HOME RANGE AND CORE AREA DETERMINATION, HABITAT USE AND SENSORY EFFECTS OF ALL WEATHER ACCESS ON BOREALWOODLAND CARIBOU, *RANGIFER TARANDUS CARIBOU,* IN EASTERN MANITOBA

BY

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A Thesis Submitted to the Faculty of
Graduate Studies in Partial Fulfilment of
the Requirements for the Degree of

MASTER OF ENVIRONMENT

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FACULTY OF GRADUATE STUDIES

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ABSTRACT

Canada's boreal woodland caribou (*Rangifer tarandus caribou* Gmelin) are listed as "Threatened" under the *Canadian Species at Risk Act* (SARA) and provincially under the *Manitoba Endangered Species Act* (MESA). Two of three provincially designated high-risk boreal woodland caribou ranges occur in eastern Manitoba and have been studied using Global Positioning System (GPS) tracking technology. This project was undertaken with the cooperation of the Eastern Manitoba Woodland Caribou Advisory Committee (EMWCAC). I investigated the development of an objective criterion using an adaptive kernel analysis to define core areas of use and the sensory effects of all weather access. A Habitat Suitability Index (HSI) model for woodland caribou was evaluated to determine if woodland caribou were selecting high quality habitat as defined by the model. Habitat use and selection at course and fine scales was assessed to determine landscape and stand level selection and use. A case study of habitat use and selection using forest inventory attribute data was also conducted and a comparative analysis was undertaken to determine differences in habitat use and selection between two ecologically distinct caribou populations.

The criteria used to define core areas yielded mapping outputs that could provide a surrogate for critical habitat and a basis for management zoning and habitat planning. Analysis of the animal use of high quality habitat as predicted by the HSI model illustrated that woodland caribou selection of high quality habitat versus its availability is significant. Course or landscape scale habitat selection and use analysis illustrated that woodland caribou require large tracts of jack pine dominated forest containing black spruce, treed rock and muskegs. At the fine or stand level scale, woodland caribou selected habitat based on discrete variables described in the forest inventory attribute data. Woodland caribou preferred 60 – 80 year old pine dominated forest with a crown closure greater than 50%, interspersed with black spruce, rock outcrop and treed muskegs. Woodland caribou habitat containing greater proportions of treed rock and muskeg in pine dominated forest was important to woodland caribou in eastern Manitoba.

The effects of the Happy Lake Road on woodland caribou use and animal energetics are measurable. Woodland caribou illustrate avoidance at approximately 2 kilometres from the road with maximum use of habitat occurring at 9 kilometres from the road. . The location of the Happy Lake Road may be favourable considering the location of the Black River. Avoidance of the Happy Lake Road by the Owl Lake animals may be a function of predator and human avoidance. General management implications from this study include the use of the objective criteria for adaptive kernel analysis to determine ecologically representative core use areas that can be used in integrated management zoning. It also has application as a tool for proactive monitoring in the determination of core areas and critical habitat in resource development and mitigation.

ACKNOWLEDGMENTS

This study was made possible by the efforts of the Eastern Manitoba Woodland Caribou Advisory Committee and the Manitoba Model Forest. Their forward thinking, leadership and support for this research was invaluable. My co-advisors, Dr. Rick Baydak and Dr. Rick Riewie have been very supportive in my academic quest. Also to committee member Dr. David Walker for his support and guidance throughout the last phase of my work. Dr. Richard Westwood, committee member and supporter, provided a great deal of support through the University of Winnipeg Centre for Forest Interdisciplinary Research (C-FIR). Also to those C-FIR students and graduates that assisted in various aspects of this research. These special people include Michele Methot, Jeff Shaddock, Melanie Rose and Tim Davis.

Special thanks to the Manitoba Model Forest and all the funding agencies associated with this project. Thanks to the late Mike Waldram, who was very supportive of woodland caribou research in the Model Forest. Thanks to my family and friends, and especially, my daughter, Cede, who had to endure some of the consequences of this quest. I dedicate this thesis to my late father, Conservation Officer, T.H. Schindler.

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INTRODUCTION

1.1 GENERAL INTRODUCTION AND BACKGROUND

Woodland caribou (*Rangifer tarandus caribo*) are listed as "Threatened" under the *Canadian Species at Risk Act* (SARA) and the *Manitoba Endangered Species Act* (MESA). Under the authority of SARA, legislation requires the development and implementation of "National Recovery Strategies" for species listed as Extirpated, Endangered or Threatened under the act. National Recovery Strategies are the responsibility of the Federal Government and are developed by National Technical Steering Committees. The Provincial obligations under SARA include the development and implementation of mandatory provincial "Recovery Strategies" and regional "Action Plans" for listed species.

In accordance with SARA, Manitoba Conservation has released Manitoba's Conservation and Recovery Strategy for Boreal Woodland Caribou (Crichton 2006). This strategy identifies 10 boreal woodland caribou populations and refers to them "ranges" (Figure 1.1). The contemporary term "range" is analogous to "herd", and represents aggregations or bands (groups) of caribou that occupy a common geographic area. This strategy includes a conservation risk assessment of all woodland caribou ranges in Manitoba and assesses 3 as "High Conservation Risk". Two of these ranges are located in eastern Manitoba. The provincial risk assessment is based on known threats to woodland caribou sustainability and the degree of existing or imminent development within the range (Crichton 2006). The Atikaki/Berens range and the Owl Lake range are both classified as "High Risk" ranges (Crichton 2006).

Although both the Atikaki/Berens and Owl Lake ranges are stable, they are at risk to decline due to the potential effects of resource development and their susceptibility to increased predation and mortality due to disease and parasites (EMWCAC, 2005).

1.2 MANAGEMENT AND RECOVERY

The Eastern Manitoba Woodland Caribou Advisory Committee (EMWCAC) was established through the Manitoba Model Forest in 1994 and has since funded various research and management initiatives aimed at the conservation of woodland caribou in eastern Manitoba, including habitat modeling, assessment of forestry activities and animal range and movement studies. An Integrated Strategy for the Owl Lake Caribou herd (TAEM 1995) has guided research and management activities in the Owl Lake Range. It also provided a framework for defining integrated forestry/woodland caribou management zones and establishing habitat objectives using a Habitat Supply Index (HSI) model (Palidwor and Schindler 1994, 1995). This strategy was updated based on new data that has been collected and analyzed and provides an enhanced framework for the conservation of woodland caribou while integrating forest harvesting as a tool for cycling and maintaining habitat supply through time (ERWCAC 2005).

The current management plan identifies an Integrated Management Zone that includes provisions for extensive experimental forestry practices to research both animal and vegetative responses. The long-term objective is to maintain a minimum of 67% of the current level of high quality habitat as defined by the Habitat Suitability Index (HSI) model in large tracts of connected forest. Future forestry operations will be based on the results of the experimental forestry practices currently being implemented in the

Management Zone (ERWCAC 2005). This strategy forms the basis for a SARA required Action Plan for the Owl Lake Range (Crichton 2006).

The EMWCAC has been active in collecting woodland caribou location and movement data through collaring and tracking using animal borne Global Positioning System (GPS) collars. GPS tracking of woodland caribou is ongoing and there are GPS location data available for animals collared from 1997 through 2006. These data have undergone preliminary analysis for the purpose of defining home range and habitat use for use in the region (Schindler 2005). The research conducted in this thesis is required in ongoing boreal woodland caribou recovery activities in eastern Manitoba.

1.3 STUDY AREA

The overall study area is located in the Manitoba portion of the Lac Seul Boreal Upland (Ecological Stratification Working Group 1995) and is also referred to as EcoRegion 90 (Manitoba Conservation 2002). The study area encompasses approximately 26,000 km^2 of woodland caribou range in eastern Manitoba and includes portions of the Atikaki/Berens Range and the Owl Lake Range (Figure 1.2). Major forest communities Ecoregion 90 are predominantly comprised of jack pine (*Pinus banksiana*), black spruce (*Picea mariana*), white spruce (*Picea glauca*), balsam fir (*Abies balsamia*), trembling aspen (*Populus tremuloidies*), balsam poplar (*Populus balsamifera*) and black ash (*Fraxinus nigra*). Jack pine forests in the study region occur primarily on upland shallow mineral soils. Jack pine forest typically contains patches of black spruce forest associated with poorly drained organic soils (Manitoba Conservation 2002). Within this Ecoregion there are three distinct Ecodistricts (Figure 1.3). These include the Berens

Berens Ecodistrict adjacent to Lake Winnipeg, the Nopiming Ecodistrict along the Ontario boundary and the Wrong Lake Ecodistrict, which lies between the other two (Ecological Stratification Working Group 1995).

These three Ecodistricts occupy 8,819 km^2 of habitat in eastern Manitoba. The Berens Ecodistrict is extensively peat land with occasional large rock outcroppings dominated by fen peatlands and black spruce and jack pine uplands. The Wrong Lake Ecodistrict is characterized by glaciolacustrine covered precambrian bedrock, containing more productive forests including pine, spruce and trembling aspen. The Nopiming Ecodistrict is bedrock dominated composed of a mixture of shallow to very shallow till deposits (Manitoba Conservation 2002).

Woodland caribou are distributed throughout these three Ecodistricts and utilize the habitats associated with the different soils, terrain and drainage that exist in each area. Woodland caribou have been studied in Ecoregion 90 for various research and management purposes since the late 1960s (Carbyn 1968, Larche 1972, Stardom 1975, Stardom 1977, Darby and Pruit 1984, Crichton 1987, Schaefer 1988, Schaefer 1990, Schaefer and Pruit 1991, TAEM 1996, TAEM 1997, Martinez 1998, TAEM 1998, TAEM 1999 and Berger et al. 2000). Much of this information has led to increased understanding of woodland caribou ecology and range use in eastern Manitoba.

1.4 NATURAL HISTORY OF WOODLAND CARIBOU IN EASTERN MANITOBA

1.4.1 Biology

Woodland caribou are a ancient member of the deer family (*Cervidae*). They have physiological adaptations that make them well adapted to extreme winter environments including short compact bodies, blunt muzzles and unusually large feet compared to other ungulates (Banfield 1974). Unlike the barren-ground caribou (migratory herds), woodland caribou are referred to as sedentary and have evolved at very low densities across the northern boreal taiga with population densities averaging 0.02 animals per km^2 (Rock 1982). Both migratory and sedentary populations are well known for their fidelity to areas within their home range at different scales to areas for calving, mating and winter foraging (Schaefer et al. 2000). Woodland caribou in eastern Manitoba are very gregarious during winter periods and solitary during spring and summer (Darby 1979).

Woodland caribou have the lowest fecundity rates of North American ungulates (Banfield 1974). Breeding in Manitoba is coincidental with the rut which occurs mid September through mid October (Shoesmith and Story 1977). Females will participate in the rut and begin breeding at age 2.5 (Darby and Pruitt 1984, Fuller and Keith 1981). Males will attempt to breed at 1.5 years of age however the social structure of the rut prevents successful breeding until age 3.5 to 4.5 years (Kelsall 1984). Calves are born in May through June after a 7.5 month gestation period (Fuller and Kieth 1981). Although pregnancy rates for woodland caribou can average 86%, unlike other ungulates, they rarely produce twins and successful recruitment of calves into the population is very low (Bergerud and Elliot 1986).

1.4.2 Ecology

Caribou are morphologically and behaviourally adapted to winter subsistence on lichen diets with terrestrial lichens (*Cladina spp.*) being the primary forage during winter periods (Edwards and Ritcey 1960, Ahti and Hepburn 1967, DesMeules and Heyland 1969, Bergerud 1989, Stardom 1975, Darby 1979, Miller 1982, Darby and Pruitt 1984, Godwin 1990, Schaefer and Pruitt 1991). Woodland caribou are known for digging or cratering through snow in search of terrestrial lichens, and is an energetically efficient foraging characteristic (Boudreau and Payette 2004). DesMeules and Heyland (1969a) assembled a ranked list of lichen species preferred by caribou. They found that the most terrestrial lichens included *Cladina alpestris*, *Cladina mitis*, *Cladina rangiferina and Cladonia uncialis* followed by the arboreal lichens *Usnea* spp., *Evernia mesomophia* and *Alectoria* spp. These were followed by *Centrariz islandica* and *Stereocaulon* spp. Feeding preferences vary depending on the locations where observations were made.

During spring animals seek and prefer rapidly growing green plants to terrestrial lichens (Bergerud 1972). During spring, summer, and early fall, caribou feed on new growth of forbs, graminoids, horsetails, fungi and the leaves of deciduous shrubs (Rettie and Messier 2000). Availability of dietary forage is also a function of use, and caribou will select habitat based on abundance and availability (Darby 1979).

Although woodland caribou prefer lichens of the genus *Cladina*, plants are also consumed. Vascular plants having green wintering shoots such as *Ledum groenlandicum* (Labrador Tea) and species from the genera *Vaccinium* (Blueberry), *Equisetum* (Horsetail), *Carex* and *Eriophorum* (Sedges) are all consumed in winter. Other plants such as *Juniperus* spp. (Juniper) and *Sarracenia purpurea* (Pitcher plants) have been

found in winter caribou feeding craters excavated in eastern Manitoba string bogs. Darby (1979) observed the Wallace-Aikins Lake herd winter feeding on arboreal lichens and cratering for sedges and ericaceous shrubs. Intermediate to old jack pine dominated stands containing uplands with abundant arboreal and terrestrial lichens are preferred by caribou in eastern Manitoba (Martinez 1998).

Lichen is considered the primary component of the caribou diet, (Johnson 1993). Arboreal lichens (*Usnea hirta, Byoria trichodes, Evernia mesomorhpa*) are also an important food source, but to a lesser degree than terrestrial lichens. In Manitoba, bog habitats are the principle source of arboreal lichens and caribou utilize arboreal or tree lichen when available. Arboreal lichen is typically not distributed evenly across the landscape, and is usually found in small concentrated patches that are used opportunistically by caribou for forage, during late winter (Schaeffer and Pruitt 1991 and Fancy and White 1985). Terrestrial lichens form a major component of winter forage and contribute more to the overall forage requirements than arboreal lichen (Cumming and Beange 1987).

Caribou show a strong response in foraging characteristics based on snow adhering or nival conditions (Stardom 1975). Woodland caribou will utilize semi-open and open bogs during fall and early winter, and switch to mature coniferous uplands containing rock ridges with jack pine in mid to late winter (Darby and Pruitt 1984). During early winter, when snow conditions are favourable for travel and foraging in open areas, caribou feed intensively on arboreal lichens. However, as snow pack and crust increase through winter, caribou then forage for terrestrial lichens on jack pine dominated rock ridges (Stardom 1977). The snow depth threshold in open lowland areas for caribou

selection of uplands for terrestrial lichens is approximately 65 cm but are variable depending on hardness and density of snow crusting (Stardom 1977). However, Brown (1990) found that caribou feeding activity exceeded these thresholds and were capable of locating forage under various snow covered terrain conditions.

Nival conditions resulting in thicker, harder snow pack in bogs can limit caribou utilization of arboreal lichen (Stardom 1975, Darby and Pruitt 1984, Schaefer and Pruitt 1991). Woodland caribou will undertake energetic compromise to forage in lichen rich habitat, rather than in habitats with less abundant forage with better nival conditions (Schaefer 1990).

In eastern Manitoba, important woodland caribou habitats consist of open larch or black spruce bogs, intermediate to mature jack pine rock ridge forest and rock ridge shored lakes (Stardom 1977). Woodland caribou are generally solitary during spring and summer and form loose aggregations in October that last through March (Darby 1979). In general boreal caribou home range size varies inversely with the amount of gregarious behaviour with larger groups having smaller ranges. Hence winter range typically contains more animals occupying a smaller area at higher animal concentrations (Darby 1979). Habitat utilization and movement are also a function of food preference and availability relative to nival conditions, predators and insects (Darby 1979). Mean reported range sizes in eastern Manitoba were variable during different seasons with spring being the largest and winter the smallest. Mean range size for spring range was 177.5 km^2, 130 km^2 (summer), 115 km^2 (autumn) and 117. 5 km^2 winter range (Darby 1979).

1.4.3 Habitat Succession

Recently burned habitat results in habitat decline for woodland caribou due to a combined reduction in terrestrial lichen supply and nival conditions that are not conducive to foraging (Schaefer Undated, Schaefer and Pruitt 1991). Schaefer (Undated) found that older stands (160 years) had less productive lichen habitat, however, nival conditions were ideal. Caribou abandonment of burned habitats is associated with reduction in forage abundance combined with the synergistic effect of nival conditions and deadfall. The process of abandonment may take 5 years due to woodland caribou adeptness in dealing with short-term habitat detriments (Schaefer and Pruitt 1991). Woodland caribou avoid recently burned areas and favour lakes, old-growth uplands and bogs for travel (Schaefer and Pruitt 1991). Habitat containing recently burned and intermediate stage forest do not provide ideal habitat conditions for woodland caribou in eastern Manitoba, but are important in the long term supply of lichen rich habitat on a landscape scale (Schaefer and Pruitt 1991). Boreal caribou are adapted to the short-term detriments of fire and are capable of abandoning affected range (Schaefer and Pruitt 1991).

Fire also influences forest ecosystems and the relationships between fire and lichen species varies. Lichens become more abundant in late-successional forests, but decline after 200 years of undisturbed growth. At this stage, fire serves to renew the vigour of forest vegetation communities; however, lichens that initially survived a fire event may die off in later stages of succession due to shade, needle fall or competition from shade-tolerant species such as feathermosses (Harris 1996).

Post-fire lichen succession is a continuous process wherein certain species dominate at different times. Longton (1992) identified lichens as important in boreal forest secondary succession where lightning-induced fire is common. Between 10 to 50 years after a fire event, cup lichens (*Cladonia* spp.) occur followed by a reindeer lichen stage between 30 to 50 years and 80 to 120 years after a fire where *Cladina* species, especially *Cladina rangiferina*, dominate. A second reindeer lichen stage follows 80 to 120 years after fire and is characterized mainly by the presence of *Cladina stellaris*.

1.4.4 Range and Distribution in Eastern Manitoba

Documentation of caribou numbers and distribution prior to the 1960's is limited. Carbyn (1968) conducted aerial surveys for woodland caribou in eastern Manitoba during the winter of 1968. He observed 28 animals near Aikens Lake, 20 animals near the Bloodvein River and 20 animals in large bogs south of the Bloodvein River. Miller (1968) observed scattered groups of caribou on the muskegs around Flintstone Lake. Neither Carbyn (1968) nor Miller (1968) estimated range size, population or numbers of caribou bands or herds in the area. Larche (1972) described woodland caribou numbers and distribution in eastern Manitoba for the period 1968 to 1972 and estimated approximately 50 animals in the Owl Lake range. Other estimates were based on government flights and observations during the reporting period. Herd estimates for unique ranges in eastern Manitoba ranged from 22 to 56 individuals. Crichton (1974) indicated that areas in eastern Manitoba are capable of support more animals, suggesting low populations.

Darby (1979) studied caribou in the Aikens Lake area from 1975 to 1978 and estimated that 30 to 40 caribou wintered in the area. Major forest fires occurred in the

Wallace Lake area in 1976, 1979, and 1986. Currently, caribou are not known to occupy this area (Manitoba Conservation 2006). Aerial telemetry and monitoring in the Owl Lake range from 1985 to 1995 suggests that the Owl Lake population has remained relatively constant with a population size of approximately 75 animals (EMWCAC 2005).

1.4.5 Limiting Factors

Potential threats related to industrial development include habitat loss, fragmentation and disturbance (Crichton 2006). Direct mortality factors in the boreal forest include over hunting and predation. Mortality from indirect causes include the introduction of parasites such as the nematode parasite or brainworm (*Parelaphostrongylus tenuis*) from white-tailed deer (*Odecoileus virginianus*) through increased contact between deer and caribou through habitat modification favourable to deer (Pitt and Jordan 1994). The responses of alternate prey species and parasites to anthropogenic activities such as forestry and recreational development can potentially contribute to decline of caribou (Dzus 2001, Charret 2003 and OMNR 2003). Direct mortality to woodland caribou can be attributed to predation and humans.

Predators of woodland caribou include wolf (*Canis lupis)*, wolverine (*Gulo gulo*), lynx (*Lynx canadensis*), golden eagle (*Aquila chrysaetos*) and ravens (*Corvus corax*) with the main predator being wolves (Kelsal 1968). In the boreal forest, wolves depend mainly on moose (*Alces* alces) as a primary prey species and other prey including caribou as a secondary food source (Seip 1992). When woodland caribou numbers are at normal or expected densities, they will co-exist with normal wolf populations. When woodland caribou densities are low, normal wolf densities (1 wolf/65-130 km^2) will limit caribou populations (Bergerud 1983). When an biological system contains 2 or more prey species with a common predator, changes in predator/prey dynamics can lead to the extinction of the secondary prey, even in absence of resource competition (Wittmer 2005). Changes in forest age and structure may force woodland caribou to occupy habitats that contain higher numbers of moose (Rempel et al. 1997) and the resulting