University of Calgary

HABITAT SELECTION AND CALF SURVIVAL IN THE TELKWA CARIBOU HERD, BRITISH COLUMBIA 1997 – 2000

by

Astrid Vik Stronen

A Master's Degree Project
submitted to the Faculty of Environmental Design in partial fulfilment of the requirements of the degree of Master of Environmental Design
(Environmental Science)

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ABSTRACT

HABITAT SELECTION AND CALF SURVIVAL IN THE TELKWA CARIBOU HERD, BRITISH COLUMBIA 1997 – 2000.

by

Astrid Vik Stronen

Prepared in partial fulfilment of the requirements of the MEDes Degree in the Faculty of Environmental Design, The University of Calgary

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September 2000

From 1997 – 1999, 32 woodland caribou (*Rangifer tarandus caribou)* from the Sustut Herd were translocated to the Telkwa Mountains in west-central British Columbia to augment recovery of the Telkwa Caribou Herd. Radiocollared caribou were located from 1997 – 2000 to determine selection of habitat features and terrain variables. Analyses were based on ranks for use and availability, to account for uncertainties in what constitutes available habitat for the Telkwa Herd. High elevation habitat (> 1700 masl) on moderate slopes (16 – 45 °) received the highest ranks, as well as 'warm'(136 – 315 °) aspects and forests > 250 years old. Locations were obtained for 8 cows with calves and 8 without calves during the summer of 1999, to determine differences in habitat selection. The summer habitat use was compared with habitat use throughout the year, to account

for differences not attributed to calving. There was a significant difference in use of elevation during calving time, when cows with calves remained at high elevations and barren cows descended to lower elevation habitat. Six caribou calves were collared to determine causes and timing of calf mortality. Three calves died shortly after birth. One calf was killed by predation, likely by a golden eagle, and one calf was abandoned by the cow. Cause of death for the third calf is unknown. The remaining three calves were alive and still following their mothers as of April 2000. Five calves were counted in the herd in 1998, and 13 in 1999. Legal mechanisms for management of caribou habitat in British Columbia were reviewed; and a habitat suitability map developed, to recommend priority areas for habitat protection. Management recommendations and changes to policy and legislation are recommended.

Keywords: British Columbia, calf mortality, calving habitat, caribou, Endangered Species Protection Act, Forest Practices Code of British Columbia, habitat suitability, Land and Resource Management Plans, Motor Vehicle (All Terrain) Act of British Columbia, *Rangifer tarandus caribou*, Wildlife Act of British Columbia, wildlife management, Woodland caribou.

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The MELP staff in Smithers made me feel very welcome from the first day. George Schultze, Mark Williams, Rick Marshall, Tom Smith and Brian Fuhr assisted with capture and collaring of caribou calves. They also shared of their wide knowledge of animals and helped with various field work, as did Rick Keim, Don Reid, Denise Stoffels and Len Vanderstar. Conservation Officers Frank Guillon and Kevin Nixon, and Bruce Kerr of Telkwa also assisted in attempts to radiocollar wolves. The GIS section at MELP provided help with all GIS-related work. The habitat suitability analysis would not have been possible without the help of James Warren.

Staff from MELP, MOF, members of the Wet'suwet'en First Nation, members of recreational organisations and others accompanied me on fieldtrips. More people offered to help than I could accommodate; I appreciate the interest of every one of you. Bill Holland of the Wet'suwet'en First Nation generously shared with me his knowledge of the Telkwa Caribou Herd. Kerrith McKay reviewed part of the manuscript.

The staff at Northern Lights Air were always accommodating. Pilots Doug Dyck, Armin Wilke, Dave Wiebe, Mark Hollenstein, Keith O'Connor and Gord Lengkeek safely piloted fixed-wing telemetry flights. In addition, their caribou observation skills were often better than mine. Pilots Tom Brooks, Daryl Adzick, and the other staff at Canadian Helicopters showed much appreciated flexibility to my unpredictable schedule for collaring caribou calves.

One day when I was in the mountains observing caribou, five caribou decided to come and do some research on me. I hope in the future that people will be able to visit the Telkwa Mountains and experience the same. I was later investigated by a group of eight wolves, and one day by a mountain goat. I will never forget these 'meetings'.

I am also grateful to those who have questioned my methods or the purpose of my work. Only in hindsight can I fully appreciate how much this has taught me.
Many people (enough for a separate chapter!) made my stay in Smithers enjoyable and memorable.

Thank you.

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LIST OF ABBREVIATIONS

AAC	- Annual Allowable Cut
ATV	- All-Terrain Vehicle
BC	- British Columbia
BC CDC	- British Columbia Conservation Data Centre
BGZ	- BioGeoclimatic Zone
BVCRB	- Bulkley Valley Community Resources Board
COSEWIC	- Committee on the Status of Endangered Wildlife in Canada
DEM	- Digital Elevation Model
DM	- District Manager
FC	- Forest Cover
FPC	- Forest Practices Code
GiC	- Governor in Council
GIS	- Geographic Information Systems
GPS	- Global Positioning System
HLP	- Higher Level Plan
IWMS	- Identified Wildlife Management Strategy
LGiC	- Lieutenant Governor in Council (Cabinet)
LRMP	- Land and Resources Management Plan
LUP	- Landscape Unit Plan
NGO	- Non Governmental Organisation
masl.	- meters above sea level
MELP	- Ministry Of Environment, Lands & Parks
MOF	- Ministry of Forests
OMP	- Operational Management Plan
PBSSC	- Provincial Backcountry Skiing-Snowmobiling Committee
RAMP	- Recreational Access Management Plan
RENEW	- Recovery of Nationally Endangered Wildlife
RSW	- Resource Selection for Windows

SLDF	- Sierra Legal Defence Fund
TCH	- Telkwa Caribou Herd
TCHRP	- Telkwa Caribou Herd Recovery Plan
TCSC	- Telkwa Caribou Standing Committee
WCEL	- West Coast Environmental Law Association
WHA	- Wildlife Habitat Area
WMA	- Wildlife Management Area

1.0 INTRODUCTION

Caribou in British Columbia (B.C.) are classified as woodland caribou (*Rangifer tarandus caribou*), and are further divided into the mountain and northern ecotypes (Stevenson and Hatler 1985). Mountain caribou live in southeastern B.C., spending most of the year at high elevations in sub-alpine and alpine habitats. Northern caribou live in the northern and west-central part of the province. They generally inhabit mountainous areas in winter, and use low elevation pine forests or windswept alpine areas where low snow depths permit cratering for terrestrial lichens (Seip and Cichowski, 1996).

The density and distribution of caribou populations in B.C. appear to be related to their ability to become spatially separated from predators (Seip and Cichowski 1996). Moose (*Alces alces)* provide an alternative prey for wolves (*Canis lupus)*, which may lead to a wolf population that is not only larger, but shows no negative feedback to declining numbers of caribou (Heard and Vagt 1998). Caribou will often occupy rugged, mountainous terrain, which keeps them spatially separated from wolves and moose (Bergerud and Miller 1984, Seip, 1992).

The general pattern throughout most of this century appears to be a population decline and range reduction of caribou in B.C. (Seip and Cichowski 1996). Declines in caribou populations may be related to many factors including licensed and subsistence hunting, severe winters, habitat alterations, and predation (Rettie and Messier 1998). Information is needed on the amount and spatial distribution of suitable habitat required to support caribou at present, and for long-term viability, and we must therefore provide some percentage of linked suitable but vacant or lightly used caribou habitat, and/or capable habitat, adjacent or in proximity to all currently occupied areas (Antifeau 1998).

Caribou were once widely distributed throughout most mountainous areas surrounding Smithers, B.C. and migrated seasonally across the Bulkley Valley, and may have formed part of a larger herd whose range extended south into Tweedsmuir park (Telkwa Caribou

Herd Recovery Team (TCHRP) 1998). Few data are available on the Telkwa Herd prior to 1997. Surveys of the Telkwa herd have indicated fluctuations in herd size from < 100 (1949), to a high of 271 (1965), and a low of 68 animals in 1984 (van Drimmelen, 1986). After 1984 managers thought the herd was increasing at a slow rate of about 3% per year, but monitoring flights in 1994, 1996 and 1997 yielded only 10, 13 and 6 animals, respectively (TCHRP 1998).

The Bulkley Valley Land and Resources Management Plan (LRMP, Bulkley Valley Community Resources Board 1996) directed the British Columbia Ministry of Environment, Lands and Parks (MELP) to protect the Telkwa Caribou Herd. The plan provides direction for management of Crown resources within the Bulkley portion of the Bulkley/Cassiar Forest District, which together with the Morice Forest District makes up the Telkwa Caribou Herd Recovery Area. There is currently no LRMP in place for the Morice Forest District. The Bulkley LRMP identifies Special Resource Management Zones where the primary objective is to maintain caribou and goat (*Oreamnus americanus)* habitat, and directed MELP, as the government agency responsible for wildlife management in the Telkwa Mountains, to bring forth a plan "to enhance and sustain a viable caribou population" (BVCRB 1996). A complete closure on hunting was implemented in 1973 for the Telkwa Herd (TCHRP 1998). Other potential liabilities for population growth are predation from wolves, grizzly and black bears (*Ursus arctos* and *U. americanus*), wolverine (*Gulo gulo*) and other predators (golden eagles (*Aquila chryseatos*), coyote (*Canis latrans*) and lynx (*Lynx canadensis*)), illegal hunting, human access, harassment from planes and helicopters, and loss and fragmentation of habitat.

Observations have indicated that the Telkwa caribou rely largely on arboreal lichens during some winters. In other winters, they have foraged on terrestrial lichens that occur on steep, windblown alpine slopes (TCHRP 1998). A one-year study was carried out in 1985-86 (van Drimmelen, 1986). Radiocollared caribou (which may not be representative for the herd as a whole) were located primarily in the alpine from March to July. They descended to sub-alpine forest by September. The caribou used mostly spruce/fir forests, 150-250 years old. Alpine habitats were then used until December.

The caribou then descended to feed on arboreal and terrestrial lichens at about 1100 meters above sea level (masl.).

Van Drimmelen (1986) concluded that the Telkwa herd spent most of its time above the tree line. This contrasts with the Tweedsmuir caribou herd 160 km to the south, which occurs most often below tree line (Marshall, in van Drimmelen 1986). Telkwa caribou seemed to use forested habitats in response to winter glazing and crusting of snow, which makes alpine food sources largely unavailable. The study showed calf survival was low for the Telkwa Herd, with calves dying during the first four months of life.

Thirty-two (32) caribou were relocated to the Telkwa Mountains during 1997-1999, to help recover the Telkwa Herd. The animals were captured from the Sustut herd, about 150 km north of Smithers; immobilised, fitted with radiocollars and flown by helicopter to the Telkwa Mountains. Four were bulls, one was an immature cow and the rest were adult cows. All collars have a uniquely coloured plastic sleeve, and each animal was fitted with coloured tags in both ears

Objectives for this study were to:

1) Determine habitat use of the Telkwa Caribou Herd, based on data collected from 1997-2000;
2) Determine survival of adult and calves of the Telkwa Caribou Herd, based on data collected from 1997-2000;
3) Develop a habitat suitability[1] map for caribou in the study area;
4) Review legal mechanisms for management of caribou habitat in British Columbia;
5) Based on 1 – 4 develop recommendations to MELP for managing the habitat of the Telkwa Caribou Herd.

[1] Suitability is defined as the ability of the habitat in its current condition to provide the life requisites of a species. Capability is the ability of the habitat, under the optimal natural (seral) conditions for a species to provide its life requisites, irrespective of the current condition of the habitat (Resources Inventory Committee, 2000).

White and Garrott (1990) define preference as whether the animal population selects some habitat types more than others and thus spends more time in these habitats (and less time in the remaining habitats) than would be expected based on the availability of each habitat type. I assessed the habitat use of the Telkwa Caribou herd from 1997- 2000, based on locations of radiocollared animals, which during these years included most of the Telkwa Herd. I examined the use of different habitat types during summer, fall, winter and spring, and compared use with availability of habitat to determine selection. Selection of habitat occurs at different scales (Johnson, 1980), which can be ordered into four categories:

1) Geographic range
2) Home range
3) Habitat
4) Food items

The behaviour of relocated animals may differ from that of animals born in the study area. This is a possible confounding factor for assessing selection at the geographic range and home range. As few data are available before relocation, this study relies on data collected from November 1997 – April 2000 only. Data collected during this study, however, are not of sufficient detail to determine selection of food items, but may indicate important areas where food selection could be studied. Because of the above limitations, I only attempt to determine selection at the habitat scale.

In chapter two I describe the study area. I also outline what is known of the Telkwa Herd's history, although little data is available prior to the transplant in 1997.

Chapter three outlines my methodology for collaring and monitoring animals. I also describe habitat variables measured, and statistical applications used.

Chapter four outlines habitat use of barren- and reproductive cows during 1999. I compare elevations used during calving time and the remainder of the year.

In chapter five I describe results from collaring of caribou calves during the summer of 1999. I also discuss overall calf production and calf survival for the herd during 1997 – 2000.

Chapter six outlines the study of habitat use during 1997 - 2000. I discuss advantages and limitations in using ranks to determine habitat suitability; habitat selection by the Telkwa caribou in comparison with other herds, and threats to woodland caribou. A habitat suitability map suggests the value of the various habitats throughout the study area to caribou.

Chapter seven discusses applicable legislation for managing habitat for woodland caribou. I suggest changes to these laws, as well as better use of existing legislation.

Chapter eight contains Traditional Ecological Knowledge of the Telkwa Caribou Herd as told by Bill Holland of the Wet'suwet'en First Nation.

Chapter nine summarises the findings of the study, and I outline recommendations for management of the Telkwa Caribou Herd and its habitat.

LITERATURE CITED:

Antifeau, T. 1998. Identification of issues involved in the process of developing and applying caribou habitat suitability models. British Columbia Ministry of Environment, Lands and Parks, Wildlife Section, Kootenay Region, Nelson, British Columbia.

Bergerud, A. T. and D. R. Miller. 1984. Antipredator tactics of calving caribou: dispersion in mountains. Canadian Journal of Zoology 62: 1566 – 1575.

Bulkley Valley Community Resources Board. 1996. Bulkley Land and Resources Management Plan. Volume 1: Consensus Management Direction. Provoke of British Columbia, May 1996.

Heard, D. C. and K.L. Vagt. 1998. Caribou in British Columbia: A 1996 status report. Pages 117 – 123 *in* M. Lankester et al., editors. Rangifer, Special Issue No. 10. 1998. Proceedings of the Seventh North American Caribou Conference. Thunder Bay, Ontario, Canada.

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

Resource Inventory Committee. 2000. British Columbia Ministry of Environment, Lands and Parks. (http://www.for.gov.bc.ca/ric/Pubs/teEcolo/whrs/whrs-05.htm#P342 -22704) as of August 2000.

Rettie, W.J. and F. Messier. 1998. Dynamics of woodland caribou populations at the southern limit of their range in Saskatchewan. Canadian Journal of Zoology. 76: 251 – 259.

Seip, D.R., 1992. Factors limiting woodland caribou populations and their interrelationships with wolves and moose in southeastern British Columbia. Canadian Journal of Zoology. 70: 1494-1503.

Seip, D. and D.B. Cichowski. 1996. Population Ecology of Caribou in British Columbia. Pages. 73 – 80 *in* K. Brown et al., editors. Rangifer, Special Issue No. 9, 1996. Proceedings of the Sixth North American Caribou Workshop. Prince George, British Columbia, Canada.

Stevenson, S.K. and D.F. Hatler. 1985. Woodland caribou and their habitat in southern

and central British Columbia. Vol. 1. British Columbia. Ministry of Forests, Victoria, British Columbia. Report No. 23.

Telkwa Caribou Herd Recovery Plan. 1998. Telkwa Caribou Herd Recovery Team, B.C Environment, Skeena Region. August 1998 (revised).

van Drimmelen, B. 1986. Telkwa Mountains Caribou Telemetry Project, Progress Report # 2. BC Environment, Smithers, June 1986.

White, G. C. and R. A. Garrott. 1990. Analysis of Wildlife Radio-Tracking Data. Academic Press, San Diego.

2.0 STUDY AREA

In this chapter I describe the vegetation and climate of the study areas, and outline what is known about the history of the Telkwa Caribou Herd prior to the transplant in 1997.

A definition of the resources deemed to be available for study organisms is a critical aspect of study design (Johnson 1980, Manly et al. 1993). These resources make up the study area, from which use is compared to availability in order to determine selection of habitat. All but one radio-collared animal were transplanted to the Telkwa Mountains, so their use of habitat may be different from animals with a lifetime of experience in the area. To account for the difficulty in defining available resources for the Telkwa herd, where most animals have had < 2 years of experience, I established a study area based on 4 factors:

1) Current use by the main portion of the Telkwa Herd;
2) Current use of animals whose movements include a larger area than the main herd;
3) Historic use (as described in chapter 8);
4) Availability of Forest Cover Data from British Columbia Ministry of Forests.

Also, habitat is not constant; e.g. areas of arboreal lichens are affected by timber harvest.

The study area is situated in west central British Columbia (B.C), east of the Coast range (Figure 1). The area is located between 53.40 and 55.20 north latitude and 125.10 to 128.30 west longitude (Figure 2), and comprises approximately 25,000 square kilometers, with elevations ranging from 300 – 3000 meters above sea level. Glaciers and rugged peaks, high alpine plateaus and deep u-shaped valleys with extensive wetlands characterize alpine areas. Biogeoclimatic zones (BGZ) in the study area are Permanent Icefields, Alpine Tundra, Engelmann Spruce - Subalpine Fir, Sub-boreal Spruce, Interior Cedar – Hemlock, Coastal Western Hemlock and Mountain Hemlock.

Arboreal lichens (*Alectoria sarmentosa* and *Bryoria spp.*) are abundant in old growth (> 120 years) forests throughout the study area; an important winter food source for caribou, in particular during years with high snowfall and/or hard crusted snowpack. Timber harvesting occurs throughout the study area, with clear-cut harvesting being the most common method.

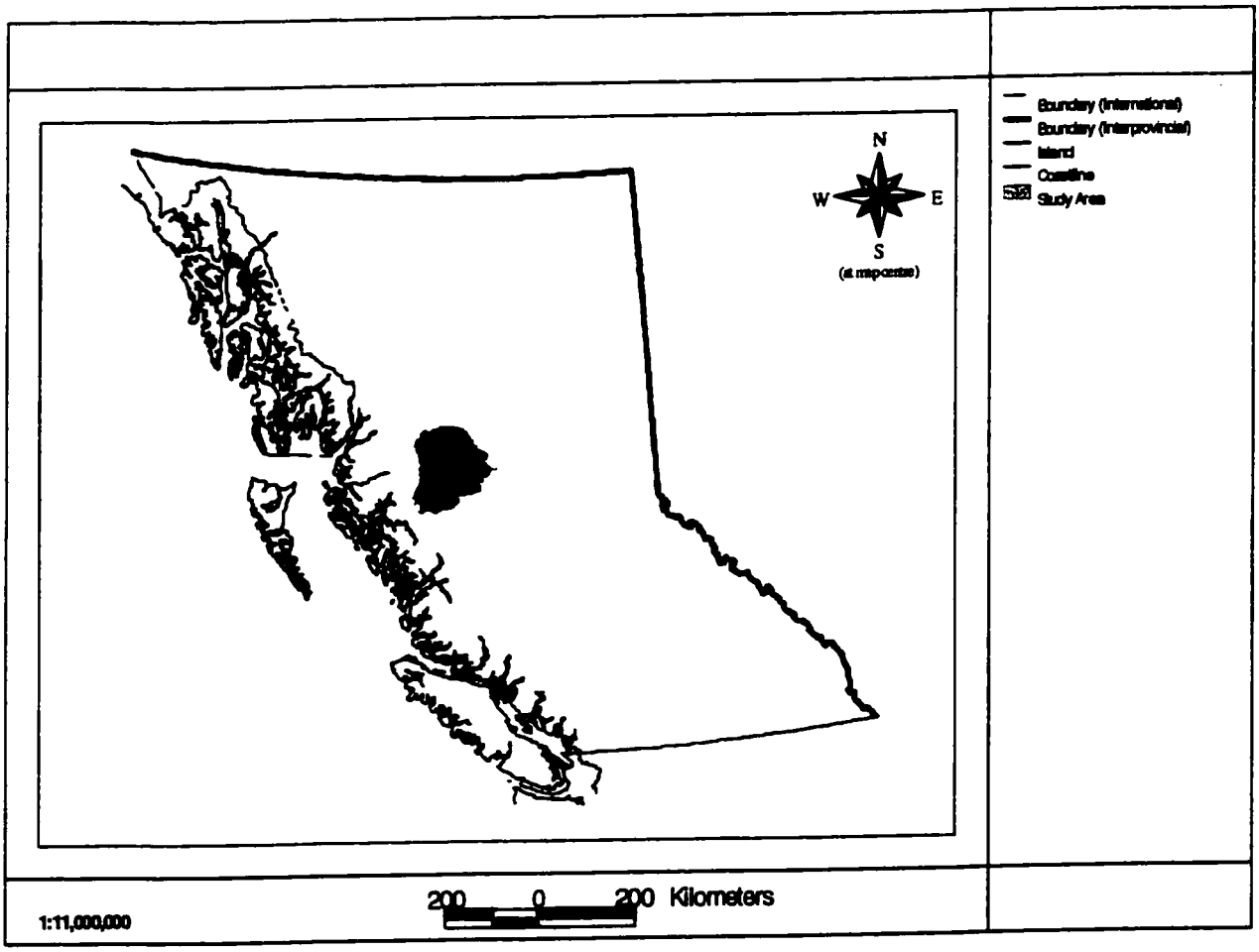

Figure 1. The study area in British Columbia, 1997 – 2000.

The climate has both coastal and inland influence, with cool summers and moderately cold winters; precipitation averaging 500 mm per year, of which about half falls as snow. Prevailing winds in the Bulkley Valley area are northwesterly in the summer, and south-easterly in the winter (G. Norton pers.comm.). I compared data from two snow stations within the study area (Hudson Bay Mountain west of Smithers, and McKendrick Creek between Smithers and Babine Lake) for January – June, 1972-1999 and 1968-1999

respectively. They indicate that 1997 and 1999 snow levels were higher than average, while 1998 was lower (Ministry of Environment, Lands & Parks, Water Branch, Skeena Region, Appendix 2).

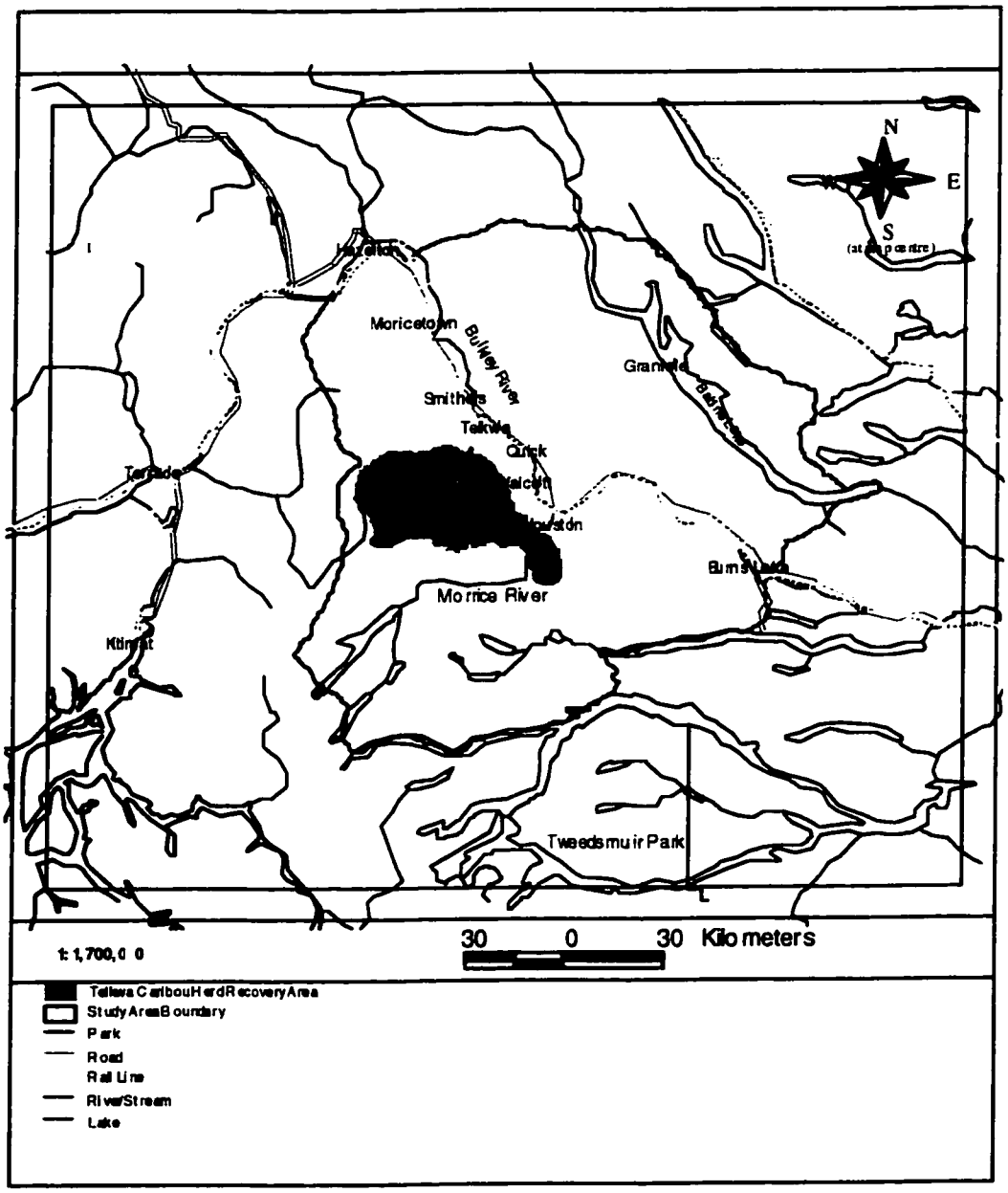

Figure 2. Study area, including the Telkwa Caribou Herd Recovery area, Telkwa Mountains, British Columbia 1997 – 2000

The Telkwa Mountains

The Telkwa range in the northwestern part of the study area comprises the core reintroduction area for the Telkwa Caribou Herd. These rolling alpine plateaux interspersed with high elevation wetlands represent prime caribou habitat.
The Telkwa Mountains have a population of about 250 mountain goats (van Drimmelen 1986 a). The Telkwa Caribou Herd is believed to have numbered around 300 animals in the early 1960s (van Drimmelen 1986 b, Skeena Wildlife Program 1997), but by 1968 this number had declined to 34 animals (van Drimmelen 1986 b). Lower elevation areas have populations of moose, mule deer (*Odocoileus hemionus hemionus*) and some elk (*Cervus elaphus*). Large predators within the range of the Telkwa Caribou herd include grizzly bears, black bears, wolverine, wolves, coyotes and golden eagles.

Prospecting activity in the early 1900s led to an extensive network of trails throughout the area, with centres of activity in the western and northeastern part of the Telkwa Mountains (Blix 1989). Together with forestry, mineral exploration expanded motorised access to these parts of the Telkwa Range. The railway line through the Bulkley Valley was opened in 1914. Increase in access enhanced hunting pressures on the Telkwa Caribou herd, which is believed to be an important factor in the decline of the herd throughout the 1960s and 1970s. A complete closure on hunting was implemented in 1973.

The proximity of caribou and goat populations only 15 km from the major transportation corridor through the Bulkley Valley makes these wildlife populations extremely valuable for recreational use (Telkwa Caribou Herd Recovery Team 1998).

This chapter has described the habitat of the Telkwa caribou, and the history of the herd prior to the transplant in 1997. Chapters 3 – 6 are based on data collected from November 1997 – April 2000.

LITERATURE CITED:

Blix, E., 1989. Trails to timberline in west central British Columbia. Fjelltur Books, Smithers, British Columbia.

Johnson, D.H., 1980. The comparison of usage and availability measurements for evaluating resource preference. Ecology, 61(1): 65-71.

Manley, B., L. McDonald and D. Thomas, 1993. Resource selection by animals. Statistical design and analysis for field studies. Chapman & Hall, London.

Skeena Wildlife Program, 1997. Telkwa Caribou Herd: A Transplant Proposal. Ministry of Environment, Lands & Parks, Skeena Region, Oct. 1997.

Telkwa Caribou Recovery Team, 1997. Telkwa Mountains Caribou Herd Recovery Plan. Ministry of Environment, Lands & Parks, Skeena Region, May 1998.

van Drimmelen, B, 1986(a). Telkwa Mountains Caribou Telemetry Project, Progress Report # 2. Unpublished report, BC Environment, Skeena Region.

van Drimmelen, B. 1986(b). Telkwa Mountains mountain goat inventory. Province of British Columbia, Ministry of Environment, Fish & Wildlife Branch Skeena Sub-region. August 1986.

PERSONAL COMMUNICATIONS:

Norton, G.; Smithers Flight Service Station

3.0 METHODOLOGY

In this chapter I describe methodology used for capture and collaring of calves, and monitoring of radiocollared animals. I also outline habitat variables measured, and statistical applications used.

Habitat use of the Telkwa Caribou Herd.

Twelve caribou were captured from the Sustut-Chase herd, radiocollared and translocated to the Telkwa Mountains in November 1997. Sixteen animals were translocated in October 1998, and four animals during February 1999. Of the thirty-two caribou four were immature bulls, one an immature cow and the rest adult cows. One resident radiocollared cow from a previous year was present. Relocations of collared animals have primarily been done within the study area. Attempts to follow animals moving out of the Telkwa Mountains have not been done on a regular basis. Radiocollared animals have been relocated throughout the year from fixed wing aircraft (Cessna 206, 185 or 172) using standard telemetry equipment. The relocation interval varied from every four days to every three weeks, depending on funding, season and weather conditions. Geographic location was determined using yoke-mounted, handheld, or panel-mounted Global Positioning System (GPS). Habitat characteristics, activity, group size, and presence of young were noted. The accuracy of relocation data is on average about $\pm$ 300 meters (pers. obs.). Most relocations were made in the morning or mid-day. For the purpose and scale of this study, these data are assumed representative of caribou habitat use for both day and night.

Survival of caribou calves

To assess the survival of calves in the Telkwa caribou herd, and obtain information on causes and timing of mortality, six calves were captured shortly after birth and equipped with radiocollars during the summer of 1999. The calves were monitored closely

throughout the summer and less frequently throughout the fall, to permit early detection of mortality. Investigation of mortality is usually required within a day, as cause of death can not be reliably determined otherwise (Adams et al. 1995 a).

Capture of Caribou Calves.– During the last week of May, fixed wing flights were carried out every second day to detect newborn calves. These surveys were carried out in areas where visual observation of cows and capture of calves, were possible. A helicopter flight was carried out on June 10, 1999 to assess reproductive status for collared cows based on presence of distended udders, hard antlers (Adams et al. 1995 a) and calves. A second flight was carried out on June 21 for those undetermined or not found during the first flight. The first observation of a cow with a calf was considered to be her calving site for that year. A helicopter flight was carried out early October, 1999 to determine the surviving cow-calf ratio for the herd. Caribou calves were captured as close to within 24 hours of birth as possible using a Bell 206 Jet Ranger and a Long Ranger helicopter, and a capture crew of 3 people. The helicopter landed as close to the cow and calf as possible, and the calf was chased on foot and captured by hand. When terrain prevented the helicopter from landing close to the animals, the capture crew was let out at the nearest suitable location. After handling, the calf was returned to the site where it was separated from its mother. In theory, this increases the chance of reunion as cows usually return to the area where separated from their calf (B. Hauer, pers. comm.).

Calves were handled using rubber gloves; after capture they were held down to the ground to reduce transfer of human scent from our clothes. Each calf was sexed and then weighed with an Accu-weigh tubular instrument scale #T-50 ($\pm$ 250g) (Dynamic Aqua-Supply Ltd., Surrey, B.C). Ages were estimated by assessing the presence/condition of umbilical cord, condition of hooves and pelage, posture, and general appearance. (Miller et al. 1988, Haugen and Speake 1958, Johnson 1951). Birth weight was calculated by subtracting 0.6 kg for each day of estimated age (Adams et al. 1995 b, Valkenburg and McNay 1997). Calf capture and mortality investigation data sheets are provided in Appendix 3. For weighing, each calf was placed on a clean flannel sheet and the four

corners hooked together onto the scales[1]. The purpose was to help minimise human odour on the calf and transfer of scent between calves, which may decrease the chance of successful reunion with the cow. Attempts were made to reduce handling to a minimum. Handling time was approximately 5 minutes from capture until release. Calves were fitted with VHF radiocollars (Lotek Engineering, Newmarket, Ontario) with motion sensitive mortality sensors. When no movement is registered after two-hours the sensor switches to mortality mode (doubled pulse rate). The collars are made from stretchable nylon material, have a section of canvas firehose sewn - in to allow the collars to eventually fall off before the calf grows to adult size; and plastic sleeves with unique colour combinations for each collar. Expansion folds with two sets of cotton stitches were sown in, intended to expand the circumference by 3 and 8 cm, respectively, as the seams disintegrate. The radio battery is guaranteed for a minimum of 38 months, and transmits on live-mode with a frequency of 60 signals/min., in mortality mode with 120 signals/min. The weight of a collar is approximately 250 grams.

Monitoring of Caribou Calves.-- Calves were monitored daily, as weather permitted, from a fixed wing aircraft (Cessna 206, 185 or 172) using standard telemetry techniques, from capture until the end of August. During September and October calves were monitored weekly, and after October calves were monitored as a part of the regular telemetry flights for the Telkwa Caribou Herd. Because I did not require information on calf habitat use, it was sufficient to obtain live signals without locating calves. This was done without low level overflights and therefore reduced disturbance to the animals.

Mortality Investigation.-- Mortalities were investigated as soon as possible by helicopter, on the same day the mortality signal was detected. After locating the carcass, the area was searched for tracks, scats or other signs. The scene and carcass was photographed and the carcass examined for obvious marks or injuries. One carcass was shipped to the Animal Health Centre laboratory in Abbotsford, B.C. for analysis. Two carcasses were analysed at the MELP laboratory in Smithers, B.C. Carcasses were

[1] There were problems keeping the calf inside the sheet, especially for vigorous calves; a sheet that could have been pulled together to form a sac may have worked better.

examined for external marks or injuries before being skinned. The inside of the skin and the body were then examined for puncture marks from teeth and claws. The stomach was checked for milk or vegetation. The membranes inside the skin were examined; dehydration will cause these membranes to dry out, and also make it more difficult to separate the skin from the body.

Analysis of data

Data collected from November 1997 – April 2000 were used for analysis, and divided into year and season based on movements of Telkwa caribou (Tables 1 and 2).

Table 1. Caribou seasons in the in Telkwa Mountains, British Columbia 1997 - 2000.

Date	Season
November 16th – April 15th	Winter
April 16th – May 15th	Spring
May 16th – September 15th	Summer
September 16th – November 15th	Fall

Table 2. The number of radiolocations per season. Telkwa Mountains, British Columbia 1997 – 2000.

Season	Season #	# locations
Winter 97-98	1	110
Spring 98	2	13
Summer 98	3	99
Fall 98	4	26
Winter 98-99	5	181
Spring 99	6	22
Summer 99	7	534
Fall 99	8	76
Winter 99-00	9	329

Independent variables considered for analysis of habitat suitability:

Table 3. Terrain and Forest Cover variables. Telkwa Mountains, British Columbia 1997 - 2000

Variable	Description
Elevation	Elevation above mean sea level
Slope	Slope in percent
Aspect	Aspect in azimuth measured from north
Curvature_75	Ruggedness/Curvature of cell (75 x 75 m)
Curvature_200	Ruggedness/Curvature of cell (200 x 200 m)
Habitat Type, consisting of: 1. Leading tree species, or 2. Non-productive descriptor	 Leading tree species in Forest Cover (FC) polygon Non-productive habitat in FC polygon
Crown closure	Percent crown closure in FC polygon
Tree age	Age of leading tree species in FC polygon

Data were analyzed by the MELP regional GIS data analyst. Data for elevation, slope, aspect and curvature were derived from a Digital Elevation Model (DEM) developed by Geographic Data BC from TRIM data using the GRID functions in Arc/INFO v7 software (Warren, 2000). Tiles from the DEM grid catalog were merged to form a seamless digital elevation model grid covering the study area. Floating point grids were generated for slope and aspect. For curvature, the original DEM was re-sampled using 75 m by 75 m and 200 m by 200 m cells (Warren 2000). The intent was to detect use of flat and gentle sloping terrain.

Data on leading tree species, crown closure, tree age and non-productive descriptor were derived from TRIM data using Forest Cover Polygons (Ministry of Forests, Inventory Branch, Victoria, scale 1: 20.000). Age is determined from the leading species (Ministry of Forests 1991). Non-productive descriptor is a classification code describing land, water or wetland that is incapable of supporting commercial forests (MOF 2000). For each variable, existing Forest Cover classes were grouped into new classes (Appendix 1),

such that new classes included one or more existing Forest Cover classes. Tiles from the Forest Cover library were extracted and clipped to the study area boundary (Warren 2000).

I followed sampling design 2 in Manly et al. (1993) where individual animals are identified and the use of resources is measured for each, but availability is measured at the population level. This approach assumes the animals identified are a random sample from the population. The Telkwa Herd is mostly relocated animals; and most of these animals are radiocollared. I assumed, therefore, that the animals identified are a random sample from the Telkwa Herd of relocated caribou.

Data for each terrain and habitat variable (Table 3) were found for all animal telemetry locations in the study area. Values for these variables (in km^2) were then summarized for the entire study area to determine percentage availability of the various classes of each variable (Appendix 1).

Statistical applications

Data for variables in Table 3 were analysed comparing use to availability, using Resource Selection for Windows (Leban 1999). Variable components were ordered by rank for usage and availability, which provides comparable results whether a questionable component is included or excluded in the analysis, and absolute statements about preference are avoided (Johnson 1980).

Some limitations to Johnson's (1980) test are listed by White and Garrott (1990):

1) The number of marked animals must be greater than the number of habitat types.
2) A large number of animals (> 30) is required to determine normality, which may be an assumption for some forms of analysis.
3) Each animal is compared as if sample sizes are identical, i.e. an animal with 10 relocations and one with 100 relocations receive equal weight.

During this study MELP staff and I monitored > 30 animals from 1997 – 2000, thus complying with the two first assumptions. The numbers of relocations, however, are not equal among study animals.

Rettie and McLoughlin (1999) also suggest that when the size of error area [$\pm$ 300 m average error for relocations] is independent of habitat patch size [Forest Cover polygons] this may lead to bias against habitat patches that typically occur in small patches. In this study, telemetry point data are linked to a set of cells (terrain features) and a set of polygons (Forest Cover), and there is likely a bias against detecting use of small patches of terrain and habitat. Using ranks also takes the possibility of this error into account. Other statistical applications were carried out using SPSS 10.0 (SPSS Inc. 1999).

LITERATURE CITED:

Adams, L. G., B. W. Dale, and L. D. Mech. 1995 a. Wolf predation on caribou calves in Denali National Park, Alaska. *In* L.N. Carbyn et al. (eds) Ecology and conservation of wolves in a changing world; proceedings of the second North American symposium on wolves. Canadian Circumpolar institute, University of Alberta, Edmonton.

Adams, F. J. Singer and B. W. Dale. 1995 b. Caribou calf mortality in Denali National Park, Alaska. Journal of Wildlife Management 59 (3): 584-594.

Haugen, A. O. And D. W. Speake, 1958. Determining age of young white tailed deer. Journal of Wildlife Management 22(3): 319-321.

Johnson, D. E. 1951. Biology of the elk calf, *Cervus canadensis nelsoni.* Journal of Wildlife Management 15 (4): 396- 409.

Leban, F. 1999. Resource Selection Analysis Software for Windows 95/NT Version 1.00 Beta 8.1 (8. Jan. 1999)

Manley, B., L. McDonald and D. Thomas, 1993. Resource selection by animals. Statistical design and analysis for field studies. Chapman & Hall, London.

Miller, F. L., 1988. Mortality of migratory barren-ground caribou on the calving grounds of the Beverly herd, Northwest Territories, 1981-83. Canadian Wildlife Service, Occasional Paper no. 66.

Ministry of Forests. 1991. Forest Inventory Manual, Chapter Three, Forest Classification. Ministry of Forests, Inventory Branch, Victoria.

Ministry of Forests. 2000. http://www.for.gov.bc.ca/resinv/reports/Rdd/search/txt/72.txt

Rettie, W. J., and P. D. McLoughlin, 1999. Overcoming radiotelemetry bias in habitat selection studies. Canadian Journal of Zoology. 77: 1175-1184.

Valkenburg, P. and M. McNay. 1997. Causes of calf mortality in the Delta caribou herd after wolf control. Unpublished paper.

Warren, J. 2000. GIS Support for the Telkwa Caribou Herd Recovery Project. Unpublished report, Ministry of Environment, Lands and Parks, Skeena Region.

White, G. C. and R. A. Garrott. 1990. Analysis of wildlife radio-tracking data. Academic Press, New York.

SPSS Inc., 1999. SPSS 10.0 (release 10.0.5, Nov 27th 1999).

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4.0 HABITAT USE BY REPRODUCTIVE AND BARREN CARIBOU COWS

In this chapter I compare elevations used by barren and reproductive caribou cows. I look at both calving time and the remainder of the year, and discuss results from other studies.

4.1 Background

Woodland caribou disperse widely (Rettie and Messier 1998), particularly in mountainous habitats, and during calving (Bergerud and Miller 1984, Cichowski 1993, Edmonds 1988, Edmonds and Smith 1991, Wood 1994). Bergerud and Miller (1984) suggested that "caribou seek high south slopes in mountains as calving locations as an antipredator tactic. By being dispersed in heterogeneous and rugged mountains and away from moose, they force wolves and bears to search large areas, reducing their capture success". As suggested by Seip (1992) one would expect dispersed migration of the Telkwa herd to high elevation areas to avoid large aggregations of caribou and reduce contact with wolves. Moose and wolves are more abundant in low elevation forests than in alpine habitats during summer (Seip 1992). Seip and Cichowski (1996) conclude that caribou aggregating on alpine plateaux for calving and summer range are fairly effective at avoiding predators, and attain the highest caribou population densities in B.C.

Edmonds and Smith (1991) observed that throughout June, cow/calf pairs were found primarily on moderate to steep slopes with southeast through south to west aspects. Edmonds and Bloomfield (1984) concluded that mountain caribou calving areas were not concentrated, but were instead isolated pockets of suitable habitat within an individual cow's summer range. They also suggested that "cows with calves may localise their activity in summer to maximise nutritional gains and minimise exposure to predators". Valkenburg and McNay (1997) observed that caribou neonates survive better in years when most calving occurred at higher elevations. Seip and Cichowski (1996) reported that in B.C., caribou populations with calving sites in alpine areas, islands, and rugged mountains experienced lower mortality and were generally stable or increasing. Also, in

west central B.C., radiocollared caribou calving in low elevation forest had very low calf survival, whereas caribou calving in alpine and subalpine habitats had higher calf survival. Cows frequently select calving sites with low vegetation cover, or sites where green-up has barely begun compared to lower elevations (Bergerud and Miller 1984, Edmonds and Smith 1991). This putative antipredator behaviour is carried out at the expense of the cow's nutritional needs. Bergerud and Miller (1984) concluded females with calves had to forego foraging in plant associations with high nutrient concentrations, and phytomass, and observed that "some of the females calved in areas that were mostly rock."

4.2 Objectives

In this part of the study I attempt to answer the following questions:

- Do pregnant females in the Telkwa Herd disperse in mountainous habitat during calving?
- Do reproductive cows select habitat different from barren cows during calving?
- If pregnant cows are found at higher elevations, is this attributed to calving, or do certain cows favour higher elevations on a year-round basis?

4.3 Hypotheses examined

The following hypotheses were examined:

Pregnant females choose calving sites in high elevation habitat.

Reproductive cows will be found at higher elevation than barren cows between May 25th and July 6th.

Caribou cows display a similar use of elevation throughout the year, excluding calving time.

Predictions:

Pregnant females will not migrate to lower elevation to take advantage of early spring growth in May.

Barren caribou cows will descend to lower elevations in May, and will be found at lower elevations than cows with calves during the period May 25th to July 6th.
There will be no difference in use of elevation between reproductive and barren cows outside calving time during 1999.

4.4 Results

To determine differences in habitat selection, locations were obtained for 8 cows with calves and 8 without calves during the summer of 1999. The summer habitat use of reproductive cows (n = 123 locations) and barren cows (n = 128 locations) were compared with habitat use throughout the year (n = 150 locations, and n = 145 locations, respectively), to account for differences not attributed to calving. Known calving times for Telkwa caribou range from May 26 (estimated from calf observed at a later date) until June 10 (Table 4). Most cows in the herd gave birth in alpine locations, in exposed areas free of snow. Some cows appeared to have given birth in higher elevation old growth forest, but as these calves were often first seen when several days old, there is less certainty in the cows' choices of calving location.

Table 4. Calving dates and calving habitat for 8 Telkwa caribou cows 1999.

Cow #	Calving date	Calving habitat	Comment
021	June 1st	Alpine	
032	June 7th	Alpine	
081	June 10th *	Forest	
151	June 7th *	Forest **	Calf several days old when first seen
251	June 3rd	Forest	
770	May 26th *	Alpine**	Calf approx. week old when first seen
256	June 7th	Forest	
870	June 3rd	Subalpine	

* Estimated ; based on calf size, mobility and appearance of hind legs.
** Observed close to alpine/forest division. As calves were several days old when first detected, calving habitat is not certain.

Cows 021 and 032 calved relatively close to each other. In the middle of June, cows 251 and 770 joined them, and the four cows and their calves remained together for at least two weeks, sometimes joined by barren cows. Although group compositions were more variable by early July, the four cows were frequently observed together.

Table 5 describes the use of elevation by barren and reproductive cows during 1999. Locations throughout the year are divided into two groups:

1) calving (May 25th – July 6th)
2) all-year (January 1st – May 24th, and July 7th – December 31st)

Analysis of variance (repeated measures, alpha = 0.05) within each group shows a significant difference in mean elevation during calving time and the rest of the year for barren cows but not for cows with calves. Analysis within each season shows a significant difference in mean elevation for calving time, but not for the rest of the year.

Table 5. Use of elevation[1] by barren- and reproductive cows during 1999. Telkwa Mountains, British Columbia.

Category	N	minimum (masl)	maximum (masl)	range	mean	variance
Barren cows, all-year	145	683	2001	1318	1669.4	29856.6
Barren cows during calving	128	683	1902	1229	1493.0	98388.5
Reprod. cows, all-year	150	580	2001	1421	1624.3	64670.8
Reprod. cows during calving	123	991	2062	1071	1623.7	94792.1

[1] 95 % confidence interval

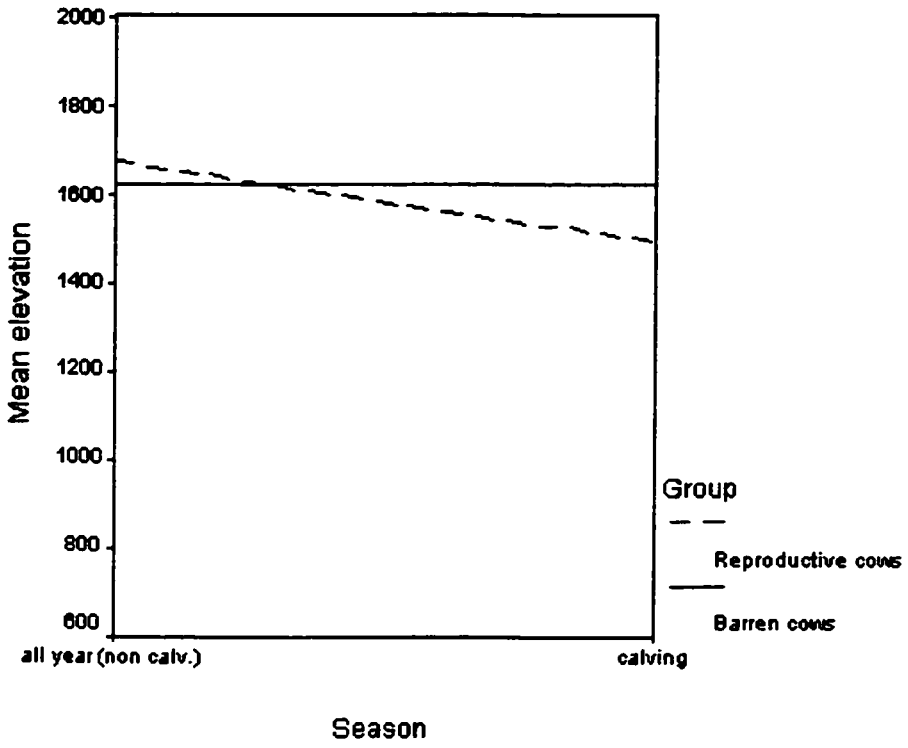

Figure 3. Mean elevation (masl.) for barren and reproductive cows during calving and the rest of the year, 1999. Telkwa Mountains, British Columbia.

Box plots describing the use of elevation for barren- and reproductive cows in 1999 are shown in Figure 4 - 7. The boxes represent the interquartile range containing 50% of the values, with a line showing the median value. Whiskers represent the highest and lowest values, excluding outliers (extreme values).

Examination of year-round habitat use (Figures 4 and 6) reveals little difference between barren and reproductive cows Most locations were obtained at or above 1600 masl. Of the 16 cows sampled, number 151 was the only cow to make extensive use of elevations below 1400 meters throughout the year.

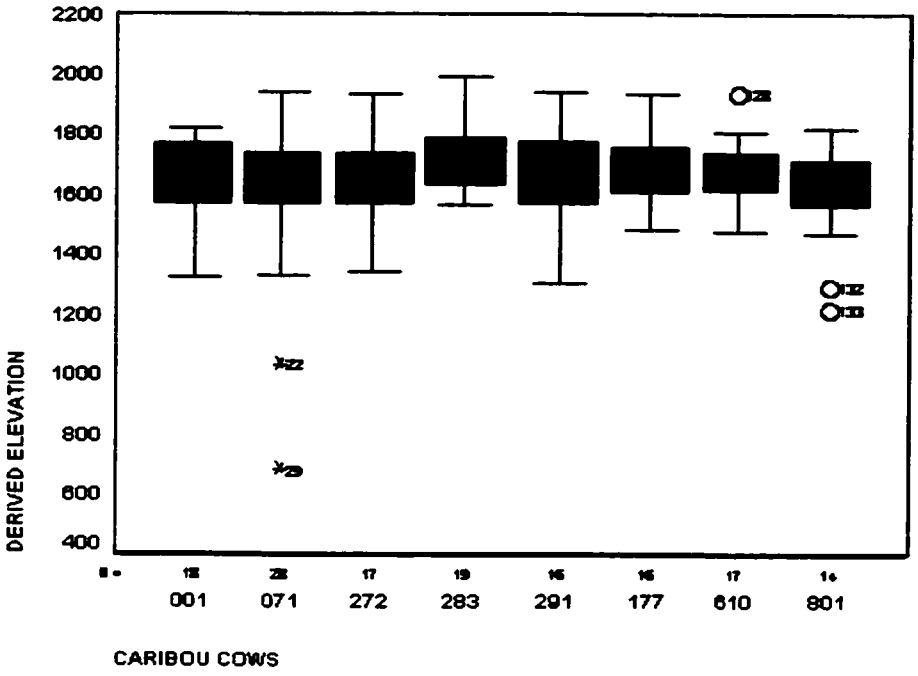

Figure 4. Barren cows use of elevation all-year, 1999. Telkwa Mountains, British Columbia

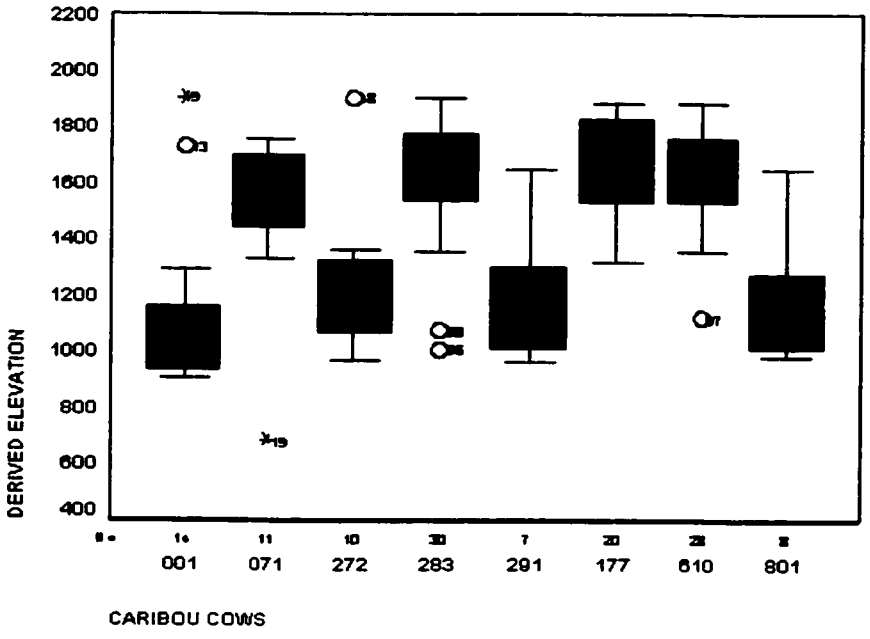

Figure 5. Barren cows use of elevation at calving time, 1999. Telkwa Mountains, British Columbia

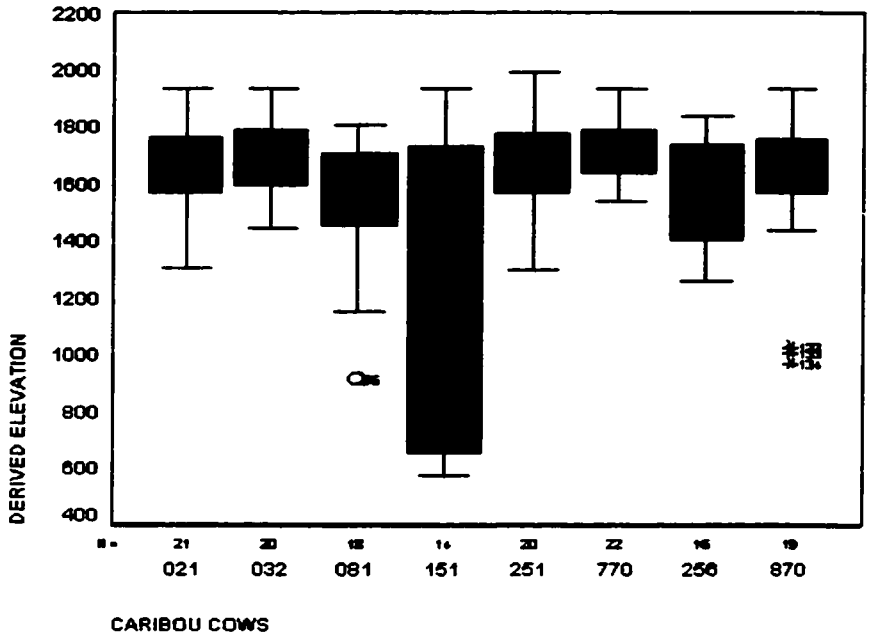

Figure 6. Reproductive cows use of elevation all-year, 1999. Telkwa Mountains, British Columbia

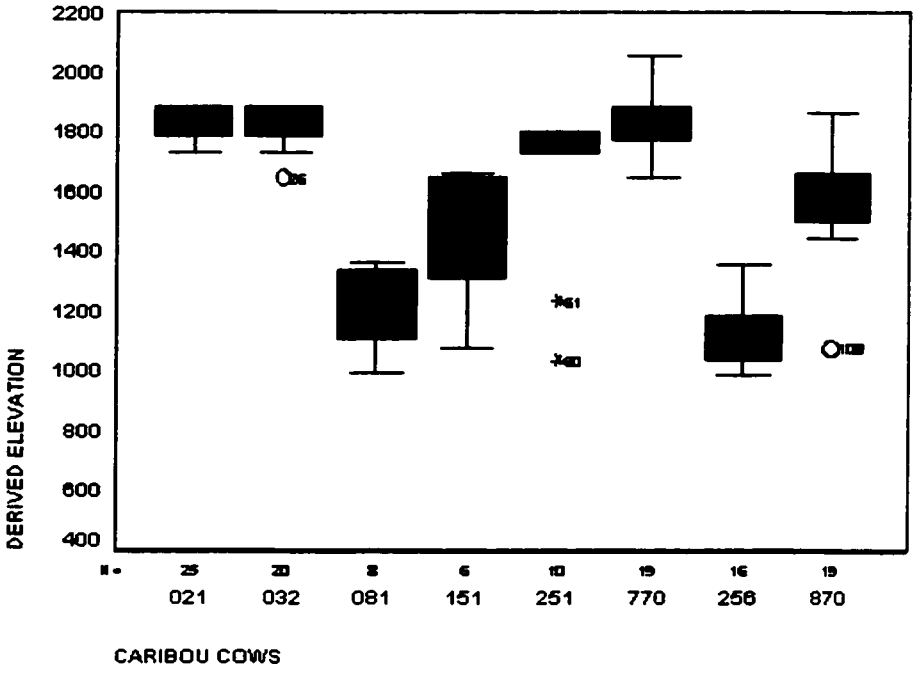

Figure 7. Reproductive cows use of elevation during calving time, 1999. Telkwa Mountains, British Columbia

There was no difference in mean elevation between calving time and the rest of the year (1624 masl.) for reproductive cows during 1999 (Table 4). Barren cows were found at a mean elevation of 1493 masl. during calving time, whereas the average was 1669 masl. throughout the rest of the year. Both reproductive and barren cows showed a narrower range in elevation during calving time than for the rest of the year (Figures 4 – 7), but both sample sizes are also smaller for this time period.

Comparing habitat use during calving with the rest of the year, both groups were found at the same maximum elevation throughout the year, whereas minimum elevation recorded was lower for reproductive cows than for barren cows (Table 5). Individual differences in elevation use are higher during calving than the remainder of the year (Figures 4 – 7). During calving, 4 of the 8 reproductive cows used a narrow band of habitat around 1800 masl. (Figure 6). These same 4 cows used lower elevations during the rest of the year (Figure 7).

4.5 Discussion

The calving time for Telkwa caribou is during early June and corresponds with that reported by Edmonds (1988) for woodland caribou in west central Alberta. She reported that calving time was earlier in a woodland population [calving in the forest] (26 May – 9 June) than in a mountain population [calving in the mountains] (4 June – 15 June). One calf appeared older that other calves when observed in early June (pers. obs). Based on physical appearance (Appendix 3) I estimated that the calf had been born May 26th. This is likely an early birth for the Telkwa Herd.

Though the number of births detected was small (n = 13), it appears that the Telkwa herd follows the same pattern as mountain caribou reported by Edmonds. Only one resident birth is dated (June 10th), and it was therefore not possible to determine potential differences in calving time between transplant and resident animals. Sample size also did not allow for a 1999 comparison between the two cohorts of transplants, where first year transplants would have been bred in the Telkwa Mountains and the second group at their original location by Sustut Lake.

Seip (1992), and Seip and Cichowski (1996) reported that adult caribou experience lower mortality rates at high elevations. Telkwa cows display similar habitat use throughout the year, with all cows remaining at high elevations. The difference between barren and reproductive cows during calving time may to some extent be due to calving. There are, however, wide differences within each group. As 4 of 8 barren cows remain at high elevations (and presumably forego nutritional opportunities, at least in spring/early summer), this could be an antipredator strategy employed regardless of reproductive status. Based on this study, possible antipredator tactics for protecting a calf can not be distinguished from those that cows seem to use for their own protection. The fact that we have had no predation of collared caribou during the past 3 years supports this hypothesis. However, caribou densities are low throughout the Telkwa Mountains. Caribou may thus be at relatively low risk regardless of elevation use.

Edmonds (1988) stated that "cows with calves in the forested habitat were found close (< 100 m) to open muskegs that had considerable amounts of standing water. This open habitat may improve the visual, auditory and olfactory detection of predators". The growing calf will depend more and more on vegetation and less on milk, which may require a wider search for suitable habitat to feed the two. Edmonds and Smith (1991) reported that cow/calf pairs localised their movements to relatively small geographic areas in early June (1-15) and did not substantially increase their ranges until after July. The Telkwa caribou displayed similar behaviour, as cow/calf pairs in the Telkwa Herd remained relatively stationary until the middle of July. Subsequently, some pairs made long distance movements. For example, one pair crossed the Telkwa River and walked north to Hankin Lake, a distance of more than 50 km over a few days. The pair later returned to the Telkwa Range.

Bergerud and Miller (1984) observed cows being extremely vigilant while in the mountains and, on two occasions, flushed at a distance of over 2 km. In two flights, females took their calves to higher and more rugged locations. Bergerud and Miller observed that calves had extreme difficulty ascending some slopes and two calves appeared to have broken legs. Cichowski (1993) suggested that undisturbed calving

habitat is important for calving success. The cautious behaviour of cows is likely strongest during the first couple of weeks of the calf's life. Some cows in the Telkwa herd appeared to be more sensitive during the first couple of weeks after calving, than during the rest of the year, as shown by their response to fixed-wing aircrafts (pers.obs.). However, individual cows showed a wide range of behaviour in this respect. Some cow/calf pairs appeared unaffected by the aircraft, whereas others moved away while the aircraft were at a relatively long distance.

Cichowski (1993) reported that during calving most adult females were found alone on ridge tops. Also, post-calving aggregations had formed by the end of June in the Itcha – Ilgachuz and Rainbow Mountains in west central B. C. Edmonds (1988) did not observe post-calving aggregations. In this study, cows 021 and 032 calved on the top of a rocky ridge east of Hunters' Basin, and cows 251 and 770 joined them in the middle of June. The ridge has a good overview of the surrounding area and few access points, but did not appear to have abundant food [I did not visit the ridge because of the high use by females and calves, but biophysical information suggests low potential for lichen production]. All four calves from these cows were found alive during the October survey.

Bergerud and Miller (1984) suggested that by remaining at high elevations females can look downslope to see an approaching terrestrial predator and have a retreat into more rugged terrain available. The use of this ridge seems to show a trade-off between predator avoidance and the availability of abundant high protein food. Cichowski (1993) suggested that low fecal nitrogen values during calving in early June indicated females migrated before new vegetation was available on the calving grounds.

Cichowski (1993) found that most calving sites were within 10 km of the previous year's calving site. Seip (1990) reported that many caribou used the same calving locations each year although others were located in quite different areas at calving time from one year to the next. Based on the limited data for Telkwa caribou, I can not analyse fidelity to calving areas within the Telkwa Herd. As most cows were transplanted it may take several years before this can be determined, because transplanted animals will require

time to explore their range. This is particularly so if environmental conditions are different from the original range in the Sustut area. Bergerud (1984) suggested that caribou use of calving areas might change from year to year, possibly as an antipredator strategy. Valkenburg et al. (1988) warned against making management decisions regarding caribou calving area based on those identified in a narrow time interval.

Although it is important to note calving areas observed to date, other sites should not be ignored, especially previously known calving areas used by the Telkwa herd (Chapter 8). It may take the transplanted animals some time to discover such areas, and dispersion of cows will probably increase with an expanding caribou herd.

In this chapter I have looked at elevation use of barren and reproductive caribou cows. I found that cows with calves use significantly higher elevations than barren cows during calving time. In chapter five I will examine the survival of caribou calves for 1999.

LITERATURE CITED:

Bergerud, A. T. and D. R. Miller. 1984. Antipredator tactics of calving caribou: dispersion in mountains. Canadian Journal of Zoology 62: 1566 – 1575.

Edmonds, E. J. 1988. Population status, distribution and movements of woodland caribou in west central Alberta. Canadian Journal of Zoology 66: 817-826.

Edmonds, E. J. and Bloomfield, M. I. 1984. A study of woodland caribou *(Rangifer tarandus caribou)* in west central Alberta, 1979 – 1983. Alberta Energy and Natural Resources, Fish and Wildlife Division.

Edmonds, E. J. and K. G. Smith. 1991. Mountain caribou calf production and survival, and calving and summer habitat use in west-central Alberta. Alberta Forestry, Lands and Wildlife, Fish and Wildlife Division. Wildlife Research Series No.4.

Cichowski, D. B. 1993. Seasonal movements, habitat use and winter feeding ecology of Woodland caribou in west-central British Columbia. Ministry of Forests, Research Branch, British Columbia. Land Management report No. 79.

Rettie, W. J. and F. Messier. 1998. Dynamics of woodland caribou populations at the southern limit of their range in Saskatchewan. Canadian Journal of Zoology 76: 251 – 259.

Seip, D. R., 1990. Ecology of woodland caribou in Wells Gray Provincial Park. Wildlife Bulletin No. B-68, March 1990. Ministry of Environment, Wildlife Branch, Victoria, British Columbia and Ministry of Parks, Kamloops, British Columbia.

----------, 1992. Factors limiting woodland caribou populations and their interrelationships with wolves and moose in southeastern British Columbia. Canadian Journal of Zoology 70: 1494-1503.

Seip, D.R. and D. B. Cichowski. 1996. Population Ecology of Caribou in British Columbia. Pages 73 – 80 *in* K. Brown et al.,editors. Rangifer, Special Issue No. 9, 1996. Proceedings of the Sixth North American Caribou Workshop. Prince George, British Columbia, Canada.

Valkenburg, P. and M. McNay, 1997. Causes of calf mortality in the Delta caribou herd after wolf control. Unpublished paper.

Valkenburg, P., J. L. Davis and D. J. Reed. 1988. Distribution of radio-collared caribou from the Delta and Yanert herds during calving. Pages 14 – 25 *in* R.D. Cameron and J. L. Davis, editors. Proceedings of the 3rd North American caribou Workshop, Cheena Hot Springs, Alaska 1987. Alaska Dep. of Fish and Game. Wildlife Tech. Bulletin No. 8.

Wood, M. D. 1994. Seasonal habitat use and movements of Woodland Caribou in the Omineca Mountains, North Central British Columbia, 1991 – 1993. Peace/Williston Fish and Wildlife Compensation Program Report No. 39.

5.0 SURVIVAL OF CARIBOU CALVES 1999

In this chapter I describe results from collaring of caribou calves during 1999. I also discuss overall calf production and calf survival in the Telkwa Caribou Herd.

5.1 Background

The Telkwa Caribou Herd Recovery Plan (TCHRP, 1998) identifies predation from wolves, grizzly and black bears, and wolverine as a potential liability for the Telkwa herd, with calves being especially at risk. Seip and Cichowski (1996) found about 40% of caribou cows lost their calves by the end of the calving period, and calf survival through the summer appeared to be related to the level of wolf predation, which is also a major cause of mortality after the initial neonatal period. Valkenburg and McNay (1997) observed that much of the calf predation on the Delta herd in Alaska occurred in mid to late summer.

Cows being transplanted to the Telkwa Mountains may influence calf survival. Cows with longer experience in the Telkwa Range will probably have more knowledge of their habitat, and assuming cows space away from each other during calving this knowledge may be difficult to acquire from more experienced animals. Possible differences in calf survival for cows newly arrived and those with at least one summer's experience may suggest some time is needed after transplants to establish successful reproduction in a new location. This could be of use for studies of other herds in a similar situation.

Miller et al. (1988) and Adams et al. (1995) found that most calf mortality occurred within the first week after birth; 97.6% and 85%, respectively. Most losses appear to occur during the first few days. Whitten et al. (1992) found 59-74% of mortalities during the first 2 days, and Miller et al. (1988) reported 77% within 3 days of birth. Rettie and Messier (1998) state that most calf mortalities occur during the first 4 – 6 weeks of life. The rapid detection of mortalities is necessary in order to determine causes of death. We conducted daily flights throughout the critical period of the first 6 weeks after birth. A

calf can be consumed in little time and clues to the cause of death thus quickly disappear. Predators moving a carcass prevent collars from entering mortality mode until some time after the death of a calf. Flights for monitoring calves were short as cows with young calves were not likely to move very much and it was sufficient to ensure live-signals were received without locating the calves every time.

5.2 Objectives

High calf mortality is a primary limiting factor that can slow or inhibit the recovery of the Telkwa Caribou Herd. The purpose of this part of the project, and collaring calves, is to answer these questions:

- when are calves lost?
- what is the cause of mortality?
- is calf mortality higher in certain types of habitat?
- are such habitats more frequently chosen by cows with less experience in the Telkwa range?
- do mortality rates differ with size of nursing groups?

5.3 Hypotheses examined

This study will attempt to test the following hypotheses:

Most caribou calf mortality occurs between June and October;

More caribou calf mortalities occur in forested habitat and at lower elevations;

A higher rate of calf loss is found for cows in their first year after transplant;

Larger group sizes will show greater frequency of predation than small group sizes.

Predictions:

There will be a decrease in the mortality rate for the calves that survive to the end of October.

Calves from cows giving birth and/or using higher elevation terrain throughout summer and early fall will experience lower mortality rates.

Calf survival for cows introduced in the Telkwa Range the winter of 1998/1999 will be lower than for the other cows.

Groups of only a few animals or single cow/calf pairs will show lower rates of predation than groups of several adults and calves.

5.4 Results

Six caribou calves were captured and collared in the period June 3rd – June 10th 1999. Five of these were bull calves, born to caribou transplanted to the Telkwa Mountains. The one female calf was born to the resident collared cow.

Table 6. Caribou calf capture data

Date	ID	Sex	Weight (kg)	Age est. (d)	Birthweight est.	Comment
1/6/99	591	M	10.0	1	9.4	
3/6/99	500	M	10.5	3	8.7	
3/6/99	580	M	10.5	3	8.7	Mortality June 7th, abandoned
7/6/99	529	M	9.8	1	9.2	
10/6/99	700	M	6.9	< 1	6.9	Mortality June 10th, avian predation
10/6/99	221	F	8.0*	1	7.4**	Mortality June 12th, unknown

* Weighed at necropsy

** Estimated from necropsy weight

Average birth weight (estimated as described in Methodology) for the captured calves were 8.4 kg, ranging from 6.9 – 9.4 kg (Table 6).

Causes of mortality

Three of the six calves captured died shortly after birth (Table 6). The other three calves were alive, still carrying their collars and following their mothers as of April 2000.

Calf # 580 appears to have died following abandonment. This calf followed the capture crew around after being collared. He was estimated at 3 days old at the time of capture (table 4). The second calf (# 221) did not want anything to do with the capture team; she

struggled vigorously (enough to prevent us from weighing her) and ran away and joined her mother immediately after release. The cow and calf were last seen together from the helicopter, a few minutes after completing the capture work. No visual observations were made during telemetry the next day, but the cow and calf were located in the same area. The following day a mortality signal was heard from the calf. Adult tracks were found circling the carcass, likely made by the mother.

The membranes inside the hide of both calves appeared dry, indicating dehydration. Calf # 221 had a few remains of what appeared to be milk curds (from nursing) in the stomach, as well as small amounts of vegetation. There were no sign of predation or scavenging on these animals, except small microtine chewing marks on the head and front leg of # 221.

Calf # 700 was found dead and partly eaten, with internal organs removed. Necropsy showed the skin has been pierced in at least two places from what appeared to be talons. From these marks, and the way the meat had been torn off the carcass, the cause of death seems to have been avian predation, most likely golden eagle. This calf did also follow the capture crew after release. Although it is likely eagle predation, it is possible that the primary cause of death was abandonment, or that the cow had not yet returned. An eagle may not have successfully attacked if the calf was under / near its mother.

Overall calf production and survival

Altogether 12 calves were counted in the summer of 1999. In addition, a cow was seen with extended udder, indicating she recently had given birth and lost her calf. Lent (1964) however observed yearlings nursing. This cow appeared to be accompanied by a yearling, which may explain the presence of an extended udder. Three of the calves died as described above, leaving 9 known calves in the herd. Some calves were too mobile to attempt capture when first seen. Others were found in forested habitat, preventing the landing of a helicopter at or near the site. Visual observations of these calves were attempted on telemetry flights and during fieldwork on the ground.

A calf survival survey was carried out in October; of the 9 calves 8 were found alive. Of the 13 calves estimated born this summer, three were born to resident cows (of which one is collared), two to the 10 cows from the first transplant, and the remaining 8 to the 20 cows from the last transplant.

The previous summer we observed only 5 calves in the Telkwa herd. Two of these were born to resident cows (without collars), the remaining three from transplanted cows. During the first transplant (November 1997), samples were taken from the captured cows to determine progesterone level and hereby determine pregnancy rate. The results from the test were not clear in showing pregnancy (H. Schwantje pers.comm.). As transplants the following year were done in October, which is even closer to the end of the mating season (and earlier in a pregnancy), samples were not taken at that time. In the spring and summer of 1999 at least one yearling calf was seen, indicating at least one calf from 1998 had survived.

5.5 Discussion

Causes of mortality

Calves disappearing in the first few days after birth may die due to failure to thrive (poor condition of calf or cow), abandonment, accident, severe weather at time of birth (exposure) or predation (Edmonds and Smith, 1991) or still birth (S. Sharpe pers. comm.). It is possible that calves were lost before we could detect them, causing calf mortality to be underestimated. Bergerud (1980) states that "the adult sex ratio for North American caribou is normally weighed to females. This imbalance occurs even though the sex ratio at birth favors males. The differential mortality of males commences at approximately 4 years of age and the disparity increases with age". The small sample size of calves collared and the obvious impact of collaring on mortality precludes analysis of possible causes of calf mortality for the Telkwa herd and analysis of potential sex related bias in mortality. Data suggests that the sex ratio at birth favour male calves. The data also indicate that avian predation could be a factor, especially for small calves

separated from their mothers. Lavigueuer and Barrette (1992) found captive caribou calves had an average birth weight of 9.4 $\pm$0.7 kg for males and 7.8 $\pm$1.5 kg for females. Weights for Telkwa calves fit well with these numbers, averaging 8.4 kg. The calf killed weighed only 6.9 kg.

At least one of six calves appears to have been abandoned by the mother. Although difficult to determine, the capture and collaring may have contributed to abandonment. The two calves (# 580 and # 700) following the capture crew after release may indicate a strong bond between cow and calf was not yet established. Lent (1964) reported that the first nursing may be delayed until the second hour or later, though his suggestion was to allow at least one half hour for bonding before capture and handling. He also states "Although the cow-calf bond starts to develop almost immediately it does not reach maximum strength for the cow for at least some hours and for the calf, not for days". If the age estimate of 3 days old at time of capture, for the first calf, is right, this should be enough time for a bond to be established. Alternatively, the bond may not have developed as usual, in which case our disturbance made the situation more difficult. As a last possibility, there may have been a good bond between the calf and cow, and our presence, handling and scent may have been enough to break it. The high sensitivity of caribou, particularly females with calves, to disturbance may have over-ridden the instinct to rejoin the calf quickly after collaring.

The second calf (# 221), which was hard to capture, difficult to hang on to and immediately joined her mother upon release, seemed to have already established a strong bond with the cow. The tracks circling the carcass and the two animals running away together after collaring suggest the cow still tolerated its presence. Lavigueur and Barrette (1992) observed captive caribou calves first ingesting solid food at 3- 10 days age of age, but conclude that during their first 45 days calves subsist almost entirely on milk, as feeding on solids seemed to be negligible during this period. The mixture of vegetation and what appeared to be milk curds in the calf's stomach may therefore indicate the calf was for some reason not getting adequate milk.

Seip (1991) indicated that caribou are extremely vulnerable to wolf predation compared to most other ungulate species. They are unable to fight off predators in the same way as moose, they do not use escape terrain like mountain sheep and mountain goats, and have a low reproductive rate compared to most other ungulates, such as deer. Therefore, caribou populations are usually the most vulnerable species in multiple prey-predator systems.

It is unlikely that the Telkwa herd has been a significant food source for any species of predator over the past years. Predators would therefore have to concentrate on other species, likely in other areas. Haber (1977, in Bergerud (1980)) and Seip (1995) proposed that predator-prey systems may exhibit more than one equilibrium point; and at densities immediately above the lowest equilibrium point there exists a "predator pit". With other prey species able to sustain a high predator population, predators could potentially keep this population in the pit. The significance of predation could change with growing numbers of caribou. With more calves being born, predators could benefit from concentrating their searching on caribou calving areas. However, Seip (1995) argues that though multiple equilibrium systems are possible, there is no compelling evidence that they are common in wolf-prey systems, and further that single predator-prey equilibrium systems generally apply, with a wide range of potential wolf and prey densities.

Overall calf production and survival

Davis et al. (1988) found average mortality rates in the Delta Herd (Alaska) for calves 0-5 months to be 56 %, while it had dropped to 5.5 % for those 5-12 months old. Seip (1990) reported that after calving in June, 58 % of radiocollared adult female caribou in Wells Grey Provincial Park had surviving calves; by October the number had dropped to 37%. Seip and Cichowski (1996) noted during post-calving surveys in late June, that calves accompanied only 50 – 64% of females. Of the 9 Telkwa calves (excluding neonatal mortality), 8 were still alive in October, which is a high survival rate. Davis et al. (1988) also reported mortality rates to be higher for males than for females, within all

cohorts. It is not possible to say if this is also the case for the Telkwa Herd. Of the 5 calves from 1998, at least one was alive early summer of 1998.

Although survival rates are lower for 1998, these sample sizes do not allow for a meaningful estimate of survival rates. Rather, calf data from November 1998- April 2000 seem to indicate that low production is a factor of equal or higher importance than the loss of calves. If the low number of calves were due to calf loss, a higher frequency of caribou cows with extended udders but without calves would be expected. Barren females commonly shed their antlers in March and April whereas pregnant females shed their antlers near calving in May and June (Bergerud 1980). During calving surveys many cows exhibited fresh antler growth. The amount of growth at this time indicated the old antlers were shed before the onset of calving.

Edmonds and Smith (1991) found that low percentage of calves in fall/early winter composition counts were associated with a previous severe winter or late spring. There is no indication that the winter of 1998-1999 had been particularly difficult in the Telkwa Range. Caribou usually give birth to one calf, although twinning may occur (Banfield 1974, Seip, 1990). Lent (1964) observed behaviour that suggest cows might adopt calves, but could not determine if this actually happened. Reported pregnancy rates[2] for caribou range from 82% (Bergerud 1980) to over 90 % (Edmonds and Smith 1991, Rettie and Messier 1998, Seip 1990, Seip and Cichowski 1996) with birth rates at 86% (Bergerud 1980, Rettie and Messier 1998). The animals brought in from other herds are expected to show pregnancy rates comparable to that of other caribou populations when they arrive in the fall. Bergerud (1980) stated that the high natality rates of North American animals indicates that fetal resorbtion is not a major concern. Commonly the nutritional stress for caribou comes in late winter when fetuses are well developed and not subject to resorption. Transplants were carried out in October and November; early in the pregnancy. It is possible that stress related to capture, immobilization drugging

[2] Bergerud (1980) for cows > 2 ½ years; Edmonds as Smith (1991) for cows > 2 years; Rettie and Messier (1998) with yearlings included; Seip (1990) and Seip and Cichowski (1996) not specified.

and transplant may have caused abortions. It is also possible that a large number of the cows selected were not pregnant.

There may not have been enough bulls to achieve normal pregnancy rates for the Telkwa herd over the past years. The number of bulls in the herd, mature animals in particular, is not known. No mature males were collared, making it difficult to count the number of bulls. As animals can travel long distances in a short time it is not reliable to observe bulls in different locations on telemetry flights made several days apart. During the rut in October 1999, at least three mature bulls were observed in the Telkwa Mountains. In addition, at least four immature bulls were seen. At least three of the calves of the year are bulls. The ratio of bulls to cows during fall 1999 seems sufficient to ensure a normal pregnancy rate, in particular as most caribou were associated in herds including at least one mature bull.

As transplanted animals arrived after the rut of 1997, the presence of two calves from resident cows in summer 1998 indicates that the herd still had sufficient mature bulls for breeding females.

Capture and collaring of caribou calves

Capturing and/or collaring of newborn caribou calves is always done with the risk of abandonment by the cow. It is a trade-off between caribou's superiority in speed at a few days of age, and the time needed to establish a bond between cow and calf strong enough to withstand interference. More time given increases the chance that the bond is strong and viable, but in only a few days the calf can outrun a human.

Calves collared during this study were usually detected in the morning, and we then returned a few hours later to capture the calf. Telemetry flights were carried out every second day until the first calf was collared, so some calves were older than others when captured. It is also likely that calves went undetected on some survey flights.
We had less trouble getting hold of calves than expected, and more abandoned calves.

Although few calves were handled, this could indicate that we were too early, and should have given cow-calf pairs more time for bonding. However, of the six, there were young calves who survived and older calves (at time of capture) that did not. The cows may differ in their commitment to their calves, and only a study of the same cows over several years, which is beyond the scope of this project, could help resolve this uncertainty.

Lavigueuer and Barrette (1992) found that male calves grew faster than female calves during the first 45 days, although Lent (1964) found no significant difference between the sexes for 32 new-born barren ground caribou. Davis et al. (1988) avoided the collaring of male calves, after expendable collars were found unsuccessful in compensating for the greater developments in their necks from calf to adult. In Chapter 9 on Management Recommendations, suggestions are made for changes in capture practices that may decrease the chance of abandonment. Although we can lower the chances of abandonment, we can never eliminate it due to the sensitivity of caribou to disturbance.

Davis et al. (1988) noted that serial calf:cow ratios measure only relative change in the proportion of calves, so they are only an index of the rate of calf mortality. Determining the actual mortality rate of calves requires ascertaining the change in absolute numbers of calves overtime. The collaring and close monitoring of calves, with the ability of getting to the carcass quickly after death, is the only way at present to determine the cause of death for caribou calves. Calves are so small that their carcasses soon disappear, and without radiotelemetry calf carcasses would be extremely difficult to find.

Estimating age of a caribou calf

As shown in appendix 3, estimating the age of a calf is based on several variables. Some are less reliable than others:

- condition of pelage is likely influenced by environmental conditions; calves born in drier and more windy areas will dry faster;
- the dryness of the umbilical cord may to some degree reflect moisture and wind
- degree of hoof wear is likely higher for calves born in rocky, rugged terrain than

the hoof wear found on calves born on softer ground. Some calves may also move more than others at the same age, and if the calf moves on rocky ground this could cause an overestimate of the calf's age.

The appearance of the body; size of head; wobbliness and the presence of an umbilical cord are likely more reliable factors for determining age, especially where calving areas are subject to variation in environmental condition.

In this chapter I have discussed the results from collaring of caribou calves during the summer of 1999, as well as overall calf production and survival for the Telkwa Caribou Herd.

LITERATURE CITED

Adams, L. G., F. J. Singer and B. W. Dale, 1995 b. Caribou calf mortality in Denali National Park, Alaska Journal of Wildlife. Management 59 (3): 584-594.

Bergerud, A. T. 1980. A review of the population dynamics of caribou and wild reindeer in North America. Pages 556 – 581 *in* Reimers, E. Gaare, E. and Skjenneberg, S. editors. Proceedings, 2nd International Reindeer/Caribou Symposium, Roros, Norway. Direktoratet for vilt og ferskvannsfisk, Trondheim.

Banfield, A .W. F. 1974. The Mammals of Canada. National Museum of Natural Sciences, University of Toronto Press.

Edmonds, E. J. and K. G. Smith. 1991. Mountain caribou calf production and survival, and calving and summer habitat use in west-central Alberta. Alberta Forestry, Lands and Wildlife, Fish and Wildlife Division. Wildlife Research Series No.4.

Davis, J. L, P. Valkenburg, P., and D.J. Reed, 1988. Mortality of Delta Herd Caribou to 24 months of age. Pages. 38 – 51 *in* R.D. Cameron and J. L. Davis, editors. Proceedings of the 3rd North American caribou Workshop, Cheena Hot Springs, Alaska 1987. Alaska Dep. of Fish and Game. Wildlife Technical. Bulletin No. 8.

Lavigueuer, L. and C. Barrette. 1992. Suckling, weaning and growth in captive woodland caribou. Canadian Journal of Zoology 70: 1753 – 1766.

Lent, P.C. 1964. Calving and related social behaviour in the barren-ground caribou. Dissertation, Department of Zoology, Univ. of Alberta, April 1964.

Miller, F. L., E. Broughton and A. Gunn. 1988. Mortality of migratory barren-ground caribou on the calving grounds of the Beverly herd, Northwest Territories, 1981-83. Canadian Wildlife Service, Occasional Paper no. 66.

Rettie, W.J. and F. Messier. 1998. Dynamics of woodland caribou populations at the southern limit of their range in Saskatchewan. Canadian Journal of Zoology 76: 251 – 259.

Seip, D. R., 1990. Ecology of woodland caribou in Wells Gray Provincial Park. Wildlife Bulletin No. B-68, March 1990. Ministry of Environment, Wildlife Branch, Victoria, British Columbia and Min. of Parks, Kamloops, British Columbia.

----------, 1991. Predation and caribou populations. Pages 46 – 52 *in* Rangifer, Special Issue No. 7, 1991.

----------, 1995. Introduction to Wolf – Prey Interactions. *in* Carbyn, L. N., S. H. Fritts and D. R. Seip, editors. Ecology and Conservation of Wolves in a Changing World. Canadian Circumpolar Institute, Occasional Publication No. 35. 620 pp.

Seip, D.R. and D. B. Cichowski. 1996. Population Ecology of Caribou in British Columbia.Pages 73 – 80 *in* K. Brown et al., editors Rangifer, Special Issue No. 9, 1996. Proceedings of the Sixth North American Caribou Workshop. Prince George, British Columbia, Canada.

Telkwa Caribou Herd Recovery Plan. 1998. Telkwa Caribou Herd Recovery Team, BC Environment, Skeena Region. August 1998 (revised).

Valkenburg, P. and M. McNay, 1997. Causes of calf mortality in the Delta caribou herd after wolf control. Unpublished paper.

Whitten, K., G.W. Garner, F.J. Mauer and R.B. Harris 1992. Productivity and early calf survival in the Porcupine caribou herd. Journal of Wildlife Management 56 (2): 201-212.

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6.0 HABITAT SUITABILITY FOR THE TELKWA CARIBOU HERD (1997 – 2000) BASED ON RANKS

This chapter outlines the study of habitat use during 1998 - 2000. I discuss advantages and limitations in using ranks to determine habitat suitability, habitat selection by the Telkwa caribou in comparison with other herds, and threats to woodland caribou. A habitat suitability map suggests the value of various parts of the study area to caribou.

6.1 Background

Rettie and Messier (1998) stated that if predation on calves and adults is the proximate limiting factor of a caribou population, then the ultimate cause likely relates to long-term habitat alteration. Although their study was based in Saskatchewan, woodland caribou populations in west-central British Columbia are likely to be in a similar situation. According to Seip (1991), forest-dwelling caribou have declined or been eliminated from large parts of their historic range in northern Ontario, Saskatchewan, Alberta and non-mountainous regions of British Columbia. Low densities are common for remnant caribou herds (0.03/km^2), but many are continuing to decline to extinction.

Seip and Cichowski (1996) suggested that current stable caribou populations should be able to maintain their densities, as long as predator avoidance strategies are not further disrupted by human- or other factors. They also argued that forest harvesting practices that produce a patchwork of different forest age classes, linked with a network of roads, may contain enough lichens to support a caribou herd, but probably will not provide an environment where caribou can effectively avoid predators and poachers. Consequently, caribou habitat management practices should provide a perpetual supply of large, contiguous areas of suitable summer and winter habitat, with little or no vehicle access and disturbance. Caribou can thus remain at low densities to avoid predators and poachers. Despite similarities between woodland caribou populations in Canada, behaviour is diverse, particularly seasonal movements and habitat use (Edmonds and Bloomfield 1984). Antifeau (1998) contends information is lacking on the amount and

spatial distribution of suitable habitat required to support caribou presently and for long-term viability. He also suggests that mapping use areas does not readily indicate relative importance of different habitat types; unless compared with availability. When resources are used disproportionately to availability, use is said to be selective (Johnson 1980, Manly et al. 1993, Alldredge et al. 1998, Morrison et al. 1998). The need for documenting resource use and availability is especially critical in efforts to preserve endangered species and manage exploited populations (Manly et al. 1993). However, what biologists determine as available habitat and what animals perceive as available habitat may be different (White and Garrott 1990). Determining available habitat for the newly relocated Telkwa caribou is difficult (see Chapter 2, Study Area). Methods based on ranks are preferred when use and availability are poorly estimated and are less sensitive to the inclusion or exclusion of a questionable resource (Johnson 1980; Alldredge and Ratti 1986,1992; Alldredge et al. 1998; White and Garrott 1990).

6.2 Objectives

The objectives of this part of the study are to answer the following questions:

- What habitat characteristics/terrain variables do Telkwa caribou select for?
- Does habitat selection vary among seasons?
- Are there differences in habitat selection among years?

6.3 Hypothesis examined

The basis for this study is the hypothesis:

Telkwa caribou will show selection (i.e. use exceeds availability) for certain habitat characteristics/terrain variables within areas currently occupied. Animals dispersing into surrounding areas will show a similar selection of habitat.

Predictions:

From habitat selection by the current Telkwa Caribou Herd, we can predict which areas will be valuable in the surrounding area; for a larger herd and/or a shift in range. With

knowledge of high suitability caribou habitat, and the linkages between such areas, herd managers can work towards maximising habitat availability for caribou when land use decisions are made.

6.4 Results

Alldredge and Ratti (1986, 1992) recommended using a minimum of 50 relocations from $\geq$ 20 animals, and limiting the number of habitats considered. Grouping all data from 1998 – 2000, I have 24 animals with $\geq$ 30 relocations, which were used for the analyses. Thomas and Taylor (1990) and Alldredge et al. (1998) advised against pooling data across individuals, because "without pooling observations, then one may observe that individual selection for resource 1 is more variable than for resource 2, so the latter may be a more critical resource to manage" (Thomas and Taylor 1990). For these reasons I had insufficient data to examine differences among years or seasons and was unable to withhold some data for testing the fit of the model.

All variables were analysed (Table 3, Chapter 3). For some variables, there were singular matrices in the Resource Selection Function. This occurs where rank use is the same as rank availability for every animal in a given habitat (Alldredge et al. 1998), or when there are a very large number of potential solutions (Bowyer et al. 1988), such as variables with too many classes relative to the number of data. For some variables this problem persisted beyond the point of which classes could be collapsed and still be meaningful; these variables were therefore not used. These classes were crown closure and habitat class. For the same reason I was unable to do Multiway Frequency Analysis (Tabachnick and Fidell 1996) or do a test of associations (Cramer 1994) between variables.

Data on curvature (terrain ruggedness) were discarded, as the measurements were not reliable (I frequently observed animals using areas near, but not in rugged terrain). An error of up to 300m for relocation data was therefore not acceptable. So that all slopes of a certain degree would be treated similar, regardless of elevation, I created a class combining elevation and slope.

Table 7. Use, availability and rank of classes for elevation/slope. N = 1424

elevation (m)	slope (%)	class	# locations	% use	% available	rank
< 1100	0 – 15	A	116	8.15	38.43	9
< 1100	16 – 45	B	38	2.67	20.75	8
< 1100	> 45	C	4	0.28	6.40	7
1100 – 1700	0 – 15	D	166	11.66	17.98	6
1100 – 1700	16 – 45	E	303	21.28	9.71	4
1100 – 1700	> 45	F	168	11.80	3.00	5
> 1700	0 – 15	G	144	10.11	2.18	3
> 1700	16 – 45	H	313	21.98	1.18	1
> 1700	> 45	I	172	12.08	0.36	2

Table 8. Use, availability and rank of classes for forest age. N = 405[1]

forest age (years)	class	# locations	% use	% available	rank
1 – 40	A	18	1.26	8.47	4
41 – 100	B	84	5.90	17.82	3
101 – 140	C	105	7.37	14.85	2
141 – 250	D	161	11.31	24.60	5
> 250	E	37	2.53	7.08	1

Table 9. Use, availability and rank of classes for aspect. N = 1416[2]

aspect (azimuth)	class	# locations	% use	% available	rank
136 – 315	A	627	44.03	47.24	1
316 - 135	B	789	55.41	48.23	2

The habitat suitability map applies the ranking of these variables to the study area, showing predicted habitat suitability for the Telkwa herd. Table 8 suggests that the Telkwa Caribou Herd use high elevation habitat at moderate slopes more often than other slope / elevations. In addition to the rolling alpine plateaux in the Telkwa Mountains,

[1] Tree line goes below 1700 masl.
[2] Areas of zero aspect (e.g. water) are excluded.

caribou make extensive use of the steep rugged mountains. Low elevation with gentle slopes is the class with highest availability, making up more than 30 % of the study area. When studying habitat selection in the Telkwa Mountain area, it is important to keep in mind that caribou have already made a significant selection of habitat by remaining in the mountains.

Less than 1/3 of locations (405 of 1424) were obtained in forested habitats (Table 9). Whereas certain animals made extensive use of forest, most spent their time above the tree line. Caribou in forested habitat mostly use forests >100 years, but appear to select forests > 250 years of age. Data points with zero aspect were excluded from the analysis. The rank values for aspect appear to contradict the information on use versus availability. However, data on use only report percentage of overall use (Table 9). Taking behaviour of individuals into account, the difference between use and availability were lowest for class A, giving it the highest rank.

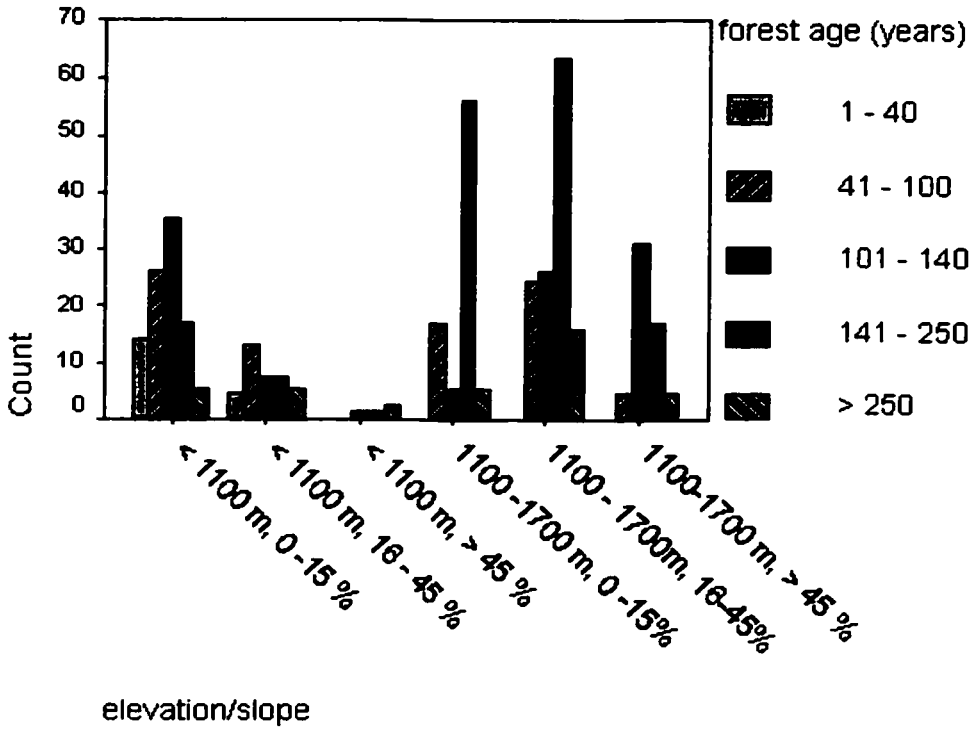


Figure 8. Distribution of forest age classes on elevation/slope, Telkwa Mountains, British Columbia 1997 – 2000.

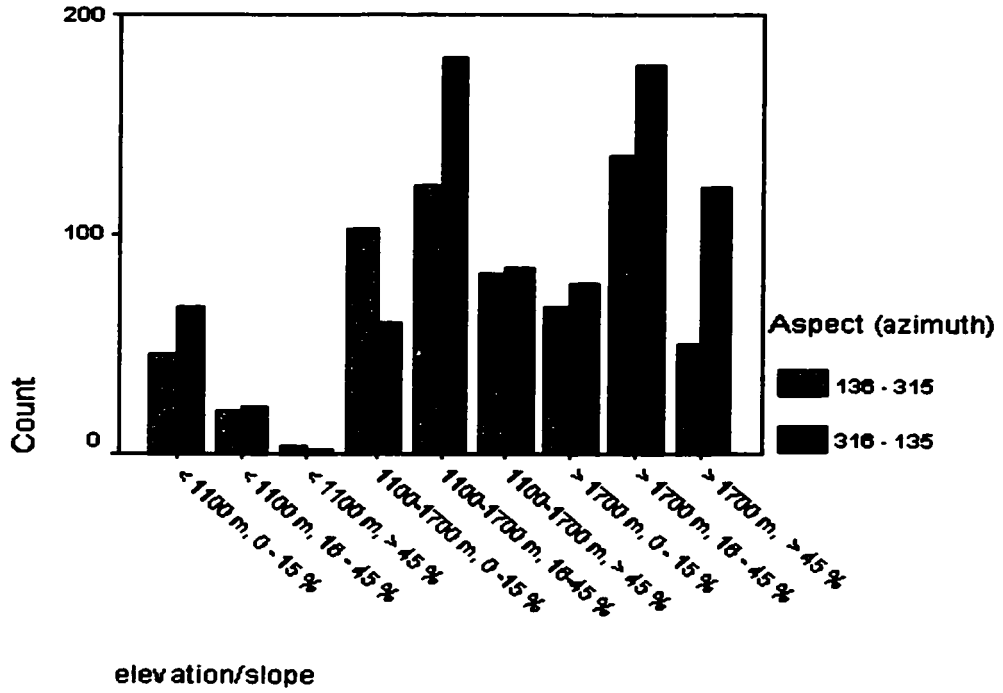


Figure 9. Distribution of aspect (azimuth) on elevation/slope, Telkwa Mountains, British Columbia 1997 – 2000.

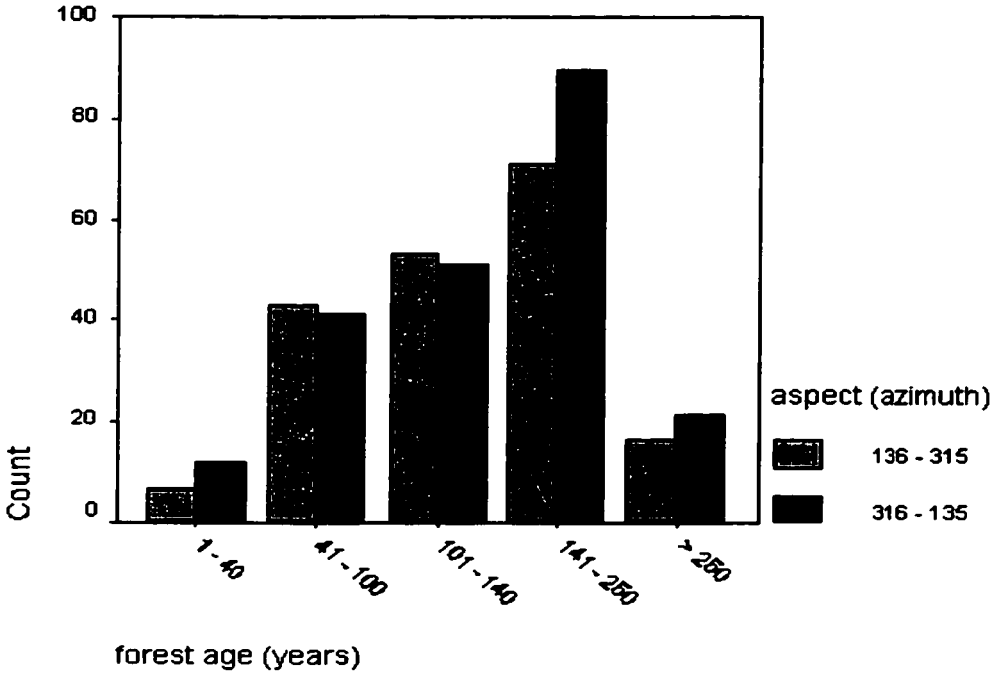


Figure 10. Distribution of aspect (azimuth) on forest age, Telkwa Mountains, British Columbia 1997 – 2000.

6.5 Discussion

Whether habitat availabilities are treated as known constants or random measures has a significant impact on the choice of appropriate statistical analyses (Thomas and Taylor 1990). When selecting a method, fundamental considerations should include the observational units of the study, the populations being compared, the hypothesis being tested, and the validity of the resource selection inference considering the data available for analysis (Alldredge et al. 1998). I will therefore review the methodology used before discussing the results of this habitat study.

Methodology used

Johnson's method does not test for habitat selection for each animal, but rather uses each animal as an observation to test for a preference by the population (White and Garrott 1990). Alldredge and Ratti (1992) state that "The Johnson method tests if the rank ordering of use and availability are the same. If the proportion used equals the proportion available for all habitats, the rank ordering of use and availability will be the same. However, the converse is not necessarily true. The use and availability proportions could be different across the habitats while still having the same rank". For instance, if I obtain results where the ranks of use and availability are the same, I can not automatically conclude that use equals availability. The method selected does not allow for absolute statements of preference, or avoidance. This represents a loss of information and sensitivity compared to other methods (Alldredge et al. 1998).

Johnson's method does not detect differences when the rank ordering of selection and availability is the same even if the percentages were quite different, thus resulting in high Type 2 errors[3] (Alldredge and Ratti 1986). As well, Johnson's method gives equal importance to all animals regardless of how many observations there are of each individual (Alldredge and Ratti 1992). I decided to use this method because it is insensitive to decisions on what constitutes available habitat for the Telkwa Caribou

[3] Type 2 error: when a difference in proportional selection is not detected (Alldredge and Ratti 1986).

Herd. Determining availability may be difficult for studies of well-established herds. For a herd with relatively little time, knowledge or need to make use of the area surrounding their release site during my study, the difficulties increased.

Habitat analysis based on the actual data is preferable to the home range procedure, for which inferences are based on a model developed from the data and also because home range represents some prior selection (White and Garrott 1990). A home range estimate for the Telkwa Herd could also be unreliable so soon after relocation, thus I decided not to use the home range approach. Even where the null hypothesis of no selection is rejected, conclusions on how critical the selected habitats are to the animal's fitness can only be determined through manipulation (White and Garrott 1990). The Telkwa Herd is at risk, and newly translocated animals may decide to seek new ranges if disturbed. I decided not to conduct any manipulative studies, as this could conflict with the primary purpose of recovering the herd, and reduce public support for recovery efforts.

Rettie and McLouglin (1999) stated that when the area of a telemetry error exceeds the mean habitat patch size, the likelihood of misclassification is great. They argue that there is bias against habitat that occurs in small patches, and that "telemetry is the correct tool for some scales of habitat-selection research, but these are generally the coarser scales". The following three errors must be considered:

- *Geographic locations:* locations have an estimated average error of $\pm$ 300 m, due to GPS inaccuracies and difficulties in determining locations of animals without visual observations (pers. obs).
- *Forest Cover Data/Digital Elevation Model:* There is no statistical number, at present, for the accuracy of the data on a forest cover map (Ann Morrison, pers. comm). The accuracy[4] of the Digital Elevation Model is between 5 and 10 m (A. Foster, pers.comm).
- *Map error:* the accuracy[4] for National Topographic Survey 1: 50, 000 maps for the area is vertically > 20 m and horizontally 100 m (Natural Resources Canada 2000).

[4] For approximately 90 % of the points, thus the error cold be higher for the remaining outlying vales.

Because over 1,400 locations were used, errors may to some extent cancel each other out. For a study of broad scale patterns in landscape and habitat use, I consider the data accuracy and precision acceptable.

Johnson (1999) discussed the consequences of statistical significance testing, whereby two very close results will be given entirely different meaning if falling on separate sides of an arbitrarily selected alpha value. As described above, the RSW program uses significance tests to determine if the relative selections for all habitats are equal. Thus values close to, but above the selected alpha value of 0.05 were determined not to be significant. This does not mean such results have no biological significance. Alldredge et al. (1998) and Johnson (1999) also argued that just because a result is statistically significant does not mean that it is biologically meaningful.

To account for the circular distribution of aspect, Beers et al.(1966) and Zar (1999) provide means to transform data on a circular scale. For the purpose of this study I decided to use only two classes of aspect; 'warm' and 'cold', as described by Terry et al. (1996) partly to keep the number of classes low (Alldredge and Ratti 1986, 1992), and transformations were therefore not necessary.

Habitat selection by Telkwa caribou in comparison with other herds

Morrison et al. (1998) defined habitat as an area with a combination of resources (food, cover, water) and environmental conditions (temperature, precipitation and presence or absence of predators and competitors) that promotes occupancy by individuals of a given species (or population) and allows those individuals to survive and reproduce. At times animals may also be located in areas used to move between suitable habitats, where they do not carry out life-functions such as feeding, calving or breeding. These links between habitats are important, especially for wide ranging species such as caribou.

When interpreting results, it is important to recognise that caribou may show variation in habitat use at one or more levels not addressed by a study. Differences in use have been

found between years (Wood and Terry 1999, Apps and Kinley 2000), seasons (Edmonds and Bloomfield 1984, Eftestol 1998, Gray 1999, Maier et al. 1999), populations (Edmonds and Bloomfield 1984, van Drimmelen 1986, Edmonds 1988, Brown et al. 1994, Stevenson et al. 1994, Wood and Terry 1999), sexes (Edmonds et al. 1988), individuals (Stevenson et al. 1994, Wood and Terry 1999, Apps and Kinley 2000), and scale (Apps and Kinley 2000).

Caribou in British Columbia are classified into two ecotypes (Stevenson and Hatler 1985). The northern ecotype depends primarily on terrestrial lichens (growing on the ground) during winter, while the mountain ecotype depends on arboreal lichens (growing on trees). In other jurisdictions, the term "mountain caribou" is sometimes used for another ecotype that inhabits mountains but primarily forages on ground-based lichens and vascular plants in winter (Apps and Kinley 2000). J. Ficht (pers.comm.) reported that Mountain caribou in west central Alberta spend a portion of the year (usually calving, summer and the rut) in the mountains and then migrate to the foothills winter ranges. They feed primarily on terrestrial lichens, as snow depths are < 1m. "Mountain" caribou herds in west central Alberta are not arboreal lichen dependant. Edmonds and Bloomfield (1984) describe mountain caribou in west-central Alberta as a migratory variety of the woodland subspecies.

The divisions between arboreal- and terrestrial lichen-dependent groups are not absolute, and may also depend on differences in climate from year to year. Northern caribou use arboreal lichens too, but not as regularly as mountain caribou (Stevenson et al. 1998). The Telkwa Caribou herd is known to feed on both lichen types during winter (van Drimmelen 1986). When icing, deep snow or other environmental conditions prevent caribou from obtaining terrestrial lichen, areas of arboreal lichens become increasingly important (van Drimmelen 1986, Edmonds 1988, Cichowski 1993).

Arboreal lichens are most abundant in old forest (Seip 1990, Cichowski 1993, Apps and Kinley 1995, Houwers 1996, Telkwa Caribou Standing Committee 1999, Wood and Terry 1999, Apps and Kinley 2000), often on trees > 120 years old (Bloomfield 1980,

Edmonds and Bloomfield 1984, Stevenson and Hatler 1985, van Drimmelen 1986, Edmonds 1988, Wood and Terry 1999). Terrestrial lichens are most abundant in forests 75 – 130 years old (Edmonds and Bloomfield 1984, Stevenson and Hatler 1985). Houwers (1996) reported that distribution of arboreal lichens in the Telkwa Mountains was patchy. Considering the slow growth rate of arboreal lichens, it would be difficult for a large herd of woodland caribou to survive solely on arboreal lichens in a low abundance area for more than one season.

The Telkwa Herd appeared to select forests > 250 old, which received the highest ranking. Except trees 141 – 250 years old, which received the lowest ranking (possibly because this class is so abundant), forests > 100 years seem to be preferred.
The use of older forests corresponds with that reported in other studies (van Drimmelen 1986, Cichowski 1993, Apps and Kinley 1995 and 2000, Terry et al. 1996, Wood and Terry 1999).

Telkwa caribou appeared to select high elevation habitat at moderate slopes. The alpine plateaux in the Telkwa Range have been important for the herd presently and historically (Chapter 8). Areas surrounding Hunter's Basin and the Camel Humps, in the northwestern part of the Telkwa Range appeared to be especially important for winter use. These were also important calving areas, both historically (Chapter 8) and now. Using these areas permits caribou to be spatially distinct from moose, and likely therefore from wolves. The Telkwa Herd is known to use high elevation alpine habitats throughout the year (van Drimmelen 1986), and this is also reported for other herds (Brown et al. 1994; Apps and Kinley 1995, 2000; Terry and Wood 1999). Use of alpine areas is commonly reported during calving (Chapter 5) and the rut (Bergerud and Elliott 1986, Edmonds 1988, Cichowski 1993). Lower elevations are commonly used in spring (Edmonds and Bloomfield 1984, Seip 1990, Warren et al. 1996, Wood and Terry 1999). However, except for a few individuals, the Telkwa Herd have remained in alpine areas during spring.

Johnson et al. (1998) suggested that caribou in the less productive alpine areas might be less selective, taking advantage of those sites with the greatest amount of lichen regardless of palatability, which may be an adaptation to a less productive environment where foraging decisions are based largely on availability. Although no assessment of food was conducted during this study, these plateaux provide good access to lichen. The plateaux are interspersed with pockets of wetlands within easy access of the alpine. Although most patches are too small to be captured in Forest Cover data, I often observed caribou in such areas and believe they are important, likely providing protein-rich sources of food. Moreover, moose were seen often in these high elevation meadows. Likely these areas bring caribou in close contact with moose, and thereby wolves; creating a trade-off between the nutritional value of wetland plants and increased predation risk.

Seip (1990) stated that wolves were closely associated with moose but both were spatially separated from caribou by differential use of elevations and habitat types. Morrison et al. (1998) argue that many of the interactions between species likely took place in the past, and much of what we observe today is the result of these interactions. Wolf predation is reported as a major cause of mortality for woodland caribou (Edmonds 1988, Brown et al. 1990). Several authors have suggested that caribou avoid lower elevations to avoid predators (Seip 1990, Brown et al. 1994, Wood and Terry 1999).

On one occasion, a band of caribou was observed within a few hundred meters of a group of mountain goats, both on an alpine plateaux; the goats closest to the edge. Although goats were generally in steeper terrain, caribou and goats were seen relatively close together on several occasions. Seip (1990) suggests that use of high elevations by caribou and mountain goats in winter make them largely invulnerable to wolves.

Use of gentle to moderate slopes throughout much of the year is common for woodland caribou (Edmonds and Bloomfield 1984, Seip 1990, Terry et al. 1996, Wood and Terry 1999), although use of steep slopes has also been reported (Hatler 1987, Terry et al. 1996). The Telkwa Caribou Standing Committee (TCSC, 1999) states that slopes < 30 % are most commonly used for foraging and should have greater emphasis for partial

canopy retention. Caribou use both southern/warm aspects (Edmonds and Bloomfield 1984, Warren et al. 1996), northern/cool aspects (Warren et al. 1996), or show no apparent selection (Seip 1990). Use may also vary between years and seasons (Terry et al. 1996, Wood and Terry 1999).

Because Telkwa caribou spend much time on mountain plateaux, the significance of aspect selection should be interpreted with this in mind. The plateaux are rarely completely flat, thus most plateaux-locations will report a value for aspect. The ridge where 4 cows and their calves spent much of their time in the early summer of 1999, faces north. There may have been other advantages of this north-facing habitat, but I suggest this location was chosen due to its inaccessibility. Nevertheless, the number of locations obtained from this ridge added substantially to the number of 'cold aspect' locations.

Threats to woodland caribou

Mallory and Hillis (1996) stated that populations of woodland/forest ecotypes range in size from 50 –50,000 animals, with 50 % of the herds below 4,000 individuals. In various parts of Canada Woodland caribou use habitat types including mature coniferous forest, alpine meadows, tundra and peatlands. Woodland caribou occur in a broad range across Canada occupying five of the eight major bioclimatic zones (ecozones) of Canada recognized by COSEWIC (Gray 1999).

Several authors reported that woodland caribou populations are declining, in B.C (Heard and Vagt 1998), across Canada (Gray 1999) as well as throughout the circumpolar region (Mallory and Hillis 1996). Causes of decline include habitat loss, habitat fragmentation, increased access, hunting and predation (Bloomfield 1980, Edmonds and Bloomfield 1984, Heard and Vagt 1998), poaching (Edmonds 1988) and the possible interaction of disturbance and predation (Mallory and Hillis 1996). Bloomfield (1980) stated that one of the most serious consequences of industrial activity has been the creation of a vast network of access into previously inaccessible caribou range.

The amount of space required by caribou to avoid predation may be significantly greater than the amounts required to obtain sufficient forage (Stevenson et al. 1994, Apps and Kinley 1995, Seip and Cichowski 1996, Stevenson et al. 1998), and Bergerud (1980) suggest that requirements for predation avoidance could be 10 times larger. This is an important consideration for potential studies of food-availability on the Telkwa caribou range.

Antifeau (1998) states that: "Analyses of habitat use in relation to habitat availability assumes that the degree of use relative to availability defines suitability, i.e. that statistical significance equates with biological significance. However, there is a concern that some habitat types that are used less than available, and which then are classified as avoided and unsuitable, may in fact be very important for short time periods within a season or perhaps only for certain years in which severe conditions occur". Apps and Kinley (2000) report that habitats may be critical but are only used by some individuals, in some years or for short periods, and may not be accounted for in model algorithms. Forests 141 – 250 years old receive the highest use, but the lowest rank. These forests may be too abundant for caribou to use in proportion to availability.

Morrison et al. (1998) state that: "In addition to outright extinction of a population or species, natural and human-induced changes in animal populations and their habitats can cause dramatic changes in the behaviour of the surviving individuals. Consequences are poorly understood, but cannot be assumed to be favourable to maintaining natural ecosystems with native communities and species". The importance of learned behaviour in caribou movements and habitat use has been discussed in several studies (Espmark 1970, Miller et al. 1972, Edmonds and Bloomfield 1984, Edmonds 1988, Apps and Kinley 1995, Hinkes and Van Daele 1996). Loss of traditional migration routes may influence dispersal, densities and movements between groups, and create small sedentary herds (Edmonds 1988, Hinkes and Van Daele 1996, Warren et al 1996). For the past three years (or more) most of the A la Peche herd have stopped their migration to the foothills and now remain in the mountains throughout the year, and the reasons for this are not clear (J. Ficht pers.comm.).

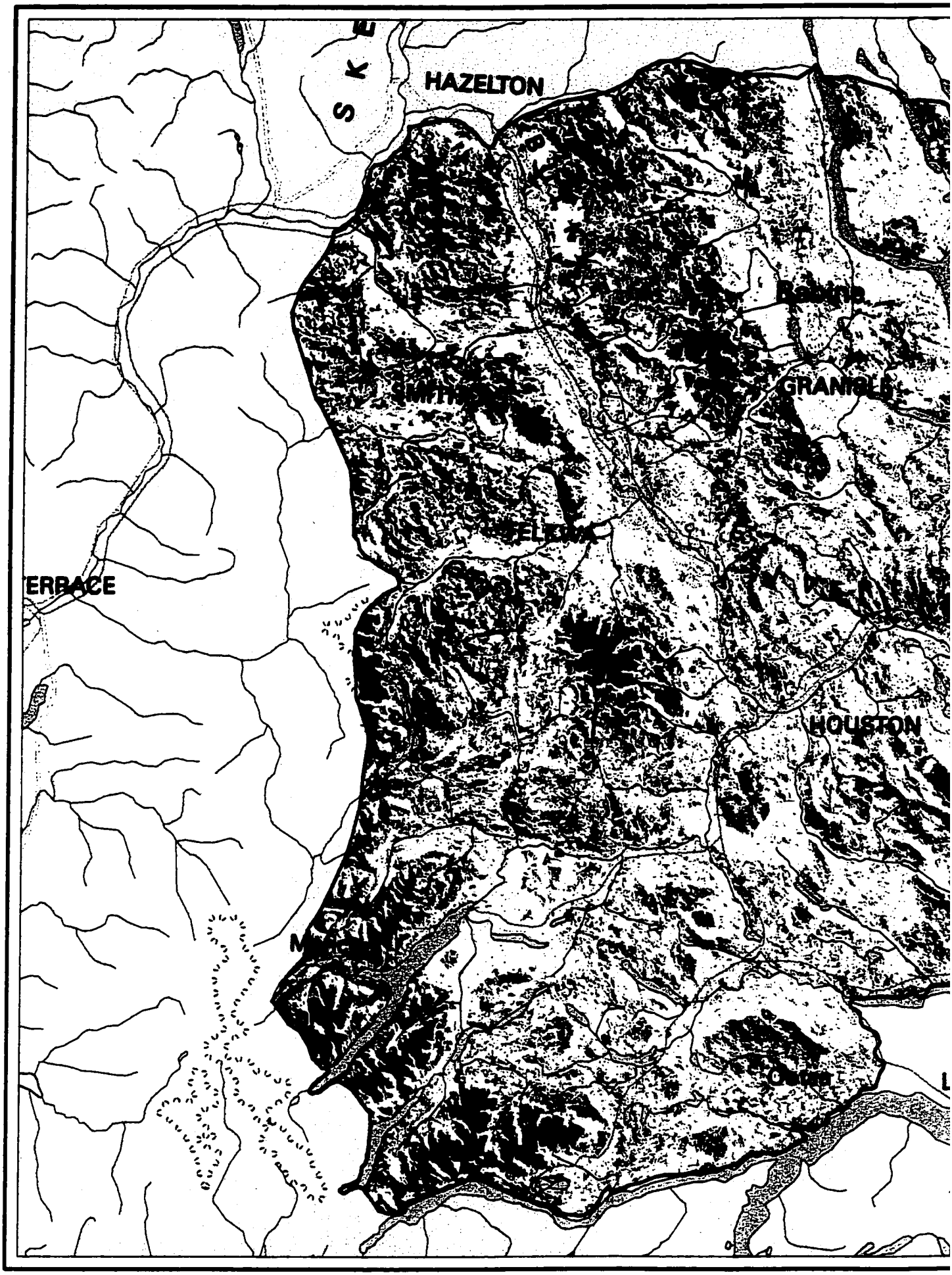
Several authors are concerned over effects of increased human access to caribou range (Bloomfield 1980, Bergerud and Miller 1984, Edmonds and Bloomfield 1984, van Drimmelen 1986, Edmonds 1988, Cichowski 1993, Brown et al. 1994, Heard and Vagt 1998, Terry and Wood 1999). Van Drimmelen (1986) expresses concern over snowmobiling on the winter ranges of the Telkwa Caribou Herd, and this has been a concern for over 25 years (Chapter 7). Farnell and McDonald (1988) also suggest that woodland caribou may be vulnerable to predation and other natural causes of death following the hardships of winter.

As described above I did not conduct manipulative studies on the effects of snowmobiles, and a correlation between two variables may say nothing concrete about the nature of the relationship between them (Morrison et al. 1998). However, observations from telemetry flights throughout the winter of 1999/2000 suggest that caribou continuously tried to space away from snowmobiles. They seem to have certain preferred ridges; movements off and onto these areas appeared related to the amount of snowmobile traffic. Extensive snowmobile trails through the winter range also provide a means of easy travel for wolves (Edmonds and Bloomfield 1984).

Banfield (1977) suggested that caribou rely almost completely on their sense of smell to detect danger. Although I never observed interactions between caribou and dogs, it is likely that the presence of dogs could cause Telkwa caribou to avoid otherwise useful habitat. This is particularly important during calving time, when cows may be extra sensitive to disturbance (Bergerud and Miller 1984) and are usually alone. In theory the Telkwa Range can support almost 300 caribou van Drimmelen 1986). Given sufficient habitat; animals settling in the area, and good survival of calves, the herd could recover towards historic numbers. As well, it is possible that the increase in the herd has attracted caribou into the area. It is easy to underestimate the power of natural dispersal to re-supply isolated sites because the process is so difficult to observe (Whittaker 1998). The presence of several uncollared mature bulls during the winter of 1999/2000 suggests that this may have occurred. Several authors have recommended using caution in interpreting

results from short term studies, as long term trends may be different (Valkenburg et al. 1988, Apps and Kinley 1995, Rettie and Messier 1998). This study was conducted over two years and because animals have had little time in the area their use of habitat may change in the future.

This chapter has outlined the study of habitat use during 1998 - 2000. I have discussed advantages and limitations in using ranks to determine habitat suitability, habitat selection by the Telkwa caribou in comparison with other herds, and threats to woodland caribou. A habitat suitability map suggests the value of the various habitats throughout the study area to caribou.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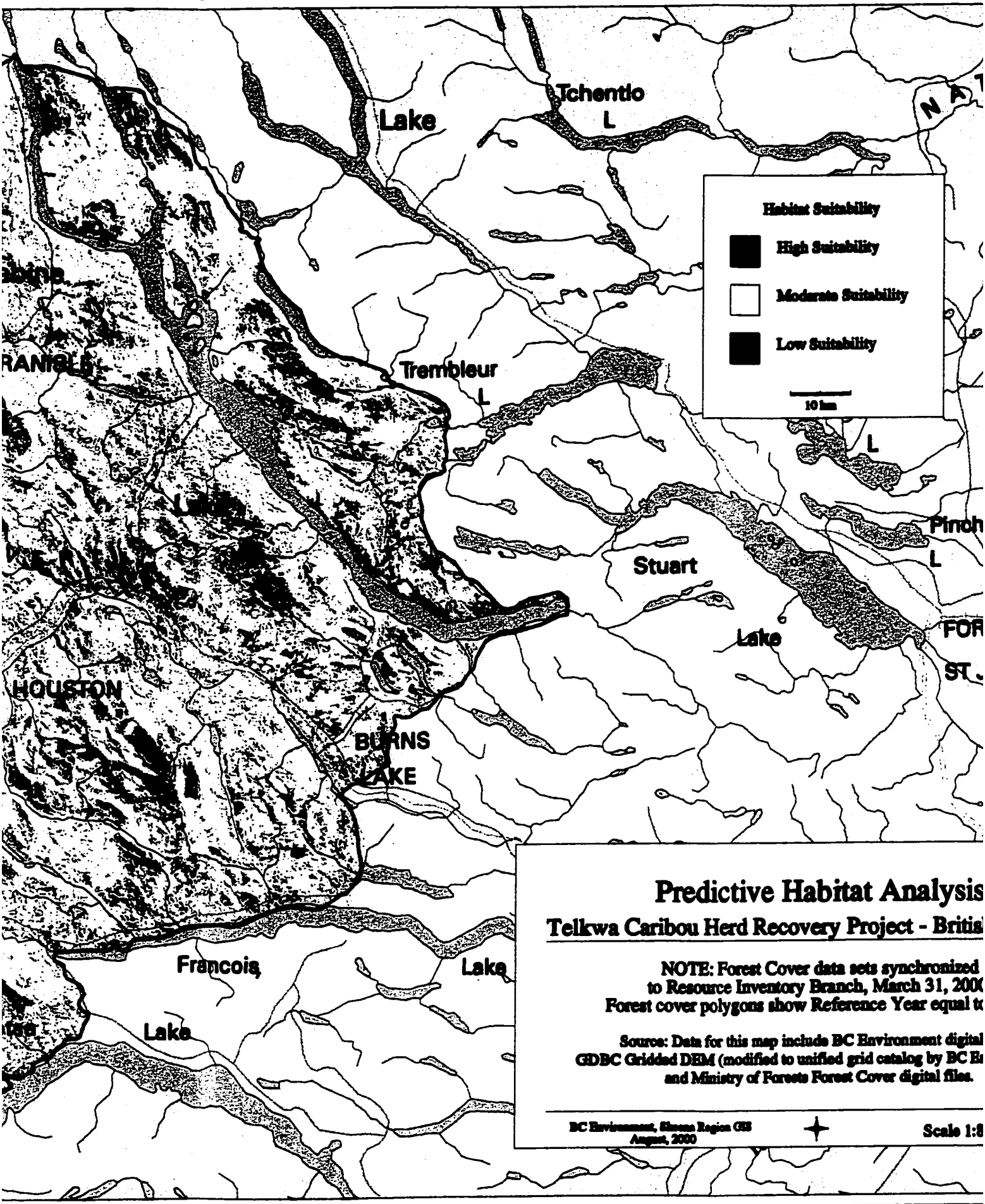
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Forest cover polygons show Reference Year equal t
Source: Data for this map include BC Environment digital
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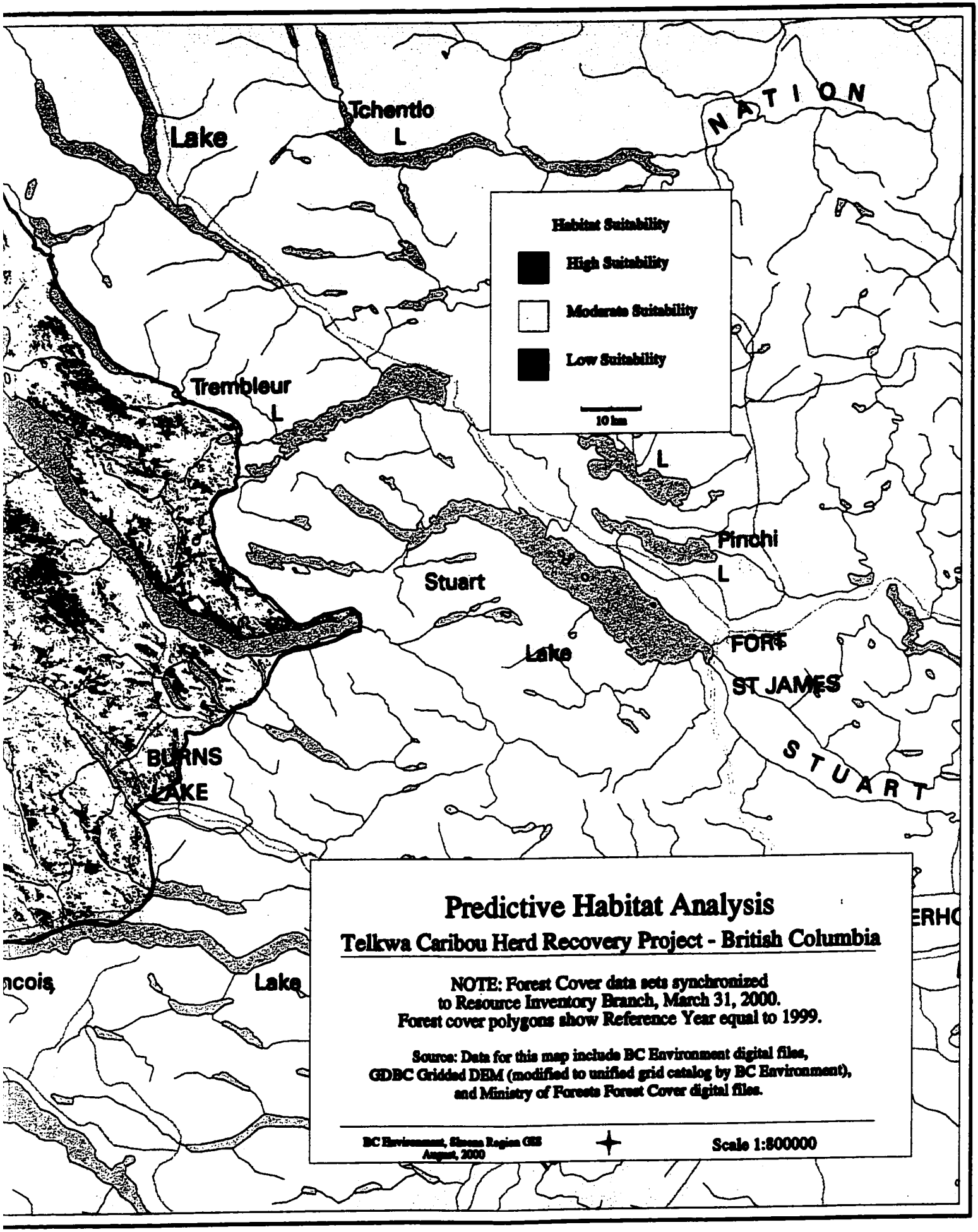
and Ministry of Forests Forest Cover digital files.
BC Environment, Skeena Region GIS
August, 2000
Scale 1:8



Predictive Habitat Analysis

Telkwa Caribou Herd Recovery Project - British Columbia

NOTE: Forest Cover data sets synchronized
to Resource Inventory Branch, March 31, 2000.
Forest cover polygons show Reference Year equal to 1999.

Source: Data for this map include BC Environment digital files,
GDBC Gridded DEM (modified to unified grid catalog by BC Environment),
and Ministry of Forests Forest Cover digital files.

BC Environment, Skeena Region GIS
August, 2000

Scale 1:800000

LITERATURE CITED:

Alldredge, J. R. and J. T. Ratti. 1986. Comparison of some statistical techniques for analysis of resource selection. Journal of Wildlife Management, 50(1): 157 – 165.

----------, 1992. Further comparison of some statistical techniques for analysis of resource selection. Journal of Wildlife Management, 56(1): 1 – 9.

Alldredge, J. R., D. L. Thomas and L. McDonald. 1998. Survey and Comparison of Methods for Study of Resource Selection. American Statistical Association. and The International Biometric Society. Journal of Agricultural, Biological and Environmental Statistics, No. 3(3): 237 – 253.

Antifeau, T. 1998. Identification of issues involved in the process of developing and applying caribou habitat suitability models. British Columbia Ministry of Environment Lands and Parks, Wildlife Section, Kootenay Region, Nelson, British Columbia.

Apps, C. and T. Kinley. 1995. Preliminary Habitat Suitability Assessment for Mountain Caribou in the Southern Purcell Mountains of B.C. Report prepared for BC Environment, Cranbrook, and East Kootenay Environmental Society, Kimberley, British Columbia.

Apps, C. and T. Kinley. 2000. Multi-scale habitat associations of Mountain Caribou in the Southern Purcell Mountains, British Columbia. Report prepared for East Kimberley Environmental Society, Kimberley British Columbia and Crestbrook Forest Industries Ltd. Cranbrook British Columbia.

Banfield, A. W. F. 1974. The Mammals of Canada. National Museum of Natural Sciences, University of Toronto Press.

Beers, T. W., P. E. Dress and L.C. Wensel. 1966. Aspect transformation in site productivity research. Journal of Forestry 64: 691 – 692.

Bergerud, A. T. 1980. A review of the population dynamics of caribou and wild reindeer in North America. Pages 556 – 581 *in* Reimers, E. Gaare, E. and Skjenneberg, S. editors. Proceedings, 2nd International Reindeer/caribou Symposium, Roros, Norway. Direktoratet for vilt og ferskvannsfisk, Trondheim.

Bergerud, A. T. and D. R. Miller. 1984. Antipredator tactics of calving caribou: dispersion in mountains. Canadian Journal of Zoology 62: 1566 – 1575.

Bloomfield, M. 1980. The impact of development, settlement and associated activities on mountain caribou in Central British Columbia, Canada. Pages. 705 – 715 *in* Reimers, E. Gaare, E. and Skjenneberg, S. editors. Proceeding, 2nd International Reindeer/caribou Symposium, Roros, Norway. Direktoratet for vilt og ferskvannsfisk, Trondheim.

Brown, W. K., J. L. Kansas and D. C. Thomas. 1994. The Greater Jasper Ecosystem Caribou Research Report, final report. Report prepared for Parks Canada, Alberta Region, and World Wildlife Fund Canada.

Bowyer, R. T, S. C. Amstrup, J. G. Stahmann, P. E. Reynolds and F. A. Burris. 1988. Multiple regression methods for modelling caribou populations. Pages. 89 – 118 *in* R.D. Cameron and J. L. Davis, editors. Proceedings of the 3rd North American caribou Workshop, Cheena Hot Springs, Alaska 1987. Alaska Dep. of Fish and Game. Wildlife Technical. Bulletin No. 8.

Cichowski, D. B. 1993. Seasonal movements, habitat use and winter feeding ecology of Woodland caribou in west-central British Columbia. Ministry of Forests, Research Branch, British Columbia. Land Management report No. 79.

Cramer, D. 1994. Introducing statistics for social research. Step-by-step calculations and computer techniques using SPSS. Routledge, London.

Edmonds, E. J. 1988. Population status, distribution and movements of woodland caribou in west central Alberta. Canadian Journal of Zoology 66: 817-826.

Edmonds, E. J. and Bloomfield, M. I. 1984. A study of woodland caribou *(Rangifer tarandus caribou)* in west central Alberta, 1979 – 1983. Alberta Energy and Natural Resources, Fish and Wildlife Division.

Eftestol, S., 1998. Fright behaviour in Norwegian wild reindeer *(Rangifer tarandus tarandus)* after disturbance by humans on foot or skis. Thesis, Department of Biology, University of Oslo, Norway.

Espmark, Y. 1970. Abnormal migratory behaviour in Swedish reindeer. Arctic 23 (3): 199-201.

Farnell, R. and J. McDonald. 1988. The influence of wolf predation on caribou mortality

in Yukon's Finlayson Caribou Herd. Pages 52 – 70 *in* R.D. Cameron and J. L. Davis, editors. Proceedings of the 3rd North American caribou Workshop, Cheena Hot Springs, Alaska 1987. Alaska Dep. of Fish and Game. Wildlife Technical. Bulletin No. 8.

Gray, D. R. 1999. Updated Status Report on the Woodland Caribou (caribou des bois) *Rangifer tarandus dawsoni* and *Rangifer tarandus caribou* in Canada. Prepared for the Committee on the Status on the Endangered Wildlife in Canada (COSEWIC), September 1999.

Hatler, D. F. 1987. Perspectives on inventories of caribou in British Columbia. Spatsizi Association for Biological Research Rep. No. 4, Wildlife Report No. R-14 July 1987.

Heard, D. C. and K. L. Vagt. 1998. Caribou in British Columbia: A 1996 status report. Pages 117 – 123 *in* M. Lankester et al., editors. Rangifer, Special Issue No. 10. 1998. Proceedings of the Seventh North American Caribou Conference. Thunder Bay, Ontario, Canada.

Hinkes, M. T. and L. J. Van Daeele. 1996. Population growth and status of the Nushagak Peninsula caribou herd in Southwest Alaska following reintroduction, 1988 – 1993. Pages 301 – 309 *in* K. Brown et al., editors. Rangifer, Special Issue No. 9, 1996. Proceedings of the Sixth North American Caribou Workshop. Prince George, British Columbia, Canada.

Houwers, C. 1996. Lichen Abundance Inventory of the Telkwa Range. Report prepared for the British Columbia Ministry of Environment, Lands and Parks, Smithers.

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

----------. 1999. The insignificance of statistical significance testing. Journal of Wildlife Management 63 (3): 763 – 772.

Johnson, C. J., K. L. Parker and D. C. Herd. 1998. Feeding site selection by Woodland Caribou in Northcentral British Columbia. Faculty of Natural Resources and Environmental Studies, Univ. of Northern British Columbia.

Maier, J. A. K., R. G. White, S. M. Murphy and M. D. Smith, 1999. Effects of overflights by low-altitude jet aircraft on habitat and terrain use by caribou.

Pages 96 – 97 *in* R. E. Haugerud, editor. Rangifer, Report No. 4, 10th Arctic Ungulate Conference, Abstracts.

Mallory, F. F. and T. L. Hillis. 1996. Demographic characteristics of circumpolar caribou populations: ecotypes, ecological constraints, releases, and population dynamics. Pages 49 – 60 *in* M. Lankester et al., editors. Rangifer, Special Issue No. 10. 1998. Proceedings of the Seventh North American Caribou Conference. Thunder Bay, Ontario, Canada.

Manly, B., L. McDonald and D. Thomas. 1993. Resource Selection by Animals. Statistical design and analysis for filed studies. Chapman & Hall, London.

Miller, F. L., Jonkel, C. J. and Tessier, G. D. 1972. Group cohesion and leadership response by barren-ground caribou to man-made barriers. Arctic 25 (3): 193 – 202.

Morrison, M. L., B. G. Marcot and R. W. Mannan. 1998. Wildlife-habitat Relationships. Concepts and Applications. The University of Wisconsin Press, Madison.

Natural Resources Canada. 2000. (http://maps.NRCan.gc.ca) as of July 2000.

Rettie, W. J. and F. Messier. 1998. Dynamics of woodland caribou populations at the southern limit of their range in Saskatchewan. Canadian Journal of Zoology 76: 251 – 259.

Rettie, W. J. and P. D. McLoughlin. 1999. Overcoming radiotelemetry bias in habitat-selection studies. Canadian Journal of Zoology 77: 1175 – 1184.

Seip, D. R.. 1990. Ecology of woodland caribou in Wells Gray Provincial Park. Wildlife Bulletin No. B-68, March 1990. Ministry of Environment, Wildlife Branch, Victoria, British Columbia and Min. of Parks, Kamloops, British Columbia.

----------.1991. Predation and caribou populations. Pages 46-52 *in* D. Heard and M. Williams, editors. Rangifer, Special Issue No. 7, 1991. Proceedings of the Fifth North American Caribou Workshop, Yellowknife, Northwest Territories, Canada.

Seip, D. R. and D. B. Cichowski. 1996. Population Ecology of Caribou in British Columbia. Pages 73 – 80 *in* K. Brown et al., editors. Rangifer, Special Issue No.

9, 1996. Proceedings of the Sixth North American Caribou Workshop. Prince George, British Columbia, Canada.

Stevenson, S. K. and D. F. Hatler. 1985. Woodland caribou and their habitat in southern and central British Columbia. Volume 1. British Columbia Ministry of Forests, Victoria, British Columbia Rep. No.23.

Stevenson, S. K., H. M. Armleder, M. J. Jull, D. G.King, E. L.Terry, G. S. Watts, B. N. McLellan and K. N. Child. 1994. Mountain Caribou in Managed Forests: Preliminary Recommendations for Managers. Ministry of Forests, Research Branch, Victoria British Columbia.

Stevenson, S. K., Lance, A. N. and H. M. Armleder. 1998. Estimating the Abundance of Arboreal Forage Lichens: User's Guide. Ministry of Forests, Research Branch, Victoria British Columbia.

Tabachnick, B. G. and L. S. Fidell. 1996. Using Multivariate Statistics. Third Edition. HarperCollins, New York.

Telkwa Caribou Standing Committee. 1999. Interim harvesting guidelines for the Telkwa Caribou Herd Recovery Program Area. Feb 12th, 1999. Draft.

Terry, E., B. McLellan, G. Watts and J. Flaa. 1996. Early Winter Habitat Use by Mountain Caribou in the North Cariboo and Columbia Mountains, British Columbia. Pages 133 – 140 *in* K. Brown et al., editors. Rangifer, Special Issue No. 9, 1996. Proceedings of the Sixth North American Caribou Workshop. Prince George, British Columbia, Canada.

Terry, E. L. and M. D. Wood. Seasonal Movements and Habitat Selection by Woodland Caribou in the Wolverine Herd, North-central British Columbia. Phase 2: 1994-1997. Peace/williston Fish and Wildlife Compensation Program Report No. 204.

Thomas, D. L. and E. J. Taylor. 1990. Study designs and tests for comparing resource use and availability. Journal of Wildlife Management 54(2): 322 – 330.

van Drimmelen, B. 1986. Telkwa Mountains Caribou Telemetry Project, Progress Report # 2. BC Environment, Smithers, June 1986.

Valkenburg, P., J. L. Davis and D. J. Reed. 1988. Distribution of radio-collared caribou

from the Delta and Yanert herds during calving. Pages 14 – 25 *in* R.D. Cameron and J. L. Davis, editors. Proceedings of the 3rd North American caribou Workshop, Cheena Hot Springs, Alaska 1987. Alaska Dep. of Fish and Game. Wildlife Technical. Bulletin No. 8.

Warren, C. D., J. M. Peek, G.L. Servheen and P. Zagers. 1996. Habitat use and Movements of Two Ecotypes of Translocated Caribou in Idaho and British Columbia. Conservation Biology Vol. 10 (2): 547 – 553.

Whittaker, R J., 1998. Island Biogeography : Ecology, Evolution and Conservation. Oxford University Press, Inc. New York, 1998.

White, G. C. and R. A. Garrott. 1990. Analysis of Wildlife Radio-Tracking Data. Academic Press, San Diego.

Wood, M. D. and E. L. Terry. 1999 Seasonal movements and habitat selection by woodland caribou in the Omineca Mountains, North-Central British Columbia.Phase 1: The Chase and Wolverine Herds (1991-1994). Peace/Williston Fish and Wildlife Compensation Program Report No. 201

Zar, J.H. 1999. Biostatistical analysis. Prentice Hall, Inc. New Jersey.

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7.0 LEGAL FRAMEWORK FOR MANAGING CARIBOU HABITAT IN BRITISH COLUMBIA

In this chapter I discuss applicable legislation for managing habitat for woodland caribou. I suggest changes to these laws, as well as better use of existing legislation.

7.1 Background

Within the constraints of the real world, we must balance human needs with those of vulnerable species. Various possibilities to grant protection should be explored, keeping in mind that our efforts are more profitable as precautions than as a cure.
Having the ability to displace other species require us to take careful consideration; to be conscious about our technology in terms of how it contributes to sustainable living for all life. For example snowmobiles and All-Terrain Vehicles (ATVs) are likely to be here to stay, and we must acknowledge people's desire to enjoy this form of recreation as much as others enjoy hiking or skiing.

Nevertheless, we should carefully analyse these activities, within the context of sustainable living. Off-road motorised vehicles keep getting better and more powerful, and are now able to enter into areas previously only accessed by foot or by horse. We cannot rely on the limitations of technology to protect wilderness and species at risk. In view of our limited knowledge, we would be wise to err on the side of caution.

Legislative arguments for access restriction need to be based on science as well as the ethical and social reasons for conservation. Science can only tell us the most likely consequences of our actions, but can not assign value to the different outcomes. Science can tell us how to manage, but never what to manage for. Even when solid scientific data is available, it is only a tool to be used towards the goal we have decided to approach, based on the environment we want to live in. Our increasing objectivity and distance from the natural world reflects our need for an ethical basis to give all this information

meaning and to put it into context. In this chapter I look at legal mechanisms for managing habitat for the Telkwa Caribou Herd. I have looked at the applicable legislation for British Columbia; which consists of:

- The Species At Risk Act
- The Wildlife Act of British Columbia
- The Forest Practices Code of British Columbia
- Land Use Planning
- The Motor Vehicle (All Terrain) Act of British Columbia

It is important to note that in the case of the current Telkwa Herd it is not a question of managing the animals; they are not hunted or otherwise directly regulated. It is managing controllable factors possibly inhibiting their recovery and long-term viability. Proximately we are managing forest harvesting, predation, hikers, dogs, ATV's and snowmobiles. Ultimately we are managing caribou's ability to cope with predation and human disturbance from resource extraction and recreational displacement through management of their habitat. It is not sufficient that legislation protect the animals; to be effective it must also secure their habitat.

7.2 Objectives

Objectives of this chapter are to review existing legislation available for managing Telkwa Caribou Herd habitat, in order to provide a framework for management recommendations; highlight where existing legislation could be better utilised, and suggest amendments to current legislation

7.3 Legal Mechanisms

The Telkwa Caribou Herd Recovery Plan (TCHRP) states that voluntary compliance with access restrictions is preferable to legislative closures, because of increased level of acceptance and involvement by stakeholders in recovery efforts, as well as reduced costs associated with enforcing legislation (TCHRP, 1998). However, voluntary agreements are not binding, and there is no authority to react if they are not followed. Agreements

are usually reached with organisations, thus anyone who is not a member does not have a part in the agreement. If voluntary agreements are not reached, or complied with, it is necessary to look at legal options for restricting access.

7.3.1 Endangered Species Legislation

The Canada Endangered Species Act was introduced in Parliament in April 2000. The act has not yet been adopted. Important sections of the Act are outlined below. I also discuss limitations in the current legislation, and suggest amendments. Where existing legislation is satisfactory, the space under proposed legislation is left open.

Table10. The Canada Endangered Species Act

Existing legislation	Proposed legislation
Section 30: (1) The Governor in Council (GiC), on the recommendation of the Minister, may make regulations establishing and amending the List of Wildlife Species at Risk based on the Committee on the Status of Endangered Wildlife in Canada's (COSEWIC) designations and classifications of wildlife species.	Section 30: (1) The Governor in Council (GiC), on the recommendation of the Minister, must make regulations establishing and amending the List of Wildlife Species at Risk based on the Committee on the Status of Endangered Wildlife in Canada's (COSEWIC) designations and classifications of wildlife species, including underlying units (subspecies, ecotypes and populations).
Section 31: (1) No person shall kill, harm, harass, capture or take an individual of a listed endangered or threatened species. (2) No person shall possess, collect, buy, sell or trade an individual of a listed endangered or threatened species, or any part or derivative of one.	
Section 32: No person shall damage or destroy the residence[1] of an individual of a listed endangered or threatened species.	Section 32: No person shall damage or destroy the critical[2] habitat of an individual of a listed endangered or Threatened species.

[1] Residence means a specific dwelling place, such as a den, nest or other similar area habitually occupied by an individual during all or part of its life cycle

[2] Where 'critical' includes sufficient habitat for species such as woodland caribou to space out to low densities in order to avoid predation.

Section 38: (1) The responsible minister must prepare a recovery plan that describes the measures to be taken to protect each wildlife species that is listed as endangered, threatened or extirpated as a result of human activity and, if possible, provide for its recovery. (3) The recovery plan must be completed within one year after listing, if the wildlife species is listed as endangered, and within two years after listing, if it is listed as threatened or extirpated. (4) The responsible minister, based on the advice of COSEWIC, must determine whether the recovery of the wildlife species is technically and biologically feasible. (5) If the recovery of the wildlife species is technically and biologically feasible, the recovery plan must address the treats to the survival of the species identified by COSEWIC, including loss of habitat, and must include (a) a description of the species and its needs, including an identification of its critical[3] habitat; (b) an identification of the threats to the survival of the species; (c) achievable population and distribution objectives that will provide for the recovery of the species and a detailed description of the research and management activities needed to meet the objectives; (g) a description of the measures needed to reduce or eliminate the threats to the survival of the species, including regulations needed to regulate or prohibit activities that will adversely affect the species or its critical habitat; (h) a mechanism for reviewing and evaluating the effectiveness of the plan	Section 38: (4) An independent scientific body (COSEWIC) must determine whether the recovery of the wildlife species is technically and biologically feasible.
Section 42: (1) A responsible minister may make regulations for the purpose of implementing measures included in recovery plans that he or she has prepared.	Section 42: (1) A responsible minister must make regulations for the purpose of implementing measures included in recovery plans that he or she has prepared.
Section 45: (1) Within three years after a species is listed as (2) vulnerable, the responsible minister must prepare a management plan for the species	

[3]Critical habitat means habitat that is identified as critical to the survival of a wildlife species in a status report or a decision under section 24.

and its critical habitat. The plan...must include any measure... the responsible minister considers appropriate.	
Section 49: (1) A responsible authority, as defined in... the Canadian Environmental Assessment Act, must notify the Minister...of any project that (a) is likely to affect a wildlife species, or its critical habitat, that is listed.... (b) is required to have an environmental assessment under that Act	Section 49: (1) A responsible authority, as defined in... the Canadian Environmental Assessment Act, must notify the Minister...of any project that (a) is likely to affect a wildlife species, or its critical habitat, that is listed....and measures to eliminate such effects.

Limitations

The Act contains critical measures towards protection, such as prohibiting killing of species at risk (Section 31) or destruction of their residence (Section 32), but has important limitations:

COSEWIC has no legal authority to implement protection and can only recommend threatened or endangered status.

The Endangered Species Act does not give COSEWIC legal authority. It identifies the committee as a source of independent advice, but it is up to the government's discretion whether to accept the committee's instructions.

COSEWIC's existing list of Species at Risk is not acknowledged

This Act will start with no listed species, although a COSEWIC listing of endangered, threatened and vulnerable species already exists. COSEWIC must again prepare listings of Species at Risk; from which the Government will choose selected species for legal designation.

Recovery of species at risk is left to the discretion of the Minister

The decision as to whether or not recovery of a species is feasible is left to political discretion. Legal designation of a species does not ensure protection and recovery. Where recovery is considered feasible, recovery plans must identify threats to species and

habitats. Obligations to reduce/eliminate such threats provide wildlife managers with legal tools to restrict activities detrimental to wildlife. This would allow the managers of the Telkwa Herd to impose access restrictions in the Telkwa Mountains, if such access is considered harmful to a listed caribou population.

There is no requirement to consider species at risk during the environmental assessment process.

The environmental assessment process is not required to ensure that projects are not causing detrimental effect on species at risk. Such requests would help ensure that a project is likely not to have detrimental effect on species at risk in order to achieve approval.

Endangered Species Legislation only applies to Federal Lands.

The effectiveness of endangered species legislation is severely compromised if only federal lands provide protection. Federal lands amount to less than five percent of Canada's landmass south of sixty degrees (Letter to Prime Minister from 640 Canadian scientists 1999). The Act does not apply in the Yukon or Northwest Territories. This limits the ability to provide sufficient habitat protection for wide ranging species such as woodland caribou.

Habitat protection is limited to 'residence' and 'critical habitat'

Depending on how definitions of 'residence' and 'critical habitat' (Section 32) are applied, woodland caribou habitat may not receive sufficient protection. Woodland caribou tend to space out and remain at low density over large areas; a strategy to avoid predation (Seip and Cichowski 1994, Seip 1991, Bergerud et al. 1984). Seip (1991) also argues that 'any reduction in caribou habitat resulting from logging or fire will concentrate the remaining caribou...and effectively increase their density.' This has two important consequences for caribou habitat protection: first, it is difficult, in many cases, to apply strict definitions for what constitutes sufficient habitat for a caribou herd.

Second, this uncertainty, combined with other land use demands makes it difficult to protect enough habitat to ensure long term viability for caribou over their natural range.

There are no avenues for citizens to legally challenge insufficient enforcement

The Act does not allow citizens to go to court when government refuses to enforce the law. This weakens the law, and the role citizens could play in protection of species at risk. The previous federal Endangered Species Act (Bill C-65, introduced in 1996 but never passed into law) gave citizens such powers (Canada Nature Federation, 2000). Protection of species at risk outside federal lands is left to the provinces. British Columbia does not have Endangered Species legislation.

As discussed in 7.3.2, the BC Wildlife Act allows designation of endangered species, but decisions to list species and to protect their habitat is left to the discretion of the minister and the cabinet. In addition, endangered species legislation must therefore secure:

1) Mandatory protection outside federal lands except where equal or stronger provincial legislation is present;
2) That citizens have power to legally challenge lack of enforcement;
3) A requirement on the government that actions carried out, authorised or funded by its agencies does not jeopardise the continued existence of a species at risk.

The Wildlife Branch of the BC Ministry of Environment, Lands and Parks (MELP) has management responsibility for caribou, but not direct control over the entire land base caribou depend on (Stevenson and Hatler 1985). At present, to protect habitat it must be reserved through other agencies or acquired from private landowners (MELP, 1994). A primary threat to species at risk in BC is agricultural and urban development. It is therefore not sufficient that legislation only apply to Crown land. Stronger legislation would also provide for establishment of recovery plans at an earlier stage than in the case of the Telkwa Caribou Herd.

7.3.2 The Wildlife Act of British Columbia

Table 2 describes current legislation. It also outlines proposed changes to the Act, as discussed below under limitations.

Table 11. The Wildlife Act of British Columbia

Existing legislation	Proposed legislation
Section 4 of the Act states that: With the consent of the Lieutenant Governor in Council (LGiC), the minister may...designate as a Wildlife Management Area (WMA) land that is under the minister's administration.	
Section 6: (1) If the LGiC considers that a species of wildlife is threatened with imminent extinction throughout all or a significant portion of its range in British Columbia because of the actions of humans, the LGiC may, by regulation, designate the species as an endangered species. (2) If the LGiC considers that a species of wildlife is likely to become endangered in BC if the factors affecting its vulnerability are not reversed, the LiGC may..... designate the species as an threatened species.	Section 6: (1) If COSEWIC considers that a species (or subspecies, population or ecotype) of wildlife is threatened with imminent extinction throughout all or a significant portion of its range in British Columbia because of the actions of humans, the LGiC must, by regulation, designate the species as an endangered species. (NOTE: All amendments proposed require that 'listed species' include every species or underlying units as defined in 1). (2) If COSEWIC considers that a species of wildlife is likely to become endangered in BC if the factors affecting its vulnerability are not reversed, the LiGC must..... designate the species as an threatened species
Section 108: The LiC may make regulations a) respecting threatened...or endangered species b) respecting the use and occupation of a WMA.	Section 108: The LiC must make regulations a) respecting threatened...or endangered species b) respecting the use and occupation of a WMA.
Section 109: The minister may make regulations b) prohibiting, restricting or allowing access by members of the public to designated areas of British Columbia, for the purpose of wildlife management. The minister may, c) with the approval of the minister responsible for the road temporarily close or restrict vehicular access to any highway or road or part of it for protection of wildlife.	Section 109: The minister must make regulations prohibiting or restricting public access, if such access is likely to cause detrimental effects on the habitat of a listed species or population.

Limitations

Habitat protection is not required

The government may choose to restrict or deny public access to an area if considered necessary to protect a wildlife population. There is however no obligation to protect wildlife habitat. The BC Conservation Data Centre (BC CDC) has listed the southern population of woodland caribou are in BC as vulnerable (BC CDC, 1999), and Stevenson and Hatler (1985) state that the need for areas where caribou management has high priority is urgent for the mountain ecotype.

The southern population is defined as mountain caribou (mountain ecotype); a group of 12-13 herds restricted to the Columbia- and Rocky Mountains, extending as far north as the Hart Range south of Chetwynd. This population is recognised as a distinct ecotype based on its dependence on arboreal lichen during the winter (Cannings et al. 1999). Other herds elsewhere may depend to a varying degree on arboreal lichens, and may be declining as well, but have not been considered at this time from the bulk of the caribou in the northern part of the province (S. Cannings pers. comm. 1999). The remaining caribou in BC are at present classified as belonging to the northern ecotype, which are not considered at risk.

An updated status report for woodland caribou is scheduled to be completed by the Committee On the Status of Endangered Wildlife In Canada (COSEWIC) in the spring of 2000. Recommendations to COSEWIC (Gray 1999) includes:

- That status designations be based on National Ecological Areas, of which there are 3 in BC that have caribou, the Northern Mountains-, Southern Mountains-, and Boreal Populations;
- That the Northern Mountain Population be classified "Not at risk" while the Southern Mountain- and Boreal Populations receive 'threatened' status. If COSEWIC adopts this designation for the Southern Mountain Population, all 'mountain ecotype' herds will be listed as 'threatened' (previously considered vulnerable), and possibly up to 12 of the 'northern ecotype' herds (previously listed

not at risk), which occupy the Southern Mountain national ecological area may also be classified as 'threatened'. While the average size of the northern ecotype herds is higher, the conservation concerns for these herds, including the Telkwa Herd, are as high as for the mountain ecotype herds. This designation should enable more effective habitat protection, e.g. for regulating use of snowmobiles in sensitive areas.

- That as an alternative to the designation by ecological area, caribou may be identified for status designation by ecotype (i.e. mountain or northern) or by metapopulations. The Southern Mountain Population is comprised of at least three metapopulations; the South East caribou metapopulation (i.e. the 13 mountain caribou herds), the West Central caribou population (Charlotte Alplands, Itcha-Ilgachuz, Rainbows, Tweedsmuir-Entiako, and Telkwa) and the East Central caribou metapopulation (Chase, Takla, Wolverine, Graham, Moberly, Kennedy Siding and Quintette).

COSEWIC has now designated caribou in the Southern Mountain National Ecological Area (including the Telkwa Caribou Herd) as threatened, and the final COSEWIC status report is planned to be completed this fall (I. Hatter, pers. comm.).

Securing habitat is a key requirement for protection of a vulnerable species, and a primary concern for most species at risk. It is particularly important for those using large areas.

No independent scientific bodies listing species at risk

The designation of a species' status as endangered or threatened does not require input from an independent scientific body. This is a serious weakness. Without required input from independent scientists on the status of wildlife, it is possible to avoid the listing of certain species altogether. Woodland caribou is an example, as protective measures often conflict with resource extraction and recreational access. Woodland caribou are not on the BC MELPs list of Identified Wildlife (MELP 1999 b), but as previously mentioned,

the western populations are listed by COSEWIC, and the southern population (mountain ecotype) is listed by BC CDC.

No required process to develop recovery plans for species at risk

Being listed by COSEWIC does not give any legal protection, as the committee has no such authority (Elgie 1998). COSEWIC is an independent scientific committee, but not an official advisory body, and there is no requirement for development of recovery plans following a COSEWIC designation of species at risk. The Recovery of Nationally Endangered Wildlife (RENEW) committee was established in 1988 to establish recovery plans for species listed by COSEWIC. Due to lack of funding few plans have been established. As with COSEWIC, RENEW or recovery plans do not have any legal authority (Elgie 1998). A recovery plan is not a guaranteed recipe for success. It will however list factors currently suspected to inhibit population growth, and measures to remove or minimise these. If, for example, human access is seen as a liability, the recovery plan will suggest measures to minimise such disturbance (TCHRP 1998).

Better use of existing laws and regulations

The Wildlife Act currently provides measures to protect species and habitat at risk. Due to conflicts with resource extraction and recreation they have not been applied to the extent suggested by the scientific community assessing the needs of vulnerable species in BC.

The Wildlife Act can be used to create an Order in Council or Minister's Order closure of an area. After cabinet approval has been obtained for an Order in Council or the Minister signs a Minister's Order, the Order becomes legally binding (S. Sharpe, pers. comm.).

The Wildlife Act may delegate powers to change regulations to the wildlife manager. Such decisions are based on technical facts, as well as social- and economic values. To prove impacts on wildlife is often difficult or not possible. It is usually valid to show a

reasonable/strong possibility of what may happen, and one would likely entertain a less strict standard for a taxon declared at risk. Support from First Nations would add strong weight to a recommendation of an area closure for protection of wildlife at risk (R. White, pers. comm).

One important consideration is weighing the investment made in the project against limitations imposed on people. A large amount of public funds (CAD $ 300,000) are already invested in the Telkwa Caribou Recovery Project. The Telkwa Mountains are a valued recreation area for several user groups, but none of who are without alternatives for their activities.

7.3.3 The Forest Practices Code of British Columbia

B.C. has addressed the province's protection of species at risk through the Identified Wildlife Management Strategy (IWMS) as part of the Forest Practices Code (FPC). A large portion of Crown land is administered by the MOF, which has management responsibility for public recreation on crown land.

Table 12. The Forest Practices Code of British Columbia

Existing legislation	Proposed legislation
Section (105): If the District Manager (DM) determines that it is necessary to protect a recreation resource or manage public recreation on Crown land, he or she may restrict, prohibit or attach a condition to.... recreational use anywhere on Crown land, except a use that is specifically permitted by or under another enactment.	Section (105): The District Manager (DM) must restrict, prohibit or attach a condition to recreational use anywhere on Crown land if causing detrimental impacts on a listed species, as well as monitor impacts where public recreation may conflict with habitat protection of a listed species.
<u>The Forest Service Road Use Regulation</u>: Section 3, (2) requires that ..subject to compliance with ..The Motor Vehicle (All Terrain) Act ..a person may operate a snowmobile on a forest service road. Section 6, (1) states: A DM..may cause a traffic control device to be erected on a forest service road...to close the road to all traffic or specific	<u>The Forest Service Road Use Regulation</u>: Section (6), (1) A DM..must cause a traffic control device to be erected on a forest service road...to close the road to all traffic or specific

categories or sizes of motor vehicles..totally or for a period of time.	categories or sizes of motor vehicles..totally or for a period of time if adversely effecting the habitat, migration or survival of a listed species.
<u>The Forest Recreation Regulation,</u> Part 4, Section 12, (1): A person who owns or is responsible for a pet must ensure that the pet does not, while on a recreation site, recreation trail or interpretative forest or in a wilderness area... (b) cause unnecessary disturbance to other persons or animals. Part 3, Section 4, (5): The district manager may refuse to consent to a proposal (for constructing, rehabilitating or maintaining a trail or recreation facility) only if he or she determines that the proposals will result in one or more of ...(b) unacceptable damage to the environment, unresolvable conflict with other resource values or uses. Part 4, Section 6, 2); A person must not operate a motor vehicle or a bicycle on a recreation site, recreation trail or interpretative forest site in a careless or negligent manner likely to ...harass, injure or kill wildlife or any other kind of animal.	<u>The Forest Recreation</u> Part 3, Section 4, (5): The district manager must refuse to consent to a proposal (for constructing, rehabilitating or maintaining a trail or recreation facility) if the project may cause detrimental impacts on species at risk.
<u>The Operational Planning Regulations,</u> Part 10, Section 69, (1) The chief forester and the Deputy Minister of MELP may, ...establish an ungulate winter range by identifying... (a) an area of land that is necessary for the winter survival of an ungulate species, and (b) objectives for the management of that area. Section 70, declares that (1) the Deputy Minister of MELP, or a person authorised by the Deputy Minister, and the chief forester, may (a) classify a species at risk as identified wildlife, if they agree that the species needs to be managed through a higher level plan, wildlife habitat area or general wildlife measure, (b) establish a mapped area of land as a wildlife habitat area, if satisfied that the mapped area is necessary to meet the habitat requirements of identified wildlife. (c) establish a management practice, that applies inside wildlife habitat areas, as a general	<u>The Operational Planning Regulations</u> Part 10, Section 69, (1) The chief forester and the Deputy Minister of MELP must ...establish an ungulate winter range for species at risk, where designation of such species and adequate ranges is based on independent scientific advice. Section 70, (1): the Deputy Minister of MELP, or a person authorised by the Deputy Minister, and the chief forester, must (a) based on mandatory advice from an independent scientific body, classify of species at risk as identified wildlife,

wildlife measure, if satisfied that the management practice is necessary to maintain the identified wildlife within those areas, and (d) establish a management practice, that applies within a specified ecosystem unit as a general wildlife measure, if satisfied that the management practice is necessary to maintain a specific habitat. (2) The classification of a species at risk as identified wildlife, and the establishment of a general wildlife measure and a wildlife habitat area, may be varied or cancelled by a written order signed by both.	(2) The classification of a species at risk as identified wildlife; establishment of a general wildlife measure and/or a wildlife habitat area may not be varied or cancelled, unless (a) in accordance with scientific advice from an independent body, and (b) a public consultation process has been provided.

As described, MOF has a mandate to manage recreation on Crown land, while MELP has management responsibility for wildlife. Sections 69 and 70 enable the two agencies to co-operate on wildlife management, as they address both the physical habitat and the applications of management practices. Land Use Planning and Higher Level Plans are examined in 7.3.4.

As mentioned above, the province has addressed BC's protection of species at risk under the Code's IWMS, to protect species at risk due to forestry and grazing activity in provincial forests. For the subsequent part of this section I will look at limitations of the IWMS and the legislation.

Limitations

No requirement to restrict access detrimental to wildlife

The DM has authority to restrict access, but there is no requirement that such measures must be taken, nor an independent body advising when such measures should be taken.

With respect to Section 105 regarding concerns over motorised disturbance to the Telkwa Herd, D. McKinley (pers.comm 1999) also advised that "the DM of the Bulkley/Cassiar Forest District would not arbitrarily single out motorised users for a restriction under 105 of the FPC of BC Act. Section 105 is not the appropriate tool to be used in protecting the Telkwa Caribou Herd; Section 109 of the Wildlife Act should be used here."

Wildlife not considered a recreation resource

MOF does not consider caribou, or other wildlife, a recreation resource (D. McKinley pers. comm 1999). The Bulkley Recreational Access Management Plan ((RAMP) 1997) states that " high risk, environmentally sensitive areas, where protection of the recreation resource is required, were identified within the district. These are areas where potential damage in the summer caused by wheeled vehicles may occur. Monitoring of these areas will indicate whether restrictions through the enactment of Section 105 ... are required." One of the areas identified is Hunter's Basin, a high use caribou area located in the core reintroduction zone of the Telkwa Mountains.

Protection from forest development not sufficient

There is no protection of habitat outside provincial forests, and the IWMS has several constraints limiting protection within these forests. Impacts from application of the strategy can not exceed 1% of the 1995 annual allowable cut (AAC). When set forth in 1993, this restriction was not intended to incorporate habitat requirements for all species (WCEL 1998). The 1% ceiling will not however be increased for Volume 2 species - both volumes must be implemented under the 1% cap on species protection (WCEL 1998). MELP (1999 a) states that the candidate species list for the Volume 2 of Identified Wildlife will be circulated for peer and stakeholder review. Thus, the decision on which species make this list will not be based on scientific information only. The 1 % ceiling on timber impact will remain the same after release of Volume 2 of Identified Wildlife.

Wildlife Habitat Areas (WHA) will be established to protect wildlife. There are however regional, district and species thresholds set, to minimise the impact on timber harvesting. As species are not uniformly distributed on any of these levels, this weakens the protection the strategy can offer. MELP (1999 a) has stated that " already constrained areas or areas that do not contribute to the timber harvesting landbase will be considered during the establishment of WHAs". The Sierra Legal Defense Fund (SLDF) (1999) has

argued that in the Cariboo-Chilcotin area, "the high elevation forests (of no commercial value) are now protected by a new provincial park [Tweedsmuir Park], but the critical winter habitat provided by lower elevation forests was excluded from the park because of pressure by logging companies".

MOF (1999 a) states that: "It is advisable not to include forest practices or targets as part of the higher level plan unless the reasons for doing it are technically sound and generally accepted as necessary to attain the objectives specified." Inclusion of specific targets for forest practices such as maintaining a minimum percentage of old-growth forest at all times, and making such targets legally binding; could provide important protection of habitat for species such as woodland caribou.

Only forest and range management practices can be addressed in the IWMS, and MELP (1999 a) also states that "Wildlife areas are not protected areas." Both timber harvest and road construction is allowed in WHAs. As previously mentioned, woodland caribou is not listed as identified wildlife by MELP, and protection is therefore not required. MELP (1999 a) states that "for the most part, WHAs will be small and widely scattered." Road construction and timber harvest would likely decrease the effectiveness of any WHA established for woodland caribou. The SLDF (1999) has also recognised this limit, stating "if there is a conflict between fibre flow and protecting endangered species, the protection for endangered species will be "relaxed" in order to fit the 1 % ceiling."

There is no required scientific input, protection or recovery plan

There is no independent scientific committee designating species at risk, and no requirements for legal protection or developments of recovery plans for listed species. When a species is not listed under Identified Wildlife in the province, the legislative protections through IWMS do not apply. Designation of species at risk as Identified Wildlife is left to the discretion of the chief forester and the Deputy Minister of MELP. The authority to cancel or vary such designations without either scientific input or public consultation is another fundamental limitation. The process for establishing ungulate

winter range is similar. Securing adequate winter range may be essential for the recovery of small populations like the Telkwa Herd.

SLDF (1999) has listed other decisions left to the discretion of the District Manager :
- the designation of objectives for Landscape Units;
- whether to allow clear-cutting in Old-Growth management Areas;
- whether to allow clear-cutting in Wildlife habitat Areas; and
- the designation of Sensitive Areas and objectives for their management.

The SLDF (1999) argues that MELP, with the most expertise on wildlife, endangered species and biodiversity, is given an inadequate role in decision-making under the FPC.

There is no requirement for cumulative impact assessment on wildlife

There are no requirements that cumulative assessment of impacts on wildlife be made from forest development. Making this a requirement for forest development would help researchers understand the impacts from timber harvesting, road building and other factors in relation to each other. These factors should not be considered in isolation, as one may magnify the effect of another. MELP (1999 a) states that both the district and the province will track cumulative impacts on timber harvest.

The Environmental Assessment Act does not apply to forest practices

The Environmental Assessment Act specifically exempts forest practices, on Crown- as well as other land as identified under the FPC. Impacts from road building, timber harvesting, and possible recreational after-use are a primary cause of concern for vulnerable wildlife.

There is no opportunity for the public to appeal the contents of decisions on IWMS/WHA

MELP (1999 a) states that decisions made and processed used in the IWMS and for establishing WHA can only be appealed in court on the basis of lack of judicial due process, not the content of the decision. The public can only argue that the law was not

followed, not that the decision is scientifically unacceptable. A public appeal process could improve the effectiveness of the IWMS.

Better use of existing legislation

The Forest Practices Code gives the DM authority to exercise extensive control over public access on Crown land. This provides a powerful tool in protecting habitat for species at risk. The Bulkley Land and Resource Management Plan (LRMP) (Bulkley Valley Community Resources Board (BVCRB), 1996) has directed that access be restricted in areas of important caribou habitat, which provides MOF with a mechanism to follow this management direction.

The TCHRP (1998) identifies the Telkwa Herd as a recreational resource for the Bulkley Valley. The Bulkley LRMP (BVCRB, 1996), examined in 7.3.4 describes the Telkwa caribou population as a 'resource', and under management direction for outdoor recreation and tourism advice to permit 'wilderness recreation and backcountry tourism opportunities, subject to caribou habitat requirements'. This indicates that recovery of the TCH could provide a potential resource for both public and commercial recreation in the future. Cannings et al. (1999), in a MELP report on the status of rare species in B.C, describe wildlife viewing as recreation, and states that thousand of recreational dollars are spent yearly by wildlife watchers. It is thus reasonable to consider wildlife, important for the recreational experience of both visitors and residents of BC (MELP, 1991), a recreational resource. The Forest Practices Code may therefore be used more extensively to protect a recreational resource such as the Telkwa Caribou Herd.

Snowmobile use of the Hunters' Basin area, part of the Telkwa Caribou Recovery area, has been a concern for over 25 years. Meeting notes from the Smithers Snowmobile Study, September 2nd, 1975, (RAMP, 1997, appendix 2) states " the chances for survival of individuals of this herd through winter could be significantly reduced if they were harassed or even visited by snowmobilers. Recommendation: - snowmobilers should be restricted from the Hunter's Basin area."

In a memorandum dated March 14th, 1977, habitat protection biologist David Bustard, while conducting fieldwork on the Telkwa Herd near Hunters' Basin, reported observing a group of caribou visibly disturbed by two groups of snowmobiles. He states: "None of the skidooers realized they had caused any disturbance. In fact, the last group of 4 skidooers didn't even see the caribou. I suggest that skidooing should be prohibited beyond Hunters' Basin itself " (Bustard 1977).

The Provincial Backcountry Skiing-Snowmobiling Committee (PBSSC) (Bulkley RAMP 1997, Appendix 1) was established by MELP in 1995 to address the growing conflict between public and commercial backcountry skiers and snowmobilers on Crown land in BC. The PBSSC defined the committee's mandate as one resolving conflicts between motorised and non-motorised use, and declined to deal with environmental issues associated with recreational use. Recommendations for resolving conflicts between motorised and non-motorised use on Crown land highlights Section 105 as the 'primary legislative tool for restricting recreational use of land", and states "this section should only be used when voluntary compliance proves ineffective."

The PBSSC advise that distinguishing between motorised and non-motorised use in an area is an appropriate and even recommended use of Section 105 of the FPC. The primary concern in the TCHRP area is protection of wildlife and not resolving conflicts between recreational user groups. But considering these user groups have themselves endorsed separate treatment under Section 105 it should be appropriate to use this legal tool in the Telkwa Caribou Herd recovery area, considering voluntary access restrictions have been attempted without achieving satisfactory compliance.

7.3.4 Land Use Planning

The IWMS states that management of woodland caribou is deferred to higher level planning processes through the Land and Resources Management Plans (LRMP); part of the current strategic planning approach under the FPC.

The only legal status LRMPs have is if certain LRMP objectives are designated a "Higher Level Plan" (HLP) under the FPC. LRMP objectives that pertain to forest resources and forest development operations and practices are appropriate for HLP status. These objectives may include reference to special use permits, in which case they become "applicable Higher Level Plans" for the purposes of mineral exploration. (L. Williams pers. comm. 1999). Other LRMP objectives are not eligible for HLP status; as such they remain Cabinet-approved as provincial policy direction that a statutory decision-maker should consider (L. Vanderstar pers. comm. 1999).

The LRMP's provide direction for Land Use Plans (LUP), and Recreational Access Management Plans (RAMP). The RAMP will be incorporated into the LUP, and portions of the LUP that direct operational plans will be declared as a HLP under the FPC by the District Manager (DM) (RAMP 1997). Therefore the LUP objectives will constitute the HLP, and the LUP strategies will constitute DM policy upon completion (D. McKinley pers. comm. 1999). The LRMP is approved by Cabinet, and does therefore constitute provincial policy.

The recovery area for the Telkwa Caribou Herd lies within the Bulkley and Morice Forest Districts in the Prince Rupert Forest Region. A LRMP has been produced for the Bulkley Forest District, but not for the Morice District. The Bulkley LRMP ((BVCRB) 1996) addresses protection of caribou habitat through creation of special management zones, 1 and 2. Management directions include restricting motorised access as it relates to caribou and goat habitat. The LRMP request "a comprehensive plan to sustain and enhance a viable caribou population." MELP addressed this through the TCHRP (1998).

Telkwa Caribou Recovery Team objectives include protecting caribou habitat by reducing disturbance to caribou from increasing human access and recreational use of the Telkwa Mountains. MELP staff consulted with the public on the TCHRP. The public consultation process was not intended to address conflicts between motorised and non-motorised users. However, the public perception was that the MELP consultation efforts were a continuation of the Recreational Access Management Planning process, co-

ordinated by MOF as part of the Bulkley Valley LRMP. This perception, together with considerable animosity between motorised and non-motorised recreational groups, made the process to some extent more complicated (M. Williams pers. comm 1998).

The LRMP contains directions for lower level planning by directing the Bulkey DM, with approval from MELP, to designate Ecosystems Network and Enhanced Timber Development areas. The plan also required The Bulkley District to co-ordinate a Recreational Access Management Plan (RAMP) for the district. Recreation is defined secondary to maintenance of caribou and goat habitat in much of the Telkwa Mountains (BVCRB 1996). As MELP has a mandate to manage for these values, the RAMP recommends this agency develop guidelines for access management in the Telkwa Mountains. The Bulkley RAMP, developed by direction of the LRMP, states "responsible recreation is a legitimate use of Crown lands and the public has a right to access recreational resources on Crown lands in the Bulkley/Cassiar Forest District, where it does not detrimentally affect the environment, endanger wildlife, or conflict with other specified land use objectives."

The Bulkley RAMP (1997) also states that The Provincial Back-country Skiing-Snowmobiling Committee (PBSSC) did not see a need for any additional legislation surrounding backcountry recreational use. Rather it recommended the formation of local agreements and it emphasised that enforcement of existing legislation and policies must be made possible. Of particular note was a recommendation to enforce the Motor Vehicle (All Terrain) Act (discussed in 7.3.5.).

Limitations

The West Coast Environmental Law Association (WCEL, 1998) is concerned that LRMP participants may not be aware of all species requiring protection. As mentioned above, the MELP List of Identified Wildlife, being considered for protection measures under the FPC, does not include woodland caribou.

The RAMP (1997) states that portions of the LUP that direct operational plans will be declared as a higher level plan under the FPC of BC Act by the Bulkley DM. It also states the Bulkley District has taken the position that recreational access restrictions should not be the subject of specific operational management plans (OMP). As an OMP would be directed by a LUP, which as a HLP is legally binding, this weakens the force of any access restrictions developed for these areas.

No access restrictions required for detrimental impact in caribou management zones

Both Special Management zones identified under the LRMP permit mineral exploration and development, and zone 2 allow logging (Bulkley Valley Consensus). The area surrounding these zones, including much of the traditional caribou habitat in the Bulkley Valley, is designated Integrated Resource Management Zone (IRM), where all values have equal consideration.

Ecosystem Network (EN) has no legislative borders

The EN borders are deliberately flexible to allow adjustment by the DM and MELP, and do not have legislated boundaries (Bulkley Valley Consensus, 1996). This flexibility could reduce the strength of the network when in conflict with other interests. The EN allows modified harvest practices.

Better use of the LRMP process

An LRMP may specify that the planning of recreational use should be addressed together with concerns for wildlife populations and species at risk, to ensure the most meaningful area designations. The planning process must include protection of all species and habitats at risk, as listed by an independent scientific body, in the terms of reference.

7.3.5 The Motor Vehicle (All Terrain) Act (MVATA) of British Columbia

Table 13. The Motor Vehicle (All Terrain) Act of British Columbia

Existing legislation	Proposed legislation
Section 4 states that (1) A person must not operate an all terrain vehicle.. (e) in such a manner as to drive, harass, chase, run over, injure or kill wildlife ... (f) in areas, seasons or periods of time prohibited by the regulations. (2) This section is subject to restrictions and prohibitions prescribed by the Park Act, the Forest Act or the Land Act, or in any regulations made under those Acts.	
Section 7: (2) the Lieutenant Governor in Council may make regulations (d) prescribing rules for driving an all terrain vehicle (h) respecting the operation of and the issue of permits for certain all terrain vehicles in prohibited areas, seasons or periods of time, and for the conduct of special sporting or competitive events...	Section 7: (2) the Lieutenant Governor in Council may make regulations... (h) respecting the operation of and the issue of permits for certain all terrain vehicles in prohibited areas, seasons or periods of time, and for the conduct of special sporting or competitive events, if confident that such use will not produce detrimental impacts on species at risk.
Section 8: (1) A person who contravenes this Act or the regulations commits an offence. (2) Every day the contravention continues constitutes a separate offence. (3) A person who commits an offence against this Act or the regulations is liable on...conviction to a fine of not more than $ 500. (6) If a person is convicted of an offence against this Act or the regulation, the justice may make an order prohibiting that person from operating an all terrain vehicle for the length of time the justice considers advisable.	Section 8: (3) A person who commits an offence against this Act or the regulations is liable on...conviction to a fine.
Section 9 : (1)On conviction of (a) a registered owner...or (b) an operator...with the knowledge and consent of the owner,.....for an offence under this Act or for any other reasonable cause, the superintendent may,..... suspend the certificate	

of registration and the identification number for that all terrain vehicle for a period not greater than 3 months.	
Section 10 on administration permits that: (2) The director, ... must institute a program of public information and safety education, including a training program of juvenile operators. (4) If an all terrain vehicle is being operated contrary to this Act or the regulations, an enforcement officer may order the all terrain vehicle to stop.	

The MVATA is a potential tool in protecting species at risk from human disturbance. The Act contains specifications for operator conduct when encountering wildlife, and measures available for violations of these regulations. Operation of an All Terrain Vehicle (ATV) is subject to restrictions prescribed by other Acts. This enables managers of wildlife, wildlife habitat and recreation to address access to wilderness areas in a comprehensive manner. The RAMP recognises this relationship, by recommending enforcement of the MVATA. As set forth in the FPC, snowmobile use on forest roads must comply with the MVATA. This provides options for regulating and/or decreasing the use of areas difficult to access without such roads.

Existing legislation provides measures to increase protection of species at risk, given active and consistent enforcement. This depends on the political will to allocate necessary funds for enforcement and for public information and education. There are however important limitations to the MVATA, reducing the Acts' value in protecting species at risk.

Limitations

Consideration of species at risk is not required when making exemptions of regulations.

Exemptions of regulations may be granted without considering species at risk, which weakens the ability of this Act to offer adequate protection for species at risk. It is

essential that no detrimental disturbance be imposed during critical periods such as a hard winter (definition of what constitutes e.g. a hard winter would be left to the discretion of MELP biologists). Such protection would be valuable for the TCH recovery.

Maximum fine for violations $ 500.

Imposing larger fines for violations causing detrimental effect to species at risk would underline the seriousness of such an offence. With active enforcement it would also serve as prevention against committing such violations.

Better use of existing legislation

The MVATA may be more extensively used to impose access restrictions where necessary to protect species at risk. This depends on sufficient funding. The PBSSC (RAMP 1997, Appendix 1) recommends that the Province take steps to enforce the MVATA and its snowmobile regulations. Specifically:

-The Attorney General's Office (Police Services Branch) should negotiate with the RCMP to enforce systematically the identification and registration requirements of the MVATA and the Snowmobile Regulations.

- Recognising that the following recommendations may increase demands on government staff, the Committee recommends that certain provincial officials should be enabled to enforce selected provisions of the MVATA. Specifically: Forest Officials and Conservation Officers...Land Officers... and Park Officials.

Enforcement of the MVATA is not an easy task, for several reasons. The vehicles are operable on difficult terrain, and cover large distances in short time. Many areas used have few people present, which makes it easier to violate the law without being discovered. The PBSSC (RAMP 1997, Appendix 1) declared that "out-of -province snowmobilers have not had any direct connection with local snowmobile clubs, and accordingly, have no incentive to comply with local agreements".

Use of such vehicles has increased during the past decades. They are becoming faster and more powerful, and are increasingly available for recreational use. Access to, and use of wilderness areas by motorised recreation will need regulation if the current trends continue. Resolving these conflicts is difficult, but will only become harder if we choose to wait until the issues are more pressing.

Increased enforcement would also be more effective if combined with public information and education about possible effects on species at risk by motorised use. Enforcement alone may prevent impacts on wildlife, but not the understanding of why these actions are harmful. The amendments suggested in Table 13 may provide better protection for the Telkwa Herd by clearly prohibiting actions disturbing the caribou by the use of a motorised vehicle. Stronger penalties for violators would also have preventative effects.

7.4 Conclusion

Environmental legislation must reflect our obligation to preserve a sustainable environment, for other species and for future human generations. To ensure enforcement of environmental legislation, laws must allow a citizen to challenge the government legally, to ensure that agencies carry out protective duties under their mandate. Division of management responsibilities may create problems for habitat protection. The RAMP emphasised co-operation between the different agencies as a key to successful planning. A future planning process in the Morice Forest District must emphasise that management of caribou habitat on both sides of the forest district border is done in collaboration.

Scientists are faced with a lack of data when determining the status for several species. For effective conservation action, lack of scientific proof must not impede the possibilities in ensuring protection of biodiversity. The mixture of lack of inventory data, together with estimates used as scientific facts may be dangerous. Designation of habitat can not require scientific proof of the area required to maintain long term viable

populations. This conflicts with the overall purpose of conservation. To prove "beyond a reasonable doubt" that habitat requirements for a herd is or will be adversely impacted, when the herd is managed towards an increase or recovery is difficult, or impossible.

Legislation reflects the values of the population it is written to serve. Regardless of how well laws address environmental requirements, they will not be passed if people can or will not live according to the consequences. The ultimate cause of most environmental problems is increased consumption from a shrinking resource base by a growing population. The increased focus on endangered species protection is a symptom of our problems, rather than a cure.

In this chapter I have discussed applicable legislation for managing habitat for woodland caribou. I have suggested changes to these laws, as well as better use of existing legislation.

LITERATURE CITED:

Bergerud, A. T. and D. R. Miller. 1984. Antipredator tactics of calving caribou: dispersion in mountains. Canadian Journal of Zoology 62: 1566 – 1575.

Bulkley Consensus. 1996. Pamphlet prepared by the Bulkley Forest District, Smithers. Bulkley Valley Community Resources Board. 1996. Bulkley Land and Resources Management Plan. Volume 1:Consensus Management Direction. Province of British Columbia, May 1996.

Bustard, D., 1977. Caribou Observations – Hunters' Basin – Camel Humps Area. Fish & Wildlife Branch memorandum, Min. Environment, Lands and Parks, March 14th, 1977.

Canada Nature Federation, 2000. Environmental groups charge Chretien Government with abandoning endangered species. Press release, April 11th, 2000.

Cannings, S.G., L.R. Ramsay, D.F. Fraser and M.A. Fraker. 1999. Rare amphibians, Reptiles and mammals of British Columbia. Wildlife Branch and Resource. Inventory Branch, British Columbia Ministry of Environment, Lands and Parks, Victoria, British Columbia.

Conservation Data Centre, List of species at risk in BC (http:/www.env.gov.bc.ca/rib/wis/cdc, as of December 4th, 1999).

Elgie, S. 1998 Protected Spaces and Endangered Species. Pages 441 – 485 *in* E. L. Hughes, E., et al., editors, Environmental Law and Policy. Edmond Montgomery Publications, Toronto, Canada.

Endangered Species Protection Act (http:/www.nearctica.com/conserve/canlaw/canend2.html) as of July 9, 2000

Forest Practices Code of British Columbia (http://www.for.gov.bc.ca/tasb/legsregs/comptoc.htm, as of December 4th, 1999)

Gray, D. R. 1999. Updated Status Report on the Woodland Caribou (caribou des bois) *Rangifer tarandus dawsoni* and *Rangifer tarandus caribou* in Canada. Prepared for the Committee on the Status on the Endangered Wildlife in Canada (COSEWIC), September 1999.

Letter to Prime Minister , 1999. Letter to Prime Minister Jean Chretien signed by 680

Canadian scientists, Feb. 24th, 1999. http://www.zoology.ubc.ca/~otto/LTR-ENG.htm.

Ministry of Environment, Lands & Parks, 1991. Managing Wildlife to 2001: A discussion paper. British Columbia Ministry Environment, Lands and Parks, Wildlife Branch, Victoria, British Columbia.

Ministry of Environment, Lands and Parks, 1994. Provincial wildlife strategy to 2001. Maintaining British Columbia's wildlife heritage. British Columbia Ministry of Environment, Lands and Parks, Wildlife Branch, Victoria, British Columbia.

Ministry of Environment, Lands and Parks, 1999 a. Frequently Asked Questions (FAQ); Identified Wildlife Strategy (http://elp.gov.bc.ca/wld/identified/strategydocs/faq.htm, as of November 14th, 1999).

Ministry of Environmet, Lands and Parks,1999 b. List of Identified Wildlife, (http://www. elp.gov.bc.ca/wld/identified/index.html, as of December 4th, 1999)

Motor Vehicle (All Terrain) Act, (http://www.qp.gov.bc.ca/bcstats/96319_01.htm, as of December 5th. 1999)

Recreational Access Management Plan, 1997 for the Bulkley Portion of the Bulkley/Cassiar Forest District, British Columbia.

Seip, D.R.. 1991. Predation and caribou populations. Pages 46-52 *in* D. Heard and M. Williams, editors. Rangifer, Special Issue No. 7, 1991. Proceedings of the Fifth North American Caribou Workshop, Yellowknife, Northwest Territories, Canada.

Seip, D. R. and D. B. Cichowski. 1996. Population Ecology of Caribou in British Columbia. Pages 73 – 80 *in* K. Brown et al., editors. Rangifer, Special Issue No. 9, 1996. Proceedings of the Sixth North American Caribou Workshop. Prince George, British Columbia, Canada.

Sierra Legal Defence Fund (http://www.sierralegal.org/reports/wildlife2.html, as of November16th, 1999).

Stevenson, S. K. and D. F. Hatler. 1985. Woodland caribou and their habitat in

southern and central British Columbia. Volume 1. British Columbia Ministry of Forests, Victoria, British Columbia Rep. No.23.

Telkwa Caribou Herd Recovery Plan (1998), Telkwa Caribou Herd Recovery Team, BC Environment, Skeena Region of British Columbia, August 1998. Revised.

Wildlife Act of British Columbia, (http://www.qp.gov.bc.ca/bcstats/96488_01.htm, as of December 5th, 1999)

West Coast Environmental Law Association (WCEL) (http://vcn.ca/wcel/wcelpub/11686.html., and wcelpub/1998/12247.html, as of December 7th, 1998)

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8.0 TRADITIONAL ECOLOGICAL KNOWLEDGE OF THE TELKWA CARIBOU HERD AS SHARED BY BILL HOLLAND OF THE WET'SUWET'EN FIRST NATION

March 1st and July 30th 1999

Caribou were found throughout the Bulkley Valley, and migrated seasonally between Tweedsmuir and the Telkwa mountains. The caribou also travelled to the Microwave, Dennis Mountain, Nanika Mountain; to the Howson Range and through Telkwa Pass. When it was difficult to find food in the alpine during the winter, the caribou would normally be around the tree line feeding, and they would eat lichen off the trees.

In 1947, 250 caribou were seen as they crossed a river. The caribou were seen for two hours as they crossed the river. Caribou travelled in groups of never less than 40. Single animals were never seen travelling alone. The caribou would often travel single file.

The railroad came in 1910, and after this the caribou stopped using the valley. In the 1920's the moose came, and in the 60's and 70's the animals migrated out and headed north, and that is why there are so many caribou up north now. This is because of the railroad and the machinery. The mining exploration and the helicopter hunting were also important in reducing caribou numbers.

The clearcuts, burning and mining exploration has caused problems for grizzly and caribou, because it has reduced their cover. This is part of the reason the caribou headed north, as this is destroying their habitat. The use of snowmobiles in the Telkwas is a problem for the caribou, as this is scaring them, and causing noise pollution on their range.

There are several areas in and around the Telkwa Mountains that have been important for the caribou. The caribou herd had several birthing grounds in the Telkwa Mountains.

They chose moist areas for calving, as the calves' hooves are soft when they are born, and they need several days for the hoofs to harden. The slopes on the sides of the mountain were often used, these are not steep and provide important feeding areas. Feeding areas were also used during the rut. Calving areas were often next to these areas.

The slopes around the top of Peacock mountain south of Houston were used as a feeding area. On the southern side of the mountain was a calving area. An important winter feeding area is the forested areas surrounding Caribou Mountain. A calving area was located on the western side of the mountain. The southeastern side of the Snowmobile ridge is also a feeding area, as well as Emerson and Dockrill ridges. From these areas, and Goathorn Creek, the caribou had migration routes down the river valleys; heading north and east.

The plateau around the Camel Humps was an important feeding area; the moist section to the west of the Camel Humps was used as a calving area. Also Little Mountain, west of the camel Humps, was an important calving area. The caribou would also feed down in Hunters Basin, and the southern part of the basin was used as a calving area.

The mountains east of Starr Creek have been important as feeding areas, as well as the Eagle Ranges were the ridges to the northeast and south-east were used for feeding. A calving area was located at the northern side of the Eagle Range, and to the north and south of the feeding area by Starr creek. At the northern side of the Telkwa River, the caribou used the Caribou Play Mountain for feeding, and the southwestern side for calving; to the north and south sides of the river. The eastern side of the Howson Ranges were also used as a feeding area. A herd of eleven caribou was seen in the Howson range. Caribou also used the Telkwa Pass. Once a large group of caribou was seen there.

The caribou used to travel south of Mooseskin Johnny Lake (originally called Howson Lake) to cross between the eastern and western mountains in the Telkwa range. They crossed the Thautil River and travelled up Starr Creek or over the mountains northeast of Starr Creek.

The caribou were curious; they came down to check out the people and their horses and could be shot this way. It was often enough to wave something in the air, then the caribou would come down to investigate.

Mountain goats stayed in the alpine, and earlier 300 goats were seen there. The goats used the steeper terrain, and were abundant in the interior steep mountains in the Telkwas'. Several areas were important for the mountain goats. North of Loljuh Creek and up to the Hunters Basin, and east towards the Hankin Plateau, and the inner part of the ridges on the eastern side of the Telkwas'. Also the northwestern side of Caribou mountain. The most important area was just north of Loljuh Creek.

(The map on the following page shows caribou use areas and caribou movement routes, as drawn by Bill Holland).

TRADITIONAL ECOLOGICAL KNOWLEDGE OF THE TELKWA CARIBOU HERD
SHARED BY BILL HOLLAND, WET'SUWET'EN FIRST NATION

5 0 5 Kilometers

1:620,000

- City/Town
- Caribou Calving Areas
- Caribou Feeding Areas
- Caribou Migration Routes

9.0 SUMMARY AND MANAGEMENT RECOMMENDATIONS

In this chapter I summarise the findings of the study, and outline recommendations for management of the Telkwa Caribou Herd and its habitat.

Habitat use of reproductive and barren caribou cows 1999

Locations were obtained for 8 cows with calves and 8 without calves during the summer of 1999, to determine differences in habitat selection. The summer habitat use of reproductive cows was compared with habitat use throughout the year, to account for differences not attributed to calving.

Most cows gave birth in the alpine, in exposed areas free of snow. Some cows appeared to have given birth in higher elevation old growth forest, but as these calves were often first seen when several days old, there is less certainty in the cows' choices of calving location. Two cows calved on the top of a rocky ridge north-east of Hunters' Basin, and two cows with calves joined them in the middle of June. The group sometimes included barren cows. Although group compositions were more variable by early July, the four cows were frequently observed together. The ridge has good overview of the surrounding area and few access points, but did not appear abundant in food. The use of this ridge seems to show a trade-off between predator avoidance and the availability of fresh, high protein food at lower elevations. All four calves were found alive during the October survey.

Analysis shows a significant difference in mean elevation between reproductive and barren cows during calving time, with barren cows using lower elevations. Differences were not significant for the rest of the year, when most locations were obtained at or above 1600 masl. Of the 16 cows sampled, only one cow made extensive use of elevations below 1400 meters throughout the year. There was no difference in mean elevation between calving time and the rest of the year (1624 masl.) for reproductive

cows. Barren cows were found at a mean elevation of 1493 masl. during calving time, while the average was 1669 masl. throughout the rest of the year. Both reproductive and barren cows showed a narrower range in elevation use during calving time than for the rest of the year, but both sample sizes are also smaller for this time period.
During calving time, 4 of the 8 reproductive cows used a narrow band of high elevation habitat around 1800 masl.; higher than during the rest of the year. Though the ranges showed more overlap between the seasons for the other 4 cows and their calves, they were found to mostly utilize elevations between 1000 and 1600 masl. during calving. For barren cows, there were 4 animals found usually 1400 – 1800 masl., while the rest were located mostly between 1000 – 1400 masl.

Cow/calf pairs in the Telkwa Herd remained relatively stationary until the middle of July. After this some pairs made long distance movements, in one case crossing the Telkwa River and walking north to Hankin Lake, a distance of over 50 km over a few days. The pair later returned to the Telkwa Range. My impression is that some cows in the Telkwa herd were more sensitive in the first couple of weeks after calving, than during the rest of the year. Individual cows showed a wide range of behaviours in this respect.
At this time I can not comment on fidelity to calving areas within the Telkwa Herd. As most cows are transplanted it may take several years before this can be determined, considering that the transplant animals will require some time to explore their range, in particular if environmental conditions change.

The significant difference between barren and reproductive cows during calving time may to some extent be due to calving. There are however wide differences within each group. As 4 of 8 barren cows remained at high elevations (and presumably missed nutritional opportunities, at least in spring/early summer), this could be an antipredator strategy employed regardless of reproductive status. Based on this study, possible antipredator tactics for protecting a calf can not be distinguished from those that cows seem to utilize for their own protection.

Suggestions for protection of calving habitat are included within the recommendations of habitat management, as discussed below.

Survival of caribou calves 1999

During 1999, a caribou calf collaring project was initiated in the Telkwa Mountains. Objectives of the project were to gain a better understanding of causes and timing of calf mortality; to determine if habitat types were possibly correlated with higher calf loss, and to assess the influence of a cow's experience in the Telkwa Range as a factor in calf survival. Six caribou calves were captured, weighed and fitted with radiocollares. Most calves were approximately one day old at capture, and average estimated birthweight was 8.4 kg. Of the 6 calves, 3 died shortly after birth. One death was attributed to avian predation; most likely golden eagle, based on talon-like marks, and the method by which meat had been torn off the carcass. One calf appeared to have been abandoned by the mother. As with the calf killed by predation, this calf followed the capture crew after release, suggesting bonding between cow and calf had not yet developed. For the third calf, cause of death is unknown. During necropsy, the membranes inside the hides of the last two calves appeared dry, indicating dehydration. There were no signs of predation or scavenging on the carcasses. The remaining three calves were alive and still following their mother in April 2000.

Known calving time for Telkwa caribou range from May 26th (estimated from calf observed at a later date) until June 10th. Five calves were counted in 1998. At least one calf is known to have survived over the winter. In 1999, 12 calves were counted, and an additional cow was seen with an extended udder, indicating she had given birth and lost her calf. The calf estimated to have been born on May 26th was larger and more mobile than other calves, suggesting this was an early birth in the Telkwa Herd. Only one resident birth is dated (June 10th), and it is therefore not possible to determine potential differences in calving time between transplanted and resident animals.

Three calves died as described above, leaving 9 calves, of which 8 were found alive in October. Calf data from 1998-2000 do not allow for meaningful estimates of survival, but indicate that low production is a factor of equal or perhaps higher importance than the loss of calves. The ratio of bulls to cows during fall 1999 seems sufficient to ensure normal pregnancy rates, in particular as most caribou were associated in herds including at least one mature bull.

Handling of newborn caribou calves

In this section I provide recommendations on capture and handling of caribou calves. Recommendations are based on experiences from the 6 calves collared in the Telkwa Mountains during 1999, as described in chapter 5:

- Allow at least 5 – 6 hours from the detection of the calf until handling. Even calves discovered immediately after birth (age may be difficult to determine from a distance/aircraft) will thus have time to complete a few series of nursings. This, and time for the cow to lick, clean, and thereby recognize her calf by scent, increases the chances of a strong bond being established before human interference.
- Attempt same-day capture when possible. The long days of late May/early June should allow for this even when calves are discovered on an afternoon flight. Permitting time for bonding must be balanced against the chance of successful capture – calves quickly become mobile. Allowing too much time, e.g. until the next morning, will likely reduce capture success.
- Wear a clean jacket/sweater and plastic gloves for each handling. This minimizes human scent on the calf, and transfer of scents between calves. Particular precautions should be taken not to wear clothes at any time worn during handling of possible predators, including dogs.
- Design capture protocol with the terrain where calves are likely to be born in mind. The calving areas of Telkwa cows were in relatively rugged terrain, where a calf is more easily captured than on flat tundra.

- Maintain a continuous evaluation of the program, and make changes throughout if required. For a herd at risk the decision to continue handling calves; given losses likely attributed to human interference, must be constantly assessed. Where individuals can be recognized, note the response of each cow for the future. If during a multi-year study a cow is found to abandon her calf once, discontinue the capture of her calves.

Habitat suitability for the Telkwa Herd (1997 – 2000) based on ranks

Studies of other transplanted caribou indicate that relocated animals may be more sedentary than resident caribou. Loss of traditional migration routes could influence dispersal, densities and movements between groups, and create small sedentary herds. Locations were obtained for the Telkwa Herd from November 1998 – April 2000, to determine habitat characteristics/terrain variables selected by Telkwa caribou, in order to predict suitable habitat for animals dispersing into surrounding areas.

Telkwa caribou appear to select for high elevation habitat at moderate slopes. Both now and historically the alpine plateaux in the Telkwa Range have been important for the herd. Especially important are the areas surrounding Hunter's Basin and the Camel Humps, in the northwestern part of the Telkwa Range. This is also an important calving area. Although no research was completed on food during this study, I believe these plateaux provide generally good access to lichen. The plateaux are interspersed with pockets of wetlands within easy access of the alpine areas. I often observed caribou in such areas and believe they are important in providing protein-rich sources of food. Moose were also often seen in these high elevation meadows. Likely these areas bring caribou in close contact with moose, and thereby wolves; creating a trade-off between the nutritional value of wetland plants and increased predation risk.

Areas of elevations > 1700 masl. are used above availability, as well are elevations 1100 – 1700 masl. with slopes 16 % and above. Elevations below 1100 masl. are all showing use below availability. Slopes > 45 % and above 1100 masl. receive use above

availability, indicating that in addition to the rolling alpine plateaux in the Telkwa Mountains, caribou make extensive use of the steep rugged mountains. On one occasion, a band of caribou was observed within a few hundred meters of a group of mountain goats, both on an alpine plateaux; the goats closest to the edge. Although goats were generally in steeper terrain, caribou and goats were seen relatively close together on several occasions. Low elevation with gentle slopes is the class with highest availability, making up more than 30 % of the study area. It is important to keep in mind that caribou have already made a significant selection of habitat by remaining in the mountains.

While certain animals have made extensive use of forest, the majority of animals have spent most of their time above the tree line during this study. Use of forest is lower than availability for all age classes of trees. The forest 141 – 250 years old received the most use; it is also the most available class. The class of trees > 250 years old are given the highest rank. Caribou in forested habitat mostly use forests >100 years, but appear to select for forests > 250 years of age. The Telkwa Caribou herd is known to utilise both arboreal and terrestrial lichens during winter.

'Warm' aspects, 136 – 315 degrees (southeast through northwest) received the highest ranking. Because Telkwa caribou spend much time on mountain plateaux, the significance of aspect selection should be interpreted with this in mind. The plateaux are rarely completely flat, thus most plateau-locations will report a value for aspect. The ridge where 4 cows and their calves spent much of their time in the early summer of 1999, faces north. There may have been other advantages of this north-facing habitat, but I suggest this location was chosen due to its inaccessibility for predators. Nevertheless, the amount of locations obtained from this ridge added substantially to the number of 'cold aspect' locations.

I did not conduct any manipulative studies on the effects of snowmobiles or other motorised vehicles. However, observations from telemetry flights throughout the winter of 1999/2000 suggest that caribou continuously tried to move away from snowmobiles. They seem to have certain preferred ridges; movements off and onto these areas appeared

correlated to the amount of snowmobile traffic. Although I never observed interactions between caribou and dogs, it is likely that the presence of dogs could cause Telkwa caribou to avoid areas of otherwise suitable habitat. This is particularly important during calving time, when cows may be extra sensitive to disturbance.

Recommendations for managing habitat for the Telkwa Caribou Herd

In this section I provide recommendations for management of habitat for the Telkwa Caribou Herd. Recommendations are based on findings on habitat use of the Telkwa Caribou Herd 1998 – 2000, as described in chapter 4 and 6. Following these suggestions are possibilities for implementing recommendations for management.

- Consider habitat suitability (Chapter 6) when making land management decisions within the range of the Telkwa Herd. Management decisions affecting caribou habitat should be made in co-operation between MELP and the Bulkley- and Morice Districts.

- Maintain large, connected areas of old forests within the range of the Telkwa Herd, particularly of trees > 250 years and older. Distribution of forested areas should consider caribou needs to space out within their range.

- Protect corridors between suitable areas (both alpine and forested), as defined on the habitat suitability map (Chapter 6).

- All access to Hunter's Basin and the surrounding area, including the Camel Humps plateau should be closed until the herd is considered not at risk, or alternatively recovery is deemed unsuccessful. Hunters Basin appears to function as a corridor from the ridge used extensively by cows and their calves, to the Camel Humps plateau. As this is the only access to the plateau from the calving area, it is critical that cows and calves can move freely.

- During calving time (late May – mid July) access to Webster Ridge should be closed.

- Changes in calving habitat should be noted each year. New areas taken in use should be incorporated as a priority in habitat protection together with already established calving sites.

- Snowmobiling should be prohibited in the Telkwa Caribou Herd Recovery Area outside the Winter Motorised Zone. The border of this zone should be moved from the valley bottom north of the plateau, to the northern edge of the plateau. This would reduce disturbance on the ridge that lies in between, a ridge which caribou use extensively.

- Starr Creek should be designated a non-motorised area. This area provides a natural corridor for caribou exploring the area surrounding Burnie Lakes as a wintering area, and caribou are already using these areas during summer.

- Trails for motorized or non-motorized recreation should not be built in the Telkwa Mountains, until the herd has recovered to 150 – 200 animals or recovery is deemed unsuccessful.

- Dogs should not be allowed in areas designated for non-motorised or motorized access. Even dogs which excelled during obedience training probably smell, move and look like wolves to a caribou.

- The applicability of the habitat suitability map should be tested. Radiocollars fitted on transplanted animals will likely last another couple of years; data collected in the next 1-2 years should be examined to make necessary changes in priorities for habitat protection. Looking at the habitat use of animals using habitat outside that of the main part of the Telkwa Herd could provide good

indications to future habitat use form the herd and migration routes between feeding areas.

Possibilities for implementing habitat management recommendations:

Below are some suggestions for implementing habitat measurements and raising public awareness regarding protection of the Telkwa Caribou Herd. Some of these possibilities have already been explored during the course of the recovery process. The availability of some of these measures depend on continued funding for the project, and the feasibility considering the status of the herd at the time.

LRMP processes:

Including the needs of species at risk (including the Telkwa Caribou Herd) in the terms of reference for LRMP stakeholder negotiations is an important first step towards habitat protection (Chapter 7). Some LRMP processes are completed or underway, which may limit the ability to respond to new knowledge of caribou habitat use in the Telkwa Caribou Recovery Area.

- Complement Bulkley/Morrice Forest District habitat protection zones. Habitat zones are already established for both districts. These should be followed when stakeholders are establishing LRMP priority zones for the Morice District. This would likely maximise the potential of the protected areas, and thus benefit both caribou and other users of the Morice portion of the Telkwa Caribou Recovery Area. In particular, resource extraction and recreation use in the southern part of the core area should be minimised, especially the Meat Cache Corridor and Emerson Ridge.
- Forest licensees and mining companies will have access to areas for resource extraction as specified during the LRMP zoning process, provided that access roads are deactivated after use. Deactivation should be such as to discourage both summer and winter motorized use.

- Recreation in the Morice part of the recovery area should be part of the initial LRMP negotiations between stakeholders, thus avoiding the passing between MOF and MELP later in the process. For future LRMP processes in the surrounding areas, this would ensure that potential conflicts between recreation and protection of species at risk are addressed from the onset of the process.

Forest harvesting

Forest harvesting occurs throughout the Telkwa Caribou Recovery Area, and cooperation between MOF, MELP, and licensees is needed to provide habitat (both food and space) for the Telkwa Caribou Herd.

- When negotiating timber harvesting with forest licensees, the goal should be avoiding clear-cuts of large areas in the Telkwa Caribou Herd Recovery Area. This may not be possible for an area of this size. Therefore, emphasis should be placed on preserving large forested areas on the northern and western sides of the Telkwa Mountains, as well as areas surrounding Howson River and Starr Creek. Protection efforts would change according to the size and distribution of the caribou herd. As suggested by the Telkwa Caribou Standing Committee (TCSC), forested areas of 500 - 1000 ha areas should be preserved where possible.
- When planning new cutblocks/access roads (particularly between Mooseskin Johnny Lake and the Telkwa River, and north of the Morice River), ensure the presence of old growth areas as corridors between high suitability areas. Corridors should ideally be a few hundred meters wide, and licensees should be required to maintain at least one corridor between feeding areas. The removal of this corridor must not be initiated until another, as approved by MELP, is available. Efforts to coordinate logging and caribou corridor protection should be done through the Telkwa Caribou Standing Committee, ensuring the cumulative areas of harvesting (all licensees in the area) are considered.
- Negotiations with licensees through the TCSC should also seek to reach agreements where logging/mining during the most critical period of calving time (last week of

May - middle of July), in particular in the forested areas surrounding Hunters' Basin are avoided/minimised.

Education/Media:

The use of public education and media has been an important tool in raising awareness about the Telkwa Caribou Herd and the need for protection of their habitat. The different avenues for public outreached outlined below vary in their requirement for time and personnel. Some are possible to carry out with volunteer help. Using volunteers would help disseminate knowledge of Telkwa caribou, and likely cause more people to work towards protection of the herd.

- Use signs to identify caribou areas, preferably with maps outlining the area. The map should display the different zones for human activity (motorised, non-motorised, etc.), and have a "You are here" sign displayed. Maps should be placed at trailheads, important forks in the road and at the start of roads leading into caribou areas. Extra signage should be used during calving time, to stress the importance of compliance at this time.
- A brochure sent out to households in Smithers, Telkwa and Houston would help increase awareness of the Telkwa caribou, and update the public on the current status of the herd. The brochure should include a map as described above, and outline what the public can do to assist the recovery of the herd (avoiding use of certain areas, do not bring dogs, reporting sightings, etc.). An update (e.g. once a year) outlining current research and the situation of the herd could be sent to households and/or be made available at the front desk at MELP. This could also show people that their cooperation in staying out of certain areas etc is helping the caribou, thereby increasing public support for habitat protection.
- Newspaper adds could be placed in the papers at calving time, including a map of areas MELP request that people do not use during late May – middle of July. The adds should emphasise that no dogs should be taken in to the Telkwa Caribou Recovery Area.

- Having a booth or display at the Fall Fair in Smithers is a possible way to reach out to a large number of people in the area. The public would be able to learn about the areas used by the current Telkwa Caribou Herd, and what they can do to help recovery of the herd (as described above). If possible, MELP staff or volunteers would be present to answer questions related to caribou habitat use and recreation.
- Volunteers monitoring access points and requesting compliance from recreational users could be a possible solution for critical areas/times, such as watching the Hunters' Basin trailhead during caribou calving time. Volunteers may be recruited from environmental – or recreational organizations, MELP/MOF or other persons interested in the Telkwa Caribou Herd.

Recreation:

Working with the various recreational user groups will be important in continuing habitat protection for Telkwa caribou. Meetings and negotiations should emphasise the need for more habitat by a growing herd, thus areas receiving little or no current use could become important in the future.

- Future forest harvesting on the slopes of Emerson Ridge may open up access for motorized use. Cooperation between stakeholders (licensees, MELP, MOF and snowmobile organisations) is required to ensure the continued protection of Emerson Ridge. Legislation prohibiting motorised use of this area (before use is established) may be required, also for the Meat Cache Corridor.
- Negotiations with motorized user groups should emphasise that much of the highly suitable caribou habitat is already motorized (the snowmobile plateau west of the Houston Snowmobile Club's cabin, the Microwave plateau). Considering the need for wintering areas for a larger caribou herd, it would be wise to not open/promote new areas for motorized use in the alpine areas surrounding the Telkwa Mountains.

In this chapter I have summarised the findings of this study. I have also outlined recommendations for management of the Telkwa Caribou Herd and its habitat.

Appendix 1.

Variable classes for terrain and habitat attributes.

Elevation (m)	Class
< 1100	1
1100 – 1700	2
> 1700	3

Slope (%)	Class
0 -15	1
16 – 45	2
> 45	3

Curvature (75 and 200 m cells)	Class
0 - 100	1
101 - 1000	2
1001 - 2000	3
> 2000	4

Aspect (°)	Class
136 - 315	1
316 - 135	2

Forest Age (years)	Class
1- 40	1
41 - 100	2
101- 140	3
141 - 250	4
> 250	5

Crown Closure (%)	Class
0 - 5	1
6 - 15	2
16 - 45	3
46 - 75	4
> 75	5

Habitat class	Class
Alpine (02)	1
Alpine forest (10)	2
Lake (15)	3
River (25)	4
Swamp (35)	5
Clearing (42)	6
Urban (52)	7
Other non-productive habitat	8
True fir (*Abies spp.*)	9
Alpine fir (*Abies lasiocarpa*)	10
Spruce (*Picea spp.*)	11
Lodgepole pine (*Pinus contorta*)	12
Aspen (*Populus tremuloides*)	13
Hemlocks (*Tsuga spp.*)	14
Other tree species	15

Appendix 2.
Snow-water equivalent measurements for two stations in the study area:

Hudson Bay Mountain

Year	1-Jan	1-Feb	1-Mar	1-Apr	1-May	15-May	1-Jun	15-Jun	Sum	Sum/# meas.
1972		404	544	663	737	620	437	0	4051	486
1973		605	701	780	787	645	533		3416	675
1974		427	493	554	538	528	531	345	2501	488
1975		317	391	457	523	455	358	0	5169	357
1976	470	665	719	846	785	752	729	673	2155	705
1977	226	317	411	500	457		244		2529	359
1978	269	307	378	442	447	404	282		3340	361
1979	315	388	499	547	555	558	478		1699	477
1980	135	221	287	356	363	246	91		2782	243
1981	204	313	385	438	595	511	336		3341	397
1982	215	377	475	531	563	545	493	142	2011	418
1983	176	299	370	396	378	343	49		2731	287
1984	234	294	375	422	454	453	388	111	3450	341
1985	280	309	454	536	649	649	363	210	2849	431
1986	199	293	348	460	489	506	414	140	2727	356
1987	221	330	421	495	502	408	287	63	2334	341
1988	194	311	416	475	426	293	181	38	2738	292
1989	255	413	484	564	568	299	155	0	3182	342
1990	305	446	560	616	577	499	149	30	3266	398
1991	423	484	608	618	574	402	143	14	4261	408
1992	457	616	700	679	661	600	370	178	1889	533
1993	271	318	324	378	412	186	0	0	2296	236
1994	207	313	431	477	431	322	115	0	1991	287
1995	280	328	380	432	381	190	0	0	3711	249
1996	336	463	513	520	598	597	447	237	3759	464
1997	394	477	568	698	707	467	380	68	2111	470
1998	272	342	414	463	460	160		0	3242	302
1999	312	357	432	475	458	448	443	317	0	405
									79531	11108
										Average=396

McKendrick Creek

Year	1-Jan	1-Feb	1-Mar	1-Apr	1-May	15-May	1-Jun	15-Jun	Sum	Sum/#meas.
1968		325	356	376	277				1334	334
1969		208	224	203	0				635	159
1970		190	224	203	0				617	154
1971		302	361	290	142				1095	274
1972		391	427	422	259	0			1499	300
1973		378	417	335	0	0			1130	226
1974	264	333	371	310	239	0			1517	303
1975		249	267	254					770	257
1976		376	427	363	201	0			1367	273
1977		239	310	173					722	241
		224	244	170					638	213
1978										
1979		277	288	253					818	273
1980		196	247	145					588	196
1981		204	183	241					628	209
1982		329	356	341					1026	342
1983		200	205	80					485	162
1984		192	216	172					580	193
1985		261	310	302	252			0	1125	225
1986		177	235	194	127			4	737	147
1987		238	287	246	87			0	858	172
1988		234	231	151	28			0	644	129
1989		260	302	262	28			0	852	170
1990		279	335	236	56			0	906	181
1991		295	320	203	50				868	217
1992		344	327	226					897	299
1993		218	233	108					559	186
1994		301	292	214					807	269
1995		190	228	179					597	199
1996		293	323	229	166				1011	253
1997		381	398	350	156			31	1316	263
1998		230	243	201					674	225
1999		279	301	253					833	278
									28133	7322
										Average= 229

Appendix 3

Schedule for study of calf survival in the Telkwa Caribou Herd

The study was divided in three phases, which may overlap.

Phase 1 ; Searching for calves (fixed wing)
Phase 2; Collaring calves (helicopter)
Phase 3; Radio-tracking to determine mortality of collared calves (fixed wing)

Phase 1;
- Started 26th of May and continued every second day until the first calves were detected. Overlapped phase 2 and 3 as insufficient number of calves (10) were found and collared during the first helicopter flight.

Phase 2;
- As soon as the first calves were detected we used a helicopter to get close and the calves were captured on foot by a capture crew of 3 people. Calves were weighed, sexed, aged and fitted with radio collars. Because of the timing of births and dispersion of caribou cows; more than one helicopter flight was needed to collar calves. A helicopter flight was carried out during the second week of June to determine reproductive status of all collared cows (hard antlers present / absent; presence of udder; calf present / absent).

Phase 3;
- Radiocollared calves were monitored daily for the first three months to increase the chance of detecting mortalities, as movement of carcasses by predators may prevent the radiocollars from switching to mortality mode.
- Monitoring of calves coincided with the regular monitoring flights every two weeks, and visual observation of all collared animals was attempted on the regular flights. On all other flights it was sufficient to ensure that live signals were found for every calf.
- During September and October flights were conducted weekly.
- After October calves were monitored as part of the regular flights for the whole Telkwa Herd.

Mortality investigations
When a signal was on mortality mode or a carcass detected visually, we went to the site by helicopter and conducted a mortality investigation. Depending on the situation, predators may be chased away to determine if they actually killed the calf or were scavenging. The scene was photographed and the calf taken back to the lab for necropsy. Carcasses were removed to reduce predator attraction to a site where other calves or adults were present.

Criteria for determining age of caribou calves From Miller et al.(1988), Haugen and Speake (1958) and Johnson (1951).	**Estimated age(d)**
Appearance of body	
1. Long legged and relatively big headed in proportion to the size of torso, humped posture, wobbly or unable to stand	< 1
2. Legs and head in proportion to torso, erect posture, sturdy	>1
Condition of pelage	
1. Encased in placental sac	0
2. Pieces of placental tissue adhering to calf's pelage or pelage soaked, hair matted down (not related to ambient wetness)	0 - <1
3. Pelage dry, and inside of ears dry	≥ 1
Umbilical cord	
1. Present	0-7
a) Fleshy and wet to touch	≤ 1
b) drying and beginning to wither, still soft or lightly scabbed	1- 3
c) dried and withered, dry scab ½ to ¼ inch	1- 7
2. Absent, or ¼ to 1/8 inch dry scab	7 +
Degree of hoof wear	
1. Hooves yellowish, translucent cartilage on tips (never walked)	0 - <1
2. Hooves blackish with lighter yellowish translucent or opaque areas; cartilage dark and dried on tips; showed no wear (might have walked but never traveled)	0- 3
3. Hooves blackish with some semitranslucent areas near tips; showed no wear (walked but never traveled), hooves black, slight wear or scratches on 3rd and 4th digits (might have traveled some), hooves black; showed wear on 3rd and 4th digits worn, (minimum travel), dew claws hard	1-3
4. Hooves black; 3rd and 4th digits worn; dew claws scratched (traveled)	4 -7
5. Hooves black, 3rd and 4th digits and dew claws well worn (well traveled)	4 -7+
Stomach contents	
1. Empty (meconium contents) never nursed or fed on vegetation	< 1
2. Milk curds, no vegetation	≤ 1
3. Milk curds with trace of vegetation	1- 3
4. Milk curds mixed with a little vegetation	≤ 3
5. Vegetation only (sign of malnutrition and starvation)	< 7
6. Some, little or no milk, considerable vegetation (no sign of malnutrition or starvation	7 +

Calf capture information Date:_____ Capture # _____

Cow frequency #_____ Calf frequency #_____ Magnet off ☐

Sex: M☐ F☐

Weight (kg) _____ Age estimate (d)_____ Weight adjusted _____
Age of calf :

Appearance of body

1. Long legged and relatively big headed in proportion to the size of torso, humped posture, wobbly or unable to stand
2. Legs and head in proportion to torso, erect posture, sturdy

Condition of pelage

1. Encased in placental sac
2. Pieces of placental tissue adhering to calf's pelage or pelage soaked, hair matted down (not related to ambient wetness)
3. Pelage dry, and inside of ears dry

Umbilical cord

1. Present
   a) Fleshy and wet to touch
   b) drying and beginning to wither, still soft or lightly scabbed
   c) dried and withered, dry scab ½ to ¼ inch
2. Absent, or ¼ to 1/8 inch dry scab

Degree of hoof wear

1. Hooves yellowish, translucent cartilage on tips (never walked)
2. Hooves blackish with lighter yellowish translucent or opaque areas; cartilage dark and dried on tips; showed no wear (might have walked but never traveled)
3. Hooves blackish with some semitranslucent areas near tips; showed no wear (walked but never traveled), hooves black, slight wear or scratches on 3rd and 4th digits (might have traveled some), hooves black; showed wear on 3rd and 4th digits worn, (minimum travel), dew claws hard
4. Hooves black; 3rd and 4th digits worn; dew claws scratched(traveled)
5. Hooves black, 3rd and 4th digits and dew claws well worn (well traveled)

Closure: Date:_____ Reason:_____

Mortality investigation Date _____ Mortality # _____

Collar frequency # _____

Sex: M ☐ F ☐

Weight (kg) _____ Found by: Mortality signal ☐ Visual observation only ☐

Examination of site:

Presence of tracks _____

Scats found _____

Presence of other sign _____

Signs of digging _____

Attempt to bury (portion buried) _____

Examination of carcass :

Position _____

Portion of carcass found _____

Marks (type and position) _____

Other injuries (broken ribs etc.) _____

Condition and position of collar _____

Cause of death: _____

Unknown ☐

"There is more territory available to us than we can see in a lifetime.. A small area closed, to afford an opportunity to another species is a small sacrifice."

Anonymous response, TCHRP public review process.