in Victoria in December 1992, that the Recovery Team strongly supports the repatriation of this animal to Alaska. The project has become one of two remaining possibilities for reestablishing free-roaming herds in North America in wilderness areas where a full range of natural selective forces will act to shape the evolutionary progress of this animal. From this point of view the most suitable locations are those where bison are located in large grassland/sedge meadow complexes in the presence of wolves.

At present there are five free-roaming wood bison populations in existence, all in Canada. Only one has so far achieved a numerical status which can be considered as self-sustaining and free of risk of extinction. The other herds number 20 to 200 head. I consider that a viable population should exceed 250 animals and that a herd of 500 animals should be well beyond risk of extinction in the long term. In northern Canada bison have suffered castastrophic losses to drowning, breaking through spring ice, and anthrax outbreaks. Because bison are gregarious such catastrophies can cause the deaths of a large number of animals at one time. Small populations are particularly vulnerable.

The extensive system of meadows in the Yukon River Flats provides an ideal ecological setting for bison and should support a population which exceeds the minimum number necessary to ensure population viability.

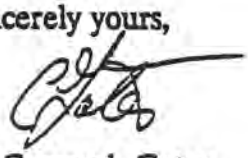
I understand there is some concern that grazing by bison may have a negative impact on grassland/wet meadow plant communities and consequently on waterfowl nesting. I would expect that negative impacts will occur only at an extremely high grazing intensity. Unlike grasslands in the Great Plains Region, much of the important winter range for bison in northern Alberta and the NWT is maintained by periodic flooding or is indeed wetland. Because such areas are highly localized in the prairies they can be subject to heavy grazing. In the north, wetlands are widely distrubuted in large patches and grazing activity is more evenly distributed. I have seen evidence of heavy grazing by bison in the Mackenzie population at a density of 4/km^2 of primary habitat. At a density of 0.4 bison/km^2, seen in the Slave River Lowlands and in Wood Buffalo National Park, little evidence of grazing is detectable. I would expect that a population of 500 bison in an area the size of the Yukon River Flats would exert little measurable influence on plant communities. One should also consider possible positive effects of grazing. At present grazing herbivores are absent from grassland/wet meadow areas in the Alaskan Interior. In the absence of grazing our research has shown that floristic species richness and productivity is less than in the presence of moderate levels of grazing (Smith, D. 1990. The impacts of wood bison grazing on a sub-hygric shrub meadow plant community type, Mackenzie Bison Sanctuary, Northwest Territories. M.Sc. thesis, University of Alberta, Edmonton). I predict that rather than having a negative impact, the reintroduction of wood bison at low to moderate densities should result in an increase in the productivity and species richness of grassland/sedge communities. Other ecosystem changes can be expected as well. For example, I would expect to see increases in avian species which thrive in more productive grasslands, and more abundant scavenging species which feed on carrion left behind by predators.

The reintroduction of wood bison into the Fort Providence area in the NWT in 1963 was anticipated at the time to eventually result in economic opportunities for the local aboriginal community. This has transpired. The community now enjoys the benefits of increased ecotourism; "bison creeps" are organized for tourists wishing to photograph or view bison at close proximity. Hunting was initiated in 1988 and now provides subsistence harvesting opportunities to residents and revenue into the local economy from trophy hunting. Trophy hunting gained international profile this year when two German hunters harvested bulls while they were accompanied by trained Native guides from Fort Providence. Last year the European Economic Community, C.I.T.E.S. Working Group approved the issuance of import permits for trophies taken from the Mackenzie population.

I view the reintroduction of wood bison into the wild in Alaska as an exceedingly important conservation initiative for this subspecies. Canada has practically achieved recovery within its boarders to the full extent possible under present constraints. The

current issue of the management of diseased herds in northern Canada persists as the single greatest constraint to further recovery here. Diseased herds are declining or have stabilized at low densities where they are subject to stochastic extinction events and processes. While we hope that all reintroduced healthy populations will eventually grow to a viable size, there is no certainty that this will occur. There is a continuing need to establish additional populations within traditional range areas to dilute the impact of losing any one herd to castrophies, be they natural or human-caused. The proposal to reintroduce wood bison into Alaska shows uncommon foresight at a time when biodiversity in many other ecosystems is suffering from the impacts of human activities.

Sincerely yours,



C. Cormack Gates
Chairman, Wood Bison Recovery Team

Department of Renewable Resources (403)872-4242 FAB#:.(403)872-4250

Northwest Territories Inuvik Region

MUSKOX/BIOLOGIST
RENEWABLE RESOURCES
GOVERNMENT OF N.W.T.
INUVIK, N.W.T. X0E 0T0

September 17, 1993

Dr. Robert Stevenson
Wildlife Biologist
Division of Wildlife Conservation
Alaska Department of Fish and Game
1300 College Road
Fairbanks, AK 99701-1599

Dear Bob:

This letter is in response to your letter dated 28 July, 1993. I apologize for the delayed reply, but I was conducting field work on Banks Island this summer and did not return to my office in Inuvik until the beginning of September. Prior to starting work in Inuvik at the start of this year, I spent most of the past 7 years working with wood bison in the Mackenzie Bison Sanctuary as part of my Master's and Doctoral research program with the University of British Columbia. I previously completed my undergraduate career at the University of Alaska - Fairbanks. Most of my graduate research was directed toward the plant herbivore interaction and how the interaction changed with varying herbivore densities. I measured changes, both in meadow community composition and standing crop, in two major meadow communities, and documented standing crop changes in four other major habitat types in the area. I am aware that your agency is pursuing the possibility of reintroducing wood bison to the Yukon Flats area. I wholeheartedly support the reintroduction of wood bison and believe the benefits associated with an introduction far outweigh any costs that have been put forth by other agencies. My comments on the three general areas you have outlined in your letter will hopefully substantiate my stance on the proposed reintroduction.

1) I believe wood bison definitely have a legitimate place in Alaska's fauna. Their reintroduction can by no stretch of the imagination be considered as that of an exotic species. Bison have historically been present in the Alaskan flora for thousands of years. The fact that recently they have been absent from Alaska is most likely related to slight changes in the range and distribution over northern North America. These changes do not respect political boundaries. Reintroduction of wood bison to Alaska represents reestablishing bison in parts of their traditional range. This proposed reintroduction parallels those earlier reintroductions of muskox to a number of areas in North America and Greenland.

   The push for presence of this large grazing mammal in the northern boreal ecosystem is akin to a similar push for increasing the presence of plains bison in a number of the southern states. I recently returned from the First International Bison Conference in LaCrosse Wisconsin and was amazed at the depth of support from native peoples,

ranchers, and the general public for the return of plains bison and to a more natural diversity in the grazing grasslands ecosystems. Not only do the lay people portray these changes as an appropriate way to return to a more natural ecological state, but conservation biologists and geneticists see the establishment of an increasing number of populations of rare species as a key to their continued survival. Of course one cannot look blindly at the well being of one species without considering potential detriments to other species already inhabiting the ecosystem. Will there be competition for food or space and if so to what extent and what will the impact be? The lack of a large resident herbivorous grazer in Yukon Flats area bodes well for a diminished impact.

2) It is difficult to predict with certainty what the impact of a bison reintroduction to the Yukon Flats will be on the current fauna. Historically, migrant nesting birds and other smaller grazers have coexisted with bison. In the Mackenzie Bison Sanctuary and area there are abundant nesting waterfowl. The numbers and diversity do not match those of the Yukon Flats, but there are substantial numbers of Northern Shovellers, Northern Pintail, Mallards, and somewhat lesser numbers of Canada Geese, Blue- and Green-winged teal, buffleheads and scaup. The number of bison to be reintroduced to the Yukon Flats is substantially smaller than those inhabiting the Mackenzie Bison Sanctuary. Over the past seven years the bison population has continued to increase to levels far exceeding those proposed for the Yukon Flats population. Although I can offer no quantifiable data on waterfowl numbers the continued presence of substantial flocks and numbers in the area would indicate a lack of any major negative impact.

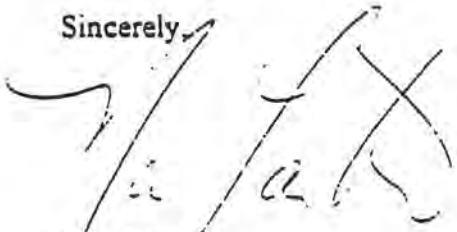
Banks Island, Northwest Territories, is a major nesting ground for snow geese, swans, and brant and currently has a muskox population of 60,000. The muskox population has shown an almost four-fold increase in the last 10 years. Muskox, like bison, are large grazers, but are even more active feeders in wet sedge meadows. The potential for negative impacts with nesting waterfowl should be at least that expected with bison. To date there has been no evidence of a major decline in waterfowl on Banks Island. The disturbance created by trampling and trails will be minor, we are not talking of Serengeti sized populations of wildebeest which can cause a major trampling impact. The presence of a small population of large grazer in the system may increase nutrient cycling and turnover, increase productivity of mesic and wet sedge meadows by reducing leaf litter and enhancing nutrient cycling (Cargill and Jefferies 1984; McNaughton 1984; McNaughton *et al.* 1988; Skarpe 1992), and actually improve nesting habitat by preventing the encroachment of conifers into dry meadow communities. All these represent positive impacts for other grazers and nesting migrants inhabiting the system. The possibility of nest disturbance must be considered in light of the number of nesting birds, the number of bison, and the negative impact to nesting birds in relation to the many other negative impacts they must face. Given a few hundred bison roaming over such a large area I would suggest the negative impact may represent the equivalent of a dozen fewer waterfowl hunters on the flyway. The fact that the Yukon Flats is subjected to recurrent incidence of fire, flooding, and drought combined with the presence of discontinuous permafrost makes some of the proposed negative impacts of bison on breeding waterfowl even more trivial in light of their overall effect on waterfowl population dynamics.

In regard to indirect effects of predators on moose populations. Moose densities in the Yukon Flats are similar to those in the Mackenzie Bison Sanctuary. Wolf numbers for the area are unknown, but in areas of high and low wolf activity moose presence in wolf scats was higher than expected given the availability of prey biomass. The potential for wolf numbers to increase given an expanded prey base is there, but the increase in prey base in the Mackenzie Bison Sanctuary and area far exceeds that proposed for the Yukon Flats and whether there has been a numerical response in the Mackenzie Bison Sanctuary and area remains to be quantified.

The target population of bison to be reintroduced into the Yukon Flats area can be achieved much easier than for smaller, more prolific breeding animals. Target levels can be set with negative impacts for waterfowl, and moose taken into account and the bison population can be managed effectively for a certain level which may include hunter harvest: yet another potential benefit.

3) The preservation of species and habitats has become of great concern over the past few years. By establishing another separate herd of wood bison in their traditional range we will not only retain the genetic diversity, but will safeguard the survival of wood bison by segregating this genetic sample from potential unpredictable catastrophic events (for example an outbreak of an exotic or endemic disease, or a major drowning event) that may strike other populations. We need to have a number of viable populations dispersed throughout their traditional range, but in suitable areas. With the current disease issue in northern Canada limiting suitable sites for reintroduction, a reintroduction into Alaska shows foresight and represents an extremely prudent decision.

Sincerely,



Nic Larter
Muskox/Caribou Biologist
Inuvik Region

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December 13, 1993 C9810-113-100

Bob Stephenson, Wildlife Biologist
Division of Wildlife Conservation
Alaska Department of Fish and Game
1300 College Road
Fairbanks, Alaska U.S.A.
99701-1599

Dear Bob:

Thank you for your letter of 1 November, 1993 requesting information on the proposed re-introduction of Wood Bison into Alaska. I shall attempt to answer your questions in the order posed.

1. From the reading that I have done concerning bison in Alaska it is evident to me that they have been long-term residents of the State for many thousands of years. Their relatively recent absence (for unexplained reasons) should not automatically preclude the investigation of whether to reintroduce them or not. The skull records clearly demonstrate that bison were native to Alaska, and were indeed the most abundant grazing ungulate. To re-establish this animal into a part of its historic range is a goal which we support.

2. I have attached some information on the present, and recent data that we in EINP have collected on the parks waterfowl populations and densities as well as such colonial nesters as the red-necked grebe, double-crested cormorants, and great blue herons. As can be seen in the excerpt from Burns, et. al (1986) the park is home to (or used by) 227 different bird species. The use of seven wetland types, by 49 water-oriented birds, was documented by them, and clearly indicates that the park supports a high density of diverse wetland bird species. The red-necked grebe declined rapidly during the late 1960's and early 1970's, primarily due to the use of park lakes by power boats. With the banning of their use in the mid 1970's this species has made a significant come-back. These birds nest within a very narrow margin (from 5 to 20 m.) from the shore and should be prone to disturbance by bison, if bison were to use that part of the wetland extensively.

..... 2

Observations of bison standing up to their bellies in water along the edges of wetlands are fairly common here, but to date we have not been able to document any adverse impacts by bison upon this wetland species. Other colonial nesting birds, which rely upon wetlands directly for their well being have also not been impacted and continue to do very well here. This should empirically lead one to believe that the quality of the waters within our wetlands have not been negatively impacted by high densities of bison and other ungulates. We do not have precise density estimates for the "number" of waterfowl that nest or stage in the park, but as the graphs in our Ecosystem Status report indicate, all observed waterfowl are doing very well. Central Alberta has experienced a drought over recent years, with a significant lowering of water levels on all major lakes and secondary pond systems throughout the region. This has likely had more of a negative impact than any posed by ungulates.

As can be seen in both Blyth and Hudson (1987), and Blyth et. al. (1993), our ungulate densities have been, and continue to be very high, both in terms of actual numbers and biomass (kg/ha of ungulates). While there have been no studies specific to the inter-relationships of bison and waterfowl here, I think that the theory of high bison densities having a negative impact on the nesting success of waterfowl is not of significant concern. I apologize for sending a rough draft of the 1993 Ecosystem Status Report, and will forward on to you the final version once it is completed. It contains the information concerning ungulate densities that you requested for recent years, and Blyth and Hudson (1987) contains all of our historical information. Both documents should be of use to you.

In addition we have been monitoring the quality of our park waters for several years, and to date have not been able to document higher than normal fecal coliform levels, even in wetlands immediately adjacent to our bison holding facilities. While the build up of feces on or adjacent to ponds and wetlands will have an effect on the growth of the associated vegetation, we view this change as beneficial rather than detrimental. All of our ponds and lakes are atrophic and several can be classed as hyper-atrophic, but this is natural for this part of the aspen parkland, and is not considered to be a cause and effect relationship with our high ungulate densities. Lakes outside the park, but close to it, have similar ecologies.

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3. I do not believe that wood bison have much of a concern over whether they reside in the Yukon, or Alaska, or the N.W.T. International boundaries are a human concern, and when it comes to restoring a species to its former pre-European range, man should attempt to do so, and should not be concerned with international politics, particularly so if the extirpation was induced by man. From that point of view the Alaskan proposal has our full support.

   We support the Alaska proposal because it represents another potential home for our Threatened Wood Bison. We produce an annual surplus (surplus to our carry capacity estimates) of about 60 wood bison, and are rapidly running out of places to relocate them within Canadian historic range. Should the disease eradication program in and around Wood Buffalo National Park not proceed, our long term options are very limited. At this point we have only been able to identify two prospective transplant sites within the wood bison historic range, and both of these are very limited. This places us in the position where we will have to identify other means of removing our surplus wood bison. Other Canadian government organizations and NGO's are placing considerable pressure upon the Canadian Parks Service to not allow wood bison from Elk island to fall into private hands (i.e. the game ranching industry), until such time as they are removed from the Threatened Species list. This pressure is strong enough that they recommend we destroy our surplus wood bison and distribute the meat to needy groups, before we proceed with the sale of the animals to game farms. While this is admittedly a last resort option, should the Wood Buffalo National Park issue not be resolved, we will soon be forced to face last resort options.

I hope that this letter, and the enclosed reports will be of use to you. Should you require clarification of any point, or more information on topics not covered, please do not hesitate to call.

Sincerely,

Gary Sargent
Superintendent
Elk Island National Park
Site 4, RR 1
Fort Saskatchewan, Alberta
T8L 2N7

Canadian Museum of Nature
Musée canadien de la nature

Tel. (613) 954-0351
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November 8, 1993

Mr. Bob Stephenson
Alaska Department of Fish and Game
1300 College Road
Fairbanks, Alaska
99701-1599 U.S.A.

Dear Bob:

As a result of our phone conversation last week, I'm including some information on bison history, focusing on wood bison. I hope it may be of use in evaluating a project for reintroducing wood bison to the Yukon Flats area of Alaska.

Bison entered central Alaska from Asia about early to middle Pleistocene time-possibly during the Kansan glaciation (Péwé 1989, Harington 1984), according to fossils from the Fox Gravel near Fairbanks. Other early specimens of bison are from deposits of possible Yarmouthian Interglacial age near Baldwin Peninsula; pre-Illinoian age sediments near Fairbanks (where an age of >450,000 years on the Ester Ash Bed gives an idea of the age of bison remains in the lower part of the Gold Hill Loess) and Sangamon (?) Interglacial beds near Tofty. As no published descriptions of these fossils are available, they are best regarded as *Bison* sp.

The large-horned or steppe bison (*Bison priscus*) is the commonest species of bison found in Alaska and the Yukon - it prevailed throughout northern Eurasia and northwestern North America (often connected during glacial phases by the Bering Isthmus) during the late Pleistocene.

Northern medium-horned bison or western bison (*Bison bison occidentalis*) evidently arose from steppe bison stock in Beringia toward the close of the last glaciation. Probably warmer, moister conditions occurred there beginning about 14,000 years ago (the time of the "birch rise" in pollen diagrams of the region), and the resulting more heavily wooded terrain favoured the rise of western bison and the demise of steppe bison (Harington 1977). Western bison spread rapidly southward, perhaps encountering northward-shifting herds of southern medium-horned bison (*Bison bison antiquus*) near the Peace River District of northern British Columbia and Alberta shortly before 10,000 years ago (Apland and Harington, in preparation). By about 9,700 years ago, western bison had reached southern Alberta (Shackleton and Hills 1977). Apparently pockets of western bison survived near the eastern flanks of the Rocky Mountains until about 3,000 years ago (Harington 1984).

I think that wood bison arose from western bison stock in northeastern Siberia and northwestern North America in the early Holocene. For example, Andrei Sher (1971) has mentioned the presence of "*Bison priscus athabascae*" from deposits dating to the close of the last glaciation or the beginning of the Holocene on the Bolshaya Chukochya River (Kolyma lowland), and I have recently obtained a radiocarbon date of about 8,000 BP on a wood bison skeleton from Victoria Island, Northwest Territories. Presumably such areas were warmer and better vegetated then (they are mainly tundra now). In 1977, as a hypothesis for testing, I suggested that the Hypsithermal (warmest period of the Holocene, then thought to be about 7,000-5,000 BP) placed relatively great and sudden stress on medium-horned bison herds, leading to the evolution of the small- horned plain bison (*Bison bison bison*) a subspecies adopted the life on the arid grasslands of western North America, and the small-horned wood bison (*Bison bison athabascae*) in more northerly areas, where they remained much like their western bison ancestors, except for smaller horns. It now appears that the Hypsithermal occurred about 9,000 BP [at least in northwestern Canada (Ritchie 1987)], perhaps accounting for the earlier presence of wood bison on Victoria Island. So my earlier hypothesis needs alteration.

I consider that wood bison ranged from eastern Siberia (depending on Sher's evidence) through Alaska and the Yukon to the margin of the Beaufort Sea (Cape Bathurst area to western Victoria Island from about 8,000 to 500 BP) dying out there, but surviving most recently near Great Slave Lake in the Northwest Territories, northwestern British Columbia, northern Alberta and west-central Saskatchewan (van Zyll de Jong 1986, Fig. 36). Therefore, considering this information along with your radiocarbon dates on specimens best referred to wood bison from Alaska of about 5,340, 2,460, 1,730, and 470 BP (plus the oral accounts you mention), and my Yukon dates of about 4,880 (new date on a specimen from a high terrace near Carmacks), 1,465 and 1,350, undoubtedly wood bison did live in Alaska and the Yukon in the late Holocene. And, considering the rather precarious existence of the subspecies; it would be worthwhile to try to restore it to appropriate range in Alaska.

Mr. Stephenson
Fairbanks Alaska
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I strongly recommend an introduction of several hundred free-ranging wood bison to the Yukon Flats, realizing that perhaps no "pure" wood bison stock remains (Harington 1977), and taking every precaution against spread of disease (particularly making sure that the introduced animals are as "clean" as possible and that they would be unable to contact other captive bison herds, as well as livestock). Regarding the impact of wood bison on waterfowl, you may wish to consult Canadian Wildlife Service and GNWT biologists who have worked in Wood Buffalo National Park. Further, my support for reintroduction of "seed herds" conforms to a similar project envisioned earlier(now partly realized) for introducing muskoxen to their former range (Harington 1961 - see attached papers). Best of luck with your endeavour.

Yours sincerely,

C.R. Harington
Curator of Quaternary Zoology

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CANADA'S GREEN PLAN
LE PLAN VERT DU CANADA

Wood Buffalo National Park
P.O. Box 750
Fort Smith, N.W.T.
X0E 0P0

October 28, 1993

Mr. Robert O. Stephenson
Wildlife Biologist
Division of Wildlife Conservation
Alaska Department of Fish and Game
1300 College Road
Fairbanks, Alaska
U.S.A.

Dear Bob

Sorry for the late response but I assume better late than never. In response to you letter of July 28, 1993, I am pleased to offer my comments on your possible re-introduction program of wood bison. I will address your questions in the order you presented them.

1. If there is scientific evidence of the prior occurrence of bison, and if the aboriginal groups have an oral history of using them, then it seems clear to me that bison do have a legitimate place as a re-introduced species. I would argue that the realization of higher integrity, and the like, all require the presence of bison.

   If it could be shown that the decline and loss of bison from the area was strongly related to human impacts, then the case for re-introduction is even stronger. If the extirpation occurred in the absence of humans, then perhaps ecosystem changes led to an un-sustainable environment - supporting evidence against re-introduction. If you have proven the presence of bison as late as 1730 AD, then surely human influence was a factor in the population decline and therefore human influence has a role to play in re-introduction.

2. Bison and waterfowl coexist in the Peace-Athabasca Delta without, as far as I can see, significant negative impact on waterfowl nesting success. Long term habitat changes induced by humans (development) are of a much greater concern. Given the size of your area and the projected bison population levels, I doubt this will be a problem.

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We also have a low moose population relative to available habitat. This is attributed to high hunting pressure, although predation by wolves is also a factor. It is entirely possible that introducing bison would lead to increased wolf populations and thereby indirect effects on moose. Especially if there are initial or persistent fluctuations in the bison population. Unfortunately, this leads back into predator control and the political arena.

(3) Any established herd of wood bison is an important contribution to the genetic diversity of the species. Regardless of the eventual outcome of the woods/plains bison genetics debate, I would welcome the eventual return of wild populations of bison across the historic range.

As an aside I don't know how much consultation and support you have with your native American folk but I have found they can be powerful friends or fearfull foes. You've probably considered this but it wasn't obvious to me.

In conclusion, I apologize if I have not been able to offer much in the way of specific information. Much of what you are dealing with involves complicated issues and decision processes that we here have long been involved with. There are no simple answers, as I am sure you know.

One final point. If there had been adequate study, in the 1920's, prior to moving the plains bison to Wood Buffalo National Park, a tremendous amount of effort and expense would have been saved down the road. While hindsight is admittedly 20/20, I hope the process you are involved with allows for as much preliminary study as possible prior to implementation. If the bison have been gone from the area for 250 years, a few more won't matter.

Please give me a call if I can be of any more help, or if you would like to discuss this further. I would appreciate it if you could keep me informed as to the progress of the project, as so many of the issues you are dealing with are ones we share. Best of luck.

Sincerely yours,

Lou Comin

Lou Comin
Chief Park Warden
Wood Buffalo National Park

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Robert O. Stephenson
Wildlife Biologist
Division of Wildlife Conservation
Alaska Dept. of Fish and Game
1300 College Road
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Aug. 23,1993

Dear Bob:

In response to your letter of July 28, 1993, I would be glad to comment on the appropriateness of reintroduction of wood bison into Alaska. I have worked on fossil bison for the last 30 years in interior Alaska and am familiar with their history. As for your outlined three questions I can respond to each individually:

1. There is no question that bison are a native Alaskan species. They show up in the Alaskan fossil record at least 500,000 years ago, and judging from the relative numbers of their bones, have been the most abundant large mammal in the interior since then, despite varied Glacial-Interglacial environments. Certainly, in the late Pleistocene dating up until about 10,000 years ago their bones are more abundant than any other animal in interior Alaska. Likewise, we have a growing number of radiocarbon dates on bison material which date since that time, down until a few hundred years ago. Their remains are present in archaeological sites in the interior, such as Dry Creek near Healy and the new sites near Delta, both north of the Alaska Range. From these and other sites we know that there was a long tradition of native Alaskans hunting bison. The presence of bison in Alaska is not just a Pleistocene phenomenon, they were here up until quite recently.

Rather than seeing bison as having become recently extinct in Alaska, it is more biologically correct to see them as having contracted their range a few hundreds of miles southward, probably for complex reasons, most of which may be unknowable from the

record (weather extreme fluctuation, overhunting??). Reintroduction is then more of a recovery of bison's former traditional distribution range. As such, bison reintroduction is more analogous to the reintroduction of muskoxen on the north slope.

Bison has a legitimate place in the fauna of Alaska. As you know moose and black bears are a very recent immigrants into Alaska compared to bison. These latter are definitely a Post-Pleistocene entrants, the former from Asia and the latter from the south. The absence of any other large lowland grazer in Alaska makes bison reintroduction appropriate, as there is no other competitor. And there is no likelihood that bison will exclude moose or other extant Alaskan species, as potential bison over-wintering habitat is ecologically limited, confined to some mountain pass regions and a few river flats.

2. I cannot say with certainty how bison reintroduced into the Yukon Flats will will impact other fauna. But judging from the modest numbers which that region can ultimately support, and their lack of competition with other grazers, I think there would be little negative impact. The species that live there now year round and migrants which nest in that region have traditionally shared it with bison historically, so it is not like introducing an Australian or African alien species. In fact the eating and recycling of sedge meadows by a large grazer should result in a more rapid turn-over of nutrients, increasing available invertebrates and more digestible plants for smaller vertebrates. The disturbance produced by bedding sites, trails, etc. by a modest number of bison should increase habitat diversity on the flats which should have a generally positive impact.

As you well know, because of their large size bison are an easy species to manage, unlike other more-prolific medium or small mammals. Bison populations can be kept in the size ranges which are desired for that habitat, as there are more than ample hunters who would be willing to hunt them at their own expense during the winter.

The cool waterlogged soils of the interior produce an unusually slow turnover of nutrients which reduce species diversity and carrying capacity for vertebrates. The reintroduction of bison makes a small step in changing that. The return of this largest of Alaskan native land mammals to its traditional habitat and range legitimizes our

sense of why wilderness should be preserved and held in its wild state.

3. As you know there is a great deal of concern these days not only about the preservation of nominal existence of species but an understanding that one should also preserve their genetic diversity. For example, wild horses, *Equus przwalski,* still exist in zoos but their hold on life is marginal because the ones preserved are so inbred that numbers have failed to increase over the original 400 or so animals (due mainly to foal mortality from genetic defects of high genetic homozygosity).

Not only does the establishment of a herd of wood bison away from the extant Canadian herds help retain some of the genetic diversity, it also makes more secure the actual survival of this group by segregating it from potential sources of a new disease outbreak, or a more virile strain of an older disease. For example, black-footed ferrets in the New World are virtually extinct, while their counterparts in Asia are doing so well they are considered pests. One of the CITES recommendations for the wood bison is a dispersal of the present herds into a variety of different more isolated localities far removed from their present reduced range. A small herd in the Yukon Flats would be a major step in the segregation of those stocks. I agree with that philosophy and would recommend the reintroduction of wood bison into Alaska and specifically the Yukon Flats.

Sincerely,

Dr. R. Dale Guthrie
Professor of Mammalogy, and
Member of international CITES bison committee

Appendix C. Refuge policy manual, Section 7 RM 12, Propagation and Stocking.

REFUGE MANUAL

12. Propagation and Stocking

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12. Propagation and Stocking

12.1 Policy. The propagation and stocking of fish and wildlife on refuge lands will be permitted when such activities are in accordance with the wildlife management objectives of the refuge.

(1) The species introduced or stocked will be indigenous to the area.

(2) Consideration will be given to endangered species where a "Recovery Plan" has been developed and approved by the Director. (See to 7 RM 2, Endangered Species Management.)

(3) Data on the life history, population dynamics, behavior, habitat requirements, and general ecology of a species must be available before introductions are attempted. This includes disease studies, analysis of available habitat, population trends and dynamics , lack of response to previous habitat restoration, natural predators, inter- and intra-specific competition, and management practices along with any needed base information.

Policies pertaining to specific groups of wildlife are as follows:

A. Waterfowl and other migratory birds. Stocking will be from wild species obtained from Service propagation facilities, when available. Wild trapped birds must be disease free based upon criteria prescribed by the National Wildlife Health Laboratory. All other sources of stocking must be certified disease free, based upon examinations conducted by qualified professionals approved by the Director.

B. Upland birds and mammals. The policy for upland birds and mammals is the same as that stated for migratory birds except that introductions from any source of stock must be approved by the director of the State wildlife agency concerned and the regional director. Special provisions related to marine mammals are found in 7 RM 9.

C. Exotics. Exotics of any fish or animal species will not be stocked or released on any unit of the National Wildlife Refuge System without a thorough review of the consistency of such actions with the objectives for which the refuge is managed and a specific authorization by the Director and the director of the State wildlife agency concerned. Biological control of pest species through introduction of natural (but exotic to the refuge) predators provides one example of appropriate use of exotics; control of certain fish populations through introduction of sterile hybrids is another.

D. Threatened and endangered species. A restoration or restocking program for threatened and endangered species may be undertaken in accordance with Section 7 Consultation procedures and an approved "Recovery Plan." Refer to 7 RM 2 and 7 RM 8 for additional information.

E. Fish. Fish may be stocked on refuges under the conditions of 7 RM 10, Fishery Resources Management. Before fish are stocked on a refuge, a fishery management plan shall be completed in cooperation with the appropriate Fishery Assistance Office and approved by the regional director.

F. Other wildlife and plants. Other stockings, reintroductions, or reestablishments of reptiles, amphibians, invertebrates, or plants may be desireable. Proper knowledge, disease information, and adequate planning as mentioned earlier will be required prior to any such undertaking.

12.2 Objectives. The objectives of propagation and stocking on lands and waters within the Refuge System are:

A. To reestablish native species within their original breeding range.

B. To augment depleted native populations reduced by catastrophe, long-term habitat loss, or unusual interspecific competition.

C. To maintain desired species composition, in both numbers and diversity.

12.3 Definitions.

A. Exotic species. All species of plants or animals (including fish) not native to the United States and not presently or historically occurring in the United States except through the intervention of man, intentional or otherwise. A non-indigenous species.

B. Native species. All species of plants or animals (including fish) having originated in and being produced, growing, or living in a particular region or environment of the United States. An indigenous species.

For purposes of this chapter, any United States species outside of its contiguous recognized range as a viable, self-sustaining population, without assistance of man, is considered an introduced native species and must be addressed on a case by case basis.

C. Propagation. Producing and rearing wildlife and plants in captivity.

D. Introduction. Releasing members of a species not already present into a natural area in a free living state.

E. Reintroduction. Releasing a species into a natural area in which it had previously existed in a viable population but has since disappeared or become greatly diminished.

F. Reestablish. To restore a breeding population or to restore use of historic habitat of a species.

G. Stocking. Releasing of wildlife into a natural area; includes introduction, reintroduction, and augmentation of an existing population.

H. Put-and-take. Stocking fish and wildlife for the sole purpose of harvesting by hunting, fishing, or trapping.

I. Wildlife. All forms of non-domestic animal life. Feral animals are not defined as wildlife.

12.4 Proposals for propagation or stocking. Whenever a propagation or stocking program or project is planned for a refuge, the refuge manager will prepare a proposal for submission to higher authority for approval.

A. Content. The proposal should contain the following information:

(1) Objectives. There should be a clear, concise statement of the long-term objectives of the proposed program. These objectives should be related to the refuge objectives and the overall management program of the refuge.

(2) Justification. Include in this section a general background statement relating to the need for the proposed program, the undesirable conditions which the program will correct, and the circumstances which contributed to the development of these undesirable conditions.

Include in this section a description of the species involved and its past and present status on the selected stocking site including previous population trends, lack of response to previous habitat restoration, predator-prey relationships, and intra- and interspecific competition. Include information on the life history, population dynamics, behavior, habitat requirements, and general ecology of the species to be stocked.

(3) Nature of program.

(a) Duration of the proposed program.

(b) Facilities and personnel needed and available.

(c) Method of release.

(d) Precautions planned to prevent disease outbreaks, destruction of habitat, or threats to other wildlife populations.

(e) Plans for monitoring and evaluation.

(f) Costs of the program.

(4) Permit requirements. Describe all permits required to carry out this program and the schedule and procedures to be followed in obtaining them.

(5) NEPA compliance. Describe steps taken, or to be taken, to ensure compliance with the National Environmental Policy Act.

(6) Consultation and coordination. Describe efforts made, or to be made, in consulting and coordinating with other Federal, State, and local agencies. Document the need for endangered species Section 7 consultation. Also, document consultation with the National Wildlife Health Laboratory, or other appropriate health authority, regarding disease potential or hazard of the proposed program.

B. Preparation. Responsibility for preparation of propagation or stocking proposals lies with the refuge manager. In many cases, his role will be that of initiator and coordinator, especially with regard to fishery proposals, where the expertise of fishery personnel will be called upon for assistance. In all cases, however, the refuge manager retains administrative control.

C. Review and approval. The proposal should be submitted at least one year in advance of the anticipated starting date. The original proposal should be submitted to the regional office and a file copy retained at the refuge.

Proposals involving exotic, threatened, or endangered species will be reviewed by the regional office and, if acceptable, forwarded to the regional office to Washington for approval. All other proposals will be approved or disapproved the regional office. The signed original will be returned, if approved. Photocopies of the signed original should be retained at each review level.

D. Revisions. Any necessary revisions to the proposal shall be prepared and submitted in the same manner as the proposal itself. Only the revised portion need be submitted.

12.5 Coordination and consultation.

A. Coordination with States. Propagation and stocking activities on refuges must be coordinated with the appropriate State wildlife agency.

B. Endangered species consultation. Proposals must be reviewed for potential impact on endangered or threatened species or their critical

habitat, in accordance with Section 7 of the Endangered Species Act. Any consultation should be noted in the proposal. Refer to 7 RM 2, for additional information.

C. Consultation with National Wildlife Health Laboratory (NWHL). Releasing animals into the wild carries with it the potential for serious disease outbreaks among natural wildlife populations. For this reason, consultation with a representative of the National Wildlife Health Laboratory or Fishery Assistance personnel will be required during initial planning of the project. This consultation should be documented in the proposal.

Periodic contact with these advisors during operations should be maintained and any mortalities of unknown causes should be submitted for diagnosis as appropriate.

D. Consultation with others. The refuge manager is encouraged to consult with other Service personnel or personnel from other government or private agencies regarding the planning or implementation of the project. Any such consultation during the planning stage should be noted in the proposal.

12.6 Permits. The refuge manager is responsible for obtaining all necessary permits prior to commencement of proposed action. Included may be scientific collecting, banding, and endangered species permits.

REFUGE MANUAL

2. Endangered Species Management

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2. Endangered Species Management

2.1 Policy. The protection, enhancement, and recovery of endangered and/or threatened species will receive priority consideration in the establishment of refuge objectives and the management of national wildlife refuges. Consideration will also be given to the protection of species identified by the State as endangered or threatened.

2.2 Objectives. The objectives of endangered species management are:

A. To prevent any species of fish, wildlife or plant from becoming extinct;

B. To restore endangered or threatened fish, wildlife or plant species to a viable, non-endangered status;

C. To protect ecosystems upon which endangered or threatened species depend; and

D. To ensure that conflicts between endangered species and other wildlife management or public use programs are resolved in favor of endangered species.

2.3 Authorities. The Service's endangered species program is authorized pursuant to the Endangered Species Act of 1973, as amended. (See 1 RM 5 for complete citation.) The purposes of this Act are to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved, and to provide a program for the conservation of such endangered and threatened species.

2.4 Definitions.

A. Endangered species. Any species which is in danger of extinction throughout all or a significant portion of its range other than a species of the class Insecta, determined by the Secretary to constitute a pest, whose protection would present an overwhelming and overriding risk to man.

B. Threatened species. Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

C. Critical habitat. The specific area or areas within the geographical area occupied by the species at the time it is listed in accordance with the provisions of Section 4 of the Endangered Species Act. It is habitat in which are found those physical or biological features essential to the conservation of the species and which may require special management considerations or protection. Critical habitat also means specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the

provisions of Section 4 of the Endangered Species Act. The Secretary makes a determination that such areas are essential for the conservation of the species.

D. Recovery team. A group of experts on a particular species, appointed by regional directors, who are drawn from agencies and organizations with greatest responsibility for and expertise in each listed species. The team may include university researchers and representatives of State agencies and private conservation groups. The purpose of the recovery team is to develop a recovery plan for a species. (See 4 AM 4.2F(3), dated May 22, 1981.)

E. Recovery plan. A systematic plan of action that outlines management requirements of existing habitat, acquisition of new habitat, and the amount of research needed to ensure an increasing population of listed species. The primary objective is to bring about the removal of species from the endangered and threatened list. In some cases, the immediate goal is to prevent the imminent extinction of a species.

F. Listed species. All species determined by the Secretary of the Interior or the Secretary of Commerce to be endangered or threatened. A list of these species is published in the Federal Register. Each list shall refer to the species in scientific and common name(s) and shall specify in what portion of its range it is endangered or threatened.

G. Delisted species. Species whose numbers have increased sufficiently to permit their names to be removed from the endangered or threatened species list.

H. Section 7 consultation. A required procedure for all Federal agencies to ensure that actions authorized, funded, or carried out by them are not likely to (1) jeopardize the continued existence of endangered or threatened species or (2) result in destruction or adverse modification of the critical habitat of these species. Agencies are required to consult with the Service, under Section 7 of the Endangered Species Act implementation. (See 50 CFR 402.)

2.5 Section 7 consultation. Refuge areas designated as critical habitat or supporting listed species (even on a temporary or intermittent basis) will require Section 7 consultation if a planned action affects a listed species or its critical habitat.

A. Purpose. The purpose of Section 7 consultation is to ensure that planned actions do not jeopardize the continued existence of any listed species or result in the destruction or adverse modification of any designated critical habitat.

B. Responsibility. Regional directors have the responsibility of ensuring that Service activities and programs within their regions comply with Section 7 and accompanying regulations. Washington offices and divisions and research centers have this responsibility for actions under their direct purview.

C. Types of effects. For purposes of Section 7 review and consultation, four types of effects upon listed species or critical habitats are identified. They are:

(1) Will not affect - Consultation is not required. This decision may be made by the refuge manager. In some cases documentation may be desirable.

(2) May affect - Formal consultation is required with the regional director concerning actions which may affect a listed species or its critical habitat either adversely or beneficially.

(3) Definite beneficial effect - Formal consultation is required with the regional director if the action contributes to the conservation of listed species or their critical habitat.

(4) Definite adverse effect - Formal consultation with the regional director is required. Action must be abandoned or modified sufficiently to eliminate the definite adverse effect on listed species or their critical habitats.

D. Consultation process. The following process shall be employed to comply with Section 7 regulations.

(1) The refuge manager will review all refuge activities and programs to determine if they may affect, adversely or beneficially, listed species or their critical habitats. Those actions requiring consultation will be immediately referred to the regional office for review accompanied by the information required in the Section 7 evaluation format. (See E, below.)

(2) The regional director upon receipt of documentation of a "may affect" action, may request the assistant regional director in whose program the action occurs and the assistant regional director for Federal Assistance to comment on the action. If, after review, the regional director concurs in the determination of "may affect", he will proceed to render a biological opinion on the action. If the regional director determines that the action will not affect listed species or their critical habitats, the refuge manager will be notified in writing.

(3) The regional director will conduct all requested consultations using the procedures contained in the Section 7 regulations. He may appoint a consultation team to provide him with recommendations prior to issuing a biological opinion.

E. Section 7 evaluation format. The following Section 7 evaluation format will be utilized in submitting information for consultation. It may also be utilized to file information on actions where a "will not affect" determination has been made.

(1) Refuge
(2) Designation _____ (Region - FY)
(3) Program(s)
(4) Listed species or critical habitats considered:
(a) Within the refuge
(b) Adjacent to the refuge
(5) Name and description of action
(6) Location (attach map)
(7) Identification of actions/activities that may cumulatively impact species (attach all pertinent information)
(8) Objectives of the action
(9) Explanation of impacts of action on listed species or their critical habitats (attach supporting biological data)
(10) Previous consultations on this or related actions/activities (attach Biological Opinions)
(11) Conclusion: (cross out one)
(a) May affect
(b) Will not affect
(12) Recommendation (including action modification)
(13) Biological assessment (attach)

2.6 Recovery plans.

A. Purpose. The purpose of recovery plans is to justify, delineate, and schedule those actions required for restoring and securing an endangered or threatened species as a viable self-sustaining member of its ecosystem.

B. Responsibility. The Secretary of the Interior and Secretary of Commerce have the responsibility for preparation of recovery plans. The Service has been delegated this responsibility by the Secretary of the Interior. The appropriate regional director has been delegated the responsibility to prepare recovery plans, but all recovery plans are approved by the Director.

C. Preparation of plan. The technical review draft may be prepared by: (1) recovery team; (2) a State, the Service, or another Federal

agency, institution, or conservation organization; or (3) a knowledgeable individual on a voluntary or contractual basis. This draft should be reviewed by appropriate individuals (experts) for biological or ecological accuracy. The Washington Office of Endangered Species should also review this draft. The agency review draft is transmitted to cooperating agencies for their review and comment on the agency's respective responsibilities in the plan. The completed plan is then forwarded to the Director for approval.

D. Implementation. The Director has been delegated the responsibility for implementing the recovery plan. Some of this implementation may be performed by other agencies, but the regional director (RD) should monitor all recovery plan activities and assure that recovery actions are progressing as fast as manpower and funding will allow.

2.7 Permit requirements. The Director, through the Federal Wildlife Permit Office, may issue a permit for the taking of endangered or threatened species from the wild if such actions are determined to be beneficial to the listed species. A request for an endangered species permit should be submitted on Form 3-200. (See Exhibit 1.)

Refuge employees, when acting within the scope of their official duties, may salvage endangered wildlife without a permit in accordance with 50 CFR 17.21. The possession of endangered or threatened wildlife must be reported verbally or in writing to the Special Agent-in-Charge (SAC) within 24 hours. Retention or disposal of the salvaged specimen must be in accordance with directions from the SAC.

The educational use of any endangered species, salvaged carcasses, or parts may be authorized through the issuance of a specific loan agreement permit between the refuge manager and the Special Agent-in-Charge, (Exhibit 2).

2.8 Captive endangered species. The holding of captive endangered species is discouraged on refuges, but may be permitted if such actions would promote the recovery of listed species. The Director will consider such actions and issue a permit only if it has been determined that the action will benefit the species. A request to hold endangered or threatened species should be submitted to the Washington Office through normal channels.

2.9 Handling and disposition of dead, injured or sick endangered and threatened species. The following procedures must be adhered to when handling and disposing of sick, injured or dead specimens. For related guidance in handling and disposing of animals consult the manual chapters on Collections, Donations and Disposals (7 RM 13.12) and Disease Prevention and Control (7 RM 17.15). The primary objective in handling a sick or injured specimen is effective treatment and care. The primary objective when encountering a dead specimen is to preserve biological materials in the best possible state for later analysis of cause of death; preserving biological materials is also preserving evidence. In conjunction with treatment of sick or

injured animals, or preservation of biological materials from a dead animal, the finder has a responsibility to ensure that evidence extrinsic to the specimen is not unnecessarily disturbed. Therefore, upon locating a dead, injured, or sick endangered or threatened species specimen, the following will apply:

A. Initial notification will be made to the nearest Service Law Enforcement (LE) office.

B. If there is an implication of human-caused injury or mortality, LE should provide specific instructions for preservation of potential evidence. LE is assigned the responsibility of notifying the RD after this initial contact by the reporting individual, and for pursuing any related investigations which are requested by the RD.

C. After LE is contacted, the reporting individual will also contact the National Fisheries Center (NFC-L), Kearneysville, West Virginia, or the National Wildlife Health Laboratory (NWHL), Madison, Wisconsin, for fish or wildlife involvements, respectively. When contacting the Laboratory/Center, the reporting individual should communicate instructions received from LE.

D. The NWHL and NFC-L are responsible for coordinating all activities involving clinical treatment and post-mortem examinations of endangered and threatened species found by or brought to the attention of Service employees. This responsibility includes issuance of specific instructions and guidance for handling individual situations. When these instructions conflict with those given by LE, the Laboratory/Center Director will contact LE and resolve the differences before finalizing the instructions with the reporting individual. If the survival of the animal is threatened by the delay, the Laboratory/Center instructions will supersede those of LE. However, the Laboratory/Center Director will in those cases contact LE after the fact to explain any change of instructions.

   The Laboratory/Center will also serve as an information repository, and transfer information regarding the current status and findings asociated with cause of death investigations of specific cases to RDs directly, or through LE (as the RD requests) and to Washington Office Public Affairs. The NWHL and NFC-L activities will be closely coordinated with the RD of the Region in which the specimen was initially located; written interim reports regarding progress of analyses, etc., will be provided to the RD on a schedule consistent with the press of the situation, or as requested by the RD. The NWHL and the NFC-L will also provide a timely final diagnostic and analytical report to the RD with a copy to the Associate Director-Research and Development.

E. The RD is responsible for immediately notifying the Associate Director-Federal Assistance (AFA) that a sensitive case is being processed, and for submitting a preliminary report and a final report after all laboratory results are received by the RD. Responsibility for notifications and writing a final report may be delegated to LE or another appropriate group by the RD.

F. AFA is responsible for advising the Director, FWS, of reports received from RDs of significant instances of dead, injured, or sick endangered/threatened species. AFA also has overall responsibility for coordinating these procedures at the Washington Office level.

G. To ensure that proper control is exercised over the disposition of specimens, or parts of specimens, Law Enforcement Chain-of-Custody records should be maintained, even though there may be no indication of illegal activity.

H. In summary, the key reporting requirements are as follows:

(1) Initially notify LE and then immediately thereafter, notify the appropriate fish or wildlife laboratory.

(2) LE will notify the RD immediately after receipt of the initial report and assume any reporting responsibilities delegated by the RD.

(3) The RD will:
- (a) upon receiving the initial LE notification notify AFA, the Washington Office coordination point, of the circumstances.
- (b) submit a report to AFA within 24 hours of field notification;
- (c) submit updates of actions and interim findings at appropriate intervals to AFA until final report is accepted by Director;
- (d) provide AFA with comprehensive report in timely manner; and
- (e) provide news releases and briefing papers to AFA for review prior to release.

(4) AFA will:
- (a) notify the Director's office immediately after receipt of the RD's initial report of a dead, injured or sick animal;
- (b) provide the Director's office and the Washington Public Affairs Office with timely and appropriate information; and
- (c) assume approval responsibility for the final report after it has been submitted by the Region.

(5) The Laboratory/Center will provide analytical and/or diagnostic services updates to the RD on a schedule agreed upon by the Laboratory/Center Director and the RD.

Clinical treatment and post-mortem examinations may be referred by the Laboratory or Center to cooperating veterinary or other facilities within the Region where the specimen is located. The whole specimen must not be transferred to the custody of some other agency, unless directed by the Laboratory/Center. However, in a situation where the specimen is already in the custody of, or is being claimed by, the State in which it was located, negotiations will be carried out by the RD to effect a release or to arrange joint jurisdiction and analysis.