14.0 SPECIES - HABITAT MODEL FOR WOODLAND CARIBOU

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

14.1 Introduction

Information from past studies in northern British Columbia (Hatler, 1986; Murray, 1992; Cichowski, 1989), current research and surveys (Wood 1993, 1996; Terry and Wood, 1998; Corbould, 1993), and, where applicable, information from other areas outside of northern B.C. have been used to create this woodland caribou model. At this time, no model verification has been completed for the Dunedin area, and the species-habitat model is predicted to have low reliability.

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 habitat use studies have been focused on the woodland caribou populations in the southeast part of the province due to the more immediate conflicts between forest harvesting and declining populations in this 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 part of the province (Terry and Wood, 1998). The species-habitat model is a step in the process to understand the relationship between caribou habitat use and habitat suitability and capability.

14.2 Distribution

14.2.1 Provincial Range

All caribou in British Columbia belong to the woodland subspecies (*Rangifer tarandus*) (Seip and Cichowski, 1996) but they can be further classified into three different ecotypes: the mountain ecotype, the northern ecotype, and the boreal ecotype (Heard and Vagt, 1996). This division into ecotypes is based on behavioural and ecological differences (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 (Seip and Cichowski, 1996). 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 (Bergerud, 1978, in Heard and Vagt, 1996). They generally summer in mountainous areas and winter in mature low elevation lodgepole pine or black spruce forests or in windswept alpine areas (Seip and Cichowski, 1996; Heard and Vagt, 1996). 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 (Heard and Vagt, 1996). Sometimes authors lump the boreal ecotype and northern ecotype together (referenced to as the northern ecotype) (Heard and Vagt, 1996). The British Columbia population of caribou was estimated at a total of 18,000 animals in 1996

(Heard and Vagt, 1996). Of these, approximately 2,300 were mountain caribou and 16,000 were northern and boreal caribou (Heard and Vagt, 1996).

Population numbers have been estimated for the general area of the Dunedin and the adjacent watersheds. The boreal caribou population in northeastern British Columbia was estimated at approximately 725 animals in 1996. The Muskwa northern caribou herd (also known as the Mt. Dell; Crest; Toad; or MacDonald-Racing herd) is found to the immediate south of the Dunedin watershed, and its range may include some of the Dunedin study area. This herd had an estimated 1,250 animals in 1996 (Heard and Vagt, 1996; D. Heard, *pers. comm*., 1996). Caribou found in the southern portion of the Dunedin study area presumably belong to this herd. Population trends of these caribou herds are unknown (Heard and Vagt, 1996).

14.2.2 Distribution in the Study Area

On a provincial basis, the relative abundance of caribou is rated as few (1 caribou per 25 km^2 to 250 km^2) present in the northern half of the Dunedin study area and the lower half is rated as moderate (1 caribou per 3.4 km^2 to 25 km^2) relative abundance (Fish, Wildlife and Habitat Protection Department, 1994). The area immediately surrounding Stone Mountain Park has a plentiful rating of over 1 caribou per 3.4 km^2 (Fish, Wildlife and Habitat Protection Department, 1994). Expected woodland caribou occurrence within the ecoregions, ecosections, and biogeoclimatic zones of the study area is summarized in Table 86.

Table 86: Expected Woodland Caribou Occurrence within the 6 Ecosection - BEC Variant Combinations Found within the Dunedin Study Area

Ecoprovinces	**TAIGA PLAINS**		**NORTHERN BOREAL MOUNTAINS**			
Ecoregions	**Muskwa Plateau**		**Northern Canadian Rocky Mountains**			
Ecosections	**MUP**		**MUF**			
BEC Variants	**BWBSmw2**	**BWBSwk3**	**BWBSmw2**	**SWBmk**	**SWBmks**	**AT**
Species						
Northern Caribou Ecotype	?	?	•	•	•	•
Boreal Caribou Ecotype	•	•	?	?	?	?

Legend:
- • = occurs in the variant
- •? = probably occurs in the variant
- ? = unlikely to occur in the variant
- x = essentially absent

Woodland caribou occur in both ecosections found within the Dunedin study area, yet as the distinction between northern and boreal ecotypes is not always clear, it is unknown which are present in the study area. Northern caribou are probably found within the more mountainous southern portion of the study area corresponding to the MUF ecosection. However, low-lying areas that dominate the central and northern portions (corresponding to the MUP ecosection) of the study area may be occupied by the boreal ecotype. This species-habitat model concentrates on the habitat requirements of the northern ecotype of woodland caribou as this ecotype presumably predominates within the study area, and most higher value caribou habitats will be found in the MUF ecosection.

14.2.3 Elevational Range

Northern caribou are expected to occur in the BWBS zone, SWB zone and the AT zone (approx. 250 m to 2,105 m) within the study area.

14.3 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. MoELP, 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 will be available (Heard and Vagt, 1996).

Caribou are characterised by a horizontal migratory behaviour as they frequent traditional calving, rutting, wintering, and post-calving ranges over a seasonal cycle (Child and King, 1991). Caribou tend to show fidelity to core areas for calving (Hatler, 1986; Farnell and McDonald, 1989), for rutting (Farnell *et al*., 1991), and to seasonal ranges (Farnell and McDonald, 1989).

In Manitoba, caribou used frozen lakes for travel, escape habitat, and to crater to drinking overflow water throughout the winter (Darby and Pruitt, 1984). Terry and Wood (1998) found that in spring "other" (non-forested areas, lakes) habitats were used more extensively than their occurrence. Caribou were observed using lakes during early winter (D. Becker, M. Wood, *pers. comms.*) possibly for drinking overflow water containing dissolved minerals.

14.4 Habitat use (Life Requisites and Seasons)

Northern caribou habitat use for the study area is broken down into three seasons – growing, early winter, and late winter. Life requisites that are rated for caribou include living, feeding, reproducing, and security, as summarized in Table 87.

Table 87: Summary of Rated Life Requisites and Seasons for Northern Caribou in the Dunedin Study Area

Rated Life Requisites and Seasons	Code	Months of Use	Comments
Living during the growing season - food	LI_G_FD	April-September	- habitats with early forage production - migrate to summer range - feed in areas of late snow-melt which can either be in the alpine or in low elevation pine forests - rutting generally occurs in the alpine
Living during the early winter season - food	LI_EW_FD	October-December	- regions of low snow cover and abundant terrestrial lichens - low-elevation forests
Living during the late winter season - food	LI_LW_FD	January-March	- either wind-swept alpine ridges or lower elevation pine - lichen forests (dependent on snow accumulations)
Reproducing by birthing - food Reproducing by birthing - security	RB_FD RB_SH	late May-mid June	- give birth on secluded alpine ridges, at treeline, or in high elevation coniferous stands.

Ecosystem units were not rated for security during the growing, early winter and late winter seasons as security habitat is not well defined for caribou. Rated life requisites are described in detail below. Additional information on rutting and thermal habitat requirements is included, although these requisites have not been rated.

14.4.1 Living

The living life requisite for northern caribou is satisfied by the presence of suitable feeding, reproducing and security habitat, which are described in detail below.

14.4.2 Feeding

Information on general feeding and habitat use over the winter season is summarized in the following section. This information is then broken into early winter, and late winter seasons. Growing season habitat use is also discussed.

General Winter Habitat Use and Lichen Ecology

Bergerud (1978) found 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. 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 in the diet (Farnell and McDonald, 1990; Farnell and McDonald, 1989; Farnell *et al.*, 1991; Stevenson and Hatler, 1985). Horsetails, grasses, and sedges (primarily *Carex* spp.) can also be components of the winter diet (Farnell and McDonald, 1990).

Terrestrial lichens are very slow growing and are most abundant in late successional forests (Cichowski, 1996). Disturbances such as logging drastically alter lichen populations, which can require 50 to 100 years to regenerate (Hale, 1983 and Rowe, 1984 in Cichowski, 1996). 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). Undisturbed areas within the winter range are important for maintaining winter forage availability (Cichowski, 1989).

Terrestrial lichens that are usually destroyed by fires but recolonize disturbed sites become abundant in mid-aged to mature stands. Xeric growing sites support abundant terrestrial lichens for hundreds of years. However, 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 sites are usually dominated by vascular plants and never produce substantial amounts of terrestrial lichens (Seip, 1996).

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 (1993) found that northern caribou in the Omineca Mountains foraged on terrestrial lichens in both lowland lodgepole pine flats and windswept alpine slopes and on arboreal lichens in upper elevation Engelmann Spruce Subalpine fir forests. Cichowski (1989) found that in pine forests, northern caribou feed predominantly by cratering for terrestrial lichens, and cratering sites were selected on the basis of 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).

Another habitat used during the winter is alpine slopes with low snow accumulations. 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. Northern caribou often move to the alpine when snow conditions below tree line restrict their ability to move around or to forage (Terry and Wood, 1998; Hatler, 1986).

Telemetry locations from the Graham River northern caribou herd indicated that the caribou spent a significant portion of at least late winter in the alpine tundra or subalpine forest. Northern caribou in this area were speculated to spend the majority of the year in alpine or subalpine habitats (Murray, 1992).

Early Winter Season

Northern caribou generally winter in low-elevation, mature pine or pine/spruce stands (Hatler, 1986). Open areas below timberline including muskegs and shrub or herb meadows are also used in winters of light snowfall (Hatler, 1986).

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 Season

During the late winter season, unfavourable snow conditions may force northern caribou to concentrate in alpine habitat (Hatler, 1986). They will move to high wind-swept ridges where there is access to terrestrial lichens when snow-depths preclude feeding in forests (Stevenson and Hatler, 1985). In studies that have covered multiple years, northern caribou have been found to use alpine habitat in winter only when snow depths preclude the use of lower elevation forests (Terry and Wood, 1998; Cichowski, 1996; Wood, 1996). Terry and Wood (1998) and Hatler (1986) found the use of alpine habitats was the result of heavy snow accumulations forcing the animals to move to higher elevations. 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 (Hatler, 1986).

Surveys completed on the east side of Williston reservoir showed high use of alpine areas by northern caribou in the late winter (D. Becker, pers. comm.). Surveys on the east side of Williston Reservoir in the Chase Mountain and Wolverine Ranges also showed high use of the alpine in the late winter (Corbould, 1993).

Growing Season

Spring habitats are often found at low-elevations, with caribou moving to alpine or subalpine ranges in summer, although use of lower elevations also occurs (Stevenson and Hatler, 1985). During the spring, northern caribou occupy the lowest elevations of the year (Hatler, 1986). Wood (1996) found northern caribou primarily in low elevation lodgepole pine and pine/spruce forests in the spring (April/May). At this time of year, northern caribou also forage in meadows and younger seral stands of pine and pine/aspen stands (Wood, 1996).

Summer ranges for northern caribou are typically alpine or subalpine, although some animals in some populations use low elevations (Stevenson, 1991). Little information has been collected on growing season diets as 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).

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). Commonly used landforms during the summer season included ridges, plateaus, and stream bottoms (Oosenburg and Theberge, 1980).

14.4.3 Reproduction

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 (Rock, 1992). Caribou do not twin; therefore potential population growth is slow.

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

Woodland caribou often show fidelity to specific areas for calving (Hatler 1986; Farnell and McDonald 1989; Farnell *et al.*, 1991). This use of traditional calving grounds and the highly dispersed pattern employed by woodland caribou is thought to be an anti-predator tactic of female caribou to reduce the vulnerability of calves and to make use of previously successful sites (Bergerud *et al.*, 1984, Seip, 1992). By calving at high elevations, female caribou space themselves away from predators such as wolves (*Canis lupus*). For woodland caribou, undisturbed mountainous habitat is important for calving success and early calf survival of woodland caribou (Bergerud *et al*., 1984).

14.4.4 Security Habitat

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

A spatial separation between caribou and moose, which generally occupy lower elevations, forces predators to search large areas, reducing their capture success (Bergerud *et al.*, 1984). More recently, however, relatively high numbers of moose exist because of the conversion of mature forested habitats to early stage habitats (logging) and the cumulative effects of milder winters over the 1980s on the increased survival of moose. Inflated numbers of early seral stage species tends to support increased numbers of predators such as wolves and bears (Seip, 1992).

In winter, large contiguous patches of unfragmented habitat may provide security cover since the preferred stands for pine-lichen tend not to have understory characteristics useful for security cover (small trees, shrubs, etc.). Habitats that offer good visibility for avoiding predators, such as the alpine, also afford some security during the winter. 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. 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).

Predators clearly 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). In Saskatchewan, Rock (1992) suggests habitat selection is probably related more to predation considerations year-round and to thermal cover/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 upland sites 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).

14.4.5 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 (1998). 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).

14.4.6 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. Alpine habitats provide cooler temperatures during periods of hot weather.

Insect harassment has been suggested as one of the reasons that caribou move to alpine habitats during part of the summer (M. 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.

14.4.7 Seasons of Use

Table 88 summarizes the rated life requisites for northern caribou for each month of the year.

Table 88: Monthly Rated Life Requisites for Northern Caribou in the Dunedin Study Area

Month	Season*	Rated Life Requisites
January	LW	LI-FD
February	LW	LI-FD
March	LW	LI-FD
April	G	LI-FD
May	G	LI-FD, RB-SH, FD
June	G	LI-FD, RB-SH, FD
July	G	LI-FD
August	G	LI-FD
September	G	LI-FD
October	EW	LI-FD
November	EW	LI-FD
December	EW	LI-FD

Legend
LW=Late Winter EW=Early Winter G=Growing LI=Living FD=Food SH=Security RB=Reproducing (birthing)
*Seasons modified per the Chart of Seasons by Ecoprovince (RIC, 1998; Appendix B).

14.5 Habitat Use and Ecosystem Attributes

Table 89 outlines how each rated life requisite relates to specific ecosystem attributes.

Table 89: Terrestrial Ecosystem Mapping (TEM) Relationships for each Life Requisite for Northern Caribou

Life Requisite	Ecosystem Attribute
Living Habitat (Feeding)	site: slope, aspect, elevation, structural stage, site disturbance soil/terrain: bedrock, terrain texture, flooding regime vegetation: % cover by layer, species list by layer, cover for each species for each layer, terrestrial lichen biomass
Reproducing (Feeding)	site: slope, aspect, elevation, structural stage, site disturbance soil/terrain: bedrock, terrain texture, flooding regime vegetation: % cover by layer, species list by layer, cover for each species for each layer
Reproducing (Security)	site: slope, aspect, elevation, structural stage soil/terrain: terrain texture vegetation: % cover by layer, species list by layer, cover for each species for each layer tree species, dbh, height, CWD

14.6 Development of the Habitat Ratings

14.6.1 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). The used ratings scheme is defined in Table 90.

Table 90: 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 Dunedin 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 87.

14.6.2 Provincial Benchmark

The provincial standard (best in B.C.) for the winter season for the northern caribou is the 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. (RIC, 1998).

The southwestern section of the Dunedin study area is located within the MUF ecosection, which has a high (100% to 76%) capability compared to the standard (RIC, 1998). The majority of the study area is located within the MUP ecosection, which has a moderately high (75% to 51%) capability compared to the standard (RIC, 1998). The Dunedin study area is therefore expected to have fairly high capability for northern caribou.

As a smaller scale reference, the Northeastern British Columbia Biophysical Overview Mapping project has assigned northern caribou habitat capability ratings for the ecosection/BEC variant combinations found within this region (Table 91) (Habitat Inventory Section, 1994).

Table 91: Ecosection/BEC Variant Combinations for Northern Caribou
Class Values for Habitat Capability Mapping of the Northeastern Portion of B.C. (Habitat Inventory Section, 1994)

Ecosection	**MUP**		**MUF**		
Variant	**BWBSmw2**	**BWBSwk3**	**BWBSmw2**	**SWBmk**	**AT**
Species					
Northern Caribou	3	3	2	2	1

Legend:
6-class rating scheme: Class 1 - high, Class 2 - moderately high, Class 3 - moderate, Class 4 - low, Class 5- very low and Class 6 - nil value.

14.6.3 Ratings Assumptions

Habitat ratings for the northern ecotype of woodland caribou are presented in Appendix 5. Each combination of ecosystem unit and structural stage was individually assessed for its ability to meet the northern caribou's seasonal requirements for feeding and security. The expanded legend and field data were used to determine if these

combinations provided the necessary ecosystem attributes (as outlined in Table 89) to meet these requirements. Further study is needed to validate and refine these ratings. The following assumptions have been made:

- During the growing season, ecosystem units with preferred vegetation and high percent cover are given high food ratings. Wet units with a predominance of sedge and horsetails receive high food ratings in the growing season.
- Northern caribou forage at lower elevations in the spring, and move to alpine and subalpine ranges in the summer. Higher elevation units in the AT, SWBmk, and SWBmks have greater value for foraging in the summer and fall due to the delayed phenology of these sites. Structural stages 2 and 3 generally have the highest value for foraging at upper elevations of the SWB and AT. In general, structural stage 1 has poor foraging value as it is mainly unvegetated. Caribou will forage more extensively in younger structural stages during the growing season. Therefore, in addition to older forested units, those units in younger structural stages (stage 4 to 5) will often have moderate growing season values.
- During the early and late winter seasons, feeding habitat is largely rated on the presence and abundance of terrestrial lichens, as this is the predominant winter forage. 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.
- This model assumes all habitats are accessible to northern caribou in the early winter season as they can tolerate fairly deep snow depths. Therefore, food ratings are assigned on the basis of presence and abundance of winter forage species. In early winter, caribou feed in areas of high lichen density; generally open, dry forests, bogs, and also windswept ridges. They are usually found in forested habitats, primarily in lower elevation pine and/or spruce dominated forests, during this time period. These forest types therefore receive moderate to high food ratings.
- Units with poor nutrient regimes often provide the most lichens. In generaly, xeric, poor sites provide abundant lichens so receive high ratings in the winter seasons. Wet sites which provide poor lichen abundance receive low ratings throughout the winter. Units with abundant sedges, horsetails or grasses can have some foraging value, and are given low ratings in the early winter, as caribou may forage in these units under low snow conditions.
- Lichen production is greatest in later successional structural stages, therefore stages 6 and 7 generally receive the highest feeding values during the early winter. Younger forests (stage 4 and 5) generally do not support lichen growth and are therefore given low foraging ratings in this season. Stagnated units in stages stage 3b or 4 may also support lichen growth, and these units receive high ratings if lichens are abundant. Stage 2 or 3 units at high elevations may also provide good lichen growth. Structural stage 1 generally has very low or nil foraging value as it is mainly unvegetated.
- In late winter, feeding areas are determined by presence and availability of lichens. Late winter snow depths in an average winter are assumed to force caribou onto windswept ridges where forage is available. As windswept ridges are probably very site specific, this make it difficult to assign ratings. All units in the SWBmks and AT were assumed accessible in the late winter, and feeding 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 their early winter ratings, as these units are probably the only ones accessible in late winter, and so will be of more value. The SC unit in the SWBmks has large amounts of lichen and is probably one of the best units for foraging in the late winter. Food in lower elevation forests is assumed to be mainly inaccessible in late winter due to deep snow depths. Therefore most BWBSmw2, BWBSwk3, and SWBmks 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 as some lichens may be available.
- Open spruce/pine forest (LL-02) has high foraging value in the BWBSmw2 in early winter as this unit has significant lichen ground cover. This unit will retain some value in the late winter season, although lichens may become unavailable due to deep snow. Black spruce bogs in the BWBSmw2

(BS/08) have ground lichens present in the older units (stage 3b) and therefore receive high foraging value in the early winter season. In late winter these sites may be inaccessible due to snow depths and therefore receive lower ratings. Dry SC units in the SWBmk provide high terrestrial lichen biomass and are rated very highly in the early winter season and moderately high in the late winter season.

- 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). Units in the SWB zone are given a minimum security habitat rating of 5 in the reproducing season due to the higher elevation of these units providing some protection from predators. Units in the SWBmks and AT receive a minimum security habitat rating of 3 in the reproducing season due to the higher elevation and greater visibility of these areas. Structural stages 1 and 2 should provide good security habitat due to the greater visibility in these units. Stage 3 should provide good concealment for birthing, as will some higher elevation forests with high shrub cover. In general, high values for security habitat for birthing are given to units providing high elevations with either high visibility, or dense shrub cover.

Although this species account focuses on the habitat requirements of the northern ecotype, habitat ratings for the BWBS should also be generally applicable to the boreal ecotype of caribou that may occupy the MUP ecosection within the study area. Habitat ratings may need to be upgraded or otherwise adjusted based on further review, as by applying the ratings developed here to the boreal ecotype it is possible some of the units may be undervalued, as boreal and northern caribou have some ecological differences in habitat use.

Boreal caribou in northeastern Alberta were found to concentrate feeding in forested, raised bogs throughout the winter (Bradshaw *et al*., 1995). The high peatland coverage in these areas provided a xeric substrate for increased production of terrestrial lichens (Bradshaw *et al*., 1995). These caribou may use denser forest stands when there are heavy snow depths (late winter), especially when snow is crusted (Bradshaw *et al*., 1995). Snow crusts were found to be thinner and less solid in denser stands than in open areas, allowing for easier movements and foraging (Bradshaw *et al*., 1995).

14.6.4 Rating Adjustment Considerations

There is a concern that fragmenting caribou habitat into a patchwork of mature and early seral forests will bring caribou and early seral ungulate species (e.g., moose) into close proximity, increase predator populations (e.g., wolves) in the area, and thereby lead to an increase in predation on caribou (Seip, 1996). Consequently, maintaining large, contiguous tracts of old forest is generally seen as preferable to maintaining fragmented patches of mature forest interspersed with clearcuts (Seip, 1996). Suitable foraging habitat should be maintained in large unfragmented patches to keep the caribou spatially separated from early seral habitats where they would encounter increased exposure to moose and wolves (Seip, 1996). Fragmentation will therefore reduce the value of ecosystem units. Fragmentation is an important part of caribou habitat suitability and can only be determined by looking at the landscape level.

Snowpack is a very important factor determining winter habitat use, yet there is insufficient understanding of this factor within the Dunedin study area to build it further into the species-habitat model at this time. Future information on snow conditions within the Dunedin area will help to refine the model.

14.7 References

B.C. Conservation Data Centre. 1997. *Rare Vertebrate Animal Tracking List (Sorted Phylogenetically Within Each Taxonomic Group).* March 10, 1997.

B.C. Ministry of Environment, Lands and Parks. 1996. *Vertebrate Red and Blue Lists*. Wildlife Branch, Victoria, B.C.

B.C. Ministry of Environment, Lands and Parks. 1992. *Caribou in British Columbia*. Public Information Brochure #92668, Queen's Printer, Victoria, B.C.

Becker, D. Personal communication. 1998. Senior Wildlife Biologist, Madrone Consultants Ltd., Duncan, B.C.

Bergerud, A. T. 1978. *The Status and Management of Caribou in British Columbia.* B.C. Fish and Wildlife Branch Report, Victoria, B.C.

Bergerud, A.T. and J.P. Elliot. 1986. *Dynamics of Caribou and Wolves in Northern British Columbia.* Can. J. Zool. 64: 1515-1529.

Bergerud, A. T., H. Butler, and D. Miller. 1984. *Antipredator tactics of calving caribou: dispersion in mountains. Can. J. Zool*. 62: 1566-1575.

Bradshaw, C. J. A., D. M. Herbert, A. B. Rippin, and S. Boutin. 1995. *Winter Peatland Habitat Selection by Woodland Caribou in Northeastern Alberta.* Can. J. Zool. 73: 1567-1574.

Child, K. and D. King. 1991. *Regional Wildlife Plan for the Omineca Sub-region, Northern Region.* B.C. Environment Wildlife Branch.

Cichowski, D. B. 1996. *Managing Woodland Caribou in West-Central British Columbia.* Pages 119-126 in *Rangifer*. Special Issue No. 9. Sixth North American Caribou Workshop, Prince George, B.C.

Cichowski, D. B. 1993. *Seasonal Movements, Habitat Use, and Winter Feeding Ecology of Woodland Caribou in West-Central British Columbia.* B.C. Min. For., Victoria, B.C. Land Manage. Rep. 83.

Cichowski, D. B. 1989. *Seasonal Movements, Habitat Use, and Winter Feeding Ecology of Woodland Caribou in West-Central British Columbia.* MSc. Thesis. Univ. B.C., Vancouver, B.C. 143p.

Corbould, F. B. 1993. *Chase Mountain/Butler Range Caribou Inventory*. Williston Wildlife Compensation Program.

COSEWIC. 1997. Can*adian Species at Risk, April 1997*. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario.

Darby, W. R. and W. O. Pruitt. Jr. 1984. Habitat Use, Movements, and Grouping Behavior of Woodland Caribou, Rangifer tarandus caribou in Southeastern Manitoba. Journal of Wildlife Management, Vol. 98: 184-190.

Farnell, R., and J. McDonald. 1990. *The distribution, movements, demography, and habitat use of the Little Rancheria caribou herd*. Final Report. Yukon Fish and Wildl. Br., Whitehorse, Yukon.

Farnell, R., and J. McDonald. 1989. *Inventory of the Wolf Lake Caribou Herd.* Final Report, Yukon Dept. of Renewable Res., Whitehorse, Yukon.

Farnell, R., R. Sumanik, J. McDonald, and B. Gilroy. 1991. *The distribution, movements, demography, and habitat characteristics of the Klaza caribou herd in relation to the Casino trail development, Yukon Territory.* Final Report. Yukon Dept. of Renewable Res., Whitehorse, Yukon.

Fenger, M. A., D. S. Eastman, C. J. Clement, and R. E. Page. 1986. *Caribou habitat use on the level mountain and horseranch ranges, British Columbia*. Ministry of Environment and Parks, Wildlife Working Report #WR-8. Victoria, B.C.

Fish, Wildlife, and Habitat Protection Department. 1994. *Wildlife Distribution Mapping, Big Game Series*. 16 maps, 1:2,000,000. Ministry of Environment, Lands and Parks, Victoria, B.C.

Habitat Inventory Section. 1994. *Northeastern British Columbia Wildlife Biophysical Project Phase 1 (Overview)*, February 1994, Ministry of Environment, Lands and Parks, Wildlife Branch, Habitat Inventory Section, Victoria. Web address: http://www.env.gov.bc.ca/wld/his/hebc.html

Hale, M. E. Jr. 1983. The Biology of Lichens. Edward Arnold Ltd., London.

Hatler, D. F. 1986. *Studies of radio-collared caribou in the Spatsizi Wilderness Park area, British Columbia, 1980-1984.* Rep. No. 3, Spatsizi Assoc. for Biol. Res., Smithers, B.C.

Heard, D. Personal Communication. 1996. Regional Wildlife Biologist for B.C. Ministry of Environment, Lands and Parks, Prince George region.

Heard, D., and K. L. Vagt. 1996. *Caribou in British Columbia: A 1996 status report.* Draft. Ministry of Environment, Lands, and Parks, Prince George, B.C.

Murray, L. J. 1992. *Habitat use and seasonal movements of radio-collared caribou in the Peace Subregion, 1988 - 1990.* Prepared for B.C. Environment, Fort St. John.

Oosenbrug, S. M., and J. Theberge. 1980. *Altitudinal Movements and Summer Habitat Preferences of Woodland Caribou in the Kluane Ranges, Yukon Territory*. Arctic. 33(1): 59-72.

Resources Inventory Committee. 1998. *British Columbia Wildlife Habitat Rating Standards.* Review Draft, April, 1998. Wildlife Interpretations Subcommittee, Wildlife Branch, Ministry of Environment Lands and Parks, Victoria, B.C.

Resources Inventory Committee. 1997a. *Standards for Wildlife Habitat Capability/suitability Ratings in British Columbia*. Review Draft, May 18, 1997. Wildlife Interpretations Subcommittee, Wildlife Branch, Ministry of Environment Lands and Parks, Victoria, B.C.

Resources Inventory Committee. 1997b. *Procedures for Wildlife Habitat Capability and Suitability Mapping.* Partial Draft, August 1, 1997. Wildlife Interpretations Subcommittee, Wildlife Branch, Ministry of Environment Lands and Parks, Victoria, B.C.

Rock, T. W. 1992. *A Proposal for the Management of Woodland Caribou in Saskatchewan.* Unpublished.

Rowe, J. S. 1984. *Lichen Woodland in Northern Canada.* Pages 225-237 *in* R. Olson, R. Hastings and F. Geddes. (Eds.). Northern Ecology and Resource Management. Univ. Alta. Press. Edmonton, Alta.

Russell, D. E. and A. M. Martell. 1984. *Winter Range Ecology of Caribou (Rangifer tarandus)*. Pages 117-144 *in* R. Olson, R. Hastings and F. Geddes. (Eds.). Northern Ecology and Resource Management. Univ. of Alta. Press. Edmonton.

Seip. D. R. 1996. *Ecosystem Management and the Conservation of Caribou Habitat in British Columbia.* Paper presented at the 7th North American Caribou Conference. In press.

Seip. D. R. 1992. *Habitat use and population status of woodland caribou in the Quesnel Highlands, British Columbia.* Wildlife Bulletin No. B-71, Queen's Printer, Victoria, B.C.

Seip, D. R. and D. B. Cichowski. 1996. *Population Ecology of Caribou in British Columbia*. Pages 73-80 in *Rangifer*. Special Issue No. 9. Sixth North American Caribou Workshop, Prince George, B.C.

Stevenson, S. K. 1991. *Forestry and Caribou In British Columbia. Rangifer*, Special Issue No. 7. 124-129

Stevenson, S., and D. Hatler. 1985. *Woodland caribou and their habitat in southern and central British Columbia.* B.C. Ministry of Forests, Land Management Report Number 23. Vol I &II.

Terry, E., and M. D. Wood. 1998. *Winter Ecology of the Wolverine Woodland Caribou Herd, North-Central B.C.* Peace/Williston Fish and Wildlife Compensation Program. Unpublished.

Wood, M. D. Personal Communication. 1998. Williston Wildlife Biologist. Fish and Wildlife B.C. Hydro Compensation Program; Ministry of Environment, Lands and Parks, Prince George, B.C.

Wood, M. D. 1996. *Seasonal Habitat Use and Movements of Woodland Caribou in the Omineca Mountains, North Central British Columbia.* Pages 365-378 in *Rangifer*. Special Issue No. 9. Sixth North American Caribou Workshop, Prince George, B.C.

Wood, M. D. 1993. *Seasonal Habitat Use, Movements and Population Status of Woodland Caribou in the Omineca Mountains, North Central British Columbia*. Peace/Williston Fish and Wildlife Compensation Program. Unpublished.