BEAR LITERATURE REVIEW AND PROPOSED MANAGEMENT STRATEGY FOR VUNTUT NATIONAL PARK, YUKON

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May 2000

EXECUTIVE SUMMARY

This report is a review of relevant published research on northern bear populations and assesses the usefulness of this information for the management of both grizzly bears and black bears in and around Vuntut National Park (VNP), Yukon. A management strategy for the bear populations in VNP is proposed following this review.

Grizzly Bear Ecology

Based on the work of Ferguson and McLoughlin (in press) and McLoughlin et al. (draft manuscript), I divided grizzly bear populations into different geographic distributions that appeared to correlate with differences in environmental and population parameters. These were barren-ground, interior, and coastal. I further divided interior grizzly bear populations into northern and southern interior to highlight the expected differences due to latitude. Mitochondrial DNA phylogeny does not uniformly support any previously published taxonomic classifications for grizzly bears based on morphology nor is any phylogentic clade supported by a subspecific taxonomic classification (Waits et al. 1998). Despite the ongoing re-evaluation of current grizzly bear taxonomic classification, I expect that contiguous populations of grizzly bears in the Yukon, including VNP, will continue to be one subspecies.

Banci (1991), Banci et al. (1994), and McLellan and Banci (1999) recommended that grizzly bear populations in the Subarctic Mountains grizzly bear zone, which includes VNP, be considered "vulnerable" as a result of past and current human activity. Banci *et* al. (1994) considered that the current impacts of land-use activities on grizzly habitat in the Subarctic Mountains grizzly bear zone were moderate for mining and low to moderate for petroleum and human access. In the future, however, the impacts of these land-use activities were expected to increase to high for mining, moderate to high for petroleum, and moderate for access (Banci *et al.* 1994).

A portion of the northeast part of VNP is within the Barn Range study area of Nagy et al. (1983a), therefore the grizzly bear density in this area are likely similar to what they found. However, the hills and large pediment slopes of the Old Crow Basin to the west of the Barn Range appeared to have lower quality grizzly bear habitat than the Barn Range. This area also appeared to have lower quality bear habitat than the Buckland Hills and lower British Mountains of Iwavik National Park to the north. As a result, I estimated the overall grizzly bear density in the Old Crow Basin and British-Richardson mountains ecoregions of VNP as approximately 15 bears/1000 km^2. These *ecoregions* of VNP are approximately 2,900 km^2, therefore, this suggests a population of approximately 44 grizzly bears for these two ecoregions withii VNP. I suspect that grizzly bear densities are lower in the Old Crow Plats because habitats appeared to be less diverse and of lower quality, although bears may be able to supplement their diet by feeding on moose calves and muskrats in the spring and early summer. As a result, I estimate grizzly bear density to be approximately 6 bears/1000 km* and since the ecoregion is approximately 1,450 km^2, this suggests a population of approximately 9 grizzly bears. Overall, I estimate approximately 53 grizzly bears within VNP or approximately 12 bears/1000 km^2 (82 km^2 per bear).

The area of the Special Management Area (SMA) outside VNP is approximately 10,666 km^2. Grizzly bear densities in the eastern and southern portions of the SMA are likely higher than within the Old Crow Flats because the land is higher and drier, consequently it has more habitats where bears can feed and travel. As a result, I estimate grizzly bear density within the SMA outside of VNP to be 9 bears/1000 km^2, which suggests a population of approximately 96 grizzly bears. The bear population estimates given for VNP and the SMA are my best guesses based on work done in other study areas. They have not been substantiated with field work, so they should be used with caution. My population estimates were considered to be all bears, not just bears >2.

I suspect that the grizzly bear population of VNP is relatively stable since it is only lightly hunted and therefore should have a predominately adult cohort within the range of 50-60% adults 6 years of age or older, but also should have healthy recruitment in the younger age classes. The grizzly bear population likely has a similar range of reproductive rates as other northern grizzly bear populations, that is, bears likely become sexually mature between 6-9 years old, have litter sizes of 1.7-2.3 cubs per litter, and have an interval between litters of 3-4.5 years. Cub mortality in VNP is likely as high as observed in other northern studies, therefore I estimate it to be between 35-45%. Adult female survivorship in VNP is likely 90-98%.

I estimate grizzly bear home ranges to be in the range of 250-350 km^2 for females and 750-900 km^2 for males in the Old Crow Basin and British-Richardson mountains ecoregions of VNP. I estimate grizzly bear home ranges to be to be in the range of 650-750 km^2 for females and 1150- 1250 km^2 for males in the Old Crow Flats of VNP. All bear trails and rubbing or marking trees that I found in the Thomas Creek Valley of VNP were on valley bottoms adjacent to creeks and rivers. They were primarily marked by grizzly bears; there was no indication that black bears had used them. There do not appear to be any major barriers to grizzly bear movement in VNP. Movement within the Old Crow Flats likely is along creek and river edges and around lake margins.

I suspect that grizzly bears in VNP will be active in the range of 60-80% of the time. They would likely be inactive or resting 20-40% of the time. Feeding and foraging would likely be about 45 to 65% of their overall time budget. Other active behaviours would include travel (4-8%), intraspecific interactions with other bears (1-5%) and other behaviours such as marking, interspecific interactions, drinking, grooming, defecating, etc. (1-1.5%, MacHutchon in press). I suspect grizzly bears of VNP generally will have a diel activity pattern with bimodal activity peaks in the morning and evening, particularly with increasing hours of darkness during late summer. The breeding season of grizzly bears in VNP is likely between mid-May and mid-July.

I suspect that grizzly bears in VNP enter dens between mid-September to late October and emerge from dens from late April to late May. The timing and duration of denning will likely vary between sex and age classes with male bears denning later and emerging earlier than females. Pregnant females will generally den for longer periods than do solitary females or females with yearlings. I suspect that most grizzly bears of VNP den on southerly facing slopes of 30-70% (17-35"). The elevation distribution of dens will be dependent on the availability of suitable denning habitat. Most bears likely den in the hills and mountains of VNP, rather than the Old Crow Flats. Dens are likely located in dry to mesic habitats on south-facing shrub or tree dominated mountain slopes. Natural caves within the limestone rock outcrops in the mountains of VNP are also likely used for dens. Any denning on the Old Crow Plats is probably limited to dry, relatively steep riverbanks.

I propose four seasons of activity for grizzly bears in VNP,

1. Spring: den *emergence* to June 15
2. Summer: June 16 to July 15
3. Late Summer: July 16 to August 31
4. Fall: September 1 to den entrance

I suspect the most well used foods of grizzly bears in VNP during the spring and early summer are bearroot (*Hedysarum alpinum*) roots, overwintered berries, sedges, grasses and horsetail (*Equisetum* spp.). The main overwintered berries used are likely kinnikinnick *(Arctostaphylos uva-ursi)*, bearberry *(Arctostaphylos rubra or A. alpina)* and crowberry (*Empetrum nigrum)*. Graminoids and horsetail are probably not readily available until late spring or early summer. I suspect the most well used foods during the summer are "green" vegetation or forbs, such as horsetail, sedges, and grasses, as well as early ripening berries. Mountain sorrel *(Oxyria digyna)* is probably eaten occasionally, as are other forbs. Various fruits are likely the main foods as soon as they start ripening in late July or early August (i.e., late summer). Blueberry *(Vaccinium uliginosum)*, soapbcrry *(Shepherdia canadensis)*, crowberry, bearberry, kinnikinnick, red currant *(Ribes triste)*, lingonberry or cranberry (*Vaccinium vitis-idaea*), and cloudberry or salmonberry (*Rubus chamaemorus*) are berry producing species that are likely eaten from late July to mid-September. Grizzly bears probably dig for bearroot roots and ground squirrels during the fall when berry availability decreases. Bearroot roots also are likely more important during poor berry years. Mammals are likely important foods whenever grizzly bears can get them. The main mammal foods are likely caribou, moose, arctic ground squirrels, voles, and lemmings. Bears likely kill or scavenge adult and yearling caribou in spring when the caribou move northward to their calving grounds along the Yukon and Alaska coastal plain. Grizzly bears likely kill or scavenge adult, yearling, and calf caribou in summer when the caribou move to their mid-summer range in the northeast comer of VNP. In spring, grizzly bears likely kill moose calves shortly after they are born.

A *Vuntut Gwitchin Oral History Study* is currently in the initial phases of research to gather traditional knowledge of the Vuntut Gwitchin First Nation. As part of their larger mandate, the project will try to gather information on Vuntut Gwitchin knowledge, beliefs, and uses of bears. I am not aware of any information on historical bear-human interactions in VNP. I suspect there were occasional problems with bears breaking into hunting and prospecting camps and likely occasional close encounters between bears and people. Poor garbage management at long term camps may have led to the death of some bears that became food-conditioned.

Currently, visitors to VNP are infrequent and this level of human activity likely has not adversely impacted the grizzly bear population. VNP is also closed to licensed hunting by non-native Yukon residents. Several Vuntut Gwitchin people currently live seasonally at a few Permanent camps in VNP and hunt on the land. Other people occasionally travel to the park from Old Crow. The impact of their activity on grizzly bears in the park is unknown.

Black Bear Ecology

There is little known about the ecology of northern black bears, particularly at the northern extent of their range, and Vuntut National Park is situated at this northern extent. Black bear populations in the Yukon are considered stable (Barichello 1997). Populations north of approximately 65" latitude in the Yukon are expected to occur in low densities and be primarily found in forested areas (MacHutchon and Smith 1990).

I suspect that black bears only rarely travel in to the Old Crow Basin Ecoregion from the Old Crow Plats. Black bear densities likely decrease from the area around the Porcupine River near Old Crow to the Old Crow Plats and then further decrease from the southern flats to the flats within VNP. Densities around the Porcupine River may be as high as observed in northern interior Alaska, that is between 90 to 100 bears/1000 km^2. However, black bear densities in the Old Crow Plats of VNP are likely as low as grizzly bear densities in the MacKenzie Delta and Arctic Coastal Plain, that is, 4-9 bears/1000 km2, which suggests a population of approximately 6-13 black bears. More information is required on the distribution and number of sightings of black bears within the Old Crow Plats, particularly within VNP to substantiate these estimates. The density in VNP may be higher if black bears in fact use the flats more than I suspect.

Black bear populations that are only lightly hunted, such as in VNP, could be relatively stable and therefore have a relatively higher adult cohort. However, because the black bear population is at the northern extent of its range, it also may be predominately adult bears because of low recruitment rates. It is hard to know which of these scenarios is most likely for this poorly understood system. I suspect that the sex ratio in the black bear population of VNP may be opposite to what is normally described, that is there may be more males than females. I think that there may be more males because of their higher dispersal from more densely populated areas to the south, the more wide ranging movements of male bears, and because the population appears to be lightly hunted, therefore, there will be less pressure than normal on this segment of the population..

I estimate that black bears in southern VNP become sexually mature between 6 to 7 years of age, have litter sires of 1.9 to 2.5 cubs, and have intervals between litters of 2 to 3 years. Black bear cub mortality in VNP may be as high or higher than reported in other northern studies, that is 30-40%, because there is minimal security habitat available, females are occupying habitats that are not very productive, and there is some competition with grizzly bears. It is hard to predict what the adult male and female survivorship in VNP would be, but is likely lower than the 90-100% found in other populations.

I suspect that black bear 100% minimum convex polygon home ranges in the Old Crow Plats Ecoregion are likely in the range of 50-100 km^2 for adult females and 100-500 km^2 for adult males. There do not appear to be any major barriers to black bear movement in VNP. Movement within the Old Crow Plats likely is along creek and river edges and around lake margins.

The breeding season of black bears in VNP is likely between mid-May and late July. I suspect that den entrance may be in early September and den emergence in late May. Most black bear dens in the Old Crow Plats are probably in similar habitat types as black bear dens were on the

Tanana River Plats, Alaska, that is in willow/alder and black spruce habitats. In addition, black bears may den in excavations along dry riverbanks.

I suspect that black bears in VNP will have similar shifts in their use of major foods as grizzly bears and I propose the same four seasons of activity for black bears in VNP. I suspect the most well used foods of black bears during the spring and early summer are overwintered berries, sedges, grasses, and horsetail. It is likely that black bears in VNP feed heavily on the catkins of balsam poplar and willow in the spring as well. The main overwintered berries used are likely kin&&nick, bearberry, and crowberry. Graminoids and horsetail arc probably not readily available until late spring or early summer. I suspect the most well used foods during the summer are green vegetation or forbs, such as horsetail, sedges, and grasses, as well as early ripening berries. Various fruits are likely the main foods as soon as they start ripening in July or early August. Blueberry, soapberry, crowberry, beat-berry, kinnikinnick, red currant, lingonberry, and cloudberry or salmonberry are berry producing species that are likely eaten from late July to early September. Black bears likely continue to forage for berries, scavenge carrion, and hunt microtines during the early fall. Mammal prey or carrion is likely an important food whenever black bears can get it. The main mammal foods are likely caribou, moose, voles, and lemmings. In spring, bears likely scavenge caribou killed by other predators such as wolves and grizzly bears when the caribou move northward to their calving grounds. In fall, black bears may be able to scavenge caribou that are kiied by other predators or kill first year calves when the caribou are on their way to their wintering areas south of the Porcupine River. In spring, black bears likely kill moose calves shortly after they are born.

I am not aware of any information on historical bear – human interactions in VNP. The black bear population of VNP is likely constrained by the same factors as grizzly bears, that is a relatively short season available to acquire the necessary energy for growth, reproduction and over-winter survival and available habitats that may be of limited quality. As a result, they also could be impacted by human use in the park Currently, visitors to VNP are infrequent and this level of human activity likely has not adversely impacted the black bear population.

Proposed Bear Manaeement Strategy

The following is a proposed bear management strategy for VNP that is intended to be implemented in two stages over ten years. This management strategy draws on the knowledge and understanding of bear ecology in VNP gained from the literature review and synthesis and it also draws on management strategies that have been implemented in other national parks and adjacent jurisdictions.

Report Section / Number	Strategy	Implementation Stage	
		5 year	10 year
4.2.1	**Human Food & Garbage Management**		
1	Consider providing bear-resistant food canisters or bags for the voluntary use of visitors to VNP.	X	
2	Provide information on managing human food and garbage to Park visitors through an active public education and bear awareness program.	X	
3	Provide information on managing human food and garbage to Vuntut Gwitchin people through informal talk, public education and bear awareness materials, the NYRRC, and the Vuntut Gwitchin government.	X	
4	Compile any relevant Vuntut Gwitchin knowledge about managing human food and garbage that can be used in the bear awareness material made available to Park visitors and other Vuntut Gwitchin people. In turn, provide the Vuntut Gwitchin with materials available from other non-native sources on managing human food and garbage.	X	
5	Formally and informally, encourage the reporting of any bear problems or bear kills at camps both inside and outside VNP.	X	
6	Work with the Vuntut Gwitchin and other management agencies in areas bordering the park to identify problem areas and minimise the potential for bears to obtain food or garbage from camps in or adjacent to the park.	X	
7	Informal, co-operative efforts would be best for identifying and dealing with potential bear - human interaction risks around existing Vuntut Gwitchin camps and other human use sites.	X	
8	Parks Canada may need to conduct more formal assessments of the risk of bear - human interactions at proposed research camps or facilities, commonly used visitor use sites, and proposed Park facilities.	X	
4.2.2	**Bear Awareness Education**		
1	Provide all VNP staff with in-depth bear safety orientation training.	X	
2	Develop a bear awareness program, including pre-trip information package that focuses on the importance of not only understanding but also applying the principles covered.	X	
3	Describe the ecological characteristics of VNP that are relevant to public understanding of the food habits, distribution, and movements of bears in the park within the pre-trip information package.		X
4	Visitors should be encouraged to read the "*You are in Bear Country*" brochure or similar information in the pre-trip information package.	X	

5	Visitors should be provided with the opportunity to view the *'Staying Safe in Bear Country"* video that is currently being produced.	X	
6	Promote a "pack in/pack out" policy to park visitors.	X	
7	Properly identify the dangers of approaching bears too closely and the legal implications of feeding-or harassing wildlife.	X	
8	Request that visitors , Vuntut Gwitchin First Nation people, and researchers record and report any bear observations, encounters or incidents to Parks Canada staff.	x	
9	Recommend that visitors carry a deterrent against bear attacks, such as bear spray.	X	
10	Encourage visitor use of bear-resistant food canisters or bags , while travelling in VNP.	X	
11	Recommend that visitors travel in groups of three or more people when hiking and camping.	X	
12	Encourage the publishing of accurate, up-to-date information by providing current bear awareness and pre-trip information materials for use in any guidebooks published on recreation in the northern Yukon.		X
13	Encourage the exchange of information on safety around bears with Vuntut Gwitchin people through informal talk the NYRRC, and the Vuntut Gwitchin government.	X	
14	Compile any relevant Vuntut Gwitchin knowledge about human safety around bears that can be used in the bear awareness material made available to park visitors. In turn, provide the Vuntut Gwitchin with materials available from other sources on human safety around bears.	X	
4.2.3	Bear Sightings, Encounters & Incidents		
1	Develop a Bear Management *Plan or Public* **Safely** *Plan* that outlines the roles and responsibilities of Parks Canada staff regarding bear management.	X	
2	Ensure that key Park Warden staff obtain appropriate training in bear capture and immobilisation.	X	
3	Ensure that Parks Canada staff receive accurate information on bear -human incidents within VNP from visitors or Vuntut Gwitchin people.	X	
4	Work on co-operative communication arrangements with the Vuntut Gwitchin and Canadian and American Federal, Territorial, and State government agencies for the sharing of information on bear - human incidents occurring in and around VNP	X	
5	Systematically record observations of bears by park staff, Vuntut Gwitchin people active in the Park and by park visitors.	X	
6	Establish a bear observation and encounter database and when there is sufficient data, use it to learn more about the ecology of bears in VNP and to evaluate potential problem areas in and around VNP.		X
4.2.4	Sustainable Harvest		

1	Work with the NYRRC and Vuntut Gwitchin First Nation to determine and monitor the number of grizzly bears harvested each year or killed in defence of life and property within VNP.	X	
2	Assist the NYRRC and Vuntnt Gwitchin First Nation to determine and monitor the number of grizzly bears harvested each year or killed in defence of life and property within the Old Crow Flats Special Management Area (SMA) outside of VNP, as well as in areas along and south of the Porcupine River.	X	
3	Formally and informally, encourage the reporting of any bear problems at camps both inside and outside VNP.	X	
4	Work with management or co-management agencies in other jurisdictions bordering the park to determine and monitor the number of grizzly bears harvested each year or killed in defence of life and property.	X	
5	If the number of grizzly bears kills in VNP and surrounding areas becomes a concern to Parks Canada staff, then it may be necessary to work with the NYRRC to encourage the establishment of total allowable harvests for grizzly bears within VNP.		X
6	Discuss with the NYRRC and Vuntnt Gwitchin First Nation the idea of protecting black bears from harvest within VNP.		X
4.2.5	**Vuntut Gwitchin Local & Traditional Knowledge**		
1	Encourage the gathering of Vuntut Gwitchin local or traditional knowledge about bears and bear ecology through the *Vuntut Gwitchin Oral History Study.*	X	
4.2.6	Field Data Collection		
1	Parks staff should record any local knowledge about bears that they receive in conversation with Vuntut Gwitcbin people working or living on the land.	*X*	
2	Ensure that staff *working* in the park record all bear observations as in section 4.3.3.	X	
3	Informal, co-operative efforts would be best for identifying and dealing with potential bear - human interaction risks around existing Vuntnt Gwitchin camps and other human use sites.	X	
4	Parks Canada may occasionally need to conduct more formal assessments of the risk of bear - human interactions at proposed research camps or facilities, commonly used visitor use sites, and proposed Park facilities.	X	
5	Examine den sites encountered while travelling in the park and measure den site characteristics.	X	
6	Examine mark trees in the field to try and determine which species of bear arc using them.	X	
7	If estimating seasonal food habits of bears is considered a priority of Parks Canada and in the absence of adequate staff training and experience, it would be best to have scats send out to a lab for analysis.	X	

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1 .O INTRODUCTION

Detailed information on the population and habitat ecology of bear populations is expensive and difficult to obtain. Yet this information, together with Fist Nations traditional knowledge, forms the foundation for an effective management strategy of bear populations in isolated, northern National Parks. This report is a review of relevant published research on northern bear populations and assesses the usefulness of this information for the management of both grizzly bears and black bears in and around Vuntut National Park (VNP), Yukon. A management strategy for the bear populations in VNP is proposed following this review.

The *Vuntut Gwitchin First Nation Final Agreement* (VGFNFA) commits Parks Canada to co-operative management of VNP with various Vuntut Gwitchin organisations. Part of the co-management process will involve the development of a Park Management Plan (PMP). The PMP will set out the purpose, goals, and operating principles to guide the development and management of the park. Assembling a database of information on the wildlife of the park and surrounding area is an integral component of the planning process.

After the introduction, section 2.0 of this report reviews the geographic and ecological setting of VNP. Section 3.0 is a review and synthesis of research and management reports on northern grizzly bear and black bear populations that were considered relevant to understanding the ecology of bears in VNP. Relevant reports are found in two bear literature binders (BLB) that accompany this report. In the literature review and synthesis, I refer to papers in the bear literature binders or elsewhere and I briefly summarise relevant information. Following this, I propose values or ranges of values that I think provide a plausible understanding of bear ecology in or around VNP. Vuntut Gwitchin traditional knowledge and information from Parks Canada staff and local people familiar with VNP was incorporated into the review as well. Topics of discussion for both grizzly bears and black bears are distribution, taxonomy and morphology, status, population characteristics, home range, movement and activity, feeding ecology, seasonal habitat use, Vuntut Gwitchm traditional knowledge, and management issues and concerns. The bear population estimates given in section 3.1.3a for VNP and the Special Management Area are my best guesses based on work done in other study areas. They have not been substantiated with field work, so they should be used with caution.

Section 4.0 is a proposed bear management strategy for VNP. Recommendations toward an effective bear management strategy for VNP that can be implemented in several phases are provided. Whenever possible, I suggest simple methods that can be used to gain more information on bear ecology in VNP and to test some of the predictions developed from the literature review.

2.0 VUNTUT NATIONAL PARK

Much of the following is from the Vuntut National Park ***Interim Management Guidelines.*** Vuntut National Park is 4,345 **km²** in size and is located in the northwestern comer of the Yukon Territory, north of Old Crow and immediately south of Iwavik National Park. VNP is bounded at the height-of-land to the north by Iwavik National Park, on the east by Black Fox Creek to its confluence with the Old Crow River, on the south by the Old Craw River and to the west by the Arctic National Wildlife Refuge, Alaska.

VNP was established by the VGFNFA in February 1995. VNP is part of the traditional territory of the Vuntut Gwitchin First Nation who are currently centred in the community of Old Crow located 60 km south of VNP.

Canada is divided into 15 ecozones under an ecological classification system VNP is located within the Taiga Cordillera Ecozone. This ecozone is located along the northernmost extent of the Rocky Mountain system and covers most of the northern half of the Yukon and northwest comer of the Northwest Territories. This ecozone is further divided into seven ecoregions of which three, the Old Crow Basin, the Old Crow Flats, and the British-Richardson Mountains, are represented within VNP's boundaries.

The following descriptions are from Ecological Stratification Working Group (1996).

2.1 Old Crow Basin Ecoregion

Most of the northern two thirds of the Park are the rolling hills and pediment slopes of the Old Crow Basin Ecoregion. The landscape is generally flat to gently rolling terrain lying within the non-glaciated Porcupine Plain and Old Crow Range. The ecoregion has a strong continental climate. Mean annual temperature for the area is -9.5°C with a summer mean of 7.5°C and a winter mean of -26°C. Mean annual precipitation ranges from 200-300 mm.

This region is classified as having a high subarctic ecoclimate. Open, very stunted stands of black spruce and tamarack, with secondary quantities of white spruce and ground cover of dwarf birch, willow, ericaceous shrubs, cotton grass, lichen and moss are predominant. Tussock tundra vegetation covers most gentle slopes. Permafrost is continuous with areas of medium ice content most abundant. Turbic Cryosols found on loamy, gently sloping pediments and on clayey lacustrine material are dominant. Regosolic and Regosolic Static Cryosols occur on river floodplains. Wetlands cover much of the ecoregion. Characteristic wetlands are polygonal peat plateau bogs with basin fens and locally occurring shore fens.

Characteristic wildlife includes caribou, grizzly and black bear, moose, beaver, fox, wolf, hare, raven, rock and willow ptarmigan, and golden eagle.

2.2 Old Crow Flats Ecoregion

The southern third of VNP is made up of the wetlands and oriented lakes of this non-glaciated ecoregion. This ecoregion is a glaciolacustrine plain that makes up the lowest portion of the Old Crow Basin. This level, low-relief ecoregion, locally referred to as "the Flats" lies at about 300 m above sea level. The climate is strongly continental. Mean monthly air temperature ranges are as extreme as anywhere in North America. Short, warm summers contrast with long, very cold winters. The mean annual temperature for the area is -10°C with a July mean of 14.5°C and a January mean of -27°C. Mean annual precipitation ranges from 200-250 mm. The region is classified as having a high subarctic ecoclimate.

Characteristic wetlands cover most of the ecoregion and are made up of polygonal peat plateau bogs with basin fens and locally occurring shore fens. Organic Cryosols are the most common wetland soils. Better drained portions of the land support open, very stunted stands of black spruce and tamarack, with minor quantities of white spruce and ground cover of dwarf birch, willow, ericaceous shrubs, cotton grass, lichen and moss. Static Cryosols on sandy alluvial material and Turbic Cryosols on loamy, ice-rich lacustrine material dominate the mineral soils of the ecoregion. Permafrost is continuous with a high ice content in the form of ice wedges and massive ice bodies.

Characteristic wildlife includes caribou, grizzly and black bear, moose, beaver, muskrat, fox, wolf, hare, raven, rock and willow ptarmigan, and bald and golden eagle.

The Old Crow Flats (14,970 km^2) is designated as a Special Management Area (SMA) in the VGFNFA. It is comprised of Vuntut National Park, Vuntut Gwitchin First Nation Settlement Land Blocks R-01A and R-10A, and additional land east and west of the settlement land blocks. The Canadian Wildlife Service, North Yukon Renewable Resource Council, Vuntut Gwitchii First Nation, and Yukon Territorial Government all have responsibilities for various aspects of the management of the SMA outside Vuntut National Park. Forty-one percent of the SMA (6,170 km'), including the area within VNP, was designated as a wetland of international significance under the Ramsar Convention in 1982. The productivity of these wetlands is considered remarkably high given the latitude. The area is important as a breeding and moulting ground to some 500,000 water birds.

2.3 British-Richardson Mountains Ecoregion

A small portion of the northeast side of VNP are the foothills and scattered peaks of the non-glaciated Barn Range. This small, low elevation mountain range is between the British Mountains to the northwest and the Richardson Mountains to the east and southeast. This ecoregion has short, cool summers. Winters are generally cold, although winters at higher elevations are more moderate during frequent periods of temperature inversion. Major mountain passes can be subject to strong outflow winds, causing severe wind chill conditions. The mean annual temperature for the area is approximately -10°C with a summer mean of 6.5°C and a winter mean of –25°C. Mean annual precipitation is around 300 mm in the northwest part of the ecoregion.

The ecoregion is characterized by alpine tundra at upper elevations and subalpine open woodland vegetation at lower elevations. Alpine vegetation consists of lichens, mountain avens, intermediate to dwarf ericaceous shrubs, and sedge, and cotton-grass in wetter sites. Barren talus slopes are common. Subalpine vegetation consists of discontinuous open stands of stunted white spruce in a matrix of willow, dwarf birch, and Labrador tea. Sedge, cotton-grass, and mosses occur in wet sites. The highest latitudinal limit of tree growth in Canada is reached in this ecoregion. The northern non-glaciated British Mountains reach 1675 m asl in the region's northern core. The ecoregion includes a small portion of non-glaciated plateau physiography composed of Tertiary sediments. Turbic Cryosols with Static Cryosols developed on colluvial and alluvial deposits are dominant. Continuous permafrost dominates in the northern half of the ecoregion. Limestone rock outcrops are significant.

Characteristic wildlife includes caribou, grizzly bear, moose, snowshoe hare, fox, and arctic ground squirrel. The ecoregion is within the range of the Porcupine caribou herd. There are no permanent settlements within the ecoregion, and land uses are restricted to subsistence wildlife trapping and hunting.

3.0 BEAR LITERATURE REVIEW AND SYNTHESIS

The following is a review and synthesis of research and management reports on northern grizzly bear and black bear populations. Reports considered especially relevant to VNP are found in two bear literature binders (BLB) that accompany this report. Appendix 1 is an annotated bibliography of all reports in the bear literature binders as well as other articles and reports on northern grizzly bear and black bear ecology that were considered of secondary interest to the project.

3.1 Grizzly Bear Ecology

Figure 1 was adapted from McLoughlin *et* al. (draft manuscript) to show the approximate location of most of the grizzly bear studies that are referred to in the following review. A list of these study areas and associated references accompanies Figure 1. Based on the work of Ferguson and McLoughlin (in press, BLB#4) and McLoughlin et al. (draft manuscript), I divided grizzly bear populations into different geographic distributions that appeared to correlate with differences in environmental and population parameters. These geographic distributions were barren-ground, interior, and coastal. Interior and barren-ground populations were characterised by relatively low density and small bears that lived in areas of low productivity and high seasonality. Coastal populations were characterised by high population density and large females that lived in areas of high primary productivity and low seasonality (Ferguson and McLoughlin in press, BLB#4). Additional differences between grizzly bear populations in different geographic distributions were suggested by McLoughlin et al. (draft manuscript). Coastal populations in areas of high habitat quality and high density generally had small home ranges and high home range overlap. Interior populations of intermediate habitat quality and density generally had moderately sized home ranges and low levels of home range overlap. Barren-ground populations with low quality habitat and low densities generally had large home ranges and high home range overlap. I further divided interior grizzly bear populations into northern and southern interior to highlight the expected differences due to latitude. The geographic distributions outlined in the study area list that accompanies Figure 1 were used throughout the following review. I suspect that bear populations in VNP fall within the ecological range of barren-ground populations, which are generally found at >65° latitude in arctic or subarctic ecosystems. However, there also may be some similarity to northern interior populations.

3.1.1 Distribution, Taxonomy and Morphology

Servheen et al. (1999, BLB #23, p. 39) shows the current and historical distribution of grizzly bears in North America. Grizzly bears are found throughout the Yukon, including VNP. The north slope of the Yukon, adjacent to VNP, is the northern extent of their range in Canada.

The following was taken from Waits *et* al. (1998, BLB #28, pp.414-415). Based on the length of the condylobassal processes of North American grizzly bear skulls, Rausch (1963) classified all mainland grizzly bears as the same subspecies (*Ursus arctos horribilis*) and all grizzly bears from the Kodiak Island archipelago (Figure 1, no. 17 & 18) as subspecies Ursus *arctos middendorffii*. Kurtén (1973) used skull measurements summarized by Rausch (1963) to propose three North American subspecies, *U.* a. *middendorffii* from the Kodiak Island archipelago, *U.* a. *dalli* of southern coastal regions of the Alaska panhandle, including Admirality, Baranoff, and Chichagof islands (ARC islands, Figure 1, islands at no. 1), and *U. a. horribilis* for all other grizzly bears. Finally, Hall (1984) utilised cranial and dentition dimensions to propose seven North American subspecies.

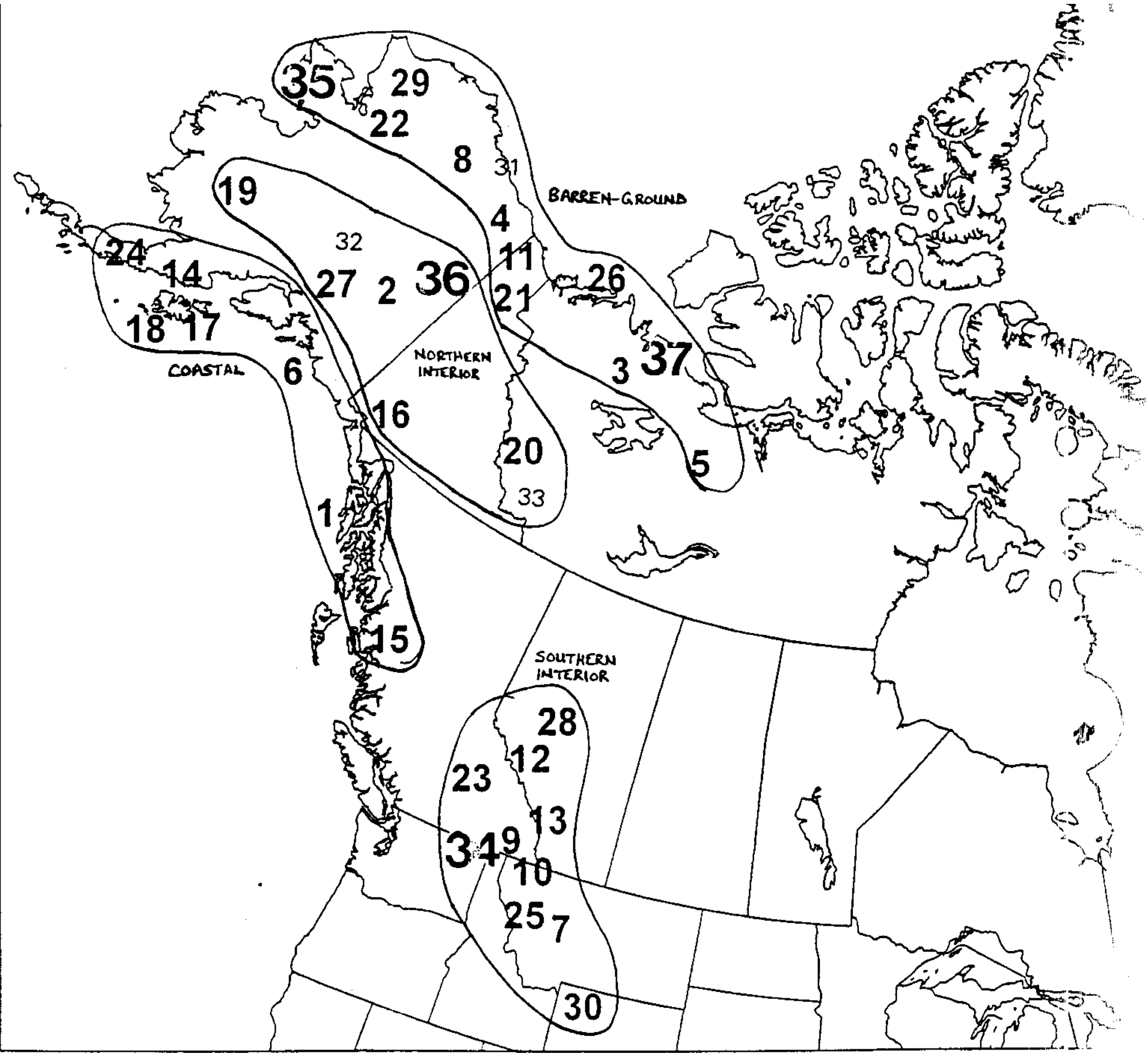

Figure 1. The location of grizzly bear study areas in North America. Refer to the accompanying list for the study area name and associated references. This figure was modified from McLoughlin ef al. (draft manuscript).

Figure 1. Continued

Map No.	Study Area	Reference(s)
	Barren-Ground	
3	Anderson-Horton R., NWT	Clarkson and Liepins (1989, 1993, 1994)
4	Arctic National Wildlife Refuge, AK	Garner *et al.* (1984, 1985, 1986), Garner & Reynolds (1986), Reynolds & Garner (1987), Phillips (1987), Young & McCabe (1997, 1998), Young *et al.* (1994)
5	Eastern NWT/Western Nunavut	Case & Buckland (1998), Gau (1998), McLoughlin *et al.* (1999, in press)
8	Eastern Brooks Range, AK	Reynolds (1976). Reynolds *et al.* (1976)
11	Ivvavik National Park, YK	MacHutchon (1996), MacKenzie & MacHutchon (1996), MacHutchon (In press)
21	Bar" Range, YT	Pearson (1972). Nagy *et al.* (1983a)
22	Noatak R., Northwest AK	Ballard *et al.* (1990, 1991.1993)
26	Tuktoyaktuk Peninsula. NWT	Harding (1976). Harding & Nagy (1980). Nagy *et al.* (1983b)
29	Western Brooks Range. AK	Reynolds (1980, 1981, 1991, 1992), Gebhard (1982). Reynolds & Hetchel (1982, 1983, 1984), Hechtel (1985)
31	Prudhoe Bay oil field. AK	Shideler and Hechtel (In press)
35	Seward Peninsula, AK	Miller & Nelson (1993). Miller *et al.* (1997)
37	Brock-Hornaday R.. NWT	Nagy & Branigan (1998)
	Northern Interior	
2	North-central Alaska Range, AK	Reynolds (1989, 1993). Reynolds 8 Boudreau (1990, 1992), Reynolds and Hetchel (1984, 1986), Reynolds *et al.* (1987), Boudreau (1995)
16	Kluane National Park, YT	Pearson (1975); McCann (1998, unpubl. data)
19	Kuskokwim Mountains. AK	Van Daele eta,. (In press)
20	Mackenzie Mountains. NWT	Miller *et al.* (1982)
27	Nelchina/Susitna basins. AK	Miller (1987, 1990a, b, c, 1993, 1994. 1997). Miller and Ballard (1980,1982), Ballard *et al.* (1982)
32	Denali National Park, AK	Stemlock (1981), Murie (1985). Stemlock & Dean (1986), Darling (1987). Dean (1987)
33	*Nahanni National Park,* NWT	*MacDougall et al. (1997)*
36	East-central Alaska	Boertje *et al.* (1987) Gasaway *et al.* (1992)
	Southern Interior	
7	East Front Rockies, MT	Aune & Brannon (1987), Aune & Kasworm (1989), Aune *et al.* (1994). Schallenberger & Jonkel (1980)
9	Flathead R. Valley. BC	McLellan (1981, 1989a, b, c), McLellan & Shackleton (1989), McCann (1991)
10	Glacier National Park, MT	Martinka (1974)
12	Jasper *National Park,* AB	*Russell et al. (1979)*
13	Kananaskis, AB	Carr (1989), Weilgus (1986). Wielgus and Bunnell (1994)
23	West Slope Rockies. BC	Woods *et al.* (1997)
23	Glacier National Park. BC	Mundy & Flook (1973)
25	South Fork Flathead, MT	Mace & Jonkel (1979.1980)
25	Swan Mountains, MT	Mace and Waller (1997, 1998), Wenum (1997)
25	Mission Mountains, MT	Servheen a Lee (1979), Servheen (1981)
28	west Central Alberta	Nagy *et al.* (1988, 1989)

Map No.	Study Area	Reference(s)
30	Yellowstone National Park. WY	Craighead *et al.* (1974, 1976, 1995), Blanchard (1987), Blanchard and Knight (1980, 1991), Knight *et* al. (1938, 1989, 1990)
34	Selkirk Mountains, ID	Almack (1985)
34	Selkirk Mountains, BC	Wielgus *et al.* (1994)
	Coastal	
1	Admiralty& Chichagof Islands, AK	Schoen and Beier (1986, 1990), Schoen *et al.* (1986, 1987), Titus and Beier (1993)
6	Copper River Delta, AK	Campbell (1985)
14	Katmai National Park, AK	Sellers *et al.* (1993), Calkins & Lewis (1990)
14	McNeil River, AK	Glenn (1973). Glen *et al.* (1976). Sellers and Aumiller (1994)
15	Khutzeymateen R. Valley, SC	MacHutchon *et al.* (1993, 1998)
17	Kodiak Island (Terra Lake), AK	Smith *et al.* (1984), Barnes *et al.* (1933). Smith and Van Daele (1990, 1991)
18	Kodiak Island (Uyak Bay), AK	Troyer & Hensel (1964), Barnes *et al.* (1988), Barnes (1990)
24	Alaska Peninsula. AK	Glenn (1973, 1975, 1980), Glenn and Miller (1980), Millers and Sellers (1992)

Five subspecies were restricted to Alaska: 1) *U a. middendorffii* of the Kodiak Island archipelago, 2) *U.* a. *gyas* of the Kenai Peninsula, 3) *U.* a. *dalli* of the northwest panhandle of Alaska, 4) *V. a. sitkensis* of southeastern Alaska including the ABC islands and the adjacent mainland, and 5) *U. a. alascensis* of the remaining mainland areas. The subspecies *U. a. sitkensis* was restricted to coastal B.C., Washington and Oregon, and *U. a. horribilis* included all inland grizzly bears in Canada and the lower 48 states. Clearly, there has not been a definitive breakdown of the different grizzly bear subspecies based on skull morphology alone.

Mitochondrial DNA analysis of grizzly bears from across North America has indicated that there are four major phylogenetic clusters or clades in different geographic regions (Waits *et* al. 1998, BLB #28). This degree of genetic differentiation of grizzly bears suggested a long-term matrilineal history of genetic isolation and the four clades may constitute evolutionary significant units. These genetically divergent populations are increasingly being recognized as appropriate units for conservation regardless of taxonomic status (Waits et *al.* 1998, BLB #28). Clade I included grizzly bear haplotypes from the southeastern Alaskan ABC islands. Clade IV were bears from southern B.C., southern Alberta, and the states of Idaho, Montana and Wyoming. Clade II were bears from throughout mainland Alaska and Kodiak Island. Clade III included grizzly bears from regions in extreme eastern Alaska and the Yukon and Northwest Territories (the region encompassing VNP). These last two clades had a contact zone in the Arctic National Wildlife Refuge, Alaska. Therefore, until additional genetic evidence is available, these two clades were promoted as one evolutionary significant unit (Waits et al. 1998, BLB #28).

Mitochondrial DNA phylogeny does not uniformly support any of the above taxonomic classifications for grizzly bears based on morphology and no phylogentic clade is supported by a subspecific taxonomic classification (Waits et al. 1998, BLB #28). However, it is suggested that additional phylogentic analysis of additional genes, particularly nuclear and Y chromosome genes, he done before current taxonomic classifications are changed (Waits *et al.* 1998, BLB #28).

Despite the ongoing re-evaluation of current grizzly bear taxonomic classification, I expect that contiguous populations of grizzly bears in the Yukon, including VNP, will continue to be one subspecies.

Table 1 outlines the range in mean weights for adult male and female grizzly bears from different populations throughout North America. Barren-ground and northern interior grizzly bears had weights within the range of variability of southern interior bears, but were generally smaller than coastal grizzly bears.

Table 1. Mean adult male and adult female weights for grizzly bear populations in North America. These data come from McLellan et al. (1994) and Ferguson and McLoughlin (in press, BLB #4).

Map NO.	Study Area	Reference(s)	Adult male weight (kg)	Adult Female weight (kg)
	Barren-Ground			
3	Anderson-Horton R.. NWT	Clarkson & Liepins (1993.1994)		105b
5	Eastern NWT/Western Nunavut	Case & Buckland (1998)		126 (60)'
8	Eastern Brooks Range, AK	Reynolds (1976)	179 (25)	109 (31)
21	Barn Range, YT	Nagy et al. (1983a)	173 (59)	116 (35)
22	Noatak R.. Northwest AK	Ballard et al. (1993)		132[a]
26	Tuktoyaktuk Peninsula. NWT	Nagy et al. (1983b)	195 (16)	124 (36)
29	W. Brooks Range. AK; 1977-1983	Reynolds and Hetchel (1964)	162 (26)	117 (35)
	Northern Interior			
2	North-central Alaska Range, AK	Reynolds (1989, 1993), Reynolds & Boudreau (1990)	224a (24)	154 (52)
16	Kluane National Pak. YT	Pearson (1975). McCann (unpubl. data)	145 (26)	121 (35)
19	Kuskokwim Mountains, AK	Van Dade et al. (In press)		170 (23)'
20	Mackenzie Mountains, NWT	Miller et al. (1962)	148 (20)	110 (28)
27	Nelchina/Susitna basins, AK	Miller & Ballard (1980, 1962). Miller (1990a, b, c), Miller (1993, 1997)	269a (12)	144 (21)
	Southern Interior			
7	East Front Rockies. MT	Aune & Brannon (1987), Aune & Kasworm (1969). Aune et al. (1994)		125
9	Flathead R. Valley, BC	McLellan (1989a, b, c)	176 (22)	114 (16)
12	Jasper National Park. AB	Russell et al. (1979)		129 (7)
13	Kananaskis, AB	Wielgus & Bunnell (1994)		120 (17)[a,d]
25	Mission Mountains. MT	Servheen & Lee (1979), Servheen (1981)		127 (3)'
28	west Central Alberta	Nagy ef al. (1939)		146 (8)[a,h]
30	Yellowstone N.P., WY; 1975-89	Blanchard (1987), Knight et al. (1988, 1969. 1990)	193 (65)	134 (63)
30	Yellowstone N.P., WY; 1959-70	Craighead et al. (1974. 1976). Stringham (1990), Blanchard (1987)	245 (33)	152 (72)
	Coastal			
1	Admiralty Island. AK	Schoen and Beier (1986, 1990)	260a (10)	168 (18)
14	Katmai National Park. AK	Sellers et al. (1993)		213 (59)
14	McNeil River, AK	Glenn (1973). Glen et al. (1976), Sellers and Aumiller (1994)	257	160
17	Kodiak Island, AK	Smith et al. (1984), Barnes et al. (1988), Smith and Van Daele (1991)	312 (10)	202 (16)
24	Alaska Peninsula, AK	Glenn (1973, 1975, 1980), Stringham (1990), Miller and Sellers (1992)	357 (21)	226 (63)

[a]Spring weights multiplied by 1.28 for females and 1.24 for males to compare with other spring/fall means (see McLellan 1994).
[b]Mean weight from 16 age classes. Data from pooled spring and fall weights.
'Philip D. McLoughlin and Francois Messier, University of Saskatchewan, data on file
[d]Michael Gibeau and Steven Herrero, University of Calgary, data on file.
[e]Robert McCann, University of British Columbia. data on file.
'Fall weights only. Divided by 1.28 to compare with other spring/fall means.
Weight estimate cited in McLellan (1994).
[h]Median weight presented in Nagy and Haroldson (1990).

Nagy (1984, BLB #14, pp. 1439-1440) demonstrated a significant correlation between body weights and chest girth measurements for 2 northern grizzly bear study areas (Barn Range, YT and Tuktoyaktuk Peninsula, NWT) as well as for the Swan Hi, Alberta. Weight to girth relationships did not differ between the two northern populations. Kingsley et al. (1988, BLB #9, pp. 982-983) presented growth curves fitted to data on age, length, and spring weight for individuals from three populations of grizzly bears in northern Canada and northwest Alaska. Females reached 90% of asymptotic length before sexual maturity and before the age of first production. Their weight remained approximately in proportion to the cube of their length. Males reached 90% of asymptotic length 0.7 to 1.7 years later than females, and had asymptotic lengths 10-15% greater. Males continued their growth in weight even longer, and reached asymptotic weights 80-100% greater than females. Variation between these populations was small compared with the total range of variation in the species.

3.1.2 Status

Banci (1991), Banci *et* al. (1994, BLB #23), and McLellan and Banci (1999, BLB #23) recommended that grizzly bear populations in the Subarctic Mountains grizzly bear ***zone*** (see Figure 2, p. 135 in Banci et al. 1994, BLB #23), which includes VNP, be considered "vulnerable" as a result of past and current human activity. Vulnerable is a Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designation and refers to any indigenous species that is particularly at risk because of low or declining numbers, occurrence at the fringe of its range or in restricted areas or for some other reason (Banci et al. 1994, BLB #23). Populations in the Subarctic Mountains were estimated at approximately 2,540 bears, which was considered to be 98% of the areas current potential. However, this number appears to be questionable. The estimate of 2,540 bears divided by the area of the zone of 397,400 km^2 gives an average density of 6.4 bears/1000 km^2 , which is likely less than it should be overall. Nevertheless, the productivity of populations in the Subarctic Mountains was considered low and consequently, hunting regulations were strict. Access was considered limited in the zone and there were few human settlements (McLellan and Banci 1999, BLB #23). Banci *et* al. (1994) considered that the current impacts of land-use activities on grizzly habitat in the Subarctic Mountains grizzly bear zone were moderate for mining and low to moderate for petroleum and human access. In the future, however, the impacts of these land-use activities were expected to increase to high for mining, moderate to high for petroleum, and moderate for access (Banci ***et*** al. 1994, BLB#23, p. 137). Total hunting and non-hunting mortality within the Subarctic Mountains has been estimated to be approximately 2.2% of the population, which was less than the estimated 4% maximum sustainable mortality, however, the proportion of the hunting kill that was female was estimated to have exceeded a safe level of 33% per year in most years. The recommendations of Banci (1991) were accepted by COSEWIC.

Protected areas within the Subarctic Mountains grizzly bear zone, such as Vuntut National Park, Iwavik National Park, Nahanni National Park and Reserve, and the newly created Fishing Branch Territorial Protected Area, which includes a wilderness preserve, habitat protected area, ecological reserve, and Vuntut Gwitchii Settlement Land, will be important core habitat reserves for grizzly bear populations to minimii the impacts of expected future increases in human activity within the zone.

3.1.3 Population Characteristics

3.1.3.a *Size and Density*

Table 2 outlines the estimated density of grizzly bear populations throughout North America. Densities are sorted from lowest to highest for each geographic distribution. Smith and Osmond-Jones (1990) compiled grizzly bear abundance estimates for the 1977 version of the ecoregion boundaries of the Yukon (i.e., Oswald and Senyk 1977). Smith and Osmond-Jones's (1990) density estimates for the former Old Crow Basin Ecoregion, which included portions of the new Old Crow Basin and Old Crow Plats ecoregions, was 11 bears per 1000 km^2 or 90 km^2/bear. This density estimate was in the middle range for barren-ground grizzly bear population estimates elsewhere. Generally, populations along the Arctic coastal plain or on the Tuktoyaktuk peninsula had much lower densities than populations in the footbills or mountains across the subarctic. Nagy (1990, BLB # 13, p. 21) reviewed grizzly bear ecology on the Yukon north slope and based on previous studies he estimated densities at 6.5 bears/1000 km^2 for the coastal plains and low foothills, 26 bears/1000 km^2 for the Barn Range and Buckland Hi, and 15 bears/1000 km^2 for the British and Richardson mountains. Estimates for the Barn Range and Buckland Hills were primarily based on the work of Nagy et *al.* (1983a, BLB #16). The estimate for the Barn Range was subsequently reduced to 23 bears/1000 km^2 by Nagy and Branigan (1998, BLB #15, p. 5) and estimates for the Richardson Mountains were increased to 19 bears/1000 km*. Nagy and Branigan (1998, BLB #15, p. 53) estimated grizzly bear densities in the MacKenzie delta to be approximately 3-4 bears/1000 km* (i.e., Aklavik-Inuvik and Inuvik grizzly bear harvest management zones).

Northern grizzly bears that have access to caribou and feed on caribou on a regular basis appear to have higher densities and productivity than populations that do not feed on caribou (Reynolds and Gamer 1987). The availability of mammalian prey, particularly caribou, may compensate for the constraints of latitude (MacHutchon in press, BLB #11).

Vuntut National Park

Old Crow Basin and British-Richardson Mountains Ecoregions – A portion of the northeast part of VNP is within the Barn Range study area of Nagy et *al.* (1983a, BLB #16), therefore grizzly bear densities in this area are likely in the same range, i.e., approximately 23 bears/1000 km*. This area is also within the summer range of the Porcupine caribou herd. However, the hills and large pediment slopes of the Old Crow Basin to the west of the Barn Range appeared to have lower quality grizzly bear habitat than the Barn Range. This area also appeared to have lower quality bear habitat than the Buckland Hills and lower British Mountains of Ivvavik National Park to the north. As a result, I estimated the overall grizzly bear density in the Old Crow Basin and British-Richardson mountains ecoregions of VNP as approximately 15 bears/1000 km*. The Old Crow Basin and British-Richardson mountains ecoregions of VNP are roughly 2/3 of the total park area of 4,345 km^2 or approximately 2,900 km^2. This suggests a population of approximately 44 grizzly bears for these two ecoregions within VNP.

Table 2. Estimated densities of grizzly bear populations in North America. Due to a variety of methods used in their derivation, comparisons must be done cautiously. Densities are usually given for all bears, including dependent young.

Map NO.	Study Area	Reference(s)	Bears/ 1000 km²	km²/ bear
	Barren-Ground			
	Arctic coastal plain, AK	Carroll (1995)	0.52.0	500-2000
29	NPR-A', AK: coastal plain	Reynolds (1980), Reynolds (1979)	1.3	760.0
	Central Brooks Range, AK	Crook (1972)	3.5	235
29	NPR-A[b], AK: mountains	Reynolds (1980), Reyndds (1979)	3.6	266.0
31	Prudhoe Bay oil field, AK	Shideler 6 Hechtel (In press)	4.0	250.0
26	Tuktoyaktuk Peninsula. NWT	Nagy *et al.* (1983b)	4-5	211.262
26	Richards I., Tuk. Peninsula, NWT	Harding (1976)	6-9	106-175
23	NPR-A[b], AK; high foothills	Reynolds (1980), Reyndds (1979)	7.7	,300
39	*Brock-Hornaday R.*, NWT	*Nagy & Branigan (1998)*	6.0	166.7
6	Eastern Brooks Range	Curatolo and Moore (1975)	7.0	142.0
6	Eastern Brooks Range. AK	Reynolds (1976)	4-7	148-260
6	Eastern Brooks Range, AK	Reynolds & Garner (1967). Miller *et al.* (1997)	6.6	147.1
	Canning R.. Central Brooks, AK	Quimby end Snarski (1974). Quimby (1974)	7-6	120-148
3	Anderson-Horton R.. NWT	Clarkson & Liepins (1994)	8-9	110-122
	Old Crow Basin/Flats ecoregions	Smith & Osmond-Jones (1990)	11.0	66.0
29	NPR-A: AK; low foothills	Reynolds (1980), Reyndds (1979)	11.1	90.0
	Arctic foothills, AK	Carroll (1995)	10-30	33-100
4	Arctic National Wildlife Refuge. AK	Reynolds & Garner (1967). Miller *et al.* (1997)	15.9	62.9
22	Noatak R., Northwest AK	Ballard *et al.* (1990, 1991), Miller *et al.* (1997)	17.9	55.9
	Richardson Mtns., YT/NWT	Nagy & Branigan (1996)	19.0	52.6
29	W. Brooks Range, AK; 1977-1983	Reynolds and Hetchel (1964)	2324	42.44
29	W. Brooks Range AK; 1992	Reynolds (1992), Miller *et al.* (1997)	29.5	33.9
21	Barn Range, YT	Nagy & Branigan (1996)	23.0	43.6
21	Bar" Range, YT	Nagy *et al.* (1983a)	26-30	33-39
37	Seward Peninsula, AK	Miller & Nelson (1993), Miller *et* al. (1997)	29.1	34.4
	Northern Interior			
2	North-central Alaska Range. AK; 1966	Reyndds (1993), Miller *et al.* (1997)	10.3	97.1
27	Upper Susitna R., AK	Miller (1990a), Miller *et al.* (1997)	10.7	93.5
20	Mackenzie Mountains, NWT	Miller *et al.* (1962)	11.6	66.0
	Yukon River Flats. AK	Bertram & Vivion (workshop abstract)	14	71.4
2	North-central Alaska Range, AK; 1992	Reynolds (1993), Miller *et al.* (1997)	14.6	68.5
38	East-central Alaska	Boertje *et al.* (1967). Gasaway *et al.* (1992)	16.0	62.5
27	Middle Susitna R.. AK	Miller *et al.* (1967, 1997)	27.1	36.9
32	Denali National Park, AK	Dean (1987)	34.0	29.4
16	Kluane National Park, YT	Pearson (1975)	37.0	27.2
	Southern Interior			
7	East Front Rockies, MT	Aune & Kasworm (1969); Aune *et al.* (1994)	7.0	142.9
12	Jasper National Park, AS	Russell *et al.* (1979)	10-12	86-102
34	Mission Mountains, MT	Servheen (1981)	20.4	49.0
10	Glacier National Park. MT	Martinka (1974)	47.2	21.2
40	Glacier National Park. BC	Mundy & Flook (1973)	5535	18-29
9	Flathead R. Valley, BC	McLellan (1934); McLellan (1989a, b, c)	60.0	12.5
	Coastal			
24	Black Lake. AK Peninsula. AK	Miller and Sellers (1992). Miller *et al.* (1997)	191.3	5.2
1	Chichagof Island, AK	Titus and Beier (1993), Miller *et al.* (1997)	318.3	3.1
17	Karluk Lake, Kodiak Island, AK	Barnes *et al.* (1988), Miller *et al.* (1997)	322.6	3.1
17	Terror lake. Kodiak Island, AK	Barnes ef *al.* (1966). Miller ef *al.* (1997)	341.7	2.9
1	Admiralty Island. AK; 1987	Schoen and Beier (1990), Miller *et al.* (1997)	398.6	2.5
14	Katmai National Park, AK	Calkins & Lewis (1990), Miller *et al.* (1997)	560.6	1.8

[b] NPR-A = National Petroleum Reserve, Alaska located in the western Brooks Range, Alaska.

Old Crow Flats Ecoregion – I suspect that grizzly bear densities are lower in the Old Crow Flats than in the Old Crow Basin and British-Richardson mountains ecoregions of VNP. Habitats in the Flats appeared to be less diverse and of lower quality for grizzly bears, although bears may be able to supplement their diet by feeding on moose calves and muskrats in the spring and early summer. I suspect that grizzly bear densities in the Old Crow Flats are similar, but slightly higher than on the MacKenzie Delta or along the Arctic coastal plain. As a result, I estimate grizzly bear density to be approximately 6 bears/1000 km*. The Old Crow Flats Ecoregion of VNP is roughly 113 of the total park area of 4,345 km^2 or approximately 1,450 km^2. This suggests a population of approximately 9 grizzly bears.

Overall, I estimate approximately 53 grizzly bears within VNP or approximately 12 bears/1000 km^2 (82 km^2 per bear). The entire Old Crow Flats area is 12,116 km^2 and was designated as a Special Management Area (SMA) in the VGFNFA. It is made up of Vuntut National Park, Vuntut Gwitchm First Nation Settlement Land Blocks R-OlA and R-10A, and additional land east and west of the Settlement Land Blocks. The Old Crow Flats constitute 41% of the SMA. The remainder outside VNP is made up of pediment slopes, rolling hills and foothii. The area of the SMA outside VNP is approximately 10,666 km^2. Grizzly bear densities in the eastern and western portions of the SMA are likely higher than within the Old Crow Flats because the land is higher and drier, consequently has more habitats where bears can feed and travel. As a result, I estimate overall grizzly bear density within the SMA outside of Vuntut National Park to be 9 bears/1000 km^2, which suggests a population of approximately 96 grizzly bears.

The bear population estimates given in this section for VNP and the Special Management Area are my best guesses based on work done in other study areas. They have not been substantiated with field work, so they should be used with caution. My population estimates were considered to be all bears, not just bears >2.

3.1.3.b Sex and Age Structure

Table 3 outlines the population characteristics of a number of grizzly bear populations throughout North America. Populations that are only lightly hunted should be relatively stable and therefore have a relatively higher adult cohort. However, a predominately adult population can also indicate a declining population that has little recruitment. The actual percent of adults reported for different populations varies with the method of data collection and the age at which bears were considered to be adults (LeFranc et al. 1987). For barren-ground grizzly bear populations, Clarkson and Liepins (1994, BLB #4) reported 56% adults 6 years and over for a population that was lightly hunted. Nagy et al. (1983a, BLB #16) reported an average of 58% adults 6 years and over for a population that was considered stable. Reynolds (1976, BLB #21) reported 63% adults 6.5 years and over for a population in the Eastern Brooks Range that was considered to be declining. The sex ratio of adult bears was usually less than 50% male, particularly in populations that were heavily hunted (Table 3).

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I suspect that the grizzly bear population of VNP is relatively stable since it is only lightly hunted and therefore should have a predominately adult cohort within the range of 50-60% adults 6 years of age or older, but also have healthy recruitment in the younger age classes.

3.1.3.c Reproductive Biology

Grizzly bears have one of the lowest reproductive rates among North American mammals (Craighead et al. 1995). Reproductive rate is determined by the mean age at which females reach sexual maturity, how often they produce litters, and the mean litter size (Bunnell and Tait 1981). Table 3 describes these characteristics for a number of grizzly bear populations throughout North America. Comparisons of these reproductive parameters among populations need to be done with caution. Sample sizes and duration of sampling periods vary widely, data on successive litters of individual females are lacking, and different methods have been employed in estimating first age of reproduction and breeding interval (LeFranc *et* al. 1987).

Grizzly bears in the North typically become sexually mature between 6-9 years old, have small litter sizes (i.e., means of 1.7-2.3 cubs per litter), and have an extended period of maternal care that means long intervals between litters (i.e., means of 3-4.5 years). These factors result in a relatively small contribution of offspring to the population over a female's reproductive life. Productivity varies among populations and appears related to nutrition of the females (Shideler and Hechtel in press, BLB #24).

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The grizzly bear population within VNP likely has a similar range of reproductive rates as other northern grizzly bear populations. As a result, I suspect that grizzly bears become sexually mature between 6-9 years old, have litter sizes of 1.7-2.3 cubs per litter, and have an interval between litters of 3-4.5 years.

3.1.3.d Mortality

The range in cub mortality rates reported for barren-ground grizzly bear populations is 32-44% (Table 3). Cub mortality was generally higher for barren-ground populations than it was for other populations in North America. In a review of North American grizzly bear populations, McLellan (1994) did not fmd any relationship between cub survivorship and bear density, the proportion of adults that were male, nor whether the population was hunted or not, i.e., no density-dependent effects. Cub mortality in the North is likely higher because of the long winters, short growing season and the lack of trees for security and escape cover (MacHutchon 1996, BLB #1 1). Adult female survivorship in barren-ground grizzly bear populations is relatively high and comparable to other populations in North America (ie., 91-98%).

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Cub mortality in VNP is likely as high as observed in other northern studies for similar reasons, therefore I estimate it to be between 35-45%. Adult female survivorship in VNP is likely similar to that observed in other northern studies, that is 90-98%.

Table 3. Estimated population characteristics of grizzly bear populations in North America. Some variables have been collected in different ways among studies so these data must be used cautiously. Sample sizes are in parentheses. These data come from McLellan et *al.* (1994) and Ferguson and McLoughlin (in press, BLB #4).

Map No.	Study Area	Reference(s)	Age of first litter (yrs)	Interbirth interval[a] (yrs)	Cub litter size (no.)	% Adult "law	Cub mort. rate	Adult Female Surv.	Hunt?
	Barren-Ground								
3	Anderson-Horton R., NWT	Clarkson & Liepins (1993, 1994)	6.0	2.9 (24)	2.3			0.95	?
4	Arctic National Wildlife Refuge. AK	Garner *et al.* (1984, 1985, 1986), Garner & Reynolds (1966)	7.3 (16)	4.1 (20)	2.1 (40)		0.43		yes
5	Eastern NWT/Western Nunavut	Case & Buckland (1998)	6.7 (6)	3.3 (6)	2.3 (19)			0.96	?
6	Eastern Brooks Range, AK	Reynolds (1976)	9.6 (19)	4.0	1.8 (13)	4 9			yes
11	Ivvavik National park. YK	MacHutchon (1996), MacHutchon (In press)			2.3 (6)		0.36		
21	Barn Range, Yr	Nagy *et al.* (1983a)	7.0 (3)[b]	4.0 (4)[b]	2.0 (6)	51			no
22	Noatak R., Northwest AK	Ballard *et al.* (1993)	6.1 (10)	3.9 (10)	2.2 (35)			0.94	yes
26	Tuktoyaktuk Peninsula. NWT	Nagy *et al.* (1983b)	6.4 (10)[b]	3.3 (8)[b]	2.3 (18)	3 3	0.46		yes
29	W. Brooks Range, AK: 1977-1983	Reynolds and Hetchel (1984)	7.9 (14)[b]	4.1 (16)[b]	2.0 (57)	4 2	0.44		no
29	W. Brooks Range, AK; 1966-1969	Reynolds (1592)			2.0 (41)		0.46		no
31	Prudhoe Bay oil field, AK	Shideler & Hechtel (In press)	5.7 (6)	3.4 (19)	2.3 (18)	4 6	0.32	0.91	?
	Northern Interior								
2	North-central Alaska Range. AK	Reynolds (1969.1993). Reynolds & Boudreau (1590)	6.2 (12)[b]	4.0 (51)	2.2 (36)	33	0.29		yes
16	Kluane National Park. YT	Pearson (19751. McCann (unpubl. data)	7.7 (7)	3.1	1.7 (11)				no
19	Kuskokwim Mountains. AK	Van Dad. *et al.* (In press)	6.3 (6,	4.5 (34)					yes
20	Mackenzie Mountains, NWT	Miller *et al.* (1982)	6.0 (32)	3.8 (11)	1.8 (6)	41			yes
27	Nelchina/Susitna basins, AK	Miller & Ballard (1980, 1962). Miller (1990a, b, c), Miller (1993, 1997)	5.6 (24)[b]	3.2 (47)[b]	2.1 (64)	27[c]	0.34		yes
	Southern Interior								
7	East Front Rockies, MT	Aune & Brannon (1967). Aune 8 Kasworm (1989), Aune *et al.* (1994)	6.0 (4)	2.6 (11)	2.2 (41)	5 4			yes
9	Flathead R. Valley, BC	McLellan (1964). McLellan (1989a, b, c)	6.1 (7)	3.1 (17)	2.2 (26)	37	0.16	0.93	yes
10	Glacier National Park, MT	Martinka (1974)			1.7 (35)				no
12	Jasper National Park, AB	Russell *et al.* (1979)	6.0 (4)		2.0 (3)	72			no
13	Kananaskis, AB	Wielgus & Bunnell (1994)	5.5	3.0	1.4			0.93	?
25	Mission Mountains, MT	Servheen & Lee (1979), Servheen (1981)	5.5	3.3		50			?
26	West Central Alberta	Nagy of *al.* (1969)	6.0 (2)	4.0 (1)					yes
30	Yellowstone N.P., WY; 197569	Blanchard (1987). Blanchard & Knight (1980), Knight *et al.* (1988, 1969, 1990)	5.7 (23)	2.6 (20)	1.9 (232)	5 5	0.15		no
30	Yellowstone N.P., WY; 1959-70	Craighead *et al.* (1974, 1976), Stringham (1990), Blanchard (1987)	5.7 (16)	3.2 (68)	2.2 (173)	46	0.26		no
36	Selkirk Mountains, SC	Wielgus *et* al. (1994)	7.3	3.0	2.2			0.96	yes
	Coastal								
1	Admiralty Island. AK	Schoen and Beier (1986, 1990)	6.1 (7)	3.9 (7)	1.8 (32)	2 4	0.20		yes
14	Katmai National Park, AK	Sellers *et al.* (1993)	7.2 (12)	5.6 (19)					no
14	McNeil Rii. AK	Glenn (1973). Glen et *al.* (1976). Sellers and Aumiller (1994)	5.9 (6)	3.6 (12)	2.2 (137)	55	0.31	0.93	no
17	Kodiak Island, AK	Smith *et al.* (1984), Barnes *et al.* (1988), Smith and Van Daele (1991)	6.7 (12)[b]	4.6 (41)[b]	2.5 (29)	3 6			yes
24	Alaska Peninsula, AK	Glenn (1973, 1975, 1980), Stringham (1990), Miller and Sellers (1992)	4.4 (9)	3.0 (61)	2.3 (200)	2 6	0.40		yes

[a]Due to a variety of methods used in their derivation, comparisons must be done cautiously.
[b]Includes incomplete or potential intervals and births. [c]Adult sex ratio changed from 53% to 27% male during study period due to heavy harvest.

3.1.4 Home Range, Movement and Activity

3.1.4.a *Home Range*

Generally, the home ranges of barren-ground grizzly bear populations are *larger* than southern or coastal populations (Table 4). This is particularly true for barren-ground grizzly bear populations in tundra or Arctic coastal plain ecosystems.

MacHutchon (1996, BLB #1 1, p. 24) treated the yearly home ranges of individual bears in the Firth River valley, Iwavik National Park as independent estimates of annual home range size to compare with those of Nagy (1990, BLB #13) for the Barn Range of northern Yukon and Nagy and Haroldson (1990, BLB #14) for three other grizzly bear populations. The weighted mean annual home range size of lone adult females in the Firth River valley was 144 km^2 (n = 9), adult females with COY was 133 km^2 (n = 4), and adult females with yearlings was 185 km^2 (n = 2). Nagy (1990, BLB #13) reported that the weighted mean annual home range size of lone adult females was 123 km^2 (n = 18), adult females with COY was 124 km^2 (n = 4), and adult females with yearlings was 101 km^2 (n = 2) for the Barn Range of northern Yukon. Mean annual home ranges in the Firth River valley were slightly larger than in the Barn Range for all adult female categories, however, they were substantially smaller than for Tuktoyaktuk Peninsula (lone adult females = 644 km^2 (n = 18), females with COY = 695 km^2 (n = 5)), west central Alberta (lone adult females = 476 km^2 (n = 22), females with COY = 252 km^2 (n = 4)), or Jasper National Park (lone adult females = 393 km^2 (n = 3)) (Nagy and Haroldson 1990, BLB #14).

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Old Crow Basin and British-Richardson mountains ecoregions -- A portion of the northeast part of VNP is within the Barn Range study area of Nagy *et* al. (1983a, BLB #16) and similar to habitats within Iwavik National Park (MacHutchon 1996, BLB #1 1), therefore home range estimates of bears in this area of VNP are likely simii to those other 2 study areas. However, the hi and large pediment slopes of the Old Crow Basin to the west of the Barn Range appeared to have lower quality grizzly bear habitat than the Barn Range. This area also appeared to have lower quality bear habitat than the Buckland Hills and lower British Mountains of Iwavik National Park to the north. As a result, I suspect that home ranges in this area are likely somewhat larger than in the Barn Range or Iwavik National Park. I estimate grizzly bear home ranges to be in the range of 250-350 km^2 for females and 750-900 km^2 for males for these two ecoregions within VNP.

Old Crow *Flats Ecoregion* - I suspect that grizzly bear home ranges are larger in the Old Crow Flats than in the Old Crow Basin and British-Richardson mountains ecoregions and similar to those for bears of the Tuktoyaktuk Peninsula (Nagy *et al.* 1983b, BLB #17). As a result, I estimate grizzly bear home ranges to be to be in the range of 650-750 km^2 for females and 1150- 1250 km^2 for males for this ecoregion of VNP.

Table 4. Estimated mean home ranges of grizzly bears in North America as reported in McLoughlin *et* al. (In press, BLB #12). Ranges were primarily adult home ranges and were calculated using the minimum convex polygon (MCP) approach unless otherwise indicated. Weighted means were calculated if ranges were estimated with small or variable numbers of locations (if data permitted).

Map No.	Study area	Reference (s)	Females km'	*n*	Males km²	*n*
	Barren-Ground					
21	Barn Range, YT	Nagy *et al.* (1983b)[d]	210	8	645	6
29	Western Brooks Range, AK	Reynolds (1980)	225	35	872	14
8	Eastern Brooks Range, AK	Reynolds (1976)[a,b]	230	8	702	5
11	Ivvavik National Park, YT	MacHutchon (1996)	259	5	744	3
26	Tuktoyaktuk Peninsula. NWT	Nagy *et al.* (1983a)[d]	670		1154	7
22	Noatak R.. Northwest AK	Ballard et *al.* (1993)	593	33	1437	15
3	Anderson-Horton R., NWT	Clarkson & Liepins (1989)	1182	14	3433	7
5	Eastern NWT/Western Nunavut	McLouglin *et al.* (In press)	2434	35	8171	19
	Northern Interior					
16	Kluane National Park. YT	Pearson (1975)	86	8	207	5
2	North-central Alaska Range, AK	Reynolds & Hetchel (1983)	132	11	710	6
20	Mackenzie Mtns., NWT	Miller et *al.* (1982)	265	6		
27	Upper Susitna R., AK	Ballard et *al.* (1982)[b]	408	13	769	10
	Southern Interior					
23	West Slope Rmkies, BC	Woods et *al.* (1997)[b]	89	14	318	23
25	South Fork Flathead, MT	Mace & Jonkel (1979, ,980)	99	2	286	5
34	Mission Mountains, MT	Servheen a Lee (1979)	133	2	1398	3
13	Kananaskis, AB	Wielgus (1986)	179	5	1198	4
9	Flathead R. Valley, BC	McLellan (1981)	200	5	446	5
7	East Front Rockies. MT	Schallenberger & Jonkel (1980)	226	3	747	5
30	Yellowstone National Park, WY	Blanchard & Knight (1991)	281	48	874	28
12	Jasper National Park. AB	Russell *et al.* (1979)	331	6	948	6
28	West Central Alberta	Nagy et *al.* (1 988)[d]	364		1918	17
35	Selkirk Mountains, ID	Almack (1985)	402	2		
	Coastal					
1	Admiralty Island, AK	Schoen eta/. (1986)	24	12	115	6
15	Khutzeymateen R. Valley, BC	MacHutchon *et al.* (1993)[c]	52	13	130	4
18	Kodiak Island, AK	Barnes (1990)	71	33	185	6
6	Copper Rii Delta, AK	Campbell (1985)	174	4	295	2
24	Alaska Peninsula. AK	Glenn & Miller (1980)	293	30	262	4

[a]Ranges calculated using the modified exclusive boundary technique.
[b]Estimate contains some multiannual ranges.
[c]Weighted means calculated from data presented.
[d]Weighted means cited in Nagy and Haroldson (1990). For females, data is presented as the midpoint between the mean for females with and without young except for the Northern Yukon, where the mean is only for females without young.

3.1.4.b Movement

Grizzly bears have the ability to travel almost anywhere they choose, however, they typically use the easiest route that also provides feeding opportunities (MacHutchon 1996 BLB #11). This is typically along valley bottoms and over low passes.

Rubbing or marking trees are generally found on bear trails or trail systems (LeFranc et al. 1987, MacHutchon et al. 1993) and are most common near creeks and streams. Rubbing and marking trees have been well described for both black bears and grizzly bears and both species may use the same tree. Marking trees are characterised by bite marks in the wood, chunks of bark tom off, bark rubbed or smoothed along one side, sap running from tree wounds, and bear hair stuck in the bark or sap (Figure 2). Hair trapped on the tree is the easiest indication of marking by either bear species or both species on the same tree. The main theories for marking include information signposts, territory defmition, sexual advertisement, and comfort and grooming (LeFranc et al. 1987). Bear "'stomps" or mark trails are occasionally associated with mark trees and both grizzly bears and black bears will make mark trails.

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All bear trails and rubbing *or* marking trees that I found in the Thomas Creek Valley of VNP were on valley bottoms adjacent to creeks and rivers (Figure 2). They were primarily marked by grizzly bears; there was no indication that black bears had used them.

I used existing maps, air photos and satellite imagery of VNP and surrounding areas to help identify potential movement routes for bears. There do not appear to be any major barriers to grizzly bear movement in VNP. Movement within the Old Crow Flats likely is along creek and river edges and around lake margins. None of the radio-collared bears in the Barn Range study of Nagy *et al.* (1983a, BLB #16, pp. 56 & 57) used the Old Crow Flats as part of their home range even though some of them occupied the upper end of Black Fox Creek and its tributaries or the upper Babbage River.

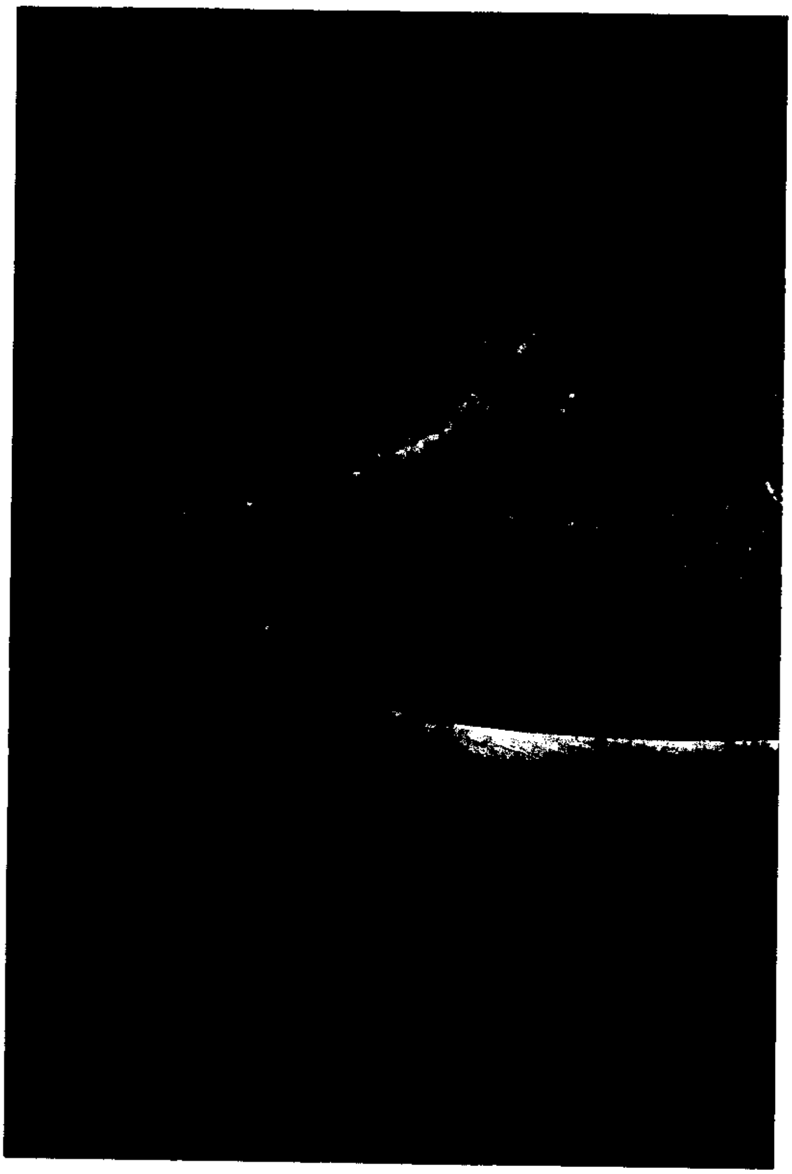

Figure 2. A grizzly bear marking tree near Thomas Creek, Vuntut National Park, Yukon.

3.1.4.c Activity Pattern and Budget

High variation in grizzly bear activity budgets and patterns has been reported across their range, among and within individuals, and among seasons (Table 5, MacHutchon in press BLB #11). Grizzly bear activity may be influenced by individual traits such as age, sex, weight, reproductive status, and physiology and by environmental factors including weather, thermal stress, predation, seasonal food type and abundance, available daylight, and human disturbance (Bunnell and Harestad 1989, Schleyer 1983, Hechtell985, McCann 1991). The duration, frequency, and diel timing of observations may influence interpretation of activity.

MacHutchon (in press, BLB #11) found that the overall time active of grizzly bears in the Fiih River Valley, Ivvavik National Park appeared to be similar to other observational studies in other areas of the far north. It was also similar to bear activity reported in studies from parts of southern Canada and the contiguous USA (Aune and Kasworm 1989, McCann 1991, Wenum 1997) and Europe (Roth 1983, Roth and Huber 1986, Clevenger *et* al. 1990), in which motion-sensing radio-collars were used to document activity (see Table 5).

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I suspect that grizzly bears in VNP will be active a similar proportion of time as found in other northern studies, which would be in the range of 6080%. They would likely be inactive or resting 20-40% of the time. Feeding and foraging would likely be about 45 to 65% of their overall time budget. Other active bebaviours would include travel (4-8%), intraspecific interactions with other bears (1-5%) and other behaviours such as marking, interspecific interactions, drinking, grooming, defecating, etc. (1-1.5%, MacHutchon in press, BLB #1 1). I suspect grizzly bears of VNP generally will have a diel activity pattern with bimodal activity peaks in the morning and evening, particularly with increasing hours of darkness during late summer (MacHutchon in press, BLB #11).

3.1.4.d Breeding Season

MacHutchon (1996, BLB #11, p. 16) reported that male and female bears were seen together between early May and early August, however, most pairs were seen together between mid-May and early July. Nagy et al. (1983a, BLB #16) observed breeding pairs between May 5 and July 15 with the highest frequency of pairing between late May and the end of June. Garner et al. (1986, BLB #5) suggested that the breeding season in the Arctic National Wildlife Refuge, Alaska extended from May through to approximately July 10 with a peak in June.

Vuntut National Park

The breeding season of grizzly bears in VNP is likely between mid-May and mid-July.

Table 5. Activity budgets and activity patterns described for grizzly bear populations in North America and Europe.

Map No.	Study Area	Reference (s)	Feed/Forage (%) χ	Feed/Forage (%) Range	Active (%) χ	Active (%) Range	Activity Pattern[a] Spring	Activity Pattern[a] Summer	Activity Pattern[a] Fall	NO. Bears	Moth!
	Barren-Ground										
4	Kongakut River, ANWR[e], AK	Phillips 1987	62'	60 - 82	78[f]	70 - 87				?	OFP
1f	Ivvavik National Park, YT	MacHutchon (In press)	56	46-62	66	59 - 81		EP/Diur	BM/Diur	5	DO
29	Western Brooks Range. AK	Gebhard 1982	59	46-67	64	57 - 85	TM	Noc/BM		1	DO
29	Western Brook?, Range, AK	Hechtel 1985			55[c]	21 - 65[d]	Noc/BM[c] - Diur[d]	Noc/BM[c]	Noc/BM[c]	5	DC
	Northern Interior										
16	Kluane National Park, YT	Pearson 1975					BM/NA	BM/NA	BM/NA	?	DO, TD
32	Tolkat R., DNP[g], AK	Stemlock & Dean 1966	68[h]	52 - 94	83[h]	62 - 100		TM/Diur		7	OFP
32	Sable Pass, DNP[g], AK	Stemlock & Dean 1986	71[h]	62-63	87[h]	62 - 99		BM/Diur	Diur	9	OFP
	Southern Interior										
7	Eastern Front Rockies, MT - lowland	Aune & Kasworm 1969			56	42-63	Noc	Noc	Noc	5	MSRC
7	Eastern Front Rockies, MT - backcountry	Aune & Kasworm 1969			50	42-63	BM	BM	BM	3	MSRC
9	Flathead R. Valley. B.C.	McCann 1991			55	34-71	BM/Diur	BM/Diur	BM/Diur	15	MSRC
25	Swan Mountains, MT	Wenum 1997			79[j]	76-64	Diur	Diur	Diur	7	MSRC
30	Yellowstone National Park. WY	Schleyer ,963				33 - 50	BM/Noc	BM/Noc	BM/Noc	?	MSRC
30	Yellowstone National Park, WY	Harting 1985			61		BM/Noc	BM/Noc	BM/Noc	?	MSRC
	Coastal										
14	McNeil River, AK	Egbert & Stokes 1976						EP/Diur	EP/Diur	?	OFP
	Europe										
	Cantabrian Mountains, Spain	Clevenger *et al.* 1990			37	35-46	BM/Diur	BM/Diur	BM/Diur	f	MSRC
	Trento, northern Italy	Roth 1983			50	45 - 60		BM/NA	BM/NA	3	FSRC
	Plitvice Lakes, Yugoslavia	Roth & Huber 1986				49-61		Noc/BM	Noc/BM	2	FSRC
	Sweden	Bjarvall & Sandegren 1967			29/43[j]		Diur		Diur	1	FSRC

[a] Diur = Diurnal, Noc = Nocturnal, BM = Bimodal peaks during the day usually, in morning and evening, TM = Trimodal peaks, EP = Evening peak. NA = more night than mid-day activity,
[b] DO = Direct observation, TD = Trap disturbance, OFP = Observation from fixed points, MSRC = Motion sensitive radio collars, FSRC = Fluctuating signal from radio collars
[c]The activity of f female with 2-2 yr dds followed from spring to fall. This was the same female observed by Gebhard (1982) the previous year.
[d] The range in activity of 4 bears observed in spring only.
[e] ANWR = Arctic National Wildlife Refuge
[f] Excludes spring observations when sample size was small.
[g] DNP = Denali National Park
[h]Excludes periods with <10 hrs observation and percent active does not include nocturnal rest, i.e.. rest that continued for extended nighttime periods.
[i]Adult females only.
[j] Percent "activity" depended on how interpretations from radio collar signals were classified.

Table 6. Den emergence and entrance dates of northern grizzly bear populations.

NO.	Study Area	Reference (s)	Den Emergence	Den Entrance
	Barren-Ground			
5	Eastern NWT/Western Nunavut	McLaughlin et *al.* (1999)	first week of May	last 2 weeks of Oct
6	Eastern Brooks Range, AK	Reynolds *et al.* (1976)		3 Oct to 31 Oct
11	Ivvavik National Park, YK	MacHutchon (19%)	April to late May	mid-Sept to late Oct
21	Barn Range, YT	Nagy et al (1983a)	late April to mid-May	
26	Richards I., Tuk. Peninsula NWT	Harding (1976)	27 Apr to 22 May	October
26	Tuktoyaktuk Peninsula. NWT	Nagy *et al.* (1983b)	26 Apr to 30 May	October
29	Western Brooks Range, AK	Reynolds (1960)		October
31	Prudhoe Bay oil field, AK	Shideler 8 Hechtel (In press)	late April to late May	late Sept to early Nov
	Northern Interior			
16	Kluane National Park, YT	Pearson (1975)	May	October
20	Mackenzie Mountains, NWT	Miller *et al.* (1962)	early May to early June	early to mid Oct

3.1.4.e Denning Chronology

Grizzly bears in the North generally enter dens between mid-September and early November and emerge from dens from late April to late May (Table 6). The timing and duration of denning varies between sex and age classes. Male bears usually den later and emerge earlier than females and pregnant females generally den for longer periods than do solitary females or females with yearlings.

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I suspect the denning dates of grizzly bears in VNP are similar to that found in other northern studies, that is, den entrance between mid-September to late October and emergence from dens from late April to late May. The timing and duration of denning will likely vary between sex and age classes with male bears denning later and emerging earlier than females. Pregnant females will generally den for longer periods than do solitary females or females with yearlings.

3.1.5 Feeding Ecology

3.1.5.a Seasons of Activity

Grizzly bear seasons of activity in the North are generally defined by significant shifts in the use of well-used foods (Hechtel1985, Phillips 1987, BLB #20; MacHutchon 1996, BLB #11). MacHutchon (1996, BLB #11, p. 17) described three seasons of activity for grizzly bears in the Firth River Valley, Iwavik National Park. The seasonal dates were:

1. Spring: den emergence to June 15
2. Summer: June 16 to July 31
3. Fall: August 1 to den entrance

The change from spring to summer corresponded with the widespread availability of common horsetail shoots in summer. The change from summer to fall corresponded with the widespread availability of blueberries. These seasonal divisions were the same as Hechtel(l985) used for grizzly bear activity in the western Brooks Range, Alaska and they were similar to that used by Phillips (1987, BLB #20) for the Kongakut River, Arctic National Wildlife Refuge, Alaska. Nagy et *al.* (1983a, BLB #16) did not define seasons of activity for grizzly bears in the Barn Range of northern Yukon; they analysed food habits on a bi-monthly basis.

Vuntut National Park

I expect that grizzly bears in VNP will have similar shifts in their use of major foods as bears in Iwavik National Park, except that there is likely an earlier ripening of fruit because VNP is further south. Therefore, I propose four seasons of activity for grizzly bears in VNP.

1. Spring: den emergence to June 15
2. Summer: June 16 to July 15
3. Late Summer: July 16 to August 31
4. Fall: September 1 to den entrance

Tbe change from spring to summer would correspond with the widespread availability of common horsetail shoots during summer. The change from summer to late summer would correspond with the widespread availability of blueberries, and the change from late summer to fall would correspond with the loss of many berries and a shift to increased digging of bearroot roots and arctic ground squirrels.

3.1.5.b Diet

A comprehensive list of spring, summer, and late summer or fall grizzly bear foods described for populations in northern Canada and Alaska is in Appendix 2. This list is summarized in Table 7.

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I reviewed previous studies, as well as, examined feeding sign at sites of bear activity and analysed bear scats in the field in June 1999. Parks Canada staff also identified some grizzly bear foods. Table 8 lists foods known or suspected to be used by grizzly bears in VNP.

3.1.5.c Seasonal Food Habits

Vuntut National Park

I suspect the most well-used foods of grizzly bears in VNP during the spring and early summer are bearroot roots, overwintered berries, sedges, grasses and horsetail. The main overwintered berries used are likely kinnikinnick (*Arctostaphylos uva-ursi*), bearberry (*Arctostaphylos rubra or A. alpina*) and crowberry (*Empetrum nigrum*). Graminoids and horsetail are probably not readily available until late spring or early summer. I suspect the most well used foods during the summer are "green" vegetation or forbs, such as horsetail, sedges, and grasses, as well as early ripening berries. Mountain sorrel (*Oxyria digyna*) is probably eaten occasionally, as are other forbs. Various fruits are likely the main foods as soon as they start ripening in late July or early August (i.e., late summer). Blueberry (*Vaccinium uliginosum*), soapberry (*Shepherdia canadensis*), crowberry, bearberry, kinnikinnick, red currant (*Ribes triste*), lingonberry or cranberry (*Vaccinium vitis-idaea*),

Table 7. Grizzly bear foods described for northern Canada and Alaska study areas.

Common Name	Scientific Name	Spring	Summer	Late Summer, Fall
Roots:				
Wing angelica	*Angelica genufleza*	X	X	X
milk vetch	*Astragalus* sp.	X		
hedysarum	*Hedysarum* spp.		X	X
alpine hedysarum, bearroot	*Hedysarum alpinum*	X	X	X
northern sweet-vetch	*Hedysarum boreale* ssp. *mackenzii*	X		
cow-parsnip	*Heracleum lanatum*	X	X	X
locoweed	*Oxytropis viscida* (syn. *O. borealis*)	X		
coltsfoot	*Petasites* sp.	X		
sweet-cicely	*Osmorhiza* spp.		X	X
Gramfnoids:		X	X	X
sedges	*Carex* spp.	X	X	X
grasses	Graminae	X	X	X
spike trisetum	*Trisetum spicatum*		X	
Horsetail	*Equisetum* spp.	X	X	X
common horsetail	*Equisetum arvense*	X	X	X
Forb & Shrub Stems, Leaves, or	**Flowers:**	X	X	X
kneeling angelica	*Angelica genuflexa*	X	X	X
milk-vetch	*Astragalus* spp.		X	
scrub birch	*Betula glandulosa*	X	X	X
paper birch	*Betula papyrifera*	X	X	X
bearflower	*Boykinia richardsonii*	X	X	X
fireweed	*Epilobium angustifolium*	X	x	X
cow-parsnip	*Heracleum lanatum*	X	X	X
Arctic lupine	*Lupinus arcticus*		X	X
mountain sorrel	*Oxyria digyna*	X	X	X
locoweed	*Oxytropis* spp.	X	X	
field locoweed	*Oxytropis campestris*	X	X	X
locoweed	*Oxytropis viscida* (syn. *O. borealis*)		X	
Labrador lousewort	*Pedicularis labradorica*		X	X
balsam poplar catkins	*Populus balsamifera*	X	X	
trembling aspen	*Populus tremuloides*	X	X	X
willow catkins	*Salix* spp.	X	X	X
Fruit:				
saskatoon	*Amelanchier alnifolia*	X	X	
bearberry	*Arctostaphylos rubra* or *A. alpina*	X	X	X
kinnikinnick	*Arctostaphylos uva-ursi*	X	X	X
red-osier dogwood	*Cornus stolonifera*			X
silverberry	*Elaegnus commutata*			X
crowberry	*Empetrum nigrum*	X	X	X
ribes spp.	*Ribes* spp.		X	X
red currant	*Ribes triste*			X
prickly rose	*Rosa acicularis*		X	X
raspberry	*Rubus* spp.		X	X
soopolallie, soapberry	*Shepherdia canadensis*	X	X	X
mountain ash	*Sorbus scopulina*		X	X
dwarf blueberry	*Vaccinium caespitosum*		X	X
blueberry	*Vaccinium uliginosum*	X	X	X
lingonberry, mountain cranberry	*Vaccinium vitis-idaea*	X	X	X
highbush-cranberry	*Viburnum edule*	X	X	X
Insects:			X	X
ants	Formicidae	X	X	X
wasps	Vespidae	X	X	X
Rodents:				
microtines		X	X	X

Common Name	Scientific Name	spring	Summer	Late Summer / Fall
northern red-backed vole	*Clethrionomys rutilus*	X		
northern flying squirrel	*Glaucomys* spp.			X
Arctic ground squirrel	*Spermophilus parryii*	X	X	X
Hoary marmot	*Marmota caligata*	X	X	
muskrat	*Ondatra zibethicus*		X	
beaver	*Castor canadensis*		X	
Ungulates:				
bison	*Bison bison*	X		
moose	*Alces alces*	X	X	X
caribou	*Rangifer tarandus*	X	X	X
Other:				
salmon				X
longnose sucker	*Catostomus catostomus*		X	
woodpecker	Picidae	X	X	
ptarmigan	*Lagopus* spp.	X	X	
grouse or ptarmigan	Phasianidae	X	X	
snowshoe hare	*Lepus americanus*	X	X	X
lynx	*Lynx* spp.	X		
grizzly bear	*Ursus arctos*	X	X	X

Table 8. Known' or possible foods of grizzly bears in Vuntut National Park, Yukon.

Common Name	Scientific Name	Spring	Summer	Late Summer / Fell
Roots:				
milk vetch	*Astragalus* sp.	X		
alpine hedysarum, bearroot*	*Hedysarum alpinum*	X	X	X
locoweed	*Oxytropis viscida* (syn. *O. borealis*)	X	X	
Graminoids:		X	X	X
sedges	*Carex* spp.	X	X	X
grasses	Graminae	X	X	X
Horsetail*	*Equisetum* spp.	X	X	X
common horsetail	*Equisetum arvense*	X	X	X
marsh horsetail	*Equisetum palustre*	X	X	X
Forb & Shrub Stems, Leaves, or Flowers:		X	X	X
milk-vetch	*Astragalus* spp.		X	
bearflower	*Boykinia richardsonii*	X	X	X
fireweed	*Epilobium angustifolium*	X	X	X
Arctic lupine	*Lupinus arcticus*		X	X
mountain sorrel	*Oxyria digyna*	X	X	X
field locoweed	*Oxytropis campestris*	X	X	X
locoweed	*Oxytropis viscida* (syn. *O. borealis*)		X	
balsam poplar catkins	*Populus balsamifera*	X	X	
Willow catkins	*Salix* spp.	X		
Fruit:				
bearberry	*Arctostaphylos rubra* or *A. alpina*	X	X	X
kinnikinnick	*Arctostaphylos uva -ursi*	X	X	X
crowberry	*Empetrum nigrum*	X	X	X
red currant	*Ribes triste*		X	X
dwarf nagoonberry	*Rubus arcticus*		X	X
cloudberry	*Rubus chamaemorus*		X	X
soopolallie, soapberry	*Shepherdia canadensis*		X	X
blueberry	*Vaccinium uliginosum*	X	X	X
lingonberry, mountain cranberry	*Vaccinium vitis-idaea*	X	X	X
Insects:			X	X
ants	Formicidae	X	X	X
wasps	Vespidae	X	X	X
Rodents:				
microtines		X	X	X
Arctic ground squirrel	*Spermophilus parryii*	X	X	X
muskrat	*Ondatra zibethicus*	X	X	
beaver	*Castor canadensis*	X	X	
Ungulates:				
moose	*Alces alces*	X	X	X
caribou*	*Rangifer tarandus*	X	X	X
other:				
fish		X		X
ptarmigan	*Lagopus* spp.	X	X	X
snowshoe hare	*Lepus americanus*	X	X	X
grizzly bear	*Ursus arctos*	X	X	X

* Foods known to be used in Vuntut National Park, but seasons of use based on o … studies.

and cloudberry or salmonberry (*Rubus chamaemorus*) are berry producing species that are likely eaten from late July to mid-September. Grizzly bears probably dig for bearroot roots and ground squirrels during the fall when berry availabiity decreases. Bearroot roots also are likely more important during poor berry years. Mammals are likely important foods whenever grizzly bears can get them. The main mammal foods are likely caribou, moose, arctic ground squirrels, voles, and lemmings. Bears likely kill or scavenge adult and yearling caribou in spring when the caribou move northward to their calving grounds along the Yukon and Alaska coastal plain. Grizzly bears likely kill or scavenge adult, yearling, and calf caribou in summer when the caribou move to their mid-summer range in the northeast corner of VNP. In spring, grizzly bears likely kill moose calves shortly after they are born. On the Yukon River Flats, Alaska, predation was responsible for 95% of known moose calf mortality and black bear (45%) and grizzly bear (39%) were the major causes of mortality (Bertram and Vivion workshop poster). Fish can be an important food of grizzly bears, but are mainly pursued in areas where they are easily caught, such as large concentrations at spawning areas. I am not aware of these types of concentrations of iish within VNP, so I do not know the seasonal importance of fish in the diet of grizzly bears.

3.1.6 Habitat Use

Grizzly bears of the Firth River Valley in Iwavik National Park generally used habitats to exploit seasonal changes in the availability of foods. However, habitat use and biophysical group use analyses showed that individual grizzly bears had different habitat selection strategies (MacHutchon 1996, BLB #11, pp. 91-92). These different strategies were likely the result of different availability of foods within habitats, different habitat availability within home ranges, different learned behaviour, and intraspecific competition which affects the establishment of the home range and also affects choices within the home range (Thomas and Taylor 1990, Craighead *et al.* 1995). Generally, however, wet mountain slopes (i.e., Willow - Horsetail and Spruce - Horsetail habitats) were used significantly more than any other group in the spring, nivation and seepage slopes (i.e., Heather - Bearflower and Alder - Heather habitats), wet mountain slopes, and drainage channels (i.e., Coltsfoot - Mountain Sorrel, Willow - Coltsfoot and Alaska Wiiow Drainage habitats) were used more than other groups in the summer, and dry to moist mountain slopes (ie., Birch - Crowberry, Willow - Birch, Spruce - Kinnikinnick and Spruce - Birch habitats) were used more than any other group in the late summer and fall.

In any study area, the value of a specific habitat type to the bear population or to individual bears will be influenced by factors other than its stand-alone food or cover value, including its position on the landscape and proximity to other habitats, the availability of animal foods, intraspecifc and interspecific competition for habitats, and local human influences. Consequently, habitat ratings that are generically assigned to a habitat should be used only for relative comparisons among habitats and not as an absolute value for any particular habitat.

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Habitat specific field plots were done in the Thomas Creek Valley of VNP in June 1999 in collaboration with Parks Canada staff. All plots recorded information on site characteristics and vegetation. These habitat plots were used to develop a preliminary habitat classification for the Thomas Creek drainage (see MacHutchon 2000). While doing these plots, I also recorded information on the use or probable use of the habitat by bears. I then rated the habitat at each field plot as high (H), moderately high (MH), moderate (M), low (L), very low (VI-), or nil (N) suitability for bears for spring (den emergence to mid-June), summer (mid-June to mid-July), late summer (mid-July to the end of August), and fall (early September to den entrance). Seasonal values were intended to reflect a habitat's relative importance for feeding primarily. The ratings were based on: food quality and availability within habitats; the quantity of bear sign within the habitat; probable bear movement associated with the habitat; terrain features; and my previous experience. I also conducted more subjective assessments of habitats during field work by walking through them and noting bear sign and bear food distribution and abundance. I obtained some additional habitat use and movement information through incidental observations of bear sign, including marking sites, bear trails, feeding sign, tracks and scats, and incidental observations of bears by park staff or local people. Table 9 lists the habitats described for Thomas Creek Valley by MacHutchon (2000) and also includes seasonal ratings of the habitat suitability for bears within the valley. The following general description of seasonal habitat use is primarily based on these ratings and field work done in Thomas Creek, so it may not be applicable to all areas of VNP. Despite the apparently high spring and summer suitability of habitats along Thomas Creek, little fresh bear sign was seen during the late spring field trip there.

3.7.6.a Spring Habitat Use

Vuntut National Park

I considered the highest value spring habitats to be those that had a high availability of foods such as bearroot and overwintercd berries. Horsetail is also an important food during the transition from spring to summer, so its availability was considered in the spring ratings as well. Availability refers to both how much of a particular food occurs in a habitat (ie., abundance) and how patchy or clumped the food is within the habitat (i.e., distribution).

Habitats on the floodplain and inactive alluvial terraces of Thomas Creek were considered to be relatively high value spring habitats primarily because of the availability of bearroot (i.e., Closed Tall Willow Shrub, Closed Balsam Polar Forest, Closed White Spruce Forest, and Closed Low Willow Shrub). In addition, some higher elevation habitats also had bearroot available (ie., Horsetail-Mountain-avens Tundra Herb, Sedge-Mountain-avens Tundra Herb). Other mountain slope habitats were considered relatively high value spring habitats because of the potential availability of overwintered berries, particularly crowberry (i.e., Open Low Birch-Crowberry Shrub).

3.1.6.b Summer Habitat Use

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I considered the highest value summer habitats to be those that had a high availability of foods such as horsetail and early ripening berries. Horsetail was most abundant and widely distributed in open wet forests, such as Open White Spruce-Horsetail Forest, that occurred on both inactive alluvial terraces and mountain slopes. Horsetail was also relatively abundant in some floodplain habitats, particularly Closed Balsam Poplar Forest and on moisture holding slopes at higher elevation (i.e., Horsetail-Mountain-avens Tundra Herb). The areas below lam

Table 9. Vegetated habitats described for the Thomas Creek Valley, Vuntut National Park by MacHutchon (2000) and their seasonal ratings for bears. Ratings are high (H), moderately high (MH), moderate (M), low (L), and very low (VL). There were no nil (N) ratings assigned.

Habitat Name	Landscape Association	Season: Sp	Su	Late Su	Fa
Sparsely Vegetated Gravel Bar	Floodplain	VL	VL	VL	VL
Closed Tall Willow Shrub	Floodplain	MH	M	MH	MH
Closed Balsam Poolar Forest	Floodplain	MH	MH	H	MH
Closed White Spruce Forest	Floodplain	MH	L	H	MH
Closed Low Willow Shrub	Alluvial Terrace	MH	M	MH	MH
Open White Spruce-Mountain-avens Forest	Alluvial Terrace	L	M	H	M
Open White Spruce-Horsetail Forest	Alluvial Terrace	L	H	MH	M
Graminoid Wetland	Valley Bottom	L	L	VL	VL
Hummocks or High-centred Terrain	Valley Bottom	L	L	M	L
Closed Tall Willow-Alder Shrub	Drainage Channel	L	L	M	L
Open Low Birch-Cotton-grass Shrub	Lower Slope	M	L	M	L
Open Medium Birch-Cotton-grass Shrub	Lower Slope	M	L	M	L
Open White Spruce-Cotton-grass Woodland	Lower Slope	L	VL	L	VL
Cotton-grass Graminoid Herb	Mid & Upper Slope	M	VL	M	L
Open Low Birch-Crowberry Shrub	Mid & Upper Slope	M	L	MH	M
Closed Tall Birch-Mountain cranberry Shrub	Mid & Upper Slope	L	L	M	L
Open White Spruce-Blueberry Forest	Mid & Upper Slope	L	M	H	M
Open White Spruce-Horsetail Forest	Mid & Upper Slope	L	H	M	L
Open White Spruce-Kinnikinnick Forest	Mid & Upper Slope	L	VL	L	L
Horsetail-Mountain-avens Tundra Herb	Mid & Upper Slope	MH	MH	L	MH
Sedge-Mountain-avens Tundra Herb	Mid & Upper Slope	M	VL	L	M
Sparsely Vegetated Mountain Ridge	Mid & Upper Slope	L	VL	L	VL

melting snow-banks have delayed phenology of herbs and, therefore, provide lush and nutrient rich early growth of some plants. Bears often feed in these areas during the period when vegetation in other areas has become coarse and of lower nutrient quality but berries have not yet ripened. Horsetail-Mountain-avens Tundra Herb is one habitat with late snow-melt, but other late snow-melt areas may be micro-sites of larger habitat classes such as within drainage channels or lower slope tussock dominated habitats.

3.1.6.c Late Summer Habitat Use

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I considered the highest value late summer habitats to be those that had a high availability of fruit-producing species such as blueberry, soapberry, and crowberry. Habitats on the floodplain and inactive alluvial terraces of Thomas Creek were considered to be relatively high value late summer habitats because of the availability of soapberry (i.e., Closed Tall Willow Shrub, Closed Balsam Polar Forest, Closed White Spruce Forest, and Closed Low Willow Shrub). Blueberry was most abundant and well distributed in open mesic white spruce forests such as Open White Spruce-Mountain-avens Forest and Open White Spruce-Blueberry Forest. Crowbeny was most common in the Open Low Birch-Crowberry Shrub habitat of mountain slopes.

3.1.6.d Fall Habitat Use

Vuntut National Park

I considered the highest value fall habitats to be those that had a high availability of foods such as bearroot and arctic ground squirrels. Similar to the spring, habitats on the floodplain and inactive alluvial terraces of Thomas Creek were considered to be relatively high value fall habitats because of the availability of bearroot (i.e., Closed Tall Wiiow Shrub, Closed Balsam Polar Forest, Closed White Spruce Forest, and Closed Low Wiiow Shrub). In addition, some higher elevation habitats had bearroot and ground squirrels available (i.e., Horsetail-Mountain-avens Tundra Herb, Sedge-Mountain-avens Tundra Herb).

3.1.6.e Denning (Winter Hibernation)

Table 10 outlines den characteristics reported for northern grizzly bear populations. MacHutchon (1996, BLB #11, p. 61) found significant differences between the mean elevation of den sites investigated in the lower Fiih River valley versus the upper Firth River valley and these differences reflected the underlying range in elevations between the two areas. Nagy et al. (1983a, BLB #16) found that the mean elevation of dens situated in the Barn Range was 618 m above sea level (a.s.l.). The mean elevation and elevation range for dens in the Barn Range was most similar to the upper Fiith River dens of MacHutchon (1996, BLB #11) even though a greater proportion of Nagy et *al.*'s (1983a) study area was at lower elevations. Reynolds et al. (1976, BLB #22) found that the mean elevation of dens in the eastern Brooks Range along the south-west border of the Arctic National Wildlife Refuge (ANWR), Alaska was 1040 m a.s.l. or 180 m above the valley floor. Their study area was in rugged mountains up to 1700 m a.s.l. with valley bottoms from 300 to 900 m a.s.l.

Table 10. Den characteristics for northern grizzly hear populations.

Map NO.	Study Area	Reference (4)	n	Elevation (m) $\bar{x}$	Elevation (m) Range	Slope (%) $\bar{x}$	Slope (%) Range	Slope (°) $\bar{x}$	Slope (°) Range	Aspect (°) $\bar{x}$	Aspect (°) Range	Orientation Gen.	Orientation Range
	Barren-Ground												
W	Western Brooks Range, AK	Reynolds (1960)	W		2701260							?	All
31	Prudhoe Bay oil field, AK	Shideler & Hechtel (In pr.)	116									S	E-W
8, W	Brooks Range, AK	Curatolo & Moore (1975)		low								S	
8	Eastern Brooks Range, AK	Reynolds *et al.* (1976)	52	1040			36-70		w-35			S	
11	Ivvavik National Park, YK; all	MacHutchon (1996)	34		220-1125	52.0	14-80	27.5	640	166	65-310	S	E-W
11	Ivvavik N. P., YK; lower Firth	MacHutchon (1996)	24	430	PO-670								
11	Ivvavik N. P.. YK; upper Firth	MacHutchon (1996)	10	706	490-1125								
21	Barn Range, YT; all	Nagy et al (1983a)	23			56.0	40-92	30.3	22-43			S	E-SW
21	Barn Range, YT; mountains	Nagy et al (1983a)	17	618	419-914								
21	Barn Range, YT; river banks	Nagy et al (1983a)	3	147	137-152								
21	Barn Range, YT; coast lowlands	Nagy et al (1983a)	3	120	117-121								
W	Richards I., Tuk. Peninsula. NWT	Harding (1976)	23			30-50	20-near vert.	17-27	11-near vert.			S	SE-SW
26	Tuktoyaktuk Peninsula, NWT	Nagy *et al.* (1983b)	70		O-30.7	64.0	0-near vert.	32.7	o-65			SW	E-NW
5	Eastern NWT/Western Nunavut	Mueller (1995)	23			67.5		34.0		197			
5	Eastern NWT/Western Nunavut	McLoughlin *et al.* (1999)	56			46.0		25.3				S	SE-SW
5	Eastern NWT/Western Nunavut	Bancí (unpubl. data)	51			54.0	12-vertical	26.2	7-w	209	26-357		
	Northern Interior												
16	Kluane National Park, YT	Pearson (1975)	10		1100-1350	70.0	58-62	35.0	30-40				E-W
20	Mackenzie Mountains. NWT	Miller *et al.* (1982)	22	1619	1402-1829		m-79		31-38			SE	E-SW

Bears in Iwavik National Park selected den sites within a relatively narrow slope range. Dens were generally on southerly aspects; 88% of dens (30 of 34) were oriented south of an east-west line (MacHutchon 1996, BLB #11). The aspect and slope of dens in Iwavik National Park was similar to those in the Barn Range (Nagy et al. 1983a, BLB #16) and the eastern Brooks Range (Reynolds *et* al. 1976, BLB #22). The mean slope of dens in Nagy et *al.*'s (1983a) study area was 58% or 30.3" (note that 100% slope is equivalent to 90" and represents a perfectly vertical slope). Dens were most often on a southerly aspect; 87% had openings oriented to the south of an east-west line. The slope range of dens on Reynolds et *al.*'s (1976) study area was 36-70% (20-35") and the majority (90%) were on southerly aspects. Grizzly bear dens in other study areas were also found to be generally oriented to the south.

Nagy et al. (1983a, BLB #16) suggested that grizzly bears of the North Slope have southerly facing dens because prevailing north and north-west winds tend to drift snow on south-facing slopes which provides an early and deep insulative cover. Reynolds et al. (1976, BLB #22) suggested that grizzly bears were taking advantage of the deeper active layer above permafrost on southern facing slopes for excavating their dens. Permafrost soils of a small particle size and high water content have a greater hardness than well-drained, coarse soils, therefore, Reynolds et al. (1976, BLB #22) suggested grizzly bears dug dens on steep slopes because the slopes were well-drained and in coarse soil substrates because these soils were easier to dig in. Results from Iwavik National Park supported Reynolds et al's (1976) hypothesis (MacHutchon 1996, BLB #11, pp. 66-67).

Almost 80% of dens in Iwavik National Park (MacHutchon 1996, BLB #11, pp. 67-68) were in dry to mesic habitats on alpine slopes or shrub and tree dominated mountain slopes. South-facing treed slopes were particularly well-used for denning where they occurred. South-facing slopes, particularly treed slopes, had the deepest active layer of any mountain slope habitats. All dens on treed slopes were excavated under the roots of a tree which provided support for the roof. On slopes without trees, dens were often dug under a patch of shrubs, presumably because the shrubs provided support for the roof of the den. Nagy et al. (1983a, BLB #16) found one den in a natural cave and Reynolds *et al.* (1976, BLB #22) found 11 dens (21%) in natural caves. All dens in Ivvavik National Park were excavated (MacHutchon 1996, BLB #11). Nagy et al. (1983a, BLB #16) found three dens along river banks and three on the edge of the coastal lowlands. Reynolds et al. (1976, BLB #22).found three dens on the coastal plain.

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I suspect that most grizzly bears of VNP den on southerly facing slopes of 30-70% (17-35"). The elevation distribution of dens will be dependent on the availability of suitable denning habitat. Most bears likely den in the hills and mountains of VNP, rather than the Old Crow Plats. Dens are likely located in dry to mesic habitats on south-facing shrub or tree dominated mountain slopes. Natural caves within the limestone rock outcrops in the mountains of VNP are also likely used for dens. Any denning on the Old Crow Flats is probably limited to dry, relatively steep riverbanks.

3.1.7 Vuntut Gwitchin Traditional Knowledge

A ***Vuntut Gwitchin Oral History Study is*** currently in the initial phases of research to gather traditional knowledge of the Vuntut Gwitchin Fist Nation. As part of their larger mandate, the project will try to gather information on Vuntut Gwitchin knowledge, beliefs, and uses of bears. Right know, the work is focussed on assembling, translating, indexing, and transcribing taped interviews from previous research, as well as, training and co-ordinating for new interviews in the coming months. There is not yet a detailed assessment of the topics that are included on the tapes (S. Smith, Nagy and Smith Anthropological and Archaeological Research, Edmonton, pers. comm.). From her own work with some of the taped material, S. Smith (pers. comm.) had not yet encountered any information specifically about bears. The ***Vuntut Gwitchin Oral History Study*** has already compiled an extensive inventory of published and unpublished materials relevant to the study.

The only available information on Vuntut Gwitchin traditional knowledge about bears is contained within E. Sherry and the Vuntut Gwitchin First Nation's (VGFN) book ***"The Land Still Speaks"*** (Sherry and VGFN 1999). The following is taken from this book.

Stories of the Raven, Gray Jay, and Grizzly – The following is from Lydia Thomas and translated by Roy Moses (Sherry and VGFN 1999, pp. 27-28):

> ***"… Soon, there was a Grizzly walking towards him. He was hungry. He told the Raven he had been without food and was having a tough time. The Raven invited the Grizzly in and served him with dishes of fish oil. The Grizzly soon got well. Often the Raven brought in a dish of fish oil. They both lived on this. The supply was running low, so the Raven said to the Grizzly, "Myfriend, you are able to kill and eat and survive. Helping each other like this is for all future times." With that, the Grizzly packed some food, thanked his host, the Raven, and*** left. The Raven ***continued to live on what he still had in his cache. To this day, when Grizzly is feasting on anything,*** Raven ***is always welcome or the Grizzly tolerates him. Whereas the wolf and foxes chase him away from their food. Also, if anyone does anything injurious to the Raven, Grizzly is sure to take revenge or defend the Raven.***
>
> ***When we watch the Gray Jays in the summer, they are busy collecting food They collect scraps of food from drying racks, berries of all kinds, and cache it. Gray Jays will cache cranberries, blackberries and other berries in old tree stumps, under tree branches, an.d on hillsides. All are good*** hiding places. ***The*** Gray ***Jay had stored up a large*** cache ***of food when along came a Grizzly who had been withoutfoodfor a long time and was hungry. The*** Gray ***Jay invited him in and went out to dig up some of his cache. Grizzly lived with Gray Jay most of the year. During this time, the Gray Jay and Grizzly ate what was in the bird's caches, berries, meat, and fish. Soon, Gray Jay knew he only had limited supplies left so he told Griuly, "'I have been able to help you this much so you must go where you***

can find food and survive." So the Grizzly left Gray Jay and started travelling. Gray Jay stayed in his area and continued storing what he could and lived on that.

The Grizzly had found an area where people were living and he was able to find food. After his strength fully returned, he returned to Gray Jay with some choice parts, bits of food. To this day, it is believed that Grizzly will defend Gray Jay *when he is abused in any way."*

Plant Use and Management: Roots - 'The Land Still Speaks" has incorrectly identified bearroot (also called alpine hedysarum) ***as Hedysarum mackenzii.*** It should be ***Hedysarum alpinum. H. mackenzii*** (recently changed to ***H. boreale*** ssp. ***mackenzii,*** Cody 1996) is commonly known as wild sweet pea or northern sweet-vetch and has poisonous roots. Grizzly bears throughout the North are known to dig for bearroot roots, but evidence of digging of wild sweet pea roots is not very strong.

The following is from Dick Nukon (Sherry and VGFN 1999, p. 106):

> ***"Roots can be picked, cleaned-up, and eaten. They are just as good as vitamins. This is the type of plant the grizzly bears*** use ***for food. This is part of an Indian legend. The grizzlies sometimes live up in the mountains where there are lots of gophers. When the gophers are under ground still hibernating, the grizzly bears go down to the river where the roots are growing and they start pulling them out and eating them. Sometimes along the river you can see where the bears have been pulling*** out ***roots. Along with this he fattens himself up with berries and other plants."***

Abundant Waters-The following is from Peter Josie (Sherry and VGPN 1999, p. 242):

> ***"You can tell the difference between male and female salmon. The male's nose is sharp*** and ***females have a short mouth. They lay their eggs, spawn, and die. They're*** just ***skinny by this point. The headwaters, [Fishing Branch], that's where the salmon goes. Chum, they go there, King salmon and coho. They are all lying on the shore. There are thousands of them and bears all the time. And these bears are smart. They make no mistake.*** They ***get fresh fish*** and ***tear off the skin. If another*** [bear] ***comes along and sees that*** [first] ***bear left the fish on the shore, he won't eat it. He wants a fresh one. Smart animals, grizzly bears and black bears. . . . There's and lots of marten too."***

Fish Ecology-The following is from Dick Nukon (Sherry and VGFN 1999, p. 248):

> ***"Lots of animals eat fish - the eagle, nwuntain hawk, king bird, fish ducks, grizzly bears, black bears, mink,*** and ***otter.... "***

3.1.8 Potential Management Issues and Concerns

3.1.8-a Bear – Human Interaction

The past experience of bears with people can have a major effect on the future response of bears to people and generally falls into three reinforcement categories: negative, neutral or positive (McCullough 1982, Gilbert 1989). Bears will avoid areas near people after being harassed, hurt, or injured and past negative experiences with people can make bears wary of humans. Cubs can learn to fear people by observing their mother's behaviour (McCullough 1982, Gilbert 1989, Herrero 1989). However, newly weaned immature bears usually undergo a curious or testing phase in their life during which they try to figure out on their own how to relate to other bears and people, irrespective of lessons they learned from their mother. During this time, they may investigate and interact with humans and their property regardless of what their mother's attitude toward people was (J. Hechtel, Yukon Renewable Resources, pers. comm.). Wariness likely involves both genetic inheritance and learning, however, past experience is probably the most important factor in a long-lived, rapidly learning animal like a bear (McCullough 1982).

Neutral interactions with people can lead to human-habituation. Human-habituation has been defmed as a reduction in the frequency of a response when no consequence is perceived by the bear (McCullough 1982, Gilbert 1989). Avoidance or fear responses fade when a threat, pain or injury (i.e., punishment) does not follow the stimulus causing the response.

Positive reinforcement for bears around people usually involves the acquisition of human food or garbage. Poor management of human food and garbage can lead to food-conditioned bears. Food-conditioning by bears occurs when bears have fed on human food or garbage and bears learn to associate humans and/or human development with potential sources of food (Gilbert 1989). Food-conditioned bears have low survival under many circumstances. They are predisposed to nuisance activity, the garbage they eat may compromise their health, and they become dangerous and unpredictable. As a result, they are frequently killed in defence-of-life or property, killed in control actions or they are translocated. It is important to make the distinction between human-habituated bears and food-conditioned bears. A food reward or food conditioning is not necessary for habituation to occur (McCullough 1982, Gilbert 1989).

Overall, bears are tolerant of humans and the likelihood of being injured by a bear is low (Herrero 1985, Herrero and Fleck 1990). The main situations leading to human injury by bears are 1) when food conditioned bears, that are also human-habituated, aggressively approach people for food and 2) when humans suddenly surprise a bear at close range, particularly a female grizzly bear with cubs. Habituated bears that are not food-conditioned are not usually a risk to humans if people behave in a predictable manner and bears do not learn to associate humans with food or garbage.

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I am not aware of any information on historical bear - human interactions in VNP. I suspect there were occasional problems with bears breaking into hunting and prospecting camps and likely occasional close encounters between bears and people. Poor garbage management at long term camps may have led to the death of some bears that became food-conditioned.

3.1.8.b Human Use

Grizzly bear populations in the North are characterized as having low reproductive potential, short periods of food availability and large individual home ranges (Reynolds 1980). The provision of access into grizzly bear habitat is a pervasive problem associated with all human activities and increased human access to grizzly bear range has been the number one contributor to declines in grizzly *bear* populations throughout North America (McLellan 1990, Banci 1991).

Displacement - Grizzly bears can be displaced from areas of human activity, but the degree of displacement depends on the type of human activity, the amount of security cover, an individual bear's past experience with humans, and the relative quality of resources around the area of human activity (McLellan 1990). Grizzly bears that are wary of humans undergo stress, and *make* temporal or spatial adjustments in their activity patterns in areas of human use (Warner 1987, Gilbert 1989, Gunther 1990, Olson and Gilbert 1994). They may stop using feeding sites near human activity if interruptions are frequent (Gunther 1990). Human-habituation can reduce the time and energy costs associated with a fear response to people (McCullough 1982, Herrero 1989, McLellan and Shackleton 1989, Gunther 1990).

Harassment-Aircraft may cause physiological stress to bears without any apparent change in behaviour *or* they can displace bears or disrupt their *normal activities* (L&Franc *et* al. 1987). Grizzly bears are generally more sensitive to helicopters than to fixed-wing aircraft. The response of an animal will depend on a variety of factors, but is likely correlated with noise level Other important factors include the availability of cover, the altitude of the aircraft, the behaviour of the aircraft, the age or sex of the bear and the bear's pre-disturbance activity (LeFranc *et al.* 1987). As with most human activity, grizzly bears are capable of habituating to aircraft disturbance. Intentional and unintentional harassment of bears by aircraft is a special concern in the North because there is little security cover (McLellan 1990).

There is some data on the thresholds of human use that are tolerable by bears (Olson and Girt 1994). however, it is diicult to generalize the actual disturbance levels from one area to another. Bears with diierent experiences with people can have diierent responses to the same level of disturbance. Generally, wary bears that experience neutral interactions with people, including not being harassed, hunted or shot at, will eventually habituate to groups of people and be less disturbed by them The number of bears tolerant or habituated to people and their level of use of an area likely increases, reaches an asymptote and then decreases as human use increases (Mattson 1990). This asymptote or threshold of human use is unknown, however, the USDA Forest Service (1990). in the development of a cumulative effects model (CEM) for grizzly bears, adopted a threshold level of 80 parties/month, concentrated in one area, over which human use was considered high intensity. Gibeau et al. (1996) and Gibeau (1998) subsequently defined the threshold between high and low human use in Banff National Park as 100 people/month.

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The grizzly bear population of VNP is constrained by a relatively short season available to acquire the necessary energy for growth, reproduction and over-winter survival, as well as, available habitats appear to be of limited quality. As a result, the grizzly bear population can be easily impacted, either directly or indirectly, by human activities and any constraints on their ability to forage could have long-term implications. This highlights the need to carefully manage human activities to minimize their impacts on bears or their food resources. Grizzly bears in VNP are likely similar to those in Ivvavik National Park in that they generally fear humans and have not habituated to human activity (MacHutchon 1996, in press, BLB #1 1). As a result, they can be easily displaced from important habitats or prey items. The availability of security cover, whether it is vegetation or darkness, can be important in reducing the displacement effects of human activity (McLellan 1990), but grizzly bears in the North have limited vegetative security cover and no darkness during most of their non-denning period. Grizzly bears that are displaced from a feeding site because of an encounter with humans will lose an immediate feeding opportunity and there will be some energetic cost to their escape, particularly if they run. Repeated disruptions have the potential to adversely affect the time available for the acquisition of necessary energy.

Currently, visitors to VNP are infrequent and this level of human activity likely has not adversely impacted the grizzly bear population. VNP is also closed to licensed hunting by non-native Yukon residents. After 1980, but prior to the creation of the park in 1995, there were 2 grizzly bears shot in subzone 1-16 and none in subzone 1-19; two subzones that used to be within the park boundaries (J. Hechtel, Yukon Renewable Resources, pers. comm.). Section 4.3.4 has more detail on non-native resident and non-resident grizzly bear and black bear harvest around VNP. Possession of firearms in the Park is now restricted to Parks Canada staff and to Vuntut Gwitchin pursuing traditional activities in the Park. Vuntut Gwitchin beneficiaries have the exclusive right to hunt within VNP for subsistence purposes (Yukon Renewable Resources 1999, BLB #30). Several Vuntut Gwitchin people currently live seasonally at a few permanent camps in VNP and hunt on the land. Other people occasionally travel to the park from Old Crow. The impact of their activity on grizzly bears in the park is unknown.

3.2 Black Bear Ecology

There is little known about the ecology of northern black bears, particularly at the northern extent of their range, and Vuntut National Park is situated at this northern extent. Most of what was known about black bears in the Yukon, up to 1986, was summarised in MacHutchon and Smith (1990, BLB #10). No additional work on black bears in the Yukon has been done since then. Portions of the following review were taken from MacHutchon and Smith's (1990) summary.

3.2.1 Distribution, Taxonomy and Morphology

Pelton et al. (1999, BLB #23, p. 146) shows the current and historical distribution of black bears in North America. Black bears inhabit all forested regions of the Yukon. They are rare in the northern Yukon although there are scattered records for the North Slope (MacHutchon and Smith 1990, BLB #10, p. 4; MacHutchon 1996, BLB #11, p. 93). These bears may have moved to the Yukon North Slope from the MacKenzie River Valley. Black bears were never seen in the Fiith River Valley of Iwavik National Park during three years of intensive work from 1993 to 1995 (personal observation). MacHutchon and Smith (1990, BLB #10, p. 4) considered black bears to be scarce north of approximately 65" latitude and to be primarily found in forested areas. One black bear subspecies, *Ursus americanus americanus* is currently recognised for most of the Yukon (Barichello 1997).

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VNP is at the northern extreme of black bear range in Canada.

3.2.2 Status

Black bear populations in the Yukon are considered stable (Barichello 1997). Populations north of approximately 65" latitude in the Yukon are expected to occur in low densities and be primarily found in forested areas (MacHutchon and Smith 1990, BLB #10).

3.2.3 Population Characteristics

3.2.3.a Size and Density

Table 11 outlines the estimated density of black bear populations throughout North America. There are only a few population density estimates for the northern interior. The *Yukon* River Flats are located at 66" latitude just downstream of Fort Yukon where the Porcupine River enters the Yukon River. This is the northernmost study of black bears in North America. Despite the northern latitude, the densities of black bears in this area were higher than found in the Tanana River Flats near Fairbanks and the Susitna River Valley in south-central Alaska. Compared to southern populations of black bears, black bear densities in the north are relatively low. However, in comparison to grizzly bear population densities throughout northern North America (see Table 2), black bear densities in the north are much greater. Despite thii, black bears reach the northern extent of their range where trees become scarce, but grizzly bears range much further north. I suspect black bear density and the northern extent of their range is influenced more by competition with grizzly bears than by the quality of the habitat. Aside from the coastal study areas of Alaska, all of the black bear densities in Table 11 are *from areas* where grizzly bears do not occur. Densities are quite high in most of these areas suggesting that black bear populations do well where they are not directly competing with grizzly bears. In addition, many interior populations, which likely occur in lower quality habitat than can be found in coastal areas, occur at higher densities than in coastal areas of Alaska where black bears are competing with grizzly bears.

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Old Crow Basin and British-Richardson mountains ecoregions - I suspect that black bears only rarely travel in to the Old Crow Basin Ecoregion from the Old Crow Flats.
Old Crow Flats Ecoregion - Black bear densities likely decrease from the area around the Porcupine River near Old Crow to the Old Crow Flats and then further decrease from the southern flats to the flats within VNP. Densities around the Porcupine River may be as high as observed in northern interior Alaska, that is between 90 to 100 bears/1000 km^2. However, black bear densities in the Old Crow Flats of VNP are likely as low as grizzly bear densities in the MacKenzie Delta and Arctic Coastal Plain, that is, 4-9 bears/1000 km*. The Old Crow Flats Ecoregion of VNP is approximately 1,450 km^2, which suggests a population of approximately 6-13 black bears. More information is required on the distribution and number of sightings of black bears within the Old Crow Flats, particularly within VNP to substantiate these estimates. The density in VNP may be higher if black bears in fact use the flats more than is suspected. First Nation local and traditional knowledge of black bear distribution would help assess the relative changes in black bear numbers north of Old Crow.

3.2.3.6 Sex and Age Structure

Table 12 outlines the population characteristics of a number of black bear populations throughout North America. The sex ratio of adult bears was usually less than 50% male, particularly in populations that were heavily hunted.

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Black bear populations that are only lightly hunted, such is likely the case in VNP, could be relatively stable and therefore have a relatively higher adult cohort. However, because the black bear population is at the northern extent of its range, it also may be predominately adult bears because of low recruitment rates. It is hard to know which of these scenarios is most likely for this poorly understood system.

I suspect that the sex ratio in the black bear population of VNP may be opposite to what is normally described, that is there may be more males than females. I think that there may be more male bears because of their higher dispersal from more densely populated areas to the south, the more wide ranging movements of male bears, and because the population appears to be lightly hunted, therefore, there will be less pressure than normal on this segment of the population..

Table 11. Estimated densities of black bear populations in North America. Most of the data in the table comes from Garshelis (1994).

Study area	References (s)	Bears/1000 km² Include cubs	Bears/1000 km² Exclude cubs	km²/bear Include cubs	km²/bear Exclude cubs
Northern Interior					
Yukon River Flats, AK	Bertram end Vivion (workshop poster)	124		6.1	
Tanana River Flats. AK	Hechtel (1991)	86	46-67	11.6	14.9-21.7
Susitna, AK	Miller (1967. 1994), Miller *et al.* (1987, 1997)	69	65	11.3	15.4
western U.S. & Canada					
Black Mesa, CC	Beck (1991)	140	110	7.1	9.1
Leonard Canyon, AZ*	LeCount (1987b, pers. comm.)	150	110	6.7	9.1
Fort McMurray, AB	Young & Ruff (1962)	179-250		4.0-5.6	
Cdd Lake. AB	Kemp (1972)	366		2.6	
Lowell, ID	Beecham (1980b, pers. comm.)	430		2.3	
Big Creek, MT	Jonkel & Cowan (1971)	450	400	2.2	2.5
Four Peaks. AZ	LeCount (1982, 1984, pers. comm.)	490	360	2.0	2.6
Council. ID	Beecham (1980a, 1983), Reynolds & Beecham (1980)	770	620	1.3	1.6
Coastal					
Kenai 1947 burn. AK	Schwartz & Franzmann (1991), Miller *et al.* (1997)	199	151	5.0	6.6
Kenai 1969 burn, AK	Schwartz & Franzmann (1991). Miller *et al.* (1997)	269	205	3.5	4.9
Prince William Sound, AK	Modafferi (1962)	500		2.0	
Long Island, WA: 1980-82 data	Lindzey *et al.* (1966)	1620	1300	0.6	0.6
Eastern U.S. & Canada					
Whii Rock, AR	Clark (1991)	90	80	11.1	12.5
Dry Creek, AR	Clark (1991)	120	90	6.3	11.1
Northeastern MN	Rogers (1987)	210	160	4.6	6.3
North-central MN	Garshelis (unpubl. data)	260	200	3.6	5.0
Bradford, ME	McLaughlin *et al.* (1994), McLaughlin (pers. comm.)	300	190	3.3	5.3
Drummond Is.. MI	Visser (pers. comm.)	350	250	2.3	4.0
Spectacled Pond, ME	McLaughlin *et* al. (1994), McLaughlin (pew. comm.)	360	200	2.6	5.0
Western MA	Fuller (pers. comm.)	390	270	2.6	3.7
Smoky Mountains NP. TN	Eiler *et al.* (1989), McLean (1991), McLean & Pelton (1994)		290		3.4
White River NWR, AR	Smith (1965)	410	360	2.4	2.6
East-central ON; 197560 data	Kolenosky (1986, 1990), Yodzis & Kolenosky (1966)	570	460	1.6	2.1
Stockton Is., WI	Trauba & Anderson (pers. comm.)	640	530	1.6	1.9
Dismal Swamp NWR, VA& NC	Hellgren & Vaughan (1969)		590		1.7
Shenandoah NP. VA	Carney (1985)		660		1.2

*Both sides of Mogollon Rim combined.

Table 12. Characteristics* of black bear populations from across North America All of the information in this table comes form Garshelis (1994). Comparisons of these reproductive parameters among populations need to be done with caution.

study area	References (s)	Age of first litter (yrs)	Interbirth interval (yrs)	Cub litter size (no.)	Adult M:F	Cub Surv. (%)	Adult Male Sun. (%)	Yrlng weight (kg)
Northern Interior								
Yukon River Flats, AK	Bertram and Vivion (workshop poster)		2	2.2		21	100	
Tanana River Flats, AK	Hechtel (1991, 1995)	6.3	3.2	2.7		62		
Susitna, AK	Miller (1967. 1994), Miller *et al.* (1967)	5.9	2.7	2.1		68		11
Western U.S.&Canada								
Big Creek, MT	Jonkel and Cowan (1971)	7.0	3.0	1.7	0.66			
Lowell, ID	Beecham (1980b, pers. comm.)	5.0		1.7	0.97			
Council, ID	Beecham (1980a, 1983), Reynolds and Beecham (1960)	4.6	2.4	1.9	0.72			
Black Mesa. CO	Beck (1991)	4.7	2.2	2.0	0.36	56	70	23
Four Peaks, AZR	LeCount (1982, 1984, pers. mm.)	4.7	2.3	2.0	1.05	56		22
Leonard Canyon, AZ*	LeCount (1967. pers. comm.)	4.6	2.0	1.6	1.05	55		23
Yosemite NP. CA; developed area	Graber (1981)	4.2	2.5	2.0	0.64			29
Yosemite NP. CA; wilderness	Keay (1990)	4.1		1.6	0.23			
Coastal								
Kenai 1947 burn, AK	Schwartz and Franzmann (1991)	5.6	2.2	2.2	0.68	74	90	16
Kenai 1969 burn, AK	Schwartz and Franzmann (1991)	4.6	2.1	2.3	0.56	91	77	24
Long Island, WA; 1980-82 data	Lindzey *et al.* (1966)			22	0.46	27	100	
Eastern U.S. & Canada								
Northeastern MN	Rogers (1987)	6.3	2.3	2.4	0.51	75		16
East-central ON; 1975-80 data	Kolenosky (1986, 1990), Yodzis and Kolenosky (1986)	5.7	2.1	2.5	0.43	53		16
Spectacled Pad, ME	McLaughlin *et al.* (1994), McLaughlin (pers. comm.)	5.4	2.0	2.5	0.42	62	60	13
Stockton Is.. WI	Trauba & Anderson (pers. comm.)	5.0	2.3	2.6	0.86	69	97	22
White River NWR, AR	Smith (1985)	4.9	2.4	2.3	1.43	66	95	
Stacyville, ME	McLaughlin *et al.* (1994), McLaughlin (pers. comm.)	4.6	2.1	2.6		73		17
Smoky Mountains NP, TN	Eiler *et al.* (1989), McLean (1991), McLean and Pelton (1934)	4.6	2.4	2.6	1.06	62		11
North-central MN	Garshelis (unpubl. data)	4.7	2.1	2.5	0.46	85	74	21
Drummond Is.. MI	Visser (pers. comm.)	4.6	2.0	2.2	0.59	59	79	20
Bradford, ME	McLaughlin et *al.* (1994), McLaughlin (pers. comm.)	4.6	2.1	2.4	0.45	29	61	16
Dismal Swamp NWR, VA & NC	Hellgren & Vaughan (1969)	4.2		2.1	2.50	75	59	
Shenandoah NP, VA	Carney (1985)	4.0	2.0	2.0	0.95	70	59	
Western MA	Fuller (pers. comm.)	3.7	2.0	2.2	0.25	53	73	20
Dry Creek. AR	Clark (1991)	3.3		2.3	0.59	90	65	37
White Rock, AR	Clark (1991)	3.3		1.4	1.45	31	95	40
Northeastern PA	Alt (1980, 1961, 1969)	3.2	2.0	3.0		64		33

*Ratios of adult males per female (M:F) were generally derived from capture samples and thus could be male-biased. Adults were considered to be >=4 years old. Adult male survival was determined from telemetry records. Most male mortality was due to hunting. but male mortality rates were high even in acme unhunted populations. All national parks (NP) and national wildlife refuges (NWR) were unhunted (although males were susceptible to hunting outside). as were White Rock, Dry Creak, Black Mesa, and Long Island during the years indicated; Four Peaks was very lightly hunted (<2% mortality). Cub survival, litter sizes, and intervals between litters were typically determined from den checks (except Susitna, Big Creek. and Yosemite) and the inter-litter interval excluded cub production following whole-litter loss. Yearling weights were obtained in the den (1314 months of age), or shortly thereafter (Susitna and Yosemite), and used as an indicator of food availability Values for all parameters were either taken directly from tie indicated sources or derived from data presented therein.
*Both sides of Mogollon Rim combined.

3.2.3.c Reproductive Biology

Like grizzly bears, black bears have a low reproductive rate. Table 12 describes reproductive characteristics for a number of black bear populations throughout North America. Comparisons of these reproductive parameters among populations need to be done with caution. Sample sizes and duration of sampling periods vary widely, data on successive litters of individual females are lacking, and different methods have been employed in estimating first age of reproduction and breeding interval.

Black bears in the central and southern Yukon were thought to produce their first litters at 6 to 7 years of age (MacHutchon and Smith 1990, BLB #10, p. 26). This age of first litter production was generally older than reported for southern populations, but consistent with that of other northern populations (Table 12 and MacHutchon and Smith 1990, BLB #10, p. 27). Black bear populations in the north Yukon may have an even later age of first litter production (MacHutchon and Smith 1990, BLB #10). The mean litter size for black bears in central and southern Yukon was estimated to be between 1 and 2 and was set at 1.9 cubs/litter because this was the mean of several interior Alaskan studies (MacHutchon and Smith 1990, BLB #10, pp. 27-28). However, litter size estimates in Table 12 indicate that the litter size of northern black bear populations may be higher, that is between 2.1 to 2.7 cubs per litter. MacHutchon and Smith (1990, BLB #10, pp. 28-29) estimated that the interval between litters would be four years for Yukon black bears, but it may be as low as 2 to 3 years. In summary, black bears in the North appear to become sexually mature between 6 to 7 years of age, have litter sizes of 1.9 to 2.7 cubs, and have intervals between litters of 2.0 to 3.0 years. These values are in contrast to grizzly bears in the North that typically become sexually mature between 6 to 9 years of age, have litter sizes of 1.7 to 2.3 cubs, and have an extended period of maternal care that results in intervals between litters of 3 to 4.5 years. In other words, black bears in the north appear to have a higher reproductive rate than northern grizzly bears. However, cub survival rates appear to be relatively low (see section 3.2.3d below).

MacHutchon and Smith (1990, BLB #10, p. 30) speculated that 20 years of age was the maximum age that most Yukon black bears produced young; only 2 black bears over 20 years of age were present in 537 kills (0.3%) between 1979 and 1986. A more recent examination of Yukon black tear kill data found that about 26 bears of 1790 (1.4%) killed between 1980 and 1998 were greater than 20 years old. The oldest bears were 27 (J. Hechtel, Yukon Renewable Resources, unpubl. data). Black bears are likely physiologically capable of producing young until the end of their lives, however, their ability to likely depends on their physical condition in any one year.

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I estimate that black bears in southern VNP become sexually mature between 6 to 7 years of age, have litter sizes of 1.9 to 2.5 cubs, and have intervals between litters of 2 to 3 years.

3.2.3.d Mortality

The range in cub survivorship reported for black bear populations in the western U.S. and Canada and interior of Alaska was 55-68% (Table 12). However, recent work in the Yukon River Flats, Alaska indicated very low cub survivorship of 21%. Generally, adult survivorship appears to be as high in northern populations as in southern populations. The black bear population of the Yukon River Flats is only lightly hunted and survival rates of adults approached 100% (Bertram and Vivion, workshop poster).

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The cub mortality rate (mortality rate is the inverse of survival rate) reported for the Yukon River Flats (79%) is very high for a black bear population. Black bear cub mortality in VNP is likely not that high, but may be as high or higher than reported in other northern studies, that is 30-40%, because there is minimal security habitat available, females are occupying habitats that are not very productive, and there is some competition with grizzly bears. It is hard to predict what the adult male and female survivorship in VNP would be, but is likely lower than the 90-100% found in some southern populations and on the Yukon River Flats, Alaska because bears are at the periphery of their range, there is minimal security habitat available, and there is some competition with grizzly bears.

3.2.4 Home Range and Movement

3.2.4.a Home Range

There are a number of different ways that home ranges are calculated (e.g., 100% minimum convex polygon, 95 or 50% minimum convex polygon, occupied area, adaptive kemal. fixed kemal, etc.) and presented (e.g., annual, multi-annual, sex and age divisions, weighted means, etc.). As a result, caution is necessary when comparing home ranges from different studies. Home ranges of black bears generally vary in size depending on the age and sex of the bear and where they live. Male bears typically have larger home ranges than female bears. MacHutchon and Smith (1990, BLB #10, pp. 7-10) reported the home ranges of radio-collared black bears in the Pelly River Valley of south-central Yukon using 100% minimum convex polygons. Female bears had a mean home range of 28.1 km^2 (range = 6.8-75.4 km^2) and males had a mean home range of 103.5 km^2 (range = 54.7-164.6 km*). These values were thought to underestimate the real home ranges because there was a lack of early spring and fall locations. These home range sizes were similar to those of black bear populations in interior Alaska and northern Alberta (MacHutchon and Smith 1990, BLB #10, pp. 7-8). The multi-year mean convex polygon home ranges for black bears on the Tanana River Flats, Alaska were 82.59, 240, and 596 km^2 for subadult females, adult females, subadult males, and adult males, respectively (Hechtel 1991). Bertram and Vivion (workshop poster) reported mean annual home ranges for female and male bears on the Yukon River Flats, Alaska to be 50 and 91 km^2, respectively.

Vuntut National Park

***Old Crow Basin and British-Richardron mountains ecoregions* --** I suspect that black bears only rarely travel in to the Old Crow Basin Ecoregion from the Old Crow Plats. ***Old Crow Flats Ecoregion* -- I** suspect that black bear home ranges in the Old Crow Flats are larger than those reported by MacHutchon and Smith (1990, BLB #10) for the Pelly River Valley of south-central Yukon and more similar to those reported by Hechtel (1991.) and Bertram and Vivion (workshop poster) for northern interior Alaska. That is, 100% minimum convex polygon home ranges are likely in the range of 50-100 km^2 for adult females and 100-500 km^2 for adult males.

3.2.4.b Movement

Like grizzly bears, black bears have the ability to travel almost anywhere they choose, however, they typically use the easiest route that also provides feeding opportunities. This is typically along valley bottoms and over low passes. Rubbing or marking trees are generally found on bear trails or trail systems (LeFranc et al. 1987, MacHutchon ***et al.*** 1993) and are most common near creeks and streams. Rubbing and marking trees have been well described for both black bears and grizzly bears and both species may use the same tree. Marking trees are characterised by bite marks in the wood, chunks of bark tom off, bark rubbed or smoothed along one side, sap running from tree wounds, and bear hair stuck in the bark or sap (see Figure 2). Hair trapped on the tree is the easiest indication of marking by either bear species or both species on the same tree. The main theories for marking include information signposts, territory definition, sexual advertisement, and comfort and grooming (LeFranc et *al.* 1987). Bear "stomps" or mark trails are occasionally associated with mark trees and both grizzly bears and black bears will make mark trails.

Vuntut National Park

All bear trails and rubbing or marking trees that I found in the Thomas Creek Valley of VNP were on valley bottoms adjacent to creeks and rivers. They were primarily marked by grizzly bears; there was no indication that black bears had used them.

I used existing maps, air photos and satellite imagery of VNP and surrounding areas to help identify potential movement routes for bears. There do not appear to be any major barriers to black bear movement in VNP. Movement within the Old Crow Flats likely is along creek and river edges and around lake margins.

3.2.4.c Breeding Season

MacHutchon and Smith (1990, BLB #10, pp. 25-26) suggested that Yukon black bears breed between early-June and the end of July. This was later than previously reported for the mating season of black bears in coastal or southern populations. Hechtel (1991) suggested that mid-May to mid-July was the breeding season for black bears in north central Alaska.

Vuntut National Park

The breeding season of black bears in VNP is likely between mid-May and late July.

3.2.4.d Denning Chronology

MacHutchon and Smith (1990, BLB #10, pp. 22-24) reported that black bears in the Pelly River Valley of south-central Yukon entered dens in late September or early October. Black bears on the Tanana River flats in north-central Alaska denned from late September to late October and emerged between early April and late April (Smith et al. 1995). Black bears in the Susitna River Valley of south-central Alaska entered dens between mid-September and mid-October and emerged between late April and mid May (Schwartz *et* al. 1987, Miller 1990e). The timing and duration of denning varies between sex and age classes. Male bears usually den later and emerge earlier than females and pregnant females generally den for longer periods than do solitary females or females with yearlings.

Vuntut National Park

I suspect the denning period of black bears in or near VNP may be even longer than found in other northern studies. Den entrance may be as early as early September and den emergence as late as late May. As mentioned above, the timing and duration of denning will likely vary between sex and age classes with male bears denning later and emerging earlier than females. Pregnant females will generally den for longer periods than do solitary females or females with yearlings.

3.2.5 Feeding Ecology

3.2.5.a Seasons of Activity

Vuntut National Park

Because of the similarity in diet, I suspect that black bears in VNP will have similar shifts in their use of major foods as grizzly bears. I propose the same four seasons of activity for black bears in VNP:

1. Spring: den emergence to June 15
2. Summer: June 16 to July 15
3. Late Summer: July 16 to August 31
4. Fall: September 1 to den entrance

The change from spring to summer would correspond with the widespread availability of common horsetail shoots. The change from summer to late summer would correspond with the widespread availability of blueberries. Black bears are not very effective at digging, therefore, I suspect that the change from late summer to fall would correspond with the loss of many berries and would signal the need to start preparing for denning. Black bears likely continue to forage for berries, scavenge carrion, and hunt microtines in the fall

3.2.5.6 Diet

A list of spring, summer, and late summer or fall black bear foods described for populations in northern Canada and Alaska is in Appendix 3. This list is summarized in Table 13.

Table 13. Black bear foods described for northern Canada and Alaska study areas.

Common Name	Scientific Name	Spring	Summer	Late Summer / Fall
Roots:				
cow-parsnip	*Heracleum lanatum*	X		
Graminoids:				
sedges	*Carex* spp.	X		
grasses	*Graminae*	X	X	
bluejoint	*Calamagrostis canadensis*	X		
Horsetail	*Equisetum* spp.	X	X	
	Equisetum arvense	X	X	
Forb &Shrub Stems, Leaves, or flowers:				
scrub birch	*Betula glandulosa*	X	X	X
paper birch	*Betula papyrifera*	X	X	X
fireweed	*Epilobium angustifolium*	X		X
cow-parsnip	*Heracleum lanatum*	X		
creamy peavine	*Lathyrus ochroleucus*	X	X	
arctic lupine	*Lupinus arcticus*		X	X
white sweet clover	*Melilotus alba*	X	X	
Labrador lousewort	*Pedicularis labradorica*		X	X
balsam poplar catkins	*Populus balsamifera*		X	
trembling aspen	*Populus tremuloides*	X	X	X
willow catkins	*Salix* spp.	X		
horned dandelion	*Taraxacum ceratophorum*	X		
red clover	*Trifolium pratense*	X	X	
American vetch	*Vicia americana*	X	X	
Fruit:				
saskatoon	*Amelanchier alnifolia*	X	X	
bearberry	*Arctostaphylos rubra* or *A. alpina*	X	X	X
kinnikinnick	*Arctostaphylos uva -ursi*	X	X	
red-osier dogwood	*Cornus stolonifera*			X
crowberry	*Empetrum nigrum*	X	X	X
wild strawberry	*Fragaria virginiana*		X	
trembling aspen	*Populus tremuloides*		X	
prickly rose	*Rosa acicularis*			X
soopolallie, soapberry	*Shepherdia canadensis*	X	X	X
blueberry, cranberry species	*Vaccinium* rpp.	X	X	
dwarf blueberry	*Vaccinium caespitosum*			X
black huckleberry	*Vaccinium membranaceum*			X
blueberry	*Vaccinium uliginosum*	X	X	X
lingonberry, mountain cranberry	*Vaccinium vitis-idaea*	X	X	X
highbush-cranberry	*viburnum edule*			X
Insects:		X	X	
ants	Formicidae	X	X	X
wasps	Vespidae	X	X	X
Rodents:				
microtines		X		
Hoary marmot	*Marmota caligata*	X	X	
muskrat	*Ondatra zibethicus*		X	
beaver	*Castor canadensis*		X	
Ungulates:				
bison	*Bison bison*	X		
moose	*Alces alces*			X
caribou	*Rangifer tarandus*	X		
other:				
fish		X		
grouse or ptarmigan	Phasianidae	X	X	
snowshoe hare	*Lepus americanus*	X	X	X

Table 14. Possible foods of black bears in Vuntut National Park, Yukon.

Common Name	Scientific Name	Spring	Summer	Late Summer / Fall
Graminoids:				
sedges	*Carex* spp.	X	X	
grasses	*Graminae*	X	X	
bluejoint	*Calamagrostis canadensis*	X	X	
Horsetail	*Equisetum* spp.	X	X	X
	Equisetum arvense	X	X	X
Forb & Shrub Stems, Leaves, or flowers:				
fireweed	*Epilobium angustifolium*	X		X
arctic lupine	*Lupinus arcticus*		X	X
Labrador lousewort	*Pedicularis labradorica*		X	X
balsam poplar catkins	*Populus balsamifera*	X	X	
willow catkins	*Salix* spp.	X	X	
h a d dandelion	*Taraxacum ceratophorum*	X		
Fruit:				
bearberry	*Arctostaphylos rubra* or *A. alpina*	X	X	X
kinnikinnick	*Arctostaphylos uva -ursi*	X	X	X
crowberry	*Empetrum nigrum*	X	X	X
red currant	*Ribes triste*		X	X
dwarf nagoonberry	*Rubus arcticus*		X	X
cloudberry	*Rubus chamaemorus*		X	X
soopolallie, soapberry	*Shepherdia canadensis*		X	X
blueberry	*Vaccinium uliginosum*	X	X	X
lingonberry, mountain cranberry	*Vaccinium vitis-idaea*	X	X	X
Insects:		X	X	
ants	Formicidae	X	X	X
wasps	Vespidae	X	X	X
Rodents:				
microtines		X	X	X
muskrat	*Ondatra zibethicus*		X	
beaver	*Castor canadensis*		X	
Ungulates:				
moose	*Alces alces*	X	X	X
caribou	*Rangifer tarandus*	X	X	X
other:				
fish		X		
grouse or ptarmigan	Phasianidae	X	X	
snowshoe hare	*Lepus americanus*	X	X	X

Vuntut National Park

I developed a list of possible black bear foods for VNP (Table 14) based on the black bear foods described for other study areas in the north (Table 13), MacHutchon and Smith (1990, BLB #10, pp. 12-18), and the known distribution of plants (Cody 1996).

3.2.5.c Seasonal Food Habits

Vuntut National Park

I suspect the most well used foods of black bears during the spring and early summer are overwintered berries, sedges, grasses, and horsetail. It is likely that black bears in VNP feed heavily on the catkins of balsam poplar and willow in the spring as well The main overwintered berries used are likely kinnikinnick, bearberry, and crowbeny. Graminoids and horsetail are probably not readily available until late spring or early summer. I suspect the most well used foods during the summer are “green” vegetation or forbs, such as horsetail, sedges, and grasses, as well as early ripening berries. Various fruits are likely the main foods as soon as they start ripening in July or early August. Blueberry, soapberry, crowberry, bearberry, kinnikinnick, red currant, lingonberry, and cloudberry or salmonberry are berry producing species that are likely eaten from late July to early September. Black bears likely continue to forage for berries, scavenge carrion, and hunt microtines during the early fall. Mammal prey or carrion is likely an important food whenever black bears can get it. The main mammal foods are likely caribou, moose, voles, and lemmings. In spring, bears likely scavenge caribou killed by other predators such as wolves and grizzly bears when the caribou move northward to their calving grounds along the Yukon and Alaska coastal plain. In fall, black bears may be able to scavenge caribou that are killed by other predators or kill first year calves when the caribou are on their way to their wintering areas south of the Porcupine River. In spring, black bears likely kill moose calves shortly after they are born. On the Yukon River Plats, Alaska, predation was responsible for 95% of known moose calf mortality and black bear (45%) and grizzly bear (39%) were the major causes of mortality (Bertram and Vivion workshop poster). Similar to grizzly bears, fish can be an important food of black bears, but are mainly pursued in areas where they are easily caught, such as large concentrations at spawning areas. I am not aware of these types of concentrations of fish within VNP, so I do not know the seasonal importance of fish in the diet of grizzly bears.

3.2.6 Seasonal Habitat Use

Vuntut National Park

I suspect that black bears primarily use habitats in the Old Crow Plats and rarely move in to the hills of the Old Crow Basin. I have little familiarity with the habitats available to black bears within the Old Crow Plats, so I cannot predict what habitats are likely to be valuable to them. Generally, the highest value habitats will be those that have a high availability (ie., distribution and abundance) of major black bear foods in each active season. The probable seasonal food habits of black bears are described above.

3.2.6.a Security Habitat

Security habitat for black bears includes habitats to avoid both bear - bear conflict and human - bear conflict. During their non-denning period, black bears use shrub and tree cover to avoid conflicts with other black bears or with grizzly bears. To avoid aggressive adult males or grizzly bears, females with cubs rely on available trees that they can climb. Black bear cubs are often sent up a tree by a female when she goes off to feed. Tree cover is important to the overall security of black bears, consequently populations of black bears rarely occupy areas devoid of trees, unless those areas also do not have grizzly bears. Black bears typically avoid areas of human activity unless attracted by an atypical food source, such as human food or garbage.

3.2.6.b Denning (Winter Hibernation)

Table 15 outlines the den characteristics described for some northern black bear populations. Black bears in the Susitna River Valley denned at low elevations in spruce-forested habitat along major rivers or creeks (Schwartz et al. 1987, Miller 1990e). Just over half of the dens were excavated by black bears, a few were tree dens in the bole of large black cottonwoods (*Populus balsamifera* ssp. *trichocarpa*) with elevated entrances, and the rest were in natural cavities. In the Tanana River Flats, Alaska, most dens were excavated by black bears, a few were in natural cavities, and some were on the surface (Smith et al. 1994, BLB #26). Bears appeared to favour willow/alder and black spruce habitats for den sites and avoided marshland and heath meadow habitats.

Vuntut National Park

Most black bear dens in the Old Crow Flats are probably in similar habitat types as black bear dens were on the Tanana River Flats, Alaska that is in willow/alder and black spruce habitats. In addition, black bears may den in excavations along dry riverbanks.

Table 15. Den characteristics **for northern black bear populations.**

Study Area	Reference (s)	*n*	Elevation (m) *x*	Elevation (m) Range	Slope %	Slope (°)	Orientation
Tanana River Flats, AK	Smith *et al.* (1994. BLB #26)	34					N
Pelly River Valley. YT	MacHutchon 8 Smith (1990, BLB #10)	9	985	792-1326			
Susitna River Valley. AK	Schwartz *et al.* (1987). Miller (1990e)	96	624	267-1324	70	35	All
Nahanni National Park, NWT	MacDougall *et al.* (1997)	6	626	615-640	C-49	O-26	E

3.2.7 Vuntut Gwitchin Traditional Knowledge

A *Vuntut Gwitchin Oral History Study* is currently in the initial phases of research to gather traditional knowledge of the Vuntut Gwitchm First Nation. As part of their larger mandate, the project will try to gather information on Vuntut Gwitchin knowledge, beliefs, and uses of bears. Bight know, the work is focussed on assembling, translating, indexing, and transcribing taped interviews from previous research, as well as, training and co-ordinating for new interviews in the coming months. The only readily available information on Vuntut Gwitchin traditional knowledge about bears is contained within E.

Sherry and the Vuntut Gwitchin First Nation's (VGFN) book "The Land *Still Speaks"* (Sherry and VGFN 1999). All the information in the book referring to bears was summarised in section 3.1.7.

3.2.8 Potential Management Issues and Concerns

Black bears interact with humans in similar ways as grizzly bears. The various forms of bear - human interaction and the potential influence of human activity on bears are reviewed in section 3.1.8.

Vuntut National Park

I am not aware of any information on historical bear - human interactions in VNP. I suspect there were occasional problems with black bears breaking into hunting and prospecting camps and likely occasional close encounters between bears and people. Poor garbage management at long term camps may have led to the death of some bears that became food-conditioned.

The black bear population of VNP is likely constrained by the same factors as grizzly bears, that is a relatively short season available to acquire the necessary energy for growth, reproduction and over-winter survival and available habitats that may be of limited quality. As a result, they also could be impacted by high human use in the park.

Currently, visitors to VNP are infrequent and this level of human activity likely has not adversely impacted the black bear population. VNP is also closed to licensed hunting by non-native Yukon residents. After 1980, but prior to the creation of the park in 1995, there were no black bears shot in subzone 1-16 or 1-19; two subzones that used to be within the park boundaries. Section 4.3.4 has more detail on non-native resident and non-resident grizzly bear and black bear harvest around VNP. Possession of firearms in the Park is now restricted to Parks Canada staff and to Vuntut Gwitchin pursuing traditional activities in the Park. Vuntut Gwitchin beneficiaries have the exclusive right to hunt within VNP for subsistence purposes (Yukon Renewable Resources 1999, BLB #30). Several Vuntut Gwitchin people currently live seasonally at a few permanent camps in VNP and hunt on the land. Other people occasionally travel to the park from Old Crow. The impact of their activity on black bears in the park is unknown.

4.0 PROPOSED BEAR MANAGEMENT STRATEGY

The following is a proposed bear management strategy for VNP that is intended to be implemented in two stages over ten years. This management strategy draws on the knowledge and understanding of bear ecology in VNP gained from the literature review and synthesis in section 3.0. It also draws on management strategies that have been implemented in other national parks and adjacent jurisdictions.

4.1 Vuntut National Park Interim Management Guidelines

Interim Management Guidelines (IMGs) are developed for new national parks. They provide interim management direction for essential park operations in Vuntut National Park until approval of a Park Management Plan. The IMGs specify the type and degree of resource protection and management needed to maintain the integrity of ecosystems and cultural resources, and recognise the rights of the Vuntut Gwitchin provided for in the VGFNFA. Under the recently proposed IMGs for Vuntut National Park, the purpose of the park is:

- to protect for all time a representative natural area of Canadian significance in the Northern Yukon Natural Region and to encourage public understanding, appreciation and enjoyment of the area so as to leave it unimpaired for future generations; and
- to recognise Vuntut Gwitchin history and culture and recognise and protect the traditional and current use of the Park by the Vuntut Gwitchin.

4.2 Bear Management Objectives

The following are. the proposed objectives of a bear management strategy for Vuntut National Park. They are intended to be consistent with the overall purpose of VNP and associated goals and objectives of the interim *Ecological Integrity Statement* as incorporated *in* to the *VNP Interim Management Guidelines.* The *Ecological Integrity Statement* and *Interim Management Guidelines* were considered the "umbrella" goals and objectives for Vuntut National Park under which specific bear management objectives would fit. The following bear management objectives are similar to the management goals for bears and people in the Inuvialuit Settlement Region (Nagy and Branigan 1998, BLB #15, p. 4).

1. To protect and maintain natural populations of black bears and grizzly bears within Vuntut National Park and surrounding ecosystems.
2. To maintain current areas of bear habitat.
3. To manage human activities, including aircraft flights, in order to prevent disturbance of bears and important seasonal habitats.
4. To ensure that the total number of bears removed each year through legal hunting, defence kills, and illegal hunting is sustainable.
5. To minimise the probability of bear - human interaction and conflict through promotion of safe conduct in bear country and by reducing the availability of human-made food attractants to bears.
6. To increase the knowledge of bear ecology and management through data collection,

research and exchange of traditional and scientific knowledge.
7. To defme appropriate management plans and training for employees of Parks Canada and Vuntut Gwitchin First Nation members regarding bears and their management.
8. To promote co-operation and information exchange regarding bear research and management among Parks Canada, the North Yukon Renewable Resource Council, and the Vuntut Gwitchin Fist Nation in the co-management of Vuntut National Park.
9. To promote inter-jurisdictional co-operation and information exchange regarding bear research and management among Canadian and American Federal, Territorial, and State government agencies and co-management boards, the Vuntut Gwitcbin First Nation, and the Inuvialuit in the management of Vuntut National Park and surrounding areas.
10. To participate in inter-agency and inter-governmental bear management strategies and programs for the contiguous protected areas in the Yukon and Alaska of which Vuntut National Park is a part.

Objectives 1 to 10 are consistent with the goals of ecosystem management under section 7.3.1 of the IMGs. Objectives 1, 8, 9, and 10 are consistent with the goals of regional integration under section 7.3.21 of the IMGs. Objectives 4, 7, 8, and 9 are consistent with the goals of Vuntut Gwitchin co-existence with the land under section 7.3.3 of the IMGs.

4.3 Strategies to Achieve Management Objectives

The following strategies are intended to meet the proposed bear management objectives for VNP outlined above. Some proposed strategies can help achieve a number of objectives and most are intended to reflect an overall management approach that is proactive rather than reactive. A m-evaluation of the successes or failures of any management strategy that is implemented should be conducted periodically, such as every five years.

4.3.1 Human Food & Garbage Management (Objectives 3, 4, 5, 6, 8, 9, 10)

Background

As reviewed in section 3.1.8a, the past experience of bears with people can have a major effect on the future response of bears to people and generally falls into three reinforcement categories: negative, neutral or positive. Bears will avoid areas near people after being harassed, hurt, or injured and past negative experiences with people can make bears wary of humans. Neutral interactions with people can lead to human-habituation. Avoidance or fear responses fade when a threat, pain or injury (i.e., punishment) does not follow the stimulus causing the response. Positive reinforcement for bears around people usually involves the acquisition of human food or garbage. Poor management of human food and garbage can lead to food-conditioned bears. Food-conditioned bears can become dangerous and unpredictable, therefore, situations that may lead to food-conditioning have to be strictly controlled (McCullough 1982; Gilbert 1989; Herrero 1985, 1989). Even a low rate of exposure to human food or garbage will reinforce problem behaviour in bears (McCullough 1982). Safe human activity around tears is not possible where bears associate people with food rewards. Proper food and garbage management by all park users, including tourists, Parks Canada staff, researchers, and local people is the most important factor that will ensure safe bear-human interactions and maintain the wilderness character of the park.

Bear-proof food canisters designed for hikers have successfully reduced bear problems in Denali National Park, Alaska (Dalle-Molle and Van Horn 1989) and Kluane National Park, Yukon (Wellwood and MacHutchon 1999). There are commercial models available for canoes and kayaks as well.

The Vuntut Gwitchin people having been living and travclling on the land for thousands of years. They have learned ways to co-exist with all wildlife, including bears and this way of life should be respected. However, non-native cultures in North America have also learned ways to co-exist with bears, so there is lots of information and some technology available from several sources that could make living and travelling on the land safe for both humans and bears. Relevant information on human safety around bears could be compiled from this variety of sources and provided to everyone living, working, or travelling in VNP.

Proposed Strategies

Some of the following proposed strategies are also relevant to other sections and have been repeated there.

1. Consider providing bear-resistant food canisters or bags for the voluntary use of visitors to VNP. Bear-resistant food bags have recently come on the market, but should be field tested before they are widely prescribed.
2. Provide information on managing human food and garbage to Park visitors through an. active public education and bear awareness program (see section 4.3.2).
3. Provide information on managing human food and garbage to Vuntut Gwitchin people: through informal talk, public education and bear awareness materials, the NYRRC, and the Vuntut Gwitchin government.

4. Compile any relevant Vuntut Gwitchin knowledge about managing human food and garbage that can be used in the bear awareness material made available to Park visitors and other Vuntut Gwitchin people. In turn, provide the Vuntut Gwitchin with materials available from other non-native sources on managing human food and garbage.
5. Formally and informally, encourage the reporting of any bear problems or bear kills at camps both inside and outside VNP to Parks Canada staff, the Vuntut Gwitchin government or the local Renewable Resource officer.
6. Work with the Vuntut Gwitchin and other management agencies in areas bordering the park to identify problem areas and minimise the potential for bears to obtain food or garbage from camps in or adjacent to the park. Mitigation measures could include education and bear awareness or portable electric fences.
7. Informal, co-operative efforts would be best for identifying and dealing with potential bear - human interaction risks around existing Vuntut Gwitchin camps and other human use sites. The focus of the effort should be on bear-proofmg or eliminating possible bear attractants such as easily accessible human food and garbage, fish offal, dog food, wastewater (also called grey water), and smokehouses. Co-operation will be. key to ensuring that people comply with suggested methods to reduce potential problems. If Parks Canada conducts formal assessments at existing camps, they risk offending local people and may not get any co-operation at all.
8. Parks Canada may need to conduct more formal assessments of the risk of bear - human interactions at proposed research camps or facilities, commonly used visitor use sites, and proposed Park facilities. A suggested method for doing bear - human interaction risk assessments is in section 4.3.6.

4.3.2 Bear Awareness Education (Objectives 3, 4, 5, 6)

Background

The key to success of any park management program are well-informed and conscientious park users (Jingfors 1995). This requires interesting and effective public education materials, but it also requires knowledgeable and conscientious park staff.

Visitors to Vuntut National Park and local people that travel and live in the park are generally interested in the environment and the animals that live there. Interpretative information that increases their understanding of bear ecology can also increase their appreciation and respect for bears and motivate them to make the extra effort necessary to minimize conflicts (Jingfors 1995). In addition, people are more likely to endorse procedural guidelines if they understand the negative implications to bears and other wildlife of not following them.

Public education programs that focus on bears should include information on ways to travel in bear country to avoid bear encounters and to avoid inadvertently displacing bears from important habitats. MacDougall et al. (1997) and Wellwood and MacHutchon (1999) suggest the following for pre-trip information packages:

- How to differentiate between grizzly and black bears based on appearance and field sign;
- Information specifically directed at grizzly and black bear ecology in the park;
- A brief discussion of the processes of habituation and food-conditioning;

- Tips on how to avoid attracting a hear to a campsite, including campsite selection, and food, garbage and waste management;
- Tips on safe hiking in bear country;
- A statement that an encounter may occur despite all necessary precautions and general guidelines on how to behave during a bear encounter;
- An introduction to the tear monitoring program;
- Locations or contacts for reporting all observations or problem bear behaviour; and
- Further information and suggested readings.

Parks Canada revised the "You are in ***Bear Country"*** brochure in early 1999 so that it is up to date with current information. Parks Canada also has financially contributed to the production of a video on human safety in bear country, titled 'Staying Safe *in Bear* Country", that is beiig produced by an independent steering committee backed by the International Association for Bear Research and Management. Production is targeted for completion in late summer 2000.

Proposed Strategies

1. Provide all VNP staff with in-depth bear safety orientation training. Without a good understanding of the principles and practices of staying safe around bears, staff will not be able to respond to important questions that may be asked by visitors and they may end up perpetuating misinformation.
2. Develop a bear awareness program, including pre-trip information package that focuses on the importance of not only understanding but also applying the principles covered. The goals of the bear awareness program and pre-trip information should be to ensure that people understand how and why, they can be proactive in reducing risk to themselves and others and their impact on bears, a person's actions can unnecessarily increase risk to themselves and/or the people that follow them, and inappropriate behaviour by humans can lead to the destruction of bears (e.g., food-conditioned bears).
3. Describe the ecological characteristics of VNP that are relevant to public understanding of the food habits, distribution, and movements of bears in the park within the pre-trip information package. This type of information can be beneficial for both decreasing bear-human interactions and increasing the appreciation and understanding of bears in the park.
4. Visitors should be encouraged to read the "You are ***in Bear Country"*** brochure or similar information in the pre-trip information package.
5. Visitors should be provided with the opportunity to view the ***"Staying Safe in Bear Country"*** video that is currently being produced.
6. Promote a "pack in/pack out" policy to park visitors.
7. Properly identify the dangers of approaching bears too closely and the legal implications of feeding ***or*** harassing wildlife.
8. Request that visitors, Vuntut Gwitchin First Nation people, and researchers record and report any bear observations, encounters or incidents to Parks Canada staff (see section 4.3.3)
9. Recommend that visitors carry a deterrent against bear attacks, such as bear spray (also known as pepper or capsicum spray). Although bear spray is not guaranteed

effective in preventing attack, it has frequently proved successful. People should know the capabilities and limitations of the product they choose. Deterrents can be useful, but should not give people a false sense of security. Training and practice are essential.

10. Encourage visitor use of bear-resistant food canisters or bags while travelling in VNP.
11. Recommend that visitors travel in groups of three or more people when hiking and camping.
12. Encourage the publishing of accurate, up-to-date information by providing current bear awareness and pre-trip information materials for use in any guidebooks published on recreation in the northern Yukon.
13. Encourage the exchange of information on safety around bears with Vuntut Gwitchin people through informal talk, the NYRRC, and the Vuntut Gwitchin government.
14. Compile any relevant Vuntut Gwitchin knowledge about human safety around bears that may be useful in the bear awareness material made available to park visitors. In turn, provide the Vuntut Gwitchin with materials available from other non-native sources on human safety around bears.

4.3.3 Bear Sightings, Encounters & Incidents (Objectives 1, 3 to 9)

Background

The following definitions apply to terms used for bear and human interactions, encounters, or incidents. **Bear-human interaction** is any of the various activities and their effects involving bears and humans, including sightings, encounters and incidents. A **sighting** or **observation** is when a human sees a bear but the bear appears to be unaware of the human. **An encounter** is when a bear is aware of human presence, regardless of whether the humans are aware of the bear or not. During encounters, bears can be displaced, they may ignore people because they are human-habituated, or they may approach people. **Displacement** refers to encounters where the bear is displaced and runs or walks away. **An incident** or **conflict** is the most serious bear - human interaction. An interaction is considered a conflict when a bear makes physical contact with a person, there is damage or loss of property or food, there is a high intensity charge by a bear toward people, people have to take extreme evasive action in response to a bear, or people have to use a deterrent on a bear. Figure 3 shows the relationship of these different terms.

Sightings or observations of bears can provide some qualitative information on the relative distribution, food habits, and habitat use of bears within VNP. Bear – human encounters also can provide the same qualitative information as bear sightings, as well as information on the general wariness or level of human-habituation of bears in the Park. Bear - human incidents or conflicts are serious events that may compromise or threaten human safety. They need to be responded to as quickly and efficiently as possible.

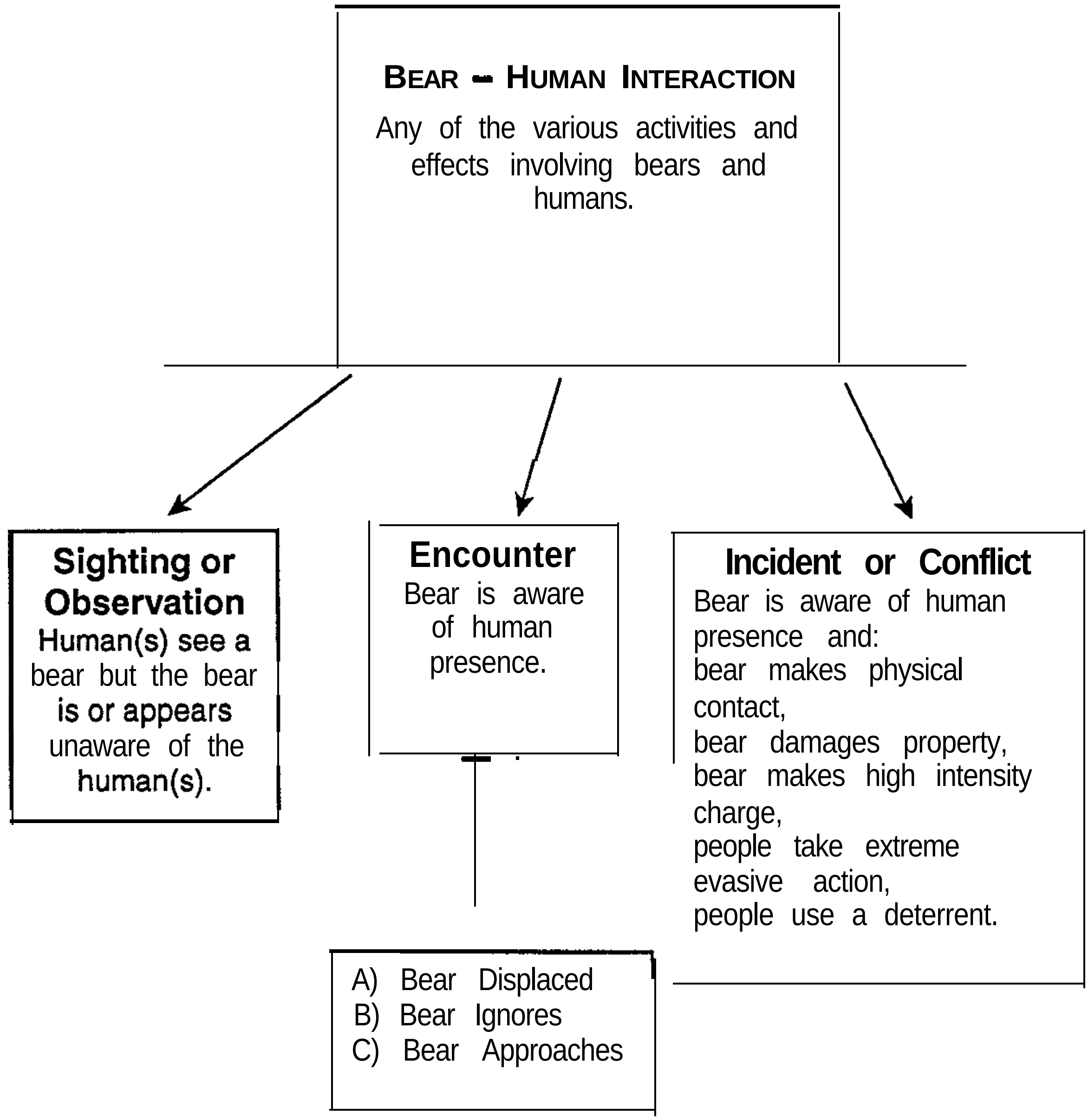

Figure 3. The relationship between sightings, encounters and incidents in bear – human interactions.

Proposed Strategies

1. Develop a ***Bear Management Plan or Public Safety Plan*** that outlines the roles and responsibilities of Parks Canada staff related to:
   a) bear management within the park,
   b) bear information to provide to park visitors;
   c) how to complete bear observation forms;
   d) the prompt reporting of bear – human incidents to Park Wardens;
   e) the necessary action if a serious bear – human incident, such as a mauling, occurs; and
   f) the proper documentation of occurrence reports about bear human incidents.
2. Ensure that key Park Warden staff obtain appropriate trainiig in bear capture and immobiiation.
3. Ensure that Parks Canada staff quickly receive accurate information on bear – human incidents within VNP from visitors or Vuntut Gwitchm people. Bear – human incidents or conflicts are serious events that may compromise or threaten human safety. They need to be responded to as quickly and efficiently as possible. Quick and accurate reporting would ensure that Parks Canada responds appropriately and area closure warnings could be given to departing groups. Bear - human encounters do not need immediate action, however the future behaviour of the bear should be monitored. The pre-trip information package given to visitors should include information on a) a definition of an immediately reportable incident including why it is important to report such incidents, b) the information that should be recorded and reported, and c) emergency contact phone numbers for reporting incidents from the park if they have a satellite phone or immediately upon their return to a community. A suggested bear observation, encounter and incident form is in Appendix 4. This type of form can be included in the pre-trip information package or, preferably, be handed out to groups when they register. Parks staff should provide an overview of the data form to the leader of each group prior to their departure. If the suggested form in Appendix 4 is adopted for use in VNP, then emergency contact phone numbers should be added to the form.
4. Work on co-operative communication arrangements with the Vuntut Gwitchin and Canadian and American Federal, Territorial, and State government agencies for the sharing of information on bear – human incidents occurring in and around VNP.
5. Systematically record observations of bears by park staff, Vuntut Gwitchin people active in the Park, and by park visitors. Use a relatively simple data collection and recording format that also gains as much information as possible. The form in Appendix 4 was intended to be useful for bear observations, as well as, bear - human encounters and incidents. The form should clearly tell people the objectives of the form, how to fill out the form, and the importance of the information collected. Parks staff should provide an overview of the data form to the leader of each group prior to their departure. The form should be printed on waterproof paperand include VNP's mailing address. Encourage all visitors to submit the forms and investigate methods to provide incentive for returning forms.
6. Establish a bear observation and encounter database and when there is sufficient data, use it to learn more about the ecology of bears in VNP and to evaluate potential

problem areas in and around VNP. The amount of information collected on the form will depend on the experience and expertise of the people making the observation.. Data of this nature must be used cautiously because in can be heavily biased for a number of reasons. Sightings are not obtained randomly, so the distribution of sightings may simply reflect where people are active and not the actual distribution of bears. Bears in open habitats are much easier to see then bears in forests or thick shrub cover, so sightings used to infer habitat use should take thii in to account.

4.3.4 Sustainable Harvest (Objectives 4, 6, 8, 9, 10)

Background

First Nation people have a special relationship with wildlife, a relationship based on subsistence needs and values extending back thousands of years. Recent land claim agreements acknowledge that relationship and confirm the right of Fist Nation's people to hunt and fish primarily for food (Yukon Renewable Resources 1997, BLB #30). The hunting rights and responsibilities of First Nations outside of VNP are summarised in Yukon Renewable Resources (1997, BLB #30).

VNP is closed to licensed hunting by non-native Yukon residents and non-residents, but Vuntut Gwitchin beneficiaries have the exclusive right to hunt within VNP for subsistence purposes (Yukon Renewable Resources 1999, BLB #30). Possession of firearms in the Park is now restricted to Parks Canada staff and to Vuntut Gwitchm pursuing traditional activities in the Park. Outside of VNP, certain Vuntut Gwitchm lands are closed to public hunting unless a hunter has prove of consent from the First Nation (Yukon Renewable Resources 1999, BLB #30, see the map on pages 39-40). Table 17 outlines the number of grizzly bear and black bear kills by subzone that have occurred in and around VNP from 1980 to 1998. The numbers in Table 17 likely do not include all bear harvest because there were changes in the reporting requirements through the years, so it is possible not all First Nation kills were reported. After 1980, but prior to the creation of the park in 1995, there were 2 grizzly bears and no black bears shot in subzone 1-16 and subzone 1-19. These two subzones no longer exist and are now within the park boundaries (Yukon Renewable Resources 1999, BLB #30, see the map on pages 39-40). More bears of both species were shot in the subzones adjacent to Old Crow and the Porcupine River. This may be for a number of reasons including higher bear populations in the area and easier access from Old Crow, therefore more human activity.

In 1998, the North Yukon Renewable Resources Council (NYRRC), the Vuntut Gwitchin government, and Parks Canada signed the ***Co-operarion Agreement: Roles, Responsibilities and Procedures for the Planning and Management of Vuntut National Park.*** Under this co-operative agreement, the NYRRC is responsible for making recommendations to the Minister of Canadian Heritage on all matters pertaining to the development and management of VNP, including the following issues of harvest:

Table 17. The total number of bear kills in northern Yukon subzones between 1980 and 1998 (Yukon Renewable Resources, unpubl. data). See the map on pages 39-40 of Yukon Renewable Resources (1999, BLB #30) for the location of the subzones.

Subzone	Grizzly Bear Kills	Black Bear Kills
I-16'	2	0
1-17	0	0
1-18	0	0
1-19	11	9
I-20'	0	0
1-21	0	1
1-22	4	6
1-31	2	2

* These sub-zones no longer exist, but prior to 1995 were within Vuntut National Park.

- routes, methods and modes of access for harvesting within the Park;
- harvest limits and seasons for harvesting in the Park;
- locations and methods of harvesting within the Park;
- co-ordination of the management of fish and wildlife populations which cross the boundary of the Park with the Fish and Wildlife Management Board, affected Renewable Resources Councils and other responsible agencies.

The Vuntut Gwitchin government is responsible for the protection of the Vuntut Gwitchin lifestyle and for ensuring that the rights of the Vuntut Gwitchin are recognized and maintained, including issues of harvest such as:

- allocating harvest opportunities for fish and wildlife under quota to the Vuntut Gwitchin; and
- collecting, maintaining and reporting of harvest information related to harvesting in the Park;

Parks Canada has overall responsibility for the management and operation of the Park. Some specific areas of responsibiity regarding harvest in VNP include:

- protecting the harvesting rights of the Vuntut Gwitchin;
- enforcing of harvest restrictions or terms and conditions which have been established for the purposes of conservation; and
- giving special attention to the control, timing and location of visitor access to the Park to avoid conflicts with Vuntut Gwitchin harvesting activities or interference with cultural resources.

Proposed Strategies

1. Work with the NYRRC and Vuntut Gwitchin First Nation to determine and monitor the number of grizzly bears harvested each year or killed in defence of life and property within VNP.
2. Assist the NYRRC and Vuntut Gwitchin First Nation to determine and monitor the number of grizzly bears harvested each year or killed in defence of life and property within the Old Crow Flats Special Management Area (SMA) outside of VNP, as well as in areas along and south of the Porcupine River. The total kill of grizzly bears in the SMA outside of VNP and in the wider region may have implications to the sustainable harvest of bears within VNP because of the wide-ranging movements of bears.
3. Formally and informally, encourage the reporting of any bear problems at camps both inside and outside VNP to Parks Canada staff, the Vuntut Gwitchm government or the local Renewable Resource officer.
4. Work with management or co-management agencies in other jurisdictions bordering the park to determine and monitor the number of grizzly bears harvested each year or killed in defence of life and property. The total kill of grizzly bears in all areas surrounding VNP may have implications to the sustainable harvest of bears within VNP because of the wide-ranging movements of bears.
5. If the number of grizzly bears kills in VNP and surrounding areas becomes a concern to Parks Canada staff, then it may be necessary to work with the NYRRC to encourage the establishment of total allowable harvests for grizzly bears within VNP. There is currently no sustainable yearly harvest rate determined specifically for north Yukon grimly bears, but Nagy and Branigan (1998, BLB #15, p. 53) considered 3% for bears >2 years old to be sustainable in the Inuvialuit Settlement Region. Three percent is likely a conservative harvest level for VNP and the SMA (see Miier 1990d), however it is important to be conservative until there is better data on existing harvest and more confidence in the population estimates. The grizzly bear population estimates that I suggested in section 3.1.3a for VNP and the Special Management Area outside VNP are my best guesses based on work done in other study areas. The numbers have not been substantiated with field work, so they should be used with caution. My population estimates were considered to be all bears, not just bears >2, so applying the safe harvest limit of 3% proposed by Nagy and Branigan (1998, BLB #15, p. 53) for all bears >2 would in fact result in greater than 3% being killed. Nevertheless, I believe these harvest levels are still sustainable, assuming my population estimates are not overly high. If there is assumed to be 53 grizzly bears in VNP (44 in the Old Crow Basin and British and Richardson mountains ecoregions plus 9 in the Old Crow Plats Ecoregion), then the estimated annual total allowable harvest would be approximately 1 to 2 bears per year. If there is assumed to be 96 grizzly bears in the SMA outside VNP (see section 3.1.3a), then the estimated annual total allowable harvest would be approximately 3 bears per year. Total allowable harvest is considered to be the number of bears harvested combined with those killed in defence of life and property (Nagy and Branigan 1998, BLB #15, p. 53). The only time that Parks Canada can restrict harvest by Fist Nations within VNP is for conservation measures or public safety reasons (see the VGFNFA). As a result, any

harvest limitations that Parks Canada tries to achieve would have to be on a voluntary basis. There is a potential risk that by trying to set quotas, Parks Canada will in fact encourage greater harvest than currently exists. That is, if an upper harvest limit is set above what is normally killed then people may think that Parks is recommending the upper level of harvest. I strongly recommend gathering background information on current and historic kills of grizzly bears by Vuntut Gwitchin First Nation people before considering working with the NYRRC to try and establish total allowable harvest limits.

6. Discuss with the NYRRC and Vuntut Gwitchin First Nation the idea of protecting black bears from any harvest within VNP. All black bears within VNP are at the northern extent of their range and populations are likely low. If this sub-population is to be maintained, then it would be best to try and protect them from harvest. As outlined above, these kind of harvest restrictions would have to be on a voluntary basis unless it can be adequately demonstrated that the black bear population of VNP is at risk.

4.3.5 Vuntut Gwitchin Local & Traditional Knowledge (Objective 6, 8)

Background

To date, there is not much Vuntut Gwitchin local or traditional knowledge about bears that has been documented (see section 3.1.7).

Proposed Strategies

1. Encourage the gathering of Vuntut Gwitcbin local or traditional knowledge about bears and bear ecology through the ***Vuntut Gwitchin Oral History Study.*** Changes in bear populations or distributions are particularly valuable pieces of information to obtain. The following are some of the questions and enquiries that could be asked of Vuntut Gwitchin people:

   Bear Observations

   - In what areas of the Old Crow Flats and hi to the north have you mostly seen bears? Where do you see black bears? Where do you see grizzly bears?
   - What time of the year do you mostly see black bears and grizzly bears in the Old Crow Flats and hills to the north?
   - Have you observed any changes in where you see grizzly bears or black bears through the years?
   - What have you noticed about where bears like to live?
   - What have you seen them eating? During what time of the year?
   - Have you observed any changes in the foods that bears eat or where they are found?
   - Are you aware of any concentrations of fish, such as at spawning areas? If so, do you know if bears feed on fish at these spots?
   - Have you seen any unusual bear feeding or hunting behaviour?
   - Have you observed any changes in the number of bears through the years or throughout one year?
   - Is there anything unusual that you have observed about bears or their

behaviour?
- Do you know where in the Old Crow Plats and bills to the north that bears den?

About the Observer
- What areas of Old Crow Plats and bills to the north do you spend your time travelling through or living?
- How do you usually travel the most? (i.e., by boat, skidoo, or on foot).

Cultural Significance
- Are bears important culturally or spiritually to the Vuntut Gwitchin?
- What role do they play in your culture?
- What kind of relationship do Vuntut Gwitchin people have with bears?
- Has the significance of bears in your culture changed over the years?
- Are bears important to you? What do they mean to you personally?
- How were bears used in the past? How are they used today?
- Are bears considered an important food to the Vuntut Gwitcbin? Are they an important resource for other reasons?
- What would it mean to you if for some reason the bear population was altered, that is, numbers of bears went up or down or natural patterns were changed?
- Are there other comments you would like to make about bears?

4.3.6 Field Data Collection (Objective 2, 6)

Background

Parks Canada staff has the opportunity to gain further knowledge about bears and bear ecology and human management concerns while working or travelling in VNP.

Proposed Strategies

1. Parks staff should record any local knowledge about bears that they receive in conversation with Vuntut Gwitchin people working or living on the land. This information is in addition to encouraging the gathering of Vuntut Gwitchin local or traditional knowledge about bears and bear ecology through the ***Vuntut Gwitchin Oral History Study.*** These additional peices of information should be detailed in trip reports or notebooks and passed on to the park ecologist so that they can be periodically compiled. Any pieces of information that Vuntut Gwitchm people have will help build an information base on bears in the area, particularly bears living in the Old Crow Plats and along the Porcupine River.
2. Ensure that staff flying to or from or working in the park record all bear observations as in section 4.3.3. A suggested bear observation form is in Appendix 4. Parks staff have the background skills to obtain sighting information that is more accurate then can potentially be obtained from park visitors. In addition, they can obtain more detailed information on habitats the bears were using, what they were feeding on, their general behaviour, their age and reproductive status, and the general phenology of bear food plants within the park. It will be valuable to pay particular attention to the distribution and relative numbers of black bears versus grizzly bears that are observed.
3. Informal, co-operative efforts would be best for identifying and dealing with potential

bear - human interaction risks around existing Vuntut Gwitchin camps and other human use sites. The focus of the effort should be on bear-proofmg or eliminating possible bear attractants such as easily accessible human food and garbage, fish offal, dog food, wastewater (also called grey water), and smokehouses. Co-operation will be key to ensuring that people comply with suggested methods to reduce potential problems. If Parks Canada conducts formal assessments at existing camps, they risk offending local people and not get any co-operation at all.

4. Parks Canada may occasionally need to conduct more formal assessments of the risk of bear - human interactions at proposed research camps or facilities, commonly used visitor use sites, and proposed Park facilities. A suggested field form for doing bear - human interaction risk assessments is in Appendix 5. Qualitative assessments are best done by a person familiar with the various habitats in the area and their likely relative value to bears. This person should also be familiar with documenting and interpreting bear sign. Assessments should be done within an approximately 250-m radius of a site. Site descriptions should be completed before risk ratings are assigned. A freehand sketch of the site and surrounding area can indicate the relative position of habitat types, trails, mark trees, and prominent geographic features. These sketches can be done on the back of the form in Appendix 5. Photographs should be taken of the site and adjacent representative habitats. The Universal Transverse Mercator (UTM) co-ordinates of sites can be determined using a Geographic Positioning System (GPS). The following should also be described and rated at each site:

    Seasonal Habitat Potential-The potential use of the area by bears based on the availability (i.e., distribution and abundance) of food plants and the possible availability of animal foods such as ground squirrels. Do a broad vegetation description and rate the general availability of individual bear foods as high (H), moderate to high (M-H), moderate (M), low to moderate (L-M), or low (L). Then rate the seasonal habitat potential for feeding as high, moderate to high, moderate, low to moderate, or low for spring, summer, and late summer or fall.

    Bear ***Travel*** Concerns-Travel concerns include features that would influence the likelihood of a bear travelling through a site or surrounding area. These can be geographic features such as valley junctions and constrictions in terrain, including rock outcrops, cliffs, cut banks, steep slopes, islands, and peninsulas. The location and proximity of wildlife trails and potential travel routes should be recorded. Bear travel concerns are rated as high, moderate, or low.

    Visibility & Other Sensory Concerns - Visibility and other sensory concerns are features that would reduce the ability of bears and humans to detect each other. Features such as vegetation and topography that limit visibility increase the potential for surprise encounters with bears. Other sensory concerns are wind and noise from rivers and creeks, which might affect the ability of bears and humans to hear each other. Visibility concerns and other sensory concerns should be rated as high, moderate, or low.

    Bear ***Sign*** - All fresh and old bear sign can be recorded as evidence of bear use. Sign can include tracks, scats, feeding, trails (minor or major), mark trails, mark trees, and beds. Some types of bear sign are more obvious than others. For example, tracks will be more obvious at sites that have sand or mud than at sites with harder substrates. Because of inequities in the ability to detect bear sign, it should have a lesser influence on the overall risk ratings than the factors described above. Bear sign can be recorded but should not be rated.

Displacement & Encounter Risk Ratings - Following the evaluations above, integrate all the factors and collectively rate each site, relative to other sites, for both the potential for displacement of bears and the potential for bear - human encounter. Each should be rated as high (H), moderate to high (M-H), moderate (M), low to moderate (L-M), or low (L) risk.

5. Examine den sites encountered while traveling in the park and measure den site characteristics. As reviewed in section 3.1.6.e, I suspect that most grizzly bears of VNP den on southerly facing slopes of 30-70% (17-35”). The elevation distribution of dens will be dependent on the availability of suitable denning habitat. Most bears likely den in the hills and mountains of VNP, rather than the Old Crow Flats. Dens are likely located in dry to mesic habitats on south-facing shrub or tree dominated mountain slopes. Natural caves within the limestone rock outcrops in the mountains of VNP are also likely used for dens. Any denning on the Old Crow Flats is probably limited to dry, relatively steep riverbanks. Extensive ground squirrel digs can sometimes be mistaken for dens, so if there is any uncertainty, search for the presence of hair on the roof and floor of the excavation. Bears usually drag vegetation into the den to form a “nest” or bed and the presence of a bed is another way to verify that an excavation is a den. A suggested field form for doing den site investigations is in Appendix 6.
6. Examine mark trees in the field to try and determine which species of bear are using them. If there is suspicion about the species of bear hair, particularly in areas where black bears are rare or not known, hair could be collected for DNA analysis to determine species. Collected hair samples should be kept dry in a paper envelope prior to shipping to a lab for analysis. Hair samples covered in pitch or sap may not be suitable for analysis.
7. Scat collection and examination can be a valuable way to learn more about the seasonal food habits of bears in VNP. However, there is little value in having Parks staff examine bear scats in the field, unless they are confident in distinguishing among the different food plants and berries. This is not that easy and would require people to spend time learning, at least, the major food species expected. In addition, people need to be able to estimate the age of scats for the information to be useful for estimating seasonal food habits. If estimating seasonal food habits of bears is considered a priority of Parks Canada and in the absence of adequate staff training and experience, it would be best to have scats send out to a lab for analysis. Scat samples can be collected opportunistically and aged by considering the age of bear activity sign and the moisture content and apparent decomposition of the scat. For each scat sample, the date of collection, estimated age of the scat, percent of scat collected, location, and habitat class should be recorded. Scats can be stored in plastic bags in the field out of the sun and then frozen for longer term storage upon returning from the field.

4.3.7 Bear Ecology Research (Objective 6)

Grizzly bears living in Vuntut National Park are part of a much larger regional population that spans the boundaries of Vuntut National Park, the Vuntut Gwitchin Fist Nation's settlement lands, Yukon Territory lands, Iwavik National Park, the Inuvialuit Settlement Region, the Arctic National Wildlife Refuge, and other Federal and State lands in Alaska. Mitochondrial DNA analysis has suggested there are two major phylogenetic clusters or clades in the North, including one clade of bears from throughout mainland Alaska and Kodiak Island and one clade from regions in extreme eastern Alaska and the Yukon and Northwest Territories (i.e., the region encompassing VNP). However, these two clades had a contact zone in the Arctic National Wildlife Refuge and, therefore, were promoted as one evolutionary significant unit (Waits et al. 1998, BLB #28, see section 3.1.1). This suggests that there is relatively free gene flow among grizzly bears in northern Yukon and Alaska and no long-term barriers to movement. I suspect that there is similar gene flow among black bears. This highlights the need for a regional perspective and regional co-operation on bear management issues, but it also suggests that localised impacts on bear populations may be ameliorated through regional immigration and emigration of bears.

Better information on bear population densities and dynamics would be helpful for further understanding the potential implications of human activity on bears, however this type of information is expensive and difficult to obtain and I do not believe it is warranted in the short term. I also do not believe there are any other significant information gaps in the understanding of grizzly bear or black bear ecology that would justify intensive or extensive scientific research within the lo-year time frame of this strategy. I think Parks Canada would be better to use their time and effort in implementing the strategies outlined in sections 4.3.1 to 4.3.6. By doing so, there would then be more relevant information available to reassess the need for more detailed research at the end of 5 to 10 years. I believe the top priority of Parks Canada should be VNP specific and regionally integrated efforts to understand and reduce, if necessary, the number of bears killed in defence of life and property because of a lack of bear safety awareness or because of poor human food and garbage management by park visitors, researchers, Vuntut Gwitchin First Nation people, and other local residents. If this can be achieved then I believe it may reduce any concerns about other potential management issues, such as exceeding sustainable harvest limits. This is not to say that there should not be effort directed at understanding current and historic harvest levels, rather that the level of harvest may not be a concern if defense of life and property kii can be reduced or eliminated. Unfortunately, this is hard to know for sure without specific information on the number of bears harvested in the region by resident hunters, non-resident hunters, and Vuntut Gwitchin Fist Nation members and the total number of bears killed in defence of life or property.

4.4 Action Plan

Table 18 outlines an action plan for achieving the management objectives for bears in VNP over the next ten years. I have indicated where I think strategies should be initiated in the short term (i.e., within 5 years) versus strategies that could be implemented in the longer term (i.e., from 5-10 years).

Table 18. The suggested time-frame for implementation of the bear management rategies identified in sections 4.2.1 to 4.2.7.

Report Section / Number	Strategy	Implementation Stage	
		5 year	10 year
4.2.1	**Human Food & Garbage Management**		
1	Consider providing bear-resistant food canisters or bags for the voluntary use of visitors to VNP.	X	
2	Provide information on managing human food and garbage to Park visitors through an active public education and bear awareness program.	X	
3	Provide information on managing human food and garbage to Vuntut Gwitchin people through informal talk, public education and bear awareness materials, the NYRRC, and the Vuntut Gwitchin government.	X	
4	Compile any relevant Vuntut Gwitchin knowledge about managing human food and garbage that can be used in the bear awareness material made available to Park visitors and other Vuntut Gwitchin people. In turn, provide the Vuntut Gwitchin with materials available from other non-native sources on managing human food and garbage.	X	
5	Formally and informally, encourage the reporting of any bear problems or bear kills at camps both inside and outside VNP.	X	
6	Work with the Vuntut Gwitchin and other management agencies in areas bordering the park to identify problem areas and minimise the potential for bears to obtain food or garbage from camps in or adjacent to the park.	X	
7	Informal, co-operative efforts would be best for identifying and dealing with potential bear - human interaction risks around existing Vuntut Gwitchin camps and other human use sites.	X	
8	Parks Canada may need to conduct more formal assessments of the risk of bear - human interactions at proposed research camps or facilities, commonly used visitor use sites, and proposed Park facilities.	X	
4.2.2	**Bear Awareness Education**		
1	Provide all VNP staff with in-depth bear safety orientation training.	X	
2	Develop a bear awareness program, including pre-trip information package that focuses on the importance of not only understanding but also applying the principles covered.	X	
3	Describe the ecological characteristics of VNP that are relevant to public understanding of the food habits, distribution, and movements of bears in the park within the pre-trip information package.		X

4	Visitors should be encouraged to read the "*You are in Bear Country*" brochure or similar information in the pre-trip information package.	X	
5	Visitors should be provided with the opportunity to view the "*Staying Safe in Bear Country*" video that is currently being produced.	X	
6	Promote a "pack in/pack out" policy to park visitors.	X	
7	Properly identify the dangers of approaching bears too closely and the legal implications of feeding or harassing wildlife.	X	
8	Request that visitors , Vuntut Gwitchin First Nation people, and researchers record and report any bear observations, encounters or incidents to Parks Canada staff.	X	
9	Recommend that visitors carry a deterrent against bear attacks, such as bear spray.	X	
10	Encourage visitor use of bear-resistant food canisters or bags while travelling in VNP.	X	
11	Recommend that visitors travel in groups of three or more people when hiking and camping.	X	
12	Encourage the publishing of accurate, up-to-date information by providing current bear awareness and pre-trip information materials for use in any guidebooks published on recreation in the northern Yukon.		X
13	Encourage the exchange of information on safety around bears with Vuntut Gwitchin people through informal talk, the NYRRC, and the Vuntut Gwitchin government.	X	
14	Compile any relevant Vuntut Gwitchin knowledge about human safety around bears that can be used in the bear awareness material made available to park visitors. In turn, provide the Vuntut Gwitchin with materials available from other sources on human safety around bears.	X	
4.2.3	Bear Sightings, Encounters & Incidents		
1	Develop a ***Bear Management Plan or Public Safety Plan*** that outlines the roles and responsibilities of Parks Canada staff regarding bear management.	*X*	
2	Ensure that key Park Warden staff obtain appropriate training in bear capture and immobilisation.	X	
3	Ensure that Parks Canada staff receive accurate information on bear -human incidents within VNP from visitors or Vuntut Gwitcbin people.	X	
4	Work on co-operative communication arrangements with the Vuntut Gwitchin and Canadian and American Federal, Territorial, and State government agencies for the sharing of information on bear - human incidents occurring in and around VNP	X	
5	Systematically record observations of bears by park staff, Vuntut Gwitchin people active in the Park, and by park visitors.	X	

6	Establish a bear observation and encounter database and when there is sufficient data, use it to learn more about the ecology of bears in VNP and to evaluate potential problem areas in and around VNP.		X
4.2.4	**Sustainable Harvest**		
1	Work with the NYRRC and Vuntut Gwitchin First Nation to determine and monitor the number of grizzly bears harvested each year or killed in defence of life and property within VNP.	X	
2	Assist the NYRRC and Vuntut Gwitchin First Nation to determine and monitor the number of grizzly bears harvested each year or killed in defence of life and property within the Old Crow Flats Special Management Area (SMA) outside of VNP, as well as in areas along and south of the Porcupine River.	X	
3	Formally and informally, encourage the reporting of any bear problems at camps both inside and outside VNP.	X	
4	Work with management or co-management agencies in other jurisdictions bordering the park to determine and monitor the number of grizzly bears harvested each year or killed in defence of life and property.	X	
5	If the number of grizzly bears kills in VNP and surrounding areas becomes a concern to Parks Canada staff, then it may be necessary to work with the NYRRC to encourage the establishment of total allowable harvests for grizzly bears within VNP.		X
6	Discuss with the NYRRC and Vuntut Gwitchin First Nation the idea of protecting black bears from harvest within VNP.		X
4.2.5	**Vuntut Gwitchin Local & Traditional Knowledge**		
1	Encourage the gathering of Vuntut Gwitchin local or traditional knowledge about bears and bear ecology through the *Vuntut Gwitchin Oral History Study*.	X	
4.2.6	**Field Data Collection**		
1	Parks staff should record any local knowledge about bears that they receive in conversation with Vuntut Gwitchin people working or living on the land.	X	
2	Ensure that staff working in the park record all bear observations as in section 4.3.3.	X	
3	Informal, co-operative efforts would be best for identifying and dealing with potential bear - human interaction risks around existing Vuntut Gwitchin camps and other human use sites.	X	
4	Parks Canada may occasionally need to conduct more formal assessments of the risk of bear - human interactions at proposed research camps or facilities, commonly used visitor use sites, and proposed Park facilities.	X	
5	Examine den sites encountered while travelling in the park and measure den site characteristics.	X	

6	Examine mark trees in the field to try and determine which species of bear are using them.	X	
7	If estimating seasonal food habits of bears is considered a priority of Parks Canada and in the absence of adequate staff training and experience, it would be best to have scats send out to a lab for analysis.	X	
4.2.7	Bear Ecology Research		
	No intensive or extensive scientific research is deemed necessary within the 10-year time frame of this strategy		X

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BEAR LITERATURE REVIEW AND PROPOSED MANAGEMENT STRATEGY FOR VUNTUT NATIONAL PARK, YUKON

APPENDICES

Parks Canada
Yukon District
Haines Junction, Yukon

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May 2000

Appendix 1. An annotated bibliography of studies done on barren-ground and northern interior bear populations of Canada and Alaska. Reports that are in the bear literature binders have a reference number before the citation and can be found in the binders under the corresponding numbered tab.

Albert, D.M., and R.T. Bowyer. 1991. Factors relating to grizzly bear-human interactions in Denali National Park. Wildlife Society Bulletin. 19:339-349.

Abstract or summary not available

Ballard, W.B., S.D. Miller, and T.H. Spraker. 1982. Home range, daily movements, and reproductive biology of brown bear in southcentral Alaska. Canadian Field Naturalist 96:1-5.

Twenty-three radio-collared adult brown/grizzly bears (*Ursus arctos*) were studied in the Nelchina Basin of southcentral Alaska during 1978 and 1979. Radio-collared bears were seen on 85.4% of 644 radio locations. Home ranges of adult females averaged 408 km^2, while those of adult males averaged 769 km^2. Daily movements of males averaged 7.7 km/d, while females averaged 7.0 km/d. Most bears entered dens in late October and emerged between 9 April and 12 May and therefore were active for half of the year. Most females became reproductively mature at 4.5 y; in three cases females successfully bred at 3.5 y. A reproductive interval of 2y was reported in one case following loss of a yearling offspring. Typical breeding intervals were 3y. Average size of 17 cub and yearling litters was 1.9: high rates of cub loss were observed. Breeding activity was concentrated in May and June. Relative to most other North American brown bear populations, brown bears in interior Alaska had larger home ranges, females reached sexual maturity at younger ages, and weaning of litters occurred earlier.

Ballard, W.B., K.E. Roney, L..A. Ayres and D.N. Larsen. 1990. Estimating grizzly bear density in relation to development and exploitation in northwest Alaska. International Conference on Bear Research and Management 8:405-413.

Grizzly bear densities within a 1,862 km^2 study area surrounding a lead/zinc mine in northwest Alaska were estimated using mark-recapture methods during late May and early June, 1987. Radio-collars were used to mark bears and assess population closure. Density estimates were 1 bear/66 km^2 for-adults (>3-years-old) and 1 bear/51 km^2 for bears of all ages. Some of the biases and problems associated with the mark-recapture method were discussed. Density estimates were used to estimate population size within and near the bear study area, and this estimate was compared with reported and suspected annual harvests. Estimated annual harvest rates in recent years had ranged from 8% to 16%. Their calculated harvest rates approached or exceeded the conservative exploitation rates of 2-4% recommended for northerly latitudes. It was concluded that current bag limits could not be liberalized without causing a reduction in the bear population.

Ballard, W.B., L.A. Ayres, S.G. Fancy, D. J. Reed, and K.E. Roney. 1990. Demography of Noatak grizzly bears in relation to human exploitation and mining development, Progress Report. Project W-23-2, Study 4.20. Alaska Department of Fish and Game, Juneau. 57 pp.

During 1989, 39 grizzly bears (*Ursus arctos*) were immobilized with a mixture of tiletamine hydrochloride and zolazepam hydrochloride. A total of 122 bears have been marked since inception of the study (1986); their most recent status has been described. Sex and age composition, baseline blood values, and body measurements collected during immobolizations were presented. Of 24 adult males marked during 1986 through 1989, 29% (7 bears) have been harvested by hunters. Of 39 marked adult females, 10.3% (4 bears) were shot, including three in 1989. During 1989, 34 adult females were radio-collared on 242 occasions. Since 1986, 62 radio-collared bears have been relocated on 1,544 occasions. Average litter size at den emergence during 1986 through 1988 was 2.22 (n=27). By den entrance size of yearling litters averaged 1.76 (n=21). A total of 1,121 relatively accurate relocations were obtained from 6 adult females instrumented with satellite radio collars in 1988. Satellite collars were programmed to transmit throughout the summer for 6 hours/day from 25 May through 10 October, shut off during denning, and then repeat the first cycle at den emergence. Only one of 6 collars provided useful data during 1989. Costs per bear relocation obtained from satellite collars averaged $27, while those obtained from conventional methods using fixed-wing aircraft averaged $68 per relocation.

Ballard, W.B., L.A. Ayres, K.E. Roney, D. J. Reed, and S.G. Fancy. 1991. Demography of Noatak grizzly bears in relation to human exploitation and mining development. Final report. Project W-22-5, W-22-6, W-23-1, W-23-2, and W23-3. Alaska Department of Fish and Game, Juneau. 227 pp.

Abstract or summary not available

Ballard, W.B., L.A. Ayres, D.J. Reed, S.G. Fancy, and K.E. Roney. 1993. Demography of grizzly bears in relation to hunting and mining development in northwestern Alaska. Scientific Monograph NPS/NRARO?NRSM-93/23. U.S. Department of the Interior, National Park Service, Denver, Colorado.

Abstract or summary not available.

23. Banci, V., D.A. Demarchi, and W.R. Archibald. 1994. Evaluation of the population status of grizzly bears in Canada. International Conference on Bear Research and Management 9:129-144.

The population status of grizzly bears (*Ursus arctos*) in Canada was evaluated within broad areas called grizzly bear zones. These zones are large, contiguous areas where the climate and landforms provide a common influence on vegetation and land-use activities, and thus on grizzly bear behavior and populations. Of the 14 grizzly bear zones that historically supported populations, 12 currently support populations. We describe past and current land-use activities that impact habitats and populations of grizzly bears and predict future impacts. Gross analyses at the level of the grizzly bear zone identified probable unsustainable annual kills and excessive female kills for many of the grizzly bear zones. Population status was evaluated by comparing an estimate of current numbers to the estimated potential of the land to support grizzly bears. Grizzly bears have been extirpated from 24% of their original range and 63% of the current range is designated at risk, either vulnerable or threatened. The 4 grizzly bear zones in which grizzly bears are not at risk face increased impacts from land-use practices within the next 5 years. We discuss the implications of the designation of population status and make recommendations to ensure the conservation of grizzly bears.

Bath, A. J. 1989. Public attitudes towards bears: implications to the management of black and grizzly bears in the Yukon. Yukon Department of Renewable Resources, Fish and Wildlife Branch, Whitehorse. 81 pp.

The Yukon Department of Renewable Resources, Fish and Wildlife Branch, commissioned Bath Associates to review relevant attitude information and provide preliminary assessments of the implication of this work to current bear management in the Yukon. This involved a literature review of pertinent materials in the field of human dimensions in wildlife resources (i.e. quantitative survey research focusing upon public attitudes, knowledge levels, compromises and educational aspects of wildlife issues). Such research offers a human component to the wildlife management equation, traditionally focused upon wildlife and habitat.

The first section of the report briefly defines some of the sociology terminology used in this type of research (i.e. attitudes, perceptions, beliefs). In addition to the available literature, preliminary perspectives of Yukon public attitudes toward bears were obtained through telephone interviews with individuals from different facets of Yukon life (i.e. placer miners, hunting guides, teacher). A survey was also administered to 112 biology students in one school in Whitehorse. Such information is not repesentative of the respective groups but it does offer some initial data on public attitudes toward bears and their management in the Yukon. Most individuals expressed a positive attitude toward bears.

Many factors can affect attitudes toward bears. Some of these are discussed in the report. Accurate knowledge about bears and positive personal experience (viewing bears) can lead to positive attitudes toward the animal. A step to improving public attitudes is to encourage the public to see bears as symbols of wilderness rather than lethargic garbage eaters, camp nuisances, or vicious man-killers. Informative talks, films and education programs can help improve knowledge about bears.

Little qualitative research has been done on public attitudes and public knowledge about bears. This report briefly evaluates and summarizes the findings of approximately fifteen studies. Perceptions and beliefs about hears, whether factual or not, *seem* to play an important role in forming attitudes toward the animal. Public attitudes may also differ between grizzly bears and black bears, with the former being more respected and feared. Black bears are seen as more abundant and more a nuisance.

As the Yukon Department of Renewable Resources, Fish and Wildlife Branch, has never collected quantitative data on a large scale on Yukon resident attitudes toward bears and public knowledge about bears, much research needs to be done. A baseline study is needed.

Future public attitudes could be monitored in accordance with policy changes against the established baseline. An identical procedure was used in black bear management in the Catskills region (New York). Future directions for the Yukon could take many forms. This report recommends implementation of six phases of surveys of public attitudes toward bears and their management. Each phase addresses a certain segment of the Yukon population (i.e. aboriginal peoples, Whitehorse residents, residents outside of Whitehorse, various interest groups, children's attitudes, and effectiveness of bear conservation educational programs). Such quantitative data will help the resource manager to make more effective decisions representative of the entire wildlife constituency.

Boudreau, T.A. 1995. The role of topography in habitat selection by grizzly bears in the north-central Alaska Range. M.S. Thesis, University of Alaska, Fairbanks. 86 pp.

Patterns of topographic habitat selection by grizzly bears (*Ursus arctos*) in the northcentral Alaska Range were determined for bears captured during 1982-1991. Aerial relocations of radio-marked individuals and family groups occurred from 15 April through 1 October. Topographic habitat was defined and measured using slope, aspect and elevation categories. Habitat use was measured using the log-likelihood technique for categorized habitats and estimated availability of habitat. Habitat selection was related to reproductive status of bears. Differences in habitat selection occurred for females with cubs, females with 2-year-olds, lone adult males, lone adult females and subadults. Selection of habitats by all age and sex classes may be closely related to the balancing of nutritional needs, avoidance of negative intraspecific interactions and reproduction, with selection of topography to enhance overall fitness and increase reproductive success.

Bromley, M. 1988. The status of the barren ground grizzly bear (*Ursus arctos horribilis*) in Canada. Government of N.W.T, Department of Renewable Resources. 39 pp.

The barren ground grizzly occurs only in the Northwest Territories and lives primarily in the barrens north of treeline throughout its annual cycle. Barren ground grizzlies can be legally killed for native subsistence use, in defense of life or property, or as part of a commercial quota totalling 20 bears (1988). Total harvest is difficult to estimate because subsistence and defence kills are incompletely reported. Population data are available for the Richards Island/ Tuktoyaktuk Peninsula area where the density of grizzly bears is 1 bear/200-262 km^2. Numbers are thought to be stable in most areas and may be increasing in the central and eastern part of the bear's range. There is no evidence for decline in any population. Food supply is the major factor influencing barren ground grizzly distribution and habitat use. There are no immediate threats to large areas of barren ground grizzly habitat, although localized development may threaten habitat in some places. Barren ground grizzlies have a low reproductive capacity. Age of first reproduction, breeding interval, and litter size are higher than documented for southern populations. Tolerance of human disturbance and associating people with food can affect bear survival. Barren ground grizzlies are vulnerable to overharvest and a conservative management is required. Research is needed on population numbers and trend, adult survival rate, and harvest rates.

Boertje, RD., W.C. Gasaway, D.V. Grangaard, D.G. Kellyhouse, and R.O. Stephenson. 1987. Factors limiting moose population growth in Subunit 20E. Progress report. Project W-22-5. Alaska Department of Fish and Game, Juneau. 86 pp.

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Carroll, G. 1995. Game management unit 26A brown bear management report. Pages 289-303 *in* M.V. Hicks, ed. Management report of survey-inventory activities. Alaska Department of Fish and Game, Juneau.

Abstract or summary not available.

1. Case, R., and L. Buckland. 1998. Reproductive characteristics of grizzly bears in the Kugluktuk area, Northwest Territories, Canada. Ursus 10:41-47.

Reproduction and survival of 13 female barren-ground grizzly bears were studied in the area southwest of Kugluktuk, Northwest Territories, between 1988 and 1995. Adult female survival rate was high (98%); the only 2 adult female mortalities were from intraspecific predation. Mean litter size was 2.3 cubs < 1 year old (n = 19) and mean birth interval was 2.6 years (n = 8). The annual natality rate was 0.87 cubs/adult female. Mean reproductive interval between successful litters was 3.3 years (n = 6). First year cub survival was 81%, and second year cub survival was 76-84%. Age at first parturition averaged 8.7 years (n = 6) which is later than in other northern grizzly bear populations; however, growth curves indicated that maturity was not delayed by nutrition. The Estimated finite rate of population increase (h) was 1.026. These results indicate that the Kugluktuk grizzly bear population can sustain a small harvest provided that females are protected.

Case, R., and S. Matthews. 1993. Barren-ground grizzly bear research and management--wildlife management unit F. Government of Northwest Territories. 12 pp.

This unpublished report specifies the GNWT's plan to ensure that human activities are conducted in such a manner that impacts on barren-ground grizzly bear abundance, distribution, and productivity are minimized by: 1) conducting an assessment of potential impacts based on current information and projected activities; 2) monitoring human activities and compiling this data for use in cumulative impact evaluations; 3) providing information and recommendations to reduce human/bear encounters and dead bears; 4) assisting industry with deterring and handling problem bears; 5) assessing the effectiveness, usefulness, and feasibility of SIBC recommendations in field settings; and 6) obtaining detailed data on types of encounters, activities leading to encounters, and outcomes. Further program objectives include obtaining demographic and ecological data to assess the potential impacts of increased industrial activities. Methods and funding requirements are discussed.

Case, R., and J. Stevenson. 1991. Observation of barren-ground grizzly bear, *Ursus arctos,* predation on muskoxen, *Ovibos moschatus,* in the Northwest Territories. Canadian Field-Naturalist 105:106-106.

Observations of grizzly bears (*Ursus arctos*) killing and feeding on muskoxen (*Ovibos moschatus*) are rare. We observed a bear feeding on a muskox bull near Coppermine, Northwest Territories. The state of the carcass and tracks in snow allowed us to reconstruct the sequence of the bear killing the muskox. We also recorded two other possible instances of grizzly bear predation on muskoxen.

Ciamiello, L.M. 1996. Management plan to reduce negative human-black bear interactions: Liard River Hotsprings Provincial Park, British Columbia. M.Sc. thesis, University of Calgary. 228 pp.

A radio-telemetry and management study of the black *bear (Ursus americanus)* in Liard River Hotsprings Provincial Park and surrounding area was conducted. Emphasis was placed on the developed portions of the park. Information was collected on: human-bear interactions, landfill site, private holdings, black bear food habits, food conditioned and non-food conditioned bear habitat use, and visitor use patterns. Three main factors were identified that contributed to negative human-black bear interactions in the Liard River study area. These factors were: (1) the availability of unnatural foods within the park and surrounding area which resulted in the food conditioning and habituation of several bears that used the park; (2) the availability of natural bear foods adjacent to areas of high human use; and (3) the lack of visitor education and information regarding basic bear biology and the ethics of camping in bear country. The combination of unnatural food availability in an eco-unit (SH) that was naturally selected for by bears made the human use areas of Liard River an extremely attractive and unsafe environment for black bears.. Management recommendations focused on restoring the natural behaviour and distribution of the Liard River black bear and enhancing visitor safety. Primary recommendations included the restriction of unnatural foods in the Liard River area, the management of humans and their activities through enforcement and education, and the improvement of park design to enhance visitor safety. Recommendations on adaptive management emphasized future research and monitoring in the park and surrounding area. The management plan was considered proactive in that the recommendations addressed the root causes of the problems.

Clarkson, P.L., and I.S. Liepins. 1989a. Inuvialuit wildlife studies: grizzly bear

research progress report 1987-1988. Wildlife Management Advisory Council (NWT) Technical Report No. 3. lnuvik, N.W.T. 43 pp.

During the 1987-88 season 49 bears (32 females, 17 males) were captured in the study area. Most of the bears were found along the Anderson, West, and Horton Rivers and associated tributaries. Radio-collars were placed on 19 females (17 adult, 2 subadult) and 10 males (8 adult, 2 subadult). A total of 120 radio locations were obtained from the collared bears. The study animals apparently did not travel from the Anderson to the Horton rivers or vice-versa. Bears along the West River and the Smoking Hills did travel to the Horton River. On average males moved greater distances than females.

The habitat appears productive and most bears were in good condition upon capture. Favoured species of plants eaten by bears occur throughout the area and are abundant along major drainages, including major tundra berry species and Hedysarum. During capture and monitoring work bears were seen feeding or in pursuit of ground squirrels, caribou, muskox, and possibly seals. Hunters interviewed from the communities appeared to have a good idea about which areas grizzly bears are using at different times of the year and what food resources they rely on. Most people felt that the bear population was increasing as more bears were being seen than in previous years. The hunter take in the area was low (l-2) in 1987.

Clarkson, P.L., and I.S. Liepins. 1989b. lnuvialuit wildlife studies: grizzly bear research progress report 1988-1989. Wildlife Management Advisory Council (NWT) Technical Report No.8. Inuvik, N.W.T. 25 pp.

Abstract or summary not available.

Clarkson, P.L., and I.S. Liepins. 1992. Inuvialuit wildlife studies: grizzly bear research progress report 1989-1991. Wildlife Management Advisory Council (NWT) Manuscript Report no.53. Inuvik, N.W.T. 26 pp.

A general summary is provided on the results obtained during the third year (1989) of the mark-recapture study and the third (1989) and fourth years (1990) of the female productivity and cub survival study in the Anderson-Horton rivers area.

A total of 86 bears was captured during June and August, 1989. Twelve adult bears (10 females, 2 males) were recaptured from previous years. In June 1990, 11 bears (5 adult females, 3 adult males, 1 yearling male and 2 male cubs of the year (COYs)) were captured. Collars were replaced on the five adult females and 1 adult male. No new bears were collared. Since 1987, 154 bears (56 males, 98 females) have been captured and marked.

Radio-collared bears (n=28) were monitored to determine female productivity, young survival, population distribution and seasonal habitat use. Female productivity and cub of the year (COY) survival were intensively monitored from 20 May - 10 June 1989. Ten adult females with COYs were monitored to determine COY mortality. One female lost her COYs during this time period. By the end of July 1989, 6 more females had lost their entire litters of COYs and one female lost 1 of her 2 COYs. Only 2 females (G51 and G86) successfully raised all of their observed COYs to the denning period in the fall of 1989. We will continue to monitor female productivity and COY survival until 1993-94.

Nine bears (8 males, 1 female) were reported to have been harvested by hunters from Tuktoyaktuk (7 bears) and Paulatuk (2 bears). No radio-collared bears were known to have died of natural causes.

Clarkson, P.L., and I. S. Liepins. 1993. Female productivity and cub survival in the Anderson and Horton Rivers area, Northwest Territories, 1987-92. Government of the Northwest Territories, Inuvik.

Abstract or summary not available.

Clarkson, P.L., and I. S. Liepins. 1993. Grizzly bear, *Ursus arctos,* predation on muskox, *Ovibos moschatus,* calves near the Horton River, Northwest Territories. Canadian Field-Naturalist 107:100-102.

An adult male and adult female Barrenground grizzly bear killed five muskox calves near Horton River, Northwest Territories in May 1989. The calves were with a herd of 40-50 muskoxen. The bears killed the calves within a two km area. At least three calves escaped. Both bears were observed feeding on the same calf.

2. Clarkson, P.L., and I.S. Liepins. 1994. Grizzly bear population estimate and characteristics in the Anderson and Horton Rivers area, Northwest Territories, 1987-89. International Conference on Bear Research and Management 9:213-221.

A population estimate of 141 (95% CI, 131-276) grizzly bears (>2 yrs old) was determined using a modified Lincoln-Petersen estimate. Reducing the number of marks available in the study area by 10%/year to compensate for lack of population closure resulted in a population estimate of 127 (95% CI, 118-248) bears (>2 yrs old). Bear densities in the study area were 9.1 bears/ 1,000 km^2 for the standard Lincoln-Petersen estimate and 8.2 bears/ 1,000 km^2 for the adjusted Lincoln-Petersen estimate. During the 3-year research period, 154 bears (97 females, 57 males) (all ages) were captured and marked. The sex ratio of the population for all ages was 67% females and 33% males. A minimum population estimate of 102 bears (67 females, 35 males) (>2 yrs old) was calculated for the study area by only including captured bears. Bear distribution throughout the study area was clumped with bears concentrating along river and creek valleys. Fourteen bears from the area died during the research period.

Craighead, D.J. 1998. An integrated satellite technique to evaluate grizzly bear habitat use. Ursus 10:187-201.

I present a method that combines 2 previously described remote-sensing techniques: Landsat-derived vegetation types (Craighead et al. 1986, 1988) and National Oceanic and Atmospheric Administration (NOAA) Tiros satellite-derived locations of grizzly bears *(Ursus arctos horribilis).* This research was completed on a 5,931 km^2 study area north of the Squirrel River, a tributary of the Kobuk River, in northwestern Alaska. Six satellite radiocollared grizzly bears were located a total of 1,624 times from 1986 to 1988. Habitat use was quantified and statistically evaluated by superimposing bear locations and home ranges on a map of vegetation cover types. I acknowledge the variability of the remote measurements and describe a technique to estimate the central tendency of a sample set of vegetation complexes about bear occurrences. The inference of selection or avoidance was made from the juxtaposition of bear and habitat. The analyses showed that individual bears clearly selected for specific habitat types, but as a group the bears were quite diverse in habitat use. This indicates that habitat needs of the studied grizzly bears were very broad and that their requirements were expansive.

Craighead, F.L., E.R. Vyse, and H.V. Reynolds HI. 1994. Paternity determination with DNA fingerprinting in a grizzly bear population. International Conference on Bear Research and Management 9:529-531.

We extracted DNA from 120 grizzly *bears (Ursus arctos horribilis) in an* arctic population for paternity analysis using DNA fingerprinting. Preliminary results indicate that a combination of several probes and/or enzymes will be necessary to identify sires of offspring with known mothers. Development of genetic profiles will provide estimates of population genetics parameters such as inbreeding coefficients, heterozygosity, and degree of polymorphism to use as a baseline in managing this, and other, more endangered, populations. We present these preliminary results in order to inform others of the direction of our research and to facilitate sample collection and lab work in other studies.

Craighead, F.L., D. Paetkau, H.V. Reynolds, E.R. Vyse, and C. Strobeck. 1995. Microsatellite analysis of paternity and reproduction in Arctic grizzly bears. Journal of Heredity 86:255-261.

We report data from analyses of microsatellite loci of 30 grizzly bear family groups which demonstrate that each cub in a litter can be sired independently, and we derive estimates of maximum reproductive success for males, from an Arctic population in northwestern Alaska that is minimally affected by human activities. These analyses were made possible by the use of single-locus primers that amplified both of an individual's alleles at eight microsatellite loci and by detailed knowledge of maternal/offspring relationships that allowed the identification of paternal alleles. No single male was responsible for more than approximately 11% of known offspring, and no more than 49% of breeding-age males successfully bred. These data contribute to an understanding of the genetic and demographic basis of male reproductive success, which is of vital importance in the maintenance of small, isolated grizzly bear populations.

Craighead, F.L., D. Paetkau, H.V. Reynolds, C. Strobeck and E.R. Vyse. 1998. Use of microsateliite DNA analyses to infer breeding behavior and demographic processes in an Arctic grizzly bear population. Ursus 10:323-327.

Analyses of microsatellite DNA, combined with behavioral observations, indicated that female grizzly bears (*Ursus arctos*) in the Arctic have a large male gene pool from which to choose. Males from a large surrounding area bred successfully with the females in our study area and competed with males who centered most of their activities in the study area. Observations of breeding activity did not reliably indicate paternity, particularly under conditions where constant monitoring was not possible. Since females tend to be strongly philopatric, male behavior (influenced to some degree by female choice) is thus the primary mechanism for maintaining genetic diversity in brown or grizzly bear populations. In isolated populations with no influx of male genes from neighboring areas, genetic diversity should be correspondingly lower.

Cronin, M.A., S.C. Amstrup, G.W. Gamer, and E.R. Vyse. 1991. Interspecific and intraspecific mitochondriai DNA variation in North American bears (*Ursus*). Canadian Journal of Zoology 69:2985-2992.

We assessed mitochondrial DNA variation in North American black bears (*Ursus americanus*), brown bears (*Ursus arctos*), and polar bears (*Ursus maritimus*). Divergent mitochondrial DNA haplotypes (0.05 base substitutions per nucleotide) were identified in populations of black bears from Montana and Oregon. In contrast, very similar haplotypes occur in black bears across North America. This discordance of haplotype phylogeny and geographic distribution indicates that there has been a maintenance of polymorphism and considerable gene flow throughout the history of the species. Intraspecific mitochondrial DNA sequence divergence in brown bears and polar bears is lower than in black bears. The two morphological forms of *U. arctos,* grizzly and coastal brown bears, are not in distinct mtDNA lineages. Interspecific comparisons indicate that brown bears and polar bears share similar mitochondrial DNA (0.023 base substitutions per nucleotide) which is quite divergent (0.078 base substitutions per nucleotide) from that of black bears. High mitochondrial DNA divergence within black bears and paraphyletic relationships of brown and polar bear mitochondrial DNA indicate that intraspecific variation across species' ranges should be considered in phylogenetic analyses of mitochondrial DNA.

Crook, J.L. 1971. Determination of the abundance and distribution of grizzly bears north of the Brooks Range, Alaska. M.Sc. Thesis, University of Alaska, Fairbanks. 78 pp.

Locations of 647 reported sightings from January 1947 to January 1971 of brown bears north of the Brooks Range, Alaska, were plotted on maps to reveal trends of relative abundance and seasonal distribution. Population composition ratios were computed from age and sex reported. An aerial survey technique is described.

Aerial surveys showed that brown bear distribution is uniform throughout central arctic Alaska. The mean density observed during 57.6 hours of aerial surveying was **1 bear** per 88 square miles. Distribution maps indicate fewer brown bears on the coastal plain than in the foothills and mountain areas, and suggest a general pattern of northward dispersal during the summer.

Observed sex-age ratios were: 15.5 percent female with young, 27.6 percent cubs and yearlings, and 56.9 percent solitary adults. The observed mean litter size was 1.8 young per female with young. The results indicate lower productivity in the northern brown bears than that reported from southcentral Alaskan brown bears.

Crook, J.L. 1972. Grizzly bear inventory and survey. Alaska Department of Fish and Game, Juneau.

Abstract or summary not available.

3. Curatolo, J.A., and G.D. Moore. 1975. Home range and population dynamics of grizzly bear (*Ursus arctos* L.) in the eastern Brooks Range, Alaska. Chapter I *in* R.D. Jakimchuk, ed. Studies of large mammals along the proposed MacKenzie Valley gas pipeline route from Alaska to British Columbia. Canadian Arctic Gas Study Ltd., Biological Report Series Volume 32.

A study of grizzly bears was conducted on the north slope of the Brooks Range, Alaska. Forty bears were captured, color-marked and released. Home range of the 12 radio-collared bears and one color-marked bear averaged 702 sq km for males and 319 sq km for females. Den locations did not appear to enlarge home range size. A significant shift occurred in habitat use from river valley habitat in the spring to mountain habitat in the summer. The density of bears within the study area was calculated at one bear per 148 sq km. The mean weight of females was 110 kg and of males 186 kg. The population has an old age structure with a mean age of 13 for males (n=23) and 11 for females (n=24). The age at first breeding for females was estimated at 8 years and the mean litter size was 1.8 (n=9).

Dalle-Molle, J.L., and J.C. Van Horn. 1989. Bear-people conflict management in Denali National Park, Alaska. Pages 121-127 *in* NWT Department of Renewable Resources, Bear-people conflicts: proceedings of a symposium on management strategies, Yellowknife, N.W.T.

Bear-people conflicts in Denali National Park increased dramatically during the 1970's as visitation to the park rose 7-fold. Incidents of proper&y damage, bears obtaining human foods, charges, and injuries increased from less than l/year prior to 1972 to a high of 37 in 1982. In 1982 a comprehensive effort was begun to reduce incidents. The bear-people conflict management plan was substantially revised. Two seasonal wildlife technicians were added to the park staff to work exclusively on the problem. Portable bear-resistant food containers were distributed to backpackers. Aversive conditioning was used on bears that had obtained food from back-country camps. As a result of this emphasis on preventative actions, since 1982 no management relocations or killing of bears have been necessary. Incidents have decreased by 8 1% parkwide, 60% in developed areas and 92% in the back-country. The number of incidents involving property damage decreased 88%. Monetary losses from damages declined 93%. Incidents of bears obtaining human food or garbage have decreased 95%.

Darling, L.M. 1987. Habitat use by grizzly bear family groups in interior Alaska. International Conference on Bear Research and Management 7:169-178.

A study of grizzly bears (*Ursus arctos*) in 1984 and 1985 in Denali National Park investigated the differences between family and single bear habitat use patterns. Differences in family age, seasons, and years contributed to differences in habitat use patterns. Proportions of cub families seen in the spring were low but increased through the field season, whereas proportions of observed yearlings remained constant. Seasonal patterns of habitat use were generally consistent among cub and yearling families and single bears. Small but notable proportions of observations of families were made in more rugged, isolated terrain, especially in spring. Habitat use patterns between the years were significantly different and probably a result of a late spring and wetter weather in 1985. The 1984 habitat use pattern was more concentrated in extreme habitat combinations (high-rugged vs. low-flat) than was the 1985 pattern.

Dean, F.C. 1987. Brown bear density, Denali National Park, Alaska, and sighting efficiency adjustment. International Conference on Bear Research and Management 7:37-43.

Aerial surveys conducted in 1983 over a stratified random sample from about 2,500 km^2 in the northeastern part of Denali National Park were used to estimate the brown bear (*Ursus arctos)* population. Twenty-three flights, totalling 68 hours, were made in a low-flying, fixed-wing aircraft; the sample coverage totaled 4,590 km^2. Aerial counts were calibrated against simultaneous, multi-observer ground coverage. A new technique combining digitized topographic and vegetation information was used to adjust for sighting efficiency. Calibration results and plot characteristics were combined to estimate sighting efficiency on all plots. The minimum density estimates for the study area, based on animals seen, were 1/44, 1/70, and 1/476 km^2 for individual bears, bear Units, and families, respectively. The same values expanded by estimated sighting efficiency were 1/31, 1/49, and 1/163.

Dean, F.C., L.M. Darling, and A.G. Lierhaus. 1986. Observations of intraspecific killing by brown bears, *Ursus* arctos. Canadian Field-Naturalist 100:208-211.

Two cases of intraspecific killing by Brown Bears (*Ursus arctos)* were observed in Denali National Park, Alaska. An adult male attacked a family, partially paralyzing a female yearling and killing the adult female. The other yearling survived at least 10 weeks as an orphan. The second instance resulted in the death of a yearling and cannibalism by an adult male.

Doll, D., W.P. McCrory, and J.D. Feist. 1974. Observations of moose, wolf and grizzly bear in the northern Yukon Territory. Ch. III *in* Canadian Arctic Gas Study Ltd., Biological Report Series Volume 22.

Data collected in the northern Yukon Territory on moose and grizzly bears in 1973 and on wolves and black bears in 1972 and 1973 are summarized. The data were collected in conjunction with studies of the Porcupine caribou herd.

Moose winter distribution in 1973 was similar to that of the previous two years. Although a few moose wintered north of the treeline, most wintered to the south. Few moose wintered in the Old Crow flats. During summer, however, this was the area of highest density.

Approximately 5 10 wolf observations were made in 1972 and 1973. Observed distribution of wolves was more reflective of areas covered by caribou surveys than of actual wolf distribution. Group sizes of wolves in 1972 and 1973 were similar to those in 1971.

One hundred forty-four grizzly bear observations were made in 1973 between 2 May and 4 November. Sows with cubs were most frequently observed in the area between Johnson Creek, the Driftwood River and the head of the Bell River. Only solitary bears were seen in the Old Crow Range, Timber Creek, Thomas Creek, Black Fox Creek and the hills between Timber and Muskeg creeks. Observed productivity averaged 1.2 cubs per sow.

Few black bears were observed in the northern Yukon in 1972 and 1973.

4. Ferguson, S.H., and P.D. McLoughlin. Accepted. Effect of energy availability, seasonality, and geographic range on brown bear life history. Ecography 1999:000-000.

Life-history theory allows predictions of how changes in environmental selection pressures along a species' geographic distribution result in discrete shifts in life-history traits. We tested for spatial patterns of 24 populations of brown bears (*Ursus arctos*) across North America that grouped according to the following environmental and population parameters: evapotranspiration as a correlate of primary productivity of vegetation, coefficient of variation of monthly evapotranspiration values as a measure of seasonality, population density, and adult female weight. Cluster analysis grouped brown bear populations into two regions: Pacific-coastal populations characterized by high population density and large females that lived in areas of high primary productivity and low seasonality, and inland and barren-ground populations characterized by relatively low density and small bears that lived in areas of low productivity and high seasonality. For each region, we tested whether life-history traits (age at maturity and interbirth interval) related to primary productivity or seasonality. High altitude (interior; >1000m) and high latitude (barren-ground; >65°N) populations respond to extremes in seasonality with risk-spreading adaptations. For example, age at maturity and interbirth interval increased with greater seasonality. In contrast, Pacific-coastal populations living on the western edge of brown bear geographic range respond to intraspecific competition at high densities by maximizing offspring competitive ability. For example, age at maturity increased with greater primary productivity and high population density. In each region, the female parent decided on the life-history trade-offs required to reduce the risks of offspring mortality depending on the environmental pattern.

Follmann, E.H. 1989. The importance of advance planning to minimize bear-people conflicts during large scale industrial and transportation developments in the north. Pages 105110 *in* NWT Department of Renewable Resources, Bear-people conflicts: proceedings of a symposium on management strategies, Yellowknife, N.W.T.

The necessity of advance planning to minimize bear-people conflicts associated with large-scale industrial projects in the North is reviewed. Government agencies in the United States and Canada, as a rule, are responsible for providing a general framework of guidelines to minimize carnivore-related problems and, on some projects, for the development of specific stipulations that must be adhered to in order for industry to obtain authorization to proceed. This general approach taken by the United States federal and Alaskan state governments differs from the approach of the Northwest Territories and Yukon Territory in Canada, where territorial government agencies, often in cooperation with industry, have developed plans to minimize bear-people conflicts. These can then be adapted by permit applicants. Industry responsibilities in this matter encompass such features as project and facility siting, project design, and construction scheduling and planning, all with the intent of minimizing bear-people conflicts. It may be required of a permit applicant to develop a specific plan to meet this objective.

Follmann, E.H., and J.L. Hechtel. 1990. Bears and pipeline construction in Alaska. Arctic 43:103-109.

Serious problems were encountered with bears during construction of the 1274-km-long trans-Alaska oil pipeline between Prudhoe Bay and Valdez. This multi-billion-dollar project traversed both black bear (*Ursus americanus* Pallas) and grizzly bear (*U. arctos* L.) habitat throughout its entire length. Plans for dealing with anticipated problems with bears were often inadequate. Most (71%) problems occurred north of the Yukon River in a previously roadless wilderness where inadequate refuse disposal and widespread animal feeding created dangerous situations. Of the 192 officially reported bear problems associated with the Trans-Alaska Pipeline System (TAPS) (197 1-79), about 65% involved the presence of bears in camps or dumps, 13% the feeding of bears on garbage or handouts, 10% property damage or economic loss, 7% bears under and in buildings, and only 5% charges by bears. Remarkably, no bear-related injuries were reported, suggesting that bears became accustomed to people and did not regard them as a threat. Following construction of the TAPS there have been proposals for pipelines to transport natural gas from Prudhoe Bay to southern and Pacific-rim markets. Based on past experience, some animal control measures were developed during the planning phase for the authorized gas pipeline route in Alaska. Fences installed around 100-person "survey" camps were found to be effective in deterring bears in two traditionally troublesome areas.

Garner, G.W., H.V. Reynolds, L.D. Martin, T.J. Wilmers, and T.J. Doyle. 1984. Ecology of brown bears inhabiting the coastal plain and adjacent foothills and mountains of the north-eastern portion of the Arctic National Wildlife Refuge. Pages 330-358 *in* G.W. Gamer and P.E. Reynolds, eds. 1983 update report - baseline study of the fish, wildlife and their habitats. U.S. Fish and Wildlife Service, Anchorage. 614pp.

Abstract or surnmary not available.

5. Gamer, G.W., H.V. Reynolds, L.D. Martin, G.J Weiler, J.M. Morton, and J.M. Noll. 1985. Ecology of brown bears inhabiting the coastal plain and adjacent foothills and mountains of the north-eastern portion of the Arctic National Wildlife Refuge. Pages 268-296 *in* G.W. Gamer and P.E. Reynolds, eds. 1984 update report - Baseline study of the fish, wildlife and their habitats. U.S. Fish and Wildlife Service, Anchorage, 777 pp.

A total of 103 brown *bears* (*Ursus arctos)* were captured and marked in May, June and July 1982-1984 on the coastal plain and adjacent foothills and mountains of the northeastern portion of the Arctic National Wildlife Refuge (ANWR). Radio-transmitters were attached to a total of 74 different bears during this time period and these bears were monitored through denning (October-November) each year. More males were captured in age classes 5.5 years of age or less, while females were more abundant in age classes 6.5 years old and older. No natural mortalities occurred among bears in 1982, however, 10 apparent mortalities occurred among 17 young bears (cubs and yearlings) in 1983. In 1984, 13 of 24 young bears were apparent mortalities. Reasons for these high mortality rates in 1983 (58.9%) and 1984 (54.2%) among young bears is unknown. Three mortalities were recorded among female bears in 1984. A young female (4.5-year old) was killed by an adult male; a mature female (14.5-year old) died of accidental strangulation on a survey marker, and another mature female (20.5-year old) died of unknown causes in October. Brown bears were observed feeding on caribou (*Rangifer tarandus*) carcasses (adults and calves) on 6 occasions in 1982, on 15 occasions in 1983, and on 17 occasions in 1984. Preliminary analysis of radio-relocation data indicate that brown bears appear to shift habitat use patterns to coastal areas in June and early July to coincide with occupancy of those habitats by calving and post-calving caribou. Emergence from winter dens occurred in late April and throughout May in 1983, but was confined to late April through mid-May in 1984, with early emergence of males and non-parturient females and later emergence of females with cubs and females with young. Elevations of den sites averaged 816 ± 61m (SE) in 1983, and 966 ± 46m (SE) in 1984. Aspects of den sites were predominantly southeast facing slopes (mean aspect, 1983=145 ± 20SE; 1984=150 ± 18SE). Slope of den sites averaged 54 ± 4% SE in 1983, and 56 ± 2% SE in 1984. In October and November, bears moved south into foothill and mountainous habitats to den in both years. Only two bears in 1983 and two bears in 1984 denned on the coastal plain and foothill habitats in the 1002c study area.

5. Gamer, G.W., H.V. Reynolds, M.A. Phillips, G.E. Muehlenhardt, and M.A. Masteller. 1986. Ecology of brown bears inhabiting the coastal plain and adjacent foothills and mountains of the north-eastern portion of the Arctic National Wildlife Refuge. Pages 665 - 692 *in* G.W. Gamer and P.E. Reynolds, eds. 1985 update report - Baseline study of the fish, wildlife and their habitats. U.S. Fish and Wildlife Service, Anchorage.

A total of 145 brown bears (*Ursus arctos*) were captured and marked in May, June and July 1982-1985 on the coastal plain and adjacent foothills and mountains of the northeastern portion of the Arctic National Wildlife Refuge (ANWR). Radio-transmitters were attached to a total of 113 different bears during this time period and these bears were monitored through denning (October-November) each year. More males were captured in age classes 5.5 years of age or less, while females were more abundant in age classes 6.5 years old and older. No natural mortalities occurred among bears in 1982, however, 10 apparent mortalities occurred among 17 young bears (cubs and yearlings) in 1983. In 1984, 13 of 24 young bears were apparent mortalities, and in 1985, and in 1985, 18 of 40 young bears were apparent mortalities. Reasons for these high mortality rates in 1983 (58.9%), 1984 (54.2%), and 1985 (45.0%) among young bears is unknown. Four mortalities were recorded during July 1985. An adult female (19.5-year old) and an adult male (20.5-year old) died over winter of exposure and drowning, respectively. Two bears (a 13.5-year old female and a 3.5-year old male) were shot by hunters. Brown bears were observed feeding on caribou (*Rangifer tarandus*) carcasses (adults and calves) on 6 occasions in 1982, on 15 occasions in 1983, on 20 occasions in 1984, and on 31 occasions in 1985. Preliminary analysis of radio-relocation data indicate that brown bears appear to shift habitat use patterns to coastal areas in June and early July to coincide with occupancy of those habitats by calving and post-calving caribou. Emergence from winter dens occurred in late April and throughout May in 1983 and 1985, but was confined to late April through mid-May in 1984, with early emergence of males and non-parturient females and later emergence of females with cubs of the year. Elevations of den sites averaged 816 ± 61m (SE) in 1983,966 ± 46m (SE) in 1984, and 964 ± 64m (SE) in 1985. Aspects of den sites were predominantly southeast facing slopes (mean aspect, 1983=145 ± 20 SE; 1984=150 ± 18SE; 1985=146 ± 18 SE). Slope of den sites averaged 54 ± 4% SE in 1983, 56 ± 2% SE in 1984, and 58 ± 3% SE in 1985. In October and November, bears moved south into foothill and mountainous habitats to den. Only two bears in each year denned in the coastal plain and foothill habitats in the 1002c study area in 1983, 1984 and 1985.

5. Gamer, G.W., and P.E. Reynolds. 1986. Final report - baseline study of the fish, wildlife and their habitats. U.S. Department of the Interior, U.S. Fish and Wildlife Service, Anchorage. 695 pp.

Abstract or summary not present.

Gasaway, W.C., R.D. Boertje, D.V. Grangaard, D.G. Kellyhouse, R.O. Stephenson, and D.G. Larson. 1992. The role of predation in limiting moose at low densities

in Alaska and Yukon and implications for conservation. Wildlife Monograph 120. 59 pp.

Abstract or summary not available.

6. Gau, R.J. 1998. Food habits, body condition, and habitat of the barren-ground grizzly bear. M.Sc. thesis. University of Saskatchewan, Saskatoon. 77 pp.

Bear populations have declined as humans have expanded their population into the remote areas of North America. The diamond industry is currently expanding exploration into the central Canadian Arctic. As a result, a multi-faceted research program into the ecology of grizzly bears (*Ursus arctos*) in the central Arctic was initiated to gather sufficient information on the affected bears to allow enlightened management policies to develop.

My portion of a larger grizzly bear ecology project examined the feeding patterns and body compositions of a sample of bears living within the region of most active diamond exploration in the Northwest Territories. Feeding patterns of bears were determined using fecal analysis, direct observation, and stable nitrogen isotope analysis. The body compositions of bears were examined by bioelectrical impedance analysis to determine if periods of nutritional stress exist, and to ascertain whether blood parameters reflect stressful nutritional periods.

Caribou (*Rangifer tarandus*) were the most common food item ingested. Barren-ground grizzly bears were adept at killing and consuming large numbers of caribou to meet their dietary protein requirements. However, the fruits of the northern berry species were critically important to the grizzly bear diet as the consumption of berries were essential for the deposition of body fat.

Two critical nutritional periods were identified for the barren-ground grizzly bears examined in my study. The early summer season, before the return of the Bathurst caribou herd from their calving grounds, corresponded to the poorest level of nutritional condition for barren-ground grizzly bears. Usable grizzly bear fat reserves were as low as 1-2% but improved upon the return of mixed post-calving herds of caribou to the study area. The late summer season, when grizzly hears entered a state of hyperphagia, was also considered critical. Bears need to accumulate large fat reserves during hyperphagia to survive winter hibernation.

The only blood parameter found to reflect the total body fat levels in both adult male and lone female grizzly bears was albumin. However, attempting to determine the nutritional status of bears using any of the blood parameters I examined appears not feasible.

Gau, R.J., and R. Case. 1999. Evaluating nutritional condition of grizzly bears via select blood parameters. Journal of Wildlife Management 63:286-291.

The use of blood parameters to estimate nutritional condition of bears has yet to be validated with actual body compositions. We used bioelectrical impedance analysis (BIA) to accurately estimate the body composition of a free-ranging population of grizzly bears (*Ursus arctos*) from the central Arctic of the Northwest Territories (NWT), Canada. We then correlated their blood hematology and metabolite parameters, previously identified by other studies on black bears (U. *americanus*) and grizzly bears to be useful indicators of nutritional condition, to the percentage of total body fat determined by BIA. None of the examined blood parameters had a significant relation with total body fat levels that were free from the effects of activity, stress, or dietary changes. Thus, interpretations of a grizzly bear's nutritional condition via the blood parameters we examined would be spurious.

Gau, R.J., S. Kutz, and B.T. Elkin. 1999. Parasites in grizzly bears from the central Canadian Arctic. Journal of Wildlife Diseases 35:618-621.

Standardized flotation techniques were used to survey 56 grizzly bear (*Ursus arctos*) fecal samples for parasites. The samples were collected during the spring and autumn of 1995 and 1996 in the central Arctic of the Northwest Territories (Canada). Parasites of the genera *Nemutodirus,* gastrointestinal coccidia, and an unidentified first stage protostrongylid larva are reported for the first time from grizzly bears feces in North America. Parasites of the genera *Diphyllobothrium* and *Baylisascaris also* were collected. Prevalence of gastrointestinal parasites were significantly different between the spring and autumn seasons (31% and 58% respectively). Thus, we provide evidence supporting the theory that bears void gastrointestinal parasites before hibernation.

Gebhard, J.G. 1982. Annual activities and behavior of a grizzly bear (Ursus *arctos*) family in northern Alaska. Masters Thesis, University of Alaska, Fairbanks.

Behavior of a grizzly bear (*Ursus* arctos) family was examined. Active behavior of the sow consisted of 91.5% foraging, 0.9% nursing, 4.3% travel, 0.2% play, 0.6% disturbance and 2.5% miscellaneous; cub activities were similar but play was 3.5%. Foraging showed seasonal shifts that took advantage of high quality foods, and increased in the fall. Ground squirrel (*Spermophilus parryii)* hunting was most important (for the sow) and in the fall provided 21,000 kcal/day. Nursing was important for cubs in spring and summer but ceased in the fall. Evidence suggests this is typical of sows with young, and that nursing does not resume until the following spring. Travel by the sow was mostly food related. Travel by the cubs served to help maintain proximity to the sow. Play was similar to black *bear's (U. americanus)* but reflected differing environments and lifestyles. Aggression largely involved prized foods. The sow's rest was light and she periodically monitored her surroundings. Seasonal patterns occurred in movements and proximity of family members.

7. Harding, L.E. 1976. Den site characteristics of Arctic coastal grizzly bears (*Ursus* arctos L.) on Richards Island, Northwest Territories, Canada. Canadian Journal of Zoology 54:1357-1363.

Winter den sites of grizzly bears (*Ursus arctos* L.) were examined during summer, 1973, and spring, 1974, and 1975. The purpose was to locate denning areas and estimate the number of bears on Richards Island, N.W.T., and to assess the importance of soil, landform, and other characteristics that determine the suitability of sites for denning. A total of 23 dens was examined. Dens were situated in river or lake banks, in Pleistocene uplands, in silty or sandy soil, and frequently with a south exposure. Density was one bear per 106 square kilometers to one per 175 square kilometers.

Harding, L.E., and J.A. Nagy. 1980. Responses of grizzly bears to hydrocarbon exploration on Richards Island, Northwest Territories, Canada. International Conference on Bear Research and Management 4:277-280.

Observations on numbers, distribution, locations of dens, and responses of grizzly bears to industrial disturbances were noted on Richards Island, Northwest Territories, during 1972-75 . During this period, 13-23 bears occupied the 2,460 km^2 area. Bear responses to hydrocarbon exploration and related activities were observed 23 times, and 35 dens were located. Bears were distributed evenly over the study area during summer but avoided camps by 1 km or more. Density was comparable to that of other arctic mountain and coastal bear populations, and no decline was apparent. Effects of industrial activities included slight loss of habitat, disturbance of denning areas resulting in abandonment of dens (2 occasions), and relocation of problem bears. It was predicted that proposed natural gas production facilities will not be compatible with continued survival of grizzly bears in Richards Island (bears apparently actively avoided drilling sites by 1 km or more).

Hayes, R.D., and A. Baer. 1992. Brown bear, *Ursus arctos,* preying upon gray wolf, *Canis lupus*, pups at a wolf den. Canadian Field-Naturalist 106:381-382.

Evidence suggests a Brown Bear (*Ursus arctos)* excavated a wolf den, then killed and ate four wolf pups that were inside.

Hayes, R.D., and N. Barichello. 1986. Wolf, moose, muskoxen and grizzly bear observations on the Yukon north slope, June 1986. Progress report. Yukon Department of Renewable Resources, Fish and Wildlife Branch, Whitehorse. 19 pp.

Abstract or summary not present.

Hayes, R.D., and D.H. Mossop. 1987. Interactions of wolves, *Curtis lupus,* and brown bears, Ursus *arctos*, at a wolf den in the northern Yukon. Canadian Field-Naturalist 101:603-604.

Two encounters between Wolves (*Canis lupus)* and Brown Bears (*Ursus arctos)* were observed at the same Wolf den in the northern Yukon. One involved Brown Bears digging at the entrance of the den. The second was a short encounter between Brown Bears and a single Wolf that was disturbed by another Brown Bear.

Hechtel, J.L. 1985. Activity and food habits of barren ground grizzly bears in Arctic Alaska. M.S. Thesis. University of Montana, Missoula. 74pp.

From 1977 to 1982 data were collected on the activity and food habits of grizzly bears in the North Slope foothills of the western Brooks Range, Alaska. Activity budgets and patterns were calculated from 987 hours of observation of radio-collared bears during 1978, 1979, 1981, and 1982. Three females with cubs were active from 20% to 40% of 24-hour periods in the weeks just after den emergence. One of these females was active 50% to 74% of 24-hour periods: her activity level dropped to a range of 15% to 30% during the first 3 days of consorting with a male. Daily variation in activity levels and cycles indicated that caution was necessary when interpreting activity data. Food habits were based on analysis of 503 scats, 360 hours of feeding observations from 1978, and feeding site and habitat examination. Three seasonal feeding strategies were evident. From den emergence through greenup, *Hedysarum alpinum* roots were the most important food, supplemented by over-wintered *Arctostaphylus rubra berries,* emerging vegetation, and the floral parts of plants. Spring habitats providing staple plant foods were dry tundra types, floodplain communities, and tussocks. As snowmelt and greenup progressed, bears grazed more succulent vegetation and flowers, primarily *Equisetum arvense, Boykinia richardsonii*, and grasses/sedges. During the summer, bears used the greatest variety of habitats, though wet sedge meadows, ecotones between wet sedge meadows and drier tundra, and late snowmelt areas were preferred. By late summer and early fall as leafy vegetation decreased in quality, bears began to feed on roots and ripening berries. Although the bears fed primarily on plants, they frequently supplemented their diet with animals. Ground squirrels were the most important fall food. The foothills are a topographically diverse area with a complex vegetative mosaic offering a good variety of plant and animal foods. Every habitat had foods of interest to bears; although general use patterns were evident, bears used all habitats throughout the year.

Jingfors, K. 1993. Wildlife of Northern Yukon National Park. Chapter 9 *in* Canadian Parks Service. Northern Yukon National Park resource description and analysis. Natural Resource Conservation Section, Canadian Parks Service, Prairie and Northern Region, Winnipeg. RM Report 93-01/INP.

Abstract or summary not available.

8. Johnston, W.G., J.A. Staniforth, and C.A. McEwen. 1985. A review of northern grizzly bear ecology and habitat mapping techniques. Yukon Department of Renewable Resources, Fish and Wildlife Branch, Whitehorse. 106 pp.

Abstract or summary not present.

9. Kingsley, M.C.S., J.A. Nagy, and R.H. Russell. 1983. Patterns of weight gain and loss for grizzly bears in northern Canada. International Conference on Bear Research and Management 5:174-178.

Seasonal weight change in the grizzly bear (*Ursus arctos*) in two populations in northern Canada was studied by fitting growth curves to spring and fall weights. The spring weight of females levels off soon after the average age of first reproduction; that of males continues to increase through maturity and eventually reaches nearly twice that of females. Males lost in winter 22% of their fall weight, the fraction changing very little with age. The weight change in females is much larger, and continues to increase with age, the oldest females gaining in summer 70% of their spring weight and losing in winter 40% of their fall weight. Mature females gain and lose not only relatively, but absolutely, more weight than males.

9 Kingsley, M.C.S., J.A. Nagy, and H.V. Reynolds. 1988. Growth in length and weight of northern brown bears: differences between sexes and populations. Canadian Journal of Zoology 66:981-986.

Growth curves were fitted to data on age, length and spring weight for individuals from three populations of the brown bear, *Ursus arctos,* in northern Canada and northwest Alaska. Females reached 90% of asymptotic length before sexual maturity and before the age of first production. Their weight remained approximately in proportion to the cube of their length. Males reached 90% of asymptotic length 0.7 to 1.7 years later than females, and had asymptotic lengths 10-15% greater. Males continued their growth in weight even longer, and reached asymptotic weights 80-100% greater than females. Variation between these populations was small compared with the total range of variation in the species.

LeFranc, Jr., M.N., M.B. Moss, K.A. Patnode, and W.C. Sugg, HI (eds.). 1987. Grizzly Bear Compendium. Interagency Grizzly Bear Committee. Bozeman, Montana. 540 pp.

Abstract or summary not present.

Leonard, R.D., R. Breneman, and R. Frey. 1990. A case history of grizzly bear management in the Slims River area, Kluane National Park Reserve, Yukon. International Conference on Bear Research and Management 8:113-123.

A management planning program for Kluane National Park Reserve was completed in 1980. A major decision was made to develop a public transit system in the Slims River Area to facilitate visitor access to a large valley glacier. The transit system was not built and the valley was managed as a backcountry hiking area for an interim period. Characteristics of grizzly bear-people conflicts were monitored from 1981 to 1987. Park staff and 2,603 registered overnight backcountry users recorded 503 grizzly observations. Observations of solitary bears increased from 40% of total bear observations in 1981 to 84% in 1987. Frequency of avoidance behavior by grizzlies decreased whereas apparent neutral and approach behaviors increased. Incidents defined as serious were infrequent from 1981 to 1984 (n=3). Serious incidents sharply increased in 1985 (n=10) and continued to be relatively infrequent in 1986 (n=6) and 1987 (n=9). Serious incidents were categorized as close approach or charge (n=10), pack robbing (n=8), food cache robbing (n=2) and disturbance of tent camps (n=4), facilities (n=3) and vehicles (n=l). Management actions resulted in the death of 5 grizzlies, relocation of 5 grizzlies and area closures. Our analysis of relevant documents from 3 national park planning and management processes indicated that grizzly bears were not adequately treated in plans and environmental assessments for the Slims River Area because of emphasis on the proposed public transit system. The relationship between habituation of grizzlies to people and food conditioning was not recognized in management of the Slims River Area as a wilderness hiking area. We considered national park management processes to be valid tools for grizzly management provided they are implemented by trained, knowledgeable staff that apply adequate information before making decisions.

Linderman, S. 1974. Ground tracking of arctic grizzly bears. Final Report. Job 4.12R. Alaska Department of Fish and Game, Juneau. 17 pp.

Abstract or summary not available.

Lynch, W. 1992. King of the barrens. Canadian Geographic May/June: 26-34.

Abstract or summary not present.

MacDougall, S.A., McCrory, W., and S. Herrero. 1997. A study of grizzly (*Ursus arctos*) and black bear (*U. americanus*) food habits and habitat use, and a bear assessment of the Rabbitkettle Lake Area of Nahanni National Park Reserve, N.W.T. Canadian Heritage, Parks Canada, Fort Simpson, N.W.T. 156 pp.

A food habits study and a hazard assessment of grizzly (*Ursus arctos*) and black bears (*U. americanus)* in the Rabbitkettle Lake area of Nahanni National Park Reserve (NNPR) was conducted by the principal researcher, Sandra MacDougall with input from Wayne McCrory and Dr. Stephen Herrerro. Emphasis was placed on the habitats around Rabbitkettle Lake and Rabbitkettle Hotsprings. Bear scats were regularly collected to determine food habits (it was often not possible to determine the species of bear leaving the scat). The food habits data were supplemented by documentation of observed habitat use, including direct observations, dens, mark trees, tracks, and evidence of feeding or other sign, and park records from 198 1- 1995. A preliminary assessment was conducted ôf the availability of similar habitats within the rest of the park. All visitor use patterns in the Rabbitkettle Lake area were evaluated. All human-bear interactions, and bear management guidelines and actions during 1994 and 1995 were reviewed. Selected case studies from previous years were also studied. Management recommendations were then formulated to minimize negative bear-human interactions in the Rabbitkettle Lake area. The results indicated that, from a bear-human conflict point of view, the Rabbitkettle Lake area contains locally important summer buffaloberry feeding habitat for bears which corresponds with the season of greatest visitor use. The summer buffalobeny feeding habitats in the Rabbitkettle Lake area may be regionally important as well; however, this was not empirically determined. Improvements to the public information system with respect to bears was identified as the primary bear management issue for the entire park. The research also identified the need for improvement in bear management

at Rabbitkettle Lake with respect to the food and garbage management system, consistency in bear management actions, problem bear management, and monitoring and adaptive management with respect to bears. In addition to these management concerns, the hazard assessment highlighted the following areas: the need for brushing-out off all trails to increase the line of sight and ways to reduce the potential for a negative bear-human interaction at each facility. Overall the Rabbitkettle Lake area was assigned a seasonal hazard rating of low to moderate in spring, high in summer and low in fall. Specific hazard ratings were assigned to each facility; these followed the same trend as the seasonal hazard ratings for the entire area.

10. MacHutchon, A.G. 1989. Spring and summer food habits of black bears in the Pelly River valley, Yukon. Northwest Science 63:116-118.

Food habits of black bears *(Ursus americanus)* from the Pelly River Valley, Yukon, were examined to determine the seasonal importance of various foods for bears inhabiting a northern environment. Food habits were determined by analysis of 59 scats and one stomach. Herbaceous material and berries accounted for 95 percent of the scat volume during spring and summer. Horsetail (*Equisetum spp.*), bearberry (*Arctostaphylos uva-ursi),* soapberry (*Sheperdia canadensis),* and graminoids were the most important foods. Overwintered berries were eaten early in spring until herbaceous vegetation became available. New berries were important from mid to late-summer. Insects, particularly ants, were frequent in scats from May to August, but were only two percent of the total diet volume. Seasonal food habit information is important because it reflects seasonal trends in black bear habitat use. Food habit preferences of bears in northern environments are generally similar to those in southern areas; however the restricted availability of different foods limits diversity in northern diets.

MacHutchon, A.G. 1993. Grizzly bear research methodology. Western Arctic District, Canadian Parks Service, Inuvik, N.W.T. 50 pp.

Canadian Parks Service, Western Arctic District contracted the preparation of a study design for grizzly bear ecology research in Iwavik National Park, Yukon. The primary purpose of the research is to obtain information on grizzly bear habitat, seasonal habitat use and movements along the Firth River corridor in order to manage human activities Such that they have minimal impact on bears. A secondary purpose of the research is the determination of transboundary movements of grizzly bears, particularly into Alaska. The study will be carried out over a two-year period, 1993 - 1995.

Methods are outlined for four main topic areas, habitat classification and mapping; grizzly bear ecology, specifically movements, food habits and habitat use; management of human activities; and communication of study progress and final results. A schedule for conducting major project tasks and a two-year budget forecast are included.

MacHutchon, A.G. 1994. Grizzly bear habitat use study, Ivvavik National Park, Yukon: 1993 progress report Western Arctic District, Parks Canada, Inuvik, N.W.T. 41 pp.

Abstract or summary not present.

MacHutchon, A.G. 1995. Grizzly bear habitat use study, Ivvavik National Park, Yukon: 1994 progress report. Western Arctic District, Parks Canada, Inuvik, N.W.T. 41 pp.

Abstract or summary not present.

11. MacHutchon, A.G. 1996. Grizzly bear habitat use study, Ivvavik National Park, Yukon: final report. Western Arctic District, Parks Canada, Inuvik, N.W.T. 142 pp.

A grizzly bear (*Ursus arctos*) study was conducted in the Firth River valley of Iwavik National Park, Yukon during 1993 to 1995 to determine grizzly bear movements, activity patterns, food habits, and seasonal habitat use and to recommend management options that would minimize the potential impacts of humans on bears. Potential human impacts include the alteration of habitat, the displacement of bears from important habitat and the destruction of bears because of negative human - bear interaction. Grizzly bears in Iwavik National Park are at the northern latitudinal limit of the species in Canada where they must contend with short periods of food availability, lack of protective cover and extremes in weather. Any human disturbance could potentially effect local populations. Funding for the study was provided by Parks Canada, Inuvialuit Final Agreement (IFA) implementation funds, and the Environmental Innovation Program of Canada's Green Plan.

The first stage of the study was the classification and mapping of habitats in the Firth River valley. Preliminary habitat classification and mapping referred to previously established classification systems. This was followed with field sampling where 9 biophysical groups and 25 vegetated habitats were described from 367 habitat sample plots. Determination of the habitats followed both hand and statistical sorting of environmental and vegetation cover data. Biophysical groups and habitats reflected common characteristics of slope, aspect, vegetation cover, soils, moisture and depth to permafrost. Habitat mapping was completed on 1:20,000 colour aerial photographs and then digitized for plotting and analysis in a Geographic Information System (GIS).

Eight grizzly bears (5 adult females and 3 adult males) were captured and radio-collared in spring 1993. Grizzly bear seasonal habitat ecology was examined using two different methods: regular aerial and ground telemetry point locations of radio-collared grizzly bears and ground focal observations of individual bears over extended periods. Radio-collars were removed from all bears in late August 1995.

Grizzly bears were located from the air or ground 510 times and 200 locations were visited on the ground to verify the habitat, confirm the bear's activity, describe the physical and vegetative characteristics of the sites, and to collect scats for food habit analysis. Locations that were not visited on the ground were assigned to a habitat at the time of location. Grizzly bears were also observed for 780 hrs to determine habitat use, activity budgets, food habits and movements.

The weighted mean, multi-annual, minimum convex polygon (MCP) home range estimate for adult females, with or without cubs, was 259 km^2 (n = 5) and for adult males it was 744 km^2 (n = 3). Weighted mean annual home ranges were slightly larger than for the Barn Range east of the Firth River valley, however, they were smaller than for three other interior grizzly bear populations.

Movements of adult males in the spring and early summer were primarily associated with mating activity. Adult females with cubs-of-the-year (COY) tended not to move as far as lone females in the spring, but became progressively more mobile as the cubs grew. Longer movements of adult females in the summer than the fall were likely associated with movements to areas where caribou were migrating through the Firth River valley. In addition, patches of emerging green vegetation, that were well-used in the summer, tended to be more dispersed than patches of berries that were well-used in the fall. Both males and females concentrated their feeding in berry patches in the fall.

Ninety-four grizzly bear marking sites were identified in the Firth River valley. Trees were the main object used for rubbing and marking, but north of treeline and in areas with little tree cover, rocks and large shrubs were used for marking. Ground marking in the form of foot pad trails were often associated with well-used marking sites. Permanent marking sites were generally found on a distinct trail or trail system and were most common adjacent to streams and rivers.

Grizzly bears generally were more widely dispersed and active further from the Firth River during spring and summer than in the fall. Most activity at the Firth River in the summer was bears searching for or feeding on caribou. In the fall, grizzly bears often fed on berries on the slopes or terraces adjacent to the Firth River.

During the spring and summer, females with COY used higher elevations than females without COY. There was no difference in elevation use by adult males and females without COY in the spring and fall, however, there was a difference in the summer. I am not certain whether this difference reflected an actual elevation separation or was simply an artefact of the elevation availability within home ranges. Elevation has a major effect on the distribution and availability of vegetation in the North, including important grizzly bear food plants, however, food was not the only factor affecting elevation selection by grizzly bears. Two other important factors were likely avoidance of conspecifics and reproduction.

Grizzly bears had different patterns of activity when they were feeding on or foraging for ungulate kills or carcasses than when they were feeding on or foraging for vegetation. Bears that were focused on ungulates spent much less time feeding or foraging and more time resting, travelling and interacting with other bears.

Grizzly bears spent more time travelling between patches of vegetation and foraging within patches in the spring than other seasons, but the distance between patches was not as great. Bears spent less time travelling in the fall than the summer and their daily movements were the same or slightly less. However, foraging time was greater in the fall than the summer. This suggested that bears had to spend more time foraging within patches but less time moving between them in the fall than the summer. Even though foraging time within patches was lower in the summer, bears fed less and slept more than in the fall

Seasonal changes in the diet of grizzly bears roughly corresponded with the phenological development of their main food plants. Following den emergence, grizzly bears fed largely on roots, primarily alpine hedysarum, and overwinter berries, e.g., crowberry, and bearberry. As green vegetation began to emerge, particularly common horsetail and bearflower, there was a shift to these foods. This occurred in mid-June. Horsetail and bear-flower were the main food plants eaten until grizzly bears started feeding on berries, particularly blueberry, in early August. Blueberries were well-used throughout August and early September. Crowberry was another berry commonly eaten in the fall, however crowberries tended to ripen later than blueberries and were not as abundant. When blueberries were not locally abundant or when they became less abundant in late fall, grizzly bears spent more time digging for alpine hedysarum roots and ground squirrels. The majority of grizzly bear feeding time was spent eating vegetation (96 - 98%), however, mammals were also important foods. Grizzly bears hunted ground squirrels all summer, however they spent more time digging for ground squirrels after the squirrels had hibernated in September. Grizzly bears attempted to dig out and catch other small mammals as well. Caribou were killed or scavenged throughout the year, but most commonly when they moved through the Firth River valley in the spring on their way to their calving grounds and again in July when they moved south-eastward through the Firth River valley to their mid-summer range.

Well-used grizzly bear food plants in the north are not that different in nutritional quality than food plants from the south, however, the growing season in the north is short and suitable growing sites are not as abundant so food plant availability is less. In addition, the diversity of major bear foods is generally less in the north than in the south.

Food plants were eaten in a variety of habitats, but they were most often eaten in habitats where they were prominent. Grizzly bears fed on shallower slopes than where they bed. Grizzly bears typically bed in the habitat in which they were feeding or they moved a short distance to an adjacent habitat or an adjacent slope. A bear's decision about where to bed likely involved several factors, however, it appeared to be primarily related to trade-offs between protection from the weather, insect relief and security from potential predators.

Grizzly bears generally used habitats to exploit seasonal changes in the availability of foods. However, habitat use and biophysical group use analyses showed that individual grizzly bears had different habitat selection strategies. These different strategies were likely the result of different availability of foods within habitats, different habitat availability within home ranges, different learned behaviour, and intraspecific competition. Individual habitat use differences made it difficult to make general statements about habitat importance that would be true for the whole population.

I used data on grizzly bear habitat use and selection, movement, and food habits, food quality and availability within habitats, incidental observations, local knowledge, previous research and my experience in the field over three field seasons to estimate the relative seasonal value of habitats and biophysical groups to grizzly bears.

Inuvialuit have a wealth of knowledge about the ecology and behaviour of grizzly bears on the Yukon North Slope. As a result, Parks Canada staff and I met with several elders and hunters to obtain local and traditional knowledge about grizzly bears on the North Slope.

There were 62 human - bear encounters recorded during this study. Grizzly bears generally appeared to fear humans and ran or walked away during most encounters. Grizzly bears that are not habituated to human activity and fear humans can be easily displaced from important habitats.

I made a number of management recommendations that I believe will help minimize the displacement of grizzly bears from important habitats, reduce the potential for negative human - bear interactions in the Firth River valley and help address Parks Canada's obligations under the IFA and the Iwavik National Park Management Plan.

MacHutchon, A.G. 1997. Grizzly bear habitat evaluation, Snake River Valley, Yukon. Canadian Parks and Wilderness Society - Yukon, Whitehorse. Research Report No. 3. 49 pp.

A grizzly bear (*Ursus arctos*) habitat evaluation was conducted in the Snake River Valley, Yukon for Yukon Wildlands Project, Whitehorse. The relative distribution and abundance of habitats, grizzly bear foods and bear sign was assessed during reconnaissance surveys and detailed plots that evaluated vegetation and site characteristics and the site specific habitat potential for grizzly bears. A broad habitat classification was developed for the Snake River Valley based on information collected during the reconnaissance surveys and detailed habitat plots.

I considered the value of a habitat in the Snake River Valley to grizzly bears was influenced by the availability and quality of plant and animal foods, a habitats position on the landscape, its proximity to other habitats, intraspecifc and interspecific competition and possibly local human influence. I focused my assessment of grizzly bear habitat value on the broad habitat types described and I rated each for spring, summer and fall. Overall, my impression of the Mackenzie Mountains Ecoregion portion of the Snake River Valley was that it had a moderate capability to support grizzly bears relative to other areas in the Yukon. I had much less time to do reconnaissance hikes or habitat plots in the Peel River Plateau portion of the Snake River, consequently the habitats are not well defined and I was not that confident in my assessment of the habitat potential for grizzly bears. My perception was, however, that grizzly bear densities in the Peel River Plateau Ecoregion were lower than in the Mackenzie Mountains Ecoregion.

MacHutchon, A.G. 1997. Grizzly bear habitat evaluation, Bonnet Plume River Valley, Yukon. Canadian Parks and Wilderness Society - Yukon, Whitehorse. Research Report No. 4. 31 pp.

A grizzly bear (*Ursus arctos*) habitat evaluation was conducted in the Bonnet Plume River Valley, Yukon for Yukon Wildlands Project, Whitehorse. The relative distribution **and** abundance of habitats, grizzly bear foods and bear sign was assessed during reconnaissance surveys and detailed habitat plots. Habitat plots evaluated vegetation and site characteristics and the site specific suitability for grizzly bears.

A broad habitat classification was developed for the Peel River watershed based on information collected during habitat plots in the Bonnet Plume River Valley and Snake River Valley (MacHutchon 1997). An assessment of grizzly bear habitat value was based on the broad habitat types described and each was rated for spring, summer and fall. **Generally,** the Bonnet Plume River had a greater abundance and seasonal diversity of grizzly bear foods than the Snake River. This was likely because there was more moisture, but also because the valley was much wider so there was more valley bottom and floodplain habitat.

Overall, my impression was that the Bonnet Plume River Valley was more productive for grizzly bears than the Snake River Valley, but that it was still in the middle range for Yukon watersheds.

MacHutchon, A.G. 1998. Grizzly bear habitat assessment, Fishing Branch River region, Yukon. Yukon Department of Renewable Resources, Whitehorse. 28 pp.

A habitat assessment was conducted in the region of the Fishing Branch River, Yukon to evaluate the suitability of habitats surrounding Bear Cave Mountain to support grizzly *bears (Ursus arctos)* during spring, summer and early fall. The relative suitability of habitats was assessed during detailed plots that recorded vegetation and site characteristics and the relative distribution and abundance of habitats was assessed during aerial reconnaissance surveys.

The assignment of grizzly bear habitat value focused on vegetation communities within 10 satellite landcover classes described for the area. The relative distribution of high and medium value vegetation communities and landcover classes in the Fishing Branch River region was used to make some recommendations toward a habitat protected area boundary that would encompass enough spring, summer, and early fall habitat to support a grizzly bear population throughout the year.

11. MacHutchon, A.G. In press. Grizzly bear activity budget and pattern in the Firth River valley. Ursus 12:000-000.

I determined the activity of 5 radio-collared grizzly bears (*Ursus arctos*) in the Firth River **Valley,** Iwavik National Park, Yukon, based on 574 hours of direct observation during 1994 and 1995. Radio-collared grizzly bears that were feeding primarily on caribou tended to spend less time feeding and more time traveling or resting than bears that were feeding primarily on plants. During most observation periods bears fed primarily on plants. All bears spent a similar amount of time active (mean 66%, range 59-81%) during which they were primarily feeding or foraging (mean 56%, range 48-62%). For most behaviors, there was no difference among seasons, however there was a difference for intraspecific behavior. Grizzly bear feeding bouts were longer in summer than fall or spring. In summer with 24 hours of daylight, grizzly bears tended to be most active in the evening and least active when the sun was lowest on the horizon. During fall, with increasing hours of darkness, grizzly bears were least active at night and had peaks of activity in the morning and evening. Grizzly bears in the Firth River Valley were not active more, relative to southern areas, to compensate for their short growing season despite having more hours of daylight and not being constrained by human disturbance. Bears appeared to meet their energy requirements in other ways; I suggest through protein and fat acquired from caribou, ground squirrels, and other small mammals. Grizzly bears in the Firth River Valley currently appear to be able to effectively exploit available resources, however further constraints on their ability to forage could have long-term implications. This highlights the need to carefully manage human activities in the north to minimize their impacts on bears or their food resources. Repeated disruptions have the potential to adversely affect the time available for the acquisition of necessary energy.

10. MacHutchon, A.G., and B.L. Smith. 1990. Ecology, status, and harvest of black bears (*Ursus americanus*) in the Yukon. Yukon Department of Renewable Resources, Fish and Wildlife Branch, Whitehorse. 117 pp.

This report is intended to provide a basis for the management of the black bear (*Ursus americanus*) in the Yukon Territory, Canada. Black bears are one of the least well understood large mammals in northern interior ecosystems. Information on the biology and population status of Yukon black bears has never been assembled, which has hampered effective management. In this report, information from a variety of sources has been drawn together so that inferences can be made regarding the capacity of Yukon bears to sustain a variety of human pressures.

Black bear management is becoming an increasingly important concern to the Yukon. Black bears' are emerging as an important recreational resource, but garbage conditioned black bears pose a substantial source of problems for residents and tourists. To date, black bears have been managed by default with the assumption that they can sustain current harvest pressure. Available evidence suggests black bears are under-utilized as a game species in most areas of the Yukon, however, in some areas they are receiving considerable pressure from human caused mortality.

Compulsory reporting of black bear kills since 1979 and two ecological studies have provided an information base from which we can consider management of Yukon black bears that is consistent with the Yukon Conservation Strategy and the goals and objectives of the Yukon Fish and Wildlife Branch.

This report is divided into nine sections. First we review available information on the biology of northern interior black bears. Our review is largely based on short term investigations of black bear ecology in the Pelly River and in the Dezadeash Range near Haines Junction, analysis of age and sex specific trends in the black bear sport harvest and studies of black bears in adjacent jurisdictions. The main concern about our knowledge of Yukon black bear biology is the lack of information with which to make realistic estimates of abundance and, therefore, sustainable yield.

Second, we consider the black bear sport harvest; general trends and regional distribution. Our review of the sport harvest is based on information submitted by hunters between 1979 and 1986 through a compulsory reporting program (Yukon Biological Submission). Management concerns about the sport harvest focus on the localized heavy harvest around some settlement areas.

Third, we summarize our knowledge of problem black bears in the Yukon, including general patterns and regional distribution. Information for this section comes from records of problem bear complaints submitted to Yukon conservation officers between 1979 and 1986. Problem black bear management concerns focus on the need for improvements in solid waste management and public attitudes.

Fourth, we examine the harvest of black bears by licenced trappers. Information for this analysis comes from a fur export data collection system initiated in 1976. Black bear harvest by trappers is not well understood, therefore there is need for a more comprehensive data collection system.

Fifth, we look at the native subsistence harvest. Native subsistence hunters are not required to report their kill, but a voluntary program was initiated in 1987 to begin collecting data on native harvest (Quock 1987). Greater native involvement in the development of black bear management programs is required.

Sixth, we consider patterns in, and management of, black bear predation on important moose populations in the southern Yukon. Predation by black bears and grizzly bears is an important concern for ungulate management.

Seventh, we summarize and evaluate the combined effect of all human caused mortality on black bears in different areas of the Yukon. There is concern that unreported mortality combined with known mortality is adversely affecting populations in some areas..

Eighth, we examine the utility of managing black bears for non-consumptive use. Wildlife viewing plays an important role in attracting tourists to the Yukon and opportunities to observe and learn about wildlife will be important in maintaining a secure future for Yukon wildlife.

In the ninth section we provide management recommendations to meet the management concerns identified in the preceding sections of the report. Strategies to implement these management recommendations will be addressed in a separate management plan.

Macmillan, S. 1992. Operational bear management plan, Western Arctic District.. Canadian Parks Service, Inuvik. PGR 92-1/NY. 36 pp.

Abstract or summary not available.

McCann, R.K. 1993. Kluane National Park grizzly bear research project: year-end report-1992. Parks Canada, Kluane National Park and Reserve, Haines Junction. 20 pp.

Abstract or summary not present.

McCann, R.K. 1994. Kluane National Park grizzly bear research project: year-end report-1993. Parks Canada, Kluane National Park and Reserve, Haines Junction. 43 pp.

Abstract or summary not present.

McCann, R.K. 1996. Kluane National Park grizzly bear research project: year-end report-1994. Parks Canada, Kluane National Park and Reserve, Haines Junction. 83 pp.

Abstract or summary not included here.

McCann, R.K. 1997. Kluane National Park grizzly bear research project: year-end report-1996. Parks Canada, Kluane National Park and Reserve, Haines Junction. 76 pp.

Abstract or summary not included here.

McCann, R.K. 1998. Kluane National Park grizzly bear research project. Interim final report to accompany the project review, October 21 & 22, 1998. Parks Canada, Kluane National Park and Reserve, Haines Junction. 128 pp.

Between 1992 and 1997 Parks Canada and the Centre for Applied Conservation Biology at the University of British Columbia conducted field research into the ecology and viability of grizzly bears (*Ursus arctos*) in Kluane National Park and Reserve (KNPR), Yukon. This formal cooperative project greatly expanded a preceding research effort by Parks Canada commenced in 1989. The KNPR Grizzly Bear Research Project was guided by an approved study design (Wielgus et al. 1992) and a steering committee of Parks Canada personnel, recognized grizzly bear researchers from Canada and the United States, and representatives of Yukon Territorial and British Columbia Provincial governments.

Briefly, the project's objectives were to document baseline ecological parameters (movements, distribution, home ranges, habitat use, food habits, activities, population dynamics and denning ecology) of the grizzly bear population. The project also sought to identify, and recommend mitigating measures for, any negative impacts on the bear population resulting from increased access into Kluane or due to the activities of peripheral jurisdictions.

This report is an interim summary of the Project's findings and covers specific issues to be addressed in the Project Review to be held October 21 & 22 in Haines Junction, Yukon. Several sections are not complete due to time limitations or outstanding data. Additionally, some appendices have been omitted pending the final version of this report. However, a complete Table of Contents detailing the outline of the final report and several tables and figures from uncompleted sections are provided. In its final form, this report will serve as the primary documentation of the Research Project's activities and methodology. Some descriptions of methods and technology are therefore presented at length. A document detailing grizzly bear management recommendations for the Kluane ecosystem, in a format compatible with the needs of land managers, will eventually accompany this report.

Between 1989 and 1997, 61 individual grizzly bears (29 males, 32 females) were captured and radio-collared with 57 initially captured in Kluane National Park, two captured in the Kluane Wildlife Sanctuary, and two captured at the Haines Junction garbage dump. The number of bears radio-collared simultaneously varied greatly within and between years, but since 1992 generally ranged between 18 and 27 bear. Throughout 1997, the Project gradually shifted emphasis towards a long-term monitoring program directed at population dynamics. This resulted in both a reduction in the number of radio-collared bears (13 bears remained radio-collared at the end of 1997) and a shift in the sex ratio of radio-collared bears toward females (12 females, 1 male).

Multiple handling of individuals (31 bears were captured more than once) to replace radio-collars resulted in the project conducting a total of 111 captures. At time of capture we marked bears to permit subsequent identification of individuals and collected data pertaining to morphological and physical characteristics (e.g., cranial measurements, body length, weight and condition), age, and genetic variability.

In total, we monitored 47 grizzly bears as cubs-of-the-year, 18 as yearlings, 29 as subadults (10 males, 10 females', nine unknown), and 50 as adults (23 males, 27 females) representing 111 unique individuals. We collected 2,913 relocations by aerial monitoring and an additional 821 relocations by remote means (satellite and GPS collars). We used relocation data to document home ranges, movements, elevational distribution and dispersal of grizzly bears. As a by-product of aerial monitoring we collected data pertaining to habitat use, denning ecology, survival, litter size, interbirth intervals and age of first reproduction. To document food habits, we collected 1,377 bear scats for analysis of food types. We also documented all known and suspected mortalities of grizzly bears in Kluane National Park and peripheral jurisdictions between 1992 and 1997 to assess the extent and causes of mortalities.

Based on the gender of 60 grizzly bears captured between 1989 and 1996, we estimated that the sex ratio of the population was not significantly different from equality (e.g., 50:50 sex ratio). The age-sex composition of the population at time of den exit was estimated annually for the years 1993 through 1997. We averaged annual estimates of the population's composition, corrected for an equal sex ratio among adults, to arrive at a mean composition of 19.4% cubs-of-year, 5.2% yearlings, 14.7% subadults, 30.3% adult males, and 30.3% adult females.

We bounded the initial capture locations of 56 grizzly bears captured in fulfilling Project objectives to define a core study area of 2,384 km^2. In contrast, aerial monitoring had to be conducted over an area of 13,624 km^2 in order to track movements of bears from the core area. Dispersal movements by subadult male grizzly bears added greatly to the total monitoring area. Adult male and female composite home ranges of 11,43 1 km^2 and 5,208 km^2 were estimated by pooling all aerial relocation data for adult males and females, respectively. We documented the use of five different major land jurisdictions by adult females.

For bears monitored from den exit in the spring to den entry in the fall weighted mean annual home range sizes were 1003 km^2 for adult males (n=9), 122 km^2 for adult females (n=54), 1281 km^2 for subadult males (n=4), and 153 km^2 for subadult females (n=6). On average, the multi-annual home range of males utilized annual home ranges 8.2 times as large as those of adult females. Multi-annual home ranges, which provide a better estimate of lifetime spatial requirements for grizzly bears were much larger. On average, the multi-annual home range of males was 1602 km^2 (n=9) which was 5.2 times as large as the mean for females of 305 km^2 (n=19). Multi-annual home ranges suggest that, on average, males utilize an area equivalent to at least 40% of the available habitat in Kluane National Park. We also assessed home range estimates for two adult females based on aerial relocation data and Geographic Positioning System (GPS) radio-collars. Home ranges estimated from GPS collar data were 2.3 and 1.6 times as large as those estimated from aerial relocation data.

To document transboundary movements by individual bears we classified each aerial location (n=2,857) of all independent radio-collared bears into one of five land jurisdictions. Fifty-seven percent of males and 30% of females used at least one land jurisdiction in addition to the Park, however, no individual was found to use more than three jurisdictions. Movements outside the Park boundaries were strongly associated with human-cased mortality with 28% of transboundary bears known, or suspected, of been killed by humans.

Analysis of the elevational distribution of grizzly bears by gender and reproductive status indicates that low elevation habitats are used extensively by males throughout the active season, and by females without cubs-of-the-year during July and August. Peak use of low elevation habitats and utilization of forage crops that grow on floodplains and river terraces coincides with the peak of rafting activity on the Alsek River. The potential for both bear-human conflicts and the disruption of foraging activities by bears has been identified as an area of management concern. Possible avoidance of males by females, particularly females with new cubs, also suggests that high elevation habitats are important for the security of family groups.

Information on food habits of bears was obtained primarily through the collection and analysis of scats. To document seasonal food habits we analyzed data on a biweekly basis for mid-May through mid-October, accepting only scats estimated to be ≤ four weeks old (n=547). Food types were combined into six different categories similar to those used by other researchers. From mid-May through to the end of July, *Equisetum* species were heavily and consistently utilized by bears. The use of other flora (primarily *Salix* catkins *in* May and *Oxytrupis* flowers in June) progressively increased in importance through to the end of June and then gradually declined while over-wintered berries and root crops (*Hedysarum*) showed gradual declines in utilization from May through to the end of June. The use of ungulates was highest in early June with 15% of scats containing ungulate remains. The use of berries increased in late July as *Shepherdia canadensis* crops ripened and berries dominated the diet through August and September while root crops gradually increased in importance and use of *Equisetum* became negligible. Roots dominated the diet in early October with secondary berry species *(Eleagnus commutata* and *Empetrum nigrum)* replacing use of *Shepherdia.*

We estimated an age of first reproduction of 8.1 years based on five observed first parturitions, one probable first parturition, and one estimated age of first parturition. Radio-collared females produced a total of 57 cubs-of-the-year in 29 litters for a mean litter size of 1.97 cubs per litter. We documented nine interbirth intervals, however, eight intervals were truncated by complete losses of new litters. We also estimated interbirth intervals for an additional seven radio-collared females. All interbirth intervals (n=16) were averaged to arrive at an estimated interval of 2.75 years. We combined mean litter size and mean interbirth interval under the assumption of a 50:50 sex ratio at birth to estimate that females produced an average of 0.358 female cubs per year.

Between 1992 and 1997, 70 confirmed and 25 assumed mortalities (22 cubs-of-the-year, three yearlings) of grizzly bears were recorded in or on the periphery of the Park. Males represented 49%, females 19% and unknown gender 32% of mortalities. Natural and suspected natural mortalities (34%) and control kills (34%) constituted the majority of deaths, followed by harvest (27%), poaching or suspected poaching (3%) and unknown cause (2%).

Since 1989, 10 radio-collared bears have died including four adult females, two subadult females, two adult males, and two subadult males. Two males were control kills by citizens, one male was a suspected poaching, and one male died of apparent natural causes. All mortalities of radio-collared females were apparently due to natural causes. We also documented a total of 27 suspected mortalities of cubs-of the-year and three yearlings accompanying radio-collared females since 1989.

Based on 171.4 bear years of monitoring on radio-collared bears we estimated annual survival rates of 0.947 for adult males, 0.948 for adult females, 0.859 for subadult males, 0.823 for subadult females, 0.757 for yearlings and 0.252 for cubs-of-the-year. We also calculated an alternative binomial survival rate for cubs-of-the-year of 0.410. Annual survival rates for new cubs in Kluane appear to be the lowest reported in the literature.

We calculated a point estimate of the population's rate of increase by iterating Lotka's equation using parameter inputs representing the female component of the population. Under our assumption that females are fecund until the age of 27 we estimated a finite rate of increase of 0.967 indicating a population decline of approximately 3% per annum. Reducing the age of fecundity to 20 years of fecundity to 20 years of age to generate an estimate comparable to other published rates of increase for grizzly bears resulted in a finite rate of increase of 0.942.

In 1996, the Research Project conducted an experimental population census based on genetic mark-recapture techniques. We partitioned an 800 km^2 subset of the core study area into 32 cells, each 25 km^2, and deployed hair traps in each cell. Each hair trap was composed of a barbed wire perimeter placed about an attractive scent. The scent attracted bears to the site and the barbed wire collected genetic samples by snagging follicle-bearing hairs from bears as they investigated the scent. We conducted a total of 1,246 trap nights over four sampling periods and collected 646 hair samples from traps. A total of 341 (53%) hair samples were submitted for genetic analysis based on the presence of follicles of which 103 were determined to be from grizzly bears. A preliminary assessment of the success of marking and recapturing bears indicated that only three bears were recaptured after initial marking in previous sampling sessions. Data are currently being analyzed with respect to determining a minimum count of grizzly bears that used the grid during the census period, Pending receipt of the genotype of all radio-collared grizzly bears known to have used the grid during the census period we currently estimate a minimum of 22 individuals in the grid.

McCormick, J.E. 1999. A food-based habitat-selection model for grizzly bears in Kluane National Park, Yukon. M.S. **Thesis, University of British Columbia, Vancouver. 50 pp.**

I examined the relationship between plant food abundance and diet, and habitat selection by grizzly bears (*Ursus arctos*) in the Alsek River Valley, Kluane National Park (KNP) in 1995 and 1996. I built a simple model that combined how much food was present in each bear habitat type (BHT) with how prevalent that food was in the diet of grizzly bears to produce a habitat food value (HFV) for each BHT. I tested the effectiveness of the model using habitat selection data from radio-collared grizzly bears.

I designed this model to make a priori predictions of selection of BHTs by grizzly bears. The model combined the relative food abundance from each BHT with the respective seasonal food values to produce a HFV for each BHT. I calculated the relative abundance of 10 grizzly bear plant foods within 8 BHTs from 478 food abundance plots. Diet was inferred from an analysis of scats collected in KNP. Four dietary seasons were distinguished based on shifts in plant foods eaten. I calculated a food value by dietary season for each plant food based on relative consumption of that food within that season.

BHTs were ranked by HFV within each season and those ranks represented predicted habitat selection by grizzly bears.

I tested the utility of this model by comparing actual habitat selection with the predictions of my model. Actual selection of BHTs by grizzly bears was measured from aerial locations (n=365) of radio-collared grizzly bears and then ranked within each dietary season. I compared the ranks of actual habitat selection (grizzly bear telemetry locations) to the ranks of predicted habitat selection (HFVs). HFVs were successful predictors of grizzly bear habitat selection.

This simple food-based model may be used by Park managers to minimise human disturbance of grizzly bears in the Alsek valley by restricting human activity in areas of high grizzly bear food value.

McLellan, B.N. 1990. Relationships between human industrial activities and grizzly bears. International Conference on Bear Research and Management 8:57-64.

Most grizzly bears (Ursus arctos) live outside parks and reserves and often have to contend with, among other things, resource extraction industries. These activities can affect individual bears and therefore populations by: 1) causing strong, energetically expensive reactions by bears that disrupt their normal behaviour, 2) displacing bears from areas of human use, 3) altering habitats in which bears live, 4) disrupting the bears' social system, and 5) industrial personnel killing bears or increasing mortality rates indirectly by improving access for hunters, poachers, other resource users, and settlers. Grizzly bears are able to adapt to many habitat changes and a temporary increase of human presence. In most cases, increased motorized access that results in a long term increase of human activity and/or settlement with consequent increase in bears being shot is the most significant aspect of industrial developments. If an industrial activity is conducted with adequate guidelines to maintain important habitats, properly locate camps, incinerate garbage, restrict use of firearms, and close motorized access after the job is complete, the bear population probably will be maintained at a satisfactory level. Although many bears may be alive when an industry has completed its work, if access remains intact, the grizzly population is placed in a precarious position and may decrease in size and eventually be extirpated. Closing access after job completion is often physically and politically difficult. Industry personnel and government managers must take leading roles in planning, advertising, and implementing road closures. Cumulative effects models have been built to predict the impact of human activities on bear populations. These models are in early stages and require data to support the coefficients used and the relationships between coefficients. Then they should be tested. One significant variable the models lack is the potential for a specific activity to be the seed for blooming additional and perhaps more harmful developments.

McLellan, B.N. 1994. Density-dependent population regulation of brown bears. Pages 15-24 in **M. Taylor, ed. Density-dependent population regulation in black,**

brown, and polar bears. International Conference on Bear Research and Management. Monograph Series No. 3.

Only a few areas had unhunted brown bear populations that were likely near carrying capacity. These few (i.e., Admiralty Island, McNeil River State Game Sanctuary, and the **northern** Yukon) gave some indication that density-dependent effects may have been operating. Bears on Admiralty Island and the northern Yukon appeared to have reduced reproduction, and in particular, long inter-litter intervals. Bears at McNeil River also had long inter-litter intervals. but it was subadult dispersal that was suggested to be the mechanism of regulation. Factors affecting the dynamics of brown bears populations appear complex and we can only speculate on their relationships. Because overall densities among areas vary greatly and appear to be related to food productivity, food is likely the ultimate regulating factor. However, in most systems, bear consumption does not appear to reduce food biomass to a level where foraging efficiency is impaired. In systems where food is clumped, foraging efficiency is likely impaired at high densities by social behavior causing displacement from feeding sites, increased vigilance, and increased energy expenditure due to social stress. Intraspecific killing also appears important, particularly where there is little security and escape cover. In systems where food is more evenly distributed, food depletion at high densities may be more significant. Although much has been published on reproductive rates and more has recently been reported on mortality rates, almost nothing has been published on dispersal. Because food production and distribution appear to interact with social behaviour as regulating factors, a social "fence effect", as described for some small mammals may operate. In such as scenario, brown bear populations would be regulated at one level by socially-induced dispersal In such as scenario reproduction and survivorship may be high in the core area and reduced or zero at surrounding "population sinks". Alternatively there a higher equilibrium density may occur where dispersal opportunities are limited because of high densities over a large area or by geography. In such an area recruitment and\or survival will be reduced in the core area. These hypothesis of the biological mechanism for density-dependent population regulation are not mutually exclusive or conclusively demonstrated for any population. The prudent manager should not assume that a reduction in density will cause an increase in the recruitment or survival of a given brown bear population, especially one that is already harvested. Understanding the mechanism of density-dependent population regulation in a brown bears population will require 'mtensive monitoring and a long term research effort. These efforts will have to repeated in different geographic areas before the generality of the conclusion are apparent.

23. McLellan, B., and V. Banci. 1999. Status and management of the brown bear in Canada. Pages 46-54 *in* C. Servheen, S. Herrero and B. Peyton, compilers. Bears: status survey and conservation action plan. IUCN, Gland, Switzerland and Cambridge, UK.

Abstract or summary not present.

12. McLoughlin, P.D., F. Messier, R.L. Case, R.J. Gau, R. Mulders, and H.D. Cluff. 1999. The spatial organization and habitat selection patterns of barren-ground

grizzly bears (*Ursus arctos*) in the Northwest Territories and Nunavut: final report to the West Kitikmeot/ Slave Study Society. University of Saskatchewan, Saskatoon. 89 pp.

The main objective of this research project was to study the spatial organization and habitat selection patterns of barren-ground grizzly bears (*Ursus arctos*) inhabiting the low Arctic tundra of mainland Nunavut and the Northwest Territories, Canada. Specifically, this project focused on the population delineation, important habitats, movement patterns, denning habits, and spatial range of mining impacts on grizzly bears. To meet the study goals, an extensive satellite telemetry programme was conducted in a study area of approximately 200,000 km^2, centered 400 km northeast of the city of Yellowknife, Northwest Territories.

From May 1995 to June 1999, we captured 264 barren-ground grizzly bears. Of the total number of captures, 152 different bears were identified. Of these 152 individuals, 39 were adult females and 36 were adult males. Among subadults (aged three to four years), 12 were females and 10 were males. We marked 30 cubs-of-the-year (16 female, 14 male), 16 yearling cubs (eight females, eight males), and nine two-year-old cubs (three females, six males). We placed 89 satellite radio-collars on 81 (n=42 females, n=39 males). For 23 bears (mostly females), break-away VHF radio-collars were fitted after satellite collars were removed.

Three populations of grizzly bears were identified in the study area using multivariate cluster analysis of movement data and home range analysis. We obtained independent clustering solutions that grouped both female and male grizzly bears into the North Slave, Bathurst Inlet, and Kugluktuk regions of the study area. Although female population ranges were completely contained within established population unit boundaries, male population ranges demonstrated overlap within boundaries. High exchange among populations for both females and males suggest that populations cannot be managed independently from one another.

We examined habitat selection first at the level of the home range. Here, habitat use was determined by the proportional availability of habitat types contained within the home range of the animal and habitat availability was determined by the proportion of habitat types in the entire study area. Selection analysis indicated that there was no significant difference between the sexes with regard to habitat selection patterns (Wilk's Lambda Approx. $F_{11,11}$ = 1.27, P = 0.37). That is, both males and females were practicing the same selection patterns when deciding where to place their home ranges in the study area. The general pattern was for bears to possess home ranges, relative to the study area, that contained preferential amounts of esker habitat, tussock/hummock successional tundra, lichen veneer, birch seep, and tall shrub riparian areas over other habitat types.

We also examined habitat selection at a finer level of selection, whereby habitat use was determined from individual satellite telemetry locations and compared to the availability of habitats within readily accessible portions of the home ranges of individual animals. Selection patterns at this scale indicated that there were significant differences in habitat selection among sexes (Wilk's Lambda Approx. $F_{10, 201}$ = 2.45, P = 0.009), seasons (Wilk's Lambda Approx. $F_{30, 591}$ = 2.75, P c 0.001), and for an interaction between sex and season (Wilk's Lambda Approx. $F_{30, 591}$ = 1.39, P = 0.08). That is, habitat selection differed for males and females, and the extent of these differences were dependent upon the season of the year. Overall, esker habitat was the most preferred habitat type for females throughout the year. In addition, riparian tall shrub and birch seep habitat were generally highly ranked by females. Tall shrub habitat was also important to males, as was esker and tussock/hummock successional tundra at varying times during the year.

Annual ranges of radio-tracked animals (238 locations per year) were estimated using 95% fixed kernel technique. The mean annual home range for adult males was 6,685 km^2 (SE = 1,351, n = 19), which was significantly larger than for females (mean = 2,074 km^2, SE = 335, n = 35). There was no difference in the annual ranges among females of differing family status. Because of smaller sample sizes, seasonal ranges were estimated using the 95% minimum convex polygon technique. There was a significant difference between the sexes with regard to the size of seasonal ranges. In addition, females possessed ranges that varied among seasons, increasing in size from spring to summer and decreasing in size from summer to autumn. Seasonal rates of movement (calculated from sraight-line distances between successive locations) were significantly higher for males than for females. Both sexes decreased movement rates from their highest rates in spring (males) and summer (females) to their lowest rates in autumn. Annual and seasonal ranges are the largest ranges reported for grizzly bears in North America. Large ranges may put individual bears in contact with humans even when developments are tens or even hundreds of kilometers from the core of the home range of the animal.

Bears entirely avoided denning in five of the 12 major habitat types available to them (wetlands, tussock/hummock successional tundra, lichen veneer, boulder fields and exposed bedrock). Esker habitats, which previously had been regarded as a major denning habitat for barren-ground grizzly bears, accounted for seven of 56 den sites. The remainder of the dens were located in typical heath tundra habitat (23/56), tall shrub riparian habitat (3/56), birch seep (5/56), spruce forest (5/56), heath tundra habitat with >30% boulder content (1 1/56), and heath tundra habitat with >30% bedrock content (1/56). One further den was located in a non-vegetated sand embankment adjacent to the Hood River. Compared to the proportional availability of habitat types in the study area, the selection of denning habitat by bears was determined to be significantly different from random (chi-squared = 381.6, df 11, P < 0.0001).

All dens were located on well-drained slopes (mean = 25.3°, SE = 1.2, n = 55). Choice of den aspect was decidedly non-random (chi-squared = 12.4, df 3, P< O.Ol), with the majority of dens facing south (25/56), followed by west (13/56), east (10/56), and north (8/56). Almost all dens were constructed under the cover of tall shrub (>0.5 m) species (*Betula glandulosa* and *Salix* spp.), the root structures of which likely support the ceilings of dens. Most dens contained substantial amounts of bedding material, which was observed to be gathered by bears prior to den entrance. Bedding material was almost exclusively composed of mats of crowberry (*Empetrum nigrum*). The majority of bears emerged from their dens in the first week of May. Den entrance occurred primarily in the last two weeks of October.

12. McLoughlin, P.D., R.L. Case, R.J. Gau, S.H. Ferguson, and F. Messier. In press. Annual and seasonal movement patterns of barren-ground grizzly bears in the central Northwest Territories. Ursus 12:000-000.

Between May 1995 and September 1997, we equipped 64 barren-ground grizzly bears (*Ursus arctos*) with satellite radiocollars within a study area of 190,000 km^2, centered 400 km northeast of Yellowknife, Northwest Territories. We estimated annual ranges of radiotracked animals (≥38 locations/ year) using the 95% fixed kernel technique with least squares cross-validating to determine bandwidths. The mean annual range for adult males (mean=6,685 km^2, SE=1,351, n=19) was larger ($P<0.001$) than for females (mean=2,074, SE=335, n=35). There was no difference ($P=0.42$) in the annual ranges among females of differing family status. Seasonal rates of movement, calculated from straight-line distances between successive locations, were higher for males than for females ($P<0.001$). Both sexes decreased movement rates from their highest rates in spring (males) and summer (females) to lowest rates in autumn, which likely results from increased food availability as the year progresses. Annual ranges presented here are the largest ranges reported for grizzly bears in North America. Low primary productivity on the barrens may explain why the annual ranges of barren-ground grizzly bears are larger than the ranges of other grizzly bear populations.

McLoughlin, P.D., S.H. Ferguson, and F. Messier. Submitted. Intraspecific variation in home range overlap with habitat quality: a comparison among brown bear populations. Evolutionary Ecology OO:OOO-000.

We develop a conceptual model of spatial organization based upon changes in home range overlap with habitat quality. We test the model using estimates of annual home ranges of adult females and densities for 30 populations of brown bears (*Ursus arctos*) in North America. We used seasonality as a surrogate of habitat quality, measured as the coefficient of variation among monthly actual evapotranspiration values for areas in which study populations were located. We calculated home range overlap for each population as the product of the average home range size for adult females and the estimated population density of adult females. Home range size varied positively with seasonality; however, home range overlap varied with seasonality in a nonlinear manner. Areas of low and high seasonality found brown bears with low home range overlap. These results are consistent with behavioural theory predicting a nonlinear relationship between food availability and territoriality.

Miller, S.D. 1987. Susitna hydroelectric project final report. Big game studies: Volume VI - black bear and brown bear. Alaska Department of Fish and Game, Anchorage. 276 pp.

Abstract or summary not available.

Miller, S.D. 1990a. Detection of differences in brown bear density and population composition caused by hunting. International Conference on Bear Research and Management 8:393-404.

Liberalized hunting regulations in a portion of southcentral Alaska resulted in an increased sport harvest of brown bears (*Ursus arctos*). A reduction in population density caused by increased hunter harvest was demonstrated using modified capture-recapture techniques. Density differences were documented between 2 areas of generally equivalent habitats but different patterns of hunter access as well as in the same area at 2 different times. Density estimates (for bears >2.0-years-old) were 6.7 bears/l ,000 km^2 (95% CI=5.2-10.1) in the intensively hunted area compared to 10.5 (95% CI=6.0-25.7) in the same area 8 years earlier, and 19.1 (95% CI=16.7-23.2) in the less intensively hunted area. The total population density estimate was 10.5 1 bears/1000 km^2 in the intensively hunted area. Males constituted a smaller proportion of the population in the heavily hunted area compared to the less intensively hunted area and to the same area studied prior to the onset of increased hunting pressure. There were relatively more younger males and more older females in the heavily hunted population.

Miller, S.D. 1990b. Impact of increased bear hunting on survivorship of young bears. Wildlife Society Bulletin 18:462-467.

Abstract or summary not available.

Miller, S.D. 1990c. Impact of increased hunting pressure on the density structure, and dynamics of brown bear populations in Alaska's Game Management Unit 13. Project W-23-2, Study 4.21. Alaska Department of Fish and Game, Juneau. 48 pp.

Abstract or summary not available.

Miller, S.D. 1990d. Population management of bears in North America. International Conference on Bear Research and Management 8:357-373.

Population management for black bears (*Ursus americanus*), brown-grizzly bears (U. *ārctos*) and polar *bears* (*U. maritimus*) in North America is reviewed. In different areas bear populations are managed to achieve goals of population control, conservation, or sustained yield. Most North American bears are managed for sustained yields and this topic is emphasized. The consequence of error in population management is high as bears reproduce slowly and reduced populations will require many years to recover. Simulation results where reproductive rates were generous, natural mortality rates were low, and harvests were 75% of maximum sustainable rates indicated that populations reduced by half will require >40 years to recover for brown (grizzly) bears and >17 years for black bears. Under optimal conditions for reproduction, natural mortality, and with males twice as vulnerable as females, maximal sustainable hunting mortality was estimated at 5.7% of total population for grizzly bears and 14.2% for black bears. In recent decades, all 3 species have obtained the status as game animals in most jurisdictions and management for control objectives is increasingly uncommon. Management for conservation requires primary emphasis on habitat protection and on minimizing mortalities from any source. Managers of hunted bear populations use information from hunters, from sex and age composition of killed bears, from research programs, and from computer simulation studies. Non-critical uses of data from any of these sources may lead to management error. Data on age-at-harvest is especially prone to misinterpretation. Techniques used to limit harvests by managers of hunted bear populations are reviewed. The primary constraints facing bear population management derive from inadequate habitat protection, political pressures, technological limitations, and inadequate financial support for management.

Miller, S.D. 1990e. Denning ecology of brown bears in south-central Alaska and comparisons with a sympatric black bear population. International Conference on Bear Research and Management 8:279-288.

Brown bears (*Ursus arctos*) in southcentral Alaska spent an average of 201 days in winter dens. Males spent the least time in dens (mean = 189 days) and parturient females the most (mean = 217 days). Females with cubs of the year and females pregnant at den entry spent the least amount of time out of dens (158 and 164 days, respectively) and males the most (180 days). No difference in den entrance date based on sex or reproductive status was observed. Mean den entrance date was 14 October. Entrance date differed between years, early entrance appeared associated with berry crop failures and colder weather. Mean date of exit from dens was earliest for males (23 April) and latest for females with newborn cubs (15 May). Exit dates also varied between years with late exits correlated with colder weather and persistent snow cover.

Dens used by brown bears in this area were excavated, no unmodified natural cavities were used. These dens collapsed during spring and summer precluding reuse. Some individuals dug dens in the same general area from year to year; mean distance between den sites used in successive years by all bears was 6.1 km. Characteristics of den sites and sixes are described. Typically dens were dug at higher elevations and on the periphery of home ranges used during summer and fall. Upon exit, most bears moved to lower elevations but females with newborn cubs tended to remain in the vicinity of den sites. Available data suggest this behavior reduces loss of newborn cubs to predation by other bears.

Compared to a sympatric population of black bears (*Ursus americanus*), brown bears denned at higher elevations, spent less time in dens, and entered dens earlier. Den exit dates were similar. Dimensions of brown bear dens were not significantly larger than excavated black bear dens and mean date of emergence from dens was about the same. A proposed hydroelectric project in this study area would likely have reduced black bear populations through impacts on black bear denning habitat. The project would have had only indirect impacts on brown bear denning habitats.

Miller, S.D. 1993a. Impacts of increased hunting pressure on the density, structure, and dynamics of brown bear populations in Alaska's Game Management Unit 115.

Final report. Projects W-22-6, W-23-1, W-23-2, W-23-3, W-23-4 and W-23-5; Study 4.21. Alaska Department of Fish and Game, Juneau. 182 pp.

During 1980-1990, brown bear (*Ursus arctos*) harvest regulations in Game Management Unit (GMU) 13 were designed to cause declines in brown bear density through harvesting in excess of sustainable levels. Primary management emphasis in this area was to produce moose (*Alces alces*) and caribou (*Rangifer tarandus*) rather than carnivores. Early predator-prey studies on the GMU 13 moose population, conducted after the population was depleted by severe winters and other factors, suggested that reduced bear numbers could result in increased moose calf recruitment and faster recovery of moose populations. These findings led to liberalized bear hunting regulations, increased harvests, and measured reductions in bear density. A season restriction designed to prevent further decline in bear numbers was initiated in 1990. However, current seasons remain more liberal and current harvests remain higher than prior to 1980. During the 1980s, annual reported harvests averaged 101 bears compared to 57 in the 1970s and 39 in the 1960s.

The current study was designed to document change in bear density in GMU 13 and evaluate the bear population's response to increased hunting pressure. This was accomplished by conducting a density estimate in 1987 and comparing it with a 1979 estimate from the same heavily hunted area of the upper Susitna River Valley (UPSU), and comparing these with a 1985 estimate in a nearby area on the middle Susitna River (MIDSU) where there was thought to be less bear hunting.

In the UPSU study area along the Denali Highway, estimated bear density was reduced by 43% between 1979 and 1987, down from 10.5 (1979) to 6.0 bears $\geq$ 2 years old/1000 km^2 (1987). The 1987 density estimate in the UPSU area was significantly lower than in the more lightly-hunted MIDSU area in 1985 (19.1 bears $\geq$ 2 years old/1000 km^2) ($P=0.04$). In the heavily-hunted UPSU area, the sex-ratio of the population (25 years old) changed from approximately 100 to 38 males/100 females between 1979 and 1987. In the more remote MIDSU area there were 77 males/l00 females in the population of bears $\geq$ 5 years old in 1985. Mean and median age of males in the population declined along with population density. Mean age of males (22 years old) was 10.5, 7.1, and 4.1 in MIDSU (1985), UPSU (1979), and UPSU (1987) studies, respectively.

Sex and age composition harvests were examined to detect trends associated with measured density changes. Data in these analyses were restricted to fall seasons which were considered more representative of the population; the data excluded kills from Subunit 13D where harvests were thought not to exceed sustainable levels by as much as in other subunits. The number and proportion of females in the harvest has increased in the kill of subadult, young adult, and old adult bears. During 1982-1988, the 3-year cumulative sex ratio for fall harvests was $\geq$60% females for bears >5 years old. This percentage declined during 1989-1991, perhaps in response to eliminating the early September hunting season in 1990. The proportion of young bears in the fall harvests has increased, especially for male bears. Both mean and median age of harvested males has declined since the mid 1970s. These changes concur with expected effects of high harvest. No trend was evident in number of days hunted by successful hunters.

Brown bear populations were reconstructed based on reported harvests, estimated population size, and assuming a 5% sustainable harvest level. In order to bracket the probable population trend, two reconstructions were calculated. The first assumed that the estimated GMU 13 population (1228 bears) existed in 1980, before the increase in hunter harvests. The second reconstruction assumed that this population existed in 1987, after the period of largest reported harvests. Regardless of which scenario was used, these reconstructions indicated that harvests exceed sustainable levels in GMU 13 as a whole (where there has been a calculated 2348% population decline), in GMU 13-excluding Subunit 13D (16-66% decline), in Subunit 13A (16-52% decline), in subunit 13B (8-75% decline), and in Subunit 13E (2570% decline). In Subunit 13C the reconstruction suggested that the population declined (13-54%) but is now stable, in Subunit 13D the reconstructions suggested the population is now stable (5% decline to 7% increase).

Changes based on population reconstruction calculations were compared with the measured changes in population density in the UPSU area. The measured change indicated a 43% decline between 1979 and 1987 compared to a calculated decline in the reconstructed population of 42% during the same period in Subunit 13E where this study area occurs.

Available harvest data and population estimates were used to estimate what density and harvest rates would be required to sustain reported harvests. Based on an assumption that 5% of the population can be harvested without decline, the bear density would have to be 45 bears/1000 km^2 in GMU 13 (excluding Subunit 13D). This calculated required density is significantly higher than the highest recorded density for an interior grizzly population in Alaska (34 bears/1000 km^2 in Denali National Park [Dean 1987)). The sustainable harvest rate for GMU 13 (excluding Subunit 13D) would have to be 11.5% for the estimated population (857 bears) not to decline during the 1983-1986 period of peak harvests. The literature does not indicate that sustainable harvest rates for grizzly bears could be this high.

The 1988-1992 management objective for grizzly bears in GMU 13 was to maintain the bear population at existing, depleted, levels. To accomplish this, harvests would need to be reduced. Sustainable harvest levels were estimated using the midpoint of the two reconstructed scenarios as the existing population and assuming that harvests of 5% of this population is sustainable. Under these assumptions, seasons need to be reduced to permit harvests of 25 bears in GMU 13 (excluding Subunit 13D) at the following levels:

Subunit	Avg. taken last 2 years (1990-92)	Sustainable harvest levels
13A	13	8
13B	9.5	4
13c	5.5	4
13D	13+	19+

13E	36	10
Total GMU 13 (except 13D)	66	25

A conservative management strategy designed to assure that further reductions in bear populations do not occur, should reduce harvests below these levels in these subunits.

Analysis of moose calf survivorship measured by autumn calf:cow ratios during the period of bear reduction did not support the hypothesis that increased bear harvests during the 1980s resulted in increased moose calf survival (Miller and Ballard 1992).

Data were compiled on reproductive rates of radio-marked brown bears. Mean litter size was 2.1 newborns (range 1-4), 1.9 yearlings, and 1.8 two-year-olds. Mean age of first reproduction was 5.6 (range 4-9). Mean interval between weanings was 4.1 years; 58% of such intervals were 3 years; 21% were 4 years; and 21% were >4 years. Before 1987, all litters separated from their mothers at age 2 or younger.. Since 1987, there were six instances (185 of weanings) where females did not separate from offspring until they were 3 or 4 years old.

Although alternative explanations are possible, the change in age of weaning and weaning interval since 1987 may be a response to increased hunting pressure. If so, the observed increase in age at weaning represents the opposite population response to heavy hunting pressure than what has been usually suggested. Increased hunting may result in reduced productivity rather than increased productivity. Data collected during 198 1-1991 indicated no change in survivorship of newborn cubs associated with bear density declines in this study area ($P=0.42$). No changes in litter size were associated with the period of increased bear hunting and declining bear density ($P>0.28$).

The observed increase in age at weaning possibly resulted from breeding/conception failures associated with too few males remaining in the population to breed all estrous females. This change probably did not result from increased age of radio-marked females as 4 of the 6 cases of delayed weaning occurred for bears <15 years old. The conception failure theory was supported by data indicating that increasing numbers of females do not produce cubs on schedule from separation from 2-year-olds (31% before 1988 compare to 54% after) ($P=0.003$). There was also an increase in the proportion of the adult female population not accompanied by offspring (7.4% before 1987 compared to 21.5% subsequently). The theory-of breeding/conception failure was also supported by a decline in the frequency with which potentially breeding females were seen with males during the breeding season (42% of observations before 1988 compared to 24% subsequently) ($P=0.02$). It is not possible to demonstrate, with available data, that these observations are responses to increased hunting and harvests of the 1980s. However, these observations form an intriguing hypothesis that merits further study.

During its fall 1992 meeting, the Alaska Board of Game changed the management objectives for GMU 13 when it adopted a grizzly bear population objective to "reduce significantly" and a harvest objective of ">125". The Board made these changes to enhance hunter harvests of moose and caribou in GMU 13. Some residents and hunters in GMU 13 testified that the bear population in GMU 13 is increasing. They based these views on frequent observations of bears and on concerns about bear damage to rural recreational cabins. The Board will consider changes designed to implement these objectives during spring 1993.

Miller, S.D. 1993b. Brown bears in Alaska: a state wide management overview. Alaska Department of Fish and Game Wildlife Technical Bulletin 11. 40 pp.

The brown bear population in Alaska is estimated between 25,000 and 39,100 bears with a best estimate at 31,700. This 1993 estimate is lower than a similarly derived 1978 estimate, not because populations have declined, but because of improved information on bear densities derived from field studies. Brown bear numbers in Alaska have probably increased since the earlier estimate in response to more conservative hunting regulations on the Alaska Peninsula in effect since 1974. About 42% of the Alaska brown bear population occurs in low density populations (<40 bears/1,000 km^2) that cover about 84% of the state; 49% occurs in high density populations (>175 bears/1,000 km^2) that cover 8.6% of the state, and 9% in intermediate density populations that cover 7.3% of the state.

An average of about 1,100 bears/year are reported killed in Alaska. The number of brown bears killed by hunters is increasing. An unknown number of additional bears are killed and not reported or die from wounds. Much of the increase in bear harvests in recent years (60%) compared to a decade ago came from harvest increases in coastal Game Management Units 9, 4, 16, and 8. Thii resulted even though hunting regulations became more conservative in Unit 8, slightly more conservative in Unit 4, and were only slightly liberalized in Unit 9. This suggests an especially high interest in hunting large coastal brown bears compared to smaller interior "grizzly" bears. However, interior areas as well as some coastal areas (Units 26, 16, 14, 6, 22, and 21) showed the largest percentages of increases in harvests relative to the baseline period.

Widespread liberalizations of bear hunting regulations, especially in interior areas, contributed to increased harvests. Harvest yield expressed as reported bear kills/unit area was highest in Unit 8 (Kodiak area). For interior populations, the highest yield (kill density) was in Subunit 13E where populations are thought to be declining. Statewide, the apparent harvest rate (AHR = average annual reported kill/estimated population) was 3.4% (2.8-4.3%). I calculated AHRs in excess of 5% for Units 13, 16, 12, 8, 6, and 4. Additional areas might be included in this list if the number of bears living in areas closed to hunting were excluded from the population estimates. In Subunits 20A and 13E where field studies determined that populations were declining (Reynolds 1993, Miller 1993), AHRs were 5.3% (4.6-6.5%) and 21.6% (15.1-38.9%), respectively.

The number of Alaska brown bears killed by nonresident hunters increased over the last 3 decades while the number of bears killed by resident hunters has declined since 1985. The numbers of brown bear tags sold to residents and nonresidents remained constant in recent years. Success rate for purchasers of resident brown bear tags is about 7.6%

compared to 50.8% for purchasers of nonresident tags. Greater numbers of residents purchase tags but do not actively hunt bears. Statewide, successful hunters took an average of 5 days to a take a bear, slightly more for nonresidents than for residents. Between the highest and lowest game management units, there was a 2-3 fold range in number of bears hunted by successful hunters. Available technology for setting hunting quotas and detecting trends in bear numbers is inadequate for precise management of populations. This, along with low reproductive rates for brown bears, argues for conservative harvest management in most areas.

Miller, S.D. 1993c. Development of bear management techniques and procedures in southcentral Alaska. Progress Report. Project W-24-1, Study 4.24. Alaska Department of Fish and Game, Juneau. 40 pp.

Premarking was accomplished for 2 brown bear density estimates. We used capture-mark-resight (CMR) techniques for an estimate scheduled to be done in 1995. One estimate will be done by Alaska Department of Fish and Game (ADF&G) in Unit 13 and the other will be done in Unit 18 by the U.S. Fish and Wildlife Service (USFWS) with technical assistance from ADF&G. An evaluation of trends in harvest data in Subunit 13E, where bear numbers are thought to be declining as a consequence of intentional harvests in excess of sustainable levels, illustrated clear trends in some parameters (especially sex ratio in kill). These trends have reversed in recent years even though harvest levels remained high. This analysis illustrated the problems associated with reliance on sex and age composition of harvest data to identify critical thresholds in harvested bear populations. A manuscript "Brown bears in Alaska" was prepared and submitted as a Chapter in the *Bear Action Plan* under preparation by the International Union for the Conservation of Nature and Natural Resources. An estimate of brown bear abundance in each Alaskan Game Management Unit was compiled with the assistance of ADF&G area and research biologists. The estimated number of brown bears in Alaska (all ages) was 3 1,700 (25,000-39,100).

Miller, S.D. 1994. Black bear reproduction and cub survivorship in south-central Alaska. International Conference on Bear Research and Management 9:263-273.

Reproductive data collected during a period of 11 years are presented for a low-density black bear (*Ursus americanus*) population occupying marginal habitat along the Susitna River. These data are contrasted with data from higher-density populations on the Kenai Peninsula also in south-central Alaska (Schwartz and Franzmann 1991), thought to occupy better habitat. Low reproductive and recruitment rates and high cub mortality rates were found in the Susitna population. Mean litter size was 2.1 for newborn cubs (range = 1-4), and 1.9 for yearlings, and sex ratio for cubs or yearlings were not different from 50:50 ($P > 0.10$). Mean age at first reproduction was 5.9 years (range = 5-7), recruitment interval was 2.7 years (range = 2-5), birth interval was 2.03 years (range = 1-4), and 59% of newborn cubs survived for 1 year (survivorship = 0.54, 95% CI = 0.42-0.66). A large proportion of adult females were without cubs following an apparent berry crop failure and again 5 years later. This generated pulses of cubs produced 2-3 years and 6-7 years after the berry crop failure. Fist year survivorship in the Susitna population was lower than in the 2 Kenai populations studied by Schwartz and Franzmann (1991) (P = 0.06 and <0.01). The parameters in the 3 Alaskan populations that varied in response to different environmental conditions were first year survivorship, recruitment interval, and age at first reproduction; litter size was not responsive. For purposes of population modeling, recruitment interval will usually be a more useful statistic than birth interval because of early mortality of entire litters. In the Susitna area, black bear productivity and calculated consumption rates of moose calves were similar to findings in the least productive Kenai population. The Susitna data were consistent with the hypothesis of Schwartz and Franzmann (1991) that productivity in Kenai bears was dependent on calf consumption rates during the spring.

Miller, S.D. 1995. Impacts of heavy hunting pressure on the density and demographics of brown bear populations in south-central Alaska. Progress report. Project W-24-3, Study 4.26. Alaska Department of Fish and Game, Juneau. 28 pp.

Brown bear (*Ursus arctos*) populations have been exposed to intensive harvest pressure in Alaska's Game Management Unit 13. Since 1980 varying kinds of liberal brown bear hunting regulations in Unit 13 have been adopted by Alaska's Board of Game. The objective for these regulations was to reduce bear abundance to increase moose (*Alces alces*) calf survivorship and moose availability for harvest by hunters.

Progress in this effort to reduce bear density was measured in a remote portion of Unit 13E where density was expected to be reduced as a consequence of high harvests in the subunit. Previous efforts had revealed significatnly lower densities in nearby highly accessible portions of Unit 13E compared with more remote areas. There was no direct measure of trends in either remote or accessible portions of the subunit. Such a measure in a remote portion of Unit 13 was obtained during spring 1995 by repeating a density estimate done 10 years earlier in the same study area. This earlier estimate was part of the study associated with the proposed Susitna Hydroelectric Project. In this study area, density changed from 18.75 independent bears/l000 km^2 in 1995 (95%CI = 15.9-23.8) in 1985 to 23.31 independent bears/1000 km^2 in 1995 (95%CI = 19.3-30.1). An anticipated decline in bear density was not documented in this study. In 1985, the sex ratio of the population was 82.4 males/100 females in 1995 (P = 0.02). Mean age of population appeared unchanged. An effort will be made to interpret these results in the final report for this project due next year.

These results should not be interpreted as characteristic of the status of bear populations throughout Unit 13 because bear density was 30% of that documented in the 1995 study was found in a nearby area with much easier access to hunters than in a 1987 study. The low density found in this 1987 study area was attributed to heavy hunting pressure (Miller 1990a).

Miller, S.D. 1997. Impacts of heavy hunting pressure on the density and demographics of brown bear populations in south-central Alaska. Alaska Department of Fish and Game, Juneau.

Abstract or summary not available.

Miller, S.D., and W.B. Ballard. 1980. Estimates of the density, structure, and biomass of an interior Alaskan brown bear population. Alaska Department of Fish and Game, Juneau.

Abstract or summary not available.

Miller, S.D., and W.B. Ballard. 1982a. Density and biomass estimates for an interior Alaskan brown bear, *Ursus arctos*, population. Canadian Field-Naturalist 96: 448-454.

Abstract or summary not available.

Miller, S.D., and W.B. Ballard. 1982b. Homing of transplanted Alaskan brown bears. Journal of Wildlife Management 46:869-876.

Forty-seven brown bears (*Ursus arctos)* were captured and transplanted in Alaska in 1979. Post-release data were adequate to evaluate the survival and homing movements for 20 adults and 9 young. At least 12 adults (60%) successfully returned from an average transplant distance of 198 km. Age (for males) and distance transplanted (sexes combined) were directly related to observed incidence of return ($P<0.05$). Sex or reproductive status did not appear to be related to observed incidence of return. Initial post-release movements of non-homing as well as homing bears indicated that most bears were aware of the correct homing direction. None of the transplanted females was known to have produced young the year after transplanting. Six of 9 cubs or yearlings transplanted with their mothers were lost. Transplanting nuisance brown bears does not appear to be a reliable management procedure.

Miller, S.D., and W.B. Ballard. 1992. Analysis of an effort to increase moose calf survivorship by increased hunting of brown bears in south-central Alaska. Wildlife Society Bulletin 20:445-454.

Abstract or summary not available.

Miller, S.D., and M.A. Chihuly. 1987. Characteristics of nonsport brown bear deaths in Alaska. International Conference on Bear Research and Management 7:51-58.

The sex, age, and other characteristics of 668 brown bears (*Ursus arctos*) killed in nonsport circumstances in Alaska during the period 1970-85 were examined. These data represent an unknown fraction of total nonsport kills as not all kills are reported. Both sport harvests and nonsport kills are increasing in Alaska. Nonsport harvests averaged 5.1% of total sport and nonsport kills. Areas with the highest human density had the highest ratio of nonsport to sport harvests. Nonsport harvests are most common during

periods when most people are in remote areas to hunt or fish. Males predominate in the nonsport kills of younger bears and females in the nonsport kills of older bears. Regulations and other factors make adult male bears more vulnerable to sport hunters than adult female bears. Partially as a result, nonsport kills contain more adult females than sport kills. An analysis based on affidavits from 224 persons killing bears revealed that bears were shot to avoid perceived danger (72%), to protect property (21%), and to eliminate nuisances (7%).

Miller, S.D., and R.R. Nelson. 1993. Brown bear - a brown bear density and population estimate for a portion of the Seward Peninsula, Alaska. Project W-23-4 and W-23-5; Study 4.0. Alaska Department of Fish and Game, Juneau. 48 pp.

Abstract or summary not available.

23. Miller, S.D., and J. Schoen. 1999. Status and management of the brown bear in Alaska. Pages 40-46 *in* Servheen, C., S. Herrero and B. Peyton, compilers. Bears: status survey and conservation action plan. IUCN, Gland, Switzerland and Cambridge, UK.

Abstract or summary not present.

Miller, S.D., E.F. Becker, and W.B. Ballard. 1987. Black and brown bear density estimates using modified capture-recapture techniques in Alaska. International Conference on Bear Research and Management 7:23-35.

Population density estimates were obtained for sympatric black bear (*Ursus americanus*) and brown bear (*U. arctos*) populations inhabiting a search area of 1,325 km^2 in south-central Alaska. Standard cature-recapture population estimation techniques were modified to correct for lack of geographic closure based on daily locations of marked animals over a 7-day period. Calculated density estimates were based on available habitat in the search area (1,317 km^2 for brown bears and 531 km^2 for brown bears). Calculated density was 2.79 brown bears/100 km^2 (2.52-3.30 bears/100 km^2) and 8.97 black bears/100 km^2 (7.74-10.21 bears/100 km^2). Calculated 95% confidence intervals were ±13.7% of the estimate for black bears and -9.8% to +18.5% of the estimate for brown bears.

Probabilities of capture based on calculated sightability indices were not equal in some instances, so confidence intervals should be interpreted cautiously. Increasing the number of marked bears during the study period resulted in altered brown bear estimates and smaller confidence intervals, but because closure was a relatively good assumption for black bears in our study area, had little effect on black bear estimates or confidence intervals. When telemetry data were used to correct input values for lack of geographic closure, the Schnabel estimator and the mean of 7 separate daily estimates yielded estimates close to our results.

We recommend our technique for additional testing as method to objectively compare bear densities between different areas or between different times. These procedures may also be appropriate for use with other species.

Miller, S.D., G.C. White, R.A. Sellers, H.V. Reynolds, J.W. Schoen, K. Titus, V.G. Barnes, Jr., R.B. Smith, R.R. Nelson, W.B. Ballard, and C.C. Schwartz. 1997. Brown and black bear density estimation in Alaska using radio telemetry and replicated mark-resight techniques. Wildlife Monographs 133:1-55.

Accurate density and population estimates are needed to manage bear populations but are difficult to obtain. Most such estimates reported for bears are largely subjective and lack estimates of precision. Fifteen brown bear (*Ursus arctos*) and 3 black bear (*U. americanus*) density estimates were obtained in Alaska during 1985 through 1992 using 2-9 replicates of capture-mark-resight (CMR) techniques in 17 different areas. Our studies used radiotelemetry to document movements of marked animals into and from search areas. This procedure essentially eliminated the need to correct density estimates for edge or periphery effects caused by absence of geographic closure. To estimate population size, we used a maximum-likelihood estimator modified to accommodate temporary movements of marked animals into and from our search areas. Our approach permitted direct calculations of density from our population estimates. Our procedures provided density estimates that are repeatable, were comparable among areas, included estimates of precision, and were more objective than methods historically used to estimate bear abundance. Our density estimation procedures have widespread applicability for other wildlife studies using radiotelemetry.

Our estimates were obtained within a wide spectrum of habitats and provided a range of Alaskan densities from 10.1 to 551 brown bears (all ages)/1000 km^2 and from 89 to 289 black bears (all ages)/1000 km^2. Our highest brown bear density is probably near the maximum for this species, but areas with lower densities (3.9/1000km^2) have been reported in Alaska. Brown bear densities were 6-80 times greater in coastal areas where abundant runs of multiple species of salmon (*Oncorhynchus spp.*) were available to bears than in interior areas. Our CMR technique provided useful data for bear population management and impact assessments and has potential for application to other species and areas.

Miller, S.J., N. Barichello, and D. Tait. 1982. The grizzly bears of the Mackenzie Mountains. Northwest Territories Wildlife Service, Yellowknife. 118 pp.

In response to concern for the hunted grizzly bear population in the Mackenzie Mountains, N.W.T., a study of bears in a representative area of the MacKenzie Mountains was carried out from 1973 until 1977 by the N.W.T. Wildlife Service. Within the 3000 km^2 study area which is in the Backbone and Sekwi Ranges of the Mackenzie Mountains bears were captured, measured, tagged and equipped with radio collars. All random observations of bears during aircraft surveys were recorded. Faecal collection and analysis was carried out to determine food habits, and habitat studies were done to determine types and extents of vegetation zones. Den characteristics and denning behaviour are described.

From 67 captured bears and a total of 109 random bear observations made from 38 individually marked bears, we determined the age structure and potential growth of the population, and its distribution and abundance. The implications to grizzly bear management were then considered.

Our data showed natality rates to be low, and we conclude that this together with the late stage of reproduction and the long inter-litter period severely limit the growth potential of the population. Including the observed mortality rates in our model indicates a declining population. We conclude that the Mackenzie Mountains grizzly bear population is marginal and any harvesting, including the current rate is excessive. Local over-exploitation of the population could cause immigration into the harvested area with a resulting slow decline in the overall population density of the entire area.

Miller, S.M., S.D. Miller, and D.W. McCollum. 1998. Attitudes toward and relative value of Alaskan brown and black bears to resident voters, resident hunters, and nonresident hunters. Ursus 10:357-376.

We describe and compare the economic benefits to and attitudes of 3 groups who use Alaskan brown bears (*Ursus arctos*) and black bears (*U. americanus*) for viewing and hunting. We compare benefits each group derived from use of bears with benefits derived from use of other wildlife species. The groups analyzed were resident and nonresident hunters who purchased hunting licenses in 1991 and Alaskan voters who were registered in 1990. Benefits of wildlife use by nonhunting nonresident tourists was not measured in this study. Each of the 3 groups was sampled in 1992 via a mailed survey designed to document their expenditures and net economic value (value from the resource in excess of what it costs to obtain) of an overnight hunting or wildlife viewing trip taken in 1991. We also documented willingness to pay for a hypothetical wildlife viewing opportunity.

Alaskan voters and hunters supported hunting for meat, but only 22% of voters and 50% of resident hunters supported trophy hunting. About half of Alaskan voters and hunters indicated tolerance for bears in urban environments. A third of Alaskan voters reported that they sometimes avoided trips into the countryside because of concerns about bears. Most voters (63%) opposed baiting as a black bear hunting technique, but more hunters favored (47%) than opposed (39%) baiting.

The average gross value (expenditures plus net value) of a voter's primary purpose wildlife viewing trip was calculated based on species seen. Trips on which bears were seen had higher average gross values ($759) than trips on which other species were seen. Average gross value of a bear hunting trip (species combined) for an Alaskan resident was $1,048 ($1,541 for a brown bear hunting trip). Trip-related expenditures were higher for non-resident brown bear hunters ($10,677) than for resident hunters ($1,247). Alaska. resident hunters, nonresident hunters, and Alaskan voters were willing to pay more for a hypothetical day trip to view brown bears ($404, $364, and $485, respectively) than for other wildlife species. We calculated total social benefit as the product of average gross value of overnight hunting or viewing trips and the estimated number of such trips taken by each of the 3 populations sampled. Total social benefit calculations permitted comparisons of the total direct benefits received by different groups of a particular wildlife use (overnight trips to view or hunt different species of wildlife in our study). Resident hunting of wildlife (all species) provided more total social benefit ($84.25 million) than primary purpose wildlife viewing trips by residents ($52.96 million) or nonresident hunting trips ($41.92 million). For trips involving bear hunting or viewing, total social benefit was higher for primary purpose wildlife viewing trips when bears were seen ($29.11 million) than for bear hunting trips taken by nonresidents ($17.05 million) or for bear hunting trips by residents ($4.15 million). Our analysis should be a useful component in the process of allocating wildlife uses among the claimants for priority in the use of these public resources.

Mueller, F.P. 1995. Tundra esker systems and denning by grizzly bears, wolves, foxes, and ground squirrels in the Central Arctic, Northwest Territories. Northwest Territories Department of Renewable Resources, Yellowknife. 68 pp.

I investigated den characteristics for grizzly bears (*Ursus arctos),* wolves (*Canis lupis*), red foxes *(Vulpes lagopus),* and arctic ground squirrels (*Spermophilus parryii*) during July and August 1994 in the Lac de Gras region of the Central Arctic, Northwest Territories. All five species established dens almost exclusively on sandy eskers rather than on rocky uplands or on sedge meadows. The estimated proportions of the main habitat types in the study region are upland (54.7%), meadow (10.5%), and esker (1.5%). During helicopter searches the dens of bears (n=32), wolves (n=37), foxes (n=39), and ground squirrels (n=2448) were found on eskers significantly more often than expected by chance ($p \leq 0.025$). The site characteristics measured at four types of den sites (bear, n=23; wolf, n=22; fox, n=19; and squirrel, n=18) and two types of control sites, adjacent and random (n=36) varied significantly. The size of esker materials at den sites was significantly smaller than the size of esker materials at both adjacent control and at random control sites. Esker materials required by industry are on average significantly larger than those used by all four types of denning animals. The slope at bear dens was significantly steeper than the slope at all other type of sites. Dens of both bears and Squirrels tended to be on the southern slopes. Significant differences were also found in the percentage cover of vegetation between the four types of den sites and the two types of controls. Percentage shrub cover was relatively high at bear dens. Percentage cover of grass, sedge, and fireweed (*Epilobium* spp.) was relatively high at wolf dens. Den sites of wolves, foxes, and ground squirrels were relatively large complexes, usually with numerous burrows. Bear dens had only a single burrow. The biomass of vegetation at den sites of wolves, foxes, and ground squirrels was relatively high and likely resulted from the activities of animals in repeated years. In contrast, vegetation at bear dens undergoes no alteration which suggests a short period of use. There were no significant differences in total nitrogen or in water content among sites. Total carbon content was significantly lower at random control sites compared to den sites. The above results suggest that it may be feasible to evaluate the suitability of habitat for denning of bears, wolves, foxes, and ground squirrels prior to industrial activities. Preliminary recommendations for further studies and impact mitigation are provided.

Murie, A. 1985. The grizzlies of Mount McKinley. University of Washington Press, Seattle. 251 pp.

This report includes my observations on grizzly bears (*Ursus arctos* L.) in Mount McKinley National Park from 1922 to 1970; studies were most intensive from 1959 to 1970.

Grizzlies range throughout the park, but favor particular areas where food is abundant. Density in a 400 square mile area along the road where most work was done was estimated at one or two bears per ten square miles. Mean litter size was 1.85 for spring cubs and 1.70 for all age-classes of cubs.

Home ranges were documented for 2, 3, or 4 years for a number of bears, primarily families that I recognized from year to year based on characteristics of females and cubs. Bears tended to occupy the same general area every year. Observed ranges, usually 5 to 12 miles in length and 1 to 5 miles wide, do not represent total home ranges because rough terrain limited visibility. Bears occupy different portions of their home ranges as food availibility and food habits shift from season to season. Home ranges overlap extensively and territoriality was not evident. A sort of "peck order" based on size, and perhaps reproductive status and past experience, determined the outcome of encounters between bears. Ordinarily, bears avoid close proximity to others.

The breeding season extends from mid-May to mid-July, with a peak in June. In spring, males wander widely in search of receptive females. A male attends one, or occasionally two, females for 1 to 3 weeks. Initially, females are intolerant of males, often trying to evade their attentions, but later become tolerant and permit the male to mount. The minimum breeding interval for females is 3 years, but is usually at least 4 years. Presumably, cubs are born in January and February. They remain with their mother until 2 1/2 years of age, continuing to nurse into the spring and summer of their third year. Occasionally, a single cub stays with its mother into its fourth summer of life. Breakup of the family usually was initiated by the mother. After separating, twin and triplet cubs often remain together, at least in loose association, for up to three summers.

Grizzly bears are omnivorous, but rely mainly on a vegetarian diet that changes as summer progresses. During May and early June, digging for roots is the predominant feeding activity. Bears graze on grasses and herbs in late June, July, and to some extent early August. Berries become a major food in August, and rooting activities increase again, especially in years when berry crops are poor. In September, digging for roots and ground squirrels are the most frequent feeding activities. Carrion is eaten whenever available, and bears occasionally capture young calves of moose and caribou in early summer. A large carcass often attracts several bears, but the largest bear in the area has priority.

Grizzly bears are potential or actual predators on a number of mammals sharing their range. Caribou and moose are wary of bears during their calving periods when bears actively prey on newborn animals. Caribou calves soon mature enough to outrun grizzlies, and caribou herds then pay less attention to passing bears. Cow moose with calves are usually able to defend their offspring from bears. Dall sheep are not vulnerable to bear predation most of the time when in their usually rugged and rocky haunts. During short migrations across valleys from winter to summer ranges, ewes and lambs are more subject to predation; bears occasionally catch a sheep then, usually by surprise in gentle terrain.

Of the smaller mammals, only ground squirrels are captured routinely by grizzlies. Bears are always alert for opportunities to surprise a ground squirrel away from its burrow, and in the fall may concentrate on digging them out for days at a time. Marmots and beaver rarely are captured. Porcupines are well protected against bears; their quills can cause temporary lameness to imprudent bears.

Bears meet a variety of other animals at carrion. Magpies and ravens obtain a small share with little problem. Wolves, however, have little chance to feed at a carcass if a bear is present, but are able to take their turn after a bear has temporarily had his fill.

Wild grizzlies in McKinley National Park, conducting their affairs undisturbed, are the essence of the wilderness spirit.

Mychasiw, L., and S. Moore. 1984. Extrapolative methods for assessing barren-ground grizzly bear denning habitat and preliminary mapping of denning habitat in the Mackenzie Delta area. Manuscript. Northwest Territories Wildlife Service, Yellowknife. 23 pp.

Abstract or summary not available.

14. Nagy, J.A. 1984. Relationship of weight to chest girth in the grizzly bear. Journal of Wildlife Management 48: 1439-1440.

Abstract or summary not present.

13. Nagy, J.A. 1990. Biology and management of grizzly bear on the Yukon north slope. Yukon Department of Renewable Resources, Fish and Wildlife Branch, Whitehorse. 68 pp.

This report reviews the biology and management of grizzly bears on the Yukon North Slope.

Densities of grizzly bears in a study area in the Barn Mountains varied from 25.6/1000 km^2 to 26.3/1000 km^2, respectively, and from 29.4/1000 km^2 to 30.3/1000 km^2 in May and September 1974, respectively. Estimate of densities for coastal plains and low foothills areas in Alaska range from 1.3 to 11.1 bears/1000 km^2. Reported data suggest a low incidence of man-caused mortalities.

The median age of male grizzly bears in the Barn Mountains was significantly greater than for those in the Tuktoyaktuk Peninsula, N.W.T. and western Brooks Range, Alaska, which is attributed to the low hunting pressure of bears in the Barn Mountains If man-caused mortalities have been light since then, the age structure of the grizzly bear population of the Barn Mountains would likely be similar to nowadays.

Minimum breeding ages for female bears were most comparable to those in southwest Yukon, the Brooks Range in Alaska and the Tuktoyaktuk Peninsula in N.W.T. The mean litter size (2.07, n=16) was consistent with that of the north-central Alaska Range. The risk of overharvesting females during years of low cub productivity is pointed out.

Average annual home range sizes for adult males, adult females without young, adult females with cubs, adult females with yearlings, and adult females with two-year olds is: 520 km^2, 123 km^2, 124 km^2, 101 km^2, and 701 km^2, respectively. In the Barn Mountains, females without cubs consistently used annual and seasonal ranges smaller than those in Tuktoyaktuk Peninsula, west-central Alberta, and Jasper National Park. Male spring/early summer ranges did not differ between those areas. The grizzly bear density of the Barn Mountains was 2-6 times greater than for the Tuktoyaktuk Peninsula, west-central Alberta, and Jasper National Park. Median spring body weights as well as maximum growth rates of bears of these four regions were smallest in northern Yukon. It is suggested that the smaller home ranges smaller body weights, and lower maximum growth rates of northern Yukon bears is most likely a result of bears competing for available space and food resources within a population at or near carrying capacity.

It is also suggested that although individual grizzly bears may prey or scavenge on carcasses of caribou that migrate through the bears' home ranges, they do not actually migrate with the herds.

Average daily rates of movement ranged from 0.5 to 3.9 km/day and 0.4 to 1.6 km/day for males and females, respectively. Males were observed more frequently than females at elevations $\leq$ 1500 ft, and females more frequently than males at elevations >1500 ft.

When compared at a monthly basis, males were observed more frequently than females at elevations $\leq$ 1500, and females more frequently than male at elevations >1500 during all months except August. Females used areas >1500 more frequently annually and during all months except during June. The elevational distribution of male grizzlies did not differ significantly from the theoretical distribution. Females generally occurred at higher elevations than males during both hunting seasons. It follows that recreation&s and hunters would have a greater probability of encountering male bears when using areas along valley floors and over slopes, and females when using mid and upper slopes. Harvest mortalities among females could be reduced by expending harvest efforts along main river corridors.

Bear feed primarily on crowberries and roots of Eskimo potato. In June/July grasses were eaten almost exclusively. Berries and grasses made up the greatest proportion of foods eaten in August and September, although legume roots and arctic ground squirrels were also important.

Known den emergence times ranged from 2-12 May. Dens were primarily (33 or 92%)k situated in the montane regions of the Arctic Plateau or British Mountains. Only three dens (8%) were situated on he Yukon Coastal Plain. Dens were situated at mean elevations of 618m ASL in the edge of the coastal wetlands. Most dens were excavated in stabilized and partially stabilized talus slopes. A southeasterly aspect was preferred for den sites. Grizzly bears were not considered to be limited by the availability of sites suitable for denning in Northern Yukon.

The Barn Mountains study was not considered extensive enough to derive reproductive information in a representative sample of females. This type of data is required to calculate acceptable man-caused mortality rates. In view of current fiscal constraints, this is not considered feasible. Instead this type of data should be extrapolated from the study in north-central Alaska Range.

It is proposed to determine current bear density for the Barn Mountains by further fieldwork. However, first priority should be given to determining densities for the Richardson Mountains and British Mountains. Two types of approaches are suggested: 1) short-term intensive capture-mark-release studies, 2) early spring den site surveys. A standardized data collection system to monitor harvest and non-harvest related mortalities is also proposed.

Grizzly bear habitat in the Northern Yukon is considered to be relatively stable due to severe climatic conditions. Unless major developments are proposed that would alter the nature of habitats on a broad scale in Northern Yukon, there may be little requirement for a detailed habitat classification. Evaluation of habitat use or importance for minor localized developments could most likely be dealt with on a site-specific basis.

No satisfactory, cost-effective method has been developed to census bears in most areas. Many workers rely on extrapolations from areas of intensive study to estimate population numbers. For the Barn Mountains a bear density of 26 bears/1000 km^2 is reported.

It is suggested that the quality of the bear habitat may be relatively low in the Malcolm River and British Mountains ecodistrict as the upper mountain slopes are relatively unvegetated. However the Porcupine Caribou herd calves, in and then migrates through this area several times during spring, summer and fall. This may off-set some limitation on bears resulting from annual variations in the relative availability of such foods as berries. By extrapolation bear densities found in similar areas in Northern Alaska and those in the Barn Range to the whole IFA settlement area the following density estimates were derived:

1) Coastal plains and low foothills - 6.5/1000 km^2
2) Barn and Buckland Mountains - 26/1000 km^2

3) British and Richardson Mountains - 15/1000 km^2
The total grizzly population in the IFA settlement area is estimated at 316 bears, including 151 bears in Northern Yukon National Park and 165 on territorial lands by extrapolating these densities.

A review of harvest strategies for grizzly bears in several North American jurisdictions is given. Strategies range from 2-6% total allowable harvest mortality depending on the assumed sex-specific vulnerabilities of bears and other variables like survival rates, age distribution, longevity, growth rates, reproductive rates, age of maturity. The LESMOD model was used to calculate sustainable harvest levels of bears for Northern Yukon. A population model was generated with the same age structure, longevity, birth, sex, and mortality rates as those observed for the Northern Yukon population. Different absolute and proportional harvest rates were applied to the model to estimate acceptable man-caused mortality rates. Subadult and adult males were considered twice, respectively three times, as vulnerable to harvest as adult annual removals were, ≤ 5 bears. The modeled population stabilized when annual removals were ≤ 7%. However, in the latter case the residual population declined progressively from a starting number of 106 bears to 101 and 74 bears as annual harvest rates increased from 1% to 7%. It is concluded that bear populations can be managed more effectively through the application of models based on absolute rather than proportional harvest rates. Actual allowable harvest rates may be much lower because LESMOD assumes that the productivity of females is constant from year to year. The model does not compensate for stochastic annual variations in cub production resulting from, for example, failures in berry crops or other food supplies.

A conservative maximum harvest mortality rate of 4 percent is proposed as it may be difficult to monitor non-harvest mortalities. The sex ratio should be 3 males to 1 female in the annual kill. Based on a wounding loss of 25%, a kill comprised of 75% males and 25% females and a maximum annual allowable kill of 4% of the estimates standing population, the maximum quota should be 5 bears (4 males and 1 female) on the territorial lands and 4 bears (3 males and 1 female) in the National Park.

The total known man-caused mortality on territorial and park lands of 2 and 6 bears, respectively, during the period 1980-1987 was less than the annual allowable kill of 5 and 4 bears, respectively, for those areas. Assuming that all mortalities have been recorded, these data suggest that the grizzly bear populations in the IFA settlement area, and in general the Northern Yukon, are largely unexploited. Harvest quotas should be established on a rotation basis within existing game management subzones to ensure a long-term uniform distribution in the harvest of bears.

The following recommendations are provided:

1) a census program should be conducted to verify that the data presented by Nagy et al (1983a) for the Barn and Buckland mountains are still valid, and verify estimates used in this paper for the Richardson and British Mountains;

2) a standardized data collection system should be maintained to monitor harvest and non-harvest related man-caused mortalities (illegal, problem wildlife, self-defence) on Territorial and Parks lands to ensure that the annual number of man-caused mortalities do not exceed the allowable annual kill;
3) research directed at determining the relative availability and productivity of existing grizzly bear habitats should be conducted to provide a valid basis for comparing the productivity of habitats and grizzly bear populations in Northern Yukon with that of other regions;
4) all translocations of problem bears should be recorded and the data included in any evaluation of annual mortalities within each management area, i.e. a translocated bear should be considered as a mortality;
5) the types and geographic distribution of personal or property damage complaints should be recorded and reviewed annually to identify potential areas where bear-man conflicts could lead to non-harvest bear mortalities;
6) annual total known man-caused mortalities should be evaluated in the context of annual mortalities in adjacent areas in Yukon, Northwest Territories and Alaska, to identify potential population sinks that could detrimentally affect the population and allowable harvest in IFA;
7) the distribution of kill locations should be evaluated on an annual basis to ensure that bears (particularly adult females) are not depleted with localized areas and to identify potential population sinks;
8) the age-sex structure of the kill should be monitored to ensure that the proportion of females in the annual and cumulative running total kill does not exceed 25%;
9) a sex-specific harvest strategy, such as that outlined by Smith (1989), should be developed and implemented in consultation with local outfitters or communities to ensure an equitable allocation of the grizzly bear resource and to minimize the risk of overharvest, particularly that of female grizzly bears;
10) educational programs directed at all land users (hunters, recreation&s, etc.) should be developed and implemented to reduce the potential for bear-man conflicts that result in bear mortalities.

Nagy, J.A. 1988. Proposed methods of mapping habitats and determining grizzly bear habitat use in the Firth River corridor, Northern Yukon National Park. Canadian Parks Service, Prairie and Northern Region, Winnipeg. 60 pp.

Abstract or summary not present.

15. Nagy, J.A., and M. Branigan. 1998. Co-management plan for grizzly bears in the Inuvialuit Settlement Region, Yukon Territory and Northwest Territories. Wildlife Management Advisory Council (North Slope and Northwest Territories). 63 pp.

Abstract or summary not present.

14. Nagy, J.A., and M.A. Haroldson. 1990. Comparisons of some home range and population parameters among four grizzly bear populations in Canada. International Conference on Bear Research and Management. 8:227-235.

Kruskal-Wallis tests were used to compare annual and seasonal activity for adult males, adult females with cubs, and adult females without cubs among grizzly bears (*Ursus arctos*) of the northern Yukon Territory; Tuktoyaktuk Peninsula and Richards Island, Northwest Territories; west-central Alberta; and Jasper National Park, Alberta. Seasons were spring-early summer (15 May to 21 July) and mid-summer-early-fall (22 July to 21 September). Multiple comparisons of mean class ranks from significant K-W tests ($P<0.05$) were used to identify statistically distinct population subsets. These comparisons showed adult females without cubs in northern Yukon used annual and seasonal ranges that were significantly smaller than those for the same class of bears in the other study areas. Adult males in northern Yukon had the smallest annual home ranges. Bears in northern Yukon had lighter spring weights, were older, had the highest population density (26-30 bears/l,000 km^2) and estimated standing biomass (243 $kg/100km^2$), and were unexploited. Differences in home range size estimates were primarily attributed to differences in population densities among study areas.

16. Nagy, J.A., R.H. Russell, A.M. Pearson, M.C.S. Kingsley, and B.C. Goski. 1983a. Ecological studies of grizzly bears in the Arctic Mountains, northern Yukon Territory, 1972-1975. Canadian Wildlife Service, Edmonton. 104 pp.

Seventy-eight different grizzly bears were captured on a 3367 km^2 study area in northern Yukon Territory. Densities were one grizzly bear per 33-39 km^2.

Eighty percent of the population consisted of subadults (>2 and < 6 years) and adults (>6 years). On average 54 percent of the adult females were not accompanied by young, indicating low productivity. Known natural and harvest mortalities were low. Factors such as productivity, age-sex distribution, known mortalities and comparisons of data from other studies suggested that the population was stable.

The breeding season was between 5 May and 15 July. Females first bred at ages 5.5-7.5 years and produced young as late as 21.5 years. An average of 2.07 young were produced on a 3-4 year interval. Young were weaned at ages 2-3 years.

Northern Yukon bears were larger than those of southwest Yukon and smaller than those of Tuktoyaktuk Peninsula, NWT. Significant increases in body weight during the active period (50-59 percent) and losses during denning (25-36 percent) were recorded. Highly significant correlations between actual weight and girth measurements were found. Weights predicted for girth measurements are given.

Highly significant correlations between age and skull width were obtained. Relationships were compared with populations in other regions. Ages predicted for skull width measurements are given.

Seasonal changes in pelage colour color caused by solar bleaching and moult were observed. Food habits appeared to be consistent with those of populations in other northern regions.

Home range data are given. Females showed a high degree of fidelity to specific areas. Subadult males had the largest home ranges. Significant differences were found in the elevational distribution of bears by sex, age and reproductive status.

Information was obtained on den site characteristics.

17. Nagy, J.A., R.H. Russell, A.M. Pearson, M.C.S. Kingsley and C.B. Larsen. 1983b. A study of grizzly bears on the barren-grounds of Tuktoyaktuk Peninsula and Richards Island, Northwest Territories, 1974-1978. Canadian Wildlife Service, Edmonton. 136 pp.

Seventy-one different grizzly bears were captured on a 17,318 km^2 portion of the Mackenzie Delta, including Tuktoyaktuk Peninsula and Richards Island, N.W.T. Densities varied from one bear per 21 l-237 km^2 in spring to one bear per 255-262 km^2 in fall.

The population was considered to be stable. Productivity was high as shown by an annual recruitment of 18.4 percent; 85 percent of females were accompanied by an average litter of 2.2 young. The interval between litters was 3.3 years. Stable numbers were maintained principally through a substantial annual harvest and natural mortalities. Males were more vulnerable to harvest than females.

The breeding season was between mid May and the end of June. Females first bred at ages 4.5-7.5 years. Young were weaned at ages 2-3 years.

Grizzly bears of Tuktoyaktuk Peninsula were larger than those of the southwestern and northern Yukon. Significant increases in body weight during the active period (21-70 percent) and losses during winter dormancy (5-34 percent) were recorded. Highly significant correlations between actual body weight and girth measurements were found. Weights predicted for girth measurements are given.

Highly significant correlations between age and skull width were also obtained. Relationships are compared with those of other populations. Ages predicted for skull width measurements are given.

Seasonal changes in pelage colour caused by solar bleaching and moult were observed.

Food habits were consistent with those of populations in other northern regions. Some bears relied heavily on Arctic ground squirrels for fall fattening.

Home range data are given. Home ranges of males and females overlapped. The size of home ranges of females appeared to be related to their reproductive status. Adult females showed a high degree of fidelity to specific home range sizes and their female cubs demonstrated a similar fidelity to the dams home range following weaning.

Grizzly bears entered winter dens in early October and emerged between the last week of April and the end of May. Information was obtained on den site characteristics.

18. Northwest Territories Department of Renewable Resources. 1991. Discussion paper towards the development of a Northwest Territories barren-ground grizzly bear management plan. Northwest Territories Department of Renewable Resources, Yellowknife. 16 pp.

Abstract or summary not present.

Paetkau, D., L.P. Waits, P.L. Clarkson, L. Craighead, E. Vyse, R. Ward, and C. Strobeck. 1998. Variation in genetic diversity across the range of North American brown bears. Conservation Biology 12:418-429.

Understanding the factors that influence the rate at which natural populations lose genetic diversity is a central aspect of conservation genetics because of the importance of genetic diversity in maintaining evolutionary potential and individual fitness. Concerns about loss of genetic diversity are particularly relevant to large carnivores, such as brown bears (*Ursus arctos*), that are distributed at low densities and are highly susceptible to human-caused population fragmentation. We used eight highly variable nuclear microsatellite markers to study current levels of genetic variation across the North American range of brown bears. The highest levels of within-population genetic diversity (H_e=0.76) were found in northern populations in the core of the North American distribution. Diversity was significantly lower in populations at the southern fringe of the distribution, in the Northwest Territories, and in southwest Alaska. Diversity was lower still in the Yellowstone ecosystem population (H_e=0.55), an isolated remnant of the larger distribution that recently extended south from the Canadian border into Mexico. The insular population on the Kodiak Archipelago had very low genetic diversity (H_e=0.26). The Yellowstone and Kodiak data suggest that the effective population for brown bears is much smaller than previously suspected. These results indicate that the levels of diversity in most undisturbed populations can be maintained only through connections to populations on the scale of the current North American distribution. At the same time, the Kodiak data demonstrate that populations well under the size for long-term conservation can persist and thrive for thousands of years, although the probability of such persistence remains unknown.

Pearson, A.M. 1972. Population characteristics of the northern interior grizzly in the Yukon Territory, Canada. International Conference on Bear Research and Management 2:32-35.

Abstract or summary not present.

Pearson, A.M. 1975. The northern interior grizzly bear, *Ursus arctos* L. Canadian Wildlife Service Report No. 34. 86 pp.

Fifty-three different grizzly bears were captured on a 1,110 km^2 study area in southwestern Yukon Territory. At least 41 were considered residents and possibly as many as 49, or a density of one grizzly per 27.1 or 22.7 km^2 respectively.

The age composition of the population showed a high percentage (76%) of adult animals. Productivity was relatively low with an average litter size of 1.7 cubs and 1.5 yearlings, late maturation of females (6.5 to 8.5 years), and a minimum of 3 years between litters.

A definitive technique of age determination was proven by counting cementum annuli in the teeth. The increase in breadth of skull was correlated with age and an acceptable, much simpler age determination technique was developed.

Specimen material was collected from 320 grizzly bears and age data from 239 were used to prepare sex specific life tables. Mortality was generally higher in adult females than in adult males and higher in adults than in the young and subadult classes.

The northern interior grizzly is a rather small ecotype in stature. I found that the average weight was 139 and 95 kg for adult males and adult females, respectively. Maximum weights were 240 and 125 kg, respectively. Weight loss over the winter was as great as 43% of the pre-denning weight. The animals added weight rapidly in the autumn when feeding on soapberries *(Shepherdia canadensis)*.

Information was collected on general colour, moult patterns and colour changes, food habits and habitat selection, behaviour, activity patterns and home range movements, and den site characteristics. The harvest of grizzlies in the Yukon was analysed in detail.

Information obtained during the study was synthesized and used as a basis for management proposals. An estimate of the total population of grizzlies in the Yukon Territory was extrapolated from the available data.

19. Pearson, A.M. 1976. Population characteristics of the arctic mountain grizzly bear. International Conference on Bear Research and Management 3:247-261.

The author presents data collected from Arctic Mountain grizzly bears that were captured and radio-tracked on a 3,367 km2 study area in the Barn Mountains, Yukon Territory during 1973 and 1974. The mean MCP home range size calculated for adult male grizzly bears was 414 km^2 (n = 9). The mean MCP home range size calculated for adult female grizzly bears was 73 km^2 (n = ?). A minimum population density of one bear per 48 km^2 was determined. Thirty-nine feces were collected during the study and analyzed for identification of foodstuffs. During late May study animals utilized berries, roots, and some grasses. Overwinter crowberries and the roots of the Eskimo potato (***Hedysarum alpinum***) were the most common. In mid-July all feces collected were composed of 100% grasses. In August, crowberries and grasses occurred in equal amounts; in

September berries were the most common component. In only two feces were animal remains found (both ground squirrel). Caribou material in the feces was noticeably absent. Notes on the dens of 12 study animals indicate that hillsides were favored with a southerly aspect. Mean elevation of the den sites was 732 m asl.

Pearson, A.M. Habitat, management and the future of Canada's grizzly bears.

Abstract or summary not present.

Pearson, A.M., and B.C. Goski. 1974. The life history of the arctic mountain grizzly bear (*Ursus arctos* L.) in northern Yukon Territory. Canadian Wildlife Service. 17 pp.

Abstract or summary not present.

23. Pelton, M.R., A.B. Coley, T.H. Eason, D.L. Doan Martinez, J.A. Pederson, F.T. van Manen, and K.M. Weaver. 1999. American black bear conservation action plan. Pages 144-156 *in* C. Servheen, S. Herrero and B. Peyton, compilers. Bears: status survey and conservation action plan. IUCN, Gland, Switzerland and Cambridge, UK.

Abstract or summary not present

Phillips, M.K. 1984. Habitat use and behaviour of grizzly bears in the Arctic National Wildlife Refuge. Pages 45-73 *in* G.W. Gamer and P.E. Reynolds, eds. 1983 update report - baseline study of the fish, wildlife and their habitats. U.S. Fish and Wildlife Service, Anchorage.

Abstract or summary not available.

20. Phillips, M.K. 1987. Behaviour and habitat use of grizzly bears in north-eastern Alaska. International Conference on Bear Research and Management 7:159-167.

Habitat use and behaviour of grizzly bears were studied in 3 areas of the Arctic National Wildlife Refuge, northeast Alaska, during 1982 and 1983. Scanning for bears resulted in 386 and 388 hours of behavioural and habitat use information. Vegetation on 3,626 ha in the Caribou Pass-Kongakut River study area was mapped to Viereck-Durness (1980) level IV. Grizzly bears devoted most of their non-hibernating time to feeding and foraging. From 22 June to 2 August, feeding and foraging on herbaceous vegetation were the predominant activities, although foraging for rodents was also observed. Important plants included horsetail (*Equisetum arvense*), grasses, sedges, and the leaves and flowers of the boykinia (*Boykinia richardsonii*). During the first two weeks of summer, bears spent almost 90% of their time feeding on caribou. Food habits and habitat use were influenced by the phenological development of herbaceous plants and berry-producing plants and availability of animal food items. During fall, crowberries, blueberries, and bearberries were important food items until the first snowfall, at which time hedysarum roots and foraging for rodents became important. During spring, tussock tundra and tall shrubland were used slightly more frequently than expected based on availability, whereas low shrubland was used much more frequently than expected. Bears observed in tall and low shrubland were usually digging for hedysarum roots. Moose may also have been important in riparian areas. During the first two weeks of summer, tussock tundra, mat and cushion tundra, and shrubland were frequently used by bears. Caribou were often seen in these habitats, probably explaining the use by bears. From mid-summer to early August, bears used sedge-grass tundra almost as frequently as expected, whereas shrub tundra and herbaceous tundra were used much more frequently than expected. Tall shrubs were also important. By early fall, use of mat and cushion tundra and shrub tundra increased, and both were used slightly more than expected (probably to feed on berries). After the first snows bears observed in these vegetation types were usually foraging or feeding on ground squirrels.

Quimby, R. 1974. Grizzly Bears. Chapter I *in* R.D. Jakimchuk, ed. Mammal studies in north-eastern Alaska with emphasis within the Canning River drainage. Canadian Arctic Gas Study Ltd., Biological Report Series Volume 24.

The size and composition of the grizzly bear population in the Canning River drainage were investigated by marking bears with collars of several types. Between 24 April and 7 October 1973, 39 grizzlies were marked. Using the Lincoln-Peterson Index, density in the drainage is estimated at between 1 per 62 sq. mi. The average age of marked bears was 11.8 years.

A total of 479 grizzlies was observed during aerial surveys. The composition of the population did not differ statistically from that found in 1972. In both 1972 and 1973 the composition of bears on the north slope of the Brooks Range differed statistically from that on the south slope. Average litter size in 1973 was 1.60 for cubs of the year and 1.71 for yearlings and older cubs.

From resightings of marked bears and aerial tracking of bears in the fall, distances travelled by some individuals were estimated. Twenty-one dug dens were found, and ten rock cave dens are described. Seasonal food habits and habitat utilization are described.

The reaction of grizzlies to low-flying aircraft was recorded; about 70% of all reactions observed .were in the "strong" category.

Quimby, R., and D. J. Snarski. 1974. A study of furbearing mammals associated with gas pipeline routes in Alaska. Chapter II *in* R.D. Jakimchuk, ed. Distribution of moose, sheep, muskox, and furbearing mammals in north-eastern Alaska. Canadian Arctic Gas Study Ltd., Biological Report Series Volume 6.

Abstract or summary not available.

21. Reynolds, H.V. 1976. North slope grizzly bear studies, Final report. Projects W-17-6 and W-17-7; Jobs 4.8R, 4.9R, 4.10R and 4.11R. Alaska Department of

Fish and Game, Juneau. 20 pp.

Denning activities of grizzly bears (*Ursus arctos* L.) were studied in the eastern Brooks Range, Alaska, during April-November 1972, 1973 and 1974. Active dens were found by tracking bears through snow or by locating bears fitted with radio transmitters. In the fall f 1973, 71 percent of the newly excavated dens were constructed from October 5-12, although some grizzlies were observed foraging and did not den until after November 7; similarly, of 8 dens located which were used in 1974, 6 or 75 percent were excavated from 3-9 October, 1 about 27 September and 1 between 19 October and 1 November. A total of 52 dens were found; 20 of these were located shortly after they had been prepared for use during the oncoming winter and 32 others were found after they had been used. In 39 instances bears dug dens in well-drained areas above the permafrost layer and in 13 cases natural caves were utilized. All dens were located in moderate to steep terrain with the exception of three dens which were dug into river banks on the coastal plain. Mean elevation of den sites was 975m (3200 ft) and 46 or 88 percent were located on southern exposures.

When caves were utilized, in every case a bed was constructed of moss, woody and/or herbaceous material. Most dug dens collapsed after the bear's departure; the few intact dens which were measured closely followed the descriptions given by Craighead and Craighead (1972) for Yellowstone grizzlies, with the exception that none were located at the bases of trees.

Two adult males moved 51 and 55 km (32 and 34 MI) to reach denning areas; another 1(individuals (2 males, 8 females) denned within their known summer range. No instance of den reuse was recorded. The remains of a two year-old bear were found in a cave den the cave was quite small and the bed was poorly constructed.

Denning took place over a relatively wide area on the north and south slopes of the Brooks Range. It does not appear at this time that denning habitat is a limiting factor on grizzly bear population dynamics in northeastern Alaska.

Reynolds, H.V. 1979. Population biology, movements, distribution and habitat utilization of a grizzly bear population in NPRA. Chapter 5 *in* Studies of selected wildlife and fish and their use of habitats on and adjacent to the National Petroleum Reserve in Alaska 177-78, Volume 1. U.S. Department of the Interior Work Group 3, Field Study 3.

Abstract or summary not available.

Reynolds, H.V. 1980. North slope grizzly bear studies. Volume I progress report. Project W-17-11; Jobs 4.14R and 4.15R. Alaska Department of Fish and Game, Juneau.. 65 pp.

Population biology, movement, distribution, and habitat utilization of grizzly bears were studied during 1977-79 in the northern foothills of the western Brooks Range. Eight-

eight of the estimated 119 bears in the 5,200 km^2 study area were captured. A density of 1 bear/ 43 km^2 was estimated in the area. The age structure of the population showed more animals in the 0.5- to 2.5-year age classes than in any others. The sex structure of that portion of the population over 1.5 years of age was 60.2 percent females and 39.8 percent males, Measures of reproductive biology which were calculated included: a mean age of 8.4 years at first production of a litter, a reproductive interval of 4.03 years, a mean litter size of 2.03 young, and a reproductive rate of 0.503 cubs/female/year. Evidence indicates that these parameters are higher than those reported in other portions of the North Slope, probably due to the availability of carrion and prey from calving caribou of the Western Arctic Herd.

Twenty-one mortalities, primarily of young-age bears, were recorded. Evidence suggests most of these were caused by adult males.

The mean distance traveled per day by grizzly bears was observed to be 5.0 km. The maximum movement by an individual was by a male which travelled 163 km to the coast of the Arctic Ocean and later returned. Home ranges were calculated for 26 grizzlies; mean home range size was 1,350 km^2 for males and 344 km^2 for females. Food habits and habitat use were investigated. Bears usually denned within their spring, summer, and fall ranges, but four individuals moved from 16.1 to 43.8 km from their fall ranges to den. The mean range of denning dates in 1977 was from 12 to 18 October and in 1978 it was from 7 to 9 October. Dens were located throughout the study area in all types of terrain and at elevations from 270 to 1,280 m. Disturbance of denning bears by seismic exploration was monitored; no abandonment of dens was observed, but the potential for adverse impact exists, especially impact affecting females with newborn cubs.

Reynolds, H.V. 1981. North slope grizzly bear studies. Volume II progress report. Project W-21-1, Job 4.14R. Alaska Department of Fish and Game, Juneau. 27 pp.

During 1980 specific aspects of grizzly bear population biology in the western Brooks Range were studied. These included age at first production of offspring, length of reproductive life, litter size, reproductive interval, and mortality of young. Thirty bears were captured; of these, 17 were recaptures, 5 were offspring of marked females, and 8 were previously unmarked adults or their offspring. Radio collars of 11 bears were replaced so subsequent reproductive behaviour of these grizzlies could be observed.

Of bears captured during 1977-80, females comprised 63 percent of the first three age classes of bears (cubs, yearlings, and 2-year-olds; n=35), a characteristic which apparently persists to a lesser degree in those bears older than 2 years of age (36 of 66 bears, 55% females). Contingent upon collection of additional data, the mean age at first production of young for western Brooks Range grizzlies was calculated at 8.1 years and mean litter size was calculated at 1.93 offspring/litter. Nineteen offspring which accompanied their mothers died during the 1977-80 period. Mortality rates for offspring of marked females were: cubs, 48 percent; yearlings, 13 percent; and 2-year-olds, 18 percent.

Reynolds, H.V. 1982. Alaska Range grizzly bear studies. Volume I progress report. Project W-21-2, Job 4.16R. Alaska Department of Fish and Game, Juneau. 10 pp.

In 1981, the 1st phase of a study was begun to determine the status and reproductive biology of a grizzly bear population in the northcentral Alaska Range. During May and June 1981, 5 bears were captured and radio-collared. The nutritional condition of all captured bears was poor, based on the protrusion of vertebrae and pelvis beneath the hides. Bear No. 1301, a 6.5-year-old male, was found dead the day after capture. Necropsy showed no external or internal fatty tissue; pulmonary edema was evident.

Of the bears captured, 2 were young adult males, 2 were subadult females, and 1 was an adult female with 2 yearling offspring. During aerial searches, 4 other solitary bears were observed but not captured.

Historical sport hunting records of grizzly bears in the study area during 1961-81 were reported. Analysis of the effects of present harvest on the population will await determination of population structure and reproductive biology.

Reynolds, H.V. 1989. Population dynamics of a hunted grizzly bear population in the north-central Alaska Range. Project W-23-1, Job 4.19. Alaska Department of Fish and Game, Juneau. 63 pp.

Abstract or summary not available.

Reynolds, H.V. 1990. Population dynamics of a hunted grizzly bear population in the north-central Alaska Range. Project W-23-2, Study 4.19. Alaska Department of Fish and Game, Juneau. 63 pp.

Population densities and harvest rates for a grizzly bear (*Ursus arctos*) population in the northcentral Alaska Range were estimated during the years 1981 through 1989; baseline population status and reproductive biology were also determined for the period 198 1 to 1985. The effects of increased harvests on this population have been the focus of investigations since 1986, continuing through 1991.

In 1989 I observed only minor changes from past production and survival rate patterns. All population estimates calculated during 1989 were adjusted for population closure. The estimated harvest rate for the minimum study area population was 21.6% in 1989, compared with a mean rate of 10.1% (1981-88). Although minimum population size of grizzlies ≥2 years of age declined from estimates of 54 in 1981 to 42 in 1989, preliminary analysis of some aspects of reproductive biology were apparently stable; i.e., the age at 1st reproduction of young was 5-7 years, observed reproductive interval was 4.3 years, and mean litter size was 2.1.

Reynolds, H.V. 1991. Grizzly bear population ecology in the Western Brooks

Range, Alaska. United States National Parks Service and United States Bureau of Land Management.

Abstract or summary not available.

Reynolds, H.V. 1992. Grizzly bear population ecology in the western Brooks Range, Alaska. Progress report 1990 and 1991. Alaska Department of Fish and Game, Fairbanks. 90 pp.

Abstract or summary not available.

Reynolds, H.V. 1993a. Evaluation of the effects of harvest on grizzly bear population dynamics in the north-central Alaska Range. Final Report. Project W-23-5, Study 4.23. Alaska Department of Fish and Game, Juneau. 94 pp.

Mark-recapture methods were used to calculate grizzly bear population density estimates in two portions of a 3,160 km^2 study area in the northcentral Alaska Range during 1992, for comparison with similar estimates calculated in the same area during 1986. Three different analytical techniques to estimate density from mark-recapture data were employed. No differences in bear density could be confirmed between the two time periods because the estimates displayed wide confidence intervals. A direct count estimate, based on intensive capture and presence of individual bears within home ranges in the area, indicated that by 1992 the population of bears 22 years of age had declined by 44% since 1981 and 38% since 1986. Application of mark-recapture estimates in areas of low bear density like the northcentral Alaska Range may be improved by increasing sightability through increased search intensity and increasing the total size of the search area. Population dynamics data have been collected annually since 198 1 to monitor the effects of harvest on the population. The number of productive adult females in the population at den emergence fluctuated between 21 and 23 during 1981-89 with an average annual harvest rate of 6.3%, but will include only 14 by spring 1993 following a human-caused mortality rate of 16.7% during 1989-92. Population numbers and productivity were affected by environmental conditions resulting in the failure of the 1983 cub cohort. Females produced their first litters at mean age 6.2 years and their first surviving litters at mean age 7.1 years. Mean litter size for cubs of the year was 2.09 (n=43) and 2.0 for offspring weaned as 2- or 3-year-olds (n=20). In 86% of observations, females that bred in one year produced cubs the next. The mean interval between production of weaned offspring was 4.0 years. Although there were differences in some measures of population productivity between 1981-86 and 1987-92, they could not be ascribed to compensatory production or survival; these differences may have been influenced by the same environmental factors that resulted in the failure of the 1983 cub cohort. Patterns of movement or fidelity to maternal or established home ranges indicated that all females remained in the vicinity of their maternal home ranges and that none emigrated from the study area. All males weaned or captured as 2- or 3-year-olds emigrated from their maternal or established home ranges within 2 years. Males 24 years of age apparently left their maternal home ranges to immigrate to the study area; none of these later emigrated from the study area although some had home ranges that extended beyond the study area boundaries. Recovery of the bear population to former levels will probably require reductions in harvest and more intensive management of females, since compensatory production or survival, if present, has not been enough to maintain adult female numbers.

Reynolds, H.V. 1993b. Effects of harvest on grizzly bear population dynamics in the north-central Alaska Range. Progress report Project W-24-1, Study 4.25. Alaska Department of Fish and Game, Juneau. 25 pp.

During 1993, the third phase began in a long-term investigation of the effects of harvest on grizzly bear (*Ursus arctos horribilis*) population dynamics in a 3,160 km^2 area of the northcentral Alaska Range. During the first two phases, as the total population size declined, the adult female segment of the population was stable at 21-23 during 1981-89, but declined to 15 by 1992. During the third phase, the recovery rate will be determined for both the total population and the productive female segment of the population. During 1993, 16 bears were captured and radiocollars placed on 15 of these, primarily to maintain the sample of radio-collared adult females. Only 14 adult females were present in the area in 1993. The number of young-age (2-5 years of age) females that are potential recruits to the adult female cohort was 15-16 during 1992-93. Fifteen bears have been killed in the Wood River drainage that were taken illegally, suspected taken illegally, taken in defense of life or property, or taken at cabins or residences but legally reported as hunter-killed animals. In comparison, in other portions of the study area, three were killed in defense of life or property, two were recorded as hunter kills at cabins or residences, and four were suspected wounding losses or unrecovered defense of life or property kills.

Reynolds, H.V., and T.A. Boudreau. 1990. Effects of harvest rates on grizzly bear population dynamics in the north-central Alaska Range. Project W-23-3, Study 4.19. Alaska Department of Fish and Game, Juneau. 59 pp.

Changes in densities and harvest rates for the grizzly bear (*Ursus arctos)* population in the northcentral Alaska Range were estimated during the years 198 1 through 1989. Baseline population status and reproductive biology were determined during the years 1981 through 1985; the effects of increased hatvests on this population were the focus of investigations from 1986 through the reporting period.

During the spring of 1990 research emphasis was placed on monitoring movements, reproductive performances, and mortalities and maintaining a representative sample of radio-collared bears for the study. One 5-year-old male moved 32 km south of the study area (i.e., maternal home range) and was shot by a hunter; another young male moved out of the study area and shed his collar. No other movements of young-aged bears were observed, although two shed their collars and their movements were not monitored.

Six adult females produced 16 cubs during 1990; the mean litter size of 2.7 was the highest recorded during this study. Mean annual litter size for cubs from 1982 to 1990 was 2.17 (n = 36), and for both yearlings and two-year-olds it was 2.00. There were 2 hunter-caused mortalities, one inside and one outside the study area, and 1 grizzly bear died of natural causes inside the study area. In addition, 2 probable human-caused mortalities that occurred during August 1989 were located. Sixteen grizzly bears were captured and radio-collared, including 8 previously collared bears that needed collar changes, 5 offspring of marked bears, and 3 previously unmarked bears.

Reynolds, H.V., and T.A. Boudreau. 1992. Effects of harvest rates on grizzly bear population dynamics in the north-central Alaska Range. Projects W-22-5, W-22-6, W-23-1, W-23-2, W-23-3, and W-23-4; Study 4.19. Alaska Department of Fish and Game, Juneau. 90 pp.

Changes in population density and harvest rates for a grizzly bear (*Ursus* arctos) population in the northcentral Alaska Range were estimated during 1986-1991 for comparison with similar data for the 1981-85 period. Baseline population status and reproductive biology were determined during 1981-85; the effects of increased harvest on this population were the focus of investigations from 1986 through 1991. Minimum estimated population size, adjusted to account for closure, declined from 71 in 1981 to 52 in 1991. The number of productive adult females in the population at den emergence fluctuated between 20 and 22 during 1981-89 with an average annual harvest rate of 6.5%, but will include only 15 by spring 1993 following a harvest rate of 14.3% during 1989-91. Population numbers and productivity were affected by environmental conditions resulting in the failure of the 1983 cub cohort. Females produced their first litters at mean age 6.3 years and their first surviving litters at mean age 7.3 years. Mean litter size for cubs of the year was 2.15 (n=41) and 2.0 for offspring weaned as 2- or 3-year-olds (n=18). In 86% of observations, females that bred in one year produced cubs the next. The mean interval between production of weaned offspring was 4.1 years. Although there were differences in some measures of population productivity between 1981-86 and 1987-91, they could not be ascribed to compensatory production or survival; these differences may have been influenced by the same environmental factors that resulted in the failure of the 1983 cub cohort. Patterns of movement or fidelity to maternal or established home ranges indicated that all females remained in the vicinity of their maternal home ranges and that none emigrated from the study area. All males weaned or captured as 2- or 3-year-olds emigrated from their maternal or established home ranges within 2 years. Males ≥4 years of age apparently left their maternal home ranges to immigrate to the study area; none of these later emigrated from the study area although some had home ranges that extended beyond the study area boundaries. Recovery of the bear population to former levels will probably require reductions in harvest and ore intensive management of females, since compensatory production or survival, if present, has not been enough to maintain adult female numbers.

22. Reynolds, H.V., and G.W. Garner. 1987. Patterns of grizzly bear predation on caribou in northern Alaska. International Conference on Bear Research and Management 7: 59-67.

The authors investigated grizzly bear use of caribou as carrion and prey in three areas: two areas were in or adjacent to the traditional calving grounds of large caribou herds, and one area that did not include caribou calving grounds. The western Brooks Range study area was located in the mountains and foothills near the calving grounds of the Western Arctic Caribou Herd (est. 200,000 in 1985); the Arctic National Wildlife Refuge study area was in the coastal plain and foothills of the eastern Brooks Range in the calving grounds of the Porcupine caribou Herd (est. 150,000 in 1985); and the Canning River study area was in the mountains and foothills of the eastern Brooks Range, 80 km southwest of the calving grounds of the Porcupine Herd. Predation or scavenging was determined from direct observation, locating radio-collared bears feeding on caribou, and from blood on the muzzles of captured bears. The Canning River bear population was distant from calving grounds, showed little use of caribou, and was characterized by low population density and productivity. Caribou were used as carrion and prey by the two grizzly bear populations for which calving caribou were available. Bear population density and productivity were higher when caribou were available, even though patterns of caribou use by bears differed between the two areas. Near the calving grounds of the Western Arctic Herd, western Brooks Range grizzly bears stayed within their established seasonal home ranges and used caribou as the caribou migrated through their home ranges. In contrast, on the Porcupine Herd calving grounds, some Arctic Refuge bears left seasonal home ranges in the mountains to take advantage of the caribou on the coastal plain, staying only as long as the calving caribou were available. In addition, some bears that preyed upon Porcupine Herd animals apparently traveled long distances following the path of migrating caribou to the calving grounds. No bears from the Canning River study area were observed to leave their home ranges to reach the calving grounds. The proportion of caribou that were killed by bears vs. those that were scavenged was not determined. Although most caribou killed by bears were calves, adults were also preyed upon. Grizzly bears of all sex and age classes fed on caribou.

Reynolds, H.V., and J.L. Hechtel. 1982. North slope grizzly bear studies. Volume III progress report. Project W-21-2, Job 4.14R. Alaska Department of Fish and Game, Juneau. 19 pp.

Specific aspects of grizzly bear population biology in the western Brooks Range were studied during 1981. These included age at first production of offspring, length of reproductive life, litter size, reproductive interval, and mortality of young. During 1977 81, the mean litter size for 49 litters was 2.00 per (range 1.63 to 2.50) year. This Gariability illustrates the importance of long-term studies to set harvest levels for bears. Mean reproductive interval in this area will be at least 4.0 years. Mortality rates for offspring accompanied by marked adult females remained high: cub mortality 46%, yearling mortality 1 1%, and 2-year-old mortality, 16%. To examine causes of cub mortality, 3 females with cubs were kept under intensive observation from 8 May to 15 June. The 2 females which remained near their dens during the first two weeks after emergence also stayed close to their cubs. These sows were successful in raising cubs until at least September. In contrast, the other female left her den shortly after emergence and occasionally left her cubs on talus slopes while she foraged as far as 4 km away. By September, only 1 of her 3 cubs survived.

Reynolds, H.V., and J.L. Hechtel. 1983a. Structure, status, reproductive biology, movement, distribution, and habitat utilization of a grizzly bear population. Volume IV progress report. Project W-22-1, Job 4.14R. Alaska Department of Fish and Game, Juneau. 22 pp.

Specific aspects of grizzly bear (*Ursus arctus)* population biology in the western Brooks Range were studied during 1982. These included age at first production of offspring, length of reproductive life, litter size, reproductive interval, and mortality of young. During 1977-82, the mean litter size for 57 litters was 1.98/year (average annual range 1.67-2.50). Mean reproductive interval in this area is at least 4.0 years. Mortality rates for offspring accompanied by marked adult females remained high: cub mortality, 44%; yearling mortality, 19%; and 2-year-old and 3-year-old mortality, 14%. Mortality rates calculated from changes in litter sizes of cubs, yearlings, and 2-year-old and 3-year-old age classes were low and inaccurate, since most mortality occurred to entire litters and not single members of litters. To examine causes of cub mortality, 3 females with cubs and 2 females with yearlings were kept under intensive observation from 16 May to 13 June. The 2 cubs of female No. 1178 were apparently killed by a large adult male which was seen with 1 cub in his mouth. The other 4 family groups under observation did not experience any mortality.

Reynolds, H.V., and J.L. Hechtel. 1983b. Population structure, reproductive biology, and movement patterns of grizzly bears in the northcentral Alaska Range. Volume II progress report. Project W-22-1, Job 4.16R. Alaska Department of Fish and Game, Juneau. 27 pp.

In 1981-82, the 1st phase of a study was begun to determine the status and reproductive biology of a grizzly bear (*Ursus arctos*) population in the northcentral Alaska Range. During this period, 35 bears were captured and 29 were radio-collared; captured bears included 13 males and 22 females. Estimated population density for the study area was 1 bear/52 km^2. Initial analysis of the structure of the population showed that few mature males were present, possibly the result of hunting pressure. Evidence suggests that females have a potentially long reproductive life span; at least some produce their first litters at about age 6 and a 25.5-year-old female weaned her 2.5-year-old offspring and bred. Based on 10 litters, including those of both cubs and yearlings, mean litter size was 1.7. All measures of population biology which were calculated should be considered tentative and contingent upon the collection of additional data.

In 1982, 11 mortalities were recorded in the study area: 6 hunter kills, 4 offspring of marked females, and 1 unmarked yearling which was not seen after the capture attempt and was presumed dead. Historical sport hunting records of grizzly bears in the study area during 1961-82 are reported. Analysis of the effects of present harvest on the population will await determination of population structure and reproductive biology.

The extent of movement and sizes of home range were apparently dependent upon sex and age of individuals. In general, adult males made the greatest movements and had the largest home range sizes. Measurements of other bears, in order of decreasing size, were as follows: breeding females, females with offspring, and young age bears (both males and females).

Reynolds, H.V., and J.L. Hechtel. 1984a. Structure, status, reproductive biology, movement, distribution, and habitat utilization of a grizzly bear population. Final report. Project W-21-1, W-21-2, W-22-l and W-22-2; Job 4.14R. Alaska Department of Fish and Game, Juneau. 29 pp.

Little field work was carried out in 1983; results that were gathered did not change the conclusions reached in previous reports. A manuscript (Appendix A) was prepared for the 6th International Conference on Bear Research and Management in February 1983 This paper, entitled "Grizzly bear population biology in the western Brooks Range, Alaska", should stand as the final report for this job. In addition, tables that include data collected during 1983 are presented in Appendices B through F.

Reynolds, H.V., and J.L. Hechtel. 1984b. Population structure, reproductive biology, and movement patterns of grizzly bears in the north-central Alaska Range. Progress report. Project W-22-2, Job 4.16R. Alaska Department of Fish and Game, Juneau. 30 pp.

In 1981-83, the 1st phase of a study was begun to determine the status and reproductive biology of a grizzly bear (*Ursus arctos*) population in the northcentral Alaska Range. During this period, 56 bears were captured and 45 were radio-collared; captured bears included 26 males and 30 females. Minimum estimated population density for the study area was 1.85 bears/100 km^2. Initial analysis of the structure of the population showed that few mature males were present, possibly the result of hunting pressure. Evidence suggests that females have a potentially long reproductive life span; at least some produce their first litters at about age 6 and a 25.5-year-old female weaned her 2.5-year old offspring and bred. Based on 13 litters, including those of both cubs and yearlings. mean litter size was 1.8. All measures of population biology which were calculated should be considered tentative and contingent upon the collection of additional data.

During 1982-83, 21 mortalities were recorded in the study area: 10 hunter kills, 6 offspring of marked females, 2 capture-related deaths, 1 adult female that was killed by an adult male, 1 adult female that died in her den, and an unmarked yearling which was not seen after the capture attempt and was presumed dead. Historical sport hunting records of grizzly bears in the study area during 1961-83 are reported. Analysis of the effects of present harvest on the population will await determination of population structure and reproductive biology.

The extent of movement and sizes of home range were apparently dependent upon sex and age of individuals. In general, adult males moved the farthest and had the largest home range sizes. Home ranges and movements of breeding females, females with offspring, and young-age animals of both sexes were much smaller than adult males, and there was a lot of individual variation within the sex and age classes,

Reynolds, H.V., and J.L. Hechtel. 1985. Population structure, reproductive biology, and movement patterns of grizzly bears in the northcentral Alaska Range. Progress report. Project W-22-3, Job 4.16R. Alaska Department of Fish and Game, Juneau. 29 pp.

In 1981, the 1st phase of a study was begun to determine the status and reproductive biology of a grizzly *bear (Ursus arctos)* population in the northcentral Alaska Range. During 1981-84, 58 bears (28 males and 30 females) were captured; 48 of these bears were radio-collared. Currently, 19 bears are radio-collared (5 males, 14 females). Minimum estimated population density for the study area was 1.85 bears/100 km^2. Initial analysis of the structure of the population showed that few mature males were present, possibly the result of hunting pressure. Evidence suggests that females have a potentially long reproductive life span; at least some produce their first litters at about age 6 and a 25.5-year-old female weaned her 2.5-year-old offspring and bred. Based on 19 litters of both cubs and yearling age classes, mean litter size was 1.95.

During 1981-84, 55 mortalities were recorded in the study area: 34 hunter kills, 2 nonsport kills, 6 capture-related, 11 missing offspring, and 2 natural adult mortalities. Movements ranging from 44 -78 km were recorded for 3 3.5-year-old males. Six other 2.5- and 3.5-year-old bears (4 males, 2 females) remained within their maternal home ranges.

Reynolds, H.V., and J.L. Hechtel. 1986. Population structure, reproductive biology, and movement patterns of grizzly bears in the north-central Alaska Range. Final Report. Projects W-21-2, W-22-2, W-22-3, and W-22-4; Job 4.16R. Alaska Department of Fish and Game, Juneau. 53 pp.

In 1981 a study was begun to determine the status and reproductive biology of a grizzly bear *(Ursus arctos)* population in the northcentral Alaska Range. During the years 1981-1985, 66 bears (33 males, 33 females) were captured; 54 of these bears were radio-collared (7 males, 14 females). The estimated population declined from 97-107 in 1982 to 79-89 in 1985. Minimum estimated population density for the study area in 1985 was 1.64 bears/100 km^2. Analysis of the structure of the population showed that few mature males were present, possibly as the result of hunting pressure, and that by 1985 both male and female numbers had declined. In addition, there were fewer females in the 3- to 5-year-old age class. Evidence suggests that females have a potentially long reproductive life span; at age 7 years some produce their first surviving litter and one 25.5 year-old female bred again after weaning her 2.5-year-old offspring. Based on 24 litters of both cub and yearling age classes, mean litter size was 2.00. Minimum reproductive interval was 4.1 years and the production success rate was 73%.

During the years 1981-85, 65 mortalities were recorded in the study area: 34 hunter kills, 2 illegal kills, 1 "defense of life or property" kill, 7 capture-related deaths, 19 offspring which were presumed dead, and 2 adult natural mortalities. Based on the present harvest rate, the reduced number of adult females in the population, and the few females in the 3- to 5-year-old age classes, we feel the population will continue to decline. Movements ranging from 44 to 78 km were recorded for four 3.5 year-old males. Eleven other bears 2-4 years of age (8 males, 3 females) remained within their maternal home ranges.

22. Reynolds, H.V., J.A. Curatolo, and R. Quimby. 1976. Denning ecology of grizzly bears in northeastern Alaska. International Conference on Bear Research and Management 3:403-409.

This paper details a study of the denning ecology of grizzly bears in the eastern Brooks Range along the southwestern border of the Arctic National Wildlife Refuge, Alaska, during April-November 1972-74. Systematic aerial searching and radio-tracking revealed 52 dens, including 29 active dens (23 dug and 6 in caves) for which the winter use was known and 23 inactive dens (16 dug and 7 in caves) for which the year of use could not be determined. Of the 52 dens, 47 (90%) were on southerly slopes, 4 (8%) were on northerly slopes, and 1 (2%) was on an easterly slope. The den sites, excluding three coastal plain dens, had a mean elevation of 1040 m asl and a mean elevation of 180 m above the valley floor. Most dens were on slopes of 20 to 35 degrees. No re-use of dug dens was found in this study; however, the authors presume that rock cave dens may have been used more than once. Bears in the study appeared to be prone to abandon dens when disturbed during or shortly after den construction.

Reynolds, H.V., J.L. Hechtel, and D.J. Reed. 1987. Population dynamics of a hunted grizzly bear population in the north-central Alaska Range. Progress Report. Project W-22-5, Job 4.19R. Alaska Department of Fish and Game, Juneau. 59 pp.

Population density and harvest rates for a grizzly bear (*Ursus arctos*) population in the northcentral Alaska Range were estimated during the years 1981 through 1986. Baseline population status and reproductive biology were determined during the years 1981 through 1985; the effects of increased harvest on this population will be the focus of investigations from 1986 through 1991. A population density estimation method was tested in a 950 km^2 portion of the study area in 1986, resulting in a point estimate of 10.67 bears 22 years of age (95% CI=7.59-25.44 bears) and a density of 1.12 bears 12 years of age/ 100 km^2 (95% CI=0.80-2.68 bears/100 km’). The point estimate provided a close approximation to the density which we calculated and adjusted for population Closure on our study area (1.04 hears ≥2 years of age/100 km^2), but the wide confidence intervals indicate the estimate’s usefulness is limited. However, these confidence limits would have been improved if we had searched quadrats for more than 3 days. Based on problems with violation of mark-recapture assumptions, as well as sightability biases, we recommend estimating population densities for bears 22 years of age only.

Only minor changes from past patterns of harvest rates, population production, or survival rates were observed in 1986. All population estimates calculated during 1986 were adjusted for population closure. The estimate of harvest rate for the minimum study area population was 11.5% in 1986 compared with the 1981-86 mean rate of 11.8%. Minimum population size of grizzlies ≥2 years of age increased from an estimated 34.4 in 1985 to 40.5 in 1986; however, a decline is still evident from the 1981 estimate of 53.0

bears 22 years of age. The difference between 1985 and 1986 population estimates of bears 22 years of age can be largely accounted for by the complete loss of the 1983 cub cohort.

Reynolds, P.E., H.V. Reynolds HI, and F.H. Follmann. 1986. Responses of grizzly bears to seismic surveys in northern Alaska. International Conference Bear Research and Management 6:169-175.

Responses of denning grizzly bears (*Ursus arctos*) to noise associated with winter seismic surveys and small fixed-wing aircraft were studied on the north slope of Alaska during the years 1978- 1981. Changes in signal amplitude and collar temperature were monitored in 4 bears denned near seismic lines. Heart rates monitored by implanted transmitters were measured in 1 of these bears and in a 2nd bear not subjected to seismic exploration activities. None of the bears left their dens as a result of seismic exploration activities. In undisturbed midwinter conditions, heart rates of 2 denned bears ranged 12-26 beats/min, but rose to 30-50 beats/min for brief periods at least once or twice in 24 hours. Signal amplitudes and collar temperatures, monitored in 1 bear, did not vary. During 3 days when were working near 1 den, changes in signal amplitude, accompanied by increases in heart rate to a maximum of 64 beats/min, indicated that the bear moved several times. Heart rates of 2 bears recorded during midwinter overflights were the same as those measured in midwinter from the ground in undisturbed conditions. About the time of emergence, heart rates were higher than those recorded in midwinter and during undisturbed resting behaviour in mid-June.

Reynolds, P.E., H.V. Reynolds HI, A. Gunn, and P.L. Clarkson. Manuscript. Grizzly bear predation on muskoxen in northeastern Alaska and Canada. 12 pp.

Abstract or summary not present.

Ruttan, R.A. 1974. Observations of grizzly bear in the northern Yukon Territory and Mackenzie River Valley, 1972. Ch. VII *in* Ruttan, R.A. and D.R. Wooley, eds. Studies of furbearers associated with proposed pipeline routes in the Yukon and Northwest Territories. Canadian Arctic Gas Study Ltd., Biological Report Series Volume 9.

Abstract or summary not present.

Schallenberger, A. 1980. Review of oil and gas exploitation impacts on grizzly bears. International Conference on Bear Research and Management 4:271-276.

In Montana, the study of grizzly bears (*Ursus arctos*) and their habitat in areas proposed for oil and gas exploitation is in the beginning stages, with few baseline data available for predevelopment guidelines. A review of literature on grizzly bears indicates exploration and development will be generally detrimental to the bears. Construction of roads into previously unroaded areas and increased use of the land by people appear to have the greatest impacts. Problems of man-bear confrontations in the Alaska pipeline experience include nonresidents' difficulties coping with resident wildlife species, illegal shooting of animals, attraction of animals to garbage at field camps, and harassment from aircraft and other motorized vehicles. Conflicts with grizzly bears prior to development of oil and gas must be determined in order to assess the effects of resource exploitation, including the cumulative influence of various land uses. Habitat essential for the survival of the grizzly bear must be identified and protected. If development occurs in areas of occupied grizzly habitat before adequate management data for grizzly bears are available, it should proceed cautiously, thus preventing irreversible damage to the habitat and the bear populations. If full development is unavoidable, restrictions should be placed on road-building, exploration, wells, fuel production, and associated activities, especially at times when grizzly bears make heavy use of a locality.

Schirokauer, D.W., and H.M. Boyd. 1998. Bear-human conflict management in Denali National Park and Preserve, 1982-94. Ursus 10:395-403.

In response to a dramatic increase in visitation and in problems with grizzly and black bears *(Ursus arctos, U. americanus)* during the 1970s, Denali National Park and Preserve implemented a comprehensive bear-human conflict management plan in 1982. The components of Denali's bear-human conflict management plan include visitor education, food-storage regulations, backcountry closures, and experimental aversive conditioning. Prior to the opening of a paved highway to the National Park in 1972, reports of bear-inflicted injuries, property damage, and bears obtaining anthropogenic food averaged cl/year. In 1982, 40 such incidents occurred. After implementation of the bear-human conflict management plan, incidents decreased steadily until 1988 when 9 occurred, a decrease of 77%. Incidents in which bears obtained anthropogenic food decreased from 23 in 1982 to 1 in 1989, a decrease of 96%. A recent slight increase in incidents (all types) may reflect the activities of either a few bears before they were removed or aversively conditioned, or bears which were never subjected to management actions. Since 1984, aversive conditioning was conducted on 2 black bears and 9 grizzly bears. In 8 of these cases, the bears avoided test camps and did not cause further problems during the season aversive conditioning occurred. Four of the bears aversively conditioned in the backcountry stayed away from camps for at least 2 years. Bears successfully broke into bear-resistant food containers in 12 of 55 attempts since 1979, due to improperly latched or defective lids and overfilled containers. There have been no reports of bears breaking into the newest model of bear-resistant food container. This work updates previous analyses of bear-human conflict in Denali National Park and Preserve.

Schoen, J.W. 1990. Bear habitat management: a review and future perspective. International Conference on Bear Research and Management 8:143-154.

Throughout the world, bears are declining in numbers and range as habitat is reduced and bear-human interactions increase. Although ursids are widely distributed and inhabit a variety of habitats, they possess a number of biological characteristics that make them particularly vulnerable to conflict with humans. The habitat concept is discussed relative to the unique characteristics of bears. Because bears are wide-ranging species of landscapes, habitat relationships must be evaluated on a broader context than habitat per se. Human activities and land uses must be factored into bear habitat relationships. Forest clearing and road building, in particular, are common problems for the conservation and management of many bear populations. An understanding of the processes of habitat fragmentation and population extinction is necessary for maintaining viable bear populations in the face of increasing habitat destruction and isolation. Several management tools and research needs for bear habitat management are discussed.

23. Servheen, C., S. Herrero, and B. Peyton. 1999. Bears: status survey and conservation action plan. IUCN, Gland, Switzerland and Cambridge, UK. 309 pp.

Abstract or summary not included here.

24. Shideler, R., and J. Hechtel. In press. Grizzly bear. Pages 105-132 *in* J.C. Truett and S.R. Johnson, eds. The natural history of an arctic oil field: development and biota. Academic Press, New York.

Abstract or summary not present.

25. Sidorowicz, G.A., and F.F. Gilbert. 1981. The management of grizzly bears in the Yukon, Canada. Wildlife Society Bulletin. 9:125-135.

A computer assisted model of grizzly bear (*Ursus arctos* L.) population growth in the Yukon Territory was developed and used to project changes in a hypothetical population based on biological data for the species. The changes observed depended mainly on the levels of adult mortality to which the model population was exposed. It appears that an annual sport harvest of 2-3% (about 100 bears) would be a safe management goal; the projection carried forward 50 years at that harvest level showed no decline in population size. Management recommendations include restrictions to control population structure and breeding potential by protecting cubs and females with cubs, and the establishment of a "1 grizzly per lifetime" limit and license quotas for nonresident hunters. In addition, further insurance against overhunting could be obtained if effective management zones based on ecophysical criteria were created.

Smith, B.L. 1990. Sex weighted point system regulates grizzly bear harvest. International Conference on Bear Research and Management 8:375-383.

A system that provided outfitters guiding non-resident hunters with a 3: 1 incentive to take male over female grizzly bears was tested in 20 outfitting areas in the Yukon Territory between 1985 and 1988. This system replaced annual quotas, 1980-1984, that had been criticized as being too small, too inflexible, and lacking incentive for male-selective or dispersive harvest. This new system was implemented in each outfitting area. Sex was confirmed through compulsory inspection of "male" pelts with attached bacula. Most other regulations were unchanged.

Most of the 20 outfitters modified hunting operations and behaviours. The behavioural changes most likely to increase male harvest were increased upland hunting, spring hunting, small plane use and hunting over "gutpiles". Generally, the kill increased, sex ratios changed little, the proportion of older bears taken increased, and the head size of bears taken increased. Future increases in male harvest are expected, but will require training of hunting guides. Outfitters ranked flexibility, opportunity to increase harvests if male proportions increased, frank individual discussions with biologists, increased potential harvest, and new population estimates, as the most beneficial attributes of this program.

Smith, B.L., and D.G. Lindsay. 1989. Grizzly bear management concerns associated with a northern mining town garbage dump. Pages 99- 103 *in* NWT Department of Renewable Resources, Bear-people conflicts: proceedings of a symposium on management strategies, Yellowknife, N.W.T.

Faro, a typical northern mining town in Yukon, evolved in the absence of any controls and planning efforts addressing solid waste management and wildlife concerns. As a result, garbage was dumped within 750 m of the town without any consideration for the potential effects on bear populations and human safety. This poor refuse disposal system created 9 identifiable grizzly bear (*Ursus arctos*) management problems: (1) property damage, (2) threat to human safety, (3) increased poaching, (4) lethal removal of "problem" bears, (5) reduced commercial hunting opportunities, (6) increased cost of problem bear management, (7) susceptibility to litigation, (8) physical injuries and deteriorated health of bears, and (9) poor public attitudes. These problems were revealed through numerous occurrence reports submitted to the government, 3 seasons of observation at the dump, 1 year of marking and radio-tracking bears, and interviews with local residents. The collected information indicated that dump-frequenting grizzly bears were often seen around the town perimeter and occasionally entering the residential areas. Some bears damaged garbage storage facilities within the town. As well, examples of specific occurrences included one marked bear causing $12,000 damage to several outfitter camps while searching for food, a cyclist being chased and having his bicycle damaged by a marauding bear, and the destruction of a marked bear attempting to approach an occupied trapping camp after deterrent attempts failed.

Inadequacies in present refuse management practices need to be remedied. Legislative changes to compel the mining industry to address current deficiencies in refuse control must be initiated. In addition, major efforts must be made to use new technologies in developing efficient and inexpensive community garbage systems that eliminate the problem of garbage availability to bears.

Smith, M.E., and E.H. Follmann. 1993 Grizzly bear, *Ursus arctos*, predation of a denned adult black bear, *U. americanus*. Canadian Field-Naturalist 107:97-99.

During a radio-tracking flight to document denning activity of Black Bears (*Ursus americanus)* in interior Alaska. a Grizzly Bear (*U. arctos*) was seen actively digging at the den of a radio-collared adult female Black Bear. Subsequent investigation of the site

revealed numerous bone fragments and a chewed radio-collar indicating predation. The den showed a second entrance where the Grizzly Bear had been digging and was successful in forcing the Black Bear to flee and be killed in the area immediately adjacent to her den.

26. Smith, M.E., J.L. Hechtel, and E.H. Follmann. 1994. Black bear denning ecology in interior Alaska. International Conference on Bear Research and Management 9:513-522.

From 1988 to 1991 we observed the denning activity of 27 radio-collared black bears (*Ursus americanus*) at 57 dens on the Tanana River Flats, near Fairbanks, Alaska. This is the northernmost population of black bears studied using radio telemetry, and nears the northern extreme of their range. We compared differences in den chronology, morphology, and habitat use, among sex, age, and reproductive classes. All bears pooled across all years gave a mean den entry date of 1 October, a mean emergence date of 21 April, and a mean den period of 205 days. Females denned earlier (30 Sep vs. 4 Oct), emerged later (23 Apr vs. 15 Apr), and had longer den periods (208 days vs. 195 days) than males. No significant differences were observed in denning chronology between adults and subadults, or among female reproductive classes. Differences in den characteristics between sex, age, and female reproductive classes were generally insignificant, except that males had larger dens than females, and females denning with young had the largest dens among the female reproductive classes. Most dens were excavated (83%, n=41), and all contained nesting material. Reuse was low (18%, n=34) and 10 dens (29%) were flooded to varying levels. Bears significantly favored willow/alder and black spruce habitat types for den sites, avoiding marshland and heath meadow habitat types.

Spraker, T.H., W.B. Ballard, and S.D. Miller. 1981. Game Management Unit 13 brown bear studies. Final report. Projects W-17-10, W-17-11 and W-21-1; Job 4.13R. Alaska Department of Fish and Game, Juneau. 57 pp.

Thirty-eight brown bears were captured and marked by the Alaska Department of Fish and Game in Game Management Unit 13 from 9 April to 23 June, 1978. Twenty-three of these bears were radio-collared. Phencyclidine hydrochloride was used to immobilize bears from a Bell 206 Jet Ranger B helicopter. Eighty-one percent of the bears were immobilized with a single drug injection. Drug dosages were: 1.4 mg/lb for yearlings, 1.0 mg/lb for females and young males and 0.75 mg/lb for adult males. Cubs-of-the-year were captured by hand. Induction time averaged 8.8 minutes and ranged from 4 to 16 minutes.

Sex ratios (1961-1979) and mean age (1969-1979(of bears reported in the sport harvest from GMU 13 were compared to those of captured bears. Males comprised 53 percent of the captured bears and 57 percent of the bears harvested. The mean age of 304 harvested males was 6.4 years compared to 6.6 years for 18 captured males. The mean age of 219 harvested females was 6.8 years compared to 7.7 years for 16 captured females. Only bears over 2.0 years of age were included in calculations of mean age of captured *animals.*

Morphological measurements are presented and briefly discussed. The largest skull measured (male) was 69.2 cm (length + width).

Baseline blood values for spring captured bears are presented.

During spring and fall 1978, 23 radio-collared bears were observed on 78 kills. Moose of all age classes comprised 87 percent of the kills. Calf moose comprised 57 percent of the moose kills and 47 percent of the total kill

Radio-collared bears preyed upon moose calves until mid-July. This confirmed results of the moose calf mortality studies which indicated that bear predation was a significant cause of calf moose mortality. After mid-July bears were observed preying upon adult moose and caribou. Overall, radio-collared bears made one ungulate kill every 6.1 days. There were no apparent differences in rates of predation between bears of various ages or family status.

27. Stemlock, J.J., and F. C. Dean. 1986. Brown bear activity and habitat use, Denali National Park-1980. International Conference on Bear Research and Management. 6:155-167.

Brown bears (*Ursus arctos*) were observed in 2 alpine areas in Denali National Park, Alaska, in 1980. The dispersion and variety of habitat types and seasonal changes in food availability influenced use of the areas by brown bears. The presence of mated pairs apparently excluded family units. Habitat use and activities of bears were influenced by the phenological development of crowberry (*Empetrum nigrum*), peavine (*Hedysarum alpinum*), horsetail (*Equisetum arvense*), polar grass (*Arctagrostis latifolia*), soapberry (*Shepherdia canadensis*), and availability of animal food items.

Stringham, S.F. 1990. Grizzly bear reproductive rate relative to body size. International Conference on Bear Research and Management 8:433-443.

Mean adult body sizes (BS) and reproductive parameters were compared across 12 populations of grizzly bears (*Ursus arctos*). BS was assessed in terms of mean adult body weight (BW) and skull length (SL). BWs of adult males and females are positively related to each other and to SL. As BS increases, litter size (C/L) and natality (C/L/IBI) tend to increase, while interbirth interval (IBI) and age at first whelping (AFW) decrease. To the extent that IBI and AFW are inversely related to maturation rates to weaning and adulthood, respectively, these results indicate a positive relationship between maturation rate and BS in a population. Both BW and SL are inexpensive predictors of reproductive rate reliable enough for management purposes where reproductive data are lacking.

Sundbo, B. 1992. Bear Management Plan • Kluane National Park Reserve. Environment Canada, Canadian Parks Service, Haines Junction. 43 pp.

This "Bear Management Plan' was developed to update the policies and operational practices in the previous plan which was written in 1985 and revised in 1987. The time period for which this plan is intended to remain valid is five years, 1992-1997. Implementation of this plan will require an annual commitment of 0.5 person years and 10.0 O&M dollars, to a total of 2.5 person years and 50.0 O&M dollars, over the life of the plan.

The Park Management Plan (1990) has identified the requirement for increased knowledge about grizzly bear populations found in Kluane. A multi-year grizzly bear study has been initiated this year. The study is a co-operative effort between the Canadian Parks Service and the University of British Columbia, with participation from the Yukon government's Dept. of Renewable Resources.

The planned six year study has a Canadian Parks Service project budget of $1,031,700.00. The University of British Columbia and the Yukon Territorial Government have agreed to contribute resources for this study.

Operational policies and procedures outlined in this plan are intended to reduce the accessibility of bears to human food and garbage, thereby reducing human/bear encounters. Bear-proof garbage containers, and the use of bear-resistant food containers are two examples of management strategies adopted to assist in the wilderness integrity of the bear populations of Kluane.

Closures of areas and trails is promoted where the likelihood of undesirable human/bear encounters is high. This management strategy will become increasingly important as park managers of habitats bears tend to frequent during their active season. Presently closures for serious human/bear encounters are being managed differently from closures resulting from a female grizzly with cubs frequenting the area. Closures resulting from the latter do not require any immediate evacuation of visitors from the area; rather they will be allowed to exit the closed area normally, while no new visitor groups are allowed access until the closure is rescinded. This strategy is intended to restrict further saturation of the area by humans; thereby providing adequate spatial area for bear family groups with which to avoid contact with humans.

In order to manage bears within the ecosystem concept, this plan acknowledges the need to discuss bear management policies both in and adjacent to Kluane National Park with other agencies, neighbouring jurisdictions, including First Nations peoples who reside in the region.

Taylor, M., ed. 1994. Density-dependent population regulation in black, brown, and polar bears. International conference on Bear Research and Management. Monograph Series No. 3. 43 p.

Although all populations are ultimately regulated by density-dependent processes, the range of population densities where density affects vital rates and the mechanisms by which density influences population dynamics have not been demonstrated for any bear population. The per capita rates of birth and death that determine the growth rate and sustainable yield rate of bear populations are partly dependent on the population number. Understanding density effects in bears is complicated by multiple year reproduction schedules, low reproduction potential, physiological and behavioral plasticity, long generation time, large home range, low population densities, and high research costs. Most if not all populations of bears have been reduced from maximum density (carrying capacity) by human induced mortality (i.e., harvest, defense, poaching, or incidental kills). Plausible hypotheses have been advanced regarding the mechanism of population regulation for bears, however re-examination of these studies suggests that alternate explanations are also supported by the available data. Evidence for any general or specific form of density effects for any population is inconclusive. Given this uncertainty, and the likelihood that maximum sustainable yield will occur close to carrying capacity, we recommend that managers assume that no increases in reproduction and no decreases in rates of natural mortality will result from reductions in population numbers, at least until such a time that density-dependent mechanisms of population regulation in bears have been documented.

Verlaine-Wright, S.W.A., B.L. Smith, and S.G. Meester. 1988. Molar differences in black and grizzly bears: a new system to distinguish interior bears from the central Yukon and northern British Columbia. Yukon Department of Renewable Resources, Fish and Wildlife Branch, Whitehorse. 17 pp.

1. Every year there is at least one serious disagreement in bear species identification between hunters and wildlife officials.
2. A few disagreements cannot be resolved using published dental criteria. The Yukon bears are substantially different in a morphological sense from southern British Columbia or California bears that other researchers have used. A cooperative study between Simon Fraser University and the Yukon Fish and Wildlife Branch was set up to resolve the problem.
3. Teeth are used because they don't grow after erupting from the gum and have minimal variation between individuals of the same species.
4. Wild black and grizzly bears do not interbreed.
5. Eight measurements and observations, mainly of molars, were taken for each of 30 grizzly and 59 black bears, mainly from the southern Yukon.
6. One of the 8 previously published techniques correctly identified all bears. The other techniques correctly identified 80-100% of the grizzly bears and 0- 100% of the black bears.
7. A method was developed that will correctly identify the skull as follows:

a. 1. On the lower jaw locate the third tooth from the back on either the left or right side (Mandibular Premolar 4).
2. Observe if a medial cusp is located in the valley of the tooth.
3. If the tooth is heavily worn or missing go on to the next technique. If a medial cusp is not present, a black bear is indicated.

b. 1. Measure the length of the hindmost tooth on the upper jaw (Maxillary Molar 2).

Measure both the right and left teeth.
2. Measure the length of the next to hindmost tooth on the upper jaw (Maxillary Molar 1). Measure both the right and left teeth.
3. Insert the averages of each of the two tooth measurements into the formula M=(3.6 x Average length of the hindmost upper teeth) + (3.1 x Average length of next to hindmost upper teeth) - 170.
4. If M is greater than 0, a grizzly is indicated. If M is less than 0, a black bear is indicated.

c. 1. Measure the length of the hindmost tooth on the upper jaw (Maxillary Molar 2). Measure both the right and left teeth.
2. Measure the width of the next to hindmost tooth on the upper jaw (Maxillary Molar 1). Measure both the right and left teeth.
3. Insert the averages into the formula M=(3.6 x Average length of the hindmost upper teeth) + (3.8 x Average width of the next to hindmost upper teeth) - 163. If M is greater than 0, a grizzly is indicated. If M is less than 0, a black bear is indicated.

8. It is recommended this method be adopted by the Yukon Fish and Wildlife Branch. Further study, particularly in northern bears, is recommended.

Waits, L., D. Paetkau, C. Strobeck, and R.H. Ward. 1998. A comparison of genetic diversity in North American brown bears. Ursus 10:307-314.

To determine if threatened brown bear (*Ursus arctos*) populations of Montana and Wyoming have lower levels of genetic variation than other North American populations, we examined mitochondrial DNA (mtDNA) and nuclear microsatellite DNA diversity in 220 brown bears from 5 areas: Kodiak Island, Alaska; Kluane National Park, Canada; Eastern Slope of the Rockies (East Slope), Canada; Yellowstone ecosystem (YE), Wyoming and Montana; and Northern Continental Divide Ecosystem (NCDE), Montana and British Columbia. Nei's genetic diversity (h) was estimated by analyzing 296 base pairs of control region sequence data from mtDNA and by microsatellite analysis of 8 independent loci. Genetic diversity was lowest in the Kodiak Island sample. The YE and East Slope samples had intermediate levels of mtDNA diversity and microsatellite diversity. Kluane and NCDE samples had high levels of mtDNA and microsatellite diversity. Genetic diversity in the YE and NCDE samples was lower than in the Kluane sample; however, these differences were statistically significant ($P<0.05$) for only 1 microsatellite locus in the YE sample. In contrast, the Kodiak Island sample had significantly less diversity ($P<0.05$) than the Kluane sample at the mtDNA locus and 6 microsatellite loci. Because genetic diversity has been suggested as critical for the evolutionary fitness of wild populations, the management implications of these results are examined and discussed.

28. Waits, L.P., S.L. Talbot, R.H. Ward, and G.F. Shields. 1998. Mitochondrial DNA phylogeography of North American brown bears and implications for conservation. Conservation Biology 12:408-417.

The historical distribution of the brown bear (*Ursus arctos*) in North America included Alaska, western Canada, the western **and** midwestem states, plus northern Mexico. Currently, the brown bear is limited to Alaska, the Canadian provinces of the Yukon, Northwest Territories, British Columbia, and Alberta, and six threatened subpopulations in the lower 48 states. To examine the evolutionary history of *U. arctos* in North America and to assess the genetic divergence between individuals from different geographic regions, we obtained 294 nucleotides of mitochondrial DNA sequence data from the control region for 3 17 free-ranging brown bears. Twenty-eight unique sequences, or mitochondrial DNA haplotypes were detected. The average sequence divergence between haplotypes was high (4.3%), and some haplotypes differed by as many as 23 nucleotides. Phylogenetic analyses using maximum parsimony revealed four major mitochondrial DNA phylogeographic groups, or clades. The significant phylogeographic structure detected in brown bears strongly contrasts with results obtained for other large carnivores and suggests limited female-mediated gene flow. The mitochondrial DNA phylogeographic clades do not correlate with taxonomic classifications for *U. arctos*, and we hypothesize that the clades were formed prior to migration of this species into North America. We suggest evolutionarily significant units for conservation in three geographic regions: (1) the Alaskan islands of Admiralty, Baranof, and Chichagof; (2) mainland Alaska, Kodiak Island, and northern Canada; and (3) southern British Columbia, southern Alberta, and the states of Idaho, Montana, and Wyoming.

Weilgus, R., R. McCann, and F.L. Bunnell. 1992. Study design for Kluane National Park Reserve grizzly bear research program. Canadian Parks Service, Prairie and Northern Region, Winnipeg. 52 pp.

Abstract or summary not included here.

Wellwood, D.W., and A.G. MacHutchon. 1999a. Risk assessment of bear - human conflict at campsites on the Alsek River, Kluane National Park, Yukon. Parks Canada, Kluane National Park and Reserve, Haines Junction. 64 pp.

A bear - human conflict risk assessment was conducted at campsites on the Alsek River in Kluane National Park, Yukon. The study area, between Serpentine Creek on the Dezadeash River and the British Columbia border on the Alsek River, was approximately 105 river kilometres long. The risk assessment objectives were to: 1) qualitatively assess and rate the potential for bear - human encounters at campsites, 2) qualitatively assess and rate the potential for displacement of bears from habitats at or adjacent to campsites, and 3) make management recommendations to Parks Canada to reduce the potential for bear - human conflicts at campsites. We qualitatively described and rated the following at each campsite: 1) relative habitat potential, including a broad vegetation description and presence and relative abundance of food plant species used by bears, 2) travel concerns, including constrictions in terrain, steep slopes and valley junctions that might influence the likelihood of bears travelling through an area, and 3) sensory concerns that reduced the ability of bears and humans to detect each other, such as poor visibility, persistent outflow winds, and loud noise from creeks. We recorded bear sign observed at and adjacent to campsites including scats, feeding sign, wildlife trails, mark trees, mark trails, **and** beds. Sixty-two campsites were identified and **fifty** were assessed and rated for their potential for bear - human conflict (35 in 1996 and 15 in 1998). Data from the Alsek Wilderness Survey of 1996 (Dill et al. 1997) and bear - human interactions on the Alsek River are discussed (Parks Canada unpubl. data). The Alsek Wilderness Survey was designed to determine how rafters learned about bears and the percentage of rafters taking measures to actively avoid bear - human interactions. We have included management recommendations that are intended to help minimize bear - human encounters **and** displacement of bears along the Alsek River.

Wellwood, D.W. and A.G. MacHutchon. 1999b. Risk assessment of bear - human conflict at campsites on the Alsek River, Tatshenshini-Alsek Park, British Columbia. BC Parks, Skeena District, Smithers. 56 pp.

A bear - human conflict risk assessment was conducted at campsites on the Alsek River in Tatshenshini-Alsek Park, B.C. The study area, between the B.C./Yukon border and the B.C./Alaska border, was approximately 100-river km. The risk assessment objectives were to: 1) qualitatively assess and rate the potential for bear - human encounters at campsites, 2) qualitatively assess and rate the potential for displacement of bears from habitats at or adjacent to campsites, and 3) make management recommendations to BC Parks to reduce the potential for bear - human conflicts at campsites. We qualitatively described and rated the following at each campsite: 1) relative habitat potential, including a broad vegetation description and presence and relative abundance of food plant species used by bears, 2) travel concerns, including constrictions in terrain, steep slopes and valley junctions that might influence the likelihood of bears travelling through an area, and 3) sensory concerns that reduced the ability of bears and humans to detect each other, such as poor visibility, persistent outflow winds, and loud noise from creeks. We recorded bear sign observed at and adjacent to campsites including scats, feeding sign, wildlife trails, mark trees, mark trails, and beds. Twelve campsites were identified, assessed and rated for their potential for bear - human conflict. We have included management recommendations and considerations that are intended to help minimise bear - human encounters and displacement of bears along the Alsek River.

Wellwood, D.W., and A.G. MacHutchon. 1999c. Risk assessment of bear-human conflict along the Donjek Wilderness Route, Kluane National Park and Reserve, Yukon. Parks Canada, Kluane National Park and Reserve, Haines Junction. 34pp.

A risk assessment of bear - human conflict was conducted along a portion of the Donjek Wilderness Route in and adjacent to Kluane National Park Reserve, Yukon. The Donjek Wilderness Route is an approximately 100 km long semi-loop route in the northern region of the park. The study area included the western and southern portion of the route (approximately 73-km) between the mouth of Hoge Creek at the Donjek River and the Alaska Highway at Copper Joe Creek. The risk assessment objectives were to: 1) qualitatively assess and rate the potential for bear - human encounters along the route and at campsites, 2) qualitatively assess and rate the potential for displacement of bears from habitats along route segments, adjacent to campsites and at campsites, and 3) make management recommendations to Parks Canada to reduce the potential for bear - human conflicts along the route and at campsites.

Ten route segments were identified and six campsites were evaluated. We described and rated relative seasonal habitat potential, travel concerns, visibility concerns, and other sensory concerns along each route segment and at each campsite. We also recorded bear sign. Route segments and campsites were then rated for their seasonal potential for bear - human conflict, i.e., displacing or encountering bears. The overall habitat potential and potential for bear - human conflict along the portion of the Donjek Wilderness Route we surveyed were lower than for either the Cottonwood Trail or Alsek River on which similar assessments were conducted (Wellwood and MacHutchon 1999a, Wellwood and MacHutchon 1999b). We made general management recommendations that are intended to help minimise bear - human encounters and displacement of bears along the Donjek Wilderness Route.

Wellwood, D.W., and A.G. MacHutchon. 1999d. Risk assessment of bear-human interaction along the Cottonwood Trail, Kluane National Park, Yukon. Parks Canada, Kluane National Park and Reserve, Haines Junction. 62 pp.

A risk assessment of bear-human interactions was conducted along the Cottonwood Trail in Kluane National Park, Yukon. The Cottonwood Trail is an 83-km semi-loop wilderness trail in the southern region of the park. Parks Canada has classified the hike as difficult and they recommend four to six days to complete the trip. Risk assessment objectives were to: 1) assess and rate the potential for bear-human encounters at campsites and along the trail, 2) assess and rate the potential for displacement of bears from habitats at or adjacent to campsites and along the trail, and 3) make management recommendations to Parks Canada to reduce the potential for bear-human interaction at campsites and along the trail.

We quantitatively or qualitatively described and rated the following at each campsite and along each trail segment: 1) relative habitat potential, including a broad vegetation description and presence and relative abundance of plant foods used by bears, 2) travel concerns that influenced the likelihood of bears travelling through the area, such as wildlife trails, constrictions in terrain, steep slopes, and valley junctions, and 3) sensory concerns that reduced the ability of bears and humans to detect each other, such as poor visibility, persistent outflow winds, and loud noise from creeks. We recorded bear sign seen at and adjacent to campsites and the trail including scats, feeding sign, wildlife trails, mark trees, mark trails and beds. Thirty-four campsites were identified and 24 were assessed and rated. Thirty-nine trail segments were identified and rated. There were more moderate or higher risk ratings in late summer than in any other season for campsites and trail segments. Data on bear-human interactions on the Cottonwood Trail are discussed. We include management recommendations that are intended to help minimize bear-human encounters and displacement of bears along the Cottonwood Trail.

Wellwood, D.W., and A.G. MacHutchon. 1999e. Risk assessment of bear - human

interaction at campsites on the Alsek River, Kluane National Park, Yukon: addendum to July 1999 report. Parks Canada, Kluane National Park and Reserve, Haines Junction. 19 pp.

Abstractor summary not present.

Wellwood, D.W., and A.G. MacHutchon. 2000. Risk assessment of bear – human interaction in the Mush & Bates Lakes area, Kluane National Park, Yukon. Parks Canada, Kluane National Park and Reserve, Haines Junction. Draft.

A risk assessment of bear – human interaction was conducted at campsites and on trails in the Mush and Bates Lakes area in southern Kluane National Park, Yukon. Mush Lake is approximately 10 km long and Bates Lake is approximately 13 km long. A one-km long creek separates the lakes. The study area included campsites and trails located along the lakes and along the creek. The risk assessment objectives were to: 1) assess and rate the potential for bear – human encounters at campsites and along trails; 2) assess and rate the potential for displacement of bears from habitats at campsites and adjacent to campsites and along trails, and 3) make management recommendations to Parks Canada to reduce the potential for bear – human interactions at campsites and along trails.

We quantitatively and/or qualitatively described and rated the following at each campsite and along each trail: 1) relative habitat potential, including a broad vegetation description and presence and relative abundance of food plant species used by bears; 2) travel concerns, including trails, constrictions in terrain, steep slopes and valley junctions that would influence the likelihood of bears travelling through an area; and 3) sensory concerns that reduced the ability of bears and humans to detect each other, such as poor visibility, persistent outflow winds, and loud noise from creeks. We recorded bear sign observed at and adjacent to campsites and on trails including scats, feeding sign, wildlife trails, mark trees, mark trails and beds. Eleven campsites were identified and nine were assessed and rated for their potential for bear – human interaction. Six trails were identified and two trails and one trail access point were assessed and rated. All campsites and trails assessed had moderate or higher risk of encounter ratings for all seasons. Displacement ratings were lower than encounter ratings for most campsites and trails. Data on bear – human interactions in the Mush and Bates Lakes area are discussed (Parks Canada unpubl. data). We have included management recommendations that are intended to help minimize bear – human encounters and displacement of bears in the Mush and Bates Lakes area.

29. Young, Jr., D.D., and T.R. McCabe. 1997. Grizzly bear predation rates on caribou calves in northeastern Alaska. Journal of Wildlife Management 61:1056-1066.

During June 1993 and 1994, 11 radiocollared and 7 unmarked grizzly bears (*Ursus arctos*) were monitored visually (observation) from fixed-wing aircraft to document predation on calves of the Porcupine Caribou (*Rangifer tarandus*) Herd (PCH) in northeastern Alaska. Twenty-six (72%) grizzly bear observations were completed (>60 min) successfully (median duration = 180 min; +/- 95% CI = 136-181 min; range = 67-189 min) and 10 were discontinued (duration <24 min) due to disturbance to the bear, or unfavorable weather conditions. Of the 26 successfully completed observations, 15 (58%) included predatory activity (encounter) directed at caribou calves and 8 (31%) included kills. Of 32 encounters, 9 resulted in kills, for a success rate of 28%. The median duration of encounters was 1 minute (+/-95% CI = 1-2 min; range = 1-6min; n=32), and the median time spent at a kill was 14 min (95% CI = 9-23 min; range = 6-56 min; n=9). Sows with young (n=4) killed more frequently (75%; P = 0.0178) than barren sows, boars and consorting pairs combined (17%; n=18). Estimated kill rate was highest for sows with young (6.3 kill&ear/day; n=4), followed by barren sows (4.6 kills/bear/day; n=8). Estimated kill rate obtained via conventional radiotracking point surveys (4.8 kills/bear/day) was higher than that obtained via concurrent bear observations (3.1 kills/bear/day). Our research provides baseline estimates of predations rates by grizzly bears on caribou calves that will enhance the capability of wildlife professionals in managing populations of both predators and their prey.

29. Young, Jr., D.D., and T.R. McCabe. 1998. Grizzly bears and calving caribou: what is the relation with river corridors? Journal of Wildlife Management 62:255-261.

Researchers have debated the effect of the Trans-Alaska Pipeline (TAP) and associated developments to *caribou* (*Rangifer tarandus*) of the central Arctic herd (CAH) since the 1970s. Several studies have demonstrated that cows and calves of the CAH avoided the TAP corridor because of disturbance associated with the pipeline, whereas others have indicated that female caribou of the CAH avoided riparian habitats closely associated with the pipeline. This avoidance was explained as a predator-avoidance strategy. We investigated the relation between female caribou and grizzly bear (*Ursus arctos*) use of river corridors on the yet undisturbed calving grounds of the Porcupine caribou herd (PCH) in northeastern Alaska. On the coastal plain, caribou were closer to river corridors than expected (P=0.038), but bear use of river corridors did not differ from expected (P=.520), but bears were farther from rivers than expected (P=0.001). Our results did not suggest an avoidance of river corridors by calving caribou or a propensity for bears for bears to be associated with riparian habitats, presumably for stalking or ambush cover. We propose that PCH caribou reduce the risks of predation to neonates by migrating to a common calving grounds, where predator swamping is the operational antipredator strategy. Consequently, we hypothesize that nutritional demands, or predator avoidance strategies, ultimately regulate habitat use patterns (e.g. use of river corridors) of calving PCH caribou.

Young, Jr., D.D., T.R. McCabe, G.W. Garner, and H.V. Reynolds III. 1994. Use of a distance-based test of independence to measure grizzly bear-caribou association in northeastern Alaska. International Conference on bear research and management 9:435-442.

We used a distance-based test of independence to measure the association between concurrent distributions of radio-collared grizzly bears (*Ursus arctos*) and calving *caribou (Rungifer* ***tarandus***) of the porcupine caribou herd (PCH) on the Arctic National Wildlife Refuge (ANWR), Alaska. The analysis utilized 552 grizzly bear and 585 caribou radio relocations recorded during 5 consecutive time intervals between 29 May and 22 June, 1988-90. Correlation coefficients of bear **and** caribou distributions tended to be positive in 1988 and negative in 1990. Those trends corresponded with annual variations in snowmelt in the Alaska portion of the PCH calving grounds and mortality for calves of radio-collared PCH cows. Concurrent distributions of bears and caribou were positively correlated ($P<0.05$) during time intervals 29 May-2 June and 8-1 June 1989. We hypothesize this occurred because the ANWR bear population did not respond to the availability of calving caribou in a homogeneous manner. The distance-based test of independence appeared to be an acceptable technique for quantifying associations between discrete, but interacting, populations of wildlife.

Yukon Department of Renewable Resources. 1984. Current management of ungulates and their predators in the Yukon Territory. Yukon Department of Renewable Resources, Wildlife Management Branch, Whitehorse. 31 pp.

Recent studies have led to a new understanding of predator-ungulate relationships, particularly involving wolves and their prey. It appears that even in natural systems wolves and their prey fluctuate widely in numbers. When prey such as moose **or** caribou begin to decline, regardless of the season, the impact of predation increases rather than decreases. If the decline continues beyond a certain threshold, predation alone can continue the decline, primarily by preventing survival of young animals to adulthood. Recovery of the prey population occurs only after predators finally decline from lack of food.

Hunting by humans can play a role in these declines primarily by killing adults, thus lowering the ratio of prey to predators and increasing the impact of predation. Reducing the number of predators to create a more favourable prey-predator ratio is an effective means of preventing or reversing a predator-maintained decline in a prey population.

Most southern Yukon moose populations are declining. The initial causes of the decline are not clear, but at present predation and hunting are keeping these populations depressed. In some populations predation alone is probably sufficient to cause continued declines. Bears and wolves are the primary predators involved. Bears are most significant as predators of very young calves, while wolves are killing calves and adults throughout the year,

An experimental program is underway to evaluate the response of moose populations to various combinations of wolf removal and bear removal. Moose hunting is also restricted to speed recovery of the populations.

The Finlayson Lake Caribou Herd has declined since at least 1977. Again the initial causes are not clear, but predation and hunting are suspected to be the present reasons. Wolves appear to be the primary predators. To halt the decline, half of the wolves in the herd's range were removed by trapping and aerial shooting in late winter 1982-83, sport hunting was restricted, and native hunters were requested to reduce the harvest. Calf survival has increased since wolves were reduced, and it appears that hunting pressure is lower.

The areas slated for predator removals comprise only a few percent of the entire Yukon and the number of wolves and bears to be removed are about 5% and 1%, respectively, of Territory-wide populations. About 30% of all moose hunting effort and harvest by Yukon residents occurs in these areas. Therefore we feel that managing predators in this restricted area is justified to increase moose populations to a level that can at least sustain recent harvests.

30. Yukon Department of Renewable Resources. 1988. A field guide to Yukon bears for the exploration and placer industries. Yukon Department of Renewable Resources, Fish and Wildlife Branch, Whitehorse. 51 pp.

Abstract or summary not present.

30. Yukon Department of Renewable Resources. 1997. Grizzly bear management guidelines. Yukon Department of Renewable Resources, Fish and Wildlife Branch, Whitehorse. 11 pp.

Abstract or summary not present.

30. Yukon Department of Renewable Resources. 1997. Hunting and fishing: rights and responsibilities of First Nation people. Yukon Department of Renewable Resources, Whitehorse. Pamphlet.

Abstract or summary not present.

30. Yukon Department of Renewable Resources. 1999. Hunting regulations summary, 1999-2000. Yukon Department of Renewable Resources, Whitehorse. 82 pp.

Abstract or summary not present.

Appendix 2. Grizzly bear foods described for northern Canada and Alaska study areas during spring (A), summer (B), and late summer / fall (C).

A. SPRING	Grizzly Bear		
Common Name	Scientific Name	Location'	Reference
ROOTS:			
Milk-vetch	*Astragalus* spp.	North Slope, AK	Quimby and Snarski 1974
		Canning River, AK	Quimby 1974
Alpine hedysarum, bearroot	*Hedysarum alpinum*	W Brooks Range, AK	Hechtel 1985
		W Brooks Range, AK	Reyndds and Hechtel 1982
		NE Brooks Range, AK, AK	Crook 1971
		E Brooks Range, AK	Reyndds 1976
		Prudhoa Bay oil-field, AK	Shideler and Hechtel in press
		ANWR, AK	Phillips 1984,1987
		North Slope, AK	Quimby and Snarski 1974
		Canning River, AK	Quimby 1974
		Canning River, AK	Linderman 1974
		Iwavik National Park, YT	MacHutchon 1996
		Barn Range, YT	Nagy et al. 1983a
		North Slope, YT	Nagy 1996
		Tuktoyaktuk Peninsula, NWT	Nagy et al. 1983b
		Ogilvie Mountains, YT	Smith unpublished data
		Peel River watershed. YT	MacHutchon 1997
		Mackenzie Mtns., NWT	Miller et al. 1962
		Kluane National Park, YT	Pearson 1975
		Kluane National Park, YT	McCann 1998
		Kluene National Park, YT	Wellwood and MacHutchon 1999
Northern sweet-vetch	*Hedysarum boreale* ssp. *mackenzii*	Prudhoe Bay oil-field, AK	Shideler and Hechtel in press
Cow parsnip	*Heracleum lanatum*	Kluane National Park, YT	Wellwood end MacHutchon 1999
Sweet-cicely	*Osmorhiza* spp.	Kluene National Park, YT	Wellwood and MacHutchon 1999
Locoweed	*Oxytropis* spp.	Kluane National Park, YT	McCann 1998
Locoweed	*Oxytropis viscida (syn. 0. borealis)*	W Brooks Range, AK	Reyndds and Hechtel 1982
Coltsfoot	*Petasites* spp.	Canning River, AK	Quimby 1974
GRAMINOIDS:		Iwavik National Park, YT	MacHutchon 1996
		. Peel River watershed, YT	MacHutchon 1997
		Kluane National Park, YT	McCann 1998
		Kluane National Park, YT	Wellwood and MacHutchon 1999
Grass	Graminae	North Slope, YT	Nagy 1990
		Slave Geological Province, NWT	Banci unpublished data
		Peel River watershed, YT	MacHutchon 1997
		Mackenzie Mtns., NWT	Miller et al. 1982
		Kluane National Park, Y-f	Pearson 1975
		Nahanni National Park, NWT	MacDougall et al. 1997
Sedge	*Carex* spp.	Mackenzie Mtns., NWT	Miller et al. 1982
		Slave Geological Province, NT	Banci unpublished data

A. SPRING **Grizzly Bear**

Common Name	Scientific Name	Location'	Reference
		Central Arctic, NT	Gau 1998
		Peel River watershed, YT	MacHutchon 1997
HORSETAIL:			
Horsetail	*Equisetum* spp.	Mackenzie Mtns., NWT	Miller et al. 1982
		Ogilvie Mountains, YT	Smith unpublished data
		Peel River watershed, YT	MacHutchon 1997
		Kluane National Park, YT	McCann 1998
		Kluane National Park, YT	Wellwood and MacHutchon 1999
		Nahanni National Park, NWT	MacDougall et al. 1997
Common horsetail	*Equisetum arvense*	Iwavik National Park, YT	MacHutchon 1998
		Kfuane National Park, YT	Wellwood and MacHutchon 1999
FORB & SHRUB STEMS, LEAVES, OR FLOWERS:		E Brooks Range, AK	Reynolds 1976
		Tuktoyaktuk Peninsula, NWT	Nagy et at. 1983b
		Iwavik National Park, YT	MacHutchon 1996
		Kluane National Park, YT	McCann 1998
Kneeling angelica	*Angelica genuflexa*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Scrub birch	*Betula glandulosa*	Nahanni National Park, NWT	MacDougall et al. 1997
Paper birch	*Be tub papyrifera*	Nahanni National Park, NWT	MacDougall et al. 1997
Bearflower	*Boykinia richardsonii.*	Iwavik National Park, YT	MacHutchon 1996
Fireweed	*Epilobium angustifolium*	Kfuane National Park, YT	Wellwood and MacHutchon 1999
Cow-parsnip	*Heracleum hnatum*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Mountain sorrel	*Oxyria digyna*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Field locoweed	*Oxytropis campestris*	Kluane National Park, YT	Weffwood and MacHutchon 1999
Locoweed	*Oxytropis* spp.	Kluane National Park, YT	Wellwood and MacHutchon 1999
Balsam poplar	*Populus balsamifera*	Kfuane National Park, YT	Wellwood and MacHutchon 1999
Trembling aspen	*Populus tremuloides*	Nahanni National Park, NWT	MacDougall et al. 1997
Willow catkins	*Salix* spp.	Canning River, AK	Linderman 1974
		Ogilvie Mountains, YT	Smith unpublished data
		Mackenzie Mtns., NWT	Miller et al. 1982
		Kluane National Park, YT	Pearson 1975
		Kluane National Park, YT	McCann 1998
		Kluane National Park, YT	Wellwood and MacHutchon 1999
		Nahanni National Park, NWT	MacDougall et al. 1997
FRUIT:			
Saskatoon	*Amelanchier alnifolia*	Nahanni National Park, NWT	MacDougall et al. 1997
Alpine bearberry	*Arctostaphylos alpina*	Canning River, AK	Linderman 1974
Red bearberry	*Arctostaphylos rubra*	W Brooks Range, AK	Hechtel 1985
		W Brooks Range, AK	Reyndds and Hechtel 1982
		ANWR, AK	Phillips 1984
		Iwavik National Park, YT	MacHutchon 1996
		Barn Range, YT	Nagy et al. 1983a
		Peel River watershed, YT	MacHutchon 1997
		Kluane National Park, YT	Wellwood and MacHutchon 1999
		Nahanni National Park, NWT	MacDougall et al. 1997
Kinnikinnick	*Arctostaphylos uva-ursi*	Mackenzie Mtns., NWT	Miller et al. 1982
		Iwavik National Park, YT	MacHutchon 1996

A. SPRING **Grizzly Bear**

Common Name	Scientific Name	Location*	Reference
		Kluane National Park, YT	McCann 1998
		Kluane National Park, YT	Wellwood and MacHutchon 1999
		Nahanni National Park, NWT	MacDougall et at. 1997
		Peel River watershed, YT	MacHutchon 1997
Crowberry	*Empetrum nigrum*	ANWR, AK	Phillips 1984
		Iwavik National Park, YT	MacHutchon 1998
		North Slope, YT	Nagy 1990
		Central Arctic, NT	Gau 1998
		Mackenzie Mtns., NWT	Miller et al. 1982
		Kluane National Park, YT	Wellwood and MacHutchon 1999
		Nahanni National Park, NWT	MacDougall et al. 1997
Soopolallie, soapberry	*Shepherdia canadensis*	Nahanni National Park, NWT	MacDougall et al. 1997
Blueberry	*Vaccinium uliginosum*	Iwavik National Park, YT	MacHutchon 1998
		Central Arctic, NT	Gau 1998
		Nahanni National Park, NWT	MacDougall 1997
Lingonberry	*Vaccinium vitis-idaea*	ANWR, AK	Phillips 1984
		Iwavik National Park, YT	MacHutchon 1998
		Ogilvie Mountains, YT	Smith unpublished data
		Slave Gedogical Province, NT	Banci unpublished data
		Central Arctic, NT	Gau 1998
		Mackenzie Mtns., NWT	Miller et al. 1982
Highbush-cranberry	*Viburnum edule*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Unspecified berries		Kluane National Park, YT	McCann 1998
INSECTS:		Mackenzie Mtns., NWT	Miller et al. 1982
Ants	*Formicidae*	Nahanni National Park, NWT	MacDougall et at. 1997
wasps	*Vespidae*	Nahanni National Park, NWT	MacDougall et al. 1997
PREY:			
Unidentified fish		Nahanni National Park, NWT	MacDougall et al. 1997
Unidentified eggs		Nahanni National Park, NWT	MacDougall et at. 1997
Northern flicker	*Coiapter auratus*	Nahanni National Park, NWT	MacDougall et al. 1997
Grouse or ptarmigan	Phasianidae	Nahanni National Park, NWT	MacDougall et at. 1997
		Central Arctic, NT	Gau 1998
Microtines	Microtines	Iwavik National Park, YT	MacHutchon 1998
		Prudhos Bay oil-field, AK	Shideler and Hechtel in press
Northern red-backed vole	*Clethrionomys rutilus*	Central Arctic, NT	Gau 1998
Arctic ground squirrel	*Spermophiius parryii*	Iwavik National Park, YT	MacHutchon 1998
		Slave Gedogical Province, NT	Banci unpublished data
		Central Arctic. NT	Gau 1998
		Peel River watershed, YT	MacHutchon 1997
Marmot	*Marmota* spp.	Nahanni National Park, NWT	MacDougall et at. 1997
Snowshoe hare	*Lepus americanus*	Nahanni National Park, NWT	MacDougall et al. 1997
Caribou	*Rangifer tarandus*	ANWR, AK	Phillips 1984, 1987
		W Brooks Range, AK	Reynolds and Garner 1987
		North Slope	Quimby and Snarski 1974
		Iwavik National Park, YT	MacHutchon 1998

A. SPRING **Grizzly Bear**

Common Name	Scientific Name	Location[a]	Reference
		Ogilvie Mountains, YT	Smith unpublished data
		Stave Geological Province, NT	Banci unpublished data
		Kluane National Park, YT	McCann 1996
		Central Arctic, NT	Gau 1996
		Nahanni National Park, NWT	MacDougall et al. 1997
		Peel River watershed, YT	MacHutchon 1997
Bison	*Bison bison*	Nahanni National Park, NWT	MacDougall et al. 1997
Moose	*Alces alces*	Kluane National Park, YT	Pearson 1975
Lynx	*Lynx* spp.	Nahanni National Park, NWT	MacDougall et at. 1997
Grizzly bear	*Ursus arctos*	Nahanni National Park, NWT	MacDougall et al. 1997
CARRION:		W Brooks Range, AK	Reyndds and Hechtel 1982
		ANWR, AK	Phillips 1964
		Canning River, AK	Linderman 1974, Quimby and Snarski 1974
		E Brooks Range, AK	Reyndds 1976, Curatdo and Moore 1975
		Barn Range, YT	Nagy et al. 1983a
		Tuktoyaktuk Peninsula, NWT	Nagy et al 1983b

[a] ANWR, AK = Arctic National Wildlife Refuge, Alaska; Canning River, AK = Canning River, Arctic National Wildlife Refuge, Alaska.

B. SUMMER **Grizzly Bear**

Common Name	Scientific Name	Location'	Reference
ROOTS:	ROOTS:		
Hedysarum	*Hedysarum* spp.	Nahanni National Park, NWT	MacDougall et al. 1997
Alpine hedysarum, bear root	*Hedysarum alpinum*	ANWR, AK	Phillips 1987
		Iwavik National Park, YT	MacHutchon 1996
		Peel River watershed, YT	MacHutchon 1997
		Mackenzie Mtns., NWT	Miller et al. 1982
		Kluane National Park, YT	Pearson 1975
		Kluane National Park, YT	McCann 1998
		Kluane National Park, YT	Wellwood and MacHutchon 1999
Cow-parsnip	*Heracleum lanatum*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Sweet-cicely	*Osmorhiza* spp.	Kluane National Park, YT	Wellwood and MacHutchon 1999
GRAMINOIDS:		W Brooks Range, AK	Hechtel 1985
		W Brooks Range, AK	Reynolds and Hechtel 1982
		ANWR, AK	Phillips 1984, 1987
		NE Brooks Range, AK	Crook 1971
		E Brooks Range, AK	Reynolds 1976
		Canning River, AK	Quimby 1974, Linderman 1974, Curatolo and Moore 1975
		Tuktoyaktuk Peninsula, NWT	Nagy et at. 1983b
		Iwavik National Park, YT	MacHutchon 1998
		Kluane National Park, YT	McCann 1998
		Kluane National Park, YT	Wellwood and MacHutchon 1999
		Peel River watershed, YT	MacHutchon 1997
Grasses	Graminae	Mackenzie Mtns., NWT	Miller et al. 1982
		Slave Geological Province, NT	Banci unpublished data
		North Slope, YT	Nagy 1990
		Prudhoe Bay oil-field, AK	Shideler and Hechtel in press
		Kluane National Park, YT	Pearson 1975
		Peel River watershed, YT	MacHutchon 1997
Sedges	*Carex* spp.	Mackenzie Mtns., NWT	Miller et al. 1982
		Slave Geological Province, NT	Banci unpublished data
		Prudhoe Say oil-field, AK	Shideler and Hechtel in press
		Central Arctic, NT	Gau 1998
		Peel River watershed, YT	MacHutchon 1997
Spike trisetum	*Trisetum spicatum*	W Brooks Range, AK	Hechtel1985
HORSETAIL:			
Horsetail	*Equisetum* spp.	W Brooks Range, AK	Hechtel 1985
		W Brooks Range, AK	Reynolds and Hechtel1982
		ANWR, AK	Phillips 1984, 1987
		Canning River, AK	Quimby 1974, Linderman 1974
		NE Brooks Range, AK	Crook 1971
		E Brooks Range, AK	Reynolds 1976
		Barn Range, YT	Nagy et at. 1983a
		Tuktoyaktuk Peninsula, NWT	Nagy et at. 1983b
		Mackenzie Mtns., NWT	Miller et al. 1982

B. SUMMER **Grizzly** Bear

Common Name	Scientific Name	Location'	Reference
		Ogilvie Mountains, YT	Smith unpublished data
		Kluane National Park, YT	McCann 1998
		Kluane National Park, YT	Wellwood and MacHutchon 1999
		Central Arctic, NT	Gau 1998
		Peel Rii watershed, YT	MacHutchon 1997
Common horsetail	*Equisetum arvense*	Iwavik National Park, YT	MacHutchon 1998
		Kluane National Park, YT	Wellwood and MacHutchon 1999
		Prudhoe Bay oil-field, AK	Shideler and Hechtel in press
FORB & SHRUB STEMS, LEAVES, OR FLOWERS:		W Brooks Range, AK	Hechtel 1985
		Canning River, AK	Linderman 1974
		Barn Range, YT	Nagy et al 1983a
		Iwavik National Park, YT	MacHutchon 1998
		Kluane National Park, YT	McCann 1998
Alder	*Alnus* spp.	Nahanni National Park, NWT	MacDougall et al. 1997
Kneeling angelica	*Angelica genuflexa*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Kinnikinnick	*Arctostaphybs uva-ursi*	Nahanni National Park, NWT	MacDougall et al. 1997
Milk-vetch	*Astragalus* spp.	Kluane National Park, YT	Wellwood and MacHutchon 1999
Scrub birch	*Betula glandulosa*	Nahanni National Park, NWT	MacDougall et al. 1997
Paper birch	*Betula papyrifera*	Nahanni National Park, N WT	MacDougall et al. 1997
Bearflower	*Boykinia richardsonii*	W Brooks Range, AK	Reynolds and Hechtel 1982
		ANWR. AK	Phillips 1984, 1987
		Iwavik National Park, YT	MacHutchon 1998
		Prudhoe Bay oil-field, AK	Shideler and Hechtel in press
Fireweed	*Epilobium angus tifolium*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Cow-parsnip	*Heracleum lanatum*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Arctic lupine	*Lupinus arcticus*	Nahanni National Park, NWT	MacDougall et al. 1997
Mountain sorrel	*Oxyria digyna*	W Brooks Range, AK	Hechtel 1985
		Ivvavik National Park, YT	MacHutchon 1998
		Kluane National Park, YT	Wellwood and MacHutchon 1999
Locoweed	*Oxytropis* spp.	Kluane National Park, YT	McCann 1998
		Kluane National Park, YT	Wellwood and MacHutchon 1999
Field locoweed	*Oxytropis campestris*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Locoweed	*Oxytropis viscida* (s yn 0. *borealis*)	W Brooks Range, AK	Hechtel 1985
Balsam poplar	*Populus balsamifera*	Kluane National Park, YT	Wellwood and MacHutchon 1999
		Nahanni National Park, NWT	MacDougall et al. 1997
Trembling aspen	*Populus tremubides*	Nahanni National Park, NWT	MacDougall et al. 1997
Willow catkins	*Salix* spp.	Mackenzie Mtns., NWT	Miller et al. 1982
		Kluane National Park, YT	McCann 1998
		Kluane National Park, YT	Wellwood and MacHutchon 1999
		Kluane National Park, YT	Pearson 1975
		Nahanni National Park, NWT	MacDougall et al. 1997
FRUIT:		ANWR, AK	Phillips 1987
Saskatoon	*Amehnchier alnifolia*	Nahanni National Park, NWT	MacDougall et al. 1997
Red bearberry	*Arctostaphybs rubra*	Mackenzie Mtns., NWT	Miller et al. 1982
		Kluane National Park, YT	Wellwood and MacHutchon 1999

B. SUMMER **Grizzly Bear**

Common Name	Scientific Name	Location*	Reference
		Kluane National Park, YT	Pearson 1975
		Nahanni National Park, NWT	MacDougall et at. 1997
		Peel River watershed, YT	MacHutchon 1997
Kinnikinnick	*Arctostaphylos uva-ursi*	Mackenzie Mtns., NWT	Miller et al. 1982
		Iwavik National Park, YT	MacHutchon 1998
		Kluane National Park, YT	Welhvood and MacHutchon 1999
		Peel River watershed, YT	MacHutchon 1997
Crowberry	*Empetrum nigrum*	Mackenzie Mtns., NWT	Miller et al. 1982
		Iwavik National Park, YT	MacHutchon 1998
		Slave Geological Province, NT	Banci unpublished data
		Kluane National Park	Wellwood and MacHutchon 1999
		Central Arctic, NT	Gau 1998
		Nahanni National Park, NWT	MacDougall et al. 1997
Currant	*Ribes* spp.	Kluane National Park, YT	Wellwood and MacHutchon 1999
Prickly rose	*Rosa acicularis*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Raspberry	*Rubus* spp.	Kluane National Park, YT	Wellwood and MacHutchon 1999
Soopolallie, soapberry	*Shepherdia canadensis*	Mackenzie Mtns., NWT	Miller et al. 1982
		Ogilvie Mountains, YT	Smith unpublished data
		Kluane National Park, YT	Wellwood and MacHutchon 1999
		Kluane National Park, YT	Pearson 1975
		Nahanni National Park, NWT	MacDougall et al. 1997
		Peel River watershed, YT	MacHutchon 1997
Mountain ash	*Sorbus scopulina*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Dwarf blueberry	*Vaccinium caespitosum*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Blueberry	*Vaccinium uiiginosum*	Mackenzie Mtns., NWT	Miller et al. 1982
		Iwavik National Park, YT	MacHutchon 1998
		Ogilvie Mountains, YT	Smith unpublished data
		Slave Geological Province. NT	Banci unpublished data
		Kluane National Park, YT	Wellwood and MacHutchon 1999
		Central Arctic, NT	Gau 1998
		Nahanni National Park, NWT	MacDougall et al. 1997
Lingonberry	*Vaccinium vitis-idaea*	Mackenzie Mtns., NWT	Miller et al. 1982
		Iwavik National Park, YT	MacHutchon 1998
		Kluane National Park, YT	Wellwood and MacHutchon 1999
		Central Arctic, NT	Gau 1998
Highbush-cranberry	*Viburnum edule*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Unspecified berries		Slave Geological Province, NT	Banci unpublished data
		Kluane National Park, YT	McCann 1998
INSECTS:		Mackenzie Mtns., NWT	Miller et al. 1982
		Iwavik National Park, YT	MacHutchon 1998
Ants	*Formicidae*	Nahanni National Park, NWT	MacDougall et al. 1997
wasps	*Vespidae*	Kluane National Park, YT	Pearson 1975
		Nahanni National Park, NWT	MacDougall et al. 1997
PREY:			
Longnose sucker	*Catostomus catostomus*	Central Arctic, NT	Gau 1998
Unidentified fish		Central Arctic, NT	Gau 1998

B. SUMMER	Grizzly Bear		
Common Name	Scientific Name	Location[a]	Reference
Woodpecker	Picidae	Nahanni National Park, NWT	MacDougall et al. 1997
Grouse or ptarmigan	Phasianidae	Nahanni National Park, NWT	MacDougall et al. 1997
		Central Arctic, NT	Gau 1998
Microtines	Microtines	ANWR, AK	Phillips 1987
		Iwavik National Park, YT	MacHutchon 1998
		Prudhoe Bay oil-field, AK	Shideler and Hechtel in press
Arctic ground squirrel	*Spermophilus parryii*	ANWR, AK	Phillips 1987
		Iwavik National Park, YT	MacHutchon 1998
		Slave Geological Province, NT	Banci unpublished data
		Central Arctic, NT	Gau 1998
		Peel River watershed, YT	MacHutchon 1997
Marmot	*Marmota* spp.	Nahanni National Park, NWT	MacDougall et at. 1997
Muskrat	*Ondatra zibethicus*	Nahanni National Park, NWT	MacDougall et at. 1997
Beaver	*Castor canadensis*	Nahanni National Park, NWT	MacDougall et al. 1997
Snowshoe hare	*Lepos canadensis*	Nahanni National Park, NWT	MacDougall et al. 1997
Caribou	Rangifer *tarandus*	ANWR, AK	Phillips 1987
		W Brooks Range, AK	Reynolds and Garner 1987
		Iwavik National Park, YT	MacHutchon 1998
		Slave Geological Province, NT	Banci unpublished data
		Central Arctic, NT	Gau 1998
		Peel River watershed, YT	MacHutchon 1997
	Alces alces	Iwavik National Park, YT	MacHutchon 1998
	Ursus arctos	Iwavik National Park, YT	MacHutchon 1998
		Kluane National Park, YT	McCann 1998
		W Brooks Range, AK	Reynolds and Garner 1987
		ANWR, AK	Phillips 1987
		Kluane National Park, YT	Pearson 1975

[a] ANWR, AK = Arctic National Wildlife Refuge, Alaska; Canning River, AK = Canning River, Arctic National Wildlife Refuge, Alaska.

C. LATE SUMMER /FALL — Grizzly Bear

Common Name	Scientific Name	Location'	Reference
ROOTS:	ROOTS:	Nahanni National Park, NWT	MacDougall et at. 1997
		Kluane National Park, YT	McCann 1998
		Kluane National Park, YT	Pearson 1975
Hedysarum	*Hedysarum* spp.	Kluane National Perk. YT	McCann 1998
		North Slope, YT	Nagy 1990
		Nahanni National Park, NWT	MacDougall et al. 1997
Alpine hedysarum	*Hedysarum alpinum*	W Brooks Range, AK	Hechtel 1985
		W Brooks Range, AK	Reyndds and Hechtel 1982
		ANWR, AK	Phillips 1984, 1987
		Canning River, AK	Quimby 1974
		E Brooks Range, AK	Reyndds 1976
		Barn Range, YT	Nagyetaf. 1983a
		Tuktoyaktuk Peninsula, NWT	Nagy et al. 1983b
		Mackenzie Mtns., NWT	Miller et al. 1982
		Iwavik National Park, YT	MacHutchon 1996
		Ogilvie Mountains, YT	Smith unpublished data
		Kluane National Park, YT	Wellwood and MacHutchon 1999
		Peel River watershed, YT	MacHutchon 1997
Cow-parsnip	*Heracleum lanatum*	Kluane National Perk, YT	Wellwood and MacHutchon 1999
Sweet-ciceiy	*Osmorhiza* spp.	Kluane National Park, YT	Wellwood end MacHutchon 1999
GRAMINOIDS:		ANWR, AK	Phillips 1987
		Kluane National Park, YT	McCann 1998
		Iwavik National Park, YT	MacHutchon 1996
		Kluane National Park, YT	Wellwood and MacHutchon 1999
Grasses	*Graminae*	Mackenzie Mtns., NWT	Miller et al. 1982
		North Slope, YT	Nagy 1990
Sedges	*Carex* spp.	Mackenzie Mtns., NWT	Miller et at. 1982
HORSETAIL:			
Horsetail	*Equisetum* spp.	Mackenzie Mtns., NWT	Miller et at. 1982
		Kluane National Park, YT	McCann 1998
		Kluane National Park, YT	Wellwood and MacHutchon 1999
Common horsetail	*Equisetum arvense*	Iwavik National Park, YT	MacHutchon 1996
		Kluane National Park, YT	Wellwood and MacHutchon 1999
FORB & SHRUB STEMS, LEAVES, OR FLOWERS:		Iwavik National Park, YT	MacHutchon 1996
		Kluane National Park, YT	McCann 1998
Kneeling angelica	*Angelica genuflexa*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Kinnikinnick	*Arctostaphylos uva-ursi*	Nahanni National Park, NWT	MacDougall et al. 1997
Scrub birch	*Betula glandulosa*	Nahanni National Park, NWT	MacDougall et al. 1997
Paper birch	*Betula papyrifera*	Nahanni National Park, NWT	MacDougall et at. 1997
Bearflower	*Boykinia richardsonii*	ANWR, AK	Phillips 1987
		Iwavik National Park, YT	MacHutchon 1996
Fireweed	*Epilobium angustifolium*	Nahanni National Perk, NWT	MacDougall et at. 1997
Cow-parsnip	*Heracleum lanatum*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Arctic lupine	*Lupinus arcticus*	Nahanni National Perk, NWT	MacDougall et al. 1997
Mountain sorrel	*Oxyria digyna*	Iwavik National Park, YT	MacHutchon 1996

C. LATE SUMMER /FALL	Grizzlv Bear		
Common Name	**Scientific Name**	**Location'**	**Reference**
Field locoweed	*Oxytropis campestris*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Trembling aspen	*Populus tremuloides*	Nahanni National Park, N WT	MacDougall et at. 1997
Willow catkins	*Salix* spp.	Mackenzie Mtns., NWT	Miller et al. 1962
		Kluane National Park, YT	Wellwood and MacHutchon 1999
		Nahanni National Park, NWT	MacDougall et al. 1997
FRUIT:			
Bearberry	*Arctostaphybs rubra* or *alpina*	W Brooks Range, AK	Hechtel 1965
		W Brtwks Range, AK	Reynolds and Hechtel1962
		Canning River, AK	Quimby 1974
		E Brooks Range, AK	Reynolds 1976
		Tuktoyaktuk Peninsula, NWT	Nagy et at. 1963b
		ANWR, AK	Phillips 1967
		Mackenzie Mtns., NWT	Miller et al. 1962
		Kluane National Park	Wellwood and MacHutchon 1999
		Kluane National Park, YT	Pearson 1975
		Nahanni National Park, NWT	MacDougall et al. 1997
		Peel River watershed, YT	MacHutchon 1997
Kinnikinnick	*Arctostaphylos uva-ursi*	Mackenzie Mtns., NWT	Miller et al. 1962
		Iwavik National Park, YT	MacHutchon 1996
		Kluane National Park, YT	Wellwood and MacHutchon 1999
		Peel River watershed, YT	MacHutchon 1997
Red-osier dogwood	*Cornus stolonifera*	Nahanni National Park, N WT	MacDougall et al. 1997
Silverberry	*Elaeagnus commutata*	Kluane National Park, YT	McCann 1996
Crowberry	*Empetrum nigrum*	W Brooks Range, AK	Hechtell965
		Canning River, AK	Quimby 1974
		Barn Range, YT	Nagy et al. 1963a
		Tuktoyaktuk Peninsula, NWT	Nagy et al 1963b
		ANWR, AK	Phillips 1967
		Mackenzie Mtns., NWT	Miller et al. 1962
		Iwavik National Park, YT	MacHutchon 1996
		Slave Geological Province, NT	Banci unpublished data
		Kluane National Park, YT	McCann 1996
		Kluane National Park, YT	Wellwocd and MacHutchon 1999
		Kluane National Park, YT	Pearson 1975
		Central Arctic, NT	Gau 1996
		Nahanni National Park, NWT	MacDougall et al. 1997
Currant	*Ribes* spp.	Kluane National Park, YT	Wellwood and MacHutchon 1999
Red currant	*Ribes triste*	Iwavik National Park, YT	MacHutchon 1996
Prickly rose	*Rosa acicularis*	Kluane National Park, YT	Wellwood and MacHutchon 1999
		Nahanni National Park, NWT	MacDougall et al. 1997
Raspberry	*Rubus* spp.	Kluane National Park, YT	Wellwood and MacHutchon 1999
Soopolallie, soapberry	*Shepherdia canadensis*	Canning River, AK	Quimby 1974
		E Brooks Range, AK	Reynolds 1976

C. LATE SUMMER /FALL — Grizzly Bear

Common Name	Scientific Neme	Location*	Reference
		Barn Range, YT	Nagy et al 1983a
		Mackenzie Mtns., NWT	Miller et at. 1982
		Iwavik National Park, YT	MacHutchon 1996
		Ogilvie Mountains, YT	Smith unpublished data
		Kluane National Park, YT	McCann 1998
		Kluane National Park, YT	Wellwood and MacHutchon 1999
		Kfuane National Park, YT	Pearson 1975
		Nahanni National Park, NWT	MacDougall et al. 1997
		Peel River watershed, YT	MacHutchon 1997
Mountain ash	*Sorbus scopulina*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Dwarf blueberry	*Vaccinium caespitosum*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Blueberry	*Vaccinium uliginosum*	W Brooks Range, AK	Hechtel 1985
		Canning River, AK	Quimby 1974
		Tuktoyaktuk Peninsula, NWT	Nagy et al. 1983b
		Mackenzie Mtns., NWT	Miller et al. 1982
		Iwavik National Park, YT	MacHutchon 1996
		Ogilvie Mountains, YT	Smith unpublished data
		Kluane National Park, YT	Wellwood and MacHutchon 1999
		Kluane National Park, YT	Pearson 1975
		Central Arctic, NT	Gau 1998
		Nahanni National Park, NWT	MacDougall et al. 1997
Lingonberry, mountain cranberry	*Vaccinium vitis-idaea*	Mackenzie Mtns., NWT	Miller et al. 1982
		Kfuane National Park, YT	Wellwood and MacHutchon 1999
		Central Arctic, NT	Gau 1998
		Nahanni National Park, NWT	MacDougall et at. 1997
Highbush-cranberry	*Viburnum edule*	Kluane National Park, YT	Wellwood and MacHutchon 1999
Unspecified berries		E Brooks Range, AK	Curatofo and Moore 1975
		ANWR, AK	Phillips 1987
		Slave Geological Province, NT	Banci unpublished data
		Kluane National Park, YT	McCann 1998
		North Slope, YT	Nagy 1990
INSECTS:		Mackenzie Mtns., NWT	Miller et at. 1982
		Iwavik National Park, YT	MacHutchon 1996
Ants	Formicidae	Nahanni National Park, NWT	MacDougall et at. 1997
wasps	Vespidae	Nahanni National Park, NWT	MacDougall et at. 1997
PREY:			
Salmon	*Onchorhyncus* spp.	Kluane National Park, YT	McCann 1998
Microtines	Microtines	Iwavik National Park, YT	MacHutchon 1996
Northern flying squirrel	*Glaucomys* spp.	Nahanni National Park, NWT	MacDougall et at. 1997
Arctic ground squirrel	*Spermophilus parryii*	W Brooks Range, AK	Hechtel 1985
		W Brooks Range, AK	Reyndds and Hechtel 1982
		ANWR, AK	Phillips 1984, 1987
		Canning River, AK	Quimby 1974
		E Brooks Range, AK	Reyndds 1976

C. LATE SUMMER /FALL	Grizzly Bear		
Common Name	Scientific Name	Location[a]	Reference
		Barn Range, YT	Nagy et al. 1983a
		Tuktoyaktuk Peninsula, NWT	Nagy et al. 1983b
		Iwavik National Park, YT	MacHutchon 1998
		Slave Geological Province, NT	Sanci unpublished data
		North Slope, YT	Nagy 1990
		Prudhoe Say oil-field, AK	Shideler and Hechtel in press
		Kluane National Park, YT	Pearson 1975
		Central Arctic, NT	Gau 1998
		Peel River watershed, YT	MacHutchon 1997
Snowshoe hare	*Lepus americanus*	Nahanni National Park, NWT	MacDougall et al. 1997
Moose	A&es *alces*	Iwavik National Park, YT	MacHutchon 1995
		Nahanni National Park, NWT	MacDougall et al. 1997
Caribou	*Rangifer tarandus*	Iwavik National Park. YT	MacHutchon 1995
		Slave Geological Province, NT	Sanci unpublished data
		Central Arctic, NT	Gau 1998
		Peel River watershed, YT	MacHutchon 1997
Grizzly bear	*Ursus arctos*	Iwavik National Park, YT	MacHutchon 1995
		Kluane National Park, YT	McCann 1998
CARRION:	CARRION:	ANWR, AK	Reynolds and Garner 1987

[a] ANWR, AK = Arctic National Wildlife Refuge, Alaska; Canning River, AK = Canning River, Arctic National Wildlife Refuge, Alaska

Appendix 3. Black bear foods described for northern Canada and Alaska study areas during spring (A), summer (B), and late summer / fall (C).

A. SPRING — Black Bear

Common Name	Scientific Name	Location'	Reference
ROOTS:			
Cow-parsnip	*Heracleum lanatum*	Liard River Hotsprings, BC	Ciarniello 1998
GRAMINOIDS:			
Grass	*Graminae*	Pelly River, YT	MacHutchon 1989
		Nahanni National Park, N.W.T.	MacDougall et al. 1997
Bluejoint	*Cahrnagrostis canadensis*	Liard River Hotsprings, BC	Ciarniello 1998
Sedge	*Carex* spp.	Liard River Hotsprings, BC	Ciarnidlo 1998
Fuzzy-spiked wildrye	*Elymus innovatus*	Liard River Hotsprings, BC	Ciarniello 1998
HORSETAIL:			
Horsetail	*Equisetum* spp.	Pelly River, YT	MacHutchon 1989
		Liard River Hotsprings, BC	Ciarniello 1998
		Nahanni National Park, N. W .T.	MacDougall et al. 1997
FORB 8 SHRUB STEMS, LEAVES OR FLOWERS:			
Fireweed	*Epibbium angustifolium*	Liard River Hotsprings. BC	Ciarniello 1998
Scrub birch	*Betula glandubsa*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
Paper birch	*Be tub papyrifera*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
Cow-parsnip	*Heracleum lanatum*	Liard River Hotsprings	Ciarniello 1998
Creamy peavine	*Lathyrus ochroleucus*	Liard River Hotsprings, BC	Ciarnieilo 1998
White sweet clover	*Melilotus alba*	Liard River Hotsprings, BC	Ciarniello 1998
Trembling aspen	*Populus tremuloides*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
Willow	*Salix* spp.	Nahanni National Park, N.W.T.	MacDougall et af.1997
Horned dandelion	*Taraxacum ceratophorum*	Liard River Hotsprings. BC	Ciarniello 1998
Red clover	*Trifolium pratense*	Liard River Hotsprings, BC	Ciarniello 1998
American vetch	*Vicia americana*	Liard River Hotsprings, BC	Ciarniello 1998
FRUIT:			
Saskatoon	*Amehnchier alnifolia*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
Bearberry	*Arctos taphybs rubra*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
Kinnikinnick	*Arctostaphybs uva-ursi*	Pelly River, YT	MacHutchon 1989
		Nahanni National Park, N.W.T.	MacDougall et al. 1997
Crowberry	*Empe trum nigrum*	Pelly River, YT	MacHutchon 1989
		Nahanni National Park, N.W.T.	MacDougall et al. 1997
Soopolallie, soapberry	*Shepherdia canadensis*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
	Vaccinium spp.	Pelly River, YT	MacHutchon 1989
Blueberry	*Vaccinium uliginosum*	Pelly River, YT	MacHutchon 1989
		Nahanni National Park, N.W.T.	MacDougall et at. 1997
Lingonberry, mountain cranberry	*Vaccinium vitis-idaea*	Pelly River, YT	MacHutchon 1989
INSECTS:		Pelly River, YT	MacHutchon 1989
Ants	*Formicidae*	Pelly River, YT	MacHutchon 1989
		Liard River Hotsprings, BC	Ciarniello 1998
		Nahanni National Park, N.W.T.	MacDougall et al. 1997
wasps	*Vespidae*	Nahanni National Park, N.W .T.	MacDougall et al. 1997
PREY:			

A SPRING	Black Bear		
Common Name	Scientific Name	Location'	Reference
Unidentified fish		Nahanni National Park, N.W.T.	MacDougall et al. 1997
Unidentified eggs		Nahanni National Park, N.W.T.	MacDougall et at. 1997
Grouse or ptarmigan	*Phasianidae*	Nahanni National Perk, N.W.T.	MacDougall et al. 1997
Microtines	Microtines		
Snowshoe hare	*Lepus americanus*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
Marmot	*Marmota* spp.	Nahanni National Park, N.W.T.	MacDougall et al. 1997
Caribou	*Rangifer tarandus*	Nahenni National Park, N.W.T.	MacDougall et al. 1997
Bison	*Bison bison*	Nahanni National Perk, N.W.T.	MacDougall et al. 1997
Grizzly bear	*Ursus arctos*	Nahanni National Park, N.W.T.	MacDougall et al. 1997

B. SUMMER	Black Bear		
Common Name	Scientific Name	Location'	Reference
GRAMINOIDS:			
grass	*Graminae*	Pelly River, YT	MacHutchon 1989
HORSETAIL:			
horsetail	*Equisetum* spp.	Pelly River, YT	MacHutchon 1989
		Liard River Hotsprings, BC	Ciarniello 1998
FORE & SHRUB STEMS, LEAVES OR FLOWERS:			
alder	*Alnus* spp.	Nahanni National Park, N.W.T.	MacDougall et al. 1997
scrub birch	*Betula glandulosa*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
paper birch	*Betula papyrifera*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
creamy peavine	*Lathyrus ochroleucus*	Liard River Hotsprings, BC	Ciarnieilo 1998
arctic lupine	*Lupinus arcticus*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
white sweet clover	*Melilotus alba*	Liard River Hotsprings, BC	Ciarniello 1998
Labrador lousewort	*Pedicularis labradorica*	Nahanni National Park, N.W.T.	MacDougall et at. 1997
balsam poplar	*Populus balsamifera*	Nahanni National Perk, N.W.T.	MacDougall et al. 1997
trembling aspen	*Populus tremubides*	Liard River Hotsprings, BC	Ciarnieflo 1998
		Nahanni National Park, N.W.T.	MacDougall et al. 1997
willow	*Salix* spp.	Liard River Hotsprings. BC	Ciarniello 1998
		Nahenni National Park, N.W.T.	MacDougall et al. 1997
Soopolallie, soapberry	*Shepherdia canadensis*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
red clover	*Trifolium pratense*	Liard River Hotsprings, BC	Ciarniello 1998
American vetch	*Vicia amerbana*	Liard River Hotsprings, BC	Ciarniello 1998
FRUIT:			
saskatoon	*Amelanchier alnifolia*	Nahanni National Perk, N.W.T.	MacDougall et al. 1997
bearberry	*Arctostaphylos rubra*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
kinnikinnick	*Arctostaphybs uva-ursi*	Pelly River, Y-r	MacHutchon 1989
crowberry	*Empetrum nigrum*	Pelly River, YT	MacHutchon 1989
		Nahanni National Park, N.W.T.	MacDougall et al. 1997
wild strawberry	*Fragaria virginiana*	Pelly River, YT	MacHutchon 1989
red raspberry	*Rubus idaeus*	Liard River Hotsprings	Ciarniello 1998
Soopolallie, soapberry	*Shepherdii canadensis*	Pelly River, YT	MacHutchon 1989
		Liard River Hotsprings, BC	Ciarniello 1998
blueberry	*Vaccinium uliginosum*	Pelly River, YT	MacHutchon 1989
		Nahanni National Park, N.W.T.	MacDougall et al. 1997
Lingonberry, mountain cranberry	*Vaccinium vitis-idaea*	Pelly River, YT	MacHutchon 1989
INSECTS:		Pelly River, YT	MacHutchon 1989
ants	*Formicidae*	Pelly River, YT	MacHutchon 1989
		Nahanni National Park, N.W.T.	MacDougall et al. 1997
wasps	*Vespidae*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
PREY:			
grouse or ptarmigan	*Phasianidae*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
marmot	*Marmota* spp.	Nahanni National Park, N.W.T.	MacDougall et al. 1997
muskrat	*Ondatra zibethicus*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
beaver	*Castor canadensis*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
snowshoe hare	*Lepus americanus*	Nahanni National Park, N.W.T.	MacDougall et al. 1997

C. LATE SUMMER / FALL	Black Bear		
Common Name	Scientific Name	Location'	Reference
FORB & SHRUB STEMS, LEAVES OR FLOWERS:			
kinnikinnick leaves	*Arctostaphybs uva-ursi*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
scrub birch	*Betula glandulosa*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
paper birch	*Betula papyrifera*	Nahanni National Park, N. W .T.	MacDougall et al. 1997
fireweed	*Epilobium angustifolium*	Nahanni National Park, N.W.T.	MacDougall et al, 1997
Arctic lupine	*Lupinus arcticus*	Nahanni National Perk, N.W.T.	MacDougall et al. 1997
Labrador lousewort	*Pedicularis labradorica*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
trembling aspen	*Populus tremuloides*	Nahanni National Perk. N.W.T.	MacDougall et al. 1997
willow	*Salix* spp.	Nahanni National Park, N.W.T.	MacDougall et al. 1997
FRUIT:			
bearberry	*Arctostaphybs rubra*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
red-osier dogwood	*Cornus stolonifera*	Liard River Hotsprings, BC	Ciarniello 1996
		Nahanni National Park, N.W.T.	MacDougall et al. 1997
crowberry	*Empetrum nigrum*	Liard River Hotsprings. BC	Ciamieilo 1996
		Nahanni National Park, N .W .T.	MacDougall et al. 1997
prickly rose	*Rosa acicularis*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
Soopolallie, soapberry	*Shepherdia canadensis*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
dwarf blueberry	*Vaccinium caespitosum*	Liard River Hotsprings, BC	Ciarniello 1996
black huckleberry	*Vaccinium membranaceum*	Liard River Hotsprings, BC	Ciarniello 1996
blueberry	*Vaccinium uliginosum*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
Lingonberry, mountain cranberry	*Vaccinium vitis-idaea*	Liard River Hotsprings	Ciamiello 1996
		Nahanni National Park, N.W.T.	MacDougall et al. 1997
highbush-cranberry	*Vibumum edule*	Liard River Hotsprings,, BC	Ciarniello 1996
INSECTS:			
ants	*Formicidae*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
wasps	*Vespidae*	Nahanni National Park, N.W.T.	MacDougall et at. 1997
PREY:			
northern flying squirrel	*Gbucomys* spp.	Nahanni National Park, N.W.T.	MacDougall et at. 1997
snowshoe hare	*Lepus americanus*	Nahanni National Park, N.W.T.	MacDougall et al. 1997
moose	*Alces alces*	Nahanni National Park, N.W.T.	MacDougall et al. 1997

Appendix 4. Proposed bear observation, encounter, and incident form.

BEAR OBSERVATION FORM

ɔur assistance in completing this form is appreciated. Information will aid staff of Vuntut National Park to better understand bears the park and to minimize potentially dangerous bear and human encounters and conflicts. Your best defence in avoiding dangerous teractions with bears is to be well-informed, be aware of your surroundings, look for fresh bear sign, and warn bears of your presence.

Please complete one form for each separate bear or bear group observed.

Park staff can assist you in completing accurate location information.

Complete all information as best you can. If you do not know the answer to a question, leave it blank.

Whenever there are numbered choices, circle the appropriate number and fill in any blank lines.

Anytime a bear makes physical contact with a person, there is damage or loss of property or food, there is a large by a bear toward people, people have to take extreme evasive action in response to a bear, or ɘople have to use a deterrent on a bear, report these incidents IMMEDIATELY to a park warden or staff member.

ighted by: ______ Phone No.: ______ Date D ___ M ___ Y ___

ime: ______ a.m./p.m. No. in Group: ______

BEAR LOCATION

ɔcation of Bears (Please be specific):

lapsheet: ______ UTM Zone: ______ Easting/ Latitude: ______ Northing/ Longitude: ______

BEAR AND PEOPLE ACTIVITY WHEN BEAR SEEN

o. of Bears: ______

pecies:
1 Grizzly
2 Black
3 Unknown

emale & Young? ʼes No

No. in Sex/Age Class:
- Unknown Adult ___
- Male ___
- Female ___
- Young of Year ___
- Yearlings ___
- Older Young ___
- Unknow. Young ___
- Unknown

Bear's Initial Activity:
1 Grazing
2 Digging
3 Eating berries
4 On Carrion
5 Travelling
6 Resting
7 Other:

ʼeople's Activity:
1 Hiking
2 In Boat
3 In Camp
4 In Helicopter
5 In Airplane
6 Other: ______

People's position in relation to bear:

Positon 1:
1 Upwind
2 Downwind
3 Crosswind
4 No wind

Positon 2
1 Upslope
2 Downslope
3 Cross-slope
4 Across Valley
5 Across Stream
6 Other:

Distance to bear: ______ m

BEAR'S REACTION TO PEOPLE

ear's reaction to people:

ıitial reaction:	Secondary reaction:
1 Unaware	1 Unaware
2 No reaction	2 No reaction
3 Walkedaway	3 Walkedaway
4 Ran away	4 Ran away
5 Advanced	5 Advanced
6 Charged	6 Charged
7 Other:	7 Other:

ears actions toward people:
1 Unaware
2 Indifferent
3 Curious
4 Uneasy
5 Frightened
6 Aggressive
7 Protective of young
8 Seeking human food
9 Other:

Did bear obtain human food? Yes No

Was a bear deterrent used? Yes No
(scare device, pepper spray, flare, etc.)
If yes, please explain:

)ther comments: ______

STAFF USE ONLY

ʼorm Source:
1 Visitor
2 Vuntut Gwitchin member
3 Other local person
4 Parks staff
5 Park Warden

Landscape association: ______
Habitat class: ______
Elevation: ______ m
Fon checked by: ______

Appendix 5. Proposed bear - human interaction risk assessment form.

BEAR - HUMAN INTERACTION ASSESSMENT FORM

Plot No.	Field No.	Date	D	M	Y
Project ID	Surveyor(s)				

LOCATION

General Location			
Mapsheet	Air Photo No.	X Co-ord	Y Co-ord
UTM Zone	Easting/ Latitude	Northing/ Longitude	

Source of Co-ordinates	Map	GPS		Photo Roll	Frame Nos.

SITE INFORMATION

Ecoregion	Ecosection	Habitat Class:

Elevation (m)	Slope (%)	Aspect (°)	L	N	NE	E	SE	S	SW	W	NW

BEAR - HUMAN INTERACTION RATINGS

Overall:	sp	Comments	Su	Comments	Fa	Comments
Displace.						
Encounter						

Attributes:	sp	Comments	su	Comments	Fa	Comments
Habitat Pot.						

	Rate	Comments
Travel Concerns		
Visibility Concerns		
Other Sensory		

Specific Habitat Evaluation:

			50 m				100 m				150 m				200 m			
Plant Foods:	Overall	Site	N	E	S	W	N	E	S	W	N	E	S	W	N	E	S	W
Animal Foods:																		
Bear Sign:																		

Comments:

Appendix 6. Proposed den investigation form for Vuntut National Park, Yukon.

BEAR DEN FORM - VUNTUT NATIONAL PARK

Plot Number:

Reuse?: N Y

Site Number:

D D M M Y Y

Surveyor:

Vegetation Form?: N | Y

No. V | F

Mapsheet

Zone:

Den Type:
1 Incidental; Aerlai Visual
2 incidental; Ground Visual

UTM Easting:

UTM Northing:

Winter of Use:
1 Unknown
2

Airphoto Line:

Airphoto:

Ecoregion:
Ecodistrict:
Landscape association:

Elevation:

Slope (%):

Aspect:

Habitat Class:

DEN CHARACTERISTICS:

Den Type: Excavated | Natural cave | Tree roots

Stabilizing Material: Roots | Rocks | Soil structure

Evidence of Previous Use?: Y | N | Type of evidence:

Den Measurements:

Entrance: Max. height: cm
Max. width: cm

Tunnel: Max. height: cm
Max. width: cm
Max. length: cm

Chamber Max. height: cm
Max. width: cm
Max. length: cm

Den Stability:
1 Stable; reusable
2 Partially collapsed
3 Collapsed

Water in Chamber:
1 None
2 Percolating through roof
3 Pooled in nest

Scat Sample: (site number) S C

Scat In or Outside Den?: I | O

Anal Plug Collected?: Y | N

Bedding Material:
Y N

Depth: cm

Matrix: Coarse | Medium | Fine

Type:

SITE DESCRIPTION: Strata (%): Tree: ____ Tall Shrub: ____ Low Shrub: ____ Herb: ____ Moss: ____

Site Position:

macro	meso	Surface Shape:	Microtopography:
A apex	C crest	CV concave	S smooth
F face	us upper slope	CX convex	M mlcromounded
us upper slope	MS middle slope	ST straight	SM slightly mounded
MS middle slope	LS lower slope	UN undulatin g	MM moderate mounded
LS lower slope	T toe		ST strongly mounded
VF valley floor	D depression		SV severely mounded
P plain	L level		EM extremely mounded
			UM ultra mounded

Exposure:	Moisture:	Soil Drainage:	Perviousness:	Flood Hazard:
N not applicable	VX very xeric	VR very rapidly	R rapidly	FR freq. & reg.
W wind	X xeric	R rapidly	M moderately	Fl frequent
I insolation	SX subxeric	W well	S slowly	M moderate
F frost	SM submesic	MW mod. well		R rare
CD cold air drain.	M mesic	I imperfectly	Free Water:	N no hazard
CS cold air sink	SH subhygric	P poorly	P present	Form: ____
	HG hygric	VP very poorly	A absent	
	SD subhydric			
	H hydric			

Soil Type: ____ Depth to Permafrost: ____

GENERAL:

Site and Den Diagram:

Photos: ID: Roll: No.

Comments: