

The Mountain Caribou in Managed Forests Program: Integrating forestry and habitat management in British Columbia.

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Abstract: Caribou in southeastern and east central British Columbia generally use old-growth forests rather than clearcuts or immature stands. During winter, they subsist on arboreal lichens, which are most abundant in old growth. The Mountain Caribou in Managed Forests program was initiated to address the question: can forest stands be managed, through silvicultural systems and habitat enhancement techniques, to provide both timber and caribou habitat? The program includes radiotelemetry, habitat capability mapping, habitat management trials, and development of an integrated strategy. The management trials are aimed at maintaining arboreal lichens and other key habitat attributes in managed stands. The strategy development component involves wildlife biologists and foresters in developing and implementing solutions to logging-caribou conflicts.

Key words: *Rangifer*, caribou, British Columbia, habitat management, forestry, partial cutting, conflicting interests.

Rangifer, Special Issue No. 7: 130–136

Introduction

The «mountain caribou» ecotype of the woodland caribou (*Rangifer tarandus caribou*) is widely but sparsely distributed throughout the mountains of southeastern and east central British Columbia (Stevenson and Hatler 1985). During winter the caribou use old-growth forests almost exclusively, feeding on the lichens *Bryoria* spp. and *Alectoria sarmentosa* that grow on mature trees (Antifeau 1987; Edwards and Ritcey 1959; Rominger and Oldmeyer 1989; Seip 1990; Servheen and Lyon 1989; Simpson *et al.* 1985). Habitat management for mountain Caribou has generally been directed at trying to protect old-growth forests from logging (Stevenson and Hatler 1985). Conflicts have arisen between habitat and timber managers, and are increasing as the demand for timber increases. In response, the Mountain Caribou in Managed Forests (MCMF) Program was initiated to address the question: can forest stands be managed, through silvicultural systems and habitat enhancement techniques, to provide both timber and caribou habitat?

Study area

Most MCMF activities take place within an intensive study area of about 19,000 km², located in the Fraser River watershed east of Prince George, British Columbia (Figure 1). Elevations range from about 600 to 2200 m. Biogeoclimatic zones occurring in the intensive study area are the Alpine Tundra Zone (AT), the Engelmann Spruce - Subalpine Fir Zone (ESSF), the Sub-Boreal Spruce Zone (SBS), and the Interior Cedar-Hemlock Zone (ICH). In the western portion of the intensive study area, which is characterized by subdued mountainous topography, the ICH is generally absent and the SBS occurs directly below the ESSF. In the eastern portion, where the topography is more rugged, the ICH occurs below the ESSF, and the SBS is restricted to valley bottoms below about 700 m. The major land use activity in the intensive study area is forestry. Most often, stands are clearcut, broadcast burned, and planted with spruce (*Picea glauca x engelmannii*) or lodgepole pine (*Pinus contorta*).

The two broad physiographic types that oc-

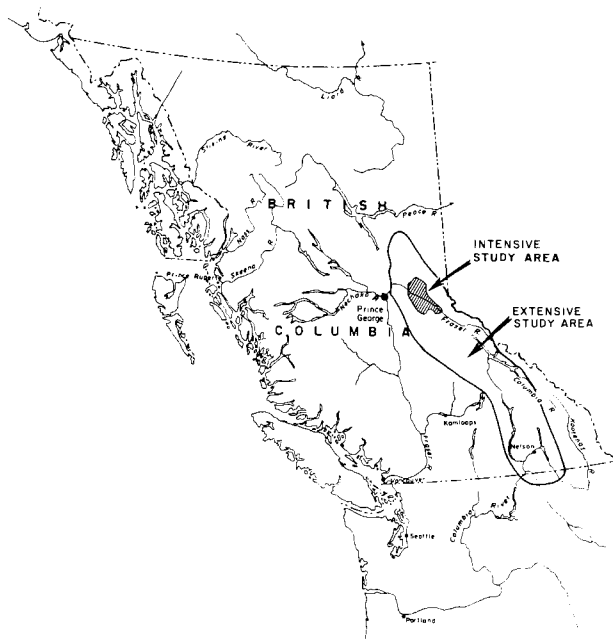


Figure 1. Location of the intensive and extensive study areas of the MCMF Program.

cur in the intensive study area, the mountain and plateau types, also dominate other caribou ranges in southeastern British Columbia (the «extensive study area» in Figure 1). Of the two broad configurations of biogeoclimatic zones, the ESSF-ICH complex is typical of most of the extensive study area. Management strategies developed in the intensive study area apply, with some modifications, to caribou ranges throughout the extensive study area. MCMF is involved in several cooperative projects in the extensive study area.

Rationale

To design suitable habitat for caribou in managed stands, managers must understand the key attributes of stands that caribou use, the function of those attributes, and the circumstances under which they are important. We reviewed studies of radio-collared caribou in southeastern and east central British Columbia to identify the key attributes of forested ranges and their functional importance (Stevenson 1989). We focused on caribou use of early and late winter ranges, because most conflicts with forestry were in those habitats.

The importance of the key attributes varies from one biogeoclimatic zone to another (Table 1). In the ESSF Zone, caribou feed mainly on

arborescent lichens from standing trees in winter, although lichens from windthrown trees and litterfall are used when available. At lower elevations (the ICH and SBS Zones), there are fewer lichens on the lower branches of standing trees, and blowdown and litterfall are more important sources of lichen. Caribou may take refuge from deep, soft snow in the ICH, where snowfall is lower, snow interception is greater, and more rooted forage is available. Generally, caribou use the ICH-M more frequently in early winter than the ICH-P or the SBS (see Table 1). In all biogeoclimatic zones, caribou are believed to be affected by access development.

When managers design habitat prescriptions to sustain wildlife populations in the long term, they must provide the attributes that can be functionally linked to survival, regardless of whether those attributes are currently limiting populations. Thus, it is important to provide escape cover, even if predator numbers are currently low, and to provide forage, even if food is not currently limiting. Management practices exist that can enhance the habitat attributes shown in Table 1, but they need to be evaluated and incorporated into an overall strategy.

Program overview

The MCMF Program is a co-operative venture of the B.C. Ministry of Environment, Ministry of Forests and the forest industry. The five-year program (1988-1993) is administered by the Ministry of Environment in Prince George. It is directed by two Committees, each with representatives from the two Ministries and the forest industry. A Technical Committee reviews technical content and progress of the program. An Advisory Committee provides comment on program direction, oversees the development of an integrated management strategy for caribou habitat throughout southeastern and east central British Columbia, and recommends policy changes where necessary.

The goal of the MCMF program is to produce integrated management solutions to mountain caribou-mature timber management problems in southeastern British Columbia (Child *et al.* 1991).

Five objectives direct program development and delivery (Figure 2):

1. To determine numbers, recruitment and causes of mortality for caribou (Radiotelemetry component);

Table 1. Estimated importance of key attributes of caribou winter range in various biogeoclimatic zones.

Attributes	ESSF	ICH/ ESSF	ICH-M ¹	ICH-P ²	SBS
Arboreal lichen produktion	H ³	H	H	M	M
Blowdown and litterfall	L	H	H	M	M
Snow interception	NA	L	M	L	L
Rooted forage production	NA	L	M	L	L
Access management	H	H	H	H	H

¹ ICH in Rocky Mountain and Columbia Mountain Physiographic Regions

² ICH in Interior Plateau Physiographic Region

³ L - low; M - medium; H - high; NA - not applicable.

- To describe seasonal patterns of habitat use and selection (Radiotelemetry component);
- To assess and map habitat capability for caribou (Habitat capability mapping component);
- To develop methods to create habitat in managed stands (Habitat management component); and
- To develop an integrated management strategy for long-term management of mountain caribou and timber in consultation with forest managers (Integrated management strategy component).

Radiotelemetry

Seasonal habitat relationships and migrations are investigated through radiotelemetry. Knowledge of habitat use patterns by mountain caribou facilitates integrating habitat needs of caribou in forest developments plans, prioritizing seasonal ranges of caribou in forest management planning, identifying core caribou management zones, and selecting sites for special forest management trials. The presence of radio-collared animals permits studies of population dynamics, herd productivity, and identification and quantification of important mortality factors.

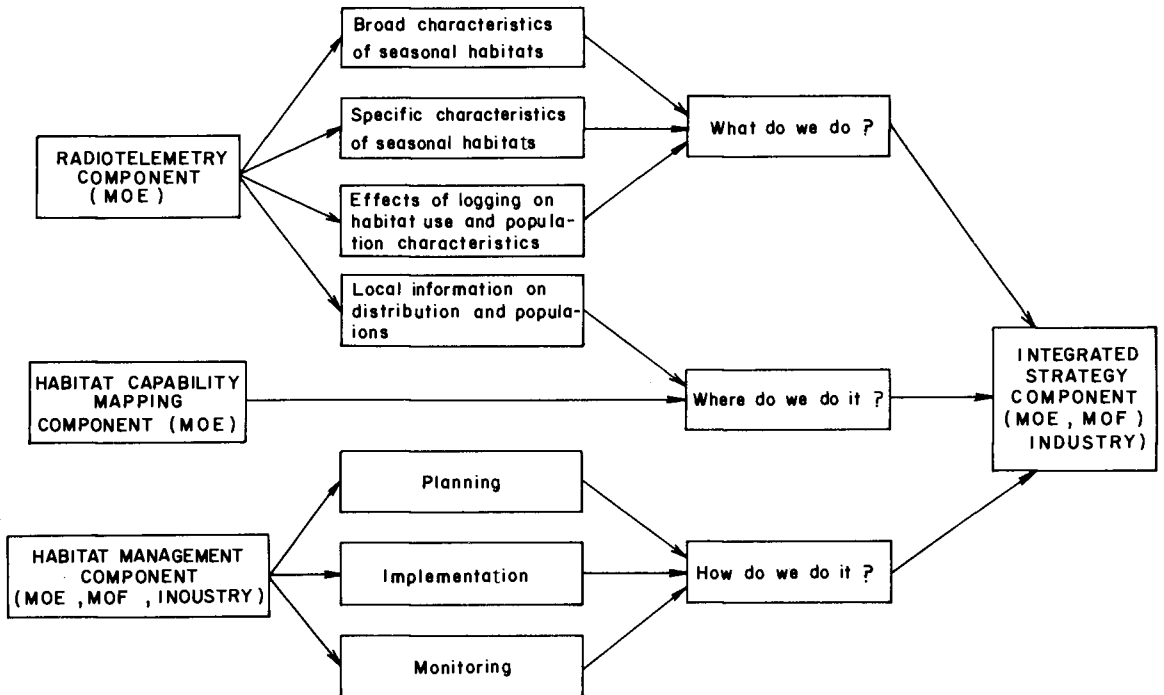


Figure 2. Interrelationship of program components for development of an integrated strategy for caribou and timber.

In addition, the radiotelemetry component has assisted in a more detailed study of micro-habitat selection by mountain caribou in winter in which caribou are tracked on the ground after initial radio relocation (Terry and McLellan 1991). This study was initiated by the B.C. Ministry of Forests (Research Branch) with two main objectives:

The first objective is to provide knowledge of winter habitat selection using micro-habitat characteristics, such as forest stand attributes, lichen abundance and snow conditions, as key attributes affecting caribou use. Using these attributes, the study focuses on two hierarchical levels of habitat selection:

- (i) a broader level focusing on selection of foraging areas within the Engelmann Spruce-Subalpine Fir biogeoclimatic zone (ESSF) where mountain caribou are known to spend the winter (Child *et al.* 1991), and;
- (ii) a smaller scale focusing on selection of micro-sites within caribou foraging areas.

The second objective is to compare micro-habitat characteristics of unmanaged stands used by caribou to characteristics of managed stands that have been harvested using partial cutting methods. A knowledge of general habitat use patterns and micro-habitat use by caribou is important to the development of an integrated management strategy for mountain caribou in managed forests.

Habitat capability mapping

The mapping component improves the manager's ability to assess impacts of proposed resource developments on caribou habitats. Capability maps may be used to guide selection of a silvicultural system on a specific site. More importantly, these capability maps assist the manager to delineate core caribou management zones and facilitate decision-making where forest developments are being planned.

Habitat management component

The rationale for the special management practices that are being evaluated in the MCMF program was described by Stevenson (1990). The use of uneven-aged rather than even-aged stand management is a central focus of the program, because it may be possible through partial cutting to maintain the key habitat attributes at all times. Partial cutting leaves a residual

stand of lichen-bearing trees that continue to provide forage for caribou, though at a reduced level, and provided lichens fragments to colonize the regenerating trees. A variety of partial cutting prescriptions are being tried, including modified diameter-limit cuts, selective harvesting to produce specific diameter distributions, and group selection systems.

Where caribou ranges are already in second growth, or where uneven-aged stand management is not an option, other management practices may be used to recreate habitat attributes. On some low-elevation ranges, thinning may improve the microclimate for lichen development and enhance the ability of the stand to intercept snow in the future. Midserral stands that already have some lichen may be thinned by girdling instead by felling. Girdling results in standing dead trees that provide a good substrate for lichen, and later a source of litterfall and blowdown. In young seral stands that are remote from a natural source of lichen dispersal, inoculation with lichen fragments may increase future availability of forage (Palmer 1987).

At present, four partial cut projects, one early thinning project, one girdling project, and one lichen inoculation project have been initiated through the MCMF program, and several more partial cuts are planned. The program monitors the effects of the special management practices on lichen abundance and growth rates, the use of partial cuts by caribou, and silvicultural impacts. Although it would be desirable to monitor the response of caribou at the population level, it has not been feasible to set up a suitable experimental design.

Effects on lichen abundance

The clump method (Stevenson and Enns 1991) is used to estimate lichen abundance in the treatment and an adjacent control area, before and after partial cutting. A standard clump of lichen is used as a reference for estimating the number of clumps present below 4.5 m on the sample trees. This method gives results that are low in accuracy but relatively precise, providing the lower crowns are readily visible. The method is not precise enough to detect year-to-year changes in lichen abundance due to growth, but is suitable for assessing the major changes in lichen biomass that result from partial cutting.

Similar methods are being used to monitor lichen abundance in partial cuts in the winter

micro-habitat selection study (Terry and McLellan 1991). Because of differences in stand structure, lichen abundance, and lichen distribution and the canopy, the clump method has been modified for use at the thinning/lichen inoculation site, and at the girdling site. Lichen litter-fall is also measured at the girdling site.

Effects on lichen growth rate

Changes in canopy microclimate resulting from partial cutting may affect the growth rates of the residual lichens. A method has been developed that allows the biomass of living lichen clumps to be repeatedly measured. The study lichens are enclosed in mesh cages, which protect the lichens during transport, prevent them from being eaten by caribou, intercept litterfall, and trap fragments that become detached. Preweighed lichen clumps are attached with silicone seal to a stable substrate of borosilicate laboratory glass, which can be detached from the cage and weighed with the lichens. The lichens are suspended in their cages from trees at the study sites, except when they are brought into the laboratory to be air-dried and weighed. Because differences in relative humidity within a narrow range significantly affect biomass measurements of the lichens, correction factors for humidity are being developed (Armleder and Waterhouse 1991).

Growth rates of lichens are being measured at two partial cuts and the early thinning site.

Use of partial cuts by caribou

In addition to determining whether partial cutting can maintain key habitat attributes for mountain caribou, another important aspect of the management trials is to determine if caribou will use the area once it has been harvested. Partially cut blocks are being monitored for caribou use during the ground surveying of habitat characteristics and radiotelemetry flights (Terry and McLellan 1991, Child *et al.* 1991).

In the intensive study area impacts on caribou use are being addressed through the micro-habitat selection study. Key attributes of caribou use sites such as the distribution of tree diameter classes, lichen abundance, lichen species composition, tree vigour, as well as tree basal area, tree density and blowdown density are being compared to partially cut blocks to determine if caribou habitat has been maintained. Snow conditions including snowpack depths

and snow types as well as caribou sinking depths are also being monitored to assess the impact partial-cutting may have on the dynamic relationship of snow conditions and forage availability.

Silvicultural impacts

Assessments of the silvicultural impacts of special management practices are critically important, but are outside the terms of reference of the MCMF program. Wherever possible, silvicultural assessments are carried out through cooperative agreements with the Ministry of Forests. Detailed silvicultural measurements are currently carried out at one site in the intensive study area, and one site in the extensive study area, both in the ESSF. A cooperative project including silvicultural assessments in the ICH is planned.

Integrated management strategy

The final objective of MCMF is to develop an integrated strategy for long-term management of caribou and timber. To direct the development of the integrated management strategy (IMS), seven further objectives have been identified:

1. To set geographic management priorities for mountain caribou populations at a provincial level;
2. To develop integrated forest and caribou management objectives;
3. To ensure the integrated strategy is adopted and implemented at all levels of the planning process;
4. To provide the tools necessary for the implementation of the management strategy;
5. To identify any external problems that hinder full implementation of an IMS and make recommendations for further action (e.g. research needs, policy changes, etc.);
6. To monitor the results of habitat management trials and caribou population status to provide feedback for the modification of the IMS; and
7. To develop an extension program (communication and training).

Because implementation of some of these objectives is beyond the terms of reference of the MCMF program, they have been referred to the Advisory Committee, which has a provincial scope. Objectives 4, 6 and 7 are primarily the responsibility of MCMF.

A set of guidelines relating forest management practices to caribou habitat will be prepared by the MCMF program implementation in the central interior of British Columbia. The guidelines may be applicable to caribou ranges throughout the southeastern portion of the province, but their adoption is at the discretion of regional staff. The guidelines are a product of three component parts.

Firstly, specific geographic zones that are important to mountain caribou will be mapped. Those areas zoned to be of high importance (core caribou ranges) will be protected from logging impacts because of their sensitivity, and uncertainty about the impacts of disturbance. Special management practices for caribou and timber will be recommended in medium zones, whereas areas zoned to be of low importance will be managed without special constraints due to caribou.

Secondly, management objectives for timber production and mountain caribou will vary from one site to another as management practices have different consequences on different sites. The guidelines will reflect the ecological classification system used by the B.C. Ministry of Forests for planning and development. The guidelines will indicate silvicultural systems (e.g. uneven-aged stand management) and management practices (e.g. group selection harvesting) that are compatible with caribou habitat values on various sites.

Thirdly, various management practices may be acceptable within a given caribou zone and biogeoclimatic subzone. Considerations that affect the choice of management systems and practices (e.g. stand composition and structure, blowdown risk, arboreal lichen abundance) will be discussed in the guidelines.

The guidelines are envisioned as a first approximation in a continuing program of adaptive management. Results of the habitat management trials may indicate that the guidelines should be modified.

As well as the guidelines, MCMF is preparing reference materials for lichen assessments. To plan for caribou habitat at the site level, managers need information about the abundance and distribution of arboreal lichens. Procedures to assess lichen abundance in association with timber cruises are being developed. A training manual providing photo illustrations of trees with known lichen abundance is in preparation. The

results will be useful to forest managers when planning timber harvesting and the wildlife managers when monitoring special harvesting treatments.

Conclusions

Because the MCMF program is still developing, and field trials are at an early stage, conclusions would be premature. The cooperative organizational structure of MCMF has the potential to replace interagency conflict over management of caribou habitat with a more integrated approach, and to establish a continuing program of adaptive management.

Acknowledgements

The MCMF program is cooperatively funded by two provincial government Ministries, nongovernment organizations, and forest companies. The B.C. Habitat Conservation Fund, B.C. Ministry of Environment, B.C. Ministry of Forests, Canada/B.C. Forest Resource Development Agreement, Canadian Forest Products (Netherlands Division), Canadian Helicopters Ltd., Carrier Lumber Company, Dunkley Lumber Ltd., the Environment Youth Corps of B.C., Northern Mountain Helicopters Ltd. Northwood Pulp and Timber Ltd. Spruce City Wildlife Association, and Wildlife Habitat Canada have contributed time, money and manpower to make the MCMF program a reality. The College of New Caledonia, Chemistry Department, provides laboratory facilities.

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Printed from manuscript after editorial review.