

# **Mountain caribou in the Harrop Procter Community Forest area**

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## BACKGROUND

The Harrop-Procter Community Cooperative has been given a 5-year license to manage the forests surrounding their communities as part of a Community Forest Pilot Project. One of few pilot projects of this nature within British Columbia (B.C.), the Co-op's tenure covers 10,800 ha in the southern Selkirk Mountains of southeastern B.C., including 5 main drainages (Harrop Creek to Irvine Creek) along the south side of the West Arm of Kootenay Lake and around into the west side of the main body of the lake (Fig. 1). This forest tenure extends from just above settled and private lands along the lake to the height of land (up to 2,400 m elevation).

Along with grizzly bear (*Ursus arctos*) and ungulate winter range, woodland caribou (*Rangifer tarandus caribou*) has been identified within the Kootenay-Boundary Land Use Plan as a species of management concern (Kootenay Inter-Agency Management Committee 1997). Both the Kootenay-Boundary Land Use Plan and recent (January 2001) modifications to caribou management priority areas and line work (G. Woods, B.C. Ministry of Water, Land and Air Protection [MWLAP], Nelson, personal communication) identify potential caribou habitat at upper elevations within the Co-op's forest tenure (Fig. 2). These areas have been designated caribou management priority 3 areas (rated from 1 to 3, with 1 being the highest).

The goal of this literature review was to provide Co-op forest managers with the background knowledge to begin to integrate caribou habitat into their forestry planning. Specific objectives were to describe the historic distribution and current distribution and status of the South Selkirk caribou herd, describe seasonal habitats and movements of these animals and caribou from adjacent herds, and provide initial recommendations for management of caribou habitat within the forest tenure area.

## METHODS

Published and unpublished reports were obtained from a number of sources, including personal reprints, libraries, government agencies, and persons associated with the International Mountain Caribou Technical Committee (IMCTC). Members of the IMCTC represent federal (US), state, provincial, academic and non-governmental organization interests, and are mandated to study and manage the South Selkirk caribou subpopulation. G. Woods and M. Knapik (MWLAP, Nelson), J. Almack (Washington Department of Fish and Wildlife), and J. Quayle (MWLAP, Victoria) kindly provided additional information, and P. Wallenius (MWLAP, Nelson) assisted with obtaining GIS coverages. T. Kinley (Sylvan Consulting Ltd., Invermere) provided useful comments on an early draft of this manuscript.

## HISTORIC AND CURRENT DISTRIBUTION

Woodland caribou are found across the mountainous and boreal habitats of northern North America. This subspecies of caribou has been divided into 3 ecotypes in B.C., boreal, northern and mountain, based on habitat use and behavioural patterns (Heard and Vagt 1998). Mountain caribou are closely associated with late-successional forests where arboreal hair lichens (*Bryoria* spp. and *Alectoria sarmentosa*), their primary winter food, are abundant (Stevenson and Hatler 1985, Antifeau 1987, Seip and Cichowski 1996, Goward 1998, Stevenson et al. 2001).

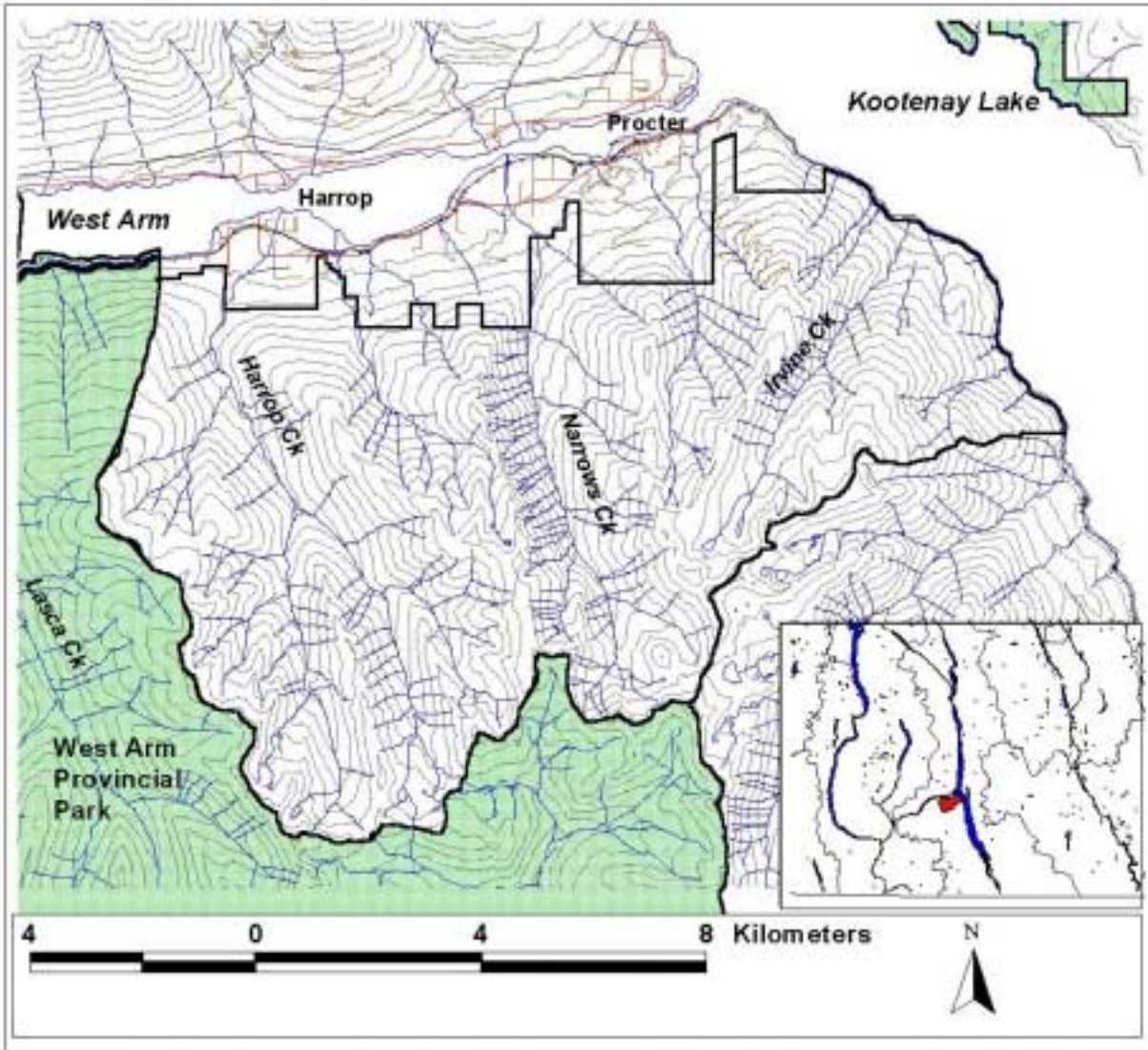
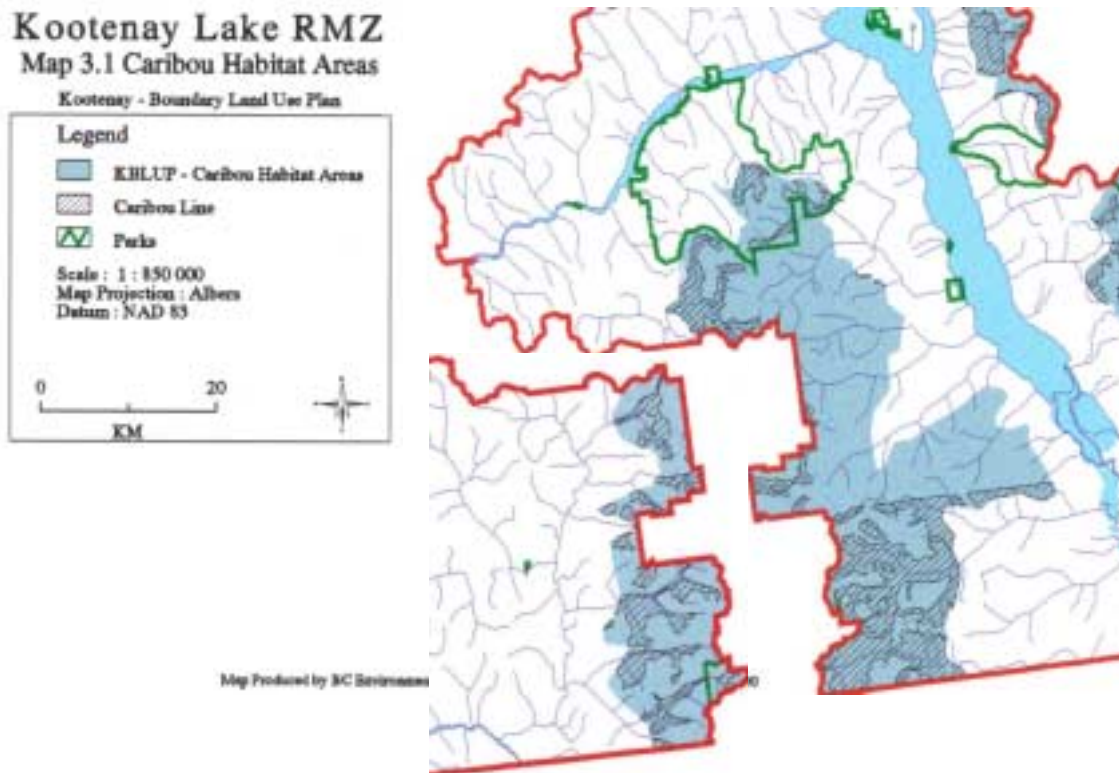


Figure 1. Location of the Harrop Procter Community Forest.



**Figure 2. Composite map of caribou habitat areas (blue shading; priority zones 1 and 2) for the South Selkirk Mountains in portions of the Kootenay Lake Resource Management Zone (inset of Arrow Lake RMZ) provided in the Kootenay-Boundary Higher Level Plan Order (<http://www.for.gov.bc.ca/pab/lup/kb/maps.htm>; effective 31 January 2001). Hatched areas are below the Caribou Line (see text). The Harrop Procter Community Forest lies east of the green park (West Arm Provincial Park) in the top centre of the map, outside of the caribou habitat areas.**

There are 13 spatially disjunct subpopulations of mountain caribou within B.C., ranging from the Canada-U.S. border to about the 55<sup>th</sup> parallel near Prince George (Heard and Vagt 1998). The South Selkirk subpopulation is the southernmost subpopulation, and are the only wild caribou found within the lower 48 states of the U.S. The closest adjacent herd of mountain caribou is in the southern Purcell Mountains (Kinley and Apps 2000, 2001). Current estimates of mountain caribou numbers are roughly 2,300 individuals, with most subpopulations either stable or declining in numbers (Simpson et al. 1997, Heard and Vagt 1998, Hatter in prep.).

Historical records of caribou distribution and abundance in the southeastern B.C. Kootenays are sparse (Spalding 2000), but it is likely that caribou inhabited and moved across most of the B.C. Purcell, Selkirk and Monashee mountains south to the international border (Russell et al. 1975, Seip and Cichowski 1996). Mountain caribou distribution in northeastern Washington, northern Idaho and northwestern Montana was also more extensive in historic times (Russell et al. 1975, USFWS 1994, Seip and Cichowski 1996). The decline in caribou numbers in the southern Kootenays may have occurred as early as the late 1800s or very early 1900s, possibly driven by overhunting, and fragmentation and loss of old growth habitat as a result of large forest fires set by miners searching for minerals (Russell et al. 1975, Spalding 2000, Hatter in prep.).

There are suggestions of caribou frequenting the current range of the South Selkirk subpopulation in large numbers in the mid-1800s. By the 1940s only small numbers were observed (Russell et al. 1975, Spalding 2000). Numbering perhaps 100 animals as recently as the 1950s, the South Selkirk subpopulation dwindled to 25-30 individuals by the early 1980s (Russell et al. 1975, USFWS 1994). In the early 1970s, a small herd of caribou was seen at the head of Narrows and Lasca creeks (Russell et al. 1975).

A number of releases have occurred in an effort to boost numbers of caribou. Between 1987 and 1990, 60 caribou from mountain and northern ecotype caribou populations further north in B.C. were released into northern Idaho (USFWS 1994, Compton et al. 1995, Warren et al. 1996). An additional 43 mountain caribou were translocated into the South Selkirk caribou range between 1996 and 1998 (Heard and Vagt 1998; Almack 1998, 2000a, 2000b). Despite these efforts, caribou numbers have continued to decline, with most mortality occurring during summer (Compton et al. 1995). The proximate cause of this decline is likely primarily related to predation (primarily cougar [*Felis concolor*] and bear [*Ursus* sp]) and emigration, with relatively low levels of human-caused mortality (poaching, collision with vehicles; Compton et al. 1995). The ultimate cause may be related to human access and disturbance, reduction in winter food supply, and habitat fragmentation, resulting in a multiple prey-predator system that supports higher numbers of other ungulate species, as well as predators, which subsequently increases predation on caribou (Seip 1992, USFWS 1994, Compton et al. 1995, Hatter 2000, Kinley and Apps 2001, Hatter in prep.).

Fifty-two South Selkirk caribou have been radiocollared and monitored since the mid-1980s (USFWS 1994; Almack 1998, 2000a, 2000b). Within the northern portion of their current range, animals have been located in the upper elevation areas in the headwaters of Five Mile and Lasca creeks and east of Ymir Mountain (within West Arm Provincial Park), with a handful of locations off the headwaters of Harrop (Mills) and Narrows creeks (G. Woods, personal communication). Although caribou have been located here at all times of the year, the greatest use has been observed during non-winter periods (Almack 2000a). During 2000, at least 4 radio-collared caribou were located within 5 km of the boundary of the Harrop Procter Community

Forest, primarily off the headwaters of Lasca Creek adjacent to Ymir Mountain. During ungulate track count work in January 2001, caribou tracks (5 sets, possibly the same animal) were observed at elevations ranging from 615 to 1,000 m on transects near Procter (Poole and Mowat 2001).

The South Selkirk caribou subpopulation currently numbers between 34 and 40 individuals (G. Woods, personal communication), and occurs in 2 main herds, centred near Stagleap Provincial Park at Kootenay Pass in southeastern B.C., and in northern Idaho. Twenty individuals are currently radiocollared (J. Almack, Washington Department of Fish and Wildlife, personal communication). A plan to transplant caribou to establish a separate herd in northeastern Washington (Audet and Allen 1996) has not been fulfilled.

The federal Committee on the Status of Wildlife in Canada (COSEWIC) lists woodland caribou in southern B.C. as vulnerable, and the mountain ecotype is provincially red-listed (endangered) in B.C. by the B.C. Conservation Data Centre. The South Selkirk caribou herd is currently listed as endangered under the US Endangered Species Act, threatened by Washington, and threatened or endangered by Idaho. The South Selkirk caribou are 1 of 3 or 4 mountain caribou subpopulations that are threatened because they exist at very low density, are relatively isolated, and are currently declining (Simpson et al. 1997, Hatter 2000, Hatter in prep.).

## **SEASONAL HABITAT USE**

Habitat use and seasonal movement patterns of the South Selkirk caribou subpopulation have been examined in depth, and the following summary is taken primarily from these reports (Table 1; Rominger and Oldemeyer 1989, Servheen and Lyon 1989, Rominger and Oldemeyer 1990, Warren et al. 1996), supplemented with mountain caribou research from elsewhere in the province. Most studies on mountain caribou have reported selection by caribou of “mature and old growth” stands, with a preference for the latter (mature is typically aged at 101-140 years; old growth at >140 years). Significant quantities of arboreal lichens are found only on trees within these late-successional stands, which are accessible to caribou on both dead and live standing trees and through windthrown trees and lichen litterfall (Antifeau 1987, Simpson et al. 1997, Goward 1998, Stevenson et al. 2001).

Mountain caribou habitat selection varies somewhat across its range, with the greatest differences observed during early winter. In areas of rugged mountains and deep snowpack, caribou show a preference for low elevation forests (Apps et al. 2001), whereas in more northern and southern portions of their range or locations with more subdued topography, including the South Selkirk subpopulation, caribou included use of higher elevation spruce-fir forests during this season (Servheen and Lyon 1989, Rominger and Oldemeyer 1989, Terry et al. 2000). Caribou in early winter have to contend with rapidly accumulating deep soft snow, which covers vascular plants and makes movement difficult. Movement upwards from early to late winter habitat occurs when the snow deepens and hardens, allowing the animals to reach the lichen-bearing forest canopy (Antifeau 1987). Movements to spring habitat follow vegetation green-up, to areas where succulent new vegetation is available. In early June, movements to higher, steeper, more secluded sites by pregnant females may function to avoid predators and increase calf survival (Bergerud et al 1984, Seip 1992). In summer, most animals in the subpopulation return to higher elevations to forage in alpine and subalpine zones, focusing on more gently sloped habitats including benches, cirques, and riparian zones. Movement to fall range results in

a shift to lower elevation, densely canopied forests. During transition periods between high to low elevation habitat, caribou are found within a broad elevation range and a variety of different habitats.

Complicating generalizations about seasonal habitat use by the South Selkirk subpopulation herd is that initial habitat use, movement and dispersal patterns of the mountain and northern ecotype caribou translocated to augment the subpopulation between 1987 and 1990 varied to some extent during the initial years post-release (Warren et al. 1996).

Group size within the South Selkirk subpopulation tends to vary throughout the year, with the smallest during spring and summer and the largest during the fall rut and late winter.

**Table 1. General description of seasonal habitat use by South Selkirk mountain caribou (citations in text).**

<b>Season</b>	<b>Relative elevation</b>	<b>Habitats</b>
<b>Early winter;</b> early Nov to mid-Jan	Low to mid (1,200-1,900 m)	Mature to old-growth hemlock-cedar and subalpine fir-spruce stands, >70% crown closure, high windthrow and lichen densities on gentle to moderate slopes
<b>Late winter;</b> mid-Jan to mid-Apr	High (>1,800 m)	Open canopied spruce-subalpine fir stands, high lichen density, gentle slopes
<b>Spring;</b> mid-Apr to early June	Mid-elevation	Mature stands with canopy openings and high productivity including avalanche chutes; steeper slopes are used because they are free of snow earliest
<b>Calving;</b> late May and early June	High	Secluded, mature-old aged stands with high lichen densities, moderate slopes
<b>Summer;</b> early June to mid-Sep	High (average 1,700 m)	Relatively gentle terrain, abundant understory cover, variable overstory
<b>Fall;</b> mid-Sep to late Oct	High to Low	Mature-old aged stands with dense understories

## REVIEW OF FORESTRY ISSUES

Following are key points made by recent researchers on mountain caribou and forestry management issues (herd names and ecotype after Heard and Vagt 1998):

Apps and Kinley 2000. South Purcell mountain caribou herd. The authors suggest that to maintain caribou forage in early winter (when caribou are at their lowest elevations and most prone to conflict with forestry), managers will need to maintain stands that have significant rates of windthrow among lichen-bearing trees (old forest conditions). Many valley-bottom locations near the heads of valleys were also associated with multi-scale attribute combinations preferred by caribou. They suggest that there is a need to provide connectivity from lower elevation sites to higher elevation sites.

Apps et al. 2001. Revelstoke (North Columbia Mountains) mountain caribou herd. This study reconfirmed the close association of mountain caribou with old-growth forests, including both lower elevation cedar-hemlock stands (primarily during early winter) and higher elevation spruce-subalpine fir stands. The authors suggest that old-growth dispersion should be managed

at several scales up to > 100 km<sup>2</sup>. At operation scales of 1:20,000, they recommend that old and mature forests are not fragmented by young stands.

Armleder and Stevenson 1996. Mountain caribou in general in the Engelmann spruce-subalpine fir (ESSF) zone. The authors conclude that high removal of timber volume can result in blowdown and heavy losses of lichen from the remaining trees. They therefore suggest that no more than 30% removal of timber volume from blocks managed as caribou habitat. They also suggest that some core caribou ranges should be set aside as no-harvest, no-access zones (refugia).

Hatter 2000. Mountain caribou in general. Hatter reported that current habitat management efforts are focussed on 4 major issues:

- 1) Identify and protect core habitat areas. Most Land and Resource Management Plans (LRMPs) have attempted to maintain 30-40% of the operable landbase in age class 8 or older (>140 years) within high-elevation, late winter habitats.
- 2) Establish alternative silviculture systems. The focus of ongoing efforts is to identify silviculture systems and habitat enhancement techniques that would sustain both timber harvest and mountain caribou winter habitat over the long term. Many of these adaptive management trials are still underway (i.e., Stevenson and Coxson 2000).
- 3) Maintain existing corridor or “linkage” areas. Travel corridors of snow interception habitat should be maintained between low and high elevations to enable caribou to move between seasonal ranges.
- 4) Access management. An access management plan is required for all subpopulations to ensure that recreation activities within mountain caribou range do not negatively impact mountain caribou.

Kinley and Apps 2000. South Purcell mountain caribou herd. In the adjacent southern Purcell caribou subpopulation, the southern portion of the range had more recent cutblocks and fires, greater road density, and more fragmentation than the northern portion; and consequently higher caribou mortality. Most adult mortality was attributed to predation, specifically by cougars.

Kinley and Apps 2001. South Purcell mountain caribou herd. Examination of mortality patterns suggests that most mortality was during the snow-free period, and was positively related to higher levels of habitat fragmentation, allowing ungulates (deer [*Odocoileus* spp], elk [*Cervus elaphus*] and moose [*Alces alces*]) and predators (primarily cougars) to expand into landscapes where they would not normally occur.

Rominger et al. 1994. South Selkirk mountain caribou herd. In a comparison of uncut and partially cut (10 years previously) stands of subalpine fir, arboreal lichen biomass per tree did not differ between stand types.

Seip and Cichowski 1996. All caribou in BC. The authors stress the need for caribou to be able to effectively avoid predators, and suggest that a patchwork of early seral and mature forests puts caribou into close proximity to predators by enhancing habitat for other prey species that prefer early seral forests. They suggest that caribou habitat management practices should provide a perpetual supply of large, continuous areas of suitable summer and winter habitat, with little or no vehicle access and disturbance (controlled access), so that caribou can space out at low densities and avoid predators and poachers.

Seip 1998. All caribou in BC. Seip (1998) suggests using an ecosystem management strategy for protecting caribou habitat by maintaining a relatively natural age class and patch size distribution within the landscape unit. This includes using stand management that maintains natural stand structure and habitat attributes such as snags and lichens.

Simpson et al. 1997. All mountain caribou in BC, with a Kootenay Region section. The authors summarize recommendations drafted at a workshop convened to define caribou management guidelines in the Kootenay Region. These recommendations included no harvest above 1,800 m in ESSF biogeoclimatic zone, and maintenance of 40% of the forest below 1,800 m and on slopes <80% in age class 8 or older (>140 yrs) in the Interior cedar-hemlock (ICH) and Montane spruce (MS) zones.

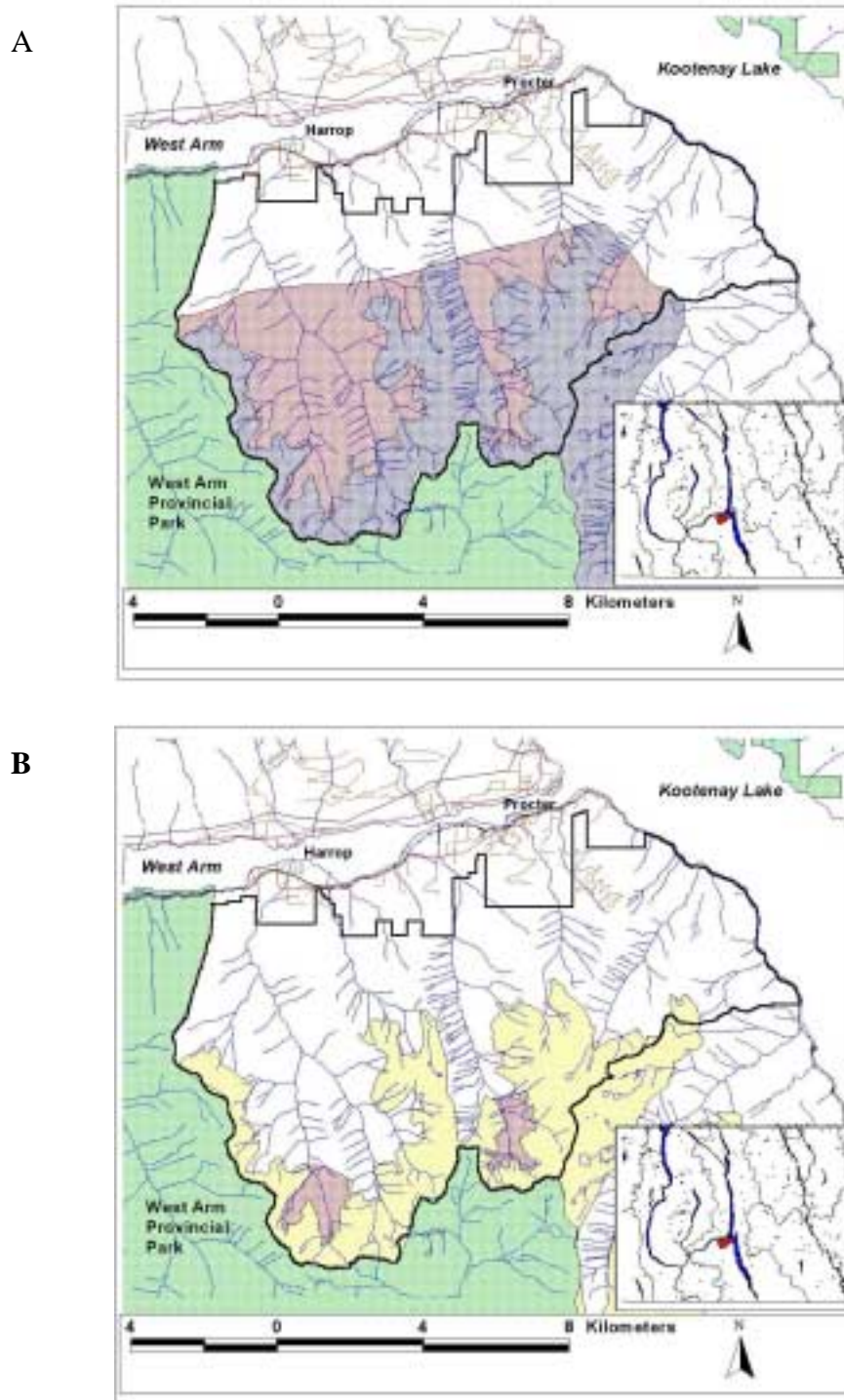
Stevenson et al. 2001. All mountain caribou in BC. The authors review caribou/forestry management for use at the landscape and stand levels of planning, including the results of partial cutting management trials begun in the 1990s. They suggest that planning for caribou habitat management at the regional and landscape scale must address problems of maintaining large contiguous areas of suitable habitat, providing linkage areas to ensure connectivity, controlling access and human activity, and separating caribou from predation by avoiding the enhancement of moose, deer and elk populations near caribou habitat. At the stand level, key recommendations are to use selection silviculture systems (single tree selection and group selection) to maintain caribou habitat in appropriate management zones, ensure pre-harvest species composition and size-class distribution are maintained, remove a maximum of 30% volume, area or basal area, limit group selection openings to 0.1 to 1.0 ha, assess and leave (safe) snags if snags support significant lichen biomass, and minimize damage to the residual stand.

Stevenson and Coxson 2000. All mountain caribou in BC. The authors found that partial cutting lowered the amount of lichen available compared to uncut stands, and resulted in an increase in the relative proportion of *Bryoria* to *Alectoria sarmentosa* (caribou appear to prefer *Bryoria* over *A. sarmentosa* in feeding trials; Rominger et al 1996). This shift in species composition is contrary to the conclusions of Rominger et al. 1994.

Terry et al. 2000. Yellowhead mountain caribou herd. In an assessment of winter habitat ecology, the authors reiterated the need to minimize habitat fragmentation and potential increased predation on caribou, and to maintain large continuous tracts of mature and old forests. They also suggest lighter volume removals (20-30%) and group selection systems to retain arboreal lichen biomass and limit excessive windthrow (Armleder and Stevenson 1996).

## **KOOTENAY-BOUNDARY LAND USE PLANS**

Landscape and strategic (operational) level forestry harvest guidelines pertaining to caribou habitat requirements have recently been revised. The Kootenay-Boundary Land Use Plan outlined previous guidelines in effect from 1997 until recently (Kootenay Inter-Agency Management Committee 1997). This plan designated 3 caribou management priority zones (1, 2 and 3; 1 being the highest priority) based on observed or perceived use of areas by caribou. Management was further stratified and applied below and above the “Caribou Line” or caribou-forestry operability line, recognized in 1994 by Ministry of Forests as the upper elevation of operable forests based on economic and silviculture restrictions. Only priority 3 areas occurred within the Harrop Procter Community Forest (Fig. 3a).



**Figure 3. A. Caribou management areas (blue and red shading) from 1997 Kootenay-Boundary Land Use Plan. Red shading shows areas below the caribou-forestry operability line (Caribou Line; see text), blue shading shows areas above. B. Recently suggested caribou management areas (yellow and red shading; G. Woods, MWLAP, Nelson, B.C., personal communication). Red shading shows areas below the Caribou Line. Provincial parks are excluded from the Crown forested land base for calculation of forest cover and forest practices requirements.**

The recently implemented Kootenay-Boundary Higher Level Plan Order (Forest Practices Code of British Columbia Act, effective 31 January 2001) established landscape level caribou habitat requirements “to retain seasonal habitats for mountain caribou in order to contribute to maintaining the viability of the existing subpopulations according to forest cover requirements shown in Table 3.1, within the caribou habitat areas shown on Map 3.1”. The South Selkirk Mountains portion of Map 3.1 is reproduced here (Fig. 2), as is Table 3.1 (Table 2). The previous priority zones were dropped in favour of 1 set of line work over which the forest cover and forest practice requirements pertain, with only former priority areas 1 and 2 included (Fig. 2). Thus, according to the Higher Level Plan, caribou management areas do not exist within the Harrop Procter Community Forest.

**Table 2. Caribou habitat requirements from the Kootenay-Boundary Higher Level Plan Order (Forest Practices Code of British Columbia Act, effective 31 January 2001; Table 3.1). Forest cover requirements are applied to Crown forested landbase within mapped caribou habitat of each landscape unit (excluding Provincial and Federal parks, Protected Areas, and Ecological Reserves). These forest cover area requirements are applied to slopes less than 80%.**

<b>Biogeoclimatic zone</b>	<b>Forest Cover and Forest Practices Requirements</b>
Subalpine Parkland	No timber harvesting
ESSF – above Caribou Line (as shown in Map 3.1) and below subalpine parkland	Maintain a minimum 70% of the forested area in age class 8 or older forests. Forested areas exclude the forest cover inventory labels alpine and alpine forest.
ESSF – below Caribou Line (as shown in Map 3.1)	Maintain 30% of the forested area in age class 8 or older. At least one-third of this 30% is to be age class 9. On an additional 20% (minimum) of the area, employ partial cutting prescriptions which maintain suitable caribou habitat attributes.
ICH – above Caribou Line (as shown in Map 3.1)	Maintain a minimum 70% of the forested area in age class 8 or older forests.
ICH – below Caribou Line (as shown in Map 3.1)	Maintain a minimum 40% of the forested area in age class 8 or older. At least a quarter of this 40% is to be age class 9.
MS	Maintain 40% of the forested area in age class 6 or older. One-quarter of this 40% is available for partial cutting prescriptions which maintain suitable habitat attributes.

Notes: See text for definition of Caribou Line  
Age class 6 = 101-120 yrs; 8 = 141-250 yrs, 9 = >250 yrs.

Recent suggested changes (G. Woods, MWLAP, Nelson, personal communication) extend caribou management areas back into the Community Forest, with areas of potential overlap with operable forest below the Caribou Line identified near the headwaters of Harrop and Narrows creeks (Fig. 3b). These areas of caribou habitat must be resolved through a regional caribou committee and may become the new rule (G. Woods, MWLAP, personal communication).

Strategic (operational) level harvest guidelines are provided in the Strategies for the Kootenay Boundary Higher Level Plan Order, May 14, 2001 (excerpt pertaining to caribou in Appendix 1). These guidelines outline stand level considerations for the maintenance of caribou habitat, including recommendations for partial cutting strategies. Guidelines for logging practices are also under review by the Regional Caribou Committee (G. Woods, MWLAP, personal communication).

### **PRELIMINARY FOREST MANAGEMENT RECOMMENDATIONS**

The Co-op should manage upper elevational areas within their Community Forest as potential caribou habitat. At the planning and strategic level, Co-op managers may wish to avoid any forestry activities within the revised caribou management priority areas, especially near the basins at the heads of drainages (Fig. 3b). Much of this area is above the traditional forest operability line. Linkage areas (movement corridors) from caribou habitat within the Community Forest are facilitated with the presence of West Arm Provincial Park adjoining over half of the southern boundary with the Forest. Given the higher amount of caribou management areas south of the west end of the Community Forest (south of the Harrop Creek drainage) and the desire to retain connectivity linkages with these areas, it might be prudent for Co-op managers to avoid harvest near the headwaters of Harrop Creek.

At the stand or operational level, forest managers should consider use of selection silviculture systems within designated caribou areas. Operational level harvest guidelines outlined in the Strategies for the Kootenay Boundary Higher Level Plan Order provide details (Appendix 1), with possible revision of recommendations to follow (G. Woods, MWLAP, personal communication). Additional information is provided in Stevenson et al. 2001 (Executive Summary in Appendix 2). Retention of trees with high lichen loads will provide adequate winter forage abundance to maintain (or encourage) use by caribou. In areas of concern in early winter habitat, managers need to retain mature trees and ensure that canopy closure is not reduced such that locomotion costs rise dramatically (Antifeau 1987). Connectivity is important, but documented caribou use within the Community Forest is limited; connectivity into the West Arm Provincial Park should be retained.

As noted above, predation is a critical issue in the South Selkirk mountain caribou subpopulation. Within designated caribou habitat, forest managers should strive to prevent the creation of summer habitat for other ungulates (i.e., moose, elk and deer; Stevenson et al. 2001). This includes avoiding logging practises that maximize fragmentation and provide suitable habitat for these edge and early-seral dependent species. Fragmented landscapes may provide a situation where caribou are unable to space-out from each other and from other species, and may increase the numbers and hunting efficiency of predators on caribou. Habitat management of predation is best achieved by avoiding cutting within designated caribou habitat.

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## **APPENDIX 1.**

Excerpt from: Strategies for the Kootenay Boundary Higher Level Plan Order, May 14, 2001.  
Part 2. Resource Management Zone Objectives

### **3. Caribou:**

#### **Forest Cover Selection:**

- (1) The following descriptions of suitable caribou habitat attributes will assist in forest cover selection, partial cutting prescriptions and identifying caribou habitat related benefits for recruitment strategies.
- (2) The location of forest cover contributing to the maintenance of caribou habitat should take into account the following:
  - a) Maintaining connectivity between seasonal habitats.
  - b) Maintaining a full range of seasonal habitats.
  - c) Maintaining large contiguous patches.
  - d) Selecting areas of the gentle slope gradients which are preferred by caribou.
  - e) Avoiding areas of topographic ruggedness which inhibit caribou use.
  - f) Selecting habitat use areas as indicated by inventory or radio telemetry data.
  - g) Maintaining dense canopy closure for snow interception in areas of early winter habitat.
  - h) Avoiding areas of high industrial or recreational access use.
  - i) Selecting windfirm stands.
  - j) Selecting stands with abundant arboreal lichen, particularly bryoria spp.

#### Partial Cutting:

- (3) Where this objective prescribes partial cutting, the following should be considered:
  - a) Avoid partial cutting in early winter habitat. Partial cutting is most suited in late winter habitat.
  - b) Residual stands should be wind-firm (the literature suggests that less than 30% volume removal maintains wind firmness). This volume removal can be accomplished through either single tree or group selection with openings averaging in the 0.1 – 0.2 ha range to a maximum of 1.0 ha for operational reasons.
  - c) If partially cut stands are to meet the definition of mature in Objective 2, refer to strategy 2 (6) above.
  - d) Caribou prefer Balsam and Balsam-Spruce forest types to Spruce and Spruce-Balsam. Give preference to maintaining the balsam component in areas of mixed species in ESSF.

- e) Abundant arboreal lichen available on standing trees is critical to the survival of caribou. Lichen abundance tends to be low on trees with few branches or dense, tangled branches. Give preference to maintaining those trees, both live and dead, with the greatest abundance of lichen found within 7 meters of the ground.

**Other Areas Within Mapped Caribou Habitat:**

- (4) In other portions of the mapped caribou habitat the following strategies should be considered:
  - a) Where even-aged management is practised consideration should be given to managing half of the area on extended rotations of at least 151 years to ensure options are available in the event of extensive habitat loss due to catastrophic disturbances. Incremental timber impacts and costs should also be considered in relation to the extent this strategy is implemented.
  - b) Where uneven-aged management is practised, prescriptions should be designed to retain trees supporting abundant lichen biomass.
  - c) Aggressive reforestation should be practised to reduce the availability of forage for other ungulates that attract predators into caribou habitat.
- (5) As per the delegation letter, the regional manager, Ministry of Forests, the regional director, Ministry of Environment, Lands and Parks, and the regional manager, Ministry of Energy and Mines, can modify Objective 3, including map 3.1 and table 3.1 to incorporate new information on caribou habitat within three (3) years and thereafter as appropriate.
- (6) In terms of integrated resource management, it may be desirable to redistribute the caribou forest cover retention targets by combining Landscape Units. That is, some LU's would have less forest cover retention than prescribed by this objective and others would have more, but in combination the prescribed retention targets would be met. This can be accomplished through the delegation letter (point d) which allows for modification of Objective 3. Note however, old and mature targets under Objective 2 have to be met on an individual LU basis.

**APPENDIX 2. EXECUTIVE SUMMARY FROM STEVENSON ET AL. 2001**