

10.0 SPECIES - HABITAT MODEL FOR WOODLAND CARIBOU

Common Name:	Woodland Caribou (Northern Ecotype)
Scientific Name:	<i>Rangifer tarandus caribou</i>
Species Code:	M-RATA
B.C. Status:	Northern Ecotype is Yellow-listed; Mountain Ecotype is Blue Listed (B.C. CDC, 1999)
Identified Wildlife Status:	None
COSEWIC Status:	Western populations were designated as vulnerable in Canada, following a review in 1984 (COSEWIC, 1997).

10.1 Introduction

Woodland caribou conservation has been a high profile resource management issue in British Columbia for many years, primarily because of the conflict between forest harvesting and conservation of caribou habitat (Seip, 1996). Most studies of habitat use have focused on the woodland caribou populations in the southeast part of the province due to the more immediate conflicts between forest harvesting, development, and declining populations in that area (Stevenson, 1991). However, with the increasing demands for forest products throughout the province and decreasing availability of these resources, the focus has expanded to include woodland caribou populations in the northern parts of the province (Wood, 1996). Presently, only three major studies completed in B.C. have focused on the northern caribou ecotype: Terry and Wood (1999) (Omineca Mountains), Hatler (1986) (Spatsizi Wilderness Area), and Cichowski (1989) (Tweedsmuir). The Omineca and Tweedsmuir studies were related to forest harvesting concerns.

Currently, Slocan Group, Mackenzie is conducting work on the same herds studied by the Peace/Williston Fish and Wildlife Compensation Program (Wood and Terry, 1999; Terry and Wood, 1999; Wood, 1996) in order to obtain more detailed information on caribou habitat use. The continued collection of data will aid in making responsible management decisions for both forestry and caribou in the area.

The recent (1999) Terrestrial Ecosystem Mapping (TEM) of the Klawli landscape unit for Slocan F.P. Ltd. Mackenzie included habitat interpretations for caribou. This exercise serves as an initial step towards understanding the relationships that exist between caribou and the ecosystems mapped and described through the TEM process. At this time, the model has not been verified for the area, and it is therefore predicted to have at best a moderate reliability. However, it is hoped that results from current fieldwork by Slocan F.P. Ltd. can be used to further refine the model over the next few years.

Information from past studies in northern British Columbia (Hatler, 1986; Murray, 1992; Cichowski, 1989), recent research and surveys within the Mackenzie Forest District (Wood, 1996 and 1998; Terry and Wood, 1999, Wood and Terry, 1999), and where applicable, information from outside of northern B.C., have been incorporated into the species account.

10.2 Distribution

Caribou inhabit the arctic tundra, alpine tundra, and northern boreal forests of North America, Russia, Norway, Sweden, and Finland. The caribou of northern North America and the reindeer of northern Europe and Asia are considered to belong to a single widespread species (*Rangifer tarandus*), although, there are some well-marked geographical subspecies (Banfield, 1977). There are six recognized subspecies in North America, one of which is presently found in British Columbia: *R. t. caribou* (Woodland Caribou)

(Banfield, 1977). Woodland caribou range from southeastern Alaska and the boreal regions of Canada from B.C. and the Yukon Territory to Newfoundland.

10.2.1 Provincial Range

All caribou in British Columbia belong to the subspecies *Rangifer tarandus caribou* (Seip and Cichowski, 1996). They range across the northern part of the province and as far south as Tweedsmuir Provincial Park and the southern Kootenays where populations are discontinuous (Nagorsen, 1990). Based on behavioural and ecological differences they can be further classified into three different ecotypes: the mountain ecotype, the northern ecotype, and the boreal ecotype (Heard and Vagt, 1996).

Mountain caribou occur in the rugged mountains of southeastern B.C. and spend most of the year in alpine and subalpine habitats. They winter at high elevations and rely primarily on arboreal lichens for food because the deep snowpack in this region prevents them from cratering for terrestrial foods (Seip and Cichowski, 1996; Stevenson and Hatler, 1985).

Northern caribou are found in the mountains of northern and western British Columbia where there is low snowfall relative to mountain caribou habitat. They generally summer in mountainous areas and winter in mature low elevation lodgepole pine or black spruce forests or in windswept alpine areas. Low snow depths in these habitats allows northern caribou to crater for terrestrial lichens, which are their primary forage during the winter (Heard and Vagt, 1996; Seip and Cichowski, 1996).

Boreal caribou are found in the boreal forests of northeastern B.C. where they occur in small, dispersed groups that are relatively sedentary throughout the year. Sometimes authors lump the boreal ecotype and northern ecotype together (referenced to as the northern ecotype) (Heard and Vagt, 1996).

The British Columbian caribou population was estimated at a total of 18,000 animals in 1996. Of these, approximately 2,300 were mountain caribou and 16,000 were northern and boreal caribou (Heard and Vagt, 1996).

Woodland caribou occurring within the Mackenzie Forest District of North-Central B.C. are assumed to belong to the northern caribou ecotype. The Morfee Mountain herd located near the town of Mackenzie are the only known exception that behave like the mountain ecotype, using the upper ESSF in the mid-winter and foraging predominately on arboreal lichens (Wood and Hengeveld, 1998). The Wolverine Caribou Herd, which occupies the Klawli landscape unit study area during different times of the year, belongs to the northern ecotype and is therefore their habitat requirements are the focus of this species account.

10.2.2 Distribution in the Project Area

The relative abundance of caribou within the study area, based on provincial distributions, is rated as moderate (1 caribou per 3.4 km² to 25 km²) to plentiful (over 1 caribou per 3.4 sq. km) (Fish, Wildlife and Habitat Protection Department, 1994).

Caribou that are present within the Klawli TEM study area belong to the Wolverine Caribou Herd (WCH), estimated at between 262 and 580 animals (Wood, 1998). The WCH has been studied closely since 1991 and is known to inhabit the Klawli landscape unit during the early winter and summer months (Figures 29 and 30) (Terry and Wood, 1999; Wood and Terry, 1999). However, most of the herd spends the majority of the year in the Wolverine and Germansen landscape units to the north and northeast of the Klawli area (Mari Wood pers. comm.).

Summer use by the WCH is considered to be limited within the Klawli, with individuals and small groups spread throughout the Klawli and adjacent landscape units (Figure 29). In comparison to the summer, habitat use during the early winter can be quite high, with large numbers of caribou moving into the area to feed on terrestrial lichens and other available forage (Mari Wood pers. comm., 1999; Terry and Wood, 1999; Wood and Terry, 1999).

Spring use of the Klawli area is considered minor. To date calving records for the area are limited with one record from the Adade Yus Mountains at the southwestern periphery of the study area, and another from the South Germansen River area at the northwestern periphery of the study area (Mari Wood, pers. Comm., 1999). Late winter use of the Klawli area is also considered to be limited to absent, due to deep snow depths occurring in the area at that time of year (Figure 30) (Wood and Terry, 1999).

The Klawli study area contains a wide range of habitat, from the low plateaus and valley country of the SBS and BWBS (a small component of the area), the higher elevation plateaus of the ESSF (predominant throughout the area), to ESSF parkland and alpine tundra (AT) at the highest elevations. Table 2 lists the area and percentage of cover by each zone and subzone within the Klawli study area. Caribou are expected to utilize all

biogeoclimatic zone, subzone and variant combinations that occur within the Klawli study area for food (see Table 57). For information on caribou observations and evidence of use during fieldwork for this project, refer to section 3.5.8.

Table 57: Expected Northern Caribou (Wolverine Caribou Herd) Occurrence within the BEC Zone, Subzone, Variant Combinations Found within the Klawli Study Area.

Ecoprovince	Ecoregions	Ecosections	BEC Variants	Expected Occurrence
Sub-Boreal Interior	Omineca Mountains	Manson Plateau (MAP)	AT	•
			ESSFmv3	•
			ESSFmvp3	•
			SBSmk1	•
		Southern Omineca Mountains (SOM)	BWBSdk1	•

Legend: • = occurs in the variant

10.23 Elevational Range

Topographic relief over the entire study averages 1000 m, and ranges from the heights of Mount Germansen at 1926 m down to Klawli Lake at 997 m. Most of the land that lies below 1200 m occurs within the southern half of the study area. At some time during the year, caribou are expected to utilize habitat present at all elevations within the study area.

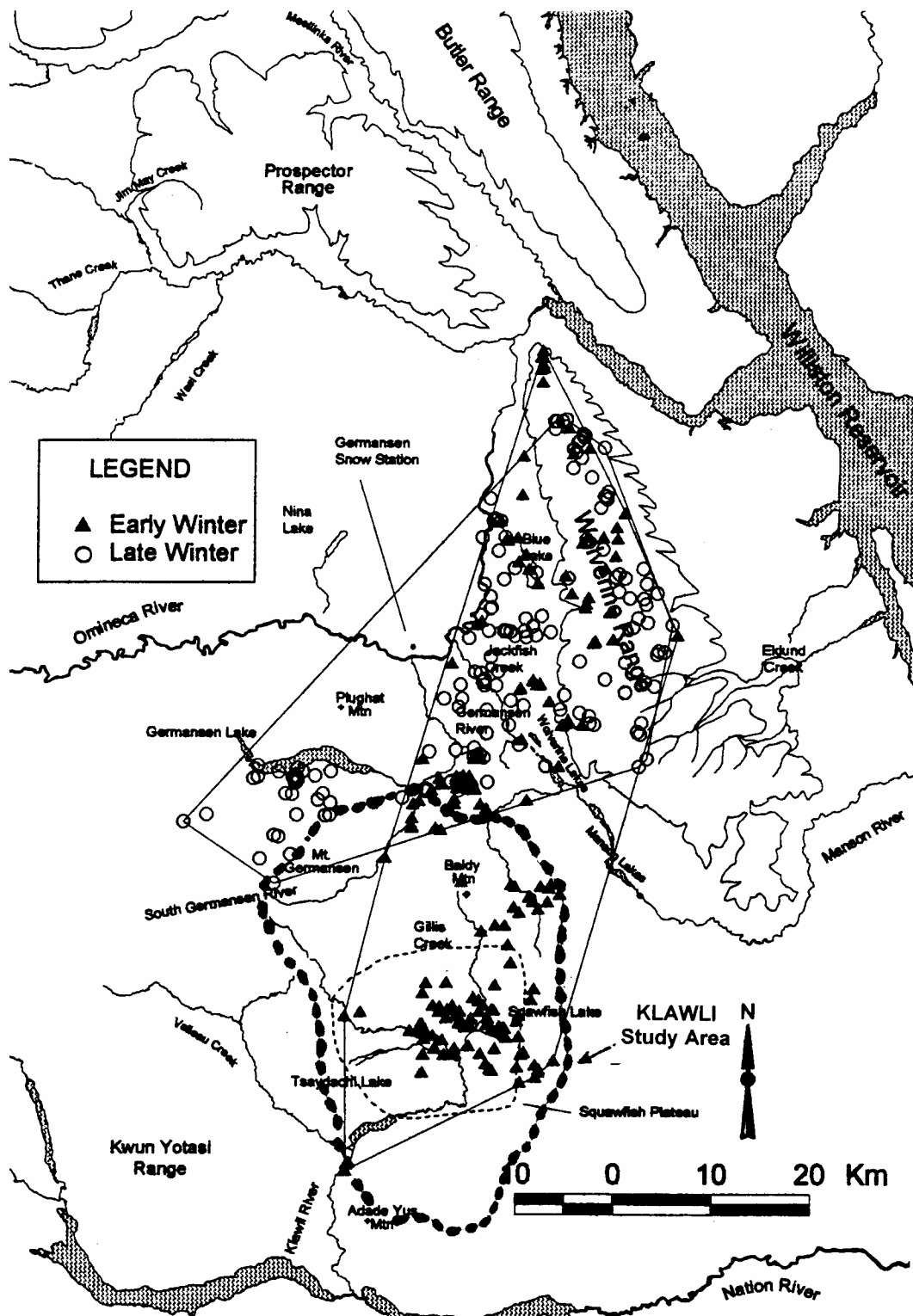


Figure 29: Early and Late Winter Locations of Radio-Collared Caribou in the Wolverine Caribou Herd (1994-1997) (Terry and Wood, 1999), in Relation to the Klawli Study Area

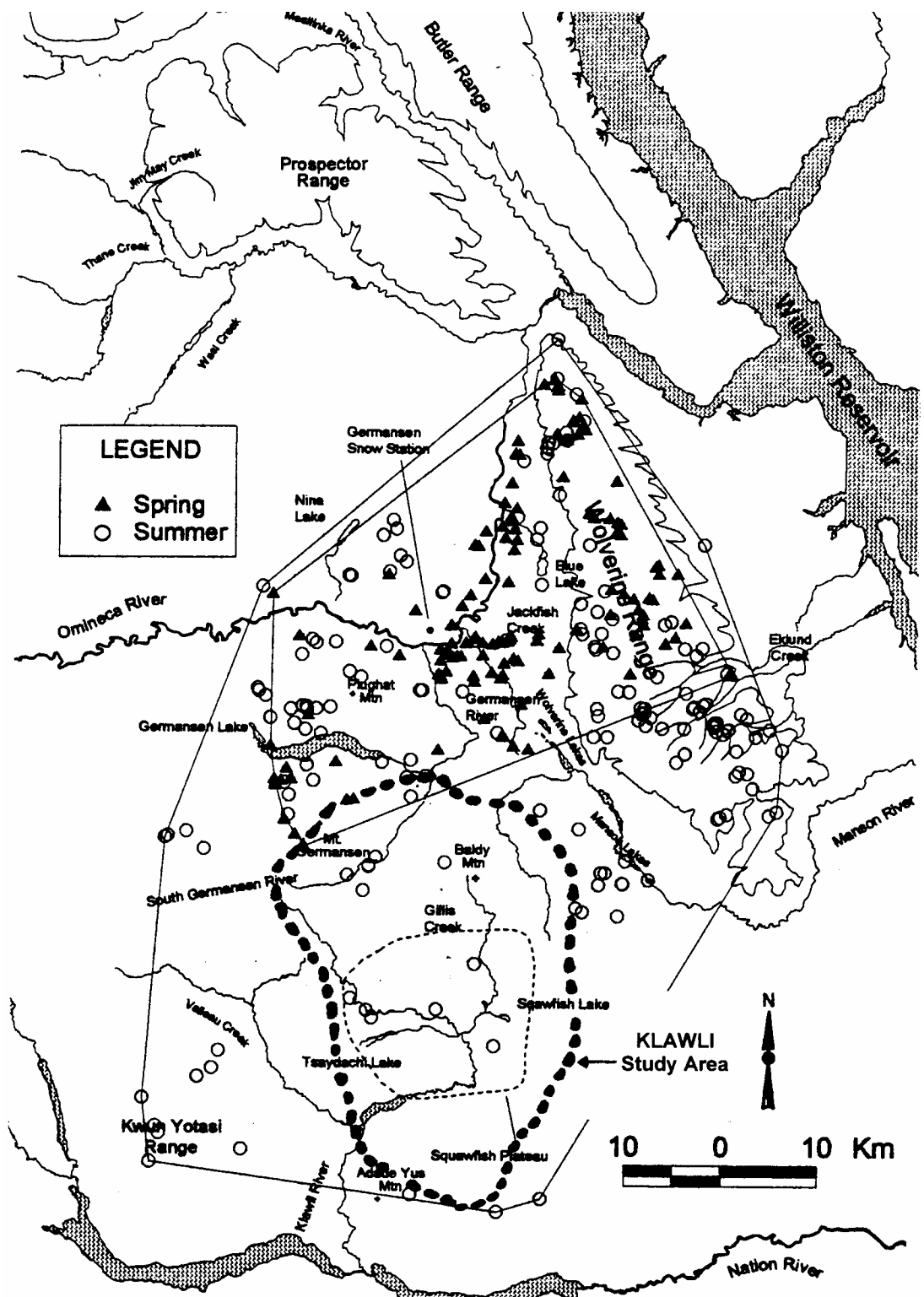


Figure 30: Spring and Summer Locations of Radio-Collared Caribou in the Wolverine Caribou Herd (1994-1997) (Terry and Wood, 1999), in Relation to the Klawli Study Area.

10.3 Ecology and Habitat Requirements

Unlike their barren ground counterparts, woodland caribou do not form large herds but instead move in relatively smaller groups (B.C. MELP, 1992). Northern caribou occupy large home ranges and migrate in response to seasonal habitat requirements. Generally they use high elevation forests and alpine habitat for calving, post-calving, summer, and rutting grounds and move to lowland forested areas in the winter (Fenger *et al.*, 1986). When snow conditions become prohibitive in the winter, caribou may move to windswept slopes in the alpine where terrestrial lichens are accessible (Heard and Vagt, 1996; Wood, 1996).

10.3.1 Seasonal Migration

Caribou are characterised by seasonal migrations, often over long distances, to frequent traditional calving, rutting, wintering, and post-calving ranges (Child and King, 1991). Caribou within the study area and elsewhere have shown fidelity to core areas for calving, for rutting, and to seasonal ranges (Terry and Wood, 1999; Wood and Terry, 1999; Farnell and McDonald, 1989; Hatler, 1986). Results from the WCH study 1994-1997 in North-Central B.C. (Terry and Wood, 1999) indicated that caribou made three separate, seasonal long distance movements throughout the year which included:

- early to mid May - moving from spring habitats to calving areas (20-45 km)
- early November - moving from summer and rut habitats to early winter ranges (20-50 km)
- early December to early January - moving from early winter range to late winter range.

Movements within the seasons were generally shorter and varied between 0.5-10 km (Terry and Wood, 1999).

In addition, seasonal vertical movement patterns were observed within the WCH. In general, caribou descended to lower elevations twice each year, once during spring (Apr-May) and again in early winter (Nov-Dec) (Terry and Wood, 1999; Wood and Terry, 1999).

10.3.2 Rutting

The rut generally occurs between late-September and mid-October (Fenger *et al.*, 1986). Alpine habitats appear to be preferred during the rutting period. The Klaza caribou herd in the Yukon moved to form large aggregations on rutting ranges on north aspect alpine areas (Farnell *et al.*, 1991). Rutting ranges were also found in the alpine by numerous authors including Farnell and McDonald (1990), Fenger *et al.*, (1986), and Terry and Wood (1999). Rutting generally occurs on, “gently sloping or rolling terrain with low vegetation where herd members are easily visible to each other” (Fenger *et al.*, 1986).

10.3.3 Predation

Predation is thought to be the major limiting factor for caribou, particularly in areas where the amount of usable habitat has been reduced by logging, fires, or fragmentation. In Saskatchewan, Rock (1992) suggests habitat selection is probably related more to predation considerations year-round and to thermal cover from insect harassment factors during the summer than it is to any of the food requisites. If food does become a limiting factor, it is generally during late winter when unfavourable snow conditions force caribou out of lowland habitats onto windswept alpine slopes where more terrestrial lichen species may be available. Historically, it would appear that late winter habitat, although important, was over-emphasised at the expense of other considerations such as predation (Rock, 1992). It is now clear that predators (wolf, bear and wolverine) interact in an additive or compensatory way with other regulatory factors (such as hunting mortality, climatic extremes, and food limitations) in their degree of influence on caribou populations (Rock, 1992).

10.3.4 Calving

Most calving occurs during late May through mid-June with the peak of calving around the first week of June (Hatler, 1986; Wood, 1996). Recruitment (the number of individuals entering the population at 1 year of age) is low and caribou do not twin; therefore potential population growth is slow (Rock, 1992). During the calving season, northern caribou move to areas that “minimize risks from predation either by using escape terrain with good visibility such as steep, isolated rock outcrops, higher than the usual areas travelled by terrestrial predators, or by dispersing widely over shrubby vegetation that affords concealment and lowered probability of detection” (Fenger *et al.*, 1986). Undisturbed mountainous habitat is important for calving success and early calf survival of woodland caribou (Bergerud *et al.*, 1984). Calving sites are usually on secluded alpine ridges, tree line, or in high elevation coniferous stands. By calving at high elevations, female caribou space themselves away from predators such as wolves (*Canis lupus*).

In late May to early June, female caribou in west-central B.C. forgo forage quality at lower elevations to calve high in the Itcha and Ilgachuz Mountains (Cichowski, 1989). The Omineca Mountain caribou were also found to calve in upper elevation balsam-spruce forests, in rocky outcrops at tree line, or in alpine and subalpine areas (Wood, 1996). In the central Yukon, northern caribou also calved in alpine habitats in a widely dispersed pattern (Farnell *et al.*, 1991).

Woodland caribou often show fidelity to specific areas for calving (Terry and Wood, 1999; Wood and Terry, 1999; Hatler, 1986; Farnell and McDonald, 1989; Farnell *et al.*, 1991). The use of traditional calving sites and the highly dispersed pattern employed by female woodland caribou is thought to be an anti-predator tactic to reduce the vulnerability of calves to predators and to make use of previously successful sites (Bergerud *et al.*, 1984, Seip, 1992).

10.3.5 Security Habitat

Security cover is most often mentioned in conjunction with calving sites, with individual dispersion across high elevation landscapes being as important as cover for security from predators. Security habitat during the calving season consists of either escape terrain combined with good visibility or shrubby vegetation providing concealment (Fenger *et al.*, 1986). High elevations also afford some protection from wolves, which generally use valleys as travel routes (Bergerud and Elliot, 1986).

In winter, large contiguous patches of unfragmented habitat may provide security cover. Habitats that offer good visibility for avoiding predators, such as the alpine, also afford some security during the winter. The use of large home ranges allows caribou to select habitats offering acceptable combinations of snow conditions and food availability, select habitats that have given them an advantage over predators, and reduce their vulnerability to predators by dispersing themselves widely (Stevenson, 1991).

10.3.6 Thermal Habitat

Traditionally thermal cover has been an important consideration for the over-winter survival of large ungulates. For woodland caribou, however, the summer period would appear to be the most critical in terms of thermal cover requirements and tends to be overlooked (Mari Wood, pers. comm.). Alpine habitat as well as dark timbered forests in the ESSF provide cooler temperatures during periods of hot weather. Insect harassment has also been suggested as one of the reasons that caribou move to alpine habitats during part of the summer (Mari Wood, pers. comm.). Cooler weather and constant breezes provide relief from insects. Farnell and McDonald (1990) found that caribou will often move to patches of snow, glaciers, and windy ridges that act as 'relief habitat' to escape harassment by insects and/or heat stress.

10.4 Habitat Use (Life Requisites and Seasons)

Northern caribou food habitat use is divided into five seasons – early winter, late winter, spring, summer, and fall, as summarized in Table 58. For this habitat suitability model, ecosystem units were not rated for security, because security habitat is not well defined for caribou at this time. In addition, security habitat is often described according to calving, which does not occur within the Klawli landscape unit (Wood and Terry, 1999). Although not rated, additional information on reproducing, rutting, security and thermal habitat have been summarized in order to provide a more comprehensive overview of caribou habitat use throughout the year.

Table 58: Summary of Rated Life Requisites and Seasons for Northern Caribou (Wolverine Caribou Herd) in the Klawli Study Area.

Rated Life Requisites and Seasons	Code	Month(s)*	Comments
Early winter - Food Habitat	FD_WE	November 1 to December 30	- regions of low snow cover and abundant terrestrial lichens - low-elevation forests
Late winter – Food Habitat	FD_WL	January 1 to March 31	- either windswept alpine ridges or lower elevation pine-lichen forests (dependent on

			snow accumulations)
Spring – Food Habitat	FD_P	April 1 to May 15 May 15 to June 16	- habitats with early forage production usually at low elevation snow free sites
Summer - Food Habitat	FD_S	June 16 to September 15	- feed in areas of late snow-melt which can be in the alpine and ESSF
Fall - Food Habitat	FD_F	September 16 to October 30	- move to higher elevation habitat near rutting grounds, rutting generally occurs in the alpine

*As outlined in Terry and Wood (1999); Wood and Terry (1999).

Note: Bold indicates the seasons when the WCH are known to utilize the Klawli TEM study area (Figures 29 and 30).

10.4.1 Food Habitat

Spring

During the spring, northern caribou mainly occupy lower elevation habitat (Terry and Wood, 1999; Wood and Terry, 1999; Hatler, 1986), but will also continue to forage in alpine and subalpine. WCH surveys showed that although caribou continued to use alpine areas during the earliest part of the spring, they also used mixed deciduous stands (aspen slopes) more frequently compared to other seasons (Terry and Wood, 1999). Wood (1996) found northern caribou primarily in low elevation lodgepole pine and pine-spruce forests in the spring (April and May). At this time of year, northern caribou also forage in meadows and younger seral stands of pine and pine-aspen stands (Terry and Wood, 1999; Wood and Terry, 1999; Wood, 1996).

Summer

During the summer northern caribou tend to space out widely throughout the herd's annual home range (4,933 km² for the WCH calculated from 6 years of radio-telemetry locations) (Wood, 1998). During this time, an increase in the use of balsam (24% of locations) as well as spruce dominated stands and AT was observed, while pine stands were used less frequently compared to use during other seasons (Terry and Wood, 1999). According to Stevenson (1991), summer ranges for northern caribou are typically alpine or subalpine, although some animals in some populations use low elevations.

Little information has been collected on growing season diets because these are not generally considered limiting. Northern caribou will forage on a diversity of grasses, sedges, forbs, browse, and lichens. Throughout the summer in the Kluane Range, Yukon Territory, northern caribou fed disproportionately in birch-sedge meadows, sedge meadow communities, and other communities with high sedge components in the subalpine and alpine (Oosenburg and Theberge, 1980). Sedge was considered to be the most important forage in determining summer habitat selection (Oosenburg and Theberge, 1980). Willows and other shrubs were also important components of the summer diet (Oosenburg and Theberge, 1980). Commonly used landforms during the summer season included ridges, plateaus, and stream bottoms (Oosenburg and Theberge, 1980).

Fall

Throughout the summer and early fall, northern caribou were found to prefer flat to rolling terrain with slopes less than 20° and northern aspects in the Kluane Range, Northwest Territories (Oosenburg and Theberge, 1980). Use of these sites may have reflected their hygric nature and consequent predominance of sedges (Oosenburg and Theberge, 1980). In North-Central B.C., during the fall rut, animals were generally found to aggregate at high elevation alpine and subalpine areas for mating with some use of pine flats (Mari Wood, pers. comm.).

Winter - General

Northern caribou depend on ground lichens for winter foraging rather than on arboreal lichens, which constitute only a very minor component of the winter diet (Bergerud, 1978). Ground lichens make up over 70% of the winter diet of northern caribou in the Yukon and northern B.C. with *Cladina* spp. and *Cladonia* spp. predominating the diet (Wood, 1996; Farnell and McDonald, 1990; Farnell and McDonald, 1989;

Farnell *et al.*, 1991; Stevenson and Hatler, 1985). Horsetails, grasses, and sedges (primarily *Carex* spp.) are also important components of the winter diet when accessible (Farnell and McDonald, 1990). For northern caribou, some of the primary early winter habitats are mature lodgepole pine or pine-spruce forests with abundant terrestrial lichens (Heard and Vagt, 1996; Wood, 1996). Wood and Terry (1999) found that northern caribou in the Omineca Mountains (the WCH) foraged on terrestrial lichens in both lowland lodgepole pine flats and windswept alpine slopes, while the Chase herd foraged on arboreal lichens in upper elevation Engelmann Spruce Subalpine Fir (ESSF) forests. Cichowski (1989) also found that in pine forests, northern caribou fed predominantly by cratering for terrestrial lichens, and cratering sites were selected based on terrestrial lichen abundance. Arboreal lichens were also used but appear to be less important than terrestrial lichens in the diet. Arboreal lichen use is greater during late winter when snow conditions are less favorable for cratering (Cichowski, 1989). Some northern caribou populations regularly winter in alpine habitats. More commonly, the alpine is used by a small proportion of caribou or by many caribou for a short time when snow conditions below tree line restrict their ability to move around or to forage (Terry and Wood, 1999; Hatler, 1986). The WCH resides in areas with low to moderate snow depths, and is therefore able to forage on terrestrial lichens primarily in low elevation forests during the early winter and sometimes late winter (depending on the snow depth). Deep snowpacks force the caribou into the alpine areas where windswept slopes allow access to lichens (Terry and Wood, 1999, Wood and Terry, 1999). Cichowski (1989) found caribou selected mature stands with a combination of abundant terrestrial lichens (Dry Lichen-Lichen Moss, Lichen Moss understories) and low productivity (low and poor forest cover types). Because terrestrial lichens are poor competitors against vascular plants, they are most abundant on open, nutrient poor sites (Hale, 1983 and Rowe, 1984 in Cichowski, 1996). These xeric (poor) growing sites can support abundant terrestrial lichens for hundreds of years. On more productive sites, terrestrial lichens may be abundant in mid-aged stands but are replaced by mosses in older stands and thus require periodic disturbance to be perpetuated. Very productive (nutrient rich) sites are usually dominated by vascular plants and never produce substantial amounts of terrestrial lichens (Seip, 1996). Use of frozen lakes in the winter has also been documented. In North-Central B.C., Terry and Wood (1999) observed caribou using lakes during early and late winter possibly for drinking overflow water containing dissolved minerals (Mari Wood pers. comm., 1999). In Manitoba, caribou used frozen lakes for travel, escape habitat, and to crater to drinking overflow water throughout the winter (Darby and Pruitt, 1984).

Early Winter

Northern caribou generally winter in low-elevation, mature pine or pine-spruce-lichen stands (Hatler, 1986). Open areas below timberline including muskegs and shrub or herb meadows are also used in early winter (Terry and Wood, 1999; Hatler, 1986). During the early winter in North-Central B.C., the WCH was observed to primarily utilize pine-lichen forests (56% of locations - of 756 radio locations obtained over 3 years from 17 animals) as well as fen and wetland habitat (21% of locations), while spruce and mixed deciduous stands were the least preferred (Terry and Wood, 1999). Analysis of data indicated that the pine and fen and wetland habitat were used significantly more than their availability, demonstrating habitat selection (Terry and Wood, 1999).

Snow depths exceeding 50 cm to 60 cm are limiting to single caribou cratering for lichens, and snow depths of 80 cm to 90 cm are considered limiting to cratering by groups of caribou (Russell and Martell, 1984). Beyond these snow depths or when hard-packed crusts develop, caribou are unable to locate and dig down to lichens (Russell and Martell, 1984). When snow depths become limiting, northern caribou will move from early winter ranges to late winter ranges. In winters of low snowfall, northern caribou will often remain in their early winter ranges (primarily lowland, coniferous forests) for the entire winter (Hatler, 1986).

Late Winter

During the late winter season, unfavourable snow conditions may force northern caribou to concentrate in alpine and subalpine habitat, or move to other low elevation areas (Mari Wood pers. comm., 1999; Terry

and Wood, 1999; Hatler, 1986). When snow-depths preclude feeding in forests caribou will move to high windswept ridges where there is access to terrestrial lichens (Stevenson and Hatler, 1985). In studies that have covered multiple years, northern caribou have been found to use alpine habitat in winter when snow depths preclude the use of lower elevation mature and old pine-lichen forests (Terry and Wood, 1999; Wood and Terry, 1999; Cichowski, 1996; Wood, 1996). Terry and Wood (1999) and Hatler (1986) suggested the use of alpine habitats was the result of heavy snow accumulations forcing the animals to move to higher elevation windswept slopes. According to Hatler (1986) such use of alpine by northern caribou indicates a stressed situation occurring in severe winters and should not be interpreted as a preferred winter habitat.

10.4.2 Seasons of Use

Caribou are expected to occur within the Klawli TEM study area during the early winter and summer seasons. Table 59 summarizes the life requisites for northern caribou for each month of the year, including those months in which the WCH occupy locations outside of the Klawli study area. As some individuals may occur at some time during the spring and/or fall food habitat for these seasons has also been rated.

Table 59: Monthly Life Requisites for Northern Caribou (Wolverine Caribou Herd).

Month	Season*	Dates	Life Requisites
January	Late Winter	Jan 1-Mar 31	Food
February			
March			
April	Spring	Apr 1-May 15	Food
May	Spring	May 16-Jun 15 - Calving	Birth, Security, Food
June	Spring and Summer	May 16-Jun 15 - Calving	Birth, Security, Food
		Jun 16-Sep 15 - Summer range	Food
July	Summer	Jun 16-Sep 15 - Summer range	Food
August			
September	Summer and Fall	Jun 16-Sep 15 - Summer range	Food
		Sep 16-Oct 30 - Fall Rut	Food, Reproduction
October	Fall	Sep 16-Oct 30 - Fall Rut	Food, Reproduction
November	Early Winter	Nov 1-Dec 30	Food
December			

*Seasons defined by Terry and Wood (1999) for Wolverine Caribou Herd in North-Central B.C.

***Bold months indicate the time of year that the WCH occupy the Klawli Study Area (Figures 29 & 30).**

10.5 Ecosystem Attributes

A number of relationships between habitat use and ecosystem attributes can be determined for caribou based on current literature, research, and local biologist knowledge. Often the habitats used most frequently are associated with specific stand structure age class, vegetation cover, etc. Table 60 lists the ecosystem attributes that are considered in the habitat ratings tables.

Table 60: Terrestrial Ecosystem Mapping (TEM) Relationships for Food Habitat Requisites for Northern Caribou (Wolverine Caribou Herd) in the Klawli Study Area.

Life Requisite	Ecosystem Attribute
Food	<u>site</u> : slope, aspect, elevation, structural stage, site disturbance <u>soil and terrain</u> : bedrock, terrain texture, flooding regime <u>vegetation</u> : % cover by layer, species list by layer, cover for each species for each layer, terrestrial lichen biomass

10.5.1 Slope and Aspect

Research on Northern Caribou in North-Central B.C. by Terry and Wood (1999) indicates that slope and aspect play an important role in habitat selection. Use of aspects as well as slope classes were found to vary significantly among seasons. Caribou used cool aspects more frequently than warm aspects during all seasons, however, caribou used warm aspects more often during spring compared to other seasons (45% of locations) (Terry and Wood, 1999). In respect to slope class use, caribou used flat and gentle slopes (<15%) extensively during all seasons. However, caribou confined their use to predominately flat areas during early winter and increased their use of moderate slopes (16-30%) during other seasons, particularly during late winter (Terry and Wood, 1999).

10.6 Development of the Habitat Ratings

10.6.1 Rating Scheme

A 6-Class rating scheme of high (1), moderately high (2), moderate (3), low (4), very low (5), and nil (6) is employed due to the substantial level of knowledge on habitat use of northern caribou (RIC, 1998). This rating scheme is suggested by RIC (1998) for use with woodland caribou at the 1:20,000 map scale and is defined in Table 61.

Table 61: Habitat Capability and Suitability 6-Class Rating Scheme (from RIC, 1998).

% of Provincial Best	Rating	Code
100% - 76%	High	1
75% - 51%	Moderately High	2
50% - 26%	Moderate	3
25% - 6%	Low	4
5% - 1%	Very Low	5
0%	Nil	6

This rating scheme is used when assigning habitat ratings to the ecosystem units present within the Klawli study area. The habitat ratings express the ability of the units to fulfil habitat requirements for the specific life requisites and seasons rated for northern caribou as previously outlined in Table 59.

10.6.2 Provincial Benchmark

The provincial standard (best in B.C.) for the winter season for the northern caribou is the Stikine Plateau (STP) ecosection, SWBun and AT subzones (within the Central Interior ecoprovince) and the provincial standard for the growing season is the STP ecosection, AT subzone (Table 62) (RIC, 1998).

Most of the Klawli study area is located within the Manson Plateau (MAP) ecosection, which has a moderate (50% to 26%) capability compared to the standard (RIC, 1998). The northern part of the study area is located within the Southern Omineca Mountains (SOM) ecosection, which has a moderately high (75% to 51%) capability compared to the standard (RIC, 1998). The study area is therefore expected to have a moderate to fairly high capability for northern caribou.

Table 62: Provincial Benchmark (shaded rows) for Woodland Caribou (RIC, 1998).

Ecoprovince	Ecosection	BGC	Broad Ecosystem Unit/Seral Stage	Rating
	Unit	Rating	Subzone	

Winter					
Sub-Boreal Interior	SOM	2	AT/ BWBSmv	AT – Alpine Tundra/ WL - Wetland	3
Northern Boreal Mountains	STP	B	AT	AT – Alpine Tundra	1
Northern Boreal Mountains	STP	B	SWBun	LP/6 – Lodgepole pine AG – Alpine grassland	1
Growing Season					
Sub-Boreal Interior	SOM	2	AT	AT – Alpine Meadow	1
Northern Boreal Mountains	STP	B	AT	AT – Alpine Tundra	1
Northern Boreal Mountains	STP	B	SWBun	LP/6 – Lodgepole pine AG – Alpine grassland	1

10.6.3 Ratings Assumptions

The following habitat model assumptions have been made:

Life Requisite and Season	Assumptions
<p>Food Habitat During the Early Winter</p> <p>FD_WE</p>	<p>During the early and late winter seasons, food habitat is largely rated on the presence and abundance of terrestrial lichens, because this is the predominant winter forage.</p> <p>This model assumes all habitats are accessible to northern caribou in the early winter season because they can tolerate fairly deep snow depths.</p> <p><u>Structural Stage</u></p> <ul style="list-style-type: none"> • In general, structural stage 1 has poor foraging quality, because it is mainly unvegetated. • Stage 2 or 3 units at high elevations may also provide good lichen growth. • Stunted units in stages 3b or 4 may support lichen growth, and these units receive high ratings if lichens are abundant (associated with the unit and stage). • Younger forests (stage 4) generally do not support lichen growth and are therefore given low foraging ratings in this season. • Lichen production is greatest in late successional structural stages of lodgepole pine forests, therefore stages 5, 6 and 7 generally receive the highest food values during the early winter. <p><u>Vegetation Characteristics</u></p> <ul style="list-style-type: none"> • Lodgepole pine stands with high terrestrial lichen coverage is assumed to be of highest quality for food habitat during the early winter. • Wetland-sedge fens also important early winter food habitat – rated up to high. • Spruce dominated forests are rated up to moderate for food ratings. <p><u>Site, Moisture Regime, Soils</u></p> <ul style="list-style-type: none"> • Dry pine stands (poor nutrient regimes – generally xeric sites) are likely to have higher lichen productivity and are therefore of higher food quality (modifier x - drier than usual). • Wet units with a predominance of sedges, horsetails or grasses receive up to moderate food ratings in the early winter, because caribou forage in these units under low snow conditions. • Wet forested sites that provide poor lichen abundance receive nil to low ratings throughout the winter. <p><u>Snow Conditions</u></p> <ul style="list-style-type: none"> • Units are also rated on the perceived accessibility of these sites due to snow depth. This becomes a limiting factor mainly in the late winter season. In a winter with non-restrictive snow conditions, food ratings over the entire winter will be the same as those of the early winter season. <p><u>Elevation</u></p> <ul style="list-style-type: none"> • Primarily found in lower elevation forested units. • Windswept ridges in AT and parkland for access to terrestrial lichens, especially when deeper snow conditions prevail at lower elevations.

Life Requisite and Season	Assumptions
<p>Food Habitat During the Late Winter</p> <p>FD_WL</p>	<p><u>Structural Stage</u></p> <ul style="list-style-type: none"> • Structural stages 2 or 3 generally have the highest value for foraging at upper elevations of the ESSF and AT. <p><u>Vegetation Characteristics</u></p> <ul style="list-style-type: none"> • In late winter, presence and availability of lichens determines feeding areas. <p><u>Snow Conditions</u></p> <ul style="list-style-type: none"> • Late winter snow depths in an average winter are assumed to force caribou onto windswept ridges where forage is accessible. <p><u>Elevation</u></p> <ul style="list-style-type: none"> • As windswept ridges are probably very site specific, this makes it difficult to assign ratings. Therefore, units in the ESSFmvp3 and AT were assumed accessible in the late winter, and food values were assigned based on the vegetation present. These ratings will be too high if these areas do not blow free of snow. Late winter ratings for these units are generally higher than the early winter ratings, because these units are probably the only ones accessible in late winter. • Food habitat in lower elevation forests is assumed to be mainly inaccessible in late winter due to deep snow depths. Therefore, most BWBS and SBS units are given ratings of nil or low for food value in the late winter. Units in these subzones with abundant lichens are rated slightly higher because some lichen may be available.
<p>Food Habitat During the Spring</p> <p>FD_P</p>	<p><u>Structural Stage</u></p> <ul style="list-style-type: none"> • In general, structural stage 1 is of poor foraging quality, because it is mainly unvegetated. • Caribou will forage more extensively in younger structural stages during the growing season. • Units in younger structural stages (stage 4 to 5) will often have moderate food values. <p><u>Vegetation Characteristics</u></p> <ul style="list-style-type: none"> • ecosystem units with preferred vegetation and high percent cover are given high food ratings. <p><u>Site, Moisture Regime, Soils</u></p> <ul style="list-style-type: none"> • Warm aspect slopes with early “green-up” are of high value in the early spring because they provide forage access earlier than other sites. <p><u>Elevation</u></p> <ul style="list-style-type: none"> • Caribou forage at lower elevations in the spring. • During spring calving, females are located in the high elevation, mainly barren habitat of the parkland and alpine tundra - to avoid predators.

Life Requisite and Season	Assumptions
Food Habitat During the Summer FD_S	<u>Structural Stage</u> <ul style="list-style-type: none"> • See spring assumptions above. <u>Vegetation Characteristics</u> <ul style="list-style-type: none"> • See spring assumptions above. <u>Site, Moisture Regime, Soils</u> <ul style="list-style-type: none"> • Wet units with a predominance of sedge and horsetails receive high food ratings. <u>Elevation</u> <ul style="list-style-type: none"> • Caribou move to alpine and subalpine ranges in the summer. • Higher elevation units in the AT, ESSFmv3, and ESSFmvp3 have greater value for foraging in the summer and fall due to the delayed phenology of these sites.
Food Habitat During the Fall FD_F	<u>Structural Stage</u> <ul style="list-style-type: none"> • See spring assumptions for structural stages. <u>Vegetation Characteristics</u> <ul style="list-style-type: none"> • ecosystem units with preferred vegetation and high percent cover are given high food ratings. <u>Elevation</u> <ul style="list-style-type: none"> • Higher elevation units in the AT, ESSFmv3, and ESSFmvp3 have greater value for foraging in the summer and fall due to the delayed phenology of these sites. • Higher elevation (AT and ESSFmv3p), open areas are also utilized during the fall rut, where caribou groups concentrate.

10.6.4 Limitations

Although units within the Klawli TEM study area contain forage habitat for caribou during the late winter, spring, and fall (rut), the area is not known to be used by the WCH during these periods (Terry and Wood, 1999). Therefore, ratings during these periods are not reflective of actual use and should not be interpreted as such. Rather, the values should be interpreted as habitat availability, for potential caribou use.

Variation in snow depth and conditions can directly influence habitat use selection by caribou from year to year, yet there is insufficient understanding of this factor within the study area and surroundings to build it into the species-habitat model at this time. Therefore, ratings at present account for use under all foreseeable winter conditions (i.e. both AT as well as low elevation forests are rated as having important winter food values). Future information on snow conditions within the Klawli, Germansen and Wolverine Range areas will help to refine the model.

10.6.5 Rating Adjustment Considerations

Recent work on the WCH indicates that the distance to nearest non-forested wetlands (meadows, swamps, small lakes) influences habitat selection during the early winter (Terry and Wood, 1999). Pairwise comparisons of seasons revealed caribou were significantly closer to wetland areas (<500 m) compared to all other seasons. Therefore, forested areas located out of this range from wetland areas during the early winter may be of lesser value. A spatial analysis of this relationship could result in ratings adjustments for various polygons, which would more accurately reflect areas most likely to be utilized during the early winter.

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