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37

Caribou Habitat Use in the Chelaslie River Migration Corridor and Recommendations for Management

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Movements and habitat use of radio-collared caribou (*Rangifer tarandus*) within the Chelaslie River "migration corridor" of the Tweedsmuir–Entiako herd were monitored from the spring of 1993 through the spring of 1995. The following conclusions were reached:

1. The area is more than simply a migration movement corridor. Even though on average it receives less winter use than the area south of Tetachuck Lake, in some years a significant number of animals winter in the area.
2. In the winter of 1993/94, when use was substantial, the caribou were most often associated with old forest on poor or low sites and with wetland/forest mosaics. This is similar to the pattern described for winter range south of Tetachuck Lake by Cichowski and Banner (1993). In periods of primarily migration movement, habitat selection is less distinct. In all years and seasons the area around Chief Louis Lake, Uduk Lake, and the Upper Chelaslie River received heaviest use.
3. Although, in the short term, simply keeping timber harvest out of the area would be the safest option for caribou, there is room for some timber development while minimizing risk to the caribou. The dynamic natural disturbance regime of fire and insect oubreaks also needs to be recognized. Management recommendations include maintaining a significant amount of the area in old or mature forest, limiting harvest to lower-value caribou habitat and lower-use areas, access control, and application of silvicultural techniques that maintain or encourage recovery of forage and caribou passage.

The Lakes District, British Columbia Ministry of Forests, funded most of the flying, and district staff helped in many other ways such as flight monitoring. Deborah Cichowski and Hannah Dickinson conducted some of the telemetry flights, and several people assisted as spotters. Larry Frey provided expert fixed-wing flying, and Craig Joiner ably piloted the spring 1993 helicopter flights. Loretta Kent provided essential GIS analysis support.

Rick Marshall (BC Environment) and other BC Environment and BC Parks staff, local guides/outfitters, and Tweedsmuir Rod and Gun Club members all deserve great credit for initially raising the issue of managing this caribou herd, and assisting with collaring. Allen Banner, Harold Armleder, Don Morgan, and Peter Ott all provided useful review comments on an earlier draft of the manuscript.

TABLES

FIGURES

1 INTRODUCTION

Caribou (*Rangifer tarandus*) in British Columbia is a species of management concern in relation to forestry. Caribou were historically more abundant and widely distributed in the southern half of the province then they are today, and the Tweedsmuir–Entiako herd is considered a high-priority population in both a regional and provincial context (Stevenson and Hatler 1985; B.C. Ministry of Forests 1995a;).

Based on concerns resulting from impending logging development, radio-collaring of the Tweedsmuir–Entiako caribou began in 1982 to identify movement patterns and habitat use (Cichowski 1993). It was found that in fall most of these animals left the north end of the park to winter south of Tetachuck Lake in the Entiako area. The potential for timber harvesting to affect the winter habitat south of Tetachuck Lake was then the subject of detailed study and management recommendations (Cichowski 1993; Cichowski and Banner 1993), and the calving and summer habitat is mostly protected in Tweedsmuir Provincial Park.

Only incidental monitoring of the caribou while migrating between the north end of the park and the winter range was conducted, yet this area (referred to as the Chelaslie Migration Corridor) is being developed for timber harvesting. Some interim management guidelines were developed,[1] but it was recognized that more information was needed to assess suitability of the guidelines and to develop comprehensive management plans. In the spring of 1993 through to the spring of 1995, a more intensive effort was made to monitor the behaviour of radio-collared caribou using the migration corridor.

Readers are referred to Cumming (1992) for a review of forestry/caribou issues throughout the continent, and Cichowski (1993) and Cichowski and Banner (1993) for more detail on the Tweedsmuir–Entiako population.

Objectives of this project were to:

1. determine the relative importance of the study area to the caribou;
2. determine if there are habitats used preferentially within the area; and
3. provide habitat management recommendations.

2 STUDY AREA

The 87 000-hectare study area is located south of Ootsa Lake and north of Tetachuck Lake, east of Tweedsmuir Provincial Park (Figure 1). The area is larger than the previously defined migration corridor in order to incorporate all observed locations of radio-collared caribou. The study area includes portions of the SBSdk, SBSmc, and ESSFmc biogeoclimatic subzones (Meidinger and Pojar 1991), and includes caribou management zone 11 of Cichowski and Banner (1993).

The area is mostly a gently rolling plateau, sloping from 850 m at Tetachuck Lake with a more rapid rise in elevation to about 1400 m along the southwest edge adjacent to Tweedsmuir Park. The major drainage is the Chelaslie River, which bisects the study area. The terrain is a mosaic of glacial ridges and depressions with numerous small wetlands. The forests are a mosaic of stands originating from fire, with about 80% of the forest cover in lodgepole pine (*Pinus contorta*), with lesser amounts of spruce (*Picea glauca* x *engelmannii*), subalpine fir (*Abies lasiocarpa*), and a very small amount of aspen (*Populus tremuloides*). About 60% of the forest is estimated to be 140 years or older, and about 2000 ha of logging development has occurred in the eastern portion of the study area.

1 *Interim Guidelines for the Tweedsmuir Caribou Migration Corridor*, B.C. Ministry of Forests, Lakes District.

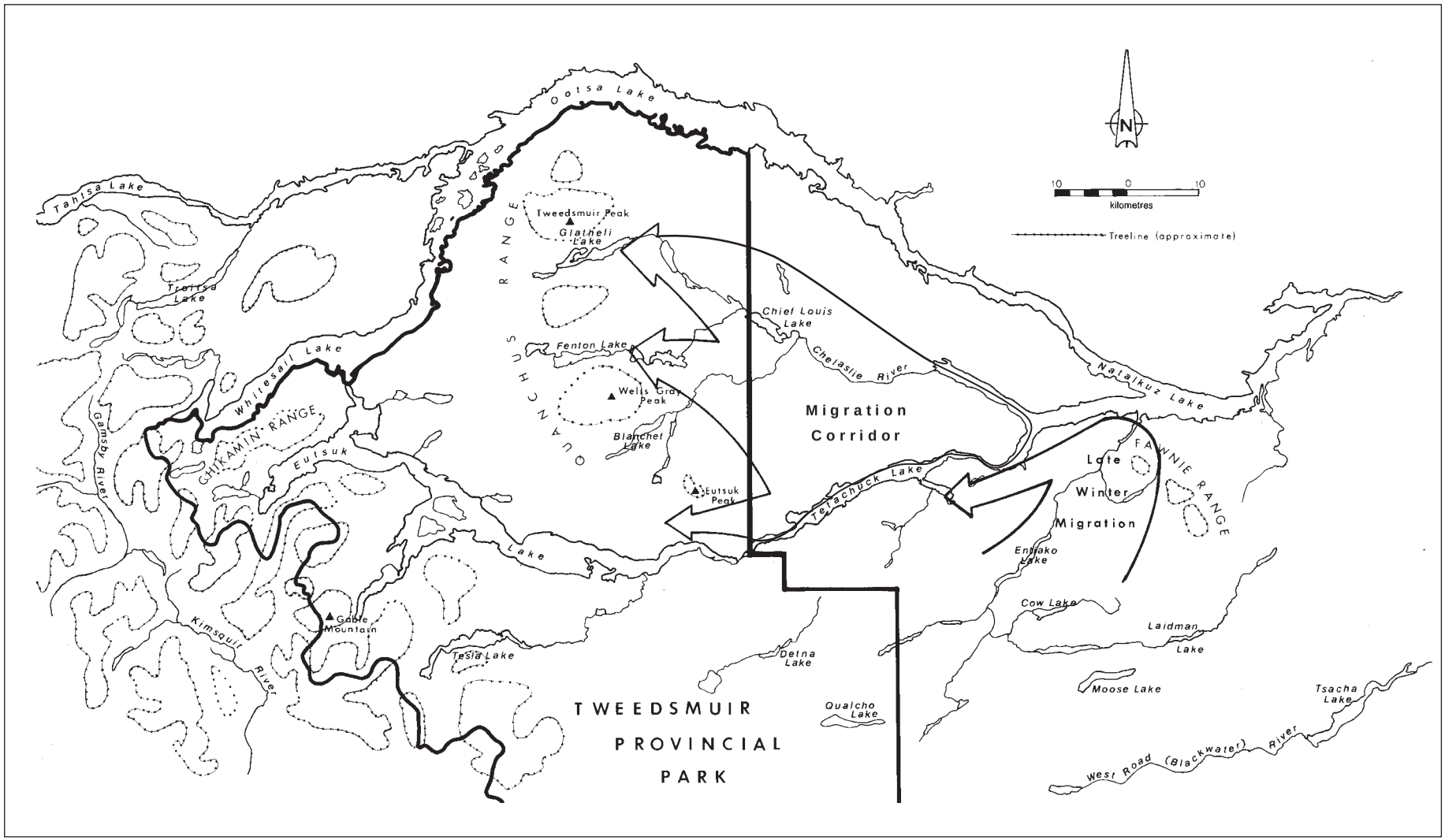

FIGURE 1 *Location of study area.*

3.1 Radio-telemetry

This study utilized 24–40[2] cow caribou and two bulls that were previously radio-collared. Caribou were captured over several years while swimming across Tetachuck Lake during fall migration (Cichowski 1993), or net-gunned from a helicopter in January/February of 1993.[3]

Collared animals were located approximately weekly using a fixed-wing aircraft (Cessna 182) or occasionally by helicopter (Bell 206), and in most cases the animals were visually sighted to confirm the location. Some spring 1993 locations were hand-plotted on 1:20 000-scale forest cover maps, but most were recorded with a Global Positioning System (GPS) receiver.

Any telemetry location system has accuracy limitations, and failure to account for possible error can potentially lead to biased results depending on how habitats are patterned (Nams 1989; Samuel and Kenow 1992). Potential error sources in this study include GPS reliability, the speed of the aircraft relative to the speed of GPS receiver updating, possible movement of an animal prior to final visual sighting, and map inaccuracies. Comparing GPS readings at 10 known locations to coordinates from 1:50 000 topographic maps, I found a mean error of 63 m with a 95% confidence interval of 165 m. This is similar to the mean error of 50 m with a 95% confidence interval of 136 m reported by Leptich et al. (1994) using a similar GPS and aircraft. Based on these results, and applying an additional allowance for other factors, I assume location accuracy of within 190 m.

3.2 Habitat Selection Analysis

Since ecosystem mapping is not available for the migration corridor, I used forest inventory mapping as a basis for describing habitat. Cichowski and Banner (1993) found that forest age-class and site-class from forest inventory maps were predictive of caribou habitat use in the Entiako area.

I combined forest cover polygons into six habitat types using forest inventory age- and site-class[4] combinations:

1. Lake — lakes
2. Wet — wetlands and other non-forest types
3. Old-P — age-class 7,8,9 (120+ years)/ low or poor site
4. Old-G — age-class 7,8,9 (120+ years)/ medium or good site
5. Mature — age-class 5,6 (80-120 years)/ any site
6. Early — age class 1,2,3,4 (<80 years)/ any site, includes harvested areas.

As there was little medium- or good-site forest in age-classes 5 and 6, and few caribou locations, site categories were combined. The lake category was excluded from habitat selection analysis as it is not of management interest, and few caribou locations were recorded on lakes.

Caribou locations were digitally overlain with 1:20 000-scale forest cover maps,[5] and the habitat type and forest inventory polygon parameters for each location recorded. The area (ha) of each habitat type in a 190-m radius around each location, representing the potential error polygon, was also determined. If the caribou have no preferences, we would expect the proportion of locations, or area, from the circles in each habitat to be similar to the proportions of each habitat in the study area.

Several statistical techniques have been developed to examine habitat use relative to

2 Number of caribou available during the study declined due to mortalities and radio failures.

3 T. Smith, Ministry of Environment, Lands and Parks, Smithers, B.C.

4 Site-class is based in ranges of site-index, an expression of forest productivity: the expected height that a tree will reach in 50 years.

5 Cover maps were recently updated (March 1993). Digitizing and forest cover summaries were conducted using the PAMAP GIS.

availability (Alldredge and Ratti 1992; Aebischer et al. 1993). I chose to use the number of radio-locations as an index of caribou activity in each habitat type, applying the methodology of Neu et al. (1974). This method puts greater weight on those animals that use the study area the most, which is appropriate given that animals that spend little time in the study area will be less affected by management within the area. With individual animals moving in and out of the study area, there are relatively few locations for any individual caribou, making methods based on comparing individual animals (e.g., composition analysis [Aebischer et al. 1993]) inappropriate.

I used the log-likelihood G statistic (Sokal and Rohlf 1981) to compare the distribution of radio-locations among habitats to that expected if locations were randomly distributed among habitats. If there were no radio-locations in a particular habitat, a value of .001 was substituted to allow use of logarithms. If the overall test was significant, Bonferroni-adjusted, 95% simultaneous confidence intervals were then used to decide whether caribou activity in individual habitat types was greater or less than expected by chance (Byers et al. 1984).

This approach weights all radio-locations equally, so that (for example) one caribou in the same location three times is treated the same as three caribou found in a location once. Further assumptions are that radio-locations are a representative and independent sample of all caribou locations, and the animals had the opportunity to select from all the habitats in the study area. Although the assumption of independence at the individual radio-location level cannot be strictly met, the number of location flights and length of time between flights was considered as adequate to meet the requirements of the analysis. This assumption was partly tested by a contingency table analysis of whether the habitat that a caribou was found in was statistically independent of the habitat that it was in during the immediately previous flight.

Analyses were conducted separately for spring and fall/winter periods. The start of spring was defined as when the number of caribou using the area south of Tetachuck Lake began to decline as animals moved north into the study area (late March). Fall/winter was defined from the time that caribou began leaving the park to the beginning of spring.

To determine the appropriateness of combining years, differences in the distribution of caribou locations among habitats by year within a season were tested by contingency table analysis and the log-likelihood G statistic (Sokal and Rohlf 1981). If there was statistical evidence of different behaviour among years, separate analyses were conducted.

I also wished to assess whether forest-cover attributes in addition to age-class and site-class might be useful in refining predictions of caribou habitat use. The 95% confidence intervals for mean values of height-class, percentage of lodgepole pine and percentage of crown closure for caribou locations in the Old-G and Old-P habitats were compared to the mean values for the study area.

The interim guidelines for the migration zone identified the area around Chief Louis Lake and the north shore of Tetachuck Lake as being particularly important to the caribou. To examine whether these areas are preferentially used, and if habitat use differs from the larger study area, the study area was subjectively sub-divided into four subzones for analysis (Figure 2).

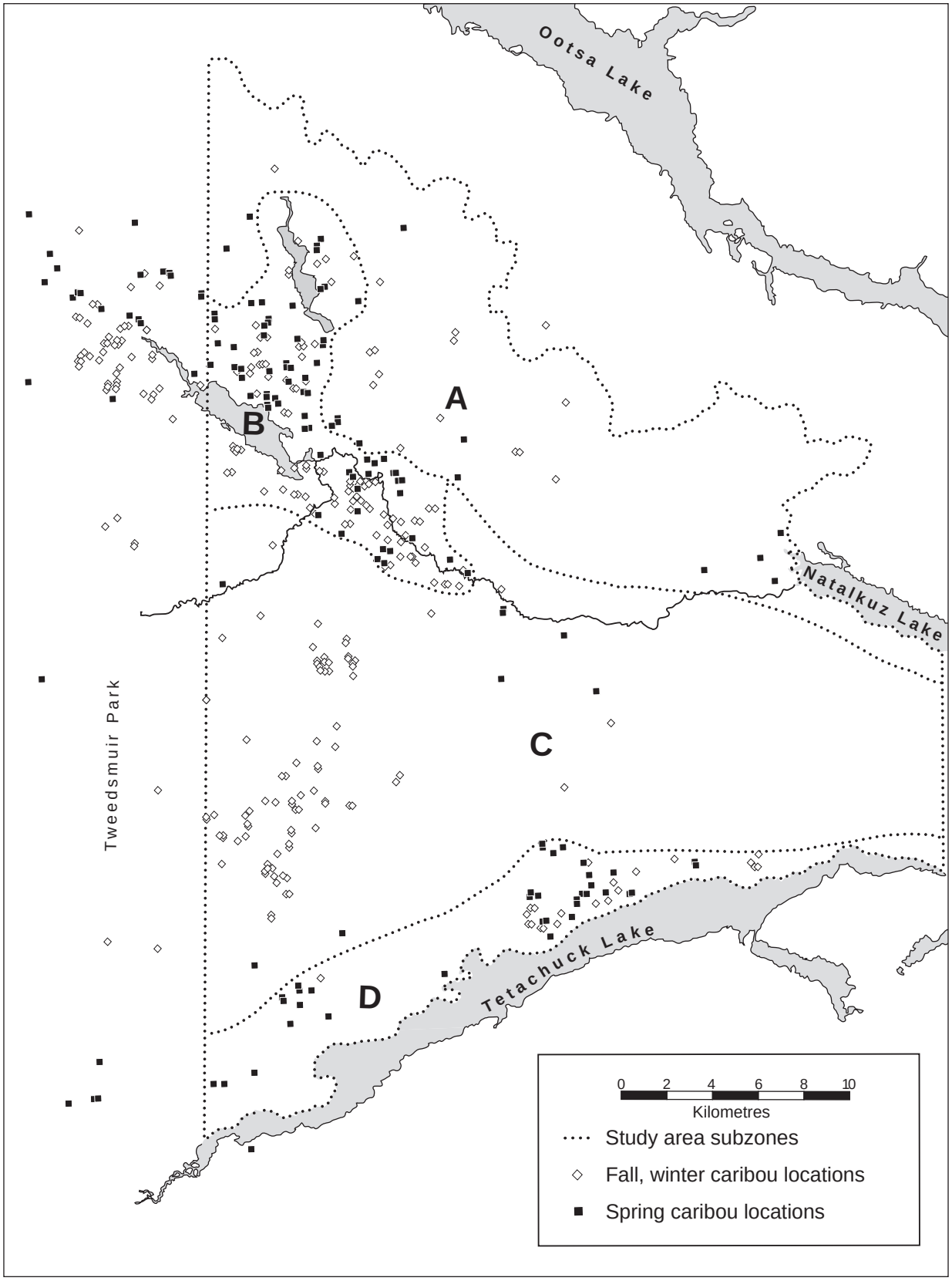

FIGURE 2 *Study area subzones and caribou locations.*

4.1 Use of the Migration Corridor

The number of collared caribou using the study area by date is shown in Figure 3. In spring the caribou generally did not move into the study area *en masse*, but rather in small groups from late March to early May. In fall some animals moved rapidly through the area while many slowly drifted south, occasionally even reversing direction and moving northwest. The proportion of collared caribou in the migration zone at any given time was as high as 50%, and in both years, especially 1993/94, some use of the area occurred all winter. In 1993/94 about 50% of the collared animals remained in the study area or adjacent parts of Tweedsmuir Park for most of the winter. The amount of use by individual animals also varied greatly, with some not using the study area at all.

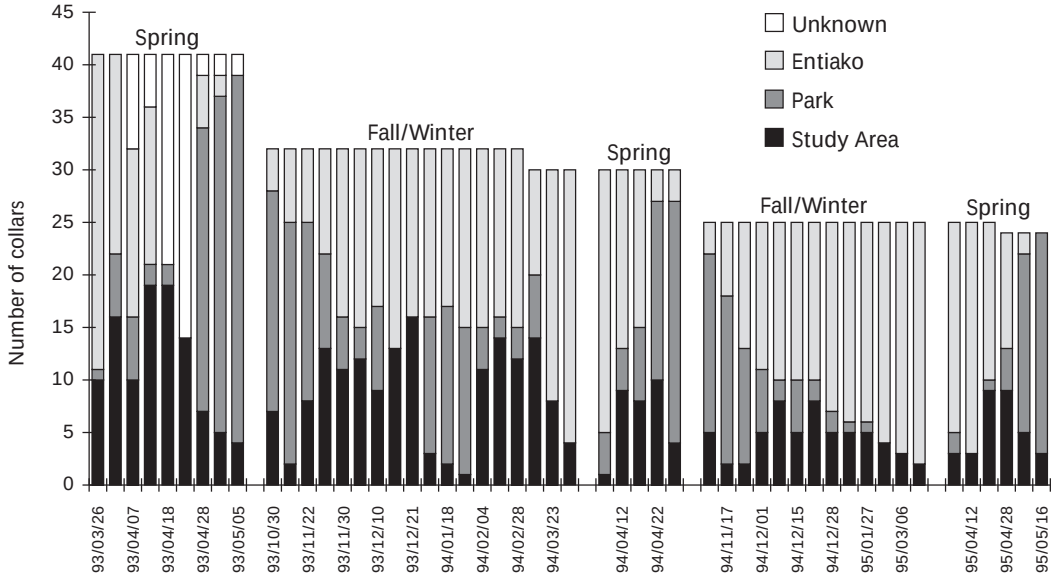

FIGURE 3 *Number of collared caribou in study area by date.*

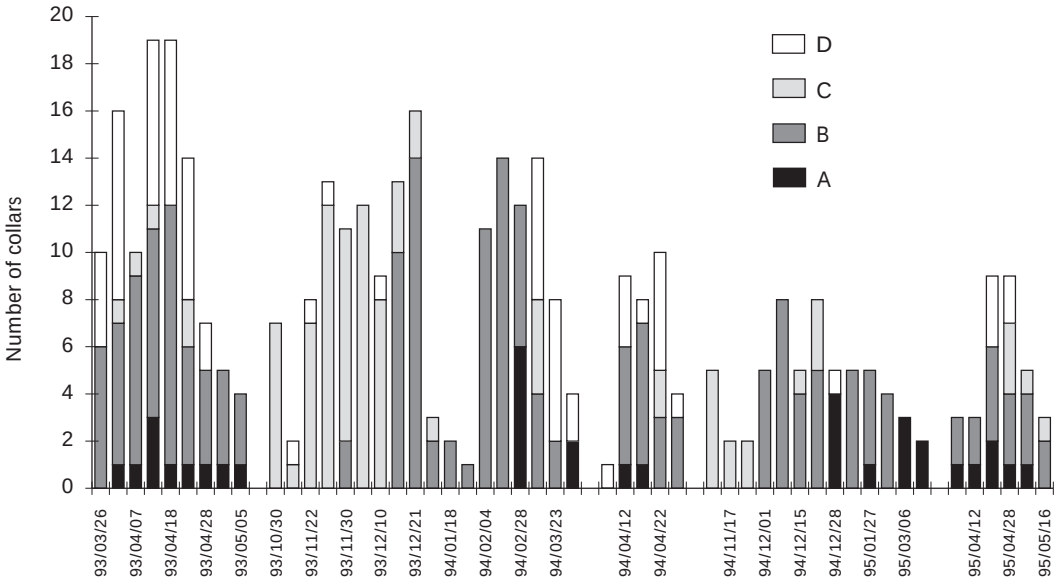

FIGURE 4 *Number of collared caribou in study area by subzone.*

The Chief Louis Lake/Uduk Lake/Upper Chelaslie River area (subzone B), 11% of the study area, received heavy use in all seasons and years, accounting for 50% of the 387 radio-locations (Figures 2 and 4). The distribution of spring locations among subzones did not differ by year (p=.373, G=3.128, 3 df), while winter locations strongly differed by year (p<.001, G=19.966, 3 df). Subzone B remained the highest-use area, but in the fall/winter of 1993/94 greater use was made of the extensive poor-site pine forest along the park boundary (subzone C) and the north side of Tetachuck Lake (subzone D). In 1994/95 there was somewhat greater use of the good-site forests of the Windfall Hills area north of the Chelaslie River (subzone A).

4.2 Habitat Selection

As the observed habitat use for point locations and the 190 m radius circles were virtually identical (Figure 5), suggesting no bias resulting from potential location error, only the point location data were used for further analyses.

4.2.1 Independence of locations This analysis was conducted separately by season, with all years combined due to limited sample size. For spring locations there was no statistical evidence (p=.73, G=12.151, 16 df) that the habitat in which a caribou was found was influenced by the habitat that it had used the previous flight.

For the fall/winter period, there was statistical evidence (p=.003, G=35.55, 16 df) that the previous location influenced habitat selection, although it was not deemed strong enough to distort the habitat selection analysis (Table 1).

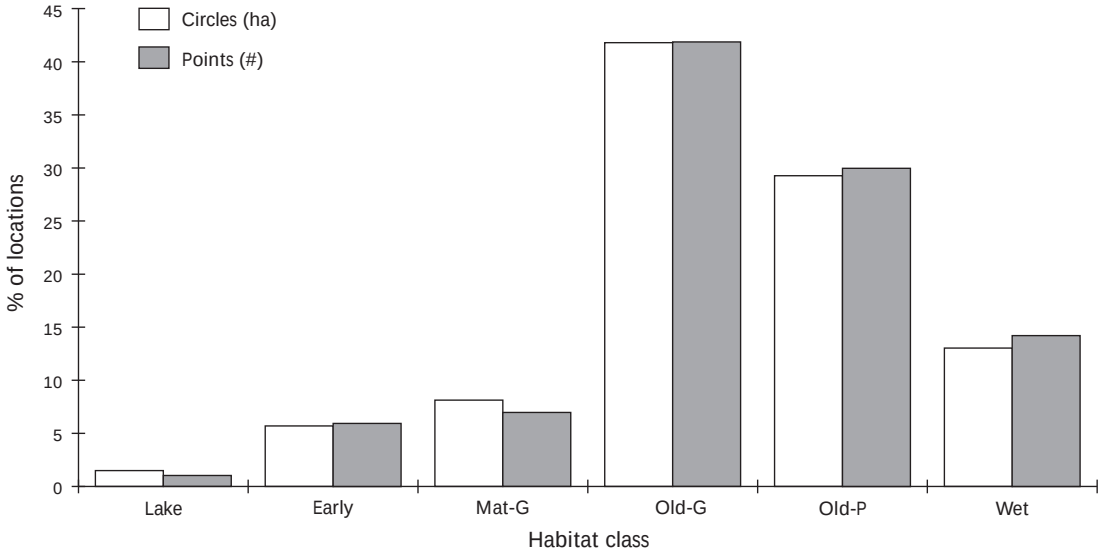

FIGURE 5 *Proportion of locations using points versus 190-m radius circles.*

TABLE 1 *Transition frequencies for fall/winter caribou locations*

Observed From	To					
	Mature	Old-G	Old-P	Wetland	Early	Total
Mature	0	2	4	0	0	6
Old-G	2	34	28	2	3	69
Old-P	6	24	26	13	3	72
Wetland	0	3	7	7	2	19
Early	1	5	1	1	2	10
Total	9	68	66	23	10	176

Observed - Expected [a] From	To					
	Mature	Old-G	Old-P	Wetland	Early	Total
Mature	0	0	2	- 1	0	1
Old-G	- 2	7	2	- 7	- 1	- 1
Old-P	2	- 4	- 1	4	- 1	0
Wetland	- 1	- 4	0	5	1	1
Early	0	1	- 3	0	1	1
Total	-1	0	0	1	0	0

a Expected = (observed row total x observed column total)/total transitions. Results rounded to nearest integer.

4.2.2 Spring habitat selection The differences in habitat use by year were not significant (p=.062, G=8.933, 4 df). Using the combined data (Figure 6), the only significant use/availability was a less than expected use of early seral forest.

4.2.3 Fall/winter habitat selection The distribution of fall/winter locations among habitats (Figure 7) differed by year (p<.001, G=23.610, 4 df). In 1993/94 when winter use of the study area was heaviest, all habitats showed a statistically significant departure from expected use based on availability. Early seral, mature, and good-site old forests were used less than expected, while poor-site old forest and wetlands were used more than expected. In the second year, early seral and mature forests were also used less than expected, but good-site old forest was used more than expected, and poor-site old forest and wetlands did not differ from expected use.

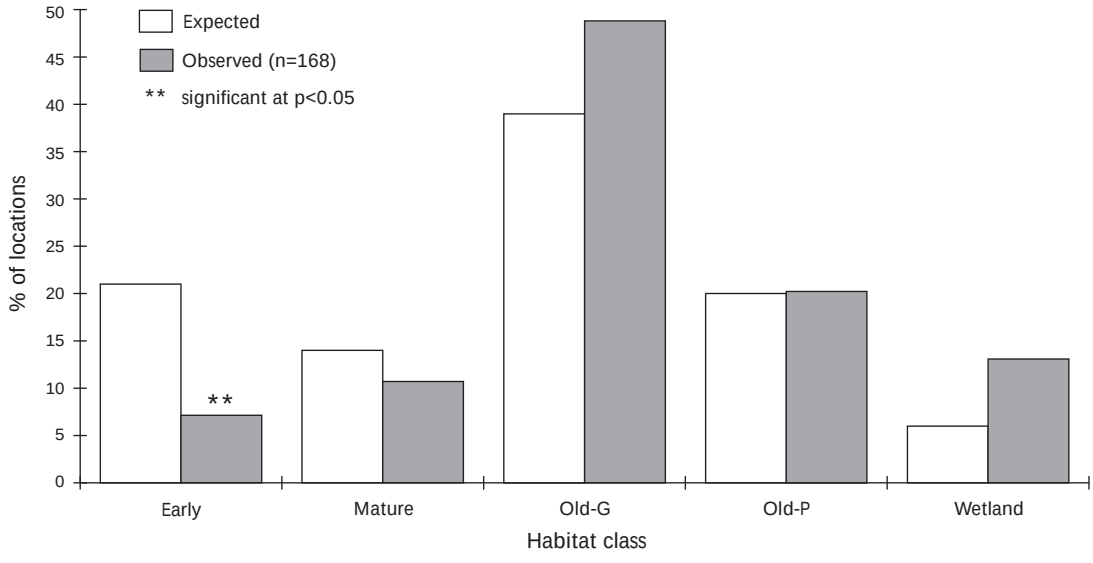

FIGURE 6 *Spring habitat selection.*

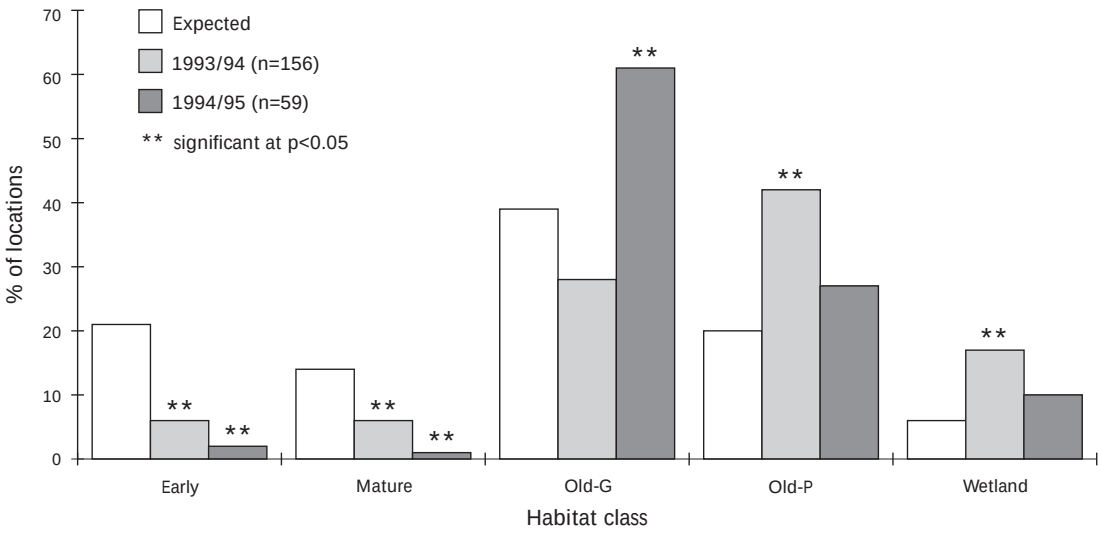

FIGURE 7 *Fall/winter habitat selection.*

4.2.4 Habitat selection within subzones
The subzones differed in habitat composition (Table 2), thus the habitat choices available to caribou differed by subzone.

Subzone B Subzone B was the only area with sufficient caribou locations to examine habitat selection separately by season and year (Figure 8). There was no evidence of habitat selection in the first spring (p=.61, G=1.820, 3 df), but there was selection for the second and third years combined (p=.02, G=9.778, 3 df). Poor-site old forest was used less than available, good-site old forest more than expected, and wetlands were used equal to expectations.

In the first fall/winter there was strong habitat selection (p<.001, G=17.408, 3 df) with mature forest and good-site old forest used less than expected, poor-site old forest used more than expected, and wetlands used about equal to expectations. There was no evidence of selection in the fall/winter of 1994/95 (p=.40, G=1.820, 3 df).

Subzones A, C, and D In subzone A the only statistically significant result was a lower-than-expected use (no locations) of early seral forest (Figure 9). This is the subzone with most of the recent logging, accounting for about 15% of the area. In subzone C there was less than expected use of early seral, mature, and good-site old forest, and greater-than-expected use of poor-site old forest and wetlands. In subzone D there was no overall significant selection among habitats (p=.43, G=3.846, 4 df).

TABLE 2 *Area (ha) of each habitat class by subzone*

	Subzone				
Habitat	A	B	C	D	Total
Early	3 598	5	12 191	2 115	17 910
Mature	2 477	82	6 094	3 234	11 888
Old-G	12 504	4 817	12 801	2 411	32 534
Old-P	3 794	2 587	9 702	413	16 495
Wetland	1 503	960	2 320	695	5 479
Total	23 877	8 451	43 109	8 869	84 305

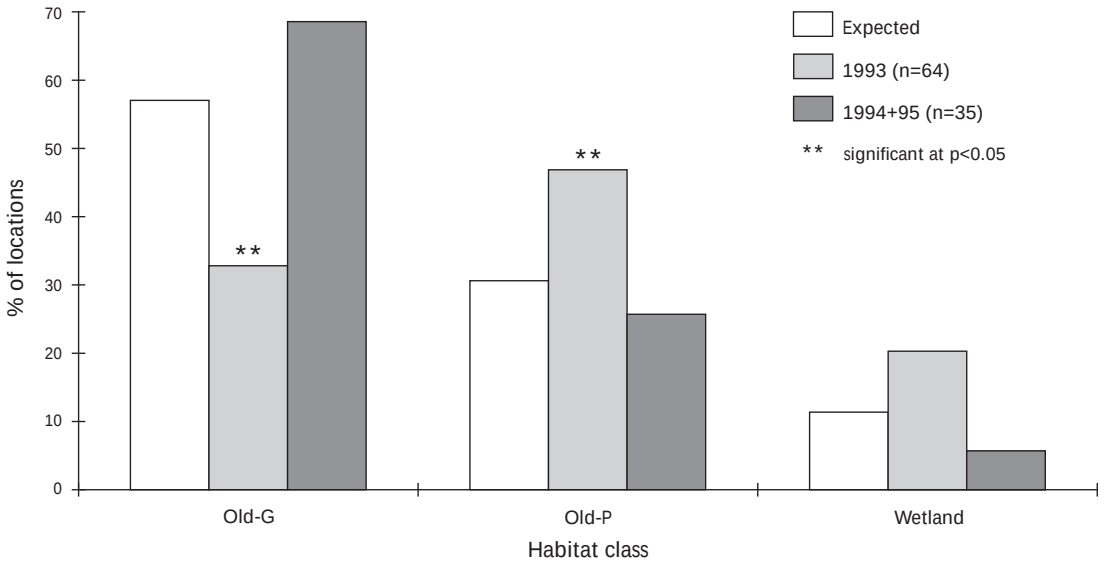

FIGURE 8A *Fall/winter habitat selection—subzone B.*

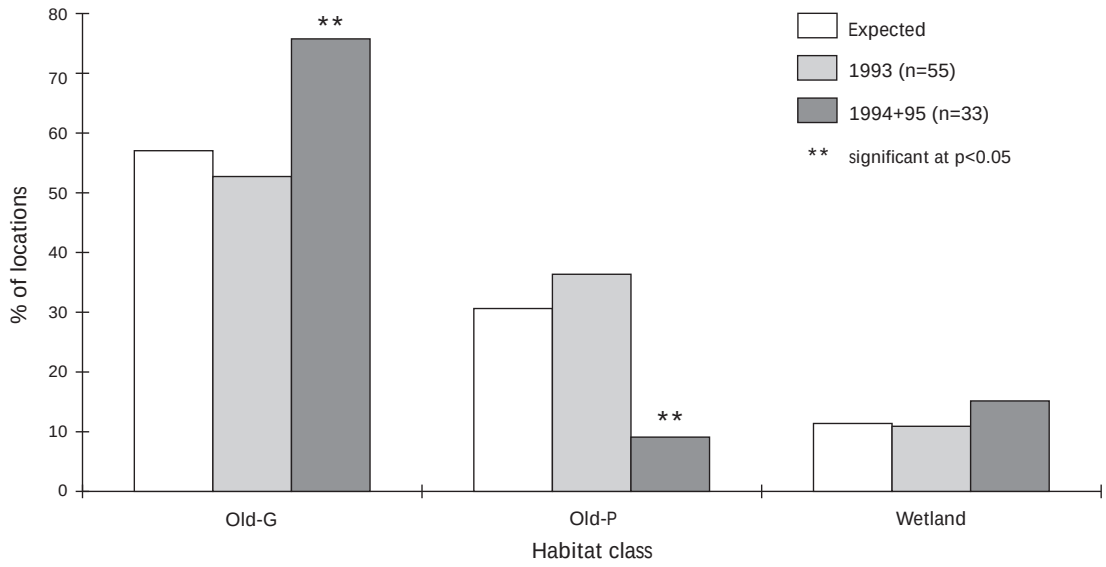

FIGURE 8B *Spring habitat selection—subzone B.*

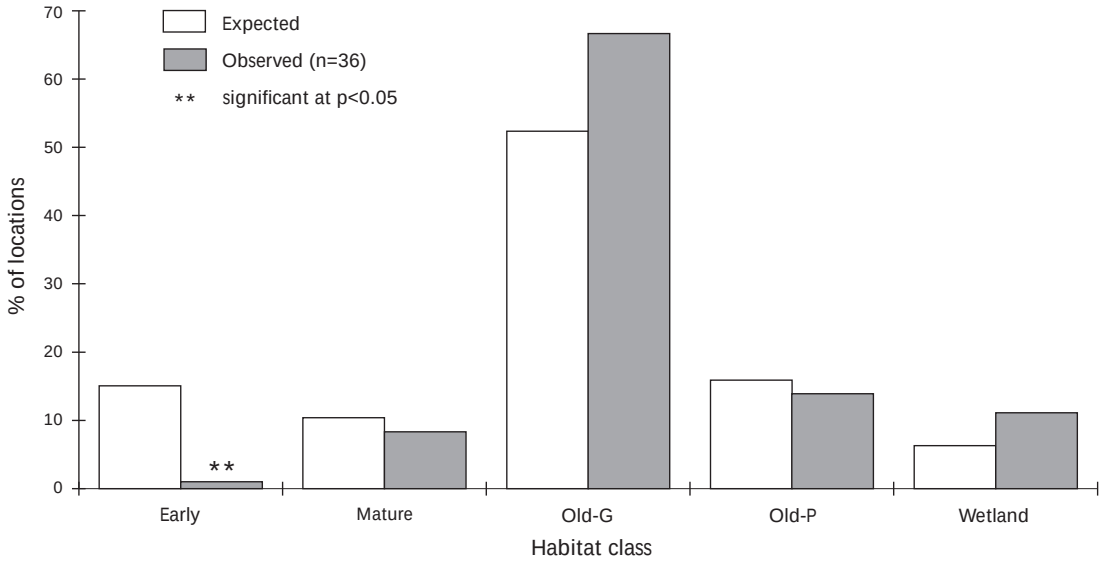

FIGURE 9A *Habitat selection—subzone A.*

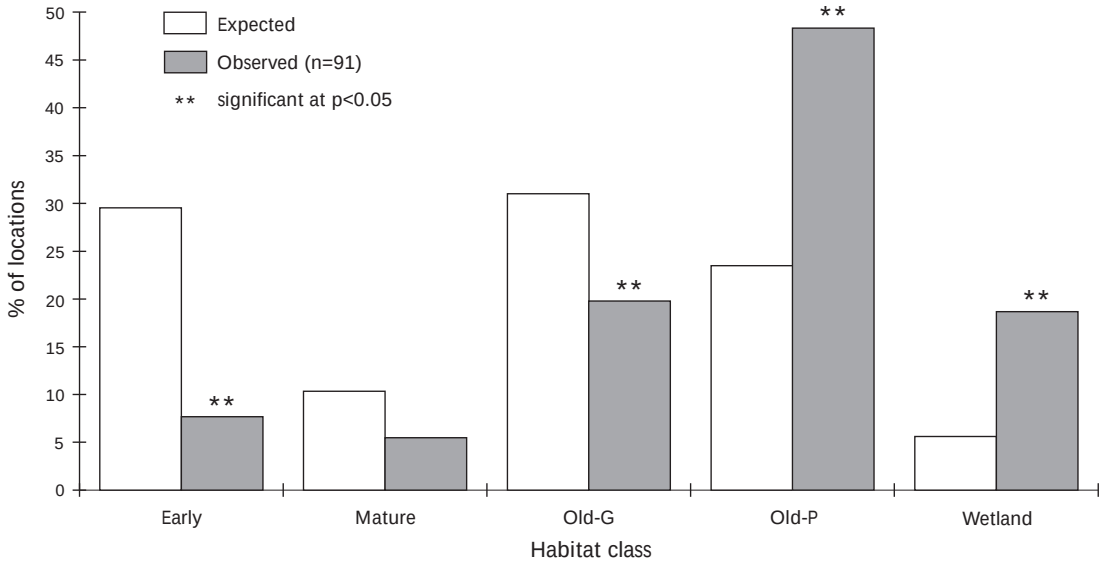

FIGURE 9B *Habitat selection—subzone C.*

4.2.5 Other forest-cover attributes In comparison to the study area as a whole, all three of the additional cover attributes examined (height class, percentage of lodgepole pine, percentage of crown closure) for caribou locations showed significantly different ($p<.05$) mean values for one or more of the comparisons (Table 3). However, the differences for percentage of crown closure and height class are likely trivial. For subzone B alone (Table 4), the only significant difference was a trivial one for height of Old-G height class in spring. Sample size was considered too limited to conduct separate analyses for the remaining subzones.

TABLE 3 *Percentage of crown closure, height class, and percentage of lodgepole pine for caribou locations versus study area*

		Caribou Locations					
	Study Area	Spring			Fall/Winter		
Habitat	**% Crown Cl**	**n**	**Mean**	**SE**	**n**	**Mean**	**SE**
Old-G	56.7	82	58.8	0.8*	80	57.7	0.8
Old-P	55.1	34	58.8	2.4	82	58.8	1.5*
	Ht-Class	**n**	**Mean**	**SE**	**n**	**Mean**	**SE**
Old-G	3.02	82	3.00	0.00*	80	3.01	0.01
Old-P	2.18	34	2.29	0.08	82	2.05	0.05*
	% Pine	**n**	**Mean**	**SE**	**n**	**Mean**	**SE**
Old-G	73.7	82	77.6	2.5	80	79.9	2.4*
Old-P	72.1	34	69.7	6.3	82	82.2	2.6*

* Indicates significantly different ($p<.05$) from area mean.

TABLE 4 *Percentage of crown closure, height class, and percentage of lodgepole pine for caribou locations versus subzone B*

		Caribou Locations					
	Subzone B	Spring			Fall/Winter		
Habitat	**% Crown Cl**	**n**	**Mean**	**SE**	**n**	**Mean**	**SE**
Old-G	58.8	54	57.2	0.9	45	59.3	1.0
Old-P	62.3	23	63.0	2.0	39	61.8	1.7
	Ht-Class	**n**	**Mean**	**SE**	**n**	**Mean**	**SE**
Old-G	3.03	54	3.00	0.00*	45	3.02	0.02
Old-P	2.09	23	2.26	0.09	39	2.08	0.04
	% Pine	**n**	**Mean**	**SE**	**n**	**Mean**	**SE**
Old-G	73.5	54	75.1	3.1	45	78.5	3.2
Old-P	83.2	23	71.8	7.1	39	82.3	4.3

* Indicates significantly different ($p<.05$) from area mean.

Animals can express selection for habitat at multiple scales. These caribou show large-scale seasonal selection by leaving the harsh, heavy snow areas of the coast mountains to winter in the much lower snow areas to the south and east (Cichowski 1993).

The migration corridor represents an intermediate area, and the degree of winter use varies by year, probably in response to winter severity. In 1993/94 about half the collared animals utilized the migration corridor and adjacent areas of Tweedsmuir Park nearly all winter, in contrast to the five-year period reported by Cichowski and Banner (1993, Table 9) when there was little use. Such flexible behaviour over large spatial scales may be critically adaptive by allowing a flexible response to varying winter conditions, reducing predictability for predators, and preventing overgrazing of slow-growing lichen forage.

Caribou also exhibit habitat selection at a smaller scale within the migration corridor, again showing flexibility between seasons and years (Table 5). One consistent result was little use of early seral forests (age classes 1–4) in all years and seasons. When the study area is used for wintering (first fall/winter), caribou select older forest, especially on poor sites, and forest/wetland complexes. These habitats would be expected to have greater abundance of terrestrial or arboreal lichen, the primary winter forage (Cichowski 1993). When most of the use is for migration (spring and second fall/winter) there is either little preference shown for particular habitats, or greater use of old forest on good sites. This general pattern of habitat selection is similar to the Entiako area (Cichowski 1993). It appears that the caribou express their selection of habitat by both preferentially using different subzones of the migration corridor, and by selection of habitats within subzones.

TABLE 5 *Summary of habitat selection*

Habitat	**Early**		**Mature**		**Old-G**		**Old-P**		**Wetland**	
Year	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
Study Area										
Spring[a]	- -		-		+		O		+	
Fall/Winter	- -	- -	- -	- -	-	++	++	+	+	+
Subzone B										
Spring					O	++	+	- -	O	+
Fall/Winter					- -	+	++	O	+	-
Subzone A[a]	- -		O		+		O		+	
Subzone C[a]	- -		-		- -		++		++	

a Data combined for both years.
- - Equals significantly less than expected ($p<.05$).
- Equals less than expected, non-significant.
++ Equals significantly greater than expected ($p<.05$).
+ Equals greater than expected use, non-significant.
O Equals very close to expected.
Blank means no test could be done.

The additional forest inventory polygon attributes of percentage of lodgepole pine, percentage of crown closure, and height-class were not helpful in predicting habitat use. This is not surprising as these attributes can be expected to be correlated with site, age, and subzone.

Caribou show further selection for microsites within forest cover types, mostly related to lichen forage availability (Cichowski 1993). Lance and Mills (1996) conducted site investigations of a randomly selected sample of the spring 1993 radio-locations compared to immediate surroundings, and suggested preferential use of open-canopied, good terrestrial lichen sites and avoidance of dense stands and heavy deadfall.

The apparent non-use of recently harvested areas in spring is somewhat surprising, as caribou begin to use more herbaceous vegetation at that time (Cichowski 1993), and other studies have reported spring use of clearcut areas.[6] In this case much of the harvested area is in the eastern portion of the study area (subzone A), and most of the caribou were further west prior to vegetation greenup. There have been incidental observations of caribou in this area feeding in recently cut areas later in the spring; however, when the bulk of the use of the migration corridor occurs, there is little use of recent clearcuts. During winter telemetry flights, caribou tracks were occasionally seen crossing recent clearcuts, thus the lack of use is likely a lack of suitable forage more than any avoidance of openings *per se*.

6 MANAGEMENT RECOMMENDATIONS

In the past the migration corridor has been considered of important but lower priority for habitat protection (Cichowski and Banner 1993). Although it is probably correct that the corridor is of less importance as wintering habitat than the area south of Tetachuck Lake, in at least some years it receives substantial winter use as well as migration use.

The objectives of a management strategy for the migration corridor should be to:

1. maintain general travel and winter foraging opportunities throughout the area;
2. reduce the probability of people and caribou being in the same place at the same time to reduce disturbance and poaching risk; and
3. minimize potential overlap of caribou and moose (and thus presumably wolves) to reduce potential predation risk.

Management recommendations for the migration zone are:

1. **Expand the area considered caribou habitat to at least include all radio locations from this study and that of Cichowski (1993).**

The area north and east of the study area boundary, and south of Ootsa Lake, is also potential caribou range, although there has been little documented use by radio-collared animals.

2. **Maintain a substantial proportion of the area in mature and old forest, especially in areas of extensive low- or poor-site classes (presumed higher density of terrestrial lichen sites) and adjacent to wetlands.**

The caribou in all seasons and years made greatest use of old forests, and avoided younger forests. Timber-harvesting rates should be conservative to allow caribou to adjust to changes and to ensure that mountain pine beetle outbreaks and other disturbances can be accommodated.

6 Sixth North American Caribou Workshop, March 1994, Prince George, B.C.

It is unknown what minimum amount of older forest is suitable for the area, recognizing caribou habitat preferences, natural disturbance dynamics, and access to timber resources. I suggest an approach based on natural disturbance regimes (B.C. Ministry of Forests 1995b). The expected age-class distribution for a mean fire-return interval of 150 years (Johnson and Van Wagner 1984) suggests maintaining about 60% of the landscape at 80 years or older, and 40% at 140 years or older. This would still allow substantial timber development, as currently the study area is estimated at 80% older than 80 years, and 60% older than 140 years.

To reduce impact on timber availability, the prescription could be reduced in the lower-use subzone (A) to 45% greater than 80 years, 30% greater than 140 years (75% of "natural levels"). General biodiversity guidelines (B.C. Ministry of Forests 1995b) should be adequate for the remaining area south of Ootsa Lake, north and east of the study area.

3. **Avoid development in the consistently high-use area around Chief Louis Lake (subzone B), and minimize disturbance along the north shore of Tetachuck Lake.**

The area (subzone B) around Chief Louis Lake, Uduk Lake, and the Chelaslie River valley for about five kilometres below Chief Louis Lake, received greatest use by the caribou and thus is of highest priority for habitat protection. Subzone D along the north side of Tetachuck Lake is also of priority, as it tends to be a staging area for animals prior to or immediately after crossing the lake. Some management activity in these areas to maintain caribou habitat and reduce potential for heavy mountain pine beetle attack may be warranted, but should be proceeded with cautiously.

4. **Through harvest pattern and scheduling, maintain a variety of travel options throughout the area.**

Caribou should have the opportunity to avoid early seral forest if they so choose. By applying a strategy of variable harvest unit sizes and shapes approximating natural disturbances (B.C. Ministry of Forests 1995b, Table 13), and requiring similar-sized, unharvested patches adjacent to harvest blocks until they have matured, a fragmentation pattern is avoided and options for caribou maintained.

5. **In development planning and silvicultural prescriptions, look for opportunities to retain good terrestrial or arboreal lichen habitat.**

Areas of good terrestrial or arboreal lichen abundance should be excluded from harvest units, or retained as patches within harvest units. Partial-cutting trials or thinning in younger stands could also be considered to maintain or potentially accelerate development of mature stand structure (Armleder and Stevenson 1995). Stands with good lichen abundance but heavy accumulations of windthrow may benefit from salvage logging to improve caribou access.

6. **Consider access controls and schedule harvesting activities to minimize human activity when greatest use of the area occurs.**

Generally, the greatest use of the area occurs from early November to early December, and late March to late April. Adjustment might have to be made in years when substantial wintering occurs in the area.

7. **Apply an adaptive management approach to development.**

Assumptions of terrestrial lichen recovery after 80 years need to be confirmed, and caribou movements and habitat use studies should be repeated once sufficient management has occurred in the area to detect a response. Appropriate study designs to answer these questions will be needed.

8. **Address other herd management issues.**

While habitat management is crucial, the low recruitment rate of this population, probably due to predation levels (Cichowski and Banner 1993), should be addressed if the population is to thrive and potentially increase.

APPENDIX 1 Number of caribou locations by year, habitat, season, and subzone

	Habitat	Lake	Early		Mature		Old-G		Old-P		Wetland		Total
	Season	F	F	S	F	S	F	S	F	S	F	S	
	Subzone												
Year 1	A	-	-	0	-	1	-	6	-	1	-	2	10
	B	-	-	0	-	0	-	29	-	20	-	6	55
	C	-	-	1	-	1	-	1	-	2	-	0	5
	D	-	-	5	-	8	-	10	-	5	-	6	34
		-	-	6	-	10	-	46	-	28	-	14	104
Year 2	A	0	0	0	0	0	7	1	1	0	0	1	10
	B	4	0	0	0	0	21	14	30	2	13	1	85
	C	0	5	0	4	0	9	1	35	0	13	1	68
	D	0	6	4	5	4	7	2	0	0	1	0	29
		4	11	4	9	4	44	18	66	2	27	3	192
Year 3	A	0	0	0	0	2	7	3	2	1	1	0	16
	B	0	0	0	0	0	24	11	9	1	2	4	51
	C	0	1	0	0	0	4	3	5	2	3	0	18
	D	0	0	1	0	2	1	1	0	0	0	1	6
		0	1	1	0	4	36	18	16	4	6	5	91
Total		4	12	11	9	18	80	82	82	34	33	22	387

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