Parsnip Grizzly Bear Population and Habitat Project

2001 Progress Report

Mountains

Plateau

Prepared by:

Lana M. Ciarniello, Elena S. Jones, Doug Heard, Ian Ross, and Dale Seip

October 2002

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

Forest Renewal British Columbia (FRBC), with funds provided by Canadian Forest Products Ltd. (Canfor) and the Pas Lumber, supported the Parsnip Grizzly Bear Project. Additional support was provided by: BC Ministry of Environment, Lands and Parks, BC Ministry of Forests, Natural Science and Engineering Research Council of Canada scholarship to L. Ciarniello, Science Council of British Columbia scholarship to J. Paczkowski, the University of Alberta, the University of Northern British Columbia, and the Spruce City Wildlife Association. We extend a most sincere thank-you to our funding agencies.

The success of the 2000 field season would not have been possible without the assistance of John Paczkowski, Glen Watts, Charles Mamo, Doug Wilson, Joe Kavanagh, Chris Ritchie, Peter Forsythe, Mike Wolowicz and Andrew deVries. A special thank-you is extended to the residents of Salmon Valley and Bear Lake who allowed us onto their land to conduct microsite habitat investigations. The Regional District of Fraser Fort George and Seppo Hirvi allowed us access to the old landfill site at Bear Lake for trapping. Greg Altoft provided exemplary flying skills for aerial darting of bears. We also appreciated the skilled helicopter flying to access microsite habitat plots by a number of Pacific Western Helicopter pilots including, Ken Knight, Chris Norman, and Mike Savignac. Fixed-wing pilot Larry Frey kept us safe on telemetry flights. Thanks are also extended to Roy Pattison for allowing us to re-fuel at his airstrip during telemetry flights. We also wish to acknowledge the assistance and support provided by Dr. Mark Boyce and Dan Tomlinson. Hawthorne Beyer provided outstanding GIS skills. We thank Tracy O'Brien for volunteer assistance during August 2000. The DNA grid study crew consisted on Garth Mowat, Kim Poole, Darcy Fear, John Paczkowski, and Mike Wolowicz. Personnel of BC Rail moved fuel for us into the mountains and reported bear sightings. We would also like to thank Mari Wood and Pam Hengeveld of the McLeod Lake Landfill Study (Peace-Williston Compensation Program) for providing data on three of their study animals (Molly, Bam Bam, and Sunshine) and for adding missing study bears to their telemetry scan.

1.0 INTRODUCTION

The management of grizzly bears (*Ursus arctos*) and their habitat is a high profile conservation issue in British Columbia. Intense public concern regarding B.C.'s grizzly management practices occurs at the international, national, provincial and local level. The Committee on the Status of Endangered Wildlife in Canada nationally lists grizzly bears as a species of special concern. In B.C., grizzly bears are a blue-listed species (vulnerable). The B.C. Forest Practices Code requires that the needs of red and blue listed species be addressed during forest management activities. Many important land use decisions in B.C. have been strongly influenced by concerns regarding grizzly bear conservation, and all of the Land and Resource Management Plans (LRMP's) within the Prince George Forest Region have identified grizzly bear conservation as a major land management concern. Forest companies that have, or are trying to obtain 3rd party environmental certification for their products, must implement acceptable practices to protect threatened and endangered species within their operating area. Consequently, there is a great need for reliable information on the habitat requirements of grizzly bears to facilitate improved forest and land management practices in B.C.

There have been several grizzly bear research projects in B.C. but these studies have focused on coastal forests or the southeastern portion of the province. Little research has been done on habitat use by grizzly bears in the central and northern portions of the province. Also, the recent development of a variety of new research and inventory tools, including DNA population census grids, Global Positioning Systems radio-collars, and Geographic Information Systems are now being used for advanced analysis techniques such as resource selection functions (RSFs). These new research and analysis techniques provide an opportunity to greatly enhance our understanding of grizzly bear habitat use.

The location of the Parsnip Grizzly Bear Project provided a number of unique opportunities to better understand grizzly bear habitat requirements:

i) the study area ranged from wilderness mountain habitat to plateau habitat that had extensive road access and forest harvesting activities. Prior to this study, little was known about the habitat use of grizzlies on the sub-boreal plateau.

ii) the area was in the Arctic watershed so the bears did not have access to salmon.

iii) the area occurred in a bottleneck of the Rocky Mountains (Hart Ranges) and may be important in providing connectivity between the southern and northern Rocky Mountains.

The purpose of this project was to improve our understanding of grizzly bear habitat use and examine the impact of forest harvesting in an area where little previous information was available. In particular we were interested in grizzly habitat use in the Sub-boreal Spruce (SBS) biogeoclimatic zone on the interior plateau. This information will help land managers in government and forest industry develop land use practices that are compatible with the conservation of grizzly bears and their habitat. This report summarizes the research results for 2001, which is the fourth year out of a projected five (1998-2002). For a copy of the progress reports for 1998, 1999, or 2000 please visit our web site at http://web.unbc.ca/parsnip-grizzly/.

1.1 Study Objectives

The objectives of the Parsnip Grizzly Bear Project were as follows:

1. To determine the abundance and population status of grizzly bears within the study area. This included obtaining estimates of population density, reproductive rates, and mortality rates;
2. To identify micro and macro seasonal habitat-use patterns, seasonal movements, home range sizes, and diet; and
3. To evaluate and contribute to improvements of the current BC grizzly bear inventory methods.

1.2 Graduate Student Research

The Parsnip Grizzly Bear Project supports two graduate student research projects. John Paczkowski is completing his Master's degree at the University of Northern British Columbia (1998-2000). John is using LANDSAT thematic mapper imagery to classify grizzly bear habitat using a greenness-based approach. Greenness habitat values were obtained from combining different spectral channels as derived from satellite imagery. Greenness is increasingly being used as a measure of the vigour of herbaceous vegetation and a surrogate for grizzly bear habitat quality. John is examining different methods to calculate greenness and using the Parsnip Grizzly Bear Project data to evaluate the effectiveness of the model in central British Columbia.

Lana Ciarniello is working on her Ph.D. at the University of Alberta (1999-2003). Lana will characterize the effects of landscape change on grizzly bear distribution and abundance. The use of habitats by bears will be compared to the amount of habitat that is available using a broad scale (the landscape) and smaller scale (home range of the grizzly bear). She will use Resource Selection Function (Manly *et al.* 1993) modeling procedures to prepare Geographic Information System maps, which will predict the probabilities of occurrence and persistence of grizzly bears in differing future scenarios (time and space). RSF will help clarify the role of food variables versus human disturbance variables in an attempt to determine whether or not the large home range size, reduced density, and different selection patterns of plateau bears was a function of human activities.

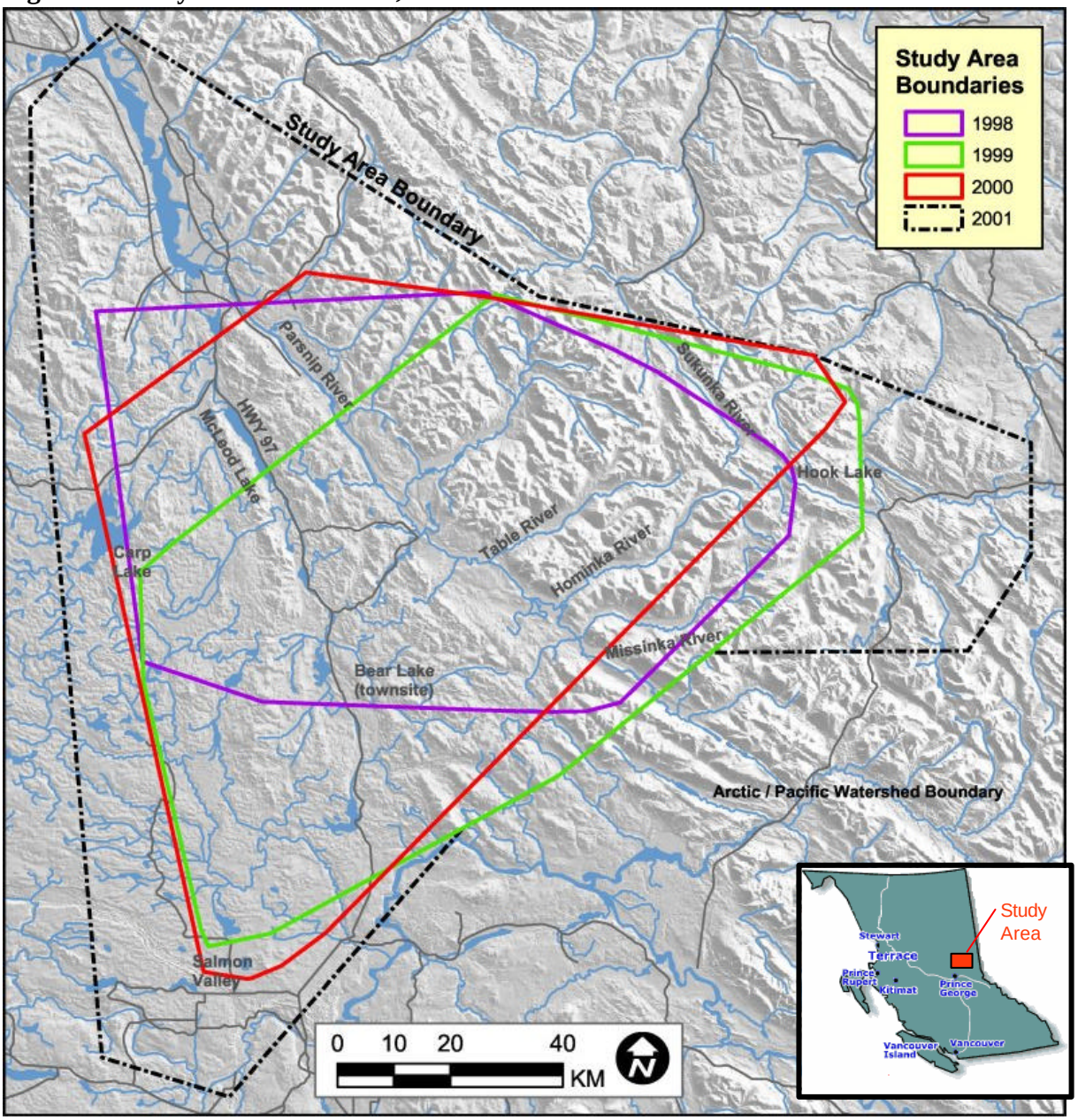
2.0 STUDY AREA

The Parsnip Grizzly Bear Project study area was based on collared movements of grizzly bears from Prince George, B.C., extending north and northeast. It encompassed the Parsnip River and its tributaries including the Missinka, Hominka, Table, Anzac and Chuchinka river drainages, but also extended past the Crooked River drainage to the west, and the Wolverine River drainage to the east. These rivers were in the Arctic watershed and consequently study bears did not have ready access to spawning salmon. In addition, several bears were collared on the plateau in the Salmon River watershed, which is part of the Fraser drainage, but none of these bears appeared to use salmon.

We used the MCP of all collared bear locations (excluding extreme outliers) to define the study area. In 1998, the study area was 7,400 km^2. In 1999, the study area expanded to 8,900 km^2 to

include the core home ranges of recently radio-collared plateau bears. The study area increased again in the spring of 2000 to 9,600 km^2, when a family group was captured and outfitted with radio-collars in the Firth Lake area. In 2001, the study area expanded to approximately 17,400km^2 primarily due to the addition of an adult male (GM51) who ranged to the west, and three subadult males – one who dispersed to the north by northwest (GM36), one who ranged south (GM47), and one who expanded his range to the east (GM29) (Figure 1).

Figure 1. Study Area Boundaries, 1998 to 2001



Extreme outliers in the western portion (e.g., bears who went to Vanderhoof district or Fort St. James) were omitted from the study area. We limited our western boundary because there was

not a representative sample of bears using this region. For all years, the core study area remained within the Prince George Forest District in central-eastern British Columbia. However, in 2001 the boundary extended south past the Salmon River, which was known to support some small salmon runs. Regardless, none of the study bears were found to consume salmon, and therefore these bears lacked this high-quality, concentrated, and predictable food supply that is important to bears along Pacific watersheds (Hilderbrand *et al.* 1999).

Two distinct topographical areas were represented within the study area: the plateau which contains rolling hills and flat valleys, and the Hart Ranges of the Rocky Mountains with steep sided bowls, avalanche chutes and upper elevation valleys. The plateau portion primarily supported spruce-subalpine fir forests with a component of lodgepole pine and aspen. Pine dominated forests occurred on drier sites. Forestry was the predominant resource extraction industry in the study area and most forestry activities occurred on the plateau. A substantial proportion of the plateau forests had been harvested over the past 40 years and supported new and regenerating cutblocks. The plateau also contained a major highway (Highway 97) and a network of forestry roads. In addition, there was the community of Bear Lake with two sawmills, the community of McLeod Lake, the town of Mackenzie, and two major logging camps (Anzac and Arctic). The southern portion of the plateau (i.e., the Salmon Valley) contained a number of agricultural activities, including hay, oats and livestock production. In 2001, we also had one grizzly bear (GM47) that made regular use of the forests surrounding the city of Prince George.

In the mountains, lower elevation forests were dominated by spruce-subalpine fir stands, but the proportion of subalpine fir became progressively greater with increasing elevation and predominated upper elevation stands. Subalpine areas and avalanche chutes supported lush shrub-forb meadows, whereas higher elevation alpine areas were composed of alpine tundra communities, barren rock, or ice/snow. The mountainous area had experienced much less industrial development, although all major watersheds had logging roads along the valley bottom and varying proportions of previous harvesting at lower elevations. However, upper elevations and the back ends of most watersheds were undeveloped wilderness. The Table River valley contained the BCR railway line, which passed through a tunnel to the Sukunka River valley on the eastern side of the Rockies.

Elevations on the plateau ranged from 580m to 1,687m (mean 860m). In the mountains, elevations ranged from 670m in the valley bottoms to the highest mountain peak, Sentinel Peak, at 2,366m. Less than 1% of the study area was contained within glacial rock and ice (i.e., essentially non-useable grizzly bear habitat). The Parsnip River formed the approximate divide between the plateau and mountainous habitat areas. Therefore, bears that primarily resided on the east side of the Parsnip River were referred to as 'mountain' bears, while bears that resided primarily on the west side of the River were referred to as 'plateau' bears.

The plateau was within the Nechako Lowland and the McGregor Plateau Ecosections of the Fraser Basin Ecoregion. The mountainous habitat was primarily within the Hart Ranges and the Hart Foothills Ecosections of the Central Canadian Rocky Mountains Ecoregion. Three biogeoclimatic zones occurred within the study area: Sub-Boreal Spruce (SBS), Engelmann Spruce – Subalpine Fir (ESSF), and Alpine Tundra (AT). The SBS zone predominated in the plateau. The most westerly plateau portion was in the SBSmk1 (Mossvale Moist Cool Sub-

Boreal Spruce) biogeoclmatic variant, while the eastern portion of the plateau consisted mainly of the SBSwk1 (Willow Wet Cool Sub-boreal Spruce) biogeoclimatic variant, and the southern portion of the plateau occurred in the SBSdw3 (Dry Warm Sub-Boreal Spruce) biogeoclimatic variant.

On the western side of the mountains, the SBSvk1 (Very Wet Cool Sub-boreal Spruce) predominated in the valley bottoms, the ESSFwk2 (Misinchinka Wet Cool Engelmann Spruce-Subalpine Fir) occurred at mid-elevations and the ESSFwc3 (Cariboo Wet Cold Engelmann Spruce-Subalpine Fir) occurred at upper elevations to treeline. On the eastern side of the mountains, the SBSwk2 (Finlay-Peace Wet Cool Sub-boreal Spruce) biogeoclimatic variant occurred in the valley bottoms and the ESSFmv2 (Bullmoose Moist Very Cold Englmann Spruce-Subalpine Fir) occurred at higher elevations up to treeline. The AT zone occurred above treeline and typically consisted of small shrubs or krummholz form trees, heath communities, barren rock, or alpine snow and ice.

Based on the climatic characteristics for the plateau biogeoclimatic units, the study area has a mean annual temperature of 2.6° C, and a mean annual precipitation increasing from 49 cm in the west to 73 cm in the east (DeLong et al. 1993). Snow usually covers the ground from late-November through mid-April. Mean annual snowfall increases from 200 cm in the plateau (west) to 300 cm in the mountains (east). Typically winter conditions begin and persist for a month longer in the mountains than on the plateau (SBS dominated zone).

3.0 METHODS

3.1 Bear Capture

Bears were captured using aerial darting, leg-snares, or culvert traps. All handling procedures follow those detailed by Ross *et al.* (2000).

We did not catch all the bears that were monitored during 2001. Three bears, Molly (MF2), Bam Bam (MM6), and Sunshine (MF7), were captured in the fall of 2000 as part of the Peace-Williston Compensation Program, McLeod Lake Landfill Study. Sunshine and GM36 are the offspring of GF35. GF35 and GM36 were Parsnip Grizzly Bear Project study animals captured in the spring 2000.

3.2 VHF Aerial Telemetry

Bears were monitored using a fixed-wing aircraft once per week, dependent upon weather conditions and aircraft availability. All bears with potential transmitters (i.e., should be working ear tag transmitters and VHF collar transmitters) were entered into the scanning receiver on every flight. Effort was expended to locate missing bears. All aerial telemetry locations were collected during daylight hours. Although weather conditions varied, and some flights were flown in poor weather, efforts were made to fly in clear weather to maximize safety. In the future GPS data may be used to determine if bear habitat use was influenced by weather conditions.

Two two-element antennas were fixed to the right and left struts of the plane facing outwards. The antennas were connected to a Lotek receiver inside the plane. A manually operated switch box controlled both antennas as well as an omni-directional belly antenna located under the plane. The plane flew at a high elevation until a signal was received at which point the omni-directional antenna was switched off and the strut antennas were used to fly a grid pattern, while descending in elevation, until a boxed area surrounding the bear was identified. The location of the bear was determined by the signal strength. Significant effort was directed at obtaining accurate aerial locations and/or visual observation of the bear. Universal Transverse Mercator (UTM) coordinates (x, y grid system) were taken with a hand-held 12 Channel Garmin® GPS unit. If a position was taken in latitude/longitude it was converted to UTM (NAD 83) using the Geographic Calculator (Blue Marble Geographics). Some aerial locations were taken from a helicopter. The methods followed that of fixed wing flights with less emphasis on grid patterns due to the hovering capability of the aircraft.

A biologist onboard the aircraft recorded the bear number, frequency, date, time, habitat type, land-base composition, canopy closure, and confidence code on a telemetry data form (refer to 1999 progress report for an example data form). The confidence code (i.e., accuracy of a location) was judged to be in 1 of 4 classes: (1) location with certainty either through visual observation or judgment of the researcher; (1-) location with certainty but could not exactly pinpoint bear; (2) location with uncertainty; and (2-) bear frequency was heard but could not be located due to weather, etc. A Did Not Locate (DNL) was given to bears that could not be found and a list of the areas searched was provided. A Did Not Fly (DNF) was given to bears that for reasons of weather or cost were not searched for on a flight date. If a visual observation of the bear was obtained the activity of the bear (e.g., resting, moving, hunting, feeding, etc.) and the number of animals present, along with an estimate of their age class (Cub of the Year, yearling, two year old, subadult, adult) were recorded on the data sheet.

A Polaroid photo was taken of each bear location. A dot was placed on the photo in the location of the bear and a north arrow was provided. The photo was used to identify the spot for later microsite habitat investigation. If necessary, the photo also allowed for later viewing of habitat and environmental conditions (e.g., snow on ground).

After the flight, the location of each bear was pinpointed on a biogeoclimatic zone map (BC Ministry of Forests) and the biogeoclimatic zone and subzone were recorded. The location was then transferred to a 1:50,000 topographic map and elevation, aspect, and a location description, were obtained. For cross validation, these attributes were also queried from Forest Cover (FCM; Ministry of Forests), Digital Elevation (DEM) and Terrain Resources Inventory Maps using a Geographic Information System (Arc Info) at a scale of 1:20,000. Additional terrain (e.g., Ministry of Forests primary species composition, age projections, etc.) and human use (distance to nearest road, etc.) data were also obtained from these maps.

Aerial locations were used to establish the home range of study animals. Home ranges were calculated using Animal Movement (Hooge and Eichenlaub 1997). 100% Minimum Convex Polygons were calculated for study animals with >10 locations. Statistical comparisons were calculated using the Mann-Whitney U test with a significance level of <0.05.

3.3 GPS Collar Data

Seventeen GPS collars were deployed on grizzly bears in 2001. The 2001 Televilt collars (all bears except GF38) were set to obtain a fix every 4 hours (i.e., 6 fixes per day). The 1998 Televilt collar (GF38) was set to obtain a fix every 6 hours (i.e., 4 fixes per day). Collars were set to download to a data-logging VHF receiver twice per season: once in August and once in November. In addition, to minimize problems with weather, etc., on the download date collars were programmed to download the same seasonal data three weeks in a row. Some bears required two download sessions to obtain most of the data. We did not utilize the third download session.

The majority of downloads occurred using a helicopter although we attempted to download from the ground to minimize cost and disturbance to the bear. On several occasions we used two receivers to download the bear to obtain the maximum amount of data: one person remained on the ground while one person was in the helicopter. The combined and repeated locations were eliminated. We also attempted to perform some downloads using a fixed-winged aircraft. However, the length of the downloads (51 minutes for the first downloads) made it difficult to remain in contact with the bear as it often moved during that period.

All UTM coordinates prior to and during capture were eliminated in order to calculate fix rates, number of 2D, and number of 3D fixes. Furthermore, we calculated the fix rate for failed collars using the day the collar was first listed as being on emergency mode rather than the day it was retrieved from the bear. Only one collar, GF17, continued to gather data while in emergency mode and for this collar we used the November download date to calculate the fix rate rather than the emergency mode date. For collars that remained on the bear but had failed we used the date and time of the last known fix as the failure date.

3.4 Resource Selection Ratios

Resource Selection Ratios followed Manly et al. 1993. Resource Selection Ratios are the ratio of the proportion used to the proportion available. In this population-level design (i.e., all animals pooled), use for all animals (w_i) was characterized by the following form:

$$w_{(x)} = (U_i / U_+) / (A_i / A_+) \qquad (1)$$

Where (U_i / U_+) refers to the proportion used at bear use locations, while (A_i / A_+) refers to the proportion available of that same covariate at randomly generated locations. If use is proportional to availability (i.e., no selection) then the number is *approximately* 1. If use is greater than availability (i.e., numbers greater than 1) there is said to be selection for the covariate, whereas if use is less than availability (i.e., a number less than 1) it implies avoidance.

VHF bear locations gathered during 1998, 1999, 2000, and 2001 along with 33,181 randomly generated computer points were overlaid on map images using a Geographic Information System (GIS; Arc Info). Only locations in which we were confident of the position of the animal were used in analysis. Repeat locations, for example multiple den-site locations, were removed from analysis as well as locations that fell outside the study area boundary (for example, GM8's excursion to Fort St. James). In addition, if a family group was collared (e.g., GF35, GM36 and

GF37) only the locations of the mother were included, unless the offspring was greater than 500 m from its mother. In addition, if an offspring split from its mother for a time (e.g., GM36 in 2001) its locations were considered independent until it returned to its mother, when locations were again removed from analysis.

Digital elevation maps were built from terrain resources inventory map (TRIM; British Columbia Ministry of Land, Air and Water Protection) images and were used to obtain elevation, slope, and aspect data for bear use and random locations. Four Landsat 5 TM images were obtained from Spatial Mapping (on behalf of Canadian Forest Products Ltd.). These four images were all collected within one month (mid- August to mid-September 1999) and were mosaiced together to form a continuous image of the study area. Erdas Imagine was used for all image processing. Forest Cover Maps (FCM) and road networks were obtained from the BC Ministry of Forests, Canfor East, and Canfor West. These map layers were used to obtain the habitat type, stand age, distance to roads, and type of road information. Vegetation Resources Inventory data was obtained from Canfor West and applied to areas where it existed.

3.5 Microsite Habitat Analysis

We visited as many of the telemetry locations as possible to conduct a microsite habitat investigation. Microsite habitat investigations were performed in an attempt to identify areas of seasonal use, and relate these areas to food availability and other important needs, such as day beds, mark trees and trails, and travel routes. Plateau bear site investigations were accessed by road where feasible. However, some sites were accessed by helicopter in an attempt to minimize bias associated with repeated selection of sites within walking distance of roads. Mountain bear site investigations were accessed by helicopter (for an example habitat data form please refer to 1999 progress report).

Site investigations were performed after the bear was known to have left the area and were normally, with the exception of den sites and kill sites, less than 14 days old. The Polaroid photographs taken at each telemetry location, in conjunction with a hand-held GPS receiver, were used to guide us to the site (refer to Section 3.2). A plot was established after the researchers were confident that certain criteria for verification of the area by a known bear have been met. Criteria used included a visual location, telemetry reliability, age of the sign/disturbance, scat, hair, and tracks.

We focused our habitat plot on what we determined to be the primary activity. As microsite habitat investigations relied on the radio-telemetry data (one point in time) we were limited in our ability to determine the primary activity (e.g., we were unable to watch bears and devise an activity budget). Therefore, rather than using time as a determination of primary activity we defined the primary activity as the activity with the most bear sign. However, on most occasions the bear was using the habitat type for more than one activity. For example, it may have been primarily bedding in an area but some feeding may have occurred within or adjacent to the bed. In multiple activity plots the primary, secondary, and tertiary activities were noted.

The primary activity identified formed the centre of a 10m x 10m plot. Site, habitat, and activity characteristics were recorded. Site characteristics included UTM coordinates, elevation, slope, and aspect. Habitat characteristics focused on site series unit (for the biogeoclimatic zone and

subzone), percent strata (tree, tall shrub, low shrubs, herbs) and canopy cover value. Activity characteristics included identification of the activity (bed, feed, mark tree, mark trail or travel) and verification (visual, confidence code of telemetry, hair, tracks, sign age, scat, disturbance). Distance to the nearest road and a description of the type of road (decommissioned, ATV access, 4X4, etc.) was recorded. In addition, the minimum distance to cover suitable to hide a bear as well as the type of cover (e.g., trees, shrubs, terrain, etc.) was noted. The cover value of a site was determined by pacing 15m in each cardinal direction and counting the visibility of five, 10cm colour bands on a 200cm cover pole (0-50, 50-100, 100-150, 150-200 cm). Photographs of the activity as well as a site diagram and comments were provided for each habitat plot performed.

The number of beds within the plot, or immediately adjacent to the plot, were counted and recorded. Beds were measured and photographed when possible. Bed measurements included length, width and depth. If a scat was found within or adjacent to the plot, in-field scat analysis was performed in order to determine actual feeding within vegetation types (Hamer and Herrero 1983) and obtain a general understanding of diet. Scats with unknown contents were collected and stored for later laboratory analysis. If grizzly bear hair was present at the site it was collected for stable isotope analysis. In addition, if bears were feeding on ants and their larva, ant samples were gathered from the stump the animal had broken. The ant samples were sent to Dr. Staffan Lindgren at the University of Northern British Columbia for species identification.

Mark trees were also measured and recorded. Recordings for mark trees included the species, age class, diameter at breast height (DBH) and the lowest and highest height of the marking. The tree was judged to be of high, medium, or low use. In 2000, UTM locations were taken for all marked trees. If mark trees were associated with a mark trail the length of the trail was noted. Mark trails and trees were judged to be either permanent or occasional.

3.6 Population Data

Population data were obtained through visual sightings of bears during aerial telemetry and microsite habitat investigation flights. If a bear had not been sighted for an extended period of time, and we were in their home range for microsite habitat analysis, the helicopter was used to obtain a visual location of the bear for the specific purpose of obtaining population data. Furthermore, from 1999 to 2001 we ensured that all study bears had a minimum of one good visual observation within each season (spring, summer, and fall). However, visual rates during telemetry flights in these years were so high we did not have to actively fulfill this procedure.

3.6.1 DNA Based Population Census

In 2000, The Parsnip Grizzly Bear Study contracted Aurora Wildlife Research to conduct a mark-recapture population census of grizzly bears (Mowat et al. 2001). The analysis of these data forms the population and density estimates provided for the study area. The report indicates 49 bears per 1,000 km^2 for the mountains as compared to 11 bears per 1,000 km^2 in the plateau. For further information on the DNA methods used and results refer to *Mowat et al. 2001*.

4.0 RESULTS

4.1 Bear Capture

Eight new grizzly bears were captured during the 2001 field season, while 12 study bears were recaptured (Table 1). Drug dosage and immobilization sequences (Appendix I) were recorded as well as physiological (Appendix II) and morphological measurements (Appendix III to V) for immobilized bears. Six black bears were incidentally captured, immobilized, and released after attaching red numbered ear tags. No other incidental wildlife was captured and no serious injuries occurred during trapping.

Table 1. Grizzly Bears Captured and Recaptured, 2001.

ID No.	Age Class[1]	Weight (kg) Estimated	Weight (kg) Actual	Date	Capture Location	Capture Method	Collar Type
GF43	ADU	109		8- May-01	Anzac	aerial dart	GPS
GF44	SUB	70		10-May–01	Powerline	aerial dart	GPS
GM45	ADU	80		11-May-01	Sukunka	aerial dart	GPS
GM47	SUB	70	79	15-May-01	Bear Lake	culvert trap	Ear tags
GM48	ADU	250-275		16-May-01	Parnsip/Hominka	aerial dart	GPS
GF49	ADU	120	109	20-May-01	Redrocky Creek	snare	GPS
GM50	JUV	40	48	20-May-01	Redrocky Creek	snare	Ear tag
GM51	ADU	300-350		26-May-01	McLeod Lake	aerial dart	GPS
Recaptures							
GM39	SUB	100	116	1-May-01	Chuchinka Creek	snare	GPS
GF34	ADU	145	158	7-May-01	Bear Lake	snare	GPS
GF4	ADU	90		8-May-01	North Anzac	aerial dart	GPS
GF7	ADU	90		8-May-01	North Anzac	aerial dart	GPS
GF11	ADU	90		10-May-01	Upper Table	aerial dart	GPS
GM47	SUB	79	79	17-May-01	Bear Lake	snare	VHF
GF35	ADU	180		25-May-01	McLeod Lake	aerial dart	GPS
GM29	ADU	80		25-May-01	Upper Sukunka	aerial dart	GPS
GM45	ADU	85		27-May-01	Sukunka	aerial dart	GPS
GF9	ADU	85		27-May-01	Upper Hominka	aerial dart	GPS
GF17	ADU	85		27-May-01	Anzac	aerial dart	GPS
GF26	ADU	150	136	2-Oct-01	Bear Lake	snare	GPS

[1]ADU adult; SUB subadult (independent); JUV juvenile (dependent)

4.2 Population Data

Fifty bears have been captured between August 1997 and October 2000 (Table 2). The 2001 field season began (April 2001) with 27 bears being actively monitored and 8 additional ear-tag transmitters on males we were unable to locate (GM3, GM8, GM14, GM19, GM22, GM28, GM31, and MM6). One additional bear, GF26, was a fall recapture and monitored from fall to denning. Table 2 provides a capture summary of the status of bears captured to date, while tables 3 and 4 provide tabulated summaries of the fates of Project bears as of December 2001.

Table 2. Status of Bears Captured, 1997 to 2001

Bear ID	Capture Date	Capture Age	No. of Radio locations				Current Status
		(yrs.)	1998	1999	2000	2001	
GF1	26-Sep-97	12	5	----	----	----	Dropped collar - May 1998
GF2	5-Oct-97	19	28	16	----	----	Mortality - June 1999 Appeared natural causes
GM3	5-Oct-97	1	17	0	0	0	Unknown; not located 99, 00 or 01
GF4	5-May-98	9	22	29	36	28	GPS Collar Failure. Last heard October 1-Oct-01
GF5	6-May-98	15	26	31	1	----	Dropped collar - Oct 1999
GM6	6-May-98	6	21	26	1	----	Mortality - LEH June 2000
GF7	8-May-98	8	23	29	35	37	Currently monitored
GM8	8-May-98	5	16	19	1	0	Dropped collar in den - 1999/2000 Ear tag not heard 2000/2001
GF9	9-May-98	9	26	33	35	37	Currently monitored
GF10	11-May-98	9	24	22	----	----	Dropped collar - August 1999
GF11	12-May-98	13	25	31	36	37	Currently monitored
GF12	12-May-98	22	25	1	----	----	Dropped collar - May 1999
GF13	10-May-98	13	24	31	28	----	Dropped collar - September 2000
GM14	13-May-98	16	1	0	0	0	Dropped collar - May 1998 Ear tag not heard 2000/2001
GF15	13-May-98	16	21	25	34	36	Currently monitored
GF16	14-May-98	10	22	28	31	35	Currently monitored
GF17	14-May-98	adult	19	27	35	35	Currently monitored. Collar on Emergency Battery Mode
GF18	14-May-98	15	22	29	23	----	Dropped collar - August 2000
GM19	17-May-98	2	0	14	0	0	Ear tag not heard 2000/2001
GM20	17-May-98	2	19	----	----	----	Mortality - LEH May 1999
GM21	18-May-98	4	22	----	----	----	Mortality - September 1998 Believed non-natural
GM22	18-May-98	8	12	12	1	0	Dropped one ear tag spring 2000 Other ear tag not heard 2000/2001
GM23	2-Sep-98	5	2	----	----	----	Mortality - LEH October 1998
GF24	12-May-99	adult	----	35	30	----	Dropped collar - August 2000 Dropped ear tag - Spring 2000
GF25	24-Sep-98	4	----	24	----	----	Dropped collar - August 1999
GF26	23-Sep-98	18	----	26	----	11	Recaptured fall 2001. Currently monitored.
GF27	14-May-99	7	----	23	----	----	Mortality - September 1999 Unknown; believed natural

Table 2. Status of Bears Captured, 1997 to 2001 *Continued*

Bear ID	Capture Date	Capture Age (yrs.)	No. of Radio locations 1998	1999	2000	2001	Current Status
GM28	14-May-99	5	----	27	18	0	Dropped collar - July 2000 Ear tag not heard after August 2000
GM29	17-May-99	3	----	25	32	33	Currently monitored
GF30	18-May-99	12	----	25	33	36	Currently monitored
GM31	18-May-99	2	----	0	0	0	Ear tag not heard 2000/2001
GF32	18-May-99	8	----	25	33	36	Currently monitored
GF33	25-Sep-99	15	----	9	39	----	Dropped collar - September 2000
GF34	4-Oct-99	5	----	7	51	40	Currently monitored
GF35	23-May-00	10	----	----	54	43*	GPS Collar Failure. Last heard 27-Aug-01
GM36	23-May-00	4	----	----	51	27*	Dropped collar - September 2001 Ear Tag failed - Spring 2001
*GF37		4	----	----	30	60*	Currently monitored
GF38	17-Sep-00	2	----	----	16	22	Dropped colla r - July 2001 Ear tag not heard 2001.
GM39	18-Sep-00	2	----	----	15	7	Mortality Spring 2001. Accompanied by sibling GF38, mistaken ID in black bear hunt
GF40	3-Oct-00	1	----	----	----	----	Mortality – Trapping fall 2000
GF41	28-Sep-00	11	----	----	14	36	Currently monitored
GF42	3-Oct-00	3	----	----	30	24	Mortality. Shot by sheep rancher Sept 2001
GF43	8-May-01	13	----	----	----	21	GPS Collar Failure. Last heard 17-Sep-01 Next heard den flight Feb. 18, 02
GF44	10-May-01	4	----	----	----	27	Mortality Oct 2001. Inc. 1 habitat location MM Undetermined cause, believed poached
GM45	11-May-01	7	----	----	----	13	GPS Collar Failure. Last heard 31-Jul-01
GF46			----	----	----	----	Bear ID used on Robson Valley Study
GM47	15-May-01	2	----	----	----	36	Dropped collar - August 2001 Ear tag currently monitored
GM48	16-May-01	10	----	----	----	12	GPS Collar Failure. Last heard 4-Sept-01
GF49	20-May-01	7	----	----	----	18	Mortality. Unknown cause, natural? 22-Aug-01
GM50	20-May-01	1.3	----	----	----	32	Currently monitored
GM51	26-May-01	12	----	----	----	17	Dropped collar 10-Sep-01
*MF2 (Molly)	20-April-00	8	----	----	49	69*	Currently monitored
*MM6 (Bam Bam)	09-May-02	2-3	----	----	21	1	Mortality. Shot by grouse hunter in defense

*Bears captured by the Peace-Williston Study that are also monitored by this project.

*GF35 – 16 locations, GM36 – 7 locations, GF37 – 29 locations, MF2 - 31 locations courtesy of Peace-Williston Study.

Table 3. Fate of Bears Capture d, 1997 - 2001

Bears Captured	Bears lost from study	Mortality	Dropped collars*	Active transmitters	Failed GPS Collars	Unable to locate Ear Tag
50 31 female	**22** 15 female	11 6 female	11 (19) 9 (11) F	**15** 12 female	**5** 3 female	**8** 1 female
19 male	7 male	5 male	2 (8) male	3 male	2 male	7 male

Numbers do not include MF2 (Molly – currently monitored) or MM6 (Bam Bam – shot fall)
*Numbers in brackets are the total number of dropped collars, while numbers outside of the brackets are after recaptures.

Table 4. Landscape where Bears Live

Total Tagged (50)		Remaining Tagged (15*) as of December 20, 2001	
Plateau Bears	*Mountain Bears*	*Plateau Bears*	*Mountain Bears*
23	27	6	9
13 female	18 female	4 female	8 female
10 male	9 male	2 male	1 male

*Number does not include bears we were unable to locate, MF2 (Molly) or MM6 (Bam Bam) PWCP study bears.

4.2.1 Dropped Collars

During 2001, four bears had the spacers on their collars rot-off (GM36, GF38, GM47 and GM51). Three of these bears (GM36, GF38, and GM47) were also outfitted with ear tag transmitters at capture. We frequently checked transmissions from ear tag transmitters during VHF/GPS flights. The failure of GM36's ear tag transmitter was noted while monitoring his VHF collar. After dropping his VHF collar we did not detect his ear tag during the remainder of the season. GF38's ear tag was delayed to start in September 2001 but did not appear to activate. GM47 was outfitted with two ear tag transmitters that allowed him to be tracked until they were programmed to shut off in mid-November, just prior to his denning up.

4.2.2 Failed Collars

Five collars failed outright during the 2001 field season (GF4, GF35, GF43, GM45, GM48). All collars were new 2001 Televilt Ltd. GPS collars. Four of the five collars went into emergency battery mode and failed within one week to one month of first displaying problems. For more on GPS collar information please refer to Section 4.5.

4.2.3 Mortality

A moratorium on hunting grizzly bears was initiated by the provincial government during 2001 and no limited entry hunt permits were issued for the study area. However, five of the study bears died during 2001 - the highest number of study bear mortality documented to date (GM39, GF42, GF44, GF49, MM6 Bam Bam). From 1998 to 2001, 11 of the 50 (22%) grizzly bears have died (Table 5). However, it must be noted that the number of known deaths might be lower than the true number because bears that have dropped their collars or have failed transmitters would only be recorded as deceased if the carcasses were found and reported. Otherwise, their status remains unknown. As mentioned under Section 4.2, the season began with 27 bears being actively monitored, which included four of the five bears that died during 2001. Three of the 27 bears dropped their collars, while 5 other collars failed. Thus, for 8 of the 27 bears their fates are

unknown resulting in 19 bears with known fates. In 2001, 4 of these 19 bears died. All 2001 deaths were plateau bears.

Table 5. Mortality for 50 Radio-Collared Grizzly Bears, 1997 to 2001

Mortality	Natural	Non-natural	Unknown
*Total = 11	2	8	1
# Females = 6	2 female	3 female	1 female
# Males = 5*	0 male	5 males	0 male

*Number does not include Bam Bam, who was shot by a guide outfitter while he was hunting grouse.

In May 2001, a guide outfitter and his client shot GM39 during the spring black bear hunt as a mistaken identity for a black bear. During our tracking, GM39 was always in the company of his sibling, GF38. Both bears were outfitted with GPS collars and had denned together with a third, unmarked bear we also believed to be a sibling. GM39 was a typical light brown bear with silver, grizzled tips of hair and no outstanding features. He was 3 years old and DNA results have revealed this sibling pair to be the offspring of GF26.

The next mortality was GF49, who was the mother of GM50 (yearling) and an untagged offspring. GF49 was found dead and consumed in a black spruce bog. The cause of her death remains unknown. GF49 was sighted from the plane feeding on berries in a cutblock two weeks prior to her death. She appeared in good health and no problems were noted. We put forth two plausible scenarios for GF49's death: first was that she died of natural causes being killed by a larger, more aggressive bear while in defense of her yearlings. The second scenario was that she was struck by a vehicle while crossing Highway 97, made her way down the bank and a few hundred meters across the Crooked River and died in the black spruce bog. In this scenario her yearlings or another bear would have consumed her. GF49 was outfitted with a GPS collar and we had hoped the locations in the collar would lend more to the story of her death. Although the collar appeared to functioning normally (not on emergency mode, shutting off on time, etc.) it had failed and did not contain any locations after July 4.

GF42 was a subadult female who covered a very large area. She often traveled from the Salmon Valley to Mackenzie. In September 2001, GF42 traveled from Mackenzie to Vanderhoof where she was shot on a ranch by the farmer after being accused of killing sheep. GF42's carcass was given to a native band for ceremonial purposes and was not inspected by Parsnip Project biologists. The condition of this bear remains unknown but we believe she was in good health at the time of her death.

GF44 died between August 16 to 24, 2001 in a regenerating cutblock. A telemetry flight on August 24 revealed GF44's collar to be in mortality mode directly adjacent to an ATV accessible logging road. ATV tracks were sighted along the road in the cutblock. A ground investigation revealed GF44's collar together with a moose carcass at the side of the road. However, her body was located 380m from the moose carcass and on the opposite side of the road. GF44 was sighted in the cutblock a fight prior to her mortality location and was noted to appear in good health. GF44's death was suspicious and it is possible that she was shot while feeding on a moose. DNA confirmed that the carcass retrieved was GF44.

MM6 (Bam Bam) had been missing for the entire 2001 field season due to a failed ear tag transmitter. He was shot in October after allegedly charging a grouse hunter.

4.2.4 Summary of Bear Status for 2001

The 2001 field season began with 27 bears being monitored and ended with 15 bears with transmitters, not including MF2 (Molly) (Table 6).

Table 6. Fate of 27 Radio-Collared Grizzly Bears, 2001

No. Bears with active transmitters	Mortality in 2001	Dropped Collars in 2001	Failed transmitters	Remaining bears December 2001
27	4 (5 with Bam Bam)	3 (4 total but one was tracked by ear tag)	5 (all GPS)	15 (16 including Molly)

4.2.5 Reproduction

The spring season allowed for confirmation of population parameters because of the ease of visual locations associated with snow cover as well as the ability to follow tracks. Table 7 provides an update of the summary of female reproductive status based on capture and visual aerial telemetry locations from 1997 to 2001. Spring 2002 visuals will be used to confirm the reproductive status presented for 2001.

Table 7. Female Reproductive Status as Determined Through Capture and Radio-Telemetry Relocations, 1997 to 2001

BEAR ID	*AGE / YEAR	YEAR					COMMENTS
		1997	1998	1999	2000	2001	
GF1	12 / 97	1 yearling	------	------	------	------	Dropped collar in den
GF2	19 / 97	1, 3-yr old	Lone	2 COY	------	------	Bear deceased 1999
GF4	9 / 98	------	1 yearling	2 COY 0 COY	Lone	Lone	
GF5	15 / 98	------	Lone	2 COY 0 COY	------	------	
GF7	8 / 98	------	Lone	Lone	Lone	Lone	
GF9	9 / 98	------	Lone	2 COY	2 ylngs.	2, 2-yr olds	Cubs believed to be denned with mother
GF10	9 / 98	------	Lone	2 COY	------	------	Unknown; dropped collar
GF11	13 / 98	------	1, 2 or **3?** yrs old	3 COY	3 ylngs.	3, 2-yr olds	Cubs believed to be denned with mother

Table 7. Female Reproductive Status, 1998 to 2001, Continued

BEAR ID	*AGE / YEAR	YEAR					COMMENTS
		1997	1998	1999	2000	2001	
GF12	22 / 98	------	2, 2 yr olds	------	------	------	
GF13	13 / 98	------	2, 2 or **3?** yrs.	2 COY 0 COY	Lone	------	
GF15	16 / 98	------	1? ylngs.	Lone	2 COYs	2 ylngs. 1 ylngs.	Last sighting 7/3/01 with 2 yearlings Lost one yearling between 7/3/01 and 7/9/01
GF16	10 / 98	------	Lone	1 COY	Lone	Lone	
GF17	AD / 98	------	Lone	Lone	Lone	Lone	
GF18	15 / 98	------	1, 2 yr old	1 COY	Lone	------	
GF24	AD / 98	------	------	2, 2yr olds	Dispersed	------	Offspring successfully dispersed spring 2000
GF25	4 / 98	------	2 **COY?**/yr	2 ylngs.	------	------	Unknown; dropped collar
GF26	18 / 98	------	3 COYs or ylngs?	3 ylngs. or **2 yrs?**	Dispersed	1 COY	Bear recaptured October 2001 with 1 COY
GF27	7 / 99	------	Lone	Lone	------	------	
GF30	12 / 99	------	------	1, 2yr old	Lone	Lone	
GF32	8 / 99	------	------	Lone	Lone	2 COYs	Bears believed to be denned with mother
GF33	15 / 99	------	------	3 ylngs.	3, 2 yr olds 2, 2 yr olds	------ ------	Last sighting 8-Sept-01 with 2, 2 yr olds; Dropped collar
GF34	5 / 99	------	------	Lone	Lone	Lone	
GF35	10 / 00	------	------	------	2, 3 year olds	Dispersed	GM36 and GF37 dispersed from mother (GF35) early in the year
GF37	4 / 00	------	------	------	Mother is GF35	Mother is GF35	Subadult bear
GF38	SUB / 00	------	------	------	Lone	Lone	Subadult bear
GF41	11 / 00	------	------	------	Lone	Lone	
GF42	3 / 00	------	------	------	Lone	Lone	Subadult bear
GF43	13 / 01	------	------	------	------	Lone	
GF44	4 / 01	------	------	------	------	Lone	Subadult bear
GF49	7 / 01	------	------	------	------	2 ylngs.	
M2	8 / 00	------	------	------	Lone	3 COYs	

*Age is her age at capture year.

? Indicates uncertainty of age but is the biologists best guess

Underline and **bold** indicates reproductive status used in Table 7, Summary of Family Groups

Cubs of the Year (COY) in 2001

Eight adult females had the potential to have cubs of the year (COYs) in 2001, while three of these females were sighted with COYs. The only mountain female sighted with COYs was GF32 who had two. During 2001, GF32 was sighted on nine occasions and all sightings were with both COYs. Her last sighting was on October 1, just prior to denning.

Two plateau females had COYs in 2001, MF2 and GF26. MF2 (Molly) had 3 COYs and was sighted 10 times during the season. Her last sighting with all 3 COYs was on September 17, a month prior to her denning on October 27. Due to tracks at her den site she was believed to have denned with all 3 offspring.

GF26 had not been monitored since dropping her collar in September 1999. In the fall of 2000, she was recaptured with one COY. GF26's last visual location with her COY was on October 16. She was believed to have denned with her COY.

Yearlings

GF15 was the only study female to have COYs in 2000. She had two COYs. GF15 is a mountain female and was sighted 12 times during the 2001 season. Her first sighting after den emergence (May 22 tracks were recorded around her den sight) was on June 12 where she was accompanied by both yearlings. She was also sighted on July 3 with both yearlings. However, on July 9 she was only sighted with one yearling. During the remainder of the year she had 8 sightings with only one yearling. GF15 was believed to have lost one of her yearlings to unknown causes between July 3 and July 9, 2002. The last visual of GF15 was on October 10 where her remaining yearling accompanied her. She was denned by the following flight on October 27.

The other family unit monitored with yearlings was a new plateau capture, GF49. One of GF49's offspring, GM50, was also captured and aged at one year. A second offspring was sighted with this family unit but was not captured. Between her capture on May 20 and August 14, GF49 was sighted 6 times with both her yearlings. On August 12, 2001, GF49 was separated from GM50 and his sibling by approximately 6 km. The subsequent flight on August 23 revealed GF49 to be in mortality mode. Ground investigation revealed GF49 to be deceased from unknown causes (please refer to Section 4.2.3). However, GM50 was monitored by his ear tag transmitter until denning where he appeared to den with his unmarked sibling.

Two Year Olds

Two mountain bear family groups with two-year-old offspring were monitored during 2001. GF9 had two, two-year olds while GF11 had three, two-year olds. GF9 was first sighted on May 22 in the vicinity of her den with both yearlings. She had 17 subsequent sightings: once alone, four times with one offspring, and 12 times with both offspring. On October 15, she appeared to be denned with both offspring and many tracks were apparent around her den sight. On November 27 she could not be located at her first den. Instead, she had moved from her first denning location to reuse her den from the previous year (approximately 2.5 km). It is unknown whether her offspring remained in the first den or moved with their mother to the second den site. There were no tracks apparent at either location. Although believed alive and most likely with their mother, the fate and location of these offspring cannot be confirmed until spring 2002.

During 2001, GF11 was accompanied by three, two-year-olds. We obtained 21 visual observations of GF11: on one occasion two bears were sighted, three bears were sighted on 6 occasions, while four bears were sighted on 14 occasions. All three offspring were last seen on September 24. Two of the two-year olds were sighted on October 1 but alpine shrubs inhibited a good view of the ground. It is believed all four bears are denning together.

These offspring were COYs in 1999 and were part of 17 COYs born that year. Of those COYs, 10 died as COYs, two have unknown fates because their mother dropped her collar, and the 5 remaining are GF9 and GF11's two year olds.

Independence

During 2001, two offspring (GM35, GF37) became independent from their mother, GF35. On May 9, GM36 was separated from his mother by a distance of two kilometers, while GF37 remained with her mother. GM36 did not return to his mother's home range for the remainder of his monitoring. GM36 moved west to Philip's Creek, Nations Arm, and Carp Lake. He dropped his collar September 8. GF37 remained with her mother for May 9 and 16 locations but was found 7 km due east from her mother on May 16. GF35's GPS collar was last heard in emergency mode on September 27. GF35 and GF37's locations were often 2 km apart but we did not find them together after her May 16 dispersal. This family group was the only bears we have had den in the mountains but spend the remainder of the year on the plateau. Due to the collar failure we were unable to locate GF35 at denning. GF37 denned on the plateau in the Firth Lake area.

Table 8. Family Groups, 1997 to 2001

Year Number of Adult Females	1997 (N=2)	1998 (N=16)	1999 (N=20)	2000 (N=17)*	2001 (N=16)*	Total
COY	0	5	17	2	6	**30**
Believed deceased	0	0	10	0	0	**10**
Unknown	0	0	2	0	0	**2**
Yearlings	1	2	5	5	4	**16**
Believed deceased	0	2?	0	0	1	**3**
Unknown	1	0	5	0	0	**6**
2 year olds	0	3	5	3	7	**18**
Believed deceased	0	0	0	1	0	**1**
Unknown	0	3	0	2	0	**5**
3 year olds	1	3	0	2	0	**6**
Believed deceased	0	0	0	0	0	**0**
unknown	0	0	0	0	0	**0**
Dispersals	1	3?	0	5	2	**11**

* Does not include the four subadult females (GF37, GF38, GF42, GF44)

? Indicates uncertainty of status

4.3 Telemetry

Flights for bear locations began on April 4 and concluded on December 20, 2001. Sixty-five fixed-winged flights were flown resulting in 383.3 fixed-wing hours. During this period the Parsnip Project gathered 780 grizzly bear locations. Two hundred and fifty-nine of the 780 locations (33%) were confirmed by visual observation of the animal(s). An additional 84 locations (16 on GF35, 8 on GM38, 29 on GF37, and 31 on MF2 (Molly)) were provided by the Peace-Williston compensation Program, McLeod Lake Landfill Study. In addition, the Conservation Officer Service provided two study bear mortality locations (GF42 and MM6). Therefore, the total number of locations used in Tables 9 and 10 was 866. However, the habitat use section (Section 4.4) was analyzed using Parsnip Project locations only as effort extended on habitat use plots was dissimilar between projects.

4.3.1 Home Range VHF

100% Minimum Convex Polygons (MCPs) were calculated for bears with >10 locations gathered during the 2001 field season (Tables 9 and 10: Figure 2). Based on 100% MCP calculations, the average home range size for females was 211 km^2 as compared to 1,163 km^2 for males (Table 11). GF42 was omitted from the summary statistics because of her abnormally large home range size. GF26 was omitted form the summary statistics because she was re-collared late in the fall so her annual home range size was not adequately represented. As a note, with the inclusion of these two females, the average home range size increased to 581 km^2.

The comparison between mountain and plateau bears was also of interest. Similar to previous years (Ciarniello et al. 2001) there was a significant difference in home range sizes between all mountain and plateau bears ($p = 0.008$). Female plateau bears had larger home range sizes than mountain females ($p = 0.019$). Incidentally, there was no significant difference between males that lived primarily in the plateau and those that lived in the mountains. However, this statistic should be viewed with caution because the sample sizes were small.

Both male and female bears crossed Highway 97 (Figure 2). In addition, bears moved between the west and east slopes of the Hart Ranges of the Rocky Mountains (mountain bear MCP's). Male and female bears also crossed the Parsnip River. Thus, there do not appear to be significant barriers to movement within the study area. Furthermore, few male and female home ranges overlapped.

Table 9. Home Range Sizes of Female Grizzly Bears (100% MCP), based on VHF locations gathered during the 2001 field season.

Bear	Landscape	No. VHF Locations	100% MCP (km^2)	Comments
~GF4	Mtn.	28	88	Failed GPS collar. No locations after 01-Oct-01
GF7	Mtn.	37	110	
GF9	Mtn.	37	77	
GF11	Mtn.	37	110	
GF15	Mtn.	36	44	
GF16	Mtn.	35	33	
GF17	Mtn.	35	20	
*GF26	Plateau	11	98	Fall capture 02-Oct-02
GF30	Mtn.	36	46	
GF32	Mtn.	36	35	
GF34	Plateau	40	285	
GF35	Plateau/Mtn.	43	1,020	Failed GPS collar. No locations after 27-Aug-01
GF37	Plateau/Mtn	60	781	
◎GF38	Plateau	22	157	Dropped GPS collar. No locations after 25-July-01
GF41	Plateau	36	250	
≥GF42	Plateau	24	7,725	Bear shot 24-Sept-01
~GF43	Mtn.	21	19	Failed GPS collar. No locations after 17-Sept-01
≥GF44	Plateau	27	112	Bear shot 24-Oct-01
≥GF49	Plateau	18	238	Bear deceased 22-Aug-01
MF2	Plateau	69	367	Accompanied by 3 COYs so likely smaller than years without COYs.

Only locations with a confidence code of 1 to 2 were used in home range analysis. Number of VHF locations includes repeat den locations, which have been omitted from the habitat use section (Section 4.4).

[1]landscape refers to bears that had their home ranges, or spent the majority of their time (>50%), east (mountains) or west (plateau) of the Parsnip River.

◎ Bears that dropped their collars during the season
* Bears that were collared late in the season
~Bears whose GPS collar outright failed and could not be located
≥ Bears that died during the season
Home range size for these bears may be underrepresented.

Table 10. Home range sizes of male grizzly bears (100% MCP), based on VHF locations gathered during the 2001 field season.

Bear	Landscape	No. VHF Locations	100% MCP (km^2)	Comments
GM29	Mtn.	33	853	
◉GM36	Plateau/Mtn.	27	2,897	Dropped collar 8-Sept-01
≥GM39	Plateau	7	n/a (12)	Bear shot in spring black bear hunt
~GM45	Mtn.	13	59	Collar failure. No locations after 31-July-01
GM47	Plateau	36	2,079	
~GM48	Mtn.	12	889	Collar failure. No locations after 4-Sept-01
GM50	Plateau	32	273	Subadult, mother (GF49) killed in August
◉GM51	Plateau	17	1,088	Dropped collar 10-Sept-01
≥MM6	Plateau	1	n/a	n/a

[1]landscape refers to bears that had their home ranges, or spent the majority of their time (>50%), east (mountains) or west (plateau) of the Parsnip River.

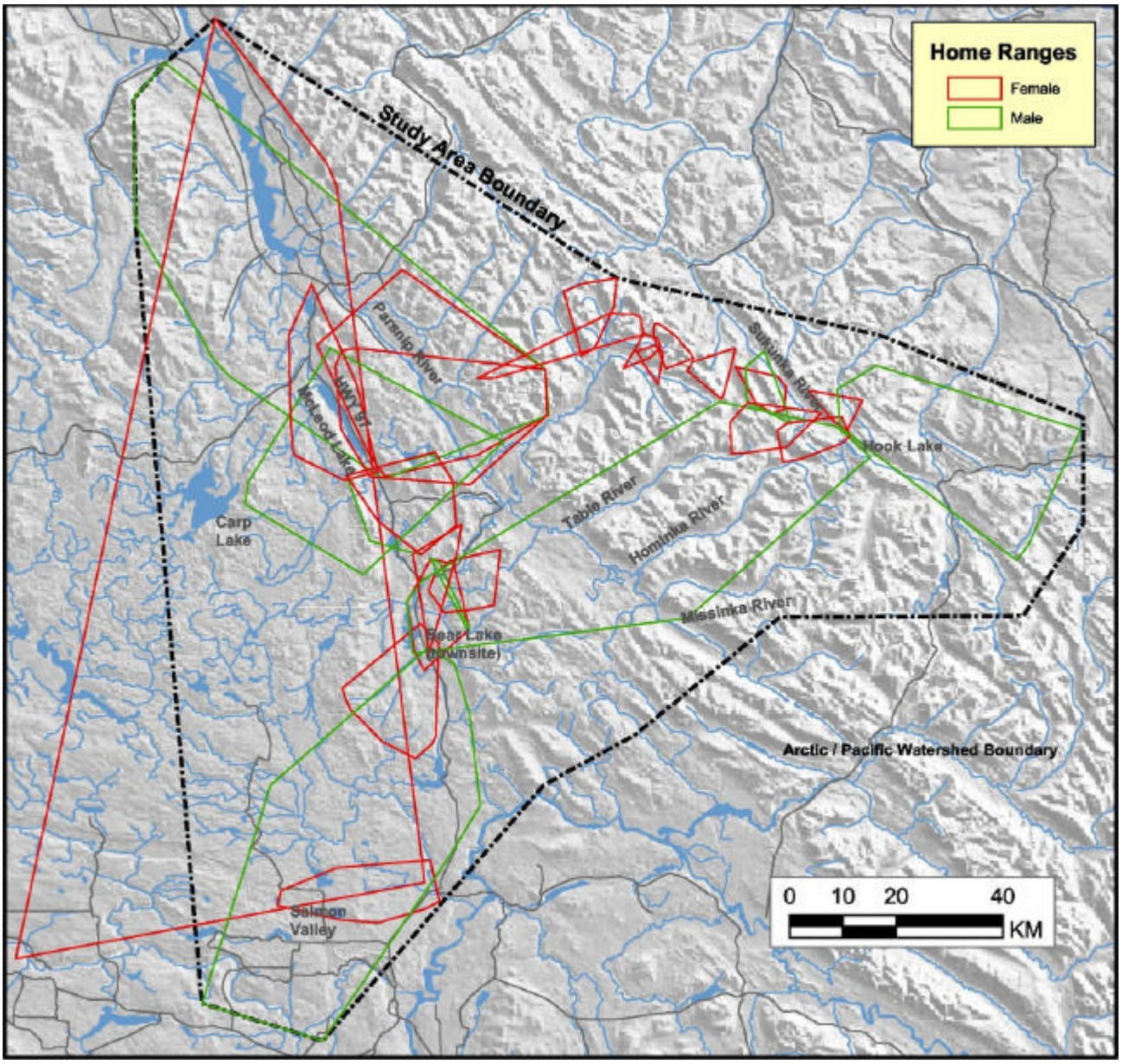
◉ Bears that dropped their collars during the season
* Bears that were collared late in the season
~Bears whose GPS collar failed
≥ Bears that died during the season.
Home range size for these bears may be underrepresented.

Table 11. Summary Statistics for Home Range Sizes Using 100% MCP, 2001

Cohort	Sample Size	Min (km^2)	Max. (km^2)	Mean (km^2)	Median (km^2)	Std. Error	Std. Deviation	P Values
[1]**All Bears**								
Mountains	15	19	1,020	251	77	92	358	
Plateau	10	112	2,897	816	279	301	952	0.008
Both	25	19	2,897	477	157	141	703	
[2]**Female Bears**								
Mountains	12	19	1,020	164	61	82	285.5	
Plateau	6	112	781	304	244	99	242	0.019
Both	18	19	1,020	211	110	64	273	
[3]**Male Bears**								
Mountains	3	59	889	600	853	271	469	
Plateau	4	273	2,897	1,584	1,584	572.5	1,145	0.157
Both	7	59	2,897	1,163	889	379	1,003	

[1]Does not include GF26 (fall capture), GF42 (outlier), GM39 (shot in the spring)
[2]Does not include GF26 (fall capture) or GF42 (outlier)
[3]Does not include GM39

Figure 2. 100% MCP Home Range Sizes for Male and Female Grizzly Bears, 2001



Note: the overlap of male and female home ranges.

Note: the difference in MCP's sizes between bears that live in the mountains and bears that live in the plateau.

4.3.2 GPS Data - General Observations, Fix Rates and Problems

NOTE: The following results are preliminary and are subject to change in future documents and publications. It is likely that more data will be acquired, and the fix rates will improve (hopefully!) when the collars are retrieved from the bears. It is inevitable that some data may be missed while downloading.

Seventeen GPS collars were deployed on grizzly bears in 2001 but only seven collars continued to function normally until the end of the season, resulting in an overall GPS collar failure rate of 41%. The average fix rate for the collars was 38.5% (min 0, max 68%). If the two GPS failures prior to any data retrieval are removed the average fix rate increases to 44%. Table 12 provides a summary of the number of fixes possible that the collar could obtain as opposed to number of fixes the collar did obtain.

Table 12. Summary of GPS Collar Data Fix Rates, 2001

	Date		Number of Fixes		Percent	Number of Fixes		
Bear ID	GPS Start	GPS End	Possible	Attained	Fix Rate %	Missed Fixes	2D Fixes	3D Fixes
≥GF4	8-May-01	9-Aug-01	544	228	42	316	88	140
*GF7	8-May-01	8-Nov-01	1104	733	66	371	289	444
*GF9	27-May-01	5-Nov-01	971	614	63	357	168	446
*GF11	10-May-01	5-Nov-01	1127	721	64	406	323	397
*GF17	27-May-01	7-Nov-01	981	389	40	592	166	222
*GF26	2-Oct-01	7-Nov-01	216	19	9	197	14	5
*GM29	25-May-01	10-Nov-01	1013	668	66	345	293	375
*GF34	7-May-01	5-Nov-01	1087	430	40	657	198	232
≥GF35	16-May-01	Unk	1050	0	0	unknown	n/a	n/a
~GF38	23-April-01	25-July-01	522	18	3	504	13	5
~GM39	22-April-01	13-May-01	112	69	62	43	47	22
≥GF43	8-May-01	9-Aug-01	546	312	57	234	138	174
~GF44	10-May-01	16-Oct-01	952	369	39	583	256	113
≥GM45	11-May-01	27-May-01	96	65	68	31 (unk)	39	26
≥GM48	16-May-01	7-Nov-01	1050	0	0	unknown	0	0
~GF49	20-May-01	22-Aug-01	566	83	15	483	45	38
~GF51	26-May-01	10-Sept-01	644	141	22	503	100	41

* GPS collars that appear to be working at the end of the season.

~ Collars that have been retrieved.

≥ Collars that are believed to have failed. (see Table 13).

Note: GF17's collar was in emergency mode but downloaded and appeared to remain working.

Although the collars appeared to obtain fixes while ground tested (i.e., left in places outside our homes) failures were noted almost immediately after deployment on bears (Table 13). One bear (GM45) had a GPS collar that failed less than two weeks after placement and had to be aerial darted again to retrieve and replace with a new GPS collar, which failed in mid-July.

The largest limitation with GPS collars was the four (possibly 5) outright failures in that the collars did not omit a VHF signal. In these cases, the whereabouts of the bear remains unknown and the collar cannot be retrieved. One of these study bears, GF4, has been with the project

since its inception and has been located on all VHF flights prior to changing her collar to GPS. She was also a mountain bear with a small home rage that is largely devoid of human activity. Thus, it is unlikely that this bear has left her home range or has been poached. In addition, her collar was reported to be in emergency mode prior to her disappearance. However, conclusive proof of a collar failure (over poaching or the animal leaving the study area) does not exist (note that the spacers installed on the collars during capture will allow these collars to eventually fall off the bear).

The other major malfunction associated with these GPS collars was their failure to gather fixes while all other properties of the collar appear to be working (e.g., it shuts off on the hour to obtain a fix, it is not in emergency mode, it switches beats per minute when the bear is active/inactive). We had four collars (GF38, GF44, GF49, and GM51) for which there was no indication of GPS failure until the collar was retrieved.

One major problem appeared to be responsible for the majority of GPS collar failures - on a number of the collars that were retrieved the o-ring between the battery pack and the collar mechanism was found to have slipped, which allowed water into the batter pack resulting in battery failure. The recovered collars did not show extensive damage from wear or bear chewing or clawing. Therefore, it is unlikely that those activities were responsible for the collar failures.

Table 13. Comments and Problems by GPS Collar, 2001

Bear ID	Comments
GF4	Collar emergency mode 9/24/01, then okay on 10/01/01 - then not heard again – missed November download. Likely collar failure as bear has not gone missing before.
*GF7	Collar OK - download Aug & Nov.
*GF9	Collar OK - download Aug & Nov.
*GF11	Collar OK - download Aug & Nov. Did not turn on for February VHF den flight.
*GF17	Emergency Mode - but downloaded Aug & Nov
*GF26	Collar OK - not put out until fall. A lot of data missed on download. Attempted to download twice in Nov but could not get all the data.
*GM29	Collar OK - download Aug & Nov. Did not turn on for Feb den flight.
*GF34	Collar OK
GF35	Collar emergency mode 8/14/01. Tracked by VHF until 8/27/01 in emergency mode. Then failed and bear not found again for remainder of season.
GF38	Collar appeared fine (normal beats per minute, etc.) but only gathered data from placement until May 15/01. There was no indication of problems. Problems were found only when the dropped collar was retrieved and downloaded.
GM39	Mortality of bear.
GF43	Bear last located Sept 17, then not found again until Feb den flight where she was denned near another collared female. Setting collar to turn on for winter VHF den flight likely triggered something in collar. Collar had failed by the November download.
GF44	Collar was normal mode and no problems with collar were noted. Then went into mortality Oct 25/01. Bear dead, collar retrieved. Problems were found only when the collar was retrieved and downloaded. Collared did not gather data past Aug 15/01. There was no indication of a problem with collar prior to this.
GM45	First collar put on bear went into emergency mode (May 11 to 23/01) – on May 28, 01 bear was recaptured and collar was replaced. The 2nd collar had short transmission distance and a

	problem was first noted July 9 then bear not heard 16, 25 &30. Very weak signal July 31. Collar not found again - missed both Aug & Nov downloads.
GM48	Collar not heard since 9/4/01. Unsure whether bear has left the study area or collar has failed. No Aug or Nov download.
GF49	Collar was normal mode. Then went into mortality Aug 22/01. Bear dead, collar retrieved. Collared did not gather data past July 4/01. There was no indication of a problem with collar. Problems were found only when the dropped collar was retrieved and downloaded.
GF51	Collar was normal mode. Bear dropped collar Sept 10/01. Collar retrieved but did not gather data after July 21/01. There was no indication of a problem with collar. Problems were found only when the dropped collar was retrieved and downloaded.

4.3.3 A Comparison of VHF and GPS Home Range Sizes

Overall, home range sizes were larger for GPS collars than those calculated using VHF locations alone (Table 14; Appendix VII). It must be noted that there are trade-offs associated with outfitting animals with GPS collars. For example, there was a lack of canopy closure/forest cover type bias associated with VHF obtained fixes, however, there were much fewer fixes and we found that excursions made by mountain bears on the days between telemetry flights were missed. These excursions may have substantially increased the bear's home range size (e.g., GF17). Also, VHF data can only be obtained on days when the weather permits flying whereas GPS data may not be as biased to weather conditions. However, when the GPS collars failed early in the season they yielded little or no data and largely underrepresented home range sizes (GF26, GF38).

Table 14. Comparison of VHF and GPS Home Range Sizes Using 100% MCP, 2001

Bear	Landscape	100% MCP		Difference (km^2)	Comments
		VHF	GPS		
Females					
GF4	Mtn.	88	199	111	GPS failure 01-Oct-01
GF7	Mtn.	110	301	191	All year
GF9	Mtn.	77	116	39	All year
GF11	Mtn.	110	195	84	All year
GF17	Mtn.	20	67	47	Emergency mode but some data
GF26	Plateau	98	22	-76	Fall capture – working GPS collar. Missed a lot on download although tried twice.
GF34	Plateau	285	321	36	All year
GF35	Plateau	1,020	N/A		Collar wouldn't download, failed outright
GF38	Plateau	157	56	-101	No GPS fixes after 15-May-01
GF43	Mtn.	19	40	21	GPS outright failure
GF44	Plateau	112	153	41	No GPS fixes after 15-Aug-01
GF49	Plateau	238	254	16	No problems indicated but no GPS data after 4-July-01
Males					
GM29	Mtn.	853	1,370	517	All year
GM39	Plateau	12	69	57	Bear shot in spring 2001
GM45	Mtn.	59	7	-52	GPS collar failure, bear now missing
GM48	Mtn.	889	N/A		Couldn't find bear to download
GM51	Plateau	1,088	1,399	311	No GPS fixes after 21-July-01

4.4 Habitat Use

The following section examines the predominant type of land-cover the bear was located within on VHF telemetry flights. In future publications, the GPS data will be summarized in a similar format. However, upon examination of the GPS data it was apparent that a higher proportion of locations were missed in closed canopy forests versus open habitats (e.g., avalanche chutes or cutblocks). For example, some of the mountain bears were found to obtain GPS fixes in a subalpine meadow on one side of the valley, and again on the other side of the valley, while they obtained few or no fixes in the forested habitat between the valleys. We are currently examining methods to correct the bias in the GPS data. However, due to the low fix rate of these collars (refer to Table 12) bias is likely to be extreme and until corrected these data should not be used for habitat analysis.

Habitat data on grizzly bear locations were gathered in three ways. First, during radio-telemetry flights a biologist onboard the aircraft classified the habitat in which the bear was located into 1 of 22 habitat types (Table 15). Second, UTM coordinates of bear locations were queried using a Geographic Information System (GIS; Arc Info). Third, we ground visited as many locations as possible to determine the activity of the bear when it was located and to collect habitat information on a finer scale (i.e., microsite habitat investigation).

A summary of habitat attributes and use data are provided for each data gathering method. Initially the 2001 results are summarized and then they are compared to the results of 1998 through 2000. Where applicable, data has been divided into mountain (i.e., east of the Parsnip River) and plateau bear (i.e., West of the Parsnip River) categories. In addition, where appropriate data has been divided into 3 seasons: spring, summer, and fall. Similar to 1999 and 2000, the spring season for 2001 was the period from den emergence to 15 July, summer was 16 July to 15 September and fall was 16 September to den entry.

4.4.1 Aerial Telemetry Observations

780 locations were obtained on radio-collared study bears, while 30 incidental sightings of non-marked bears were recorded. A biologist onboard the aircraft classified the habitat in which the bear was located into 1 of 22 primary land-cover types (Table 15). In 2001, mountain bears were found more often in Subalpine parkland (37%) than the remaining mountainous land-cover types. The decrease in use between 2000 and 2001 of the alpine/subalpine shrub land-cover types shifted to an increase in use of the subalpine parkland. Normally, subalpine shrub occurs just above parkland. It was apparent that both of these habitat types were important for mountain grizzly bears.

Similar to 2000, plateau bear were primarily located within low elevation spruce forests (36%). This forest type consisted primarily of mature to old growth treed habitat that had not been logged. The second most common plateau habitat types were cutblocks and spruce and pine plantations (cumulative total 19.5%). The mixed wood habitat type primarily consisted of areas that had been previously harvest but were now regenerated into a mosaic of deciduous and coniferous trees. If these 'previously harvested' habitat types are combined, the cumulative total is 36%, or the same as the use of mature and old land-cover types. Wet habitats of floodplain forests or floodplain riparian accounted for a cumulative total of 17.6% on the plateau and 3.1%

in the mountains. Floodplain riparian was used to describe those habitats close to the edge of a river and influenced by the water table. These habitats were largely willow, alder or rhododendron shrubs and seepage water was often present. Floodplain forests normally consisted of sparsely forested habitats with black spruce and were also influenced by the water table.

Table 15. Primary Land Cover Types Recorded During Aerial Telemetry Flights for Radio-Collared Grizzly Bears, 2001

	Cumulative Mountains & Plateau		Separate % Frequency	
Primary Land Cover Types Recorded	No. of Observations	% Frequency	Mountains	Plateau
Barren alpine-ice & rock	22 (22 M; 0 P)	3	5.3	0
Alpine snow	40 (40 M; 0 P)	5	9.6	0
Alpine grassland	15 (15 M; 0 P)	2	3.6	0
Subalpine parkland	154 (154 M; 0 P)	20	37	0
Subalpine spruce/balsam	55 (55 M; 0 P)	7	13.2	0
Subalpine shrub	36 (36 M; 0 P)	5	8.7	0
Low elevation spruce forest	135 (4 M; 135 P)	17	1	36
Low elevation pine forest	23 (1 M; 22 P)	3	0.2	6
Mixed Wood	65 (5 M; 60 P)	8	1.2	16.5
Clearcut	22 (2 M; 20 P)	3	0.5	5.5
Spruce plantation	48 (5 M; 60 P)	6	1.2	11.8
Pine plantation	9 (1 M; 8 P)	1	0.2	2.2
Floodplain forest	27 (1 M; 26 P)	3	0.2	7.2
Floodplain riparian	50 (12 M; 38 P)	6	2.9	10.4
Avalanche chute	32 (32 M; 0 P)	4	7.7	0
Burn	26 (26 M; 0 P)	3	6.3	0
Upland wetland	0	0	0	0
Upland stream	0	0	0	0
Active road	0	0	0	0
Deactivated road	0	0	0	0
Railroad	0	0	0	0
Other	12 (0 M; 12 P)	2	0	3.3
Capture Locations omitted	9 (5 M; 4 P)	1	1.2	1.1
	780	100	100	100

Incidental observations were separated from radio-telemetry locations because they were biased towards habitats with little canopy closure, which increased visibility (Table 16). Consequently, sightings of incidental bears were more common in the mountains than on the plateau (i.e., subalpine parkland or alpine grasslands versus valley bottom spruce). Overall, the frequency of incidental observations was slightly lower than in 1999 (n=37) and 2000 (n=47). However, unlike previous years, the mountains were only flown once per week in 2001. Population inferences should not be made from these incidental observations because it is not known whether we were sighting different of the same unmarked animals.

In the mountains, the majority of bears were sighted within the subalpine parkland habitat followed by the burned over habitat. It is interesting to note that in 2000 subalpine shrub was the most commonly reported habitat type for both mountain study bears and incidental observations,

while in 2001 mountain study bears and incidental observations were primarily within the subalpine parkland habitat.

Unlike the mountains in which visibility was good for most habitat types except the subalpline spruce/balsam, on the plateau few habitats have good visibility and incidental observations were much less frequent. For the plateau, clearcuts and plantations had the highest incidental sightings rate (10%). However, these were also the habitats with the least canopy closure.

Table 16. Primary Land Cover Types Recorded for Incidental Observations of Grizzly Bears, 2001.

Primary Land Cover Types Recorded	Number of Observations	Percent Frequency
Barren alpine-ice & rock	1	3
Alpine snow	2	7
Alpine grassland	4	13
Subalpine parkland	8	27
Subalpine spruce/balsam	1	3
Subalpine shrub	0	0
Low elevation spruce forest	1	3
Low elevation pine forest	1	3
Mixed Wood	0	0
Clearcut	1	3
Spruce plantation	2	7
Pine plantation	0	0
Floodplain forest	0	0
Floodplain riparian	2	7
Avalanche chute	1	3
Burn	5	17
Upland wetland	0	0
Upland stream	0	0
Active road	0	0
Deactivated road	0	0
Railroad	0	0
Other	1	3
	30	100

4.4.2 Use Versus Availability Analysis and Just Use

We compared a use versus availability for some key landscape attributes using resource selection ratios. Use greater than availability (i.e., number >1) implies selection for the attribute, whereas use less than availability (i.e., number <1) implies avoidance.

The following use versus availability analyses is largely from a report prepared by Ciarniello et al. 2002. For complete methods, Resource Selection Functions (multivariate analysis) as well as information on the univariate analysis used in Resource Selection Ratios, please refer to the Ciarniello et al. 2002 document. The objectives of that report were to predict areas with higher probabilities of grizzly bear occurrences as well as to examine whether or not these results were

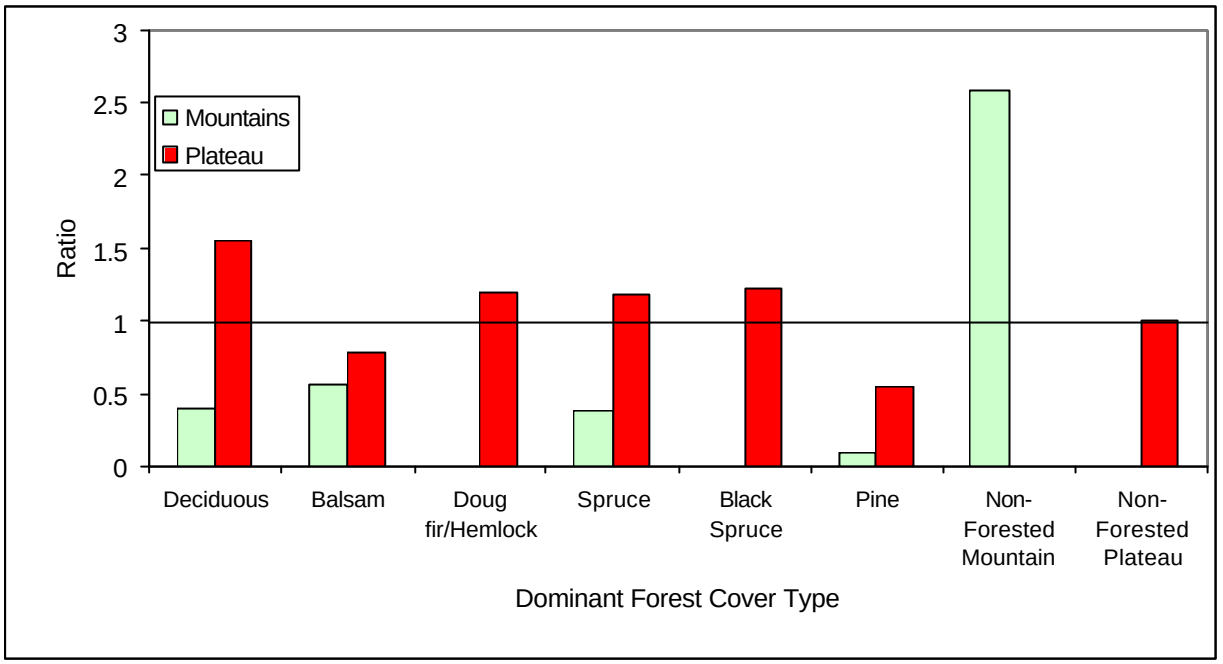
consistent with our knowledge of grizzly bear use of the study area. For a copy of this document, please visit our web page.

Bear locations gathered during 1998, 1999, 2000, and 2001 along with 33,181 randomly generated computer points were overlaid on map images using a Geographic Information System (GIS; Arc Info). Only locations for which we were confident of the position of the animal were used in analysis and all repeat locations (e.g., multiple den site locations) were removed. Of the 866 locations gathered during 2001, 633 of them met the criteria for habitat analysis (305 Mtn: 358 Plt). From 1998 to 2001, 2,307 bear locations met the criteria for analysis on 49 grizzly bears. Of these 2,307 locations, 1,520 were from the mountains while 787 were from the plateau (58P: 367M in 1998; 133P: 465M in 1999; 238P: 383M in 2000; 358P: 305M in 2001).

In 2001, use of land-cover types by plateau bears was more evenly distributed than for mountain bears (Figure 3). These results are inconsistent with those presented in Section 4.4.1, land-cover types recorded by the biologist on telemetry flights, in which spruce forests were the primary forest type recorded at VHF bear locations. We are currently investigating the inconsistency in these data and presently believe the discrepancy may be due to different data collection methods. Specifically, the land-cover data contained within the GIS database were not as precise as the 22 habitat types the biologist was able to identify from viewing the ground at the time of the location. However, because these 22 habitat types do not exist in the GIS database they cannot be applied back to a GIS analysis. Therefore, in an attempt to approximate the habitat classes used by the biologist with those obtained by querying the bear locations in the GIS database we lumped the GIS classes into ones best representing our knowledge of the landscape. However, the GIS databases were designed to depict attributes important to commercial logging operations, which were not necessarily those deemed by biologists to be the most biologically relevant to bears. Therefore, some of the details afforded by the visual recording of the habitat type at the location have been lost. The selection for deciduous habitat appeared to be driven by a three bears that lived primarily in the Salmon Valley and Prince George.

Unlike plateau bears, mountain bears exhibited clear selection for non-forested land-cover types. These forest types did not exist on the plateau as they were typically mid-to-high elevation habitats that consisted of krumholtz trees, slide alder, and avalanche chutes. In the mountains, a significant portion of the GIS database for mid-to-upper upper elevation habitats was classified as non-forested or alpine, meaning it holds little or no commercial value. If the percent frequencies of non-commercial habitat types contained in Table 15 are combined (barren alpine, alpine snow, alpine grassland, subalpine shrub, avalanche chute) there is also clear selection of these non-commercial land-cover types. As a note, non-commercial habitats were more clearly defined in the GIS database then those with commercial value, which allowed for easier classification than on the plateau.

Figure 3. Predominant Forest Cover Type at Radio-telemetry Locations of Mountain and Plateau Grizzly Bears, 2001.

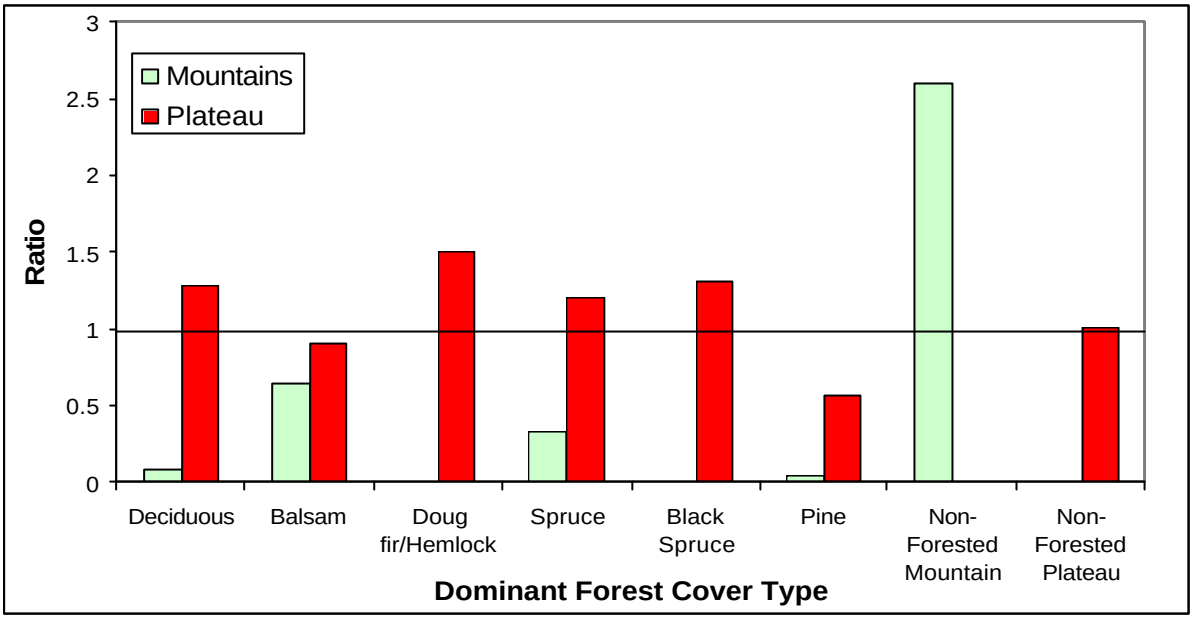


Mountains n=305; Plateau n=358

Figure 4 provides a selection ratio for all years combined (1998 to 2001). In the plateau, the most commonly recorded land-cover type selected for by bears was Douglas fir/Hemlock, followed by black spruce and deciduous mixes. Using a Resource Selection Function analysis (multivariate statistical technique as opposed to univariate) we could not detect selection for any of the plateau habitat types. However, this was in relation to the withheld land-cover types of white spruce, black spruce and Douglas fir (Ciarniello et al. 2002).

From 1998 to 2001, mountain bears exhibited a similar pattern. Overall, they were found to strongly select for non-commercial habitat types. Using a RSF analysis, and withholding white space, black spruce and Douglas fir, mountain bears also selected for sub-alpine fir and balsam fir land-cover types (Ciarniello et al. 2002). The upper limit of the sub-alpine parkland was classified as Balsam. Consequently, these findings are consistent with those presented above in Section 4.4.1.

Figure 4. Predominant Forest Cover Type at Radio- telemetry Locations of Mountain and Plateau Grizzly Bears, 1998 to 2001.



1998 n= 58 P: 367 M, 1999 n= 133 P: 465 M, 2000 n= 238 P: 383 M, 2001 n=358 P: 305 M

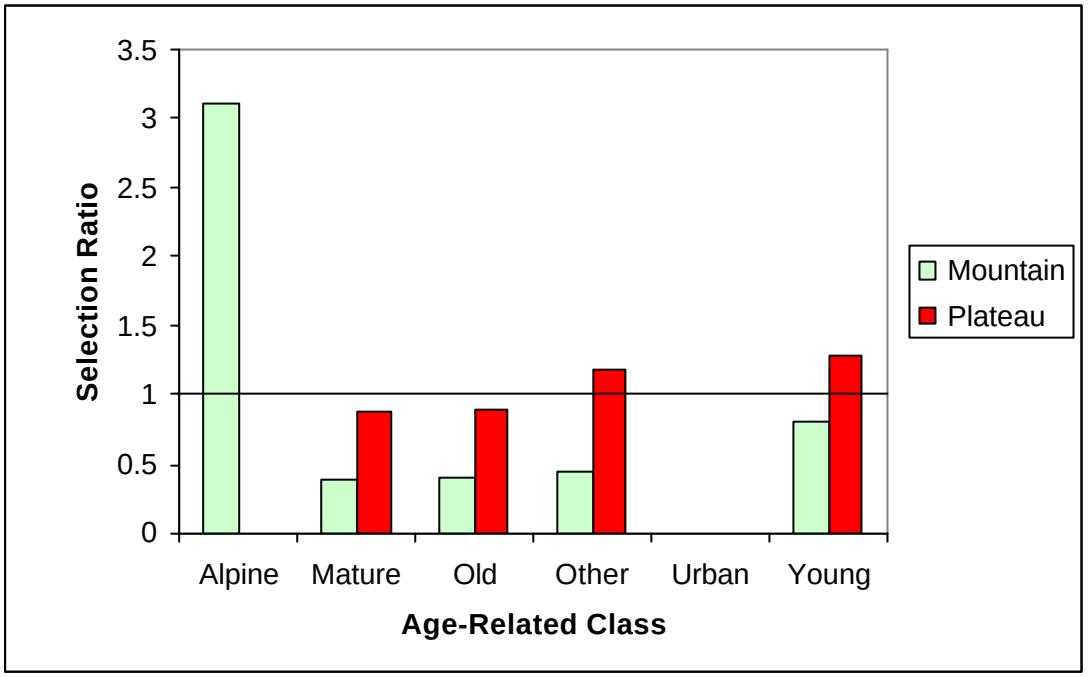
Forests were also classified into the following age or age-related categories: young (0 to 45 years), mature (46 to 99 years), old (>100 years), alpine (dynamic state), and other (non-commercial brush, non-productive brush, swamps, fens, etc.). Non-commercial forests were not assigned an age within the GIS database. Therefore, we assigned them to an 'alpine' category, which represents high elevation habitats in a dynamic state of ages. There was an urban category in the database for developed areas. However, we did not record any bear use of urban classified areas. Similar to land-cover types, use of age-related classes was move evenly distributed among plateau bears than mountain bears (Figure 5). Although plateau bears selected for young and other age-related classes, a RSF analysis using 'mature' as the reference category revealed that only the 'other' age-related class was significantly selected (p=<0.00001; Ciarniello et al. 2002). In the plateau, 'other' referred primarily to riparian areas, bogs and fens for which age information was not available. Selection for wet areas adjacent to rivers and ponds was consistent with aerial telemetry findings. These riparian areas were also known to contain important forage for bears during all seasons.

Mountain bears selected for alpine age-related classes. This was not surprising because mountain bears were often located in alpine landscapes. In a RSF analysis (Ciarniello et al. 2002) mountain bears were also found to select for young age classes, although this selection was not significant (p=0.655). The selection for young-age landscapes within the mountains was a reflection of bears moving to burns that produced an abundance of blueberries. In addition, cutblocks that were difficult to access by ground occurred in the northeastern portion of the mountains (upper Sukunka River area). In the spring of 2001, one mountain male bear was often located within these young-age (i.e., 0-45 years) cutblocks. Mountain bears were seldom located in the low elevation valley bottoms, which consisted primarily of old age forest stands.

However, site visits to old-growth forest habitat in the mountains revealed well-used travel routes that were largely associated with adult male locations. Further investigation of old-growth habitat type is required to better interpret this coefficient. Mountain bears also selected against 'other' landcover types. This was not surprising because in the mountains the 'other' habitat category largely refers to rock or talus terrain.

Both mountain and plateau bears had complete avoidance of the 'urban' labeled land-cover categorized in the GIS database. However, complete avoidance of an area is an extremely important feature of grizzly bear habitat use.

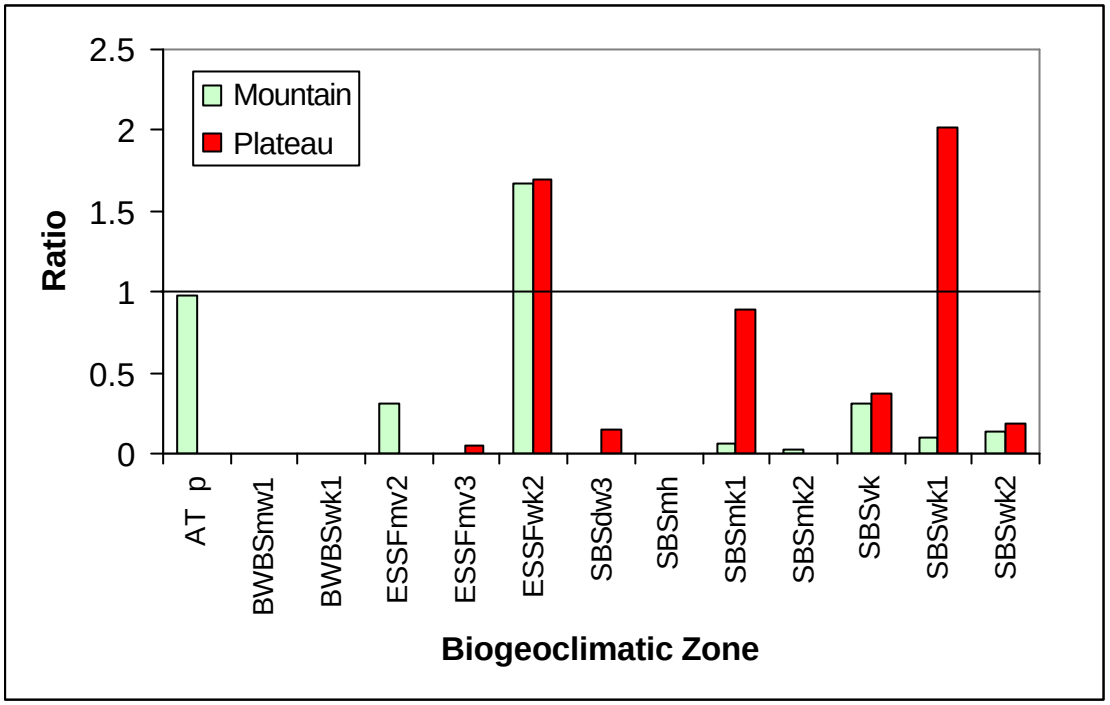
Figure 5. Forest Stand Age Classes Used by Mountain and Plateau Bears, 1998 to 2001.



We also examined the biogeoclimatic zones in which the locations occurred (Figure 6). For mountain and plateau bears there was a selection for the ESSFwk2 biogeoclimatic zone. Meidinger and Pojar (1991) considered this biogeoclimatic zone to be year round high-quality grizzly bear habitat. The ESSFwk2 zone occurred in a relatively small proportion on the plateau but bears were located within this zone greater than its availability. The majority of use of the ESSFwk2 zone in the plateau occurred along the mountain ridge west of McLeod Lake. Plateau bears also selected for the SBSwk1 biogeoclimatic zone. This zone was wetter than the SBSmk1 and contained many bear forage items. Unlike the plateau, the SBSwk1 occurred in only a small proportion within the mountains.

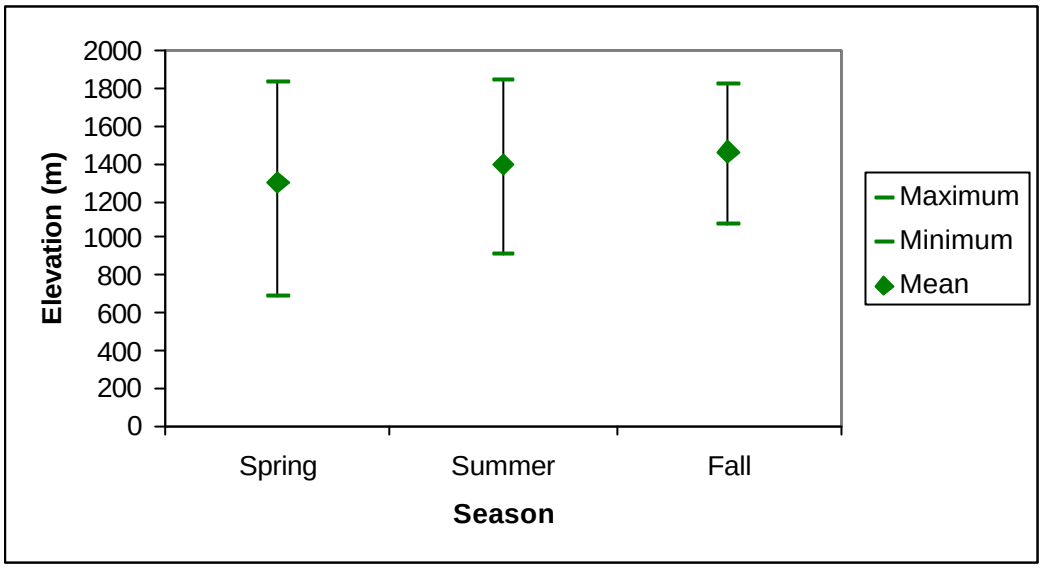
The Alpine Tundra (AT) biogeoclimatic zone occurred in very small proportions on the plateau and there was no use recorded by bears in this zone. However, this may be due to a lack of study animals in the area where this zone occurs (i.e., by the divide of Arctic Lake). In the mountains use of the AT zone was in proportion to its availability. Meidinger and Pojar (1991) state that the AT alpine zone offers important habitats for grizzly bears, particularly where the soils allow easy digging.

Figure 6. Grizzly Bear Locations and Biogeoclimatic Zones in the Mountainous and Plateau Landscapes, 1998 to 2001.



We were interested in examining whether or not bears were using lower elevations in the spring and following the snowmelt as new vegetation was revealed. Therefore, rather than using a use/availability analysis technique we begin by presenting only the use data by season. Similar to 2000, mean elevation for mountain bear locations rose slightly throughout the seasons (Figure 7). In the spring, the mean elevation was 1,294 metres (range 693 to 1,829), for summer the mean was 1,395 metres (range 911 to 1,845), and for fall the mean was 1,465 (range 1,072 to 1,820). Indeed, mountain bears tended to use the snow-free lower elevation valley bottoms in the spring and followed the snowmelt up the mountain as the season progressed, thus tracking the early phenological stages of vegetation.

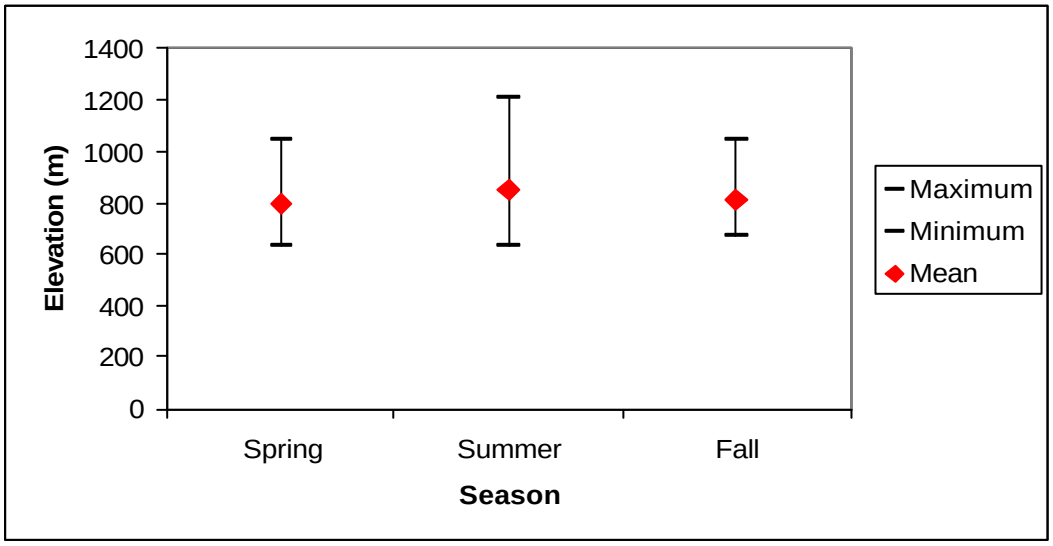
Figure 7. Elevation Ranges for Mountain Bears by Season, 2001.



Spring n = 153; Summer n = 95; Fall n = 57. Spring = den emergence to 15 July (n= 252); summer = 16 July to 15 September (n=260); fall = 16 September to den entry (n=259).

Mean elevations at use locations for plateau bears rose slightly from spring to summer but decreased again during the fall (Figure 8). In spring the mean elevation for plateau bear locations was 801 (range 637 to 1,047), for summer the mean was 855 (range 634 to 1,205), and for the fall the mean use was 813 (range 674 to 1,045). The plateau portion of the study area did not have the elevational differences found in the mountains.

Figure 8. Elevation Ranges for Plateau Bears by Season, 2001.

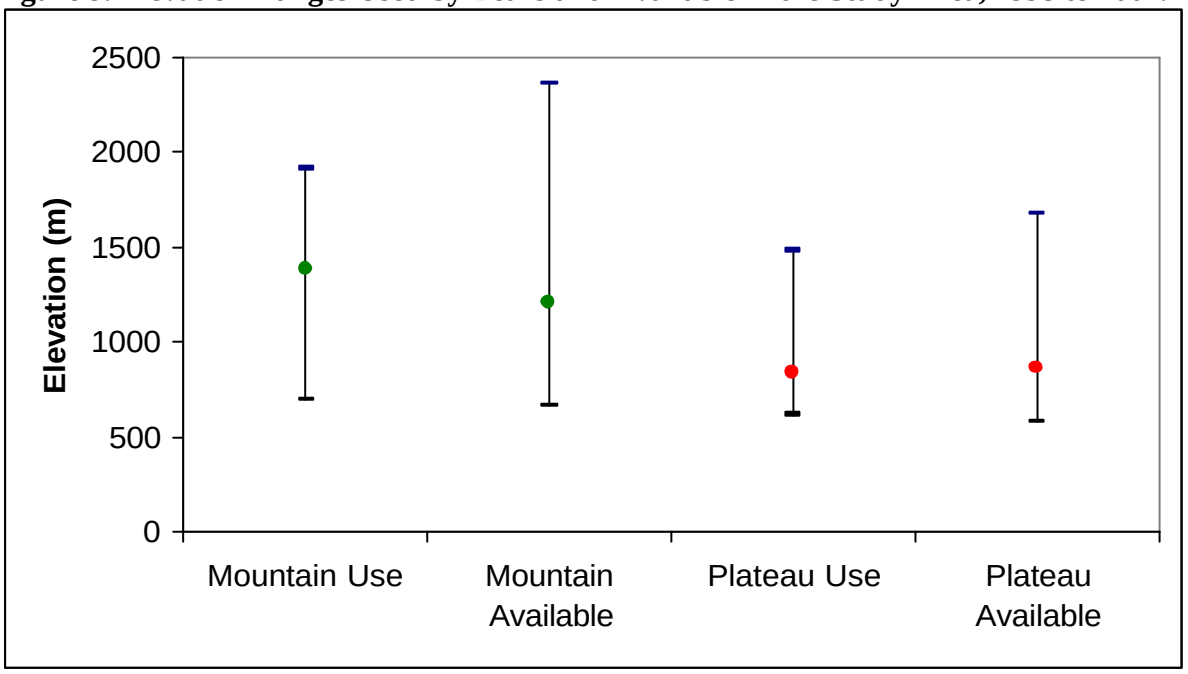


Spring n = 157; Summer n = 122; Fall n = 79

Figure 9 provides a selection ratio of used versus available elevation and the range associated with use and random locations. For all seasons combined, mountain bears used habitats that ranged from 693 to 1,922 meters in elevation, with a mean of 1,384 m. Available to mountain bears were habitats ranging from 670 m to 2,366 m with a mean of 1,217 m. It is interesting to note that mountain bears avoided using the high elevation habitats above 1,922 m, which primarily consist of rock, ice and glacial peaks.

Plateau bears used habitats that ranged from 623 m to 1,481 m with a mean of 838 m (Figure 9). Available to plateau bears were habitats ranging from 580 m to 1,687 m, with a mean of 861 m. Unlike mountain bears, plateau bears used habitats similar to the mean amount of that elevation available (838 m use, 861 m for available). Similar to mountain bears, plateau bears did not use the upper portion of elevation available to them; however, this may be an artifact of not obtaining a representative sample of bears in the mountainous regions of the plateau.

Figure 9. Elevation Ranges Used by Bears and Available in the Study Area, 1998 to 2001.



We also examined the distance to the nearest road for bear locations (Figure 10). For the study area, there was an overall avoidance of roads by grizzly bears until approximately 2.5 km. There was neither selection nor avoidance of areas associated with roads between 2.5 to 4.5 km. Overall, grizzly bear use of the landscape increased with further distances from roads. This means, the further one is from a road, the more likely there are to be bears. For more on distance to roads, type of road, and mountains versus plateau in a separate analysis please refer to *Ciarniello et al. 2002,* which is available on our web page.

Figure 10. Grizzly Bear Locations Versus Distance to the Nearest Road for both Landscapes, 1998 to 2001.

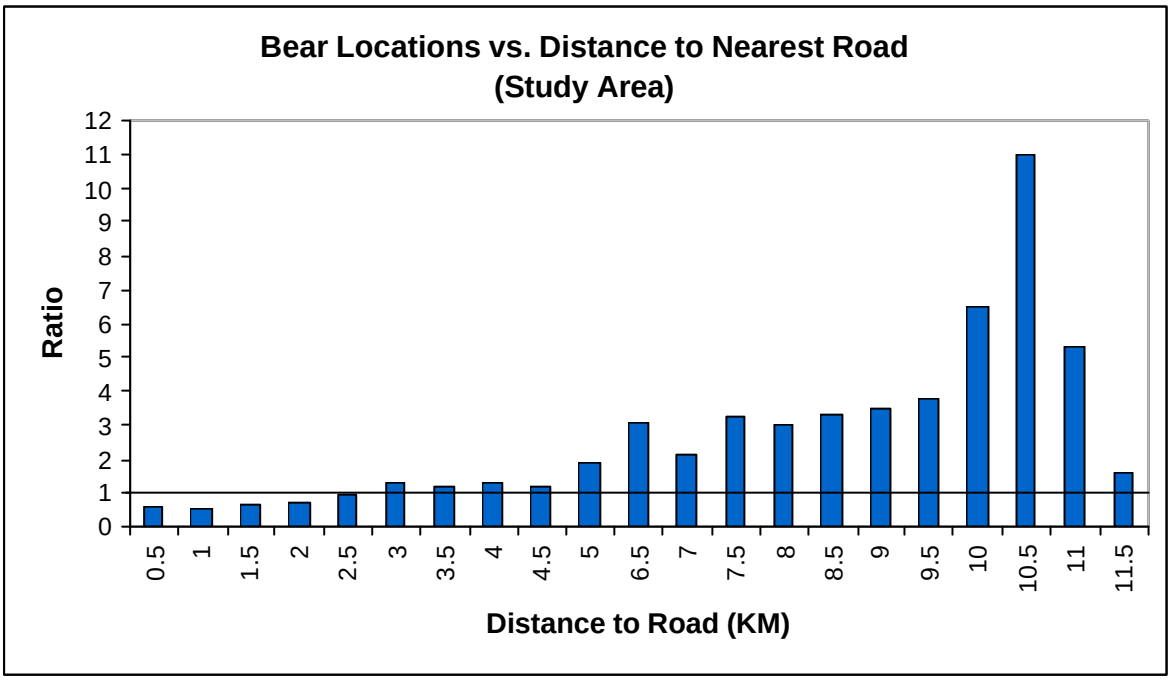
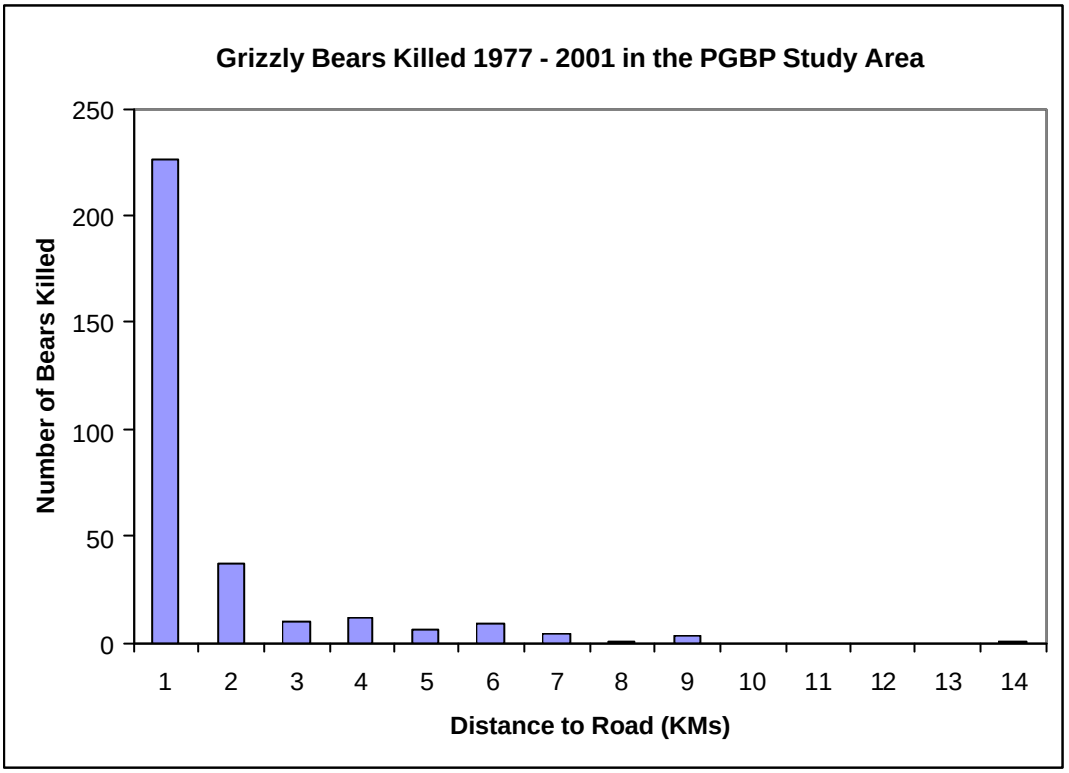


Figure 11 depicts the number of grizzly bears killed as a function of the distance to the nearest road. Seventeen percent (n=54) of the bears killed within the study area were within 0-100 m from a road, 32% (n=99) within 0-200 m, 39% (n=121) within 0-300m, 43% (n=133) within 0-400 m, and 58% (180) within 0-500 m of the closest road. Seventy-three percent (n=227) occurred within 1 km of a road. Hunters are only required to report their kill site to within the nearest kilometer. Thus, it is likely that the majority of these kills occurred closer to a road than 1 km. Overall, the majority of grizzly bears killed within the study area occurred closer to roads than random and the frequency of bear deaths decreased as the distance to the road increased. Most of the kills occurring furthest from roads occurred at a fly in guide outfitting camp within the mountains, while some bears had been hit by a train used to transport coal from two mines within the mountains.

Figure 11. Grizzly Bear Kills in Relationship to Distance to the Nearest Road, 1977 to 2001 Limited Entry Hunt and Problem Wildlife Database Information.



4.4.3 Microsite Habitat Investigations

To conduct microsite habitat investigations we visited some bears' locations recorded during the aerial telemetry flight. First, results of the 2001 microsite habitat plots are presented. Next, these are compared to 1998 and 2000 to examine trends and variations between years. All microsite habitat results are also provided by season.

In 2001, 147 microsite habitat investigations were conducted, representing 19% (147 / 780) of telemetry locations (Table 17). Unlike previous years, similar effort was not expended on microsite habitat plots during all 3 seasons and fewer investigations were conducted during the fall.

Table 17. Microsite Habitat Investigations by Bear by Season, 2001.

Bear	Spring	Summer	Fall	**Total**
GF4	3	0	0	3
GF7	3	0	0	3
GF9	0	1	1	2
GF11	3	4	1	8
GF15	2	1	1	4
GF16	3	1	0	4
GF17	2	3	0	5
GM29	1	2	0	3
GF30	3	1	0	4
GF32	0	5	1	6
GF34	5	1	1	7
GF35	3	0	0	3
GM36	3	1	0	4
GF37	1	4	0	5
GF35, GM 36	2	0	0	2
GF35, GF37	1	0	0	1
GF35, GM36, GF37	0	0	1	1
GF38	2	4	0	6
GF38, GM39	2	0	1	3
GF41	5	0	3	8
GF42	2	1	1	4
GF43	0	1	0	1
GF44	5	3	2	10
GM45	3	0	0	3
GM47	8	7	1	16
GM48	3	4	0	7
GF49	0	3	0	3
GM50	0	3	0	3
GF49, GM50	2	1	0	3
GM51	3	2	0	5
*Incidental	3	1	1	5
M2 (Molly)	2	3	0	5
TOTAL	**75**	**57**	**15**	**147**

* Incidental site investigations conducted on unmarked bears

During 1998, 59 habitat plot investigations were conducted representing 14% of the total locations. In 1999, 133 habitat plots were investigated representing 20% of the total locations. In 2000, 122 microsite habitat investigations were conducted, representing 17% of the total locations. For 1998 to 2001, approximately 2,500 locations have been gathered and on-site habitat analysis has been conducted on 461 of these locations, resulting in an overall site visitation rate of 18% of VHF gathered locations (Table 18).

Table 18. Number of Grizzly Bear Microsite Habitat Investigations, by Bear and by Season, Conducted During 1998, 1999, 2000 and 2001 in the Parsnip River Study Area.

Bear ID	Spring	Summer	Fall	Total
GF1	Dropped collar soon after capture			0
GF2	3	1	1	5
GM3	1	1	1	3
GF4	7	2	3	12
GF5			1	1
GM6	2	2	2	6
GF7	8	4	2	14
GM8	8	9	2	19
GF9		8	2	10
GF10	1	2		3
GF11	5	7	2	14
GF12		1		1
GF13		4	1	5
GM14	Bear not located			0
GF15	2	3	3	8
GF 16	3	4	3	10
GF17	3	6	5	14
GF18	4	4	2	10
GM19	1	7	3	11
GM20	3	5		8
GM21	1	2	3	6
GM22	2	4	6	12
GM23	Bear deceased			0
GF24	11	17	8	36
GF25	8	7	1	16
GF26	8	9	2	19
GF27	1	2		3
GM28		3		3
GM29	3	7	1	11
GF30	3	3		6
GM31	Bear not located			0
GF32	1	6	3	10
GF33	12		5	17

Bear ID	Spring	Summer	Fall	Total
Table 18. Microsites 1998 to 2001 by Season Cont'				
GF34	12	6	4	22
GF35	3			3
GM36	3	3		6
GF37	1	4		5
GF35, GM36	2			2
GF35, GF37	1			1
GF35, GM36, GF37	4	2	2	8
GF38	2	4		6
GF38, GM39	2		6	8
GF41	5		3	8
GF42	2	1	1	4
GF43		1		1
GF44	5	3	2	10
GM45	3			3
GM47	8	7	1	16
GM48	3	4		7
GF49		3		3
GM50		3		3
GF49, GM50	2	1		3
GM51	3	2		5
MF Nutmeg	1			1
MF2 Molly	3	5	1	9
MM6 Bam Bam		2	1	3
MF Diggie			1	1
MF Belle			1	1
Incidental	2	13	14	29
TOTAL	**168**	**194**	**99**	**461**

Microsite habitat plots were accessed by both ground and helicopter. Overall, 48% (n=70) of the locations were accessed by road, 2% were accessed by road then canoe (n=3, total ground access of 50%), while 50% (n=74) were accessed by helicopter. Similar to previous years, approximately 1 out of every 4 sites that we attempted to land or hover exit was not accessible due to limited landing sites, poor weather, or presence of bears.

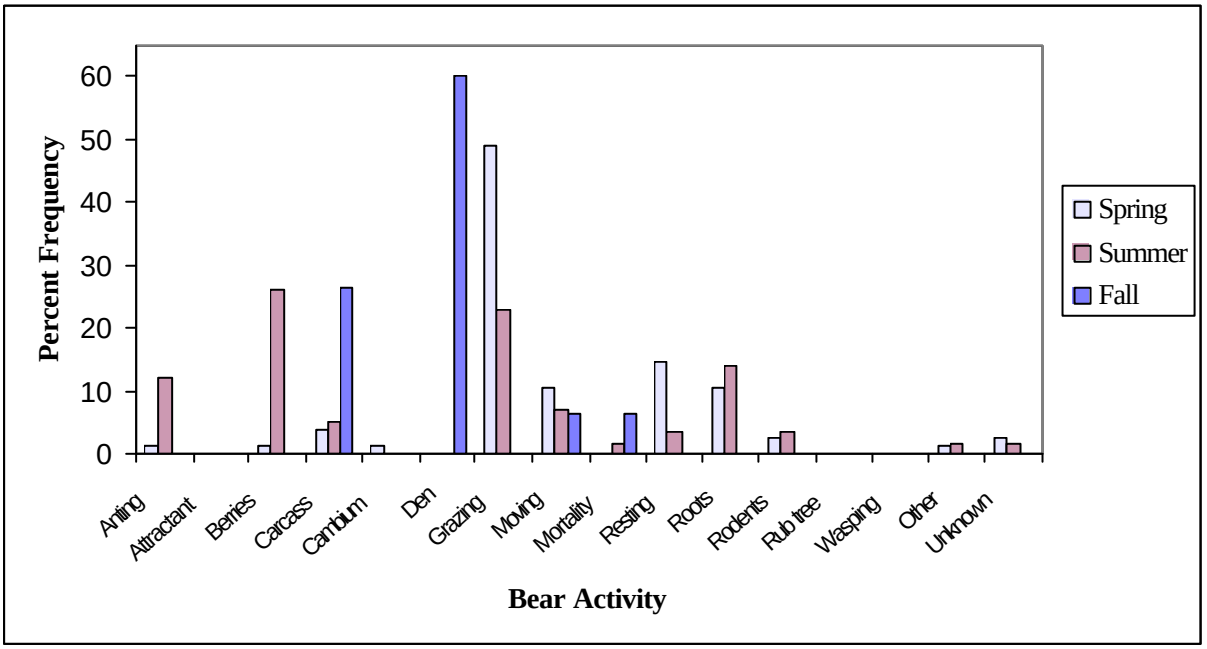
At each habitat plot, the primary activity of the bear was classified into one out of 16 activity categories (Figure 12). Similar to previous years, grazing of vegetation was the predominant activity recorded at spring habitat plots (49%). Grazing was an activity common to both mountain and plateau grizzly bears. Resting was the second most commonly recorded activity in spring (15%), followed by moving and foraging for roots (both 11%) or rodents (3%). Spring ungulate fresh kills or carcasses accounted for 4% and were all in the plateau. While digging for roots was mainly a mountain bear activity it occurred in both landscapes. Digging for rodents

was recorded to occur only in the mountains. Bears foraged infrequently on ants and their larva in the spring (1%) and most of these sites appeared to be for exploratory purposes only as few ants are active in the spring.

As the herbaceous green vegetation matured, grazing decreased as the primary activity and was replaced by berry feeding (26%). Feeding on berries occurred in both the mountains and plateau. Due to the apparent abundant berry crop in the mountains during 2001, a number of mountain bears moved during berry season to access large expanses of burned over habitats. In contrast, plateau bears predominately fed on berries in 15 to 30 year old clear-cuts, except when feeding on the berries of Devil's club, which was often associated with the undergrowth in mature and old forest age classes. Grazing vegetation was the second most common activity recorded at microsite plots during the summer (23%), followed by digging for roots (14%). Resting sites decreased in the summer (3.5%), while carcasses increased slightly (5%). Foraging for ants/larva (12%) increased in both the burned over habitat in the mountains and burned clear-cuts on the plateau to the fourth most common activity recorded.

In the fall it is possible that some activities have not been represented (n=15). From the plots conducted, denning was the primary activity recorded to occur in the fall (60%). This was not surprising because we biased our sites towards visiting den locations. During the fall, at 27% of the chosen sites bears were found to have fed on fresh kills or carcasses. All carcass sites were in the plateau. Moving (7%) and resting (7%) activities also increased in the fall. Similar to 2000, grazing of vegetation was not recorded as a primary activity in the fall of 2001.

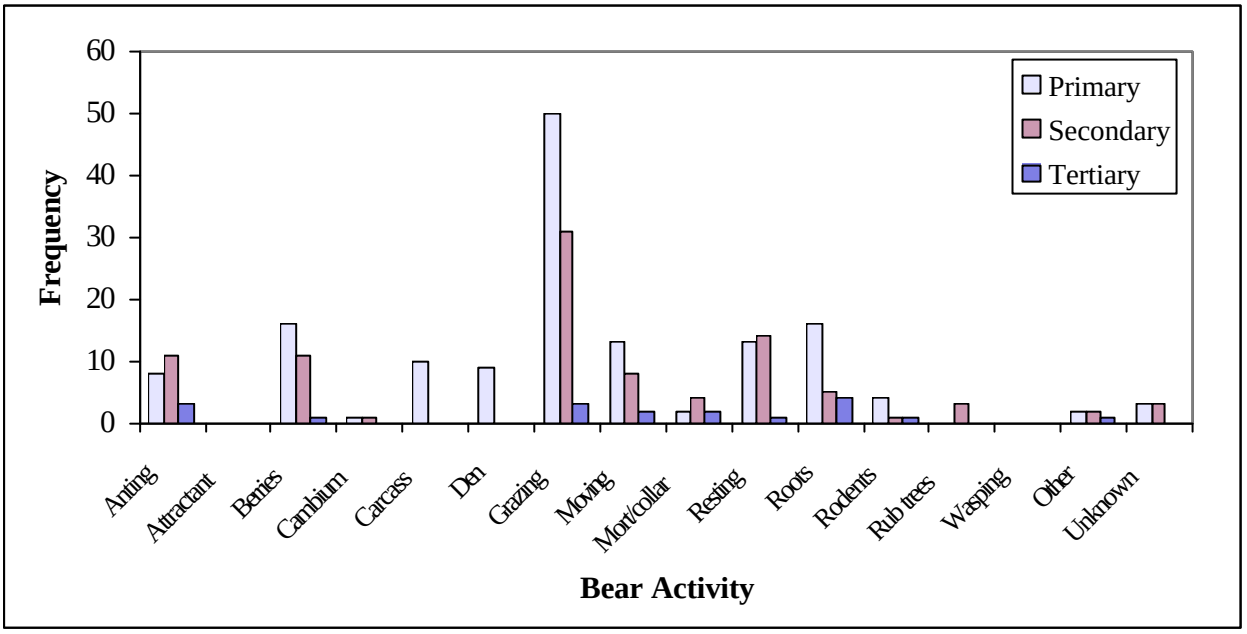
Figure 12. Bear Activity by Season for 2001, Based on Microsite Habitat Investigations.



Spring was defined as den emergence to 15 July, summer was 16 July to 15 September, and fall was 16 September to den entry.

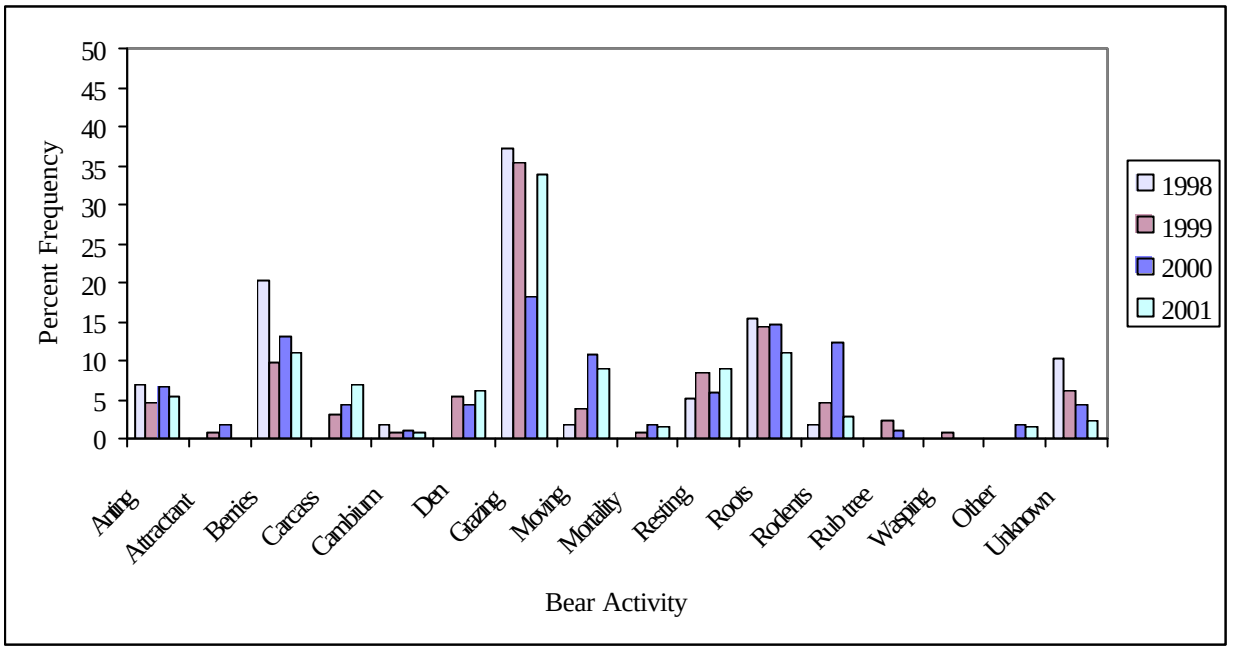
Habitat plot investigations revealed that bears used some areas for multiple purposes. For example, a bear may bed down in an area and also sporadically graze on nearby surrounding vegetation. In order to adequately document multiple habitat use, primary, secondary and tertiary activities were recorded at each site investigated (Figure 13). Not all sites had more than one activity. We recorded 147 primary activities (as discussed above), 94 secondary activities, and 18 tertiary activities. The most commonly occurring secondary activity recorded at microsite plots was grazing (31%), followed by resting (14%), and berry feeding (11%) and foraging on ants/larva (11%). Tertiary activities were recorded to occur less frequently digging roots (4%), grazing and foraging on ants/larva (each 3%), and moving (2%).

Figure 13. Comparison of Primary, Secondary, and Tertiary Activities Recorded at Microsite Habitat Plots, 2001.



We next compared the results to previous years (Figure 14). For all years, grazing was the most common activity recorded at microsite habitat plots. In 1998, berry feeding was the second most commonly noted activity. However, in 1999, 2000 and 2001, digging for roots was the second most commonly recorded activity, with berry feeding being the third most frequent activity recorded. From these data, it is apparent that a number of similarities exist between years.

Figure 14. A Comparison of Bear Activities Between 1998, 1999, 2000 and 2001, based on Microsite Habitat Investigation Plots.

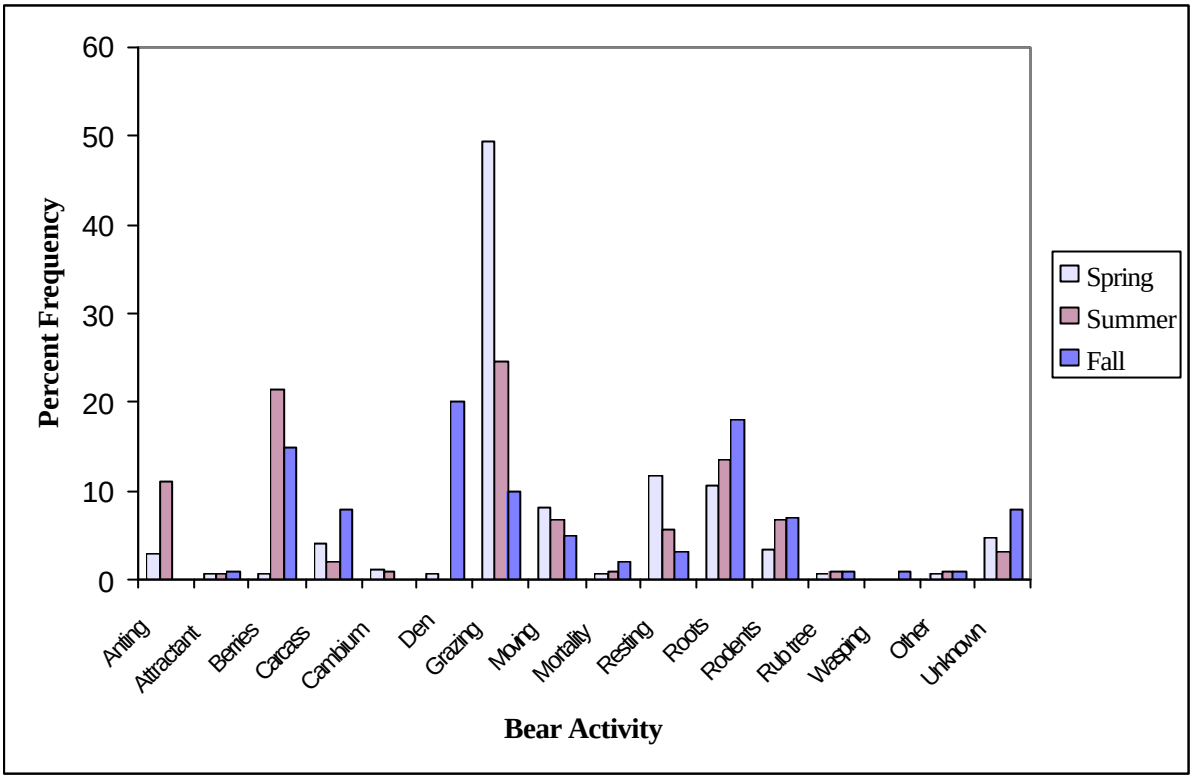


The use of habitats was also pooled for all years and then analyzed by season (Figure 15). Bear activity varied seasonally throughout the years. Close to half off all spring plots conducted have had grazing vegetation recorded as the primary activity (49%). The second most common activity to occur in spring was resting (12%), digging for roots (11%), and traveling (8%).

During the summer, bear use at microsite habitat plots was more consistent. Grazing remained the primary activity (25%) and berries a close secondary activity (21%), followed by digging for roots (14%), and foraging on ants/larvae (11%). Digging rodents (7%), moving (7%), and resting (6%) were the next most commonly occurring activities during the summer.

In the fall, the most common activity was denning (20%), followed by digging roots (18%), feeding on berries (15%), grazing (10%), carcasses and unknown use (each 8%), digging rodents (7%), and moving (5%). In all years, grazing decreased from spring to fall. Feeding on carcasses was moderate in the spring, decreased in the summer while the berries were available, and increased in the fall. Digging roots was an activity primarily performed by mountain bears. Digging roots was an important activity in all seasons for mountain bears but especially during the fall when bears returned from the burned habitat to their denning habitat. Berries were limited at high elevations and mountain bears were often found digging roots and bulbs of vegetation.

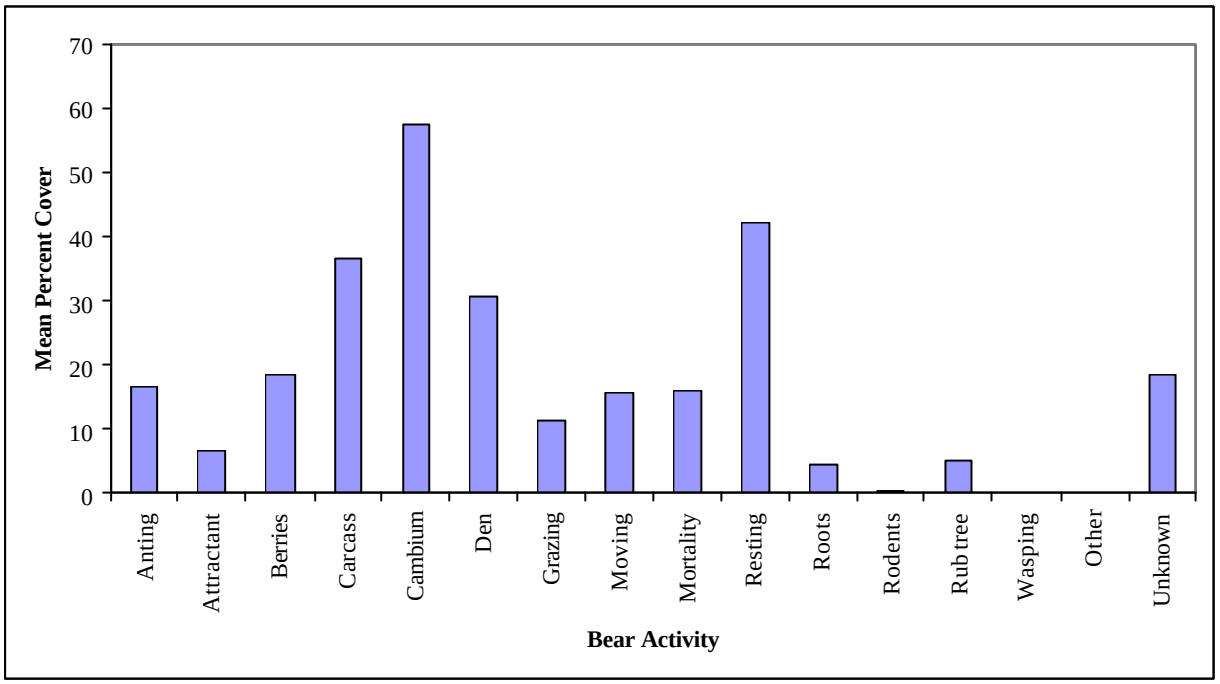
Figure 15. Bear Activity by Season for 1998, 1999, 2000, and 2001 based on Microsite Habitat Investigations.



For 1998, spring was defined as den emergence to 30 June, Summer was 1 July to 31 August, and fall was 1 September to den entry. For 1999 to 2001, Spring was defined as den emergence to 15 July, Summer was 16 July to 15 September, and fall was 16 September to den entry.

During site investigations we estimated the tree canopy closure for each activity site (Figure 16). Mean canopy closure was highest for the cambium feeding sites (58%), followed by bedding sites (42%), sites where carcasses were consumed (37%), and den sites (31%). Sites used for grazing vegetation, and digging roots and rodents were associated with little canopy closure, such as open avalanche chutes or canopy gaps in forests. Thus, it is likely that bears prefer canopy closure for some important activities, such as resting and denning, while more open canopies were preferred for foraging on vegetation and berries. The preference for more open canopies for foraging was likely the result of increased forage available in these areas.

Figure 16. Mean Percent Forest Canopy Closure Recorded at Microsite Habitat Investigation Plots, 1998 to 2001.



We compiled a list of bear foods consumed at microsite habitat plots from 1998 to 2001 (Table 19). The ratings provided are subjective assessments based on frequency of foods found consumed in plots conducted during 2001. The symbol, *, under the Code column indicates new foods discovered during the 2001 field season, while a * under the Season Use column indicates a new subjective rating for 2001. We did not include foods that we believed were consumed incidentally. Thus, all foods listed have been encountered at microsite plots with positive bear sign, and with the exception of meat and domestic items, were found to be consumed at more than one microsite habitat plot. For ratings in earlier years, refer to that year's progress report.

Table 19. Food Species Recorded at Microsite Habitat Plots, 1998 to 2000.

CODE	Latin Name	Common Name	Seasonal Use intensity Spring	Summer	Fall
Trees					
ABIELAS	*Abies lasiocarpa*	Subalpine fir	Low		
PINUCON	*Pinus contorta*	Lodgepole pine	Low		Low
PICEENG	*Picea glauca*	White spruce	Low		
Shrubs			**Low**	***High**	***Medium**
AMELAIN	*Amelanchier alnifolia*	Saskatoon		Medium	Medium
ARCTUVA	*Arctostaphylos uva-ursi*	Kinnikinnik	Low		
CORNSTO	*Cornus stolonifera*	Red-osier dogwood		*Medium	*Medium
EMPENIG	*Empetrum nigrum*	Crowberry	Low		Low
LONIINV	*Lonicera involucrata*	Bracted honeysuckle		High	Low
OPLOHOR	*Oploplanax horridus*	Devil's club		High	Low
RIBELAC	*Ribes lacustre*	Bristly black currant		Medium	Medium
RIBEOXY	*Ribes oxycantholdes*	Wild gooseberry		Low	Low
ROSAACI	*Rosa acicularis*	Prickly rose	Low		Low
RUBUIDA	*Rubus idaeus*	Wild red raspberry		Low	Low
RUBUPAR	*Rubus parviflorus*	Thimbleberry		*Medium	Low
SALIX	*Salix spp.*	Willow	Low	Low	
SAMBRAC	*Sambucus racomosa*	Red elderberry		Low	Low
SHEPCAN	*Shepherdia canadensis*	Canada buffalo-berry		Medium	
SORBSCO	*Sorbus scopulina*	Western mountain ash			Low
SORBSIT	*Sorbus sitchens*	Sitka mountain ash			Low
VACCCAE	*Vaccinium caespitosum*	Dwarf blueberry			Medium
VACCMEM	*Vaccinium membranaceum*	Black huckleberry		*High	High
VACCMYRT	*Vaccinium myrtilloides*	Velvet-leaved blueberry		High	High
VACCOVA	*Vaccinium ovafolium*	Oval-leaved blueberry		*Medium	Medium
VACCOXY	*Vaccinium oxycoccos*	Bog cranberry	Low		*Low
VACCSCO	*Vaccinium scoparium*	Grouse-berry			Low
*VACCULI	*Vaccinium uliginosum*	Bog blueberry		Low	
VACCVIT	*Vaccinium vitis-idaea*	Lingonberry			Low
VIBUEDU	*Viburnum edule*	Highbush cranberry		*Medium	*****Medium
Forbes			***High**	***Medium**	**Low**
ANGEARG	*Angelica arguta*	White angelica	*Low	Low	
ASTER	*Aster spp.*	Aster species	*Medium	Low	Low
ASTRAGU	*Astragalus spp.*	Milk vetch	Medium		Medium
CALTLEP	*Caltha leptosepala*	Alpine white marsh marigold		Low	
EPILANG	*Epilobium angustifolium*	Fireweed	High	Low	
*EPILCIL	*Epilobium ciliatum*	Purple-leaved willowherb	Low		
EQUIARV	*Equisetum arvense*	Common horsetail	Medium	Medium	
EQUIPRA	*Equisetum pratense*	Meadow horsetail	Medium	Medium	
*EQUIFLU	*Equisetum fluviatile*	Swamp horsetail	Medium		
ERYTGRA	*Erythronium grandiflorum*	Glacier lily	High	High	Low
FRAGVIR	*Fragaria virginiana*	Wild strawberry		Low	

CODE	Latin Name	Common Name	Seasonal Use intensity Spring	Summer	Fall
HEDYALP	*Hedysarum alpinum*	Alpine hedysarum	Medium		Medium
HEDYBOR	*Hedysarum boreale*	Sweetvetch	High	Low	High
HERALAN	*Heracleum lanatum*	Cow parsnip	*Medium	High	*Low
*HIERALB	*Hieracium albiflorum*	White-flowered hawkweed	Low		
LATHOCH	*Lathyrus ochroleucus*	Creamy pea vine	Low		Low
*LYSIAME	*Lysichiton americanum*	Skunk cabbage		Low	
MAIASTE	*Maianthemum stellatum*	Star-flowered false solomon's-seal	Low		
MENYTRI	*Menyanthes trifoliata*	Buckbean	*Medium		
OSMORHI	*Osmorthiza species*	Sweet cicely	Low		High
OXYRDIG	*Oxyria digyna*	Mountain sorrel		Low	Medium
*PEDIBRA	*Pedicularis bracteosa*	Bracted lousewort	High	Low	
PETASAG	*Petasites sagittatus*	Arrow-leaved coltsfoot	Low		
*POTEPAL	*Potentilla palustris*	Mash Cinquefoil	Medium	Low	
RUBUPUB	*Rubus pubescens*	Dewberry		Low	
SENETRI	*Senecio triangularis*	Arrow-leaved groundsel		Low	
SMILRAC	*Smilacina racemosa*	False Solomon's seal	Low	Low	Low
SMILSTE	*Smilacina stellata*	Star-flowered false Solomon's seal			Low
STREAMP	*Streptopus amplexifolius*	Twisted-stalk	Low	Medium	Low
TARAOFF	*Taraxacum officinale*	Common dandelion	High	Low	*Low
TRIFREP	*Trifolium repens*	White clover	High	High	Low
TRIFPRE	*Trifolium pratense*	Red clover	High	Medium	Low
URTIDIO	*Urtica dioica*	Stinging nettle	Medium	Low	
*VALEDIO	*Valeriana dioica*	Mash valerian	Medium		
VALESIT	*Valeriana sitchens*	Sitka valerian	*High	Medium	Low
VERAVIR	*Veratrum viride*	Indian helabore	*Medium		
Ferns			**Medium**	**None**	**None**
ATHFIL-FEM	*Athyrium filix-femina*	Lady Fern	Medium		
DRYOEXP	*Dryopteris expansa/assimilis*	Spiny wood fern	Low		
*MATTSTR	Matteucia struthiopteris	Ostrich fern	Medium		
Gramminoids			***High**	***Medium**	**Low**
BROMUS	*Bromus species*	Bromes	*High	Low	
CAREX	*Carex species*	Sedges	*Medium		
DESCCAE	*Deschampsia caespitosa*	Tufted hair grass	Low	Low	
POA	*Poa species*	Bluegrass species	*High	*Medium	
TRISSPI	*Trisetum spicatum*	Spike trisetum	Low		
Other Sources					
	Formicidae	Ants	*Low	*High	*Low
	Vespidae	Wasps			Low
	Ungulate/bear	Carcasses	High	Low	*High
	Alces alces	Moose (adult and calf)	High	Low	*Medium
	Rangifer tarandus	Caribou	Medium	Low	

CODE	Latin Name	Common Name	Seasonal Use intensity		
			Spring	Summer	Fall
	Ursus arctos	Grizzly bear		Low	
	Ursus americanus	Black bear			Low
	Castomomus commersoni	Common white sucker*	Low		
	Marmota spp.	Marmot		Low	Medium
	Lemus sibericus	Microtines	Medium	High	Medium
	Turdus migratorius	Robin		Low	
Human Influenced Foods					
	Alfalfa		Medium	Low	
	Domestic cow	*Carcass*			Low
	Gut piles	*Ungulate*			Medium
	Oats				High

* Under Code section indicates new foods for 2001
* Under Ratings section indicates different rating for 2001

Bedding Sites

During 2001, we documented bedding as the primary activity 9% (13/147) of the time, the secondary activity 10% (14/147), and the tertiary activity 1% (2/147) of the time. At these sites we documented the characteristics (i.e., length, width and depth) of 39 day beds. The highest number of beds recorded at one site was 4, which occurred on one occasion at a moose calf kill site at the end of July. On five occasions, 3 day beds were found. Three of these sites were moose carcass locations, and two were day beds associated with den sites. Eight sites contained two day beds, while 26 sites contained one day bed.

Similar to previous years, beds were usually made in circular depressions with a radius of just less than 1 meter. In most cases, shallow excavations or scraping between 2 and 20 cm deep were made, likely to access moist or cooler soils. Consistent with previous years, mountain bears were observed bedding on remnant snow patches in high temperatures. In these cases, the bears tended to lay with their bellies on the snow in order to displace heat. In the plateau, bedding sites were documented to occur in forests with little understory or in association with carcass sites in alder thickets. Resting was an activity that was consistently documented to occur throughout the year although it may be higher in spring because bears tend to remain within the vicinity of their dens sites after emergence.

Rub Trees

Six plots were found to contain mark trees, for a total of nine mark trees (n=31, 1998 to 2001). However, rub trees were not recorded as the primary activity at any of the habitat plots, while they were a secondary activity 2% of the time. Rub trees recoded for 2001 were *Abies lasiocarpa (2), Picea glauca (2), Pinus contorta (3),* and *Populus balsamifera (2).* Some rub trees were incidentally encountered and recorded.

Meat

Meat items, excluding digging for rodents and microtines, were encountered 7% of the time (10/147). One of these plots was a beaver house which had been torn apart and we concluded from a bit of fur at the site that at least one of the beavers had been consumed.

The most commonly fed upon meat item on the plateau was moose, representing 5 of the 147 sites (3.4%). Three of these sites were moose calf sites, while two were adult moose. One of the moose had been hit by a car on Highway 97 and scavenged by GM51. The carcasses were largely consumed before our site visit and it is unknown whether the bears killed or scavenged the animals.

We know of three other sites which were not visited but in which moose were consumed. One site was on GF37 where she was sighted from the telemetry plane and helicopter feeding on a moose that was on the edge of the water in the Parsnip River. Thick brush and no road access made this site inaccessible. However, she remained at this adult moose carcass for just under two weeks.

On May 25, 2001, GF34 was sighted from the telemetry plane running across a secondary logging road with a moose calf in her mouth. The cow moose was also sited nearby the location. Her GPS collar shut off during the sighting and we were unable to obtain the location where she stopped to consume the calf. We were unable to find the location from ground.

On November 5, 2001, GM47 was located by helicopter nearby a very large, adult bull moose. On the following day, GM47 was located by fixed-wing aircraft where he was sighted lying on top of the large bull moose carcass. We returned to the site by helicopter but could not access the site due to the presence of other animals.

Only one large animal carcass plot occurred in the mountains. This site was at a location of a mountain male (GM48) and was in a retention patch in a cut block. At this site we found what we believed to be the inverted hide of a grizzly bear cub of the year. The hide was collected and a piece was sent the *Wildlife Genetics International Ltd.* for DNA testing. Unfortunately, the DNA was too degraded to obtain a positive species identification. We do not know whether GM48 killed or scavenged the cub. However, on the proceeding flight to this location he was sighted with an adult bear, which was believed to be a female as it was breeding season.

No other large animal carcasses were found to have been consumed by mountain bears in 2001. The most consistent meat item contained in mountain bear diets appeared to be microtines and rodents. Digging for rodents occurred as a primary activity 3% of the time, a secondary activity and tertiary activity 1% of the time, and the majority of this was for microtines although two marmot digs were also recorded. We have no evidence that bears pursued microtines or rodents in the plateau portion of the study area.

Non-natural Attractants

In 2001, oats were not a plentiful crop in the Salmon Valley. Apparently, residents of the Salmon Valley decided not to plant oats in 2001 to deter grizzly bears from loitering around their residence. We did not have any oat feeding sites in 2001. One Salmon Valley bear was found to

have fed on a dead cow/fetal calf carcass that the farmer had intentionally placed in a retention patch on his farm. We placed this investigation in the carcass category although it could also be a non-natural attractant.

One male (GM47) appeared to make regular use of the Foothills Landfill in Prince George. He spent months within the city limits, traveling between the Foothills Landfill and the Lower Mud River Landfill. He dropped his collar in the berry bushes surrounding a house in the Chief Lake area. The resident was unaware she had a grizzly bear on her property. Although we did habitat plots on his locations around Prince George, we did not access his Foothills Landfill locations due to the presence of a number of bears.

Other bear Activities Recorded at Microsite Habitat Plots

In the spring of 2001 we investigated a number of plots in mature and old growth forests with a thick moss understory. At these plots we noticed moss turned over so that the matted under-portion was facing up. By removing the moss layer ourselves we revealed a number of emergent green vegetation shoots. We believe that bears in early spring (prior to green-up, while snow patches remain on the ground) were feeding on the emergent shoots within the under layer of the moss.

At 2% of the 147 plots we were unable to find evidence of bear habitat use. In these cases habitat data was gathered in order to document the characteristics of the general area because we were confident the bear was in the area based on the aerial telemetry location. However, rather than focusing plot centre at the primary activity, it was placed directly at the telemetry location. On most occasions we believed the bear was traveling through the area at the time of the location. However, these sites were not classified as traveling unless a trail or tracks were found.

Denning

In 2001, we located 19 grizzly bear den sites. Between 1997 and 2001, 80 den sites have been located by VHF telemetry (Figure 16). Of the 80 den sites, 10 were sites where male bears denned, 58 were female bear den sites, and 7 were dens of unknown bears. These 80 den sites represent 34 individual animals. Therefore, we have multi-year den site locations on some bears. Twenty-eight of the den sites occurred on the plateau, while 52 occurred in the mountains. We have recorded den re-use on 3 occasions (GF9 in 1998 and 2001, GF16 in 2000).

We attempted to access as many den sites from 2000 as possible. In 2001, we visited 9 of the den sites recorded in 2000. One of the plateau den sites (GF34) was a very large bird's nest structure made out the boughs of fir trees and placed between a small clump of regenerating fir and spruce, making use of the tree trunks to hold the sides of the nest structure. The den did not have a roof but instead utilized the intertwined boughs of the trees to protect it from weather.

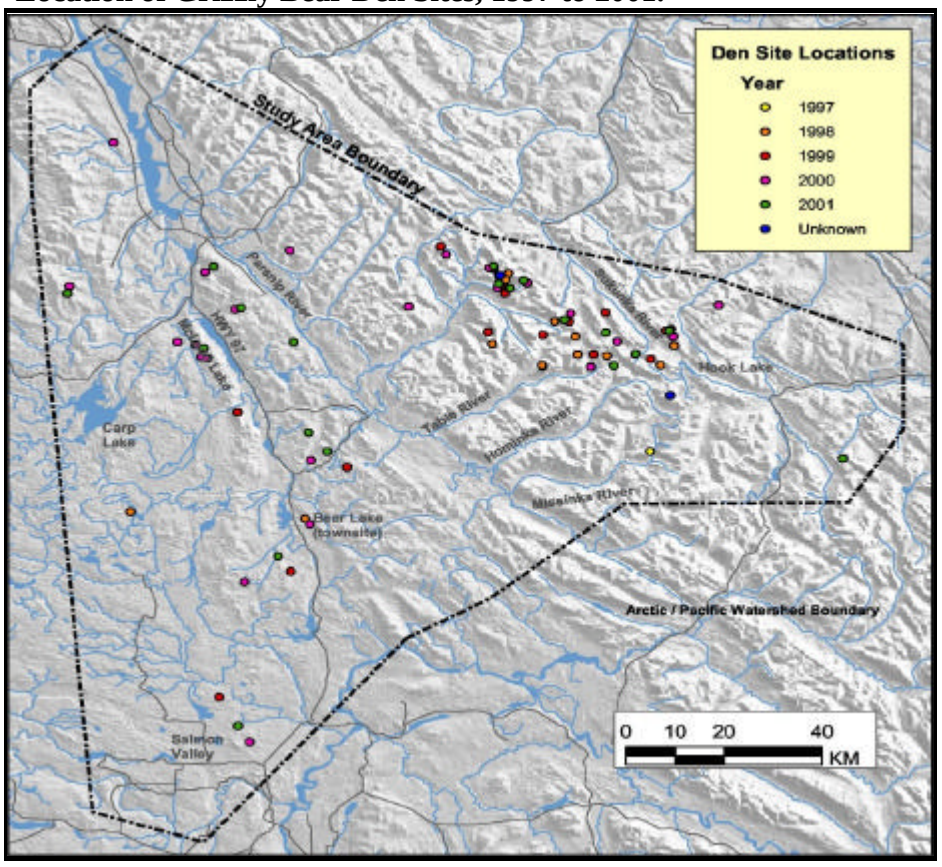
We visited two dens in older regenerating cutblocks of mixed-wood forest. Both dens were excavated into a small bank. In addition, both dens had partially collapsed above the chamber portion of the bed site. From the hair and bedding material within the den it appeared that the dens collapsed during the winter while the bear was within the den. Both bears attempted to use the roots of the trees to stabilize the roof, however, both were under stumps and the roots appeared to have partially given way allowing the roof to collapse in on the bear.

We investigated 5 mountain bear dens. Four of these dens were excavated into the sides of steep slopes, all were stable, and all were reusable. One of those dens was a large rock cave den.

On October 15, GF9 and both her two-year olds appeared to den in a high elevation bowl. We recorded her den site and saw one of her offspring enter the den. We also downloaded her GPS collar in early November from a ridge opposite her den site. However, on a flight on November 27, GF9 moved from her den site to reuse her den site from 2000. We do not know why GF9 moved den sites or whether her offspring remained in the first den site or moved with their mother. Because her move was two to three weeks after the download and we downloaded her from a ridge on the ground rather than hovering with the helicopter, we do not believe it was related to human disturbance.

Two bears (GF26 and her COY and GF7) moved from their initial den sites following the November helicopter GPS downloads. GF7 had denned up on October 15 on a very steep slope. She was located in her den from October 15 to November 5. She was downloaded November 5 from the helicopter while hovering. The next fixed-wing telemetry flight on November 14, GF7 had moved to a new den site in an adjacent bowl. GF26 was a plateau female who ran out of her den during the download. She immediately went to a new den area approximately 7 km from her first den site.

Figure 17. Location of Grizzly Bear Den Sites, 1997 to 2001.



4.5 Evaluation of Ear Tag Transmitters

Eight male bears had ear tag transmitters that should still have been functioning during the 2001 field season (GM3, GM8, GM14, GM19, GM22, GM28 GM31, MM6). Despite extensive searches of their home ranges, we did not locate any of these bears. We believe the transmitters have failed or the antennas have broken off making their transmission distances extremely short; perhaps only a few hundred meters. MM6 (Bam Bam) was shot during 2001 and his ear tag was not functioning.

Two bears (GM36 and GF37) began the year with functioning ear tag transmitters. One of those bears, GM36, was also monitored by his VHF radio-collar. In spring, the ear tag was noted to have failed. GM36 dropped his collar in September 2001 and has not been located since. GF37 had two ear tag transmitters. One transmitter failed in late spring/early summer 2001 but the other remained working until shutting off in November 2000. Prior to failure, GF37's ear tag transmitter went to 126 beats per minute.

One female captured in the fall of 2000 was outfitted with a GPS collar and an ear tag transmitter (GF38) that was set to start in September 2001. This female dropped her GPS collar in July 2001, however, despite extensive search of this subadult female's home range, she was not heard in 2001. We believe her ear tag transmitter failed to activate.

Two of the males that were captured in 2001 were outfitted with ear tag transmitters - GM50, who was with his mother, GF49 until her death, and GM47 - a lone subadult male. Both bears were tracked all year by their ear tag transmitters, which shut off just before den-up in November.

If using ear tag transmitters it is prudent to weigh the cost and benefits. Thick vegetation may catch on the transmitters and rip them from the ear. In addition, when ear transmitters have been retrieved we have found that most were missing antennas. In our experience with ear tag transmitters we believe they are generally reliable for the ***first year*** that they are put on the bear. However, most ear tag transmitters either failed early into their second year or did not turn on in their second year. In addition, most do not turn on when activated on delay (i.e., set to turn on at some point in the future).

5.0 SUMMARY

- During the 2001 field season, 20 grizzly bears were captured; 8 new bears and 12 recaptures. Since August 1997, 50 different bears have been captured.
- 27 bears were monitored at the beginning of the 2001 field season. 16 bears were monitored as of December 2001, including MF2 (Molly).
- 5 bears died during 2001, which is the highest number of study bears to die in one year (4 Parsnip study bears and 1 Peace-Williston bear also monitored by this project). Even though there was a moratorium on grizzly bear hunting and 2001 was a good year for bear foods. Four of these deaths were known or believed to be human caused, while one was from an unknown cause but believed natural.
- All of the five 2001 deaths were plateau bears.
- Since August 1997, there have been 11 known deaths of the 50 study bears (6 F: 5 M). One of the two Peace-Williston bears we also monitor was shot in 2001 resulting in 12 known deaths for 52 bears.
- Eight adult females had the potential to have cubs of the year (COYs) in 2001, but only three of those females were sighted with COYs. One mountain female (GF32) had 2 COYs. Two plateau females had COYs, GF26 had one COY and MF2 (Molly) had 3 COYs. All COYs are believed to have survived and denned with their mothers.
- GF15 was the only study female to have COYs in 2000. She had two yearlings at the beginning of 2001 but lost one yearling between July 3 and July 9, 2001.
- GF49 also had two yearlings at capture in 2001. GF49 died of unknown causes in August but her yearlings are believed to be denning together.
- GF9 was accompanied by two, two-year olds, while GF11 was accompanied by three, two-year olds. These offspring were COYs in 1999 and were part of 17 COYs born that year. Of those COYs, 10 died as COYs, two have unknown fates because their mother dropped her collar, and the 5 remaining are GF9 and GF11's two year olds.
- One family group became independent during 2001. GF35 separated from her male offspring (GM36) on May 9. She had two subsequent locations with her female offspring, GF37, but separated from her on May 16.
- GF35, GM36 and GF37 (the Firth Lake family group) were the only bears to den in the mountains but spend the remainder of the year on the plateau (see 2000 progress report for details). Due to the collar failure we were unable to locate GF35 at denning. GM36 dropped his VHF collar in September before den-up. GF37 denned on the plateau in the Firth Lake area.
- Unlike previous years, bears were located only once per week in 2001 by fixed-winged telemetry.

- 866 VHF locations were gathered during 2001, which includes 84 locations provided by the McLeod Lake Landfill Study (Peace-Williston Compensation Program, Mari Woods), and two provided by the Conservation Officer Service.
- Thirty-three percent of Parsnip Grizzly Bear Project locations (n=780) were confirmed by visual observation of the animal(s).
- The average home range size for females was 211 km^2 as compared to 1,163 km^2 for males
- Female plateau bears had significantly larger home range sizes than female mountain bears (p=0.019).
- There was no significant difference in home range sizes between males that lived in the mountains and males that lived on the plateau (p=0.157).
- 17 GPS collars were deployed in 2001 but only seven collars continued to function normally until the end of the season, resulting in a 41% failure rate.
- The average fix rate for GPS collars, excluding the two outright failures, was 44%
- For working GPS collars, 100% MCP home ranges were slightly larger using GPS locations than VHF locations.
- In 2001, biologist classified land-cover types revealed mountain bears were found more often in subalpine parkland (37%) and subalpine spruce/balsam (13.2%) than the remaining land-cover types. Plateau bears were primarily located within valley bottom spruce (36%), cutblocks (19.5%), and mixed-wood forests (16.5%).
- Of the 866 VHF locations gathered during 2001, 633 met the criteria for habitat analysis (305 mountains: 358 plateau). From 1998 to 2001, 2,307 bear locations met the criteria for analysis on 49 grizzly bears (1,520 mountains; 787 plateau).
- For 1998 to 2001, mountain bears exhibited clear selection for non-forested mountain land-cover types, such as krumholtz trees, slide alder, and avalanche chutes. The same pattern was found in 2001 alone.
- In 2001, plateau bears selected for deciduous mixes. This was likely the result of three of the plateau bears having their home ranges within the Salmon Valley and Prince George.
- Plateau bears selected for 'other' and 'young' age classes, although only the selection for 'other' was statistically significant. In the plateau, 'other' primarily refers to wet habitats not adjacent to rivers or lakes, bogs and fens, etc.
- Mountain bears exhibited significant selection for 'subalpine and alpine' age classes. Young age classes, which were primarily burns, were also selected for by mountain bears, although this selection was not significant (p=0.655). As a note, it is likely that burned over habitat is important to mountain bears, however, the analysis requires selection on a seasonal bases (i.e., during berry season) rather than all seasons combined.
- Mountain and plateau bears selected for the ESSFwk2 biogeoclimatic zone.
- Plateau bears selected for the SBSwk1 biogeoclimatic zone.

- Mountain bears used habitats that ranged from 693 to 1,922 meters in elevation with a mean of 1,384. Available to mountain bears were habitats ranging from 670 m to 2,366 m with a mean of 1,217 m. Thus, mountain bears avoided using the highest elevation habitats, which consisted primarily of rock, ice and glaciers.
- Plateau bears used habitat that ranged from 623 m to 1,481 m, with a mean of 838 m. Available to plateau bears were habitats ranging from 580 m to 1,687 m, with a mean of 861 m. Plateau bears used elevations similar to the mean amount available.
- There was an overall avoidance of roads by grizzly bears until approximately 2.5 km. Overall, grizzly bear use of the landscape in both the mountain and the plateau increased with further distances from roads.
- The Limited Entry Hunt and Problem Wildlife database revealed that 73% of grizzly bears shot in the Study Area between 1977 and 2001 were within 1 km of a road (32% 0-100 m). The majority of grizzly bears killed within the study area occurred closer to roads than random and the frequency of kills decreased as the distance to roads increased.
- 147 microsite habitat investigations were conducted during 2001, representing 19% of the telemetry locations.
- From 1998 to 2001, approximately 2,500 locations have been gathered and on-site habitat analysis has been conducted on 461 of these locations, resulting in a site visitation rate of 18%.
- In 2001, 50% of the sites were accessed by ground while 50% were accessed using helicopter.
- Grazing vegetation was the predominant activity recorded at spring habitat plots (49%), followed by resting (15%), moving and foraging for roots (both 11%).
- In summer, berry feeding was the main activity (26%) followed by grazing (23%), digging for roots (14%) and anting (12%).
- In fall, carcass sites (27%), moving (7%), and resting (7%) were the primary activities after denning.
- For 1998 to 2001, grazing was the most common activity recorded at plots. In 1998, the second most common activity recorded was berry feeding, followed by digging for roots. For 1999 to 2001, the second most common activity was digging for roots, followed by feeding on berries. There were many similarities among years.
- Overall grazing decreased each year from spring to fall, whereas digging for roots increased from spring to fall.
- The highest canopy closure recorded was for cambium feeding sites (58%), followed by bedding sites (42%), sites where carcasses were consumed (37%) and den sites (31%). Bears preferred canopy closure for some important activities, such as resting and denning, while more open canopies were preferred for foraging on vegetation.

- For 1998 to 2001, 3 species of trees, 25 species of shrubs, 36 forbs, 3 ferns, 11 meat items, 4 human influenced foods, as well as numerous species of gramminoid and carex species were recorded to have been fed upon by bears at microsite habitat plots.
- In 2001, 19 grizzly bear den sites were located by VHF telemetry.
- From 1998 to 2001, 80 grizzly bear den sites have been located using VHF telemetry and incidental sightings.
- Nine den sites from 2000 were visited in 2001.
- Den re-use has been recorded on 3 occasions from 1998 to 2001.
- Ear tag transmitters should only be relied on for the first year only. Most transmitters do not begin again in their second year or fail after a few months of monitoring in their second year.

6.0 LITERATURE CITED

Begon, M., J.L. Harper, and C.R. Townsend. 1996 (3rd edition). Ecology: Individuals, populations and communities. Blackwell Science Ltd., London, England. 1068 pp.

Ciarniello, L.M., M.S. Boyce, and H. Beyer. 2002. Grizzly Bear Habitat Selection Along the Parsnip River, British Columbia. Unpublished report Prepared for the British Columbia Ministry of Forests, Prince George Forest Region. Prince George, B.C. 24 pp.

Ciarniello, L.M., J. Paczkowski, D. Heard, I. Ross, and D. Seip. Parsnip Grizzly Bear Population and Habitat Project: Progress Report for 2000. Prince George Forest Region. 55 pp.

Hamer, D. and S. Herrero. 1983. Ecological studies of the grizzly bear in Banff National Park. Final Report. Prepared for Parks Canada. University of Calgary. Calgary, Alberta. 303 pp.

Hilderbrand, G.V., Schwartz, C.C., Robbins, C.T., Jacoby, M.E., Hanley, T.A., Arthur, S.M. and C. Servheen. 1999. The importance of meat, particularly salmon, to body size, population productivity, and conservation of North American brown bears. Can. J. Zool. **77**:132-138.

Hooge, P. N. and B. Eichenlaub. 1997. Animal movement extension to arcview. ver. 1.1. Alaska Biological Science Center, U.S. Geological Survey, Anchorage, AK, USA.

Johnson, D. H. 1980. The comparison of usage and availability measurements for evaluating resource preference. Ecology 61:65-71.

Mamo, C., J. Paczkowski, I. Ross, and R. Serrouya. 1999. Parsnip Grizzly Bear Population and Habitat Inventory Project: progress report for 1998. British Columbia Conservation Foundation, Prince George. 32 pp.

Manly, B. F. J., L. L McDonald, and D. L. Thomas. 1993. Resource selection by animals. Chapman and Hall, London.

Meidinger, D. and J. Pojar. 1991. Ecosystems of British Columbia. Special Report Series 6. Ministry of Forests, Victoria, British Columbia. 330 pp.

Mowat G., K. G. Poole, D. R. Seip, D. C. Heard, R. Smith, and D. W. Paetkau. 2001. Comparative Densities of Grizzly Bears in Mountainous and Plateau Environments in Central British Columbia. Unpublished Manuscript.

Ross, I., J. Paczkowski, C. Mamo, and L.M. Ciarniello. 2000. Parsnip Grizzly Bear Population and Habitat Inventory Project: progress report for 1999. Arc Wildlife Services, Calgary, Alberta. 53 pp.

Zar, J.H. 1999. Biostatistical analysis, 4h edition. Prentice Hall, Upper Saddle River, New Jersey. 663 +append.

7.0 APPENDICIES

Appendix I. Immobilization Data

	Drug dose (mg)						Injection time (hrs)				
	Telezol					Ketamine					
ID No.	1st	2nd	3rd	4th	5th	1st	1st	2nd	3rd	4th	5th
GF43		900						1325			
GF44	900						1646				
GM45	900						1250				
GM47	300	300					1229	1231			
GM48	1200	700					1412	1435			
GF49	1000						1452				
GM50	400						1501				
GM51		960	960	400	500			937	939	1005	1011
Recaptures											
GM39	800						1136				
GF34	1100					500	1154	1254			
GF4	900						1503				
GF7		900						1220			
GF11	900	600					1247	1301			
GM47	500	150					954	958			
GF35	1000	1000	250	250			1248	1302	1313	1322	
GM29	1000						1647				
GM45	960						1104				
GF9	960						1233				
GF17		960						1513			
GF26	1000						816				

Appendix II. Physiological Parameters

Physiological parameters from grizzly bears captured in the Parsnip Grizzly Project Study area, 2001.

Physiological parameters measured at time since immobilization																		
	Temperature (Celsius)						Pulse						Respiration					
ID No.	10	20	30	40	50	60	10	20	30	40	50	60	10	20	30	40	50	60	Injuries noted
GF43		37.6		36.9				106		96				16		12			Scar below left eye. Abnormal nodule on left ear.
GF44	40.9	40.5	40.0	39.6	39.2		112		110	108	108		40		28	24	18		None
GM45			36.9	36.3	35.8				65	65	60				4	4	5		None
GM47	38.3	38.2	38.1	37.9			140	130	126	128			10	10	12	10			
GM48		39.3	39.2	39.2				104	116	110				16	20	22			
GF49		39.0				39.1		104	112			100		14				20	None. Swollen snared foot.
GM50			38.7	38.5					116	108					24	20			None
GM51		40.4		39.8	39.8	39.8	116	102		84	82	76	108	106		40	66	60	Fresh deep wounds on muzzle. Older wounds on neck.
Recaptures																			
GM39	39.8	39.6			39.5		116	100			100		40	24			32		Small minor abrasion on wrist.
GF34	39.1		39.2				140		120	124			12		12	12	40		Swollen snared foot. Minor cuts on lips.
GF4		36.9		36.8				70	70					8	7				None noted
GF7		39.0	39.2	39.2				90	80	78				3	3	3			Lots of blood at dart wound.
GF11		37.5	37.1	37.1				104	102	96				8	7	6			Left nostril slit - old injury.
GM47	38.5	38.4					176	176					34	18					Snared foot swollen, skin not broken.
GF35			38.2	36.4	36.2					120	104				20	20	18		Old scar on right hand side.
GM29		37.2		36.8	36.5			68	35	64	62			3	3				Weeping wounds from bite on neck.
GM45		39.7	39.7					90	90					12	14				None
GF9		40.1	40.0	39.7				84	76	86				20	11	10			None
GF17		39.3	39.0	39.0				96	68	64	72			8	6	5	4		None
GF26	38	38.2	38.2										15						Small infected puncture wound on right rear leg.

Appendix III. Morphological Data

(Sex, age, weight, chest girth)

Morphological data from grizzly bears captured in the Parsnip Grizzly Project Study area, 2001. Sex, age, weight, estimated age and chest girth.

ID No.	Age*	Capture Date	Weight (kg) actual	estimated	Chest Girth (cm)
GF43	13	5/8/01	109		94
GF44	4	5/10/01	70		82
GM45	7	5/11/01	80		89
GM47	2	5/15/01	70	79	90.5
GM48	10	5/16/01	250-275		125
GF49	7	5/20/01	120	109	94
GM50	1.3	5/20/01	40	48	69
GM51	12	5/26/01	300-350		149
Recaptures					
GM39	**3**	5/1/01	100	116	99
GF34	7	5/7/01	145	158	110
GF4	12	5/8/01	90		91
GF7	11	5/8/01	90		99
GF11	16	5/10/01	90		85
GM47	2	5/17/01	79	79	90.5
GF35	11	5/25/01	180		115
GM29	5	5/25/01	80		80
GM45	7	5/27/01	85		89
GF9	11	5/27/01	85		86
GF17	AD est.11	5/27/01	85		89
GF26	21	10/2/01	150	136	108

*Ages have been adjusted to 2001 for bears captured and aged in previous years.

Appendix IV. Intercanine Distance and Pad Measurements

Morphological data from grizzly bears captured in the Parsnip Grizzly Project Study area, 2001. Intercanine distance and pad measurements.

	Dimensions (mm)						
	Intercanine		Right Rear Pad		Right Front Pad		Body
ID No.	top	bottom	Length	Width	Length	Width	Length
GF43	nr*	nr					1780
GF44				110		115	1590
GM45				110		125	1840
GM47	75	54	201	128	98	108	1560
GM48				150			2150
GF49				118		118	1950
GM50							1490
GM51				165		85	2210
Recaptures							
GM39			225	125	120	135	1830
GF34			227	138			2110
GF4				120		125	1790
GF7				113			1850
GF11				105			1930
GM47	75	54	201	128	98	108	1560
GF35				125		125	2110
GM29				120		120	1820
GM45				110		125	1840
GF9				105		125	1650
GF17				105		120	1730
GF26	60	55		130			1790

all measurements in mm

Appendix V. Tooth wear, Colour and Body Condition

Morphological data from grizzly bears captured in the Parsnip Grizzly Bear Project Study area, 2001. Tooth wear, colour and body condition.

ID No.	Premolar taken	Missing/ broken teeth	Tooth wear			Colour/ Markings	Body condition
			Inc.	Can.	Mol.		
GF43	UL		m	m	h	Typical - light narrow bar between front legs	Thin - noticable ribs, hips, spine
GF44	Yes	none	l	l	l	Dark Legs - sides and head very blonde	Thin but not extreme
GM45	LL	none	m	l	m	Dark legs - grizzled neck and shoulders	Thin
GM47	LR	none	l	l	l	Dark legs, grizzled body, light head and neck	Thin but not emanciated
GM48	LL	none	m	m	m	Dark legs, very light on top of body and head	No fat but lots of muscle mass
GF49	UL	none	m	m	m	Dark legs, light grizzled body	Thin
GM50	UR	none	l	l	l	Dark legs, light grizzled body	Thin
GM51	UL	LL chipped	m	l	m	Very dark legs, light colored strip on neck	Excellent
Recaptures							
GM39		none	l	l	l	Dark legs, blonde body and collar	Fair
GF34		UC chipped	l-m	l-m	m	Dark legs, blonde saddle	Good - ribs are palpable
GF4		URC broken	h	m	h	Typical - light on top	Very thin and bony
GF7		none	m	m	m	Dark legs - very blonde body	Thin but not overly
GF11		none	h	m	h	Dark legs, blonde body	Very thin
GM47		none	l	l	l	Dark legs, grizzled body, light head and neck	Thin but not emanciated
GF35		none	m	m	h	Covered with mud and water	Good
GM29		none	l	l	l		Very thin
GM45		none	m	l	m	Dark legs - grizzled neck and shoulders	Thin
GF9		none	m	l	m	Blonde, not rubbed	Thin
GF17		none	m	l	h	Dark legs - grizzled body, light bar behind front legs	Very thin
GF26		none	h	h	h	Typical	Moderate fat around body

Appendix VI. Ages of Grizzly Bears Captured, 1997 to 2001

Ages of Grizzly Bears Captured in the Parsnip River Study Area, 1997 to 2001, as determined by counts of cementum annuli.

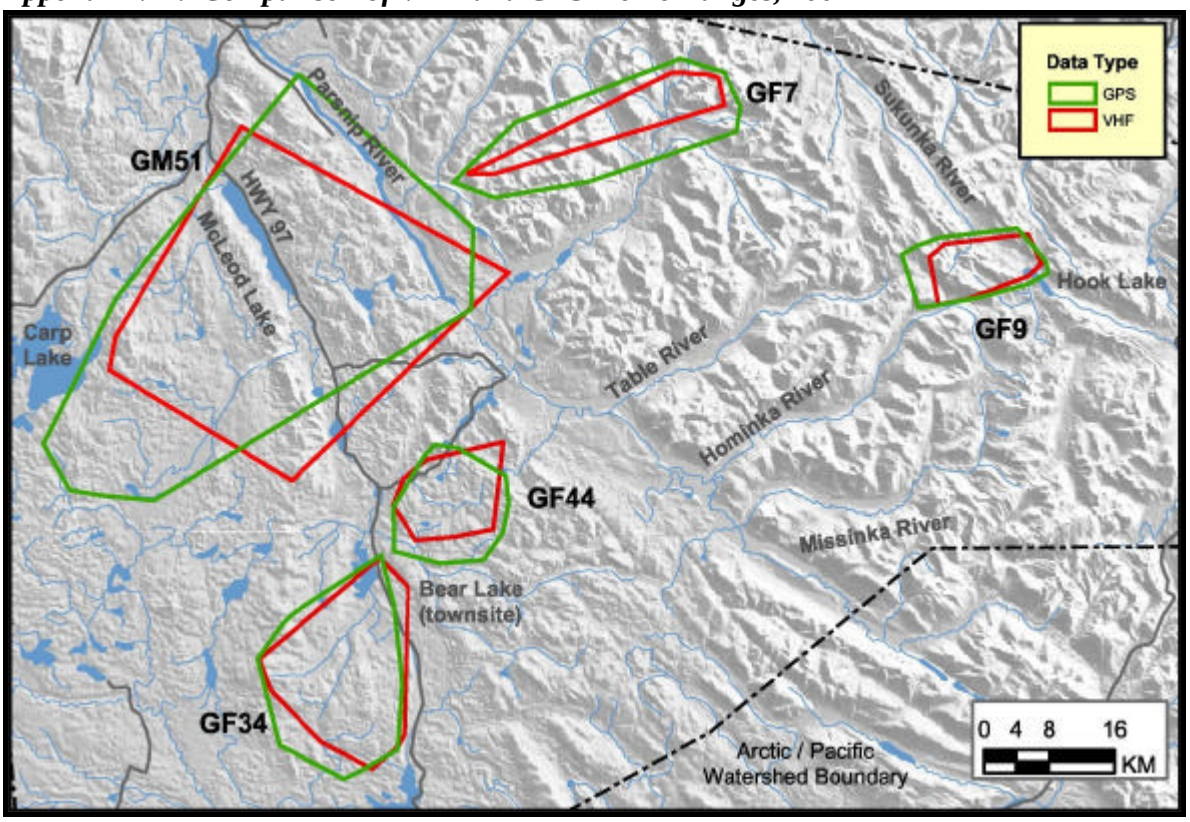
Bear	Sex	Date of First Capture	Age at Capture	Comments
GF1	F	26-Sep-97	12	
GF2	F	5-Oct-97	19	
GM3	M	5-Oct-97	1	
GF4	F	5-May-98	9	
GF5	F	6-May-98	15	
GM6	M	6-May-98	6	
GF7	F	8-May-98	8	
GM8	M	8-May-98	5	
GF9	F	9-May-98	9	
GF10	F	11-May-98	9	
GF11	F	12-May-98	13	
GF12	F	12-May-98	22	
GF13	F	10-May-98	13	
GM14	M	13-May-98	16	
GF15	F	13-May-98	16	
GF16	F	14-May-98	10	
GF17	F	14-May-98	unknown	Abnormal histology
GF18	F	14-May-98	15	
GM19	M	17-May-98	2	
GM20	M	17-May-98	2	
GM21	M	18-May-98	4	
GM22	M	18-May-98	8	
GM23	M	2-Sep-98	5	
GF24	F	12-May-99	unknown	Unknown reason
GF25	F	24-Sep-98	4	Has 2 COY
GF26	F	23-Sep-98	18	
GF27	F	14-May-99	7	
GM28	M	14-May-99	5	

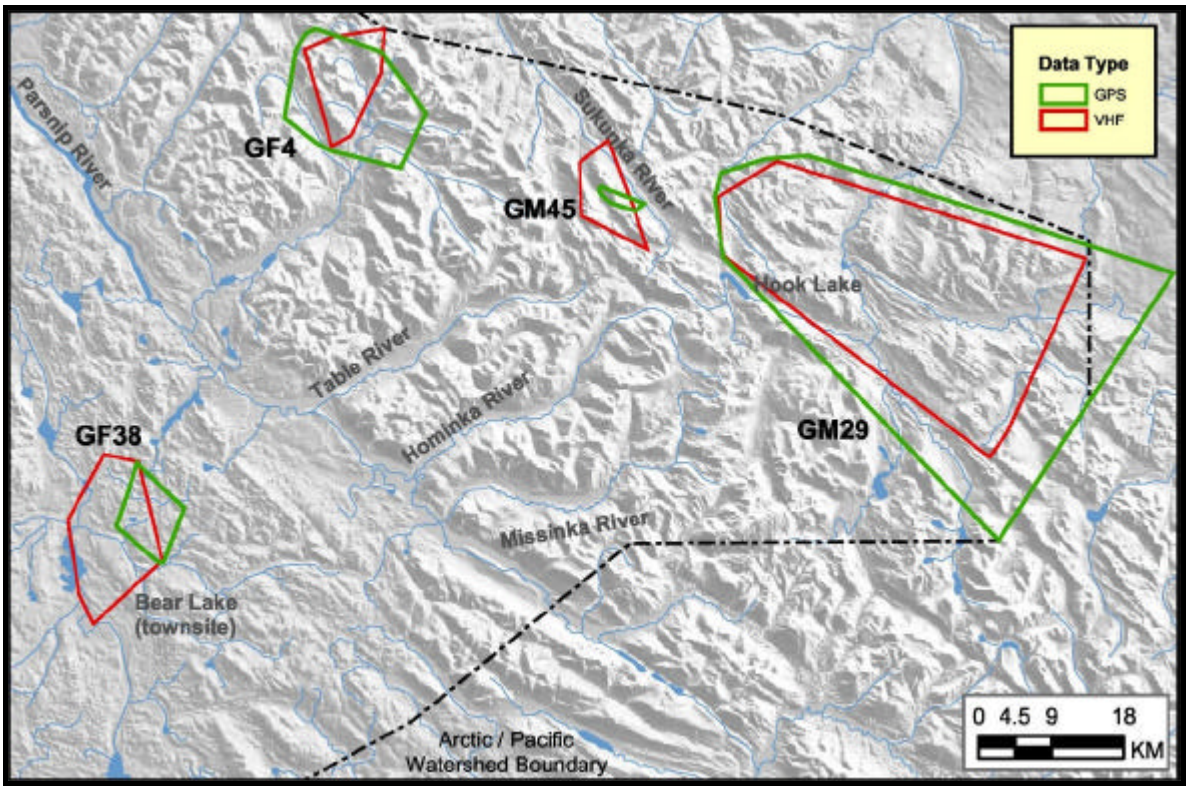
Ages of Grizzly Bears, 1997 to 2001 Continued

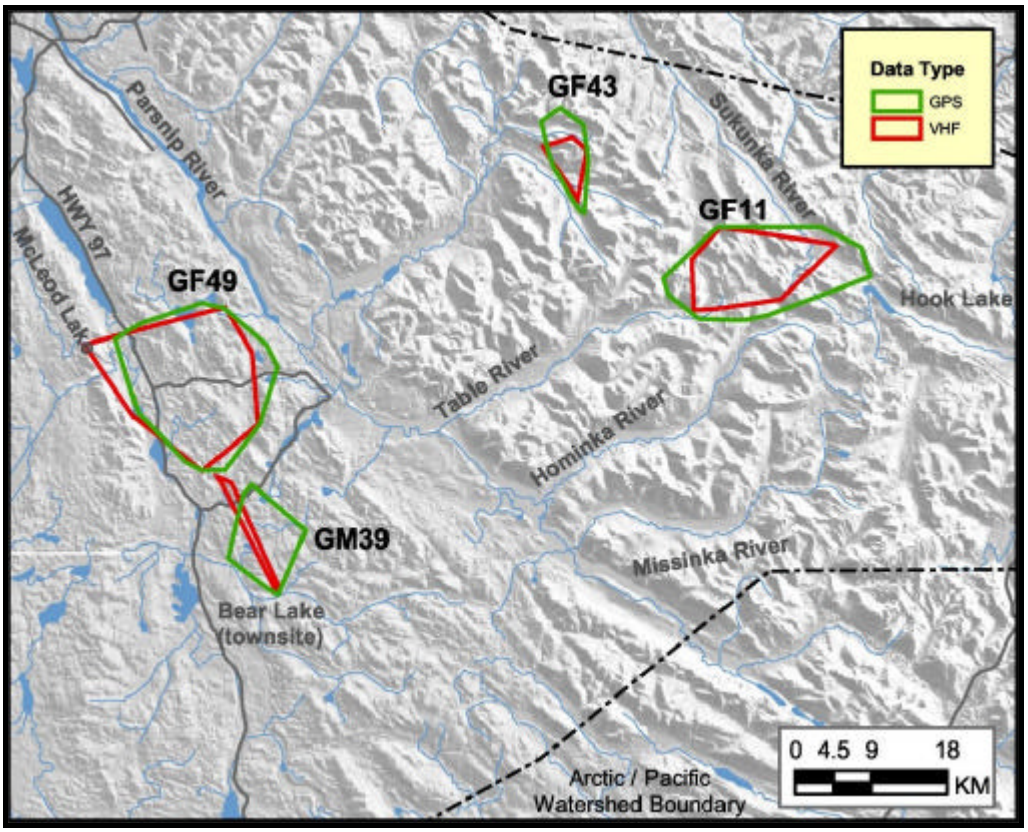
Bear	Sex	Date of First Capture	Age at Capture	Comments
GM29	M	17-May-99	3	
GF30	F	18-May-99	12	
GM31	M	18-May-99	2	No tooth -- known 2 yr. old
GF32	F	18-May-99	8	
GF33	F	25-Sep-99	15	
GF34	F	4-Oct-99	5	
GF35	F	23-May-00	10	
GM36	M	23-May-00	4	
GF37	F	1-Sep-00	4	
GF38	F	17-Sep-00	estimate 3-4	Misplaced sample but sibling (GM39) is 2 yrs
GM39	M	18-Sep-00	2	
GF40	F	3-Oct-00	1	Sample re-sent in 2001 to check age
*GF41	F	28-Sep-00	**11**-12	
GF42	F	3-Oct-00	3	
GF43	F	8-May-01	13	
GF44	F	10-May-01	4	
GM45	M	11-May-01	7	
GM47	M	15-May-01	2	
GM48	M	16-May-01	10	
GF49	F	20-May-01	7	
GM50	M	20-May-01	1.3	
GM51	M	26-May-01	12	

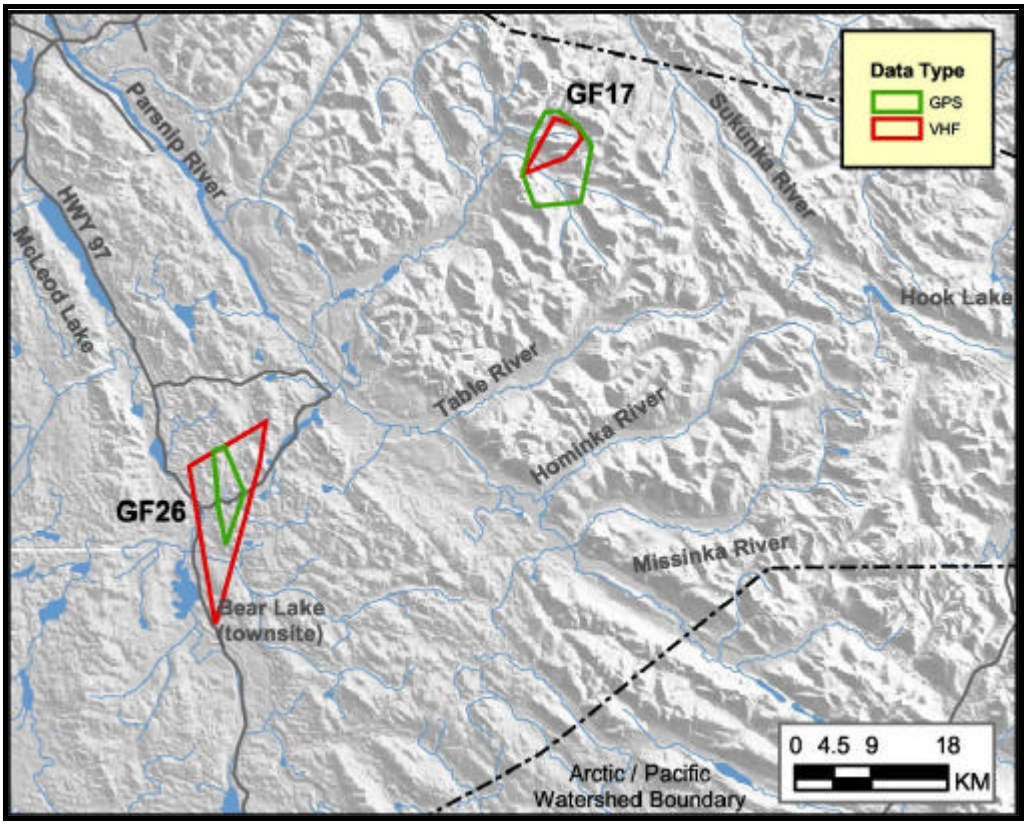
* Mattson's Lab reported "ambiguous evidence" on GF41's age with the best evidence indicating 11 years.

Appendix VII. Comparison of VHF and GPS Home Ranges, 2001






Data Type
GPS
VHF
GF43
GF11
GF49
GM39
Parsnip River
HWY 97
McLeod Lake
Sukunka River
Hook Lake
Table River
Hominka River
Missinka River
Bear Lake
(townsite)
0 4.5 9 18
KM
Arctic / Pacific
Watershed Boundary


Data Type
GPS
VHF
GF17
GF26
Parsnip River
HWY 97
McLeod Lake
Sukunka River
Hook Lake
Table River
Hominka River
Missinka River
Bear Lake
(townsite)
0 4.5 9 18
KM
Arctic / Pacific
Watershed Boundary