

MOUNTAIN CARIBOU INTERACTIONS WITH WOLVES AND MOOSE IN CENTRAL BRITISH COLUMBIA

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ABSTRACT: Mountain caribou (*Rangifer tarandus caribou*) populations in south-eastern British Columbia are declining over most of their range and are listed as Threatened. Predation has been documented as the major cause of declining caribou numbers. Excessive predation by wolves (*Canis lupus*) has been related to increased moose (*Alces alces*) numbers. The increase in moose appears to be the result of a natural colonization process that has been enhanced by human-caused habitat change. Options to reduce the rate of predation include reducing wolves, reducing moose, and reducing the amount of early seral habitat that supports moose. Current management includes population control of moose and wolves. Monitoring and assessment of these approaches will guide the future management strategy used to maintain mountain caribou in south-eastern British Columbia.

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Mountain caribou are an ecotype of woodland caribou (*Rangifer tarandus caribou*) that live in the mountains of south-eastern British Columbia, extending into northern Idaho (Heard and Vagt 1998). The mountains inhabited by these caribou experience extremely high snowfall during the winter which prevents the caribou from cratering through the snow to obtain terrestrial forage. Consequently, mountain caribou winter in upper elevation subalpine forests (Terry et al. 2000, Apps et al. 2001, Johnson et al. 2004) and feed almost exclusively on arboreal lichens (*Bryoria* spp.).

Historically, mountain caribou were abundant and widely distributed throughout the mountains in south-eastern British Columbia, but over the past century their numbers and distribution have greatly declined (Spalding 2000). Population declines and range contraction have continued in recent years (Wittmer et al. 2005). For example, the George Mountain herd just east of Prince George was observed to be declining over the past few decades and

was completely extirpated by 2004 (Seip, unpublished data). As a result of these declines, mountain caribou are nationally listed as Threatened and the subject of ongoing recovery efforts (Mountain Caribou Technical Advisory Committee (MCTAC) 2002).

Initially, management concern for mountain caribou focused on protecting old-growth subalpine forests that provide the arboreal lichens that they rely on during winter. In response, a large amount of subalpine forest habitat has been protected from logging to provide caribou winter range (MCTAC 2002). However, research over the past few decades has indicated that the primary cause of declining mountain caribou herds is excessive levels of predation on both calves and adults during the summer (Seip 1992, Kinley and Apps 2001, Wittmer et al. 2005). Grizzly bears (*Ursus arctos*), black bears (*U. americanus*), wolves (*Canis lupus*), and cougars (*Felis concolor*) can all be major predators. Bear predation is important throughout the range of mountain caribou, whereas cougar preda-

tion is more significant in the southeastern parts of the province, and wolf predation is more significant in the central portion of the province (Wittmer et al. 2005).

Winter survival of mountain caribou is quite high because they have minimal exposure to predators during this time. Bears are hibernating, and wolves are found at lower elevations where they are sustained primarily by moose (*Alces alces*) (Seip 1992). Conversely, moose and wolves often move to higher elevations in summer which increases both the spatial overlap of wolves and caribou and the predation of adult and calf caribou.

The key question is why is predation by native predators resulting in decline of caribou now, given that these animals co-existed in the past? It is unlikely that grizzly bear populations have increased above historic levels, rather, they have probably been reduced in many areas due to hunting. In contrast, wolf populations have probably increased in response to increasing moose populations. Wolves exhibit a strong numerical response to increasing prey availability (Messier 1995), and the number of moose in central British Columbia has greatly increased over the past century.

Today, the density of moose in central British Columbia is greater than 1 moose/km² (Walker et al. 2006). There is some debate as to whether moose were completely absent from this region (Hatter 1950, Peterson 1955), or were sparse and scattered in the early 1900s (Spalding 1990). Regardless, moose began to increase in number in the early 1900s, and their distribution spread contiguously across central British Columbia. For example, in the mountains immediately east of Prince George, the colonization was recorded by local settlers:

"In 1911 Ernest Jenson left his native Denmark and came to Canada. A few months later, he moved to the Dome Creek area ... In 1912 and 1913, he was hired on as a hunter for the Grand Pacific

Railway....

Although moose were present in the area since about 1900, Ernest spent a whole year in the forests before seeing one. The moose were working their way south at about eight to ten miles per year. It wasn't long before they were in great abundance... Caribou were in abundance and it was common to see small herds in every valley" (Boudreau 1998).

Early settlers also reported that the arrival of moose coincided with the decline in caribou, although the interaction among moose, wolves, and caribou was not obvious to them:

"I asked him what he thought the reason was for the decline of the caribou populations... Do you think the moose had any bearing on it? I asked.

I can't see how. They don't even eat the same kind of food, and yet the caribou did start going down hill shortly after the moose arrived. Probably the wolves were more responsible than anything else. I mean they sure killed a lot of them" (Boudreau 1998).

It was similarly reported in other parts of their range that decline in mountain caribou numbers coincided with an increase in moose numbers (Edwards 1956, Bergerud and Elliot 1986).

It appears that the decline in mountain caribou and their distribution in central British Columbia are primarily due to excessive predation, and that this predation is related to high wolf numbers that are sustained by the increased numbers of moose (Bergerud and Elliot 1986, Seip 1992). The cause of the increased number and distribution of moose is probably a combination of natural and human-caused factors. The initial increase and spread of moose during the early 1900s

may have been related to a warming period following the end of the Little Ice Age (Luckman 2000). Subsequent climatic warming in central British Columbia over the past century (B.C. Ministry of Environment 2002) would have further encouraged increased moose abundance and distribution as severe winters became less common. Consequently, at least part of the increase in moose numbers is probably related to climate change.

However, there is also reason to believe that the increase in moose and the associated decline in mountain caribou are, in part, related to human-caused habitat change. The forest ecosystems in and adjacent to traditional range of mountain caribou had a very low frequency of natural disturbance resulting in a landscape dominated by mature and old forests (Seip 1998, Delong 2007). Under the natural disturbance regime, these landscapes would provide little early seral habitat at low elevations that is preferred by moose as winter range. However, forest harvesting and human settlement has greatly increased the amount of early seral habitat, thereby increasing habitat suitability for moose within much of the range of mountain caribou.

Such habitat change appears to have benefited moose at the expense of mountain caribou. An analogous situation for mountain caribou exists in south-eastern British Columbia where cougars (*Felis concolor*) are a major predator of caribou (Kinley and Apps 2001). Climatic and landscape changes that benefit deer (*Odocoileus* spp.) and elk (*Cervus elaphus*) habitat have increased these ungulate populations that, in turn, sustain high cougar numbers resulting in increased predation of caribou.

MANAGEMENT IMPLICATIONS

Recently completed recovery plans for mountain caribou identify the need to reduce the rate of predation to achieve recovery (MCTAC 2002, Hart and Cariboo Mountains Recovery Implementation Group (HCMRIG

2005). These plans recognise that management actions could occur at different trophic levels to reduce predation, and include:

1. Directly reduce wolf numbers by killing wolves or implementing reproductive control. This approach would have the most direct and immediate effect on reducing wolf numbers and wolf predation on caribou. However, wolf control is very controversial, and the management action would have to be used as an ongoing program because wolves would quickly recover following the cessation of any control program if moose habitat and moose numbers were not reduced.
2. Reduce wolf numbers by reducing the number of moose which provide the primary prey of the wolf population. Moose populations could be reduced by liberalizing hunting regulations, which is somewhat less controversial than predator control, but still a significant concern to hunters and First Nations. Also, moose reduction would have to be an ongoing program because the moose population will soon recover if good quality habitat is available. The potential for enhanced moose hunting to be a long-term solution is compromised by an ongoing decline in the number of hunters in British Columbia, as well as the feasibility of hunters being able to adequately reduce moose to very low densities in inaccessible areas. There is concern that in the short term, wolves deprived of moose will temporarily increase their predation on caribou. A short-term wolf control program may be required to reduce wolf numbers to a level compatible with reduced moose numbers.
3. Reduce the rate of forest harvesting, prescribed burning, and other practices which create early seral habitat. Reducing early seral habitat on the landscape should reduce

moose numbers and lead to lower wolf numbers. This approach is favoured by environmental groups, but further reductions in forest harvesting concerns the forest industry (HCMRIG 2005). Although much of the upper elevation habitat that is used by caribou is already protected from forest harvesting, reducing the number of moose and wolves would require an additional reduction in the rate of logging in adjacent valley bottoms, even though caribou seldom use those low elevation areas in central British Columbia.

If the latter approach was implemented, there would be a substantial lag time before the existing cut blocks regenerated to a stage where they no longer provided good moose habitat. Consequently, moose reduction and/or wolf control for several decades may be required until cut blocks mature beyond good moose habitat. Some environmental groups accept use of interim predator management if it is used as a temporary tool while habitat recovers, but oppose predator management (reduction) if it is used as a permanent solution in place of habitat management (HCMRIG 2005).

The degree that forest harvesting would have to be reduced to adequately reduce wolf numbers is unclear. The HCMRIG (2005) recommended that moose habitat suitability in areas adjacent to mountain caribou habitat should not exceed the amount that would occur under a natural disturbance regime in that area. However, given that moose are a recent colonizer to mountain caribou range, it may be that even under the natural disturbance regime moose and wolf numbers would be too great to allow caribou to co-exist. If so, there may be no possibility of using habitat management to maintain self-sustaining caribou herds in some or all areas, and ongoing predator-prey management would be required to maintain caribou populations.

In practice, these three approaches are not mutually exclusive, and a management

strategy could include some combination of reducing the amount of early seral habitat, increasing the moose harvest, and some direct wolf control or reduction. A similar set of options also applies to managing the predator-prey interactions among caribou, deer, and cougars in south-eastern British Columbia. At this time, the final management approach to maintain mountain caribou in British Columbia is still evolving.

In the meantime, a variety of these management approaches have been implemented, including reproductive control of wolves in the Quesnel Highlands, moose reduction in the Parsnip watershed, and moose reduction in the Revelstoke area. Limiting the creation of early seral habitat is an important management consideration in parks where there is no competing concern for timber supply and production. Research projects are in place to monitor all these management programs, and the resulting information will be used to refine the future application of these management practices.

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