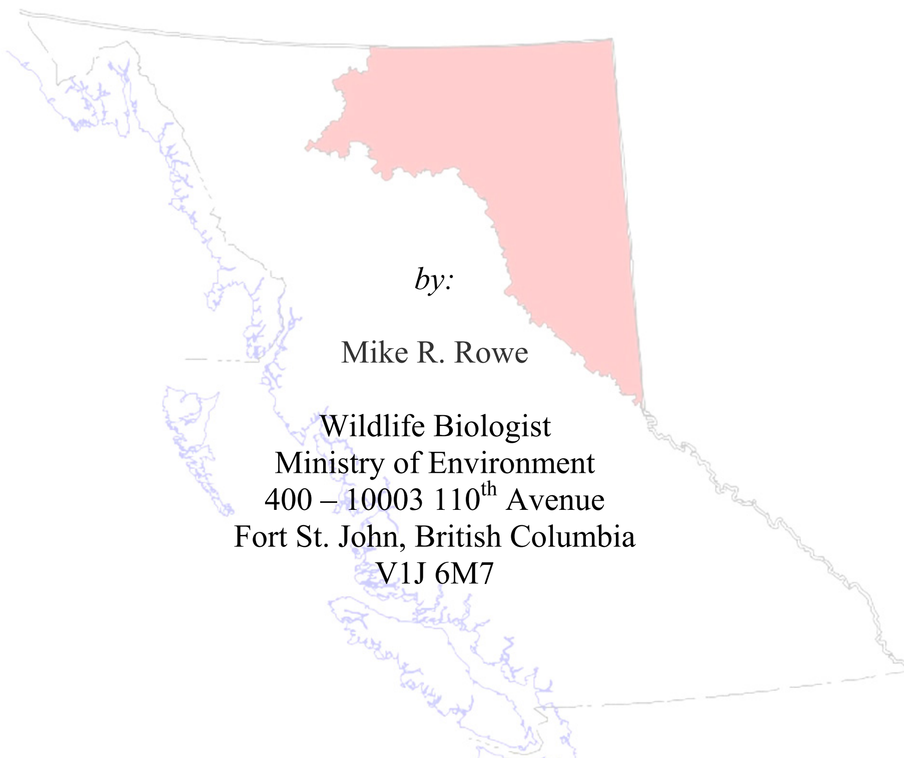
PEACE REGION TECHNICAL REPORT

Boreal Caribou Movement and Habitat Selection Within the Maxhamish Range



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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 due to noted population declines across its global range (COSEWIC 2002). In addition, boreal caribou are *blue-listed* within British Columbia by the BC Conservation Data Centre due to a high probability of population decline with low calf recruitment as a proximate cause (CDC 2006). Prior to 2000, very little was known regarding the density and distribution of boreal caribou within BC (Culling and Culling, 2006). Since that time, a number of research initiatives have been carried out within BC to acquire the data needed to address boreal caribou conservation concerns. The most notable project to date took place within the Snake-Sahtaneh Range from 2000 to 2004. This was a large scale GPS/VHF boreal caribou telemetry project in which 57 adult cow caribou (as well as 31 wolves and 9 black bears) were collared in an attempt to study the ecology and seasonal habitat selection of the herd in relation to predator habitat selection (Culling and Culling, 2006).

In 2006 a small-scale complimentary GPS collaring project was proposed within portions of the adjacent Maxhamish Boreal Caribou Range. This project involved the GPS collaring of 8 caribou within the Kiwigana and Capot-Blanc core habitat areas of the range. The objectives of this project were to:

- *evaluate and refine the Kiwigana and Capot-Blanc boreal caribou core habitat areas as defined by Culling et al, 2004*
- *determine general habitat use patterns including seasonal movements, home range size, connectivity, travel corridors, and calving sites*

Although there is no regulated harvest of boreal caribou within British Columbia, there are a number of potential threats to the viability of caribou within the Maxhamish range. The primary threat is habitat loss and/or fragmentation by industrial development and its indirect effects on predation.

Study Area

Boreal caribou ranges were delineated as part of the Interim Oil and Gas Industry Guidelines for Boreal Caribou Ranges in Northeast British Columbia (Culling et al. 2004). The boundaries, as shown in Figure 1, were produced using historical data, telemetry data, local knowledge, and habitat qualities (Culling et al. 2004). The study area used for this project (Figure 2) consisted of 2 of the 3 core habitat areas delineated within the Maxhamish Range north of Fort Nelson, BC (the Capot-Blanc and the Kiwigana). The Maxhamish range totals 7095km^2, while the Kiwigana and Capot-Blanc Cores measure 1301km^2 and 875km^2 respectively. The Maxhamish Range is bisected by the Fort Liard Highway (Highway 77 within BC) running between the Kiwigana and the Capot-Blanc Cores.

The Maxhamish Range occurs completely within the Taiga Plains Ecoprovince containing only one biogeoclimatic zone/subzone (BWBSmw2 – Black and White Boreal Spruce Moist Warm 2). This subzone is characterized by aspen – white spruce forest in better drained sites and lodgepole pine or black spruce forest often with a minor component of tamarack on more poorly drained sites (Delong, 1990). The elevation ranges from approximately 250m to 650m above sea level within the Capot-Blanc and Kiwigana core areas.

The most abundant ungulate within the study area is moose (*Alces alces*). Moose density was estimated to be 87 moose/1000km^2 +/- 25% at 90% confidence in February of 2004 within the Management Units overlapping the study area; MU's 7-55 and 7-56 (Backmeyer, 2004). Also in 2004, caribou density was estimated to be 31 caribou/1000km^2 +/- 63% at 80% confidence within the same area (Backmeyer, 2004). Factors contributing to the uncertainty around the caribou population estimate include the low number of caribou observed and the lack of a sightability correction. An additional caribou inventory was carried out within the Maxhamish Range in March of 2006 by the Ministry of Environment. At that time, caribou density was estimated to be 28 caribou/1000km^2 +/-55% at 80% confidence (36/1000km^2 within the core areas and 3.3/1000km^2 outside the cores areas of the Maxhamish Range). A sightability correction factor was produced using the GPS collared caribou within the Capot-Blanc and Kiwigana cores. Although the number of observations used to produce a sightability estimate was low (n = 10), only 30% of collared caribou within survey blocks were observed during normal transect flights (Ministry of Environment, unpublished report).

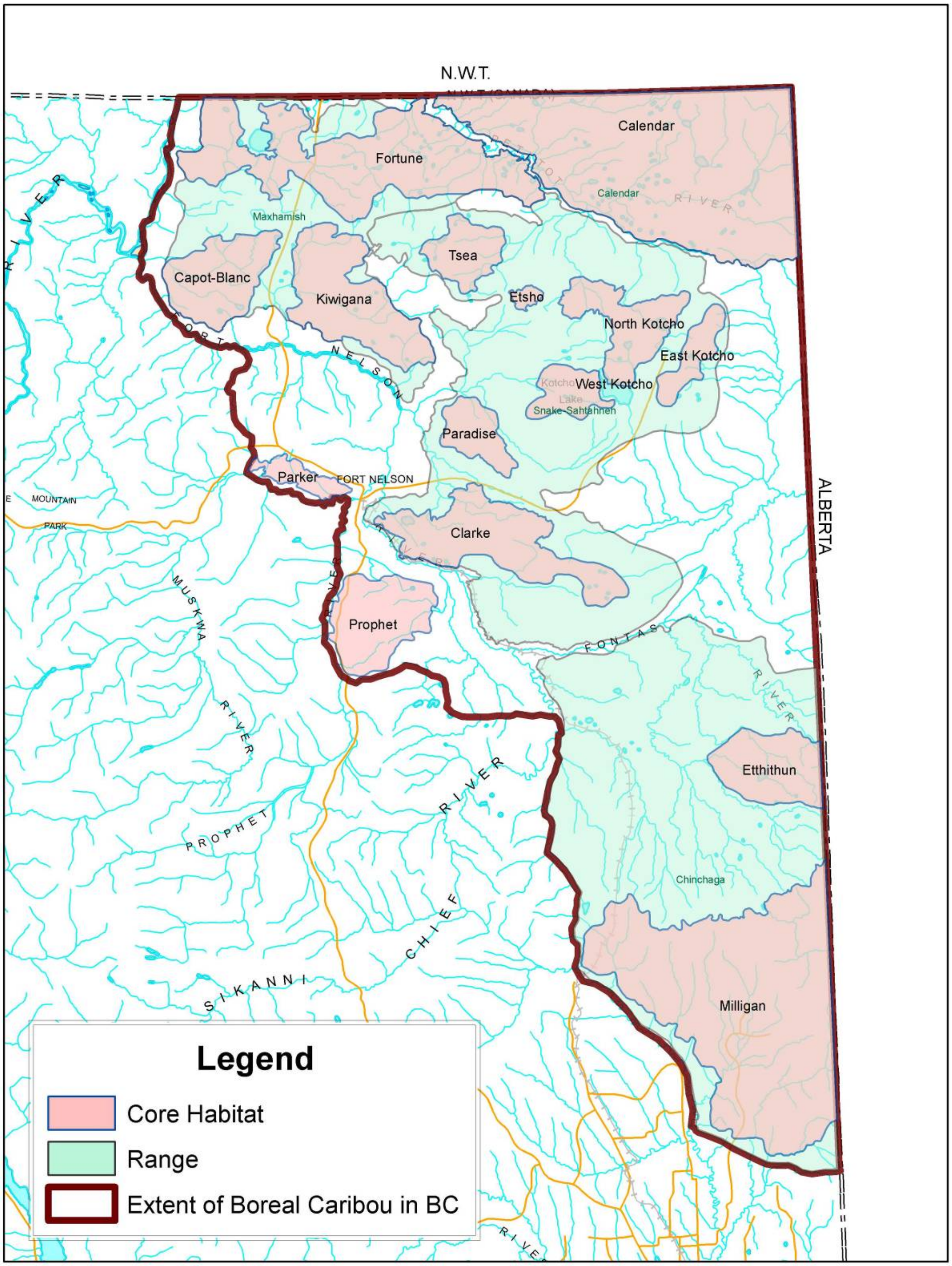

Figure 1. Boreal Caribou range extent and core habitats as defined by Culling et al, 2004.

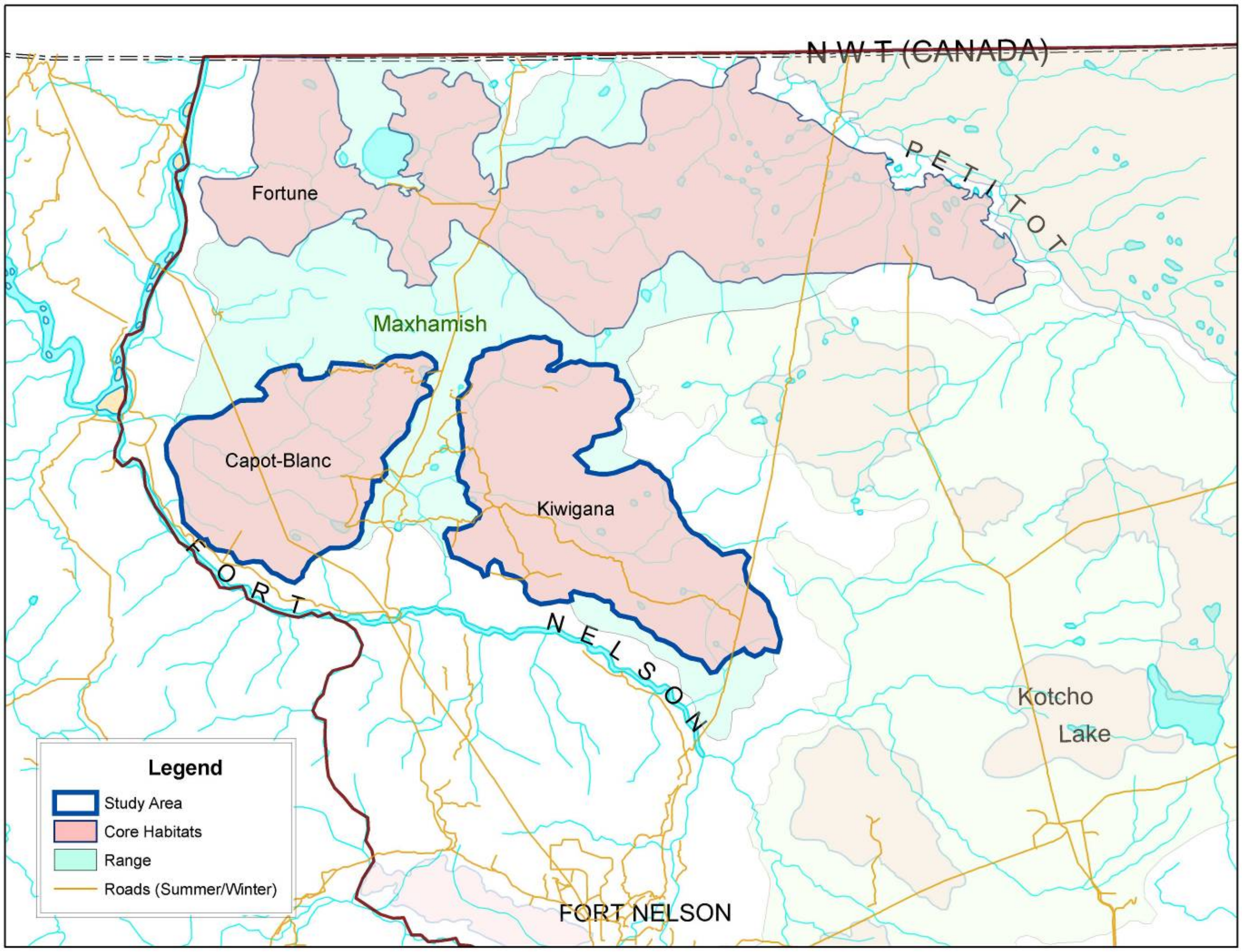

Figure 2. Study area for the 2006-2007 GPS collaring project within the Kiwigana and Capot-Blanc Core Habitats of the Maxhamish Boreal Caribou Range.

Methods

Capture, Collaring and Retrieval

Boreal caribou were captured using a net-gun fired from a Bell Jet Ranger 206 helicopter. The collars used were refurbished POSREC-Science C-600 models from Televilt Positioning, Sweden. This collar type has a built-in 12 channel Global Positioning System (GPS) receiver and very high frequency (VHF) transmitter. It collects and stores positional data "on-board" and must be retrieved in order to download data. It is equipped with a timed drop-off mechanism designed to allow the collar to fall off the animal at a programmed date. In this case, the collars were programmed to release after 365 days. The collars on caribou C1 to C7 were programmed to record positional fixes once every 6 hours (3:00, 9:00, 15:00, 21:00 local time, GMT -7). The collar on caribou C8 was programmed to record positions once every 4 hours.

The release mechanism failed on 5 of the 8 collared caribou, and 4 of the animals had to be recaptured using a net-gun (one collar that did not release was a mortality). All collars were relocated using the VHF signal from the collar.

GPS Data Analysis

Following collar recovery, all 8 collars were shipped to Televilt headquarters in Sweden for download of the positional data stored-on-board. Once outputs had been received the positions were entered into a GIS. Outlying points were removed including those that were recorded prior to collar deployment or after collar retrieval (or mortality). All "1D" type fixes (those fixes acquired using less than 3 satellite vehicles) were removed from the GIS because they were not thought to give reliable positional fixes. The remaining 6039 data points were analyzed. Minimum Convex Polygon (MCP) home ranges, kernel analyses, and movement paths were produced for all 8 caribou using Home Range Extension (Rodgers and Carr, 1998) for ArcGIS 9.1. Kernel analyses were completed using a smoothing factor of h = 0.6.

Home ranges were analyzed seasonally using 6 seasons; calving (May and June), summer (July and August), rut (September and October), early winter (November and December), mid winter (January and February), and late winter (March and April). Calving and rutting peaks were presumed to be similar to those observed in the Snake-Sahtaneh; May 15 and September 30 respectively (Culling and Culling, 2006).

Not all collars performed identically or consistently as shown in Tables 1 and 2. In particular, collars on animals C1, C3, C5, and C6 in particular failed most often to record positional fixes at scheduled times (23% or more of the fixes on these collars failed to acquire a position for at least 3 consecutive 6 hour intervals). It is unclear whether this failure was due to collar malfunction or selection of habitats with denser canopy covers. Autocorrelation errors were not corrected for during the analysis of this project.

Table 1. Summary of collar performance for caribou collared in the Capot-Blanc (C1 to C3) and the Kiwigana (C4 to C8) core boreal caribou habitat areas from February 2006 to February 2007. Note that animals C2 and C3 were mortalities.

CARI	FREQ	1D	2D	3D	3D+	Grand Total
C1	152.120	8	325	151	45	529
C2	152.039	8	190	152	483	833
C3	152.027	2	66	47	11	126
C4	152.019	3	181	189	912	1285
C5	152.049	6	192	83	23	304
C6	152.070	5	325	161	59	550
C7	152.109	14	213	183	396	806
C8	150.649	15	302	366	984	1667
Grand Total		61	1794	1332	2913	6100

Table 2. Intervals between collar fixes for the collars programmed to record 4 fixes daily ("normal" function of the collar is a 6 hour interval between fixes).

CARIBOU	6 HOUR	12 HOUR	18 HOUR	> 18 HOUR
C1	35%	24%	15%	27%
C2	79%	14%	6%	2%
C3	32%	19%	10%	38%
C4	90%	8%	2%	0%
C5	27%	14%	9%	50%
C6	43%	18%	16%	23%
C7	66%	19%	6%	8%

Results

Eight adult female boreal caribou were captured between January 31 and February 2, 2006. Three collars were installed within the Capot-Blanc core on 2 different groups. The remaining 5 collars were deployed within the Kiwigana core area.

Core Habitat Areas

The core habitat areas as defined by Culling et al, 2004 were evaluated using GPS fixes acquired during this project. Of all GPS locations per core, 92% and 97% occurred within Capot-Blanc and Kiwigana Cores respectively. There was limited use outside of the Capot-Blanc core in wet meadow habitats to the southeast of Patry Lake as well as short forays outside of the core to the north and east (Figure 3). In the Kiwigana a small portion of habitat was utilized outside the delineated core in the south (Figure 4). All potential calving sites (locations recorded in the month of May) also occurred within the core areas. There was no movement of caribou measured between the 2 core areas.

There were no caribou collared in the northern extent of the Kiwigana core, therefore the lack of use by collared animals should not suggest that this area is unoccupied.

Home Ranges

Figure 5 displays the 100% MCP annual home ranges for each caribou. Mean annual home range size for all collared caribou (excluding C3, an early mortality with only 5 months of data) was 344 +/- 50 km^2 (n = 8; range 198 to 591).

Seasonal home ranges were defined as calving (May and June), summer (July and August), rut (September and October), early winter (November and December), mid winter (January and February), and late winter (March and April). Of these 6 seasons, early winter had the highest average MCP size, and late winter the smallest (Figure 6).

Kernel analysis was completed within each range using all 2D, 3D, and 3D+ locations (Figures 7 and 8). The kernel analysis represents a measure of habitat utilization within each core and allows activity centres to be visualized.

The work of Culling and Culling (2006) demonstrated a selection of areas of extremely low slope by boreal caribou within the Snake-Sahtaneh Range. Although not completed to the same level of precision, Figure 9 shows areas within the Kiwigana core of low slope as well as caribou selection in the form of kernel home ranges.

Movement Corridors

Figure 10 represents GPS caribou locations as polylines. Each successive caribou location has been joined by a line to form a continuous path. Average length of these lines (excluding C3) was 732 +/- 180km (n=7; range C2-490km to C8-952km). Very few movement paths occurred outside of the defined core habitats.

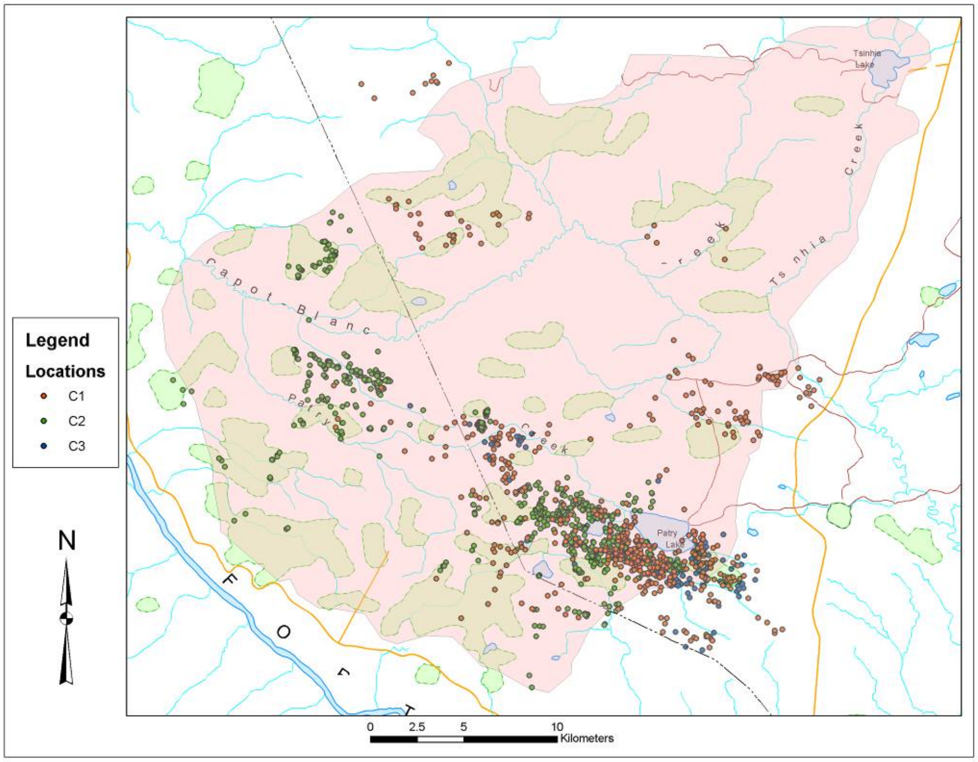

Figure 3. Point locations of GPS collared caribou within the Capot-Blanc Core (February 2006 to January 2007).

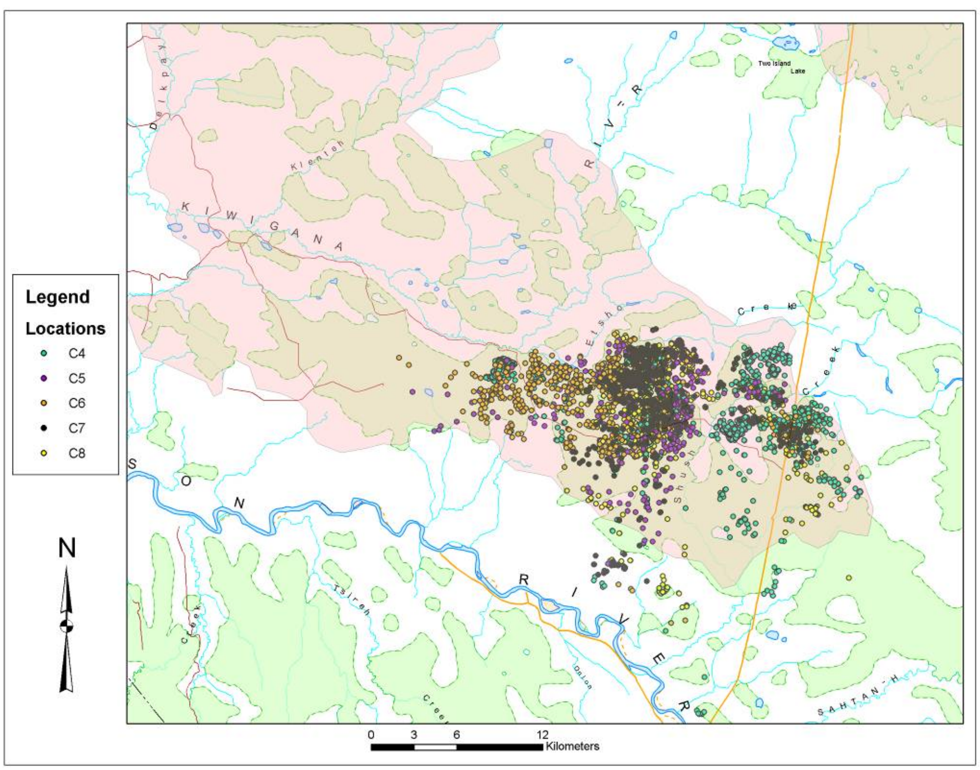

Figure 4. Point locations of GPS collared caribou within the Kiwigana Core (February 2006 to January 2007).

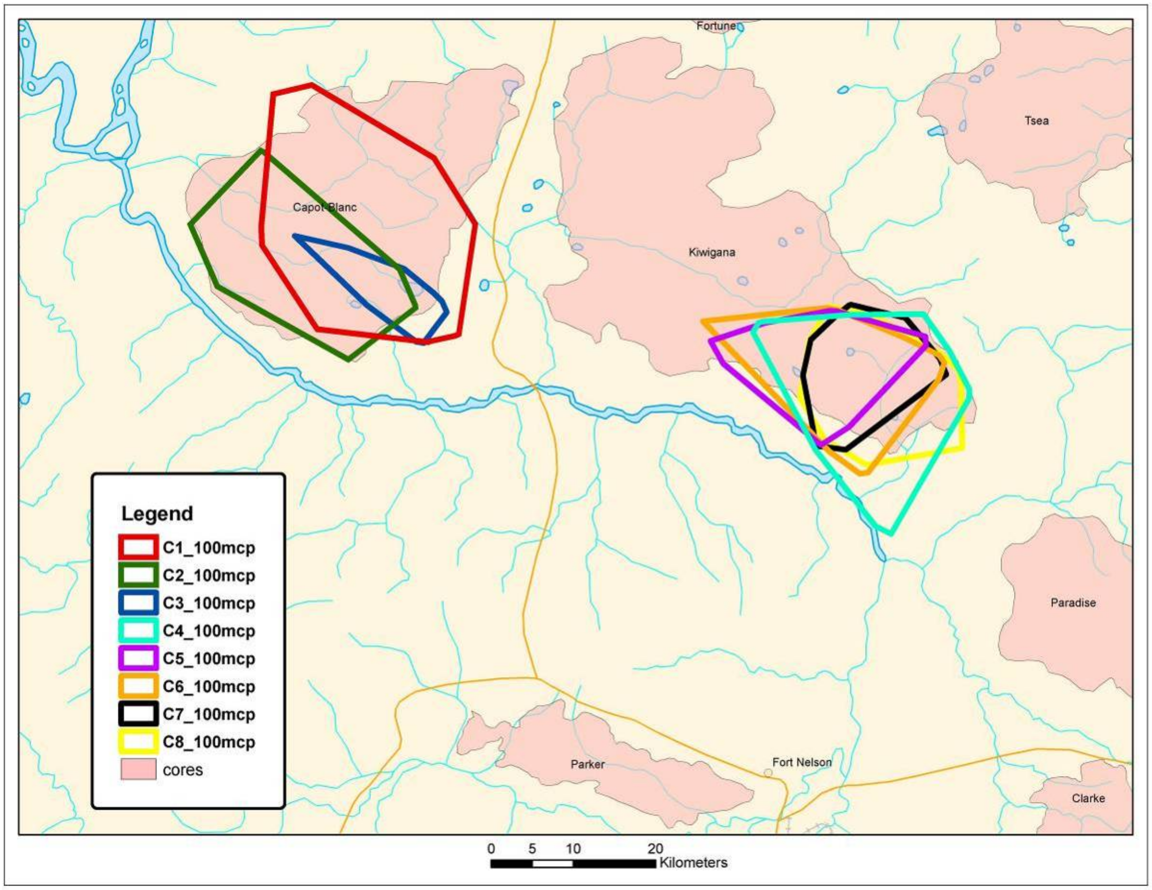

Figure 5. Minimum Convex Polygon 100% home ranges for boreal caribou in the Capot-Blanc and Kiwigana cores.

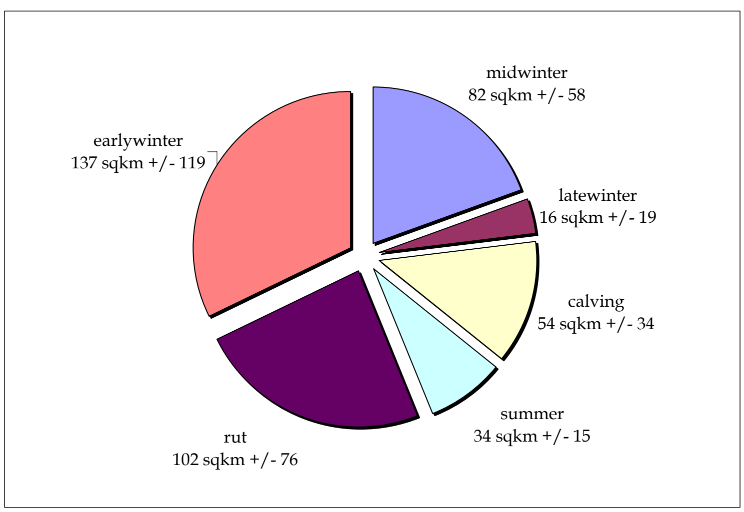

Figure 6. Average seasonal home range 100% MCP size. Seasons defined as calving (May and June), summer (July and August), rut (September and October), early winter (November and December), mid winter (January and February), and late winter (March and April).

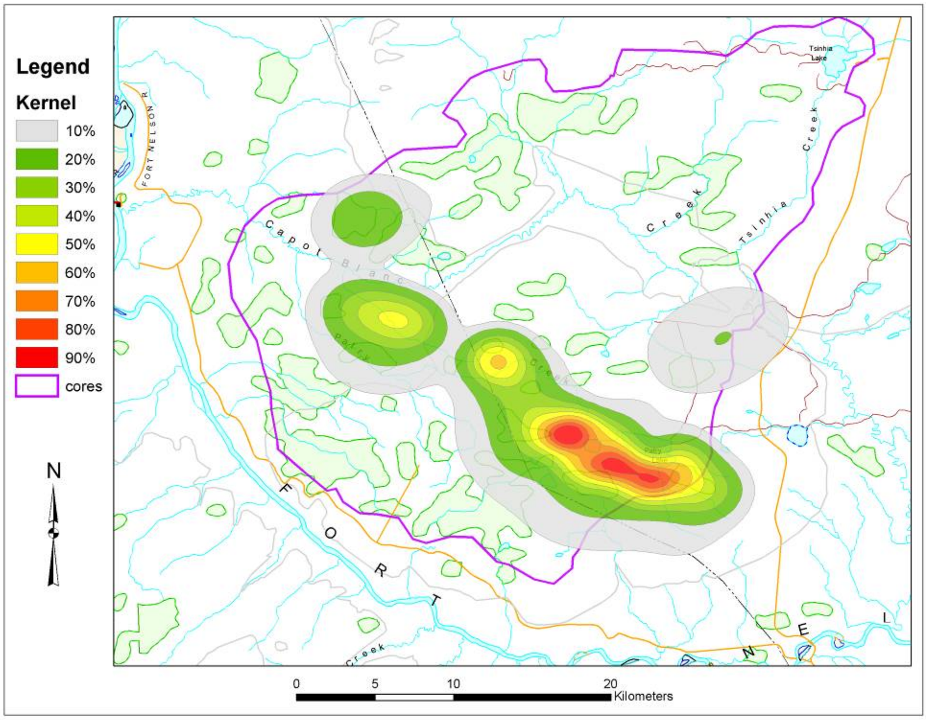

Figure 7. Home range utilization intensity represented as kernels with h = 0.6 for the Capot-Blanc core area.

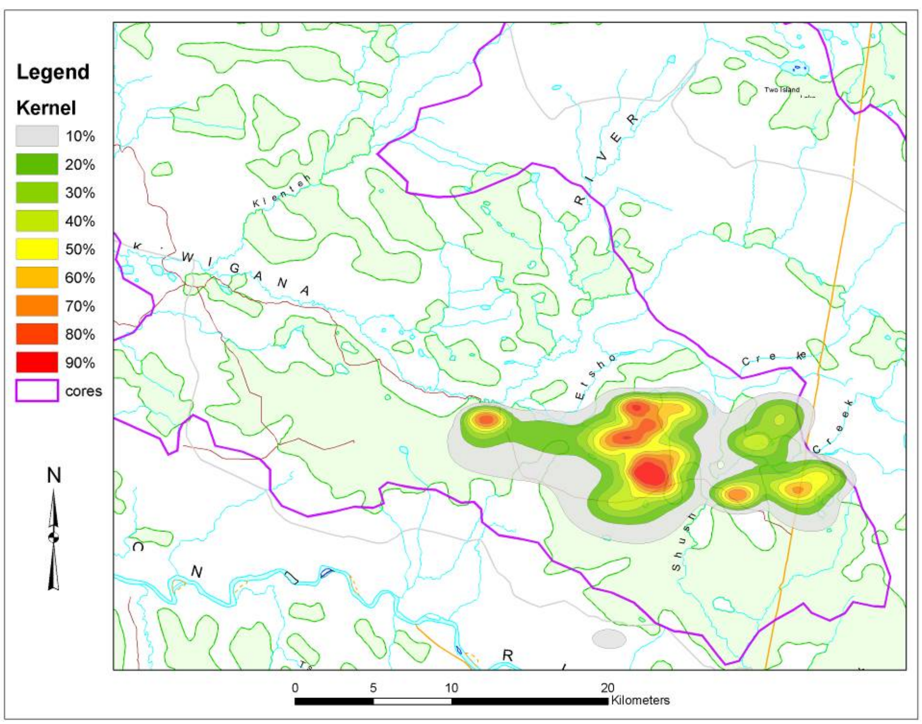

Figure 8. Home range utilization intensity represented as kernels with h = 0.6 for the Kiwigana core area.

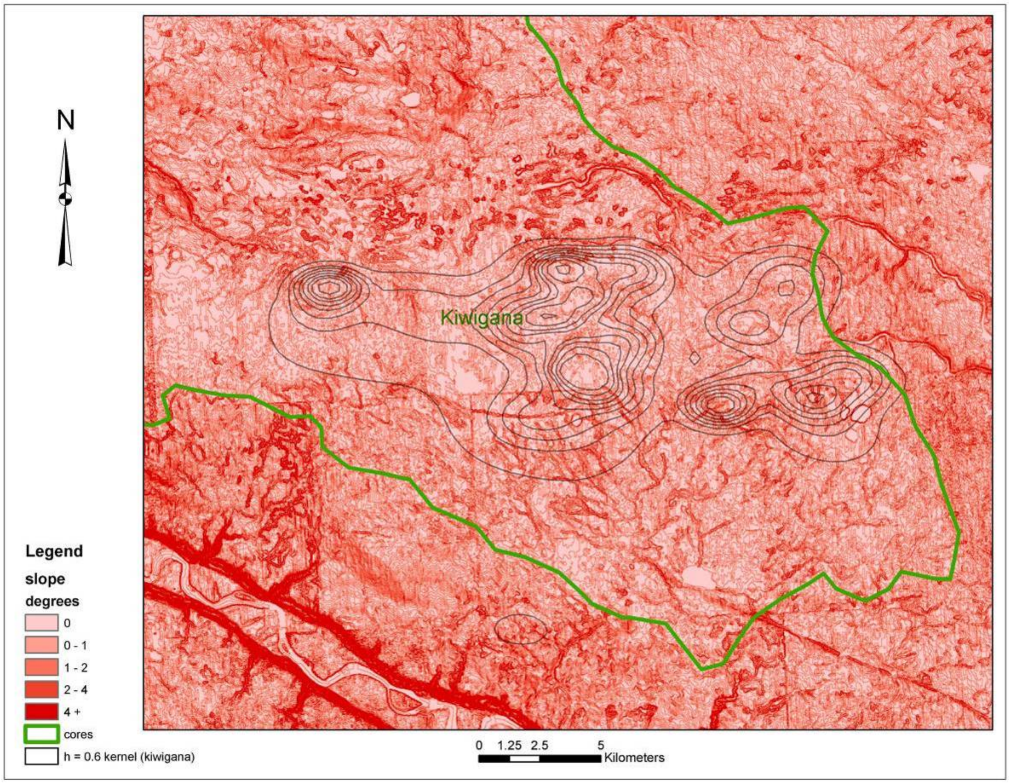

Figure 9. Raster image of slope with probability contours of caribou locations within the Kiwigana core area.

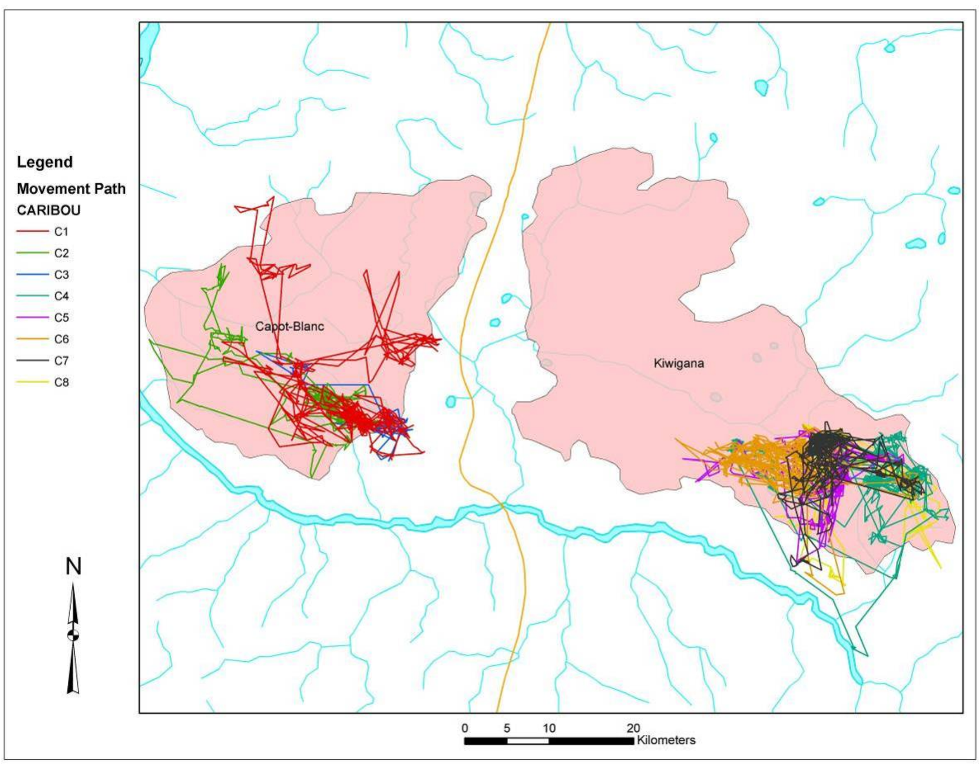

Figure 10. Movement patterns of collared caribou within the Capot-Blanc and Kiwigana core areas.

Discussion

Although much smaller in scale, many of the results of this GPS collaring project can be compared to the work of Culling and Culling (2006) within the Snake-Sahtaneh Range. As in the Snake-Sahtaneh study, this project found the suitability of the boreal caribou ranges (especially the core habitat areas), to be a very high predictor of actual habitat use by boreal caribou. While 94% of total locations during the Snake-Sahtaneh fell within the core habitats, 96% of locations during this project fell within the Kiwigana and Capot-Blanc core areas. The annual 100% MCP home range size was smaller for the collared Maxhamish animals (344 +/- 50 km^2) than what was observed in the neighbouring Snake-Sahtaneh Range (1,468 +/- 128 km^2 (n = 33; range 375 to 3,592). Also, no movement of caribou between ranges was recorded, which was also common in the Snake-Sahtaneh. The analysis of selection of low slope areas was not as comprehensive as in the Snake-Sahtenah, but it appears extreme low gradient areas are also important within the Maxhamish Range.

Woodland caribou declines across North America have predominantly been attributed to predation as a proximate cause (Bergerud and Elliott, 1986). Results of the Snake-Sahtaneh study indicated that pregnancy rates were high (96%) but calf survival was low (20-29% survived to 6 weeks, while only 12-14% survived to October of their first year) (Culling and Culling, 2006). Low calf recruitment was also observed within the Maxhamish Range with 6 calves/100 cows measured in March of 2006 (Ministry of Environment, Unpub. Rep). Since industrial disturbance has the potential to alter predator-prey relationships (James, 1999), measures should be taken to mitigate potential effects within boreal caribou core ranges. Management conclusions from this study support those suggested by Culling and Culling (2006):

- Within core habitat areas measures should be taken to avoid habitat loss, fragmentation, and alienation
- No new all season roads should be built within core habitats and all roads should be decommissioned as soon as possible
- No new facilities should be permitted within core habitats
- Limit the amount of linear disturbances such as seismic lines, winter roads, and pipelines within core habitats

Acknowledgements

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