

**Distribution and Movements of Woodland Caribou on Disturbed
Landscapes in West-Central Manitoba: Implications for Forestry**

By

Carrie-Anne Lander

A Thesis submitted to the Faculty of Graduate Studies of

The University of Manitoba

in partial fulfillment of the requirements for the degree of

MASTER OF NATURAL RESOURCES MANAGEMENT

Natural Resources Institute

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FACULTY OF GRADUATE STUDIES

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Abstract

Forest operations have been implicated in adversely impacting woodland caribou populations. In order to improve on existing forestry mitigation plans on caribou ranges, the distribution and movements of the Kississing-Naosap herd on disturbed landscapes in west-central Manitoba was examined across a variety of scales. The results indicate a hierarchical pattern of selection by woodland caribou, with seasonal differences. Caribou avoided disturbance across all scales, and selected for mature coniferous habitat types. At a finer scale they selected for summer paths with greater arboreal lichen cover and winter paths with greater visibility. Caribou also selected areas further into cover, away from forest edges. Based on these results, I recommend that leave areas within operating areas be composed of a mosaic of mature jack pine, treed muskeg, and spruce cover types, and at least 1 km in width. I also recommend harvesting larger blocks, obliterating roads post-harvest, and encouraging the regeneration of coniferous stands.

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Chapter 1: Introduction

1.1 Introduction

The boreal ecotype of woodland caribou (*Rangifer tarandus caribou*) is listed as “threatened” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2002). Human activity and development are largely implicated in the decline in numbers of woodland caribou, especially in more southern regions (Bergerud, 1974; Rebizant et al., 2000). Forest harvesting in particular has been implicated in adversely impacting caribou populations across the country (Cumming and Beange, 1993), despite attempts by forest companies to reduce the impacts. Since arboreal and terrestrial lichens are a major food source for most woodland caribou populations (Rebizant et al., 2000), they tend to occupy areas of the boreal forest which are lichen-rich (mature coniferous stands) (Hristienko, 1985). Mature forests are also most valuable to forest companies, thus posing a conflict. In addition to creating widespread habitat loss, clear-cutting creates further problems with respect to increased predation, decreased food availability, increased snow accumulation that decreases the accessibility of those food sources (Johnson et al., 2004), increased displacement (Chubbs et al., 1993), and loss of security cover (Bolen and Robinson, 2003:332). Consequently, as the demand for timber increases in Canada, so too has the awareness of the impacts that forestry activities have on woodland caribou and their habitat, and thus management for this species has become a high priority (Cumming, 1992; Johnson et al., 2003). In order for mitigation plans to be effective, information on the habitat requirements of specific herds is necessary. In places where mitigation plans already exist, it is essential to monitor their effectiveness. This study seeks to address the information gaps as outlined in Tolko

Industries Ltd.'s (1999) "Forest Management/Woodland Caribou Mitigation Plan" for the Naosap and Peterson Operating Areas, with respect to habitat use of the Kississing-Naosap woodland caribou herd. This was accomplished by conducting a multi-scale analysis of habitat selection by this herd across three spatial scales and for the snow-covered and snow-free seasons.

1.2 Problem Statement

Several of the ten woodland caribou ranges identified in the province overlap with Tolko Industries Ltd.'s (Tolko) Forest Management License Areas, three of which are currently considered to be at high risk due to the occurrence of industrial activity in the area (Manitoba Conservation, 2005). One of these ranges – the Kississing-Naosap range – overlaps with the Naosap and Peterson Operating Areas, where Tolko has been harvesting since the late 1990's. All harvest and renewal should be completed by spring of 2007 in the Naosap area, and then operations will commence in the Peterson area, where they have identified mature forest stands targeted for harvest over the next 5 years as indicated in their forest harvest plans (D. Cross, pers. comm., 2006). This overlap of forestry activities and important woodland caribou habitat is challenging to managers who want to preserve woodland caribou values without compromising their wood supply (Tolko Industries Ltd., 1999). These concerns prompted Tolko to develop a mitigation plan for these operating areas. However, since habitat use data for the Kississing-Naosap woodland caribou herd is limited, a determination of seasonal habitat use patterns is essential in developing a better understanding of their habitat requirements, from which the mitigation plans can evolve. Furthermore, it will be important to assess whether

Tolko's current forest management practices are meeting the objectives outlined in their woodland caribou-forest management mitigation plans. These plans are designed to provide for future contiguous habitat for caribou, avoid increased predation by reducing favorable habitat conditions for alternate prey species such as moose (*Alces alces*), maintain contiguous blocks of undisturbed habitat represented by a mosaic of habitats of known importance to caribou, maintain undisturbed travel corridors and leave areas, and the development of special management prescriptions (such as buffers, altering road locations, restricting activity during certain seasons, minimizing ground disturbance, and emphasizing natural regeneration) (Tolko Industries Ltd., 1999). In particular, this research will assess the effectiveness of the mitigation measures relating to the leave areas.

1.3 Objectives

The focus of this research is to determine the variables that influence seasonal movements and distribution of woodland caribou at different spatial scales, in order to improve upon existing forest mitigation plans for the Kississing-Naosap caribou range. The main spatial scales will consist of the path or movement scale, and distribution scales within harvested areas and within the home range. The main seasons are defined as the "snow-covered" and "snow-free" seasons.

The specific objectives are:

- To identify factors explaining the distribution of woodland caribou within their home range in the snow-covered and snow-free seasons.

- To identify factors explaining the distribution of woodland caribou within the Naosap Operating Area in the snow-covered and snow-free seasons.
- To identify factors explaining the location of movement paths within harvested areas in the snow-covered season.
- To identify factors explaining the locations of woodland caribou within harvested areas in the snow-free season.

1.4 Thesis Organization

I began in Chapter 1 with a general introduction to the issues surrounding forest management in woodland caribou habitat, and in particular those in my study area, followed by the objectives of this particular study. Chapter 2 involves a characterization of woodland caribou, including their status provincially and nationally. In this chapter I also review the literature on the impacts of forestry to woodland caribou. I then go on to discuss the role of the forest industry in adaptive management, with a review of current recommendations for harvesting on woodland caribou range. I end the chapter with a review of the current management efforts across Canada. In Chapter 3 I introduce the research that forms the basis of this thesis, as well as the study area and subjects. I then highlight the results of this research followed by an interpretation of the findings. I conclude in Chapter 4 with a review of the key findings, management implications stemming from these findings, and recommendations for future research.

Chapter 2: Background

To set the stage for this research, it is necessary to first discuss some background information on woodland caribou, the forest industry, and the relationship between the two. Hence in this chapter, I give an overview of the species including a physical description, and information on reproduction, diet, habitat, population limiting factors, and behaviors. I introduce the Federal Species at Risk Act (SARA) and the status of woodland caribou under this Act, and in the province of Manitoba. I then continue with a discussion on the direct and indirect impacts that forest harvesting has on this species with respect to various habitat, behavioral, and mortality factors. The following section involves a discussion of how these impacts can be avoided or reduced, utilizing a variety of forest management practices. The chapter is concluded with a look at some of the current management efforts across Canada, with respect to recovery and forest management guidelines in woodland caribou range.

2.1 Biology and Ecology of Woodland Caribou

2.1.1 Physical Description

Woodland caribou are an even-toed hoofed mammal of the deer family (*Cervidae*), and a ruminant with a four-chambered stomach (Hristienko, 1985; Whitaker, 1996:815). They are mid-sized cervids, slightly larger than white-tailed deer (*Odocoileus virginianus*), but much smaller than elk (*Cervus elaphus*) and moose (Banfield, 1974; Beacham and Castronova, 2001:138). Adult males may reach up to 8 feet long, 4 feet high (at the shoulder), and 600 pounds in weight, while adult females usually weigh no more than 300 pounds (Whitaker, 1996:842; Beacham and Castronova, 2001:138).

Caribou have larger hooves and wider muzzles than other members of the deer family (Beacham and Castronova, 2001:138). The large concave hooves are a morphological adaptation to deep snow or icy conditions (Whitaker, 1996:844; Geist, 1998:319) and act as paddles for swimming (CPAWS, 2004). The hollow air-filled hairs of their coats also keep caribou dry (Geist, 1998:319), and give them buoyancy when swimming (Whitaker, 1996:845).

They are also distinguished from other members of the deer family by their large, distinctive antlers that are somewhat flat and have several tines, in addition to one that protrudes down the snout (Whitaker, 1996:842; Beacham and Castronova, 2001:138). Unlike other members of the deer family, both sexes of woodland caribou grow antlers (Cumming, 1992; Whitaker, 1996); however, those of females are somewhat skimpy (Whitaker, 1996), and may be inconspicuous (Beacham and Castronova, 2001:138). Woodland caribou are brownish in color, with a white rump and shaggy mane below a whitish neck (Whitaker, 1996; Beacham and Castronova, 2001:138).

2.1.2 Reproduction

Woodland caribou breed in the fall, with each mature bull attracting a rutting group of several cows and juveniles, which he strongly defends from other males (Whitaker, 1996; Beacham and Castronova, 2001:139). After 7½-8 months gestation, 1 or (rarely) 2 calves are born between May and July (Whitaker, 1996). Because females do not start breeding until about 3 or 4 years of age (Beacham and Castronova, 2001:139), and usually only one calf is born each year (Hristienko, 1985), woodland caribou have a relatively low reproductive rate (Cumming, 1992). Birth rates average around 80% per

year, and 40-70% of calves may succumb to predation, severe weather, or malnutrition (Beacham and Castronova, 2001:139). As an adaptation for predator avoidance, females usually disperse widely (Cumming, 1992) and choose the most isolated habitats for calving (Beacham and Castronova, 2001:139).

2.1.3 Diet

It is a well-known fact that lichens form a very important part of woodland caribou diets (Rebizant et al., 2000), especially during winter when they are the principal food source (Whitaker, 1996:845). Holleman et al. (1979) found that in winter nearly 5 kg of lichens per day were consumed by an 80 kg caribou. Some populations of woodland caribou, such as the mountain sub-populations, subsist mainly on arboreal species of lichen during winter (Terry et al., 2000; Kinley et al., 2003). Terrestrial lichens, located by sight and smell through the snow, are used by woodland caribou in most other parts of Canada (Cumming, 1992). The terrestrial reindeer lichens (such as *Cladina stellaris*, *C. rangiferina*, and *C. Mitis*) are the primary late winter food of woodland caribou (Bergerud, 1972).

Despite their relatively low protein content (2-5%) (Johnson et al., 2001), lichens are high in digestible carbohydrates, which are a good source of energy for cold weather conditions (Nellemann et al., 2000). Caribou will also supplement their winter diet with green wintering plants (Bergerud, 1971; Darby and Pruitt, 1984; Rominger and Oldemeyer, 1990), which are higher in nutrients and protein (Thomas and Armbruster, 1996).

Summer diets may include various ground forbs, deciduous shrubs, and arboreal and ground lichens (Bergerud, 1972; Darby and Pruitt, 1984; Thomas and Armbruster, 1996). However, it is inappropriate to generalize caribou food habits across geographical regions (Rominger and Oldemeyer, 1990), and it is important to note that even though caribou are adapted to a diet of lichens, they are not essential to their survival (Bergerud, 1972). Instead these animals are highly plastic in the type of foods they will eat (Hristienko, 1985). Bergerud (1977) catalogued an extensive list of the food types eaten by woodland caribou: 62 lichen species and 282 seed plants (qtd. in Johnson, 1993). Ahti and Hepburn (1967) also provided a thorough list of woodland caribou plant foods.

2.1.4 Habitat

Woodland caribou generally inhabit mature lichen-rich forests within the boreal ecotype (Hristienko, 1985). Extensive stands (1000s of square kilometers) of these mature forests are required to maintain viable populations (Rebizant et al., 2000). Previous studies on woodland caribou habitat use have shown trends in habitat selection, with variation among scales examined. At the finest scale caribou often select for sites that have heavier lichen loads than unused sites (Terry et al., 2000; Johnson et al., 2001; Mosnier et al., 2003). They also may choose sites with specific lichen species, such as in northern B.C. where they frequently selected feeding sites across pine terraces with *Cladonia spp.* and *Cladina mitis* (Johnson et al., 2001). However, access to ground lichens may be limited by snow conditions, and woodland caribou may respond to this by moving to sites with less deep snow. Mosnier et al.'s (2003) results indicate sinking depth as one of the main influences over caribou microhabitat selection. In this case, they may

choose sites with greater canopy cover, where snow is less dense and thick, and less energetically costly to crater or move in (Schaefer, 1996).

At a coarser scale of selection, caribou may be selecting those cover types associated with the preferred forage types. Furthermore, coarser scale selection may relate to more limiting factors, such as avoiding predation (Rettie and Messier, 2000). Woodland caribou are reported to select more open habitats in order to reduce the risk of contact with predators (Bergerud and Page, 1987). For example, Darby and Pruitt (1984) reported the Aikens Lake herd of woodland caribou chose semi-open and open bogs in early autumn, with the onset of the rut. They used these open bogs until about mid-February when snow restricted their travel, at which point they moved up to jack pine-rock ridges. At all other times of the year besides October and early winter, they selected mature coniferous uplands.

During spring and summer, woodland caribou have been reported to use islands and lakeshores in order to escape predation (Bergerud, 1985). For example, woodland caribou on Lake Nipigon islands in Ontario spent 8-9 months of the year on smaller islands with relatively low habitat quality, presumably because there were no predators present there (Cumming and Beange, 1987). They avoided the larger islands where moose and wolves (*Canis lupus*) were found (Cumming and Beange, 1987). During summer, other herds tend to use a greater diversity of habitats than in other seasons (e.g. Darby and Pruitt, 1984).

In sum, woodland caribou have been reported to choose particular cover types across a number of spatial scales, which may correspond to forage preferences, forage availability and accessibility, and in particular, limiting factors such as predation. Just as

they are versatile in the food types they choose, woodland caribou will also use a wide variety of habitats throughout their range (Rominger et al., 1994), and this can depend on various factors as outlined below.

2.1.5 Population Limiting Factors

Food has been reported to be the limiting factor for migratory populations and where predation is absent (e.g. Adamczewski et al., 1988), however for the boreal ecotype of woodland caribou, predation is the primary limiting factor (Bergerud and Elliot, 1986; Rettie and Messier, 1998). For example, an 8-year study by Bergerud and Page (1987) found the chief cause of caribou mortality was predation by wolves and grizzly bears (*Ursus arctos*). Furthermore, after controlling for predators, they concluded that weather had little effect on the survival of calves. This contradicted their hypothesis that maternal nutritional condition, affected by severe winter conditions, would influence the viability of calves (Bergerud and Page, 1987).

Furthermore, in an experimental wolf reduction in northern British Columbia (B.C.), Bergerud and Elliot (1986) reported calf survival increased significantly in the 3 years that wolves were reduced. In fact, caribou densities may approach up to 8.9 km^{-2} in the absence of predators (Edmonds, 1987, Fong et al., 1991, Seip, 1991; qtd. in Johnson, 1993). Where wolves do exist in caribou range, caribou densities can still increase, if they can maintain a spatial separation from the wolves' other prey species (Rettie and Messier, 2000). Normally, wolves rely on moose as their primary prey with caribou and other species as their secondary prey (Bergerud, 1983; qtd. in Johnson, 1993). Wolf densities of $>.007 \text{ km}^{-2}$ are usually too high for caribou to maintain their numbers, but if they have

sufficient habitat to accommodate their anti-predator dispersal strategy, moderate densities of $<.014 \text{ km}^{-2}$ may be tolerated (Bergerud and Elliot, 1986).

The spacing technique used by caribou is an anti-predator strategy which may decrease encounter rates with predators and increase searching time for predators (Bergerud and Elliot, 1986; Ouellet et al., 1996), making caribou less profitable to search for, and thus less likely to be captured (Bergerud and Page, 1987). For example, cows often disperse widely into small groups or individually to bear their calves in isolation (Brown and Theberge, 1990), such as on islands or lakeshores (Bergerud, 1985).

The ultimate cause of woodland caribou population declines then is presumably influenced by long-term habitat alteration (Rettie and Messier, 1998; Schaefer, 2003). If habitat changes to early seral stage forests, abundance of wolves' primary prey (e.g. moose, elk, or deer) may increase, leading to an increase in wolves (Rettie and Messier, 1998; Seip, 1998). Subsequently, this higher number of wolves results in increased predation on woodland caribou, whereas previously the two may have co-existed with no major declines in caribou. This scenario occurred in northwestern B.C. in the 1930's and 1940's where caribou were reported to have co-existed with a relatively low density of wolves, until moose moved into the region and woodland caribou populations suffered major declines (Bergerud and Elliot, 1986). Furthermore, the animals may be forced into sub-optimal habitats as they try to escape this heightened predation risk, resulting in reduced forage efficiency and increased competition for food (Kotler et al., 1994; Ouellet et al., 1996). In this case, predation may indirectly be causing declines through compromised nutrition and its effects on body condition and reproductive potential.

Other factors aside from predation and insufficient forage need to be credited for causing deaths. For caribou calves these include stillbirths, birth defects, weather, drowning, accidents, and social interactions like trampling (Hristienko, 1985). For adults these include drowning, fighting between males, deaths in parturition, disease/parasites, accidents, and predation (Hristienko, 1985). Simpson et al. (1985) found that in the Columbia Mountains of B.C., 8 caribou died in snow avalanches, 2 bulls died after locking antlers, 1 died from starvation after injuring their neck, and 2 calves died from poor maternal nutrition. These are all examples of how some of the other factors aside from predation had to be influencing mortality. Moreover, population limiting factors may differ spatially and temporally (Leopold, 1933), so it is important to examine each local population. In any case, woodland caribou are very vulnerable to population decline, because they lack the reproductive elasticity of other cervids (Cumming, 1992).

2.1.6 Sociality and Movements

Woodland caribou are more mobile than other ungulates found in the boreal forest (Cumming, 1992; Johnson et al., 2002). They are not as gregarious as barren-ground caribou, usually only congregating in small herds of three to ten animals (Beacham and Castronova, 2001:138). In southeastern Manitoba mean group size was found to be between 5.5 and 6.2 animals for all seasons except late spring-summer, which was 1.2 (Darby and Pruitt, 1984). This reflects the fact that caribou cows will split up and disperse widely into small groups or singly at calving time. The adult bulls are generally solitary for most of the year, except for during breeding (Fuller and Keith, 1981; Beacham and Castronova, 2001:139). In the fall they move to particular locations for