

**PEARY CARIBOU –
A CASE FOR A NATIONAL PARK ON NORTHERN
BATHURST ISLAND**

Prepared for the Canadian Nature Federation by:

Frank L. Miller
Canadian Wildlife Service
Research Scientist Emeritus/
Arctic Institute of North America
Research Associate

April 25, 2001

Table of Contents

Executive Summary	2
A. Value of the Peary Caribou in the High Arctic	6
B. History of Decline and Present Status	6
C. High Arctic Physical Setting	8
D. Seasonal Habitat Requirements	8
E. Caribou needs and factors which cause ecological stress.....	9
F. Factors that affect caribou and caribou range sensitivity	11
G. Critical Habitat	11
H. The 'Weakest Link' and the Need for Habitat Protection	12
I. The effects of disturbance	13
J. Additional Stress for Peary Caribou on Bathurst Island	14
K. Conclusions/Recommendations	14
L. Source References	18
Appendix A – Background information and tables	22
Appendix B - Seasonal habitat ranges for Peary caribou on Bathurst Island and in the Bathurst Island Complex	4

Executive Summary

Peary caribou (*Rangifer tarandus pearyi*) have been listed by the Committee on the Status of Endangered Wildlife in Canada as 'endangered' since 1991. Among the members of the North American deer family, only Peary caribou have been able to become established and persist on the Canadian High Arctic Islands. Peary caribou are found uniquely in Canada, and thus the Canadian government has the lead responsibility for their protection and survival as a recognized endangered form of wildlife in Canada. Their continued survival is important for Canada's biodiversity (and for the biodiversity of the world, as their entire known range is restricted to Canada). Also, the Peary caribou's continued survival is important to the High Arctic Inuit who have relied upon them for their traditional, subsistence-based way of life. The best way to prevent Peary caribou from becoming extinct is to conserve geographically-defined populations where they are identified (e.g., Bathurst Island population). The creation of a national park on northern Bathurst Island would go a long way toward providing a safe haven for Peary caribou, which would allow the continued annual use of major calving areas and some of the best range for all seasons of the year.

Over the past four decades, the Peary caribou on the Queen Elizabeth Islands have suffered declines of more than 90%. From a population of 26 000 in 1961, there could now be as few as 2000 animals left. The most recent drastic declines were from 1994 to 1997. On Bathurst Island, the population declined 96% in 3 years from 2800 animals in 1994 to fewer than 100 in 1997. The apparent cause of the decline is severe winter and spring weather. Severe winters are often characterized by heavy snowfall, but deadly conditions consist of a combination of snow and ice conditions that make it difficult or impossible for caribou to access forage (plants) in winter and especially during late winter and early spring. Thus, although there may be an adequate food supply, the caribou cannot get to it because it is inaccessible beneath ice and/or hard snow pack. Under those conditions, juvenile, subadult and adult caribou may starve, few or no new calves will be born or survive, and all animals are in desperately poor condition. During the recent population crash, large die-offs coincided with unusually severe winter and spring conditions. Many juveniles, subadults and adults starved to death and no or few new calves were born annually from 1995 to 1997.

The High Arctic is renowned for its extremely harsh conditions. Summer is essentially the only snow-free time of year, and generally only lasts throughout July. Spring (June) and autumn (August) are often very favourable times of year

for caribou, but weather conditions can still be a source of ecological stress in bad years. Adequate foraging conditions in winter and spring are critical for all caribou to survive and for pregnant females to maintain a satisfactory nutritional state for the developing fetus and for successful calving. Then, adequate forage conditions are critical in summer and autumn to allow all animals to make up lost body fat and condition, for maternal females to meet the added demands of lactation, for breeding females and males to enter the early winter rut in good condition and for all caribou to prepare for the long, demanding winter ahead.

Caribou are grazing animals, and as such they require year-round access to forage (plants). They migrate seasonally throughout the year: breeding females and their companion animals (their young and mostly juvenile and subadult females) moving from the calving grounds (spring), to postcalving range (summer), to breeding areas (fall-early winter), to wintering areas, then back to their calving areas. Adult males and many younger males follow a similar pattern of seasonal movements, but they apparently do so mainly to maximize their year-round intake of forage. Range selection by pregnant and maternal females at calving and shortly afterward appears to be governed both by forage availability and temporary escape from wolves.

For a caribou population to persist and grow, it requires the following: a) a satisfactory nutritional state that allows breeding by an adequate number of males and conception by most of the adult females; b) survival of a high percentage of pregnant females to birth, a subsequent high rate of births of healthy calves, and a high rate of survival of those calves to breeding age; and c) adequate habitat conditions so that, over the years, the annual rate of births exceeds the rate of deaths. On a yearly basis, Peary caribou require enough year-round habitat to escape wolf predation, give birth to calves, make up their fat reserves in the summer, breed, forage, and space themselves out so that, for much of the year, adult males are separated from females, their young and associated, mostly female, juvenile and subadult companion animals. During exceptionally unfavourable years, access to critical habitat is essential for caribou survival.

Caribou can be sensitive to human-caused disturbance, and the degree of sensitivity may be influenced by age, sex, and the time of year. Adult females with calves are most sensitive to disturbance, which may cause a disruption of the mother-young bond, or cause the animals to abandon traditional habitat. In particular, activities that have been documented to cause changes in caribou behaviour are oil exploration, drilling, installation of infrastructure, the use of

vehicles, and low-flying aircraft. Factors that affect caribou sensitivity to such disturbances are group size, body condition/fat reserves, fidelity to traditional areas, reproductive status, wolf predation, and environmental stress.

Critical habitat is defined as any portion of the caribou range which, if caribou could not access at crucial times, would result in environmental stress that would cause high levels of mortality (a higher death rate than the rate of young entering the population). Factors that affect the sensitivity and degree of importance of seasonal range include intensity of range use, size of seasonal range, food value, escape (from predation) value, and sensitivity to pollutants. While it may be possible to assign relative degrees of sensitivity to different seasonal ranges, no part of the annual range is dispensable, particularly in the most severe years. Habitat is only as good as its weakest link. That is, there is little value protecting only caribou calving grounds, for example, if the herd does not have access to adequate summering, breeding, and wintering areas.

The most pressing concern about disturbance occurring on critical habitat is the consequences to Peary caribou in unfavourable years. Following an unusually severe winter, there may only be an extremely limited amount of forage that is accessible while the remainder of the range is covered under hard snow pack and/or ice cover. At those times, caribou are in extremely poor condition and are severely nutritionally-stressed. If human-caused disturbance deters caribou from using their traditional areas which comprise most, or in the few exceptionally severe years, essentially all of the snow/ice free forage areas, the lack of available forage could cause calf production to fail entirely and many juvenile, subadult and adult caribou to starve.

For the Peary caribou on Bathurst Island, the risks associated with disturbance on traditional range may threaten the continued existence of that population at their current low number. The northeastern portion of Bathurst island has traditionally provided the best quality habitat during spring, summer, and generally year-round. Development in this area poses a serious, if unpredictable, threat to those Peary caribou. **With so few animals remaining, allowing any additional stress is a completely unacceptable risk as it could seriously compromise the ability of the population to recover.**

Recommendations

1) The Peary caribou within the Bathurst Island complex should be afforded the maximum amount of protection by creating a national park on northern Bathurst Island. This would protect the population's principal calving areas and a significant portion of critical seasonal range that is consistently used during all seasons by the majority of the caribou on Bathurst Island.

2) The Canadian government should recognize the uniqueness of the Peary caribou in the High Arctic, and accept its responsibility as the principal steward for the conservation and protection of this nationally endangered species.

3) Territorial and federal governments should recognize the central role of Peary caribou in the High Arctic Inuit culture and subsistence way of life. This is another crucial reason why most of the Peary caribou on Bathurst Island should be afforded maximum protection in a national park to help assure the desired continued utilization by future generations of High Arctic Inuit.

A. Value of the Peary Caribou in the High Arctic

The Peary caribou (*Rangifer tarandus pearyi*) is an “Endangered” form of wildlife in Canada, based on Environment Canada’s Peary Caribou Status Report (Miller 1990, Committee on the Status of Endangered Wildlife in Canada 1991). The current known world-wide range of the purest genetic line of Peary caribou is restricted to the Canadian High Arctic Islands (those islands entirely north of 74° N latitude, collectively known as the Queen Elizabeth Islands). Peary caribou on the Queen Elizabeth Islands are the only representatives of the entire North American deer family (Cervidae: moose, elk, caribou, and deer) and the only form of the caribou/reindeer genus *Rangifer* to have successfully established themselves and persist on the Canadian High Arctic Islands. The caribou is the pivotal animal in Inuit culture and only Peary caribou are available on the Queen Elizabeth Islands to allow Inuit hunters to follow their traditional, subsistence-based way of life.

Thus, the Peary caribou is “Endangered,” uniquely Canadian, a major component in the biodiversity of the Canadian High Arctic, and a culturally and economically important renewable resource for High Arctic Inuit. The passing of the Peary caribou from the High Arctic Terrestrial Ecosystem would be an ecological catastrophe of international note. The best preventive measure appears to be the conservation of geographically defined populations of Peary caribou, in order to maintain maximum biodiversity and, at the same time, foster genetic diversity through the long-term maintenance of metapopulations within the High Arctic Terrestrial Ecosystem. Creation of a national park on northern Bathurst Island would go a long way toward that goal by providing a safe oasis for Peary caribou, which would include the continued annual use of major calving areas and some of the best range for all seasons of the year.

B. History of Decline and Present Status

Peary caribou on the Queen Elizabeth Islands have suffered an overall decline in number of more than 90% in the past four decades. When first surveyed by air in summer 1961, Peary caribou on the Queen Elizabeth Islands were estimated at about 26 000 (Tener 1963). Currently, there could be as few as 2000. **Their current population sizes (on an island basis) are now mere remnants of their former sizes and their future prosperity, if not survival, is endangered and in doubt.**

Peary caribou within the Bathurst Island complex have declined from an estimated 3600 in 1961 to fewer than 100 in 1997 (Tener 1963, Miller *et al.* 1977, Miller 1995, 1998, Gunn and Dragon, unpubl. data, 1997). The first known major die-off occurred in winter and spring 1973/74 (Table 1: Miller *et al.* 1977). Twenty years (1974/94) of overall recovery then followed. Unfortunately, the population then declined by over 96% between summers 1994 and 1997 (Table 1). Aerial surveys also have shown that in addition to the outstandingly high levels of mortality, Peary caribou within the Bathurst Island complex essentially did not produce or successfully rear calves in those 3 consecutive years (1995-97). The Peary caribou population within the Bathurst Island complex is now perilously low, likely with no more than 50 breeding-aged females left.

Throughout all of this time, favourable or unfavourable periods, northeastern Bathurst Island has remained the most used range by the greatest number of caribou. Therefore, there is good reason to believe that the well-being of caribou on northeastern Bathurst Island will play a principle role in the general prosperity of the caribou population within the entire Bathurst Island complex. This is true because critical ranges for all seasons of the year are proportionally greater on northeastern Bathurst Island than anywhere else within the complex, particularly during late winter and spring pre-calving, calving and spring-summer postcalving. (See maps in Appendix B)

The estimated number of Peary caribou on Bathurst Island proper declined from 2700 in summer 1961 to 230 animals estimated in summer 1974. Subsequently, the caribou on Bathurst Island experienced a two-decade healthy overall increase to an estimated 2800 animals in 1994. Unfortunately, the caribou then experienced 3 consecutive years of extremely unfavourable snow/ice conditions that brought them crashing down to an estimated <100 animals by summer 1997. Their previous recovery, however, suggests that a similar recovery is possible for Bathurst caribou.

The cause of the recent drastic declines of Peary caribou is most likely severe winter weather. In extremely severe winters, there have been drastic levels of mortality among 1+ yr-old caribou (and muskoxen) and disastrous losses of the associated subsequent calf crop. Total annual winter snowfall is a good suggestive indicator of at least the likelihood of a severe winter having occurred, if not the actual relative severity of the winter. However, it is not suggested that the actual depth of snow cover is necessarily the lethal factor per se. What appears to create

lethal conditions are the various combinations of the characteristics of the snow pack (depth, hardness, and density) together with the frequency, timing, amount, and extent of icing events. The issue is the relative unavailability of forage, i.e. **the necessary forage (food supply) is there but the caribou cannot get to it because it is inaccessible beneath ice and snow . Caribou may starve and some pregnant females will fail to produce and/or rear viable offspring** as a result of environmental stresses caused by extensive and prolonged relative unavailability of forage in those years.

To date no other environmental or ecological factors, in recent times, appear to have significantly influenced the growth and prosperity of Peary caribou populations on the Queen Elizabeth Islands.

C. High Arctic Physical Setting

The Canadian Queen Elizabeth Islands form the remote and isolated northern apex of the North American continent. The region is known for its extremely harsh environment and its general paucity of vegetation compared even to mainland tundra ranges. In this arduous setting only two forms of large grazing animals have been able to establish themselves there - the Peary caribou and the muskox (*Ovibos moschatus*).

The climate of the region is characterized by short, cool summers and long, extremely cold winters. Snow cover usually begins melting in early June, and often rapidly dissipates to bare ground from mid June through late June, except for snow banks in sheltered sites (Potter 1965). Summer is the period when the ground is generally essentially snow-free, and lasts from the beginning of July to the end of August (however, August is better thought of as autumn). Winter starts when the mean daily temperature falls below 0°C, usually about or before 15 September. The stormiest months are September and October and much of the annual snowfall may occur in those months.

D. Seasonal Habitat Requirements

Caribou require year-round access to forage, refuge from wolf predation, and enough habitat so that bulls and cows with young can be separated during much of the year. Different seasonal conditions and life cycle events dictate the needs of a caribou herd. The year can be divided into three periods to provide an overview of seasonal constraints.

1st. Period: March-May (Late winter), and June (Spring)

Period of greatest range restriction and forage unavailability, associated with extreme environmental stress and high nutritional demands for all caribou, with the greatest drains being on females about to give birth (parturient cows).

2nd. Period: July (Summer) and August (Autumn)

Period of relative abundance and availability of high quality vegetation - necessary for all caribou to restore body condition (muscle) and to build up fat reserves and particularly for breeding animals to enter into a favourable reproductive state during the subsequent early winter rut.

3rd. Period: September-November (Early Winter) and December-February (Mid Winter)

Period of transition from high quality diet to low quality maintenance diet. In favourable years, animals do well. In unfavourable years, their failure to remain in good condition often leads to subsequent high levels of mortality over the remainder of winter and through spring (Dec-Jun) and poor initial calf production during the next calving period (Jun), or low levels of early survival of calves (Jun-Jul).

Seven types of “caribou-year” (Jun-May) in terms of relative favourableness to individual Peary caribou and their population can be considered according to levels of forage availability, quality, and level of wolf predation (Table 2). On an ecological basis, the “caribou-year” begins with births in June and ends with death and the promise of new life in the following May. Table 3 provides a more detailed look at the periods in the caribou life cycle, the condition of seasonal range, and the nutritional states of the herd in each season.

E. Caribou needs and factors which cause ecological stress

Peary caribou in the High Arctic face extremely harsh living conditions. These conditions place a significant amount of ecological stress upon caribou, especially in very unfavourable years. Certain times of year are more demanding than others, and consequently caribou are more sensitive to disturbances at these times and in different parts of their annual range.

All of the following are paramount necessities for the continued well-being of a population of caribou and all demand ample habitat that provides a sufficient forage supply at all seasons of the year:

- 1) A satisfactory nutritional state that allows vigorous breeding by an adequate number of bulls and cows to result in conception of a large proportion of the cows;
- 2) Survival of a high percentage of those pregnant cows through pregnancy to birth, a subsequent high rate of births of viable newborns, and successful rearing of most of those calves to 1-year of age (and, most importantly, to breeding age).
- 3) Of equal importance, the habitat must also be bountiful enough over a period of years to result in the overall annual rates of death being less than the overall rates of replacement by new individuals into the population during that time period.

Age and sex sensitivities

Caribou of different sex and age groups have differing needs and seasonal constraints. The timing of calving is acute, as it must occur just prior to the period of maximum growth and nutrient dynamics in the forage plants (e.g., Russell *et al.* 1993). **Free and undisturbed access to an adequate amount of high-quality forage during the early stage of lactation is critical to successful early rearing of calves and subsequent survival of those calves through their first year of life. It is also crucial to the maternal cow's capability to recover to a satisfactory level for conception, successful pregnancy and even survival during the next winter through spring** (e.g., Thomas 1982).

Breeding bulls are more burdened than cows for much of the year. They have expended their body reserves during the early winter rut and the larger body size of a bull imposes higher energy demands than for a smaller-bodied cow. This condition persists even with the added costs of gestation to cows, until after calving, when the reverse situation occurs and cows require more energy (e.g., Russell *et al.* 1993).

Young non-breeding caribou are still in a rapid-growth stage and they do not accumulate proportionally as much fat reserves as mature animals. Therefore, in extremely unfavourable years many of them will be among the first to succumb to prolonged severe environmental stresses. In an advance weakened state, they either die of starvation or become "easy targets" for wolves.

F. Factors that affect caribou and caribou range sensitivity

The relative degree of sensitivity to disturbance of caribou and caribou range at different times of the year are estimated in **Table 4**. Both the caribou and their seasonal range are **very highly sensitive to disturbance in the spring and summer, and highly sensitive in late winter**. Sensitivity ratings are moderate throughout autumn, early winter, and mid-winter. Factors that affect caribou sensitivity to disturbances are group size, body condition/fat reserves, fidelity to traditional areas, reproductive status, wolf predation, and environmental stress. These factors are explained in greater detail in Appendix A.

G. Critical Habitat

A credo in business is - “Everything is location-location-location!”. Certainly, if caribou populations have a single guiding principle, it is essentially the same - everything is habitat-habitat-habitat. In this context “habitat” is used collectively (and synonymously with location) and includes all scales from annual home range, to seasonal ranges (including migration routes), to daily ranges and all range types, plant communities, plant associations and specific sites within those ranges.

The caribou is a medium-sized grazing animal. As such, they require a continual adequate supply of forage plants, and anything that seriously hinders or, more importantly, prevents them from obtaining their necessary daily sustenance is detrimental to the individual and thus to the population. **Therefore, “critical habitat” is considered as any portion of the range which, if caribou could not access at crucial times, would result in environmental stress at levels which would cause mortality that exceeded the associated rate of reproduction and survival of young in that year.** This scenario would necessarily result in an overall decline in the number of individuals within the population.

The primary importance of the habitat is the provision of a necessary ongoing adequate food supply (forage). When severe winter and spring conditions (ice and snow pack) make most of the forage on the range inaccessible to caribou, whatever few areas of exposed vegetation there is represent the only food supply. **Caribou must be able to access those areas, or face calving failures and/or starvation.**

Important habitat areas for the Bathurst Island Peary caribou herd are identified in Appendix B. The figures illustrate the known calving, rutting, wintering and summering areas.

H. The ‘Weakest Link’ and the Need for Habitat Protection

Although Peary caribou habitat can be divided into distinct areas for different seasonal needs, this does not enable a clear prioritization of the different seasonal ranges. **The overall range is only as good as its “weakest link”,** or most unfavourable season(s) in any given year. That is, conserving, for example, only calving habitat will have little overall conservation value if the caribou do not have access to adequate habitat and forage throughout the rest of the year. Similarly, the protection of the caribou range during the stressful wintry part of the year will be of little value if the caribou cannot subsequently make back their body condition and build up their fat reserves during the favourable time of the year (summer-autumn). **No seasonal range is dispensable.**

The three generalized seasonal periods (late winter-spring; summer-autumn; early-mid winter) can be used to understand why it is important to protect a large proportion of the Peary caribou’s annual range, and not just, say, its calving grounds. Over the long run, protection of the Peary caribou’s range during the 1st period is necessary to get them through the most environmentally stressful times of the year. Then, protection of their ranges during the 2nd period is mandatory to bring the breeding females and males into good reproductive condition for the early winter breeding period (the rut) and to permit the caribou’s nutritional recovery to face the environmental rigours of the next oncoming winter. Finally, protection of the ranges during the 3rd period will maximize the probability of survival during the subsequent late winter and spring and promote successful initial calf reproduction and early survival of the newborn offspring. Conditions during all three periods or six seasons must be consecutively satisfactory for the continued well-being of individuals and particularly for the continued growth in size of the population.

Thus, a significant amount of caribou range needs protection during all seasons of the year to foster the caribou’s year-round long-term survival and especially its prosperity. This is especially true if the population is to remain stable or expand while being utilized at meaningful sustainable annual harvest levels by Inuit hunters.

I. The effects of disturbance

The distribution and characteristics (hardness and density) of snow cover, the presence of ground fast ice, icing in the snow pack, and ice glaze on the surface of the snow cover, plus freezing and thawing regimes in winter and spring, can create extremes beyond which some Peary caribou cannot cope. Therefore, it seems axiomatic that any form of disturbance that seriously hinders or prevents access to, or causes avoidance or abandonment of, critical seasonal habitat in severely unfavourable years has the potential for indirectly causing dire effects on Peary caribou. Abandonment of ranges by Peary caribou due to industrial exploration activities has not been proven. It has, however, already been implicated by Inuit hunters in declines of caribou on Bathurst Island (Freeman 1975, Miller *et al.* 1977, Miller and Gunn 1978). At this time, application of the “Precautionary Principle” for Peary caribou is the most valid approach, if the preservation of an “Endangered” and unique form of wildlife in Canada is indeed a primary consideration.

Large-scale industrial exploratory and exploitation activities have the potential to reduce or prevent access to or use of favourable or critical habitat sites (e.g., Cameron *et al.* 1979, 1992, 1993 Cameron and Whitten 1979, Smith and Cameron 1983, Whitten and Cameron 1985, Nellemann and Cameron 1998). Localized, potential habitat disturbance or destruction is possible from the use of tracked vehicles, spills of oil, fuel or drilling mud and the construction of installations, roads and aircraft landing strips (e.g., Gunn *et al.* 1981, Gunn 1984, 1990). Abandonment of critical habitat on traditional calving, postcalving and rutting areas is of particular concern (**Appendix B**; e.g., Miller and Gunn 1979, Gunn and Miller 1986, Miller 1990).

Human caused disturbance may have a negative impact on maternal care of newborn calves. The maternal cow licks and feeds her calf within the first minutes of life, which initiates the “mother-young bond.” As the calf grows, it solicits milk and care from the mother and further develops the bond. Everything indicates that a strong mother-young bond is necessary for the survival of the calf during the first several months of life (e.g., de Vos 1960, Pruitt 1960, Lent 1966, Kelsall 1968, Skoog 1968, Miller and Broughton 1974, Miller 1982, Miller *et al.* 1988). The potential for disrupting or preventing the mother-young bond has been described for inadvertent disruptions (e.g., Lent 1966, Miller and Broughton 1974, Mauer *et al.* 1983, Whitten *et al.* 1984). Such separations are most likely to occur if the calf is so young that the cow has not had sufficient time to identify

herself with the calf, or if frequent human activity around the area of separation discourages the cow from returning and staying long enough to locate her calf.

Thus, any human disturbance during calving or immediately afterwards (and also even during late postcalving) that causes prolonged separation of the cow from her calf will increase the level of mortality among newborn calves. Therefore, it seems reasonable to assume that human disturbance has the potential for interfering with production and early survival of calves. This will be true both in favourable years and especially so in exceptionally unfavourable years. **Any additional mortality resulting from human disturbance will occur on top of naturally occurring mortality and, thus, further hinder the recruitment of new animals into the population.**

J. Additional Stress for Peary Caribou on Bathurst Island

Prolonged extreme malnutrition brought on by exceptionally unfavourable snow and ice conditions that persist during winter and spring periods will occur at unknown intervals. Such unfavourable years will lead to high levels of mortality and high loss or total failure of the associated calf crop. Cows with calves are most likely to abandon and/or avoid areas when exposed to human disturbance (e.g, Lent 1966, Miller and Broughton 1974, Mauer *et al.*1983, Whitten *et al.* 1984). When those areas are critical habitat at that time of the year, **intensive human disturbance could prevent the animals from getting to the limited available forage supply and tip the delicate balance between the animal and its range in those seasons.** If the disturbance persists long enough, it could indirectly cause the deaths of animals from starvation (extreme undernutrition). **Therefore, every effort should be made to guarantee that there will be no human activities on such areas that would disrupt or prevent caribou occupation in precarious times.**

K. Conclusions/Recommendations

Conclusions

(1) I believe that protection of Peary caribou at the level of the geographic population is the most biologically sound approach to the long-term conservation of a uniquely Canadian form of caribou. The geographic population is also the most practical scale for the implementation of biologically

sound management prescriptions for Peary caribou.

(2) Essentially all of the extremely high levels of mortality of 1+ yr-old Peary caribou and associated calf crop failures during a 26-year period (1972-1997) can be attributed to death by prolonged extreme malnutrition (starvation), brought on by exceptionally unfavourable snow and ice conditions that persisted in the five most extreme winter-spring periods during those years. This condition is the most likely cause for the sporadic drastic reductions of Peary caribou throughout most of their history on the Queen Elizabeth Islands. **Unfortunately, we cannot predict or mitigate weather - but we can prevent any additional stress in the form of severe industrial disturbance from occurring on caribou calving areas and critical seasonal caribou habitat.**

(3) The consequences to Peary caribou of human-caused disturbances which lead to avoidance or abandonment of seasonally critical habitat will be influenced mainly by the season of the year and the overall unfavourableness of that entire year. The consequences would be even more severe in times when exceptionally unfavourable environmental conditions persist in consecutive years (such as happened from 1994/95 to 1996/97). Therefore, it is reasonable to conclude that any form of industrial development and associated human-induced activities that would hinder and especially prevent Peary caribou on Bathurst Island from using critical seasonal habitat could significantly intensify the environmental stress. **This is particularly true for northeastern Bathurst Island because of relative importance of the range there compared to other sections of the island. Thus, human disturbance at the wrong time of the year and in the wrong place could greatly increase the level of mortality and degree of calf loss** during such environmentally unfavourable periods and possibly even during more favourable times.

(4) It is likely that what will dictate how individual caribou within each geographic population will respond to large-scale developments and associated activities will be determined in each case by the viability of the alternatives that are available to the members of each population. We can not necessarily always expect favourable outcomes when large-scale development and human-induced activities are involved, especially when they occur at a scale well-beyond anything the caribou have experienced to date.

(5) Northern Bathurst Island was chosen primarily for its excellent representation of the western High Arctic Ecosystem, and the addition by Parks

Canada of northeastern Bathurst Island to the National Park System would markedly enhance the national program of including exemplary representations of all of the major Ecological Regions of Canada. The presence of Peary caribou as a 'theme animal' - in this case an "Endangered" form of wildlife that is unique to the Canadian High Arctic - and the long-term benefits that Peary caribou would derive from ranging and especially calving within a National Park, should be viewed as an extra incentive for Northern Bathurst's inclusion in the National Park System.

(6) The Stewart River drainage area and the north-south lateral drainage area from the Stewart River north to the west arm of Young Bay on northeastern Bathurst Island are the principal Peary caribou calving areas within the Bathurst Island complex. These calving areas have been used annually by the greatest number of pregnant and maternal females on Bathurst Island. **Any activity or development that seriously hinders or prevents calving from taking place on these calving areas could have a very negative impact of the future growth of the Peary caribou population within the Bathurst Island complex.** Thus, these calving areas are the most important areas to protect in order to foster the current and future well-being of the Peary caribou population within the Bathurst Island complex, and possibly ultimately provide animals for re-colonization elsewhere on the Queen Elizabeth Islands.

(7) The coastal area to the northeast of Young Bay serves as a secondary calving area in some years and also warrants protection for the long-term benefit of the Peary caribou population on Bathurst Island.

(8) The consideration of Northern Bathurst Island as a National Park should in no way be dictated by the number of Peary caribou currently present there, as Peary caribou have occurred there at high numbers in the past and will in all likelihood do so again in the future.

Recommendations

(1) I recommend that the Peary caribou population within the Bathurst Island complex be afforded maximum protection by creating a National Park on northern Bathurst Island that will protect the principle calving areas and a significant portion of critical seasonal range that is consistently used at all seasons of the year by the majority of caribou within that population.

(2) I recommend that the Canadian Government recognize the uniqueness of the Peary caribou in Canada's High Arctic Terrestrial Ecosystem and accept the Government's responsibility as the Steward of Canada's natural heritage to help assure the conservation and preservation of the Peary caribou.

(3) I recommend that all levels of government recognize the central role of Peary caribou in High Arctic Inuit culture and subsistence way of life, thereby accepting the need for the conservation of Peary caribou for continued utilization within sustainable limits by Inuit hunters from the two High Arctic settlements.

L. Source References

- CAMERON, R.C.; REED, D.J.; DAU, D.R.; and SMITH, W.T. 1992.** Redistribution of calving caribou in response to oil field development on the Arctic Slope of Alaska. *Arctic* 45:338-342.
- CAMERON, R.C.; SMITH, W.T; FANCY, S.G.; GERHART, K.L.; and WHITE, R.G. 1993.** Calving success of female caribou in relation to body weight. *Canadian Journal of Zoology* 71:480-486.
- CAMERON, R.C.; WHITTEN, K. 1979.** Seasonal movements and sexual segregation of caribou determined by aerial survey. *Journal of Wildlife Management* 43:626-633.
- CAMERON, R.C.; WHITTEN, K.R.; SMITH, W.T; and ROBY, D.D. 1979.** Caribou distribution and group composition associated with construction of the Trans-Alaska pipeline. *Canadian Field-Naturalist* 93:155-162.
- COSEWIC. 1991.** Status report on the Peary caribou *Rangifer tarandus pearyi*. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ont. 116 pp.
- de VOS, A. 1960.** Behaviour of barren-ground caribou on their calving grounds. *Journal of Wildlife Management* 24:250-258.
- FREEMAN, M.M.R. 1975.** Assessing movement in an Arctic caribou population. *J. Environ. Manage.* 3:251-257.
- GUNN, A. 1984.** A review of research on the effects of human activities on barren-ground caribou of the Beverly and Kaminuriak herds, Northwest Territories. Northwest Territories Wildlife Service unpublished file report no. 43:1-66.
- _____. 1990.** The decline and recovery of numbers of caribou and muskoxen on Victoria Island. *In: Harrington, C.R. (ed.). Canada's missing dimension: science and history in the Canadian Arctic Islands.* *Can. Mus. Nature, Ottawa, Ont.* 2:590-607.
- _____; and MILLER, F.L. 1986.** Traditional behaviour and fidelity to caribou

calving grounds by barren-ground caribou. Rangifer Special issue No. 1:151-158.

___; **MILLER, F.L.; and THOMAS, D.C. 1981.** The current status and future of Peary caribou (*Rangifer tarandus pearyi*) on the Arctic Islands of Canada. Biol. Conserv. 19(1980-81):283-296.

KELSALL, J.P. 1968. The migratory barren-ground caribou in Canada. Canadian Wildlife Service Monograph No. 3. Queen's Printer, Ottawa. 339 pp.

LENT, P.C. 1966. Calving and related social behavior in the barren-ground caribou. Zietschript Tierpsychologica 23(6):701-756.

MAUER, F.J.; GARNER, G.W.; MARTIN, L.D.; and WEILER, G.J. 1983. Evaluation of techniques for assessing neonatal caribou calf mortality in the Porcupine caribou herd. In Garner, G.W. and Reynolds, P.E. eds. 1982 update report baseline study of the fish, wildlife and their habitats. United States Fish and Wildlife Service, Anchorage, Alaska. pp. 201-226.

___ . 1990. Peary caribou status report. Environment Canada, Canadian Wildlife Service Western & Northern Region. Edmonton, Alta. 64 pp.

MILLER, F.L. 1991. Peary caribou calving and postcalving periods, Bathurst Island complex, Northwest Territories, 1989. Technical Report Series No. 118. Canadian Wildlife Service Western & Northern Region. Edmonton, Alta. 72 pp.

___ . **1998.** Status of Peary caribou and muskox populations within the Bathurst Island complex, south-central Queen Elizabeth Islands, Northwest Territories, July 1996. Technical Report Series No. 317. Canadian Wildlife Service Western & Northern Region. Edmonton, Alta. 147 pp.

___; **and BROUGHTON, E. 1974.** Calf mortality on the calving grounds of the Kaminuriak caribou. Canadian Wildlife Service Report Series No. 26:1-26.

- MILLER, F.L.; and GUNN, A. 1978.** Inter-island movements of Peary caribou south of Viscount Melville Sound, Northwest Territories. *Can. Field-Natur.* 92:327-333.
- ___; **and GUNN, A. 1979.** Responses of Peary caribou and muskoxen to helicopter harassment. *Canadian Wildlife Service Occasional Papers No.* 40:1-90.
- ___; **RUSSELL, R.H.; and GUNN, A. 1977.** Distributions, movements and numbers of Peary caribou and muskoxen on western Queen Elizabeth Islands, Northwest Territories, 1972-74. *Canadian Wildlife Service Report Series No.* 40:1-55.
- NELLEMANN, C.; and CAMERON, R.D. 1998.** Cumulative impacts of an evolving oil-field complex on the distribution of calving caribou. *Canadian journal of Zoology* 76:1425-1430.
- POTTER, J.G. 1965.** Snow cover. Department of Transportation, Meteorological Branch, Ottawa, Ont. *Climatological Studies No.* 3:1-69.
- PRUITT, W.O. Jr. 1960.** Behavior of the barren-ground caribou. *University of Alaska Biological Papers No.* 3:1-44.
- RUSSELL, D.E.; MARTELL, A.M.; and NIXON, W.A.C. 1993.** Range ecology of the Porcupine caribou herd in Canada. *Rangifer, Special Issue No.* 8:1-167.
- SMITH, W.T.; and CAMERON, R.D. 1983.** Responses of caribou to industrial development of Alaska's Arctic Slope. *Acta Zoologica Fennica* 175:43-45.
- SKOOG, R.O. 1968.** Ecology of the caribou (*Rangifer tarandus granti*) in Alaska. Ph.D. Thesis. University of California, Berkeley. 699 pp.
- TENER, J.S. 1963.** Queen Elizabeth Islands game survey, 1961. *Canadian Wildlife Service Occasional Papers No.* 4:1-50.
- THOMAS, D.C. 1982.** The relationship between fertility and fat reserves of Peary caribou. *Canadian Journal of Zoology* 60:597-602.

WHITTEN, K.R.; and CAMERON, R.C. 1985. Distribution of caribou calving in relation to the Prudhoe Bay oil field. *In* A.m. Martell and D.E. Russell, eds. Proceedings of the first North American Caribou Workshop, Whitehorse, Yukon, 28-29 September 1983. Canadian Wildlife Service, Ottawa, Ont. pp. 35-39.

WHITTEN, K.R.; GARNER, G.W.; and MAUER, F.J. 1984. Calving distribution, initial productivity and neonatal mortality of the Porcupine caribou herd, 1983. *In* Garner, G.W. and Reynolds, P.E. eds. 1983 update report baseline study of the fish, wildlife and their habitats. United States Fish and Wildlife Service, Anchorage, Alaska. pp. 359-391.

Appendix A – Background information and tables

Table 1. Population statistics for Peary caribou within the Bathurst Island complex during summer in the 4 years when major losses of 1+ yr-old caribou were detected, south-central Queen Elizabeth Islands, Nunavut

Year (Jun to Jun)	Approximate mean population estimate	% decline from previous year
1973/74	300	63
1994/95	2100	30
1995/96	500	76
1996/97	100	80

^a Based on a traditional home range size of 27 000 km² for the Peary caribou population within the Bathurst Island complex.

Table 2. Possible annual variation in environmental stress and ecological pressure on individuals within a Peary caribou population in relation to their forage supply and associated wolf predation

Type of caribou year ^a	Forage supply		Wolf predation
	Availability	Quality	
Best	High	High	Low
Well above average	High	High	High ^b
Above average	High	Low ^c	Low
Average	High	Low	High
Poor	Low	High	Low
Drastic	Low	Low	Low
Cataclysmic	Low	Low	High

^a Favourableness of year is measured in terms of Peary caribou population growth in size, increase (Average to Best) or decline (Poor to Cataclysmic); “stability” is possible in ‘Average years’.

^b In a ‘Well above average’ year wolf predation is assumed to be in balance with the capability of prey population to sustain it.

^c In an ‘Above average’ year the quality of the forage is considered to be relatively low compared to the ‘Best’ and the ‘Well above average’ years but adequate for the necessary maintenance, recovery and growth of Peary caribou within that population in that year.

Table 3. Annual cycle of the seasons within a caribou-year (June-May) by range restrictions, nutritional states of the caribou and life history events or stages for individuals within the Peary caribou population on Bathurst Island, south-central Queen Elizabeth Islands, Nunavut

Season	Periods of Caribou Life Cycle	Range Restrictions	Nutritional states
<p>Spring (June)</p>	<p>Calving period - few calves born in late May in very favourable years, early July in worst years. Peak generally 2nd or 3rd week June.</p> <p>Wolf predation on calves can be significant, especially when caribou numbers low.</p>	<p>Available habitat greatly restricted, accessible forage greatly reduced, limited to poorly vegetated patches of snow-free ground or shallow snow covered-ground. Crucially restricted in some years, lethally so in some few years when snow/ice conditions exceptionally severe during previous winter.</p>	<p>Pregnant and maternal cows in a severe negative energy balance, even in favourable years. High energy demand in last stages of pregnancy, necessary for successful calving rates. Bulls in negative energy balance, need more time for recovery. Best chance for young animals if growth begins early.</p>
<p>Summer (July)</p>	<p>Maximum growth period for bulls and young animals.</p> <p>Heavy wolf predation on newborn calves could be a serious condition, even in favourable years.</p>	<p>Best period for annual habitat use, widespread available high quality forage.</p>	<p>All healthy caribou in positive energy balance. High energy demand for lactating females. Critical period for restoration of body reserves for breeding bulls and cows, and for survival of all animals throughout next winter.</p>

Season	Periods of Caribou Life Cycle	Range Restrictions	Nutritional states
Autumn (August)	Dispersal occurs in response to better availability of forage at intermediate and higher elevations. Wolf predation not important unless caribou numbers low.	Highly favourable range conditions , vegetation quality starts to decline.	Still high energy demand , especially for maternal cows. Positive energy balance , growth and fat restoration continues.
Early Winter (September - November)	Seasonal migrations to rutting (breeding) and wintering areas. Early stage of pregnancy Wolf predation only problematic when caribou numbers low. Initial period of annual survival, considerable stress in some years .	Range conditions and availability of forage highly variable - from very favourable to exceptionally poor. Early freezing rain can reduce available forage. Worst years - forage chronically reduced by mid winter. Extent of range occupation dependent on weather conditions.	Variable: favourable years - continued growth. Unfavourable years - either maintenance or negative energy balance. Breeding bulls depleted energy reserves. Pregnant cows require high level of nutrition for fetal growth.
Mid-Winter (December - February)	Pregnant females in mid-term pregnancy. Often severely adverse period of survival in unfavourable years, less stressful in favourable years. Environmental stress intensifies. Wolf predation only problematic when caribou numbers low.	Increasing snow and ice cause reduced usable range and available forage . Extent of area used by caribou depend on snow and ice conditions.	Maintenance is adequate in favourable years, all caribou in negative energy balance in unfavourable years . Bulls have seriously expended fat reserves in bad years.

Season	Periods of Caribou Life Cycle	Range Restrictions	Nutritional states
<p>Late Winter (March - May)</p>	<p>Most stringent period of survival. Cows in advanced stage of pregnancy. Near or total failure to produce viable calves in extremely unfavourable years.</p>	<p>Lowest level of forage availability, except in worst years when spring conditions are even worse. Maximum snow cover and presence of ice.</p>	<p>All caribou in negative energy balance - in most unfavourable years caribou become seriously debilitated or die. Large energy demand on pregnant cows - many will die in the worst years. Bulls and young animals severely depleted fat reserves.</p>

Table 4. Generalized rating for sensitivity of Peary caribou and Peary caribou range to land use activities during the different seasons of the “caribou-year (Jun-May)”^a

Seasons of the year	Caribou sensitivity rating ^b		Range sensitivity rating ^c		Caribou-range sensitivity rating ^d	
Spring	Very high	(5)	Very high	(5)	Very high	(5)
Summer	Very high	(5)	High	(4)	Very high	(5)
Autumn	Moderate	(3)	Moderate	(3)	Moderate	(3)
Early winter	Moderate	(3)	Moderate	(3)	Moderate	(3)
Mid winter	Low	(2)	Moderate	(3)	Moderate	(3)
Late winter	High	(4)	High	(4)	High	(4)

^a Factors used to develop generalized ratings are given in Tables 5 and 6.

^b Ratings could have ranged from 1 (Very low) to 5 (Very high).

^c Ratings could have ranged from 1 (Very low) to 5 (Very high).

^d Caribou-range sensitivity rating = [caribou sensitivity rating] + [range sensitivity rating]: ratings could have ranged from 1 (Very low) to 5 (Very high).

Sensitivity rating factors

The following summarizes the factors that were used estimate caribou and caribou sensitivity ratings.

Caribou sensitivity

Caribou may respond to disturbance differently under different circumstances.

Response to distance

Refers to the likelihood that caribou will move away from human activities or structures. It also considers the possible presence of human-induced physical and/or psychological barriers to directional movements, while shifting range, in seasonal migration, or daily foraging activities.

Maternal cows with calves are most sensitive to such disturbances, bulls are the least sensitive.

Although debilitated individuals often do not respond in obvious ways, **anything that hinders or prevents movements to or use of critical habitat**, especially during late winter and spring, **is considered potentially detrimental to the animal's well-being** (chances of survival or successful reproduction in unfavourable years) and is, therefore, included in this category.

Density and group size

Because of their relatively low numbers and overall mean densities, individuals in any Peary caribou population do not form big groups like migratory barren-ground caribou do. Aggregations of Peary caribou are largest in summer, autumn and early winter, but even at those times groups of 25 or more individuals would be relatively rare. However, disturbance of social groups and/or larger temporary aggregations could have a significant impact and possibly lead to increased mortalities, particularly during spring calving and spring-summer postcalving.

Although pregnant cows are spaced away from each other and usually solitary at the time of giving birth, any disturbance during or immediately after the birthing process could markedly increase losses of newborn calves. Any prolonged separation of maternal cows from their newborn calves could have lethal consequences. Small group sizes during mid winter and late winter would minimize the detrimental exposure of Peary caribou to human-induced novel stimuli.

Condition/fat reserves

Any disturbance that requires additional energy or interferes with feeding has the greatest effect in late winter and spring (calving and early postcalving). Pregnant females about to give birth would have the greatest demands and, thus, would likely be more subjected to any detrimental response resulting from human-induced activities or their associated structures. Intense and prolonged interference could be important even during summer and autumn, especially to calves. Peary caribou have to maximize their intake of high-quality forage at those times for nutritional recovery, body growth and the accumulation of body reserves for vigorous breeding activities during the early winter rut and maintenance throughout the coming long winter and spring.

Area fidelity

Female Peary caribou use traditional calving and early postcalving areas. **The use of most of those**

areas is mandatory in years with unfavourable snow and ice conditions that severely restrict forage availability at those times on other portions of the range. Therefore, calving and early postcalving areas should be considered especially important critical habitat for the continued prosperity of the caribou population. Most of the same areas will be used for calving and early postcalving even in years with relatively favourable snow condition and the general absence of widespread icing.

This condition pertains because the physical characteristics of those areas consistently lead to patchy snow-free and shallow snow-covered sites before snow melts throughout the rest of the range. There also appears to be a high rate of repeated use of the same general rutting (breeding) areas from year to year. This condition results in repetitive use of some sections of early winter range. In unfavourable years, particularly the worst ones, the severe restriction of available forage due to snow and/or ice cover compresses the amount of usable range throughout the winter into and sometimes through spring.

The **most stringent bottle-neck** in relative forage availability consistently **occurs each year in late winter and spring**, regardless of the level of severity caused by the then prevailing snow and ice conditions. In the worst years, however, levels of severely limiting snow and ice cover can initiate lethal conditions as early as the later part of early winter.

Reproduction

Human-caused disturbance can result in abandonment of calves by their mothers and lead to higher levels of calf deaths during calving into early winter before the calves are weaned. **Avoidance or displacement from the most favourable calving areas could significantly reduce production of viable neonates.** Drastic losses or even essentially total calf crop failures can occur in years when parturient and maternal cows are experiencing exceptionally severe and greatly prolonged relative unavailability of forage. This condition would be especially harsh if the cows were forced to avoid or abandon areas with critical habitat sites, which were necessary for their survival and subsequent production of viable young. **Disturbance and displacement of cows and calves during the first month or two after birth could result in increased mortality of calves and even many cows.** All caribou are susceptible to such exposure during wintry periods of the year, usually late winter and spring, but in the worst years even during early winter and mid winter.

Environmental stress

Survival and physical condition of Peary caribou are influenced by weather-related factors (mainly snow/ice, timing, amounts, distribution, persistence and characteristics; the resulting relative unavailability of forage; and timing, abundance and quality of plant growth). Other than for these weather and forage-related concerns, the greatest ecological pressure comes from wolf predation (see below). When environmental stress actually sets in, its additive effects can initiate deterioration of body condition, as early as November during exceptionally unfavourable years. Most of the individuals would not succumb, however, until late winter or even spring. Also, the subsequent impact on the calf crop could not be detected until the spring calving and early postcalving period or even well into the summer period.

Mortality

Human-induced disturbance and hindrance, or especially prevention of seasonal use of critical habitat, would be seriously debilitating or even lethal to Peary caribou because of the often widespread and sometimes range-wide relative unavailability of forage brought on by then prevailing snow and ice conditions.

Predation

The greatest detrimental pressure on Peary caribou, other than weather/forage related stresses, comes from wolf (*Canis lupus*) predation. Heavy predation could lead to an imbalance between caribou and wolves when a Peary caribou population is in a multi-year decline. When the Peary caribou population is at a crucially low number, even light wolf predation could become a paramount factor in depressing the number of caribou even lower and greatly delaying or preventing recovery of the caribou population until the pressure of wolf predation is removed. This condition can be true even in the presence of favourable snow and ice conditions and an abundant high quality forage supply.

Caribou range sensitivity

Intensity of use

Any area that is used in almost every year and particularly in the most unfavourable years is crucial to the continued well-being of the caribou population and should receive the highest level of protection (i.e. critical habitat). The same late winter foraging sites and spring calving and immediate postcalving areas are used almost every year. What makes these areas particularly important is that they represent only a small portion of the total range - as they must be either snow-free or with shallow snow cover at those times of the year (and no ice on, in or under the snow cover).

Relative size of seasonal range

This factor is related to the “Intensity of range use” but is not related to group and population size. Snow and ice conditions and durations dictate the amount of the overall range that will be available to foraging animals at different seasons of the year. Therefore, the greatest restrictions of access to range occur as the long (Sep-Jun) wintry part of the year progresses. The greatest environmental ‘bottle-neck’ occurs in each and every year during late winter and spring periods. More and more range becomes available to the caribou with increasing loss of snow cover and/or ice, which also allows access to the previously unavailable better vegetated sites. Thus, vastly reduced late winter and spring ranges need the greatest protection. However, **seasonal ranges in all periods of the year, regardless of relative size, require protection at a level that enables the population to prosper, because the annual range is - “only as good as its weakest link”** (see below).

Food value

For successful reproduction, caribou require, from conception until birth, a high level of nutrition and adequate availability of forage of satisfactory quality. This must be followed by an ample supply of high-quality forage during lactation (summer-autumn) to promote high rates of early survival of newborn calves. The ability to obtain sufficient amounts of satisfactory quality forage is important year-round for all caribou regardless of sex or age. The highest quality forage is consistently

obtained in the summer and autumn periods of plant growth. Maintenance level diets pertain for most of each year. Therefore, any human-caused disturbance that hinders or prevents ready access to high-quality forage during its relatively short span of availability is of special concern and can be considered a potential serious threat.

Escape value

It is important that the overall range available to caribou at every season (period) of the year is large enough to allow escape from predation and to allow enough habitat for caribou to be able to space out over the range. With adequate habitat, predation is spread around and aggressive encounters between caribou are reduced when bulls and most young males are separated at satisfactory distances from females for most of the year. This separation is particularly important shortly before, during and immediately after calving. This is accomplished by males following patterns new plant growth on coastal areas, while females and calves space-out on more exposed, poorer vegetated, interior sites at intermediate elevations.

Sensitivity to pollutants

Lichens are vulnerable to pollutants deposited by atmospheric fall-out. Although lichens are generally scarce on the Queen Elizabeth Islands and make up only a minor portion of the Peary caribou's diet compared to mainland barren-ground caribou, lichens are utilized and especially during the wintry period (Sep-Jun). There currently is no apparent reason for major concern at this time but the potential for nuclear accidents and radioactive fall-out over the Canadian Arctic from atmospheric transport is real.

Table 5. Factors used to develop caribou sensitivity ratings^a during the ‘caribou-year, spring (Jun) through late winter (Mar-May)

Seasons of the year ^b	Response to disturbance	Density and group size	Condition/ fat reserves	Area fidelity	Reproduction	Mortality	Environmental stress ^c	Overall rating ^d
Spring	5	5	5	5	5	5	5	5.0
Summer	5	5	5	3	4	5	5	4.6
Autumn	4	4	4	1	4	2	4	3.3
Early winter	3	3	3	1	3	3	3	2.7
Mid winter	2	2	2	2	1	4	2	2.1
Late winter	4	2	4	4	2	5	5	3.9

cont.

Appendix A - Table 5. Continued

^a Notes on factors are provided below, relative ratings range from 1 (Very low) to 5 (Best).

^b Periods of the year by month(s) are described in Table 1.

^c Weather (snow, ice and freezing rain) and predators.

^d Overall rating is the sum of ratings for each factor within each period of the year divided by the number of factors: e.g., Spring (Jun) period is $5 + 5 + 5 + 5 + 5/5 = 24/5 = 5.0$.

Table 6. Factors used to develop Peary caribou range sensitivity ratings^a during the ‘caribou-year, spring (Jun) through late winter (Mar-May)

Seasons of the year ^b	Intensity of use	Relative size	Food value	Escape value	Sensitivity to pollutants	Overall rating ^c
Spring	5	5	4	5	5	4.8
Summer	1	1	5	5	2	2.8
Autumn	2	2	4	4	2	2.8
Early winter	3	3	3	3	5	3.4
Mid winter	4	4	2	2	5	3.4
Late winter	5	5	2	2	5	3.8

cont.

Table 6. Continued

^a Notes on factors are provided below and relative ratings range from 1 (low) to 5 (high).

^b Based on annual cycle of seasons relative to life history events or stages and nutritional states of caribou (see Table 1).

^c Overall rating is the sum of ratings for each factor within each period of the year divided by the number of factors: e.g., Spring (Jun) period is $5 + 5 + 4 + 5 + 5/5 = 24/5 = 4.8$.

Appendix B - Seasonal habitat ranges for Peary caribou on Bathurst Island and in the Bathurst Island Complex