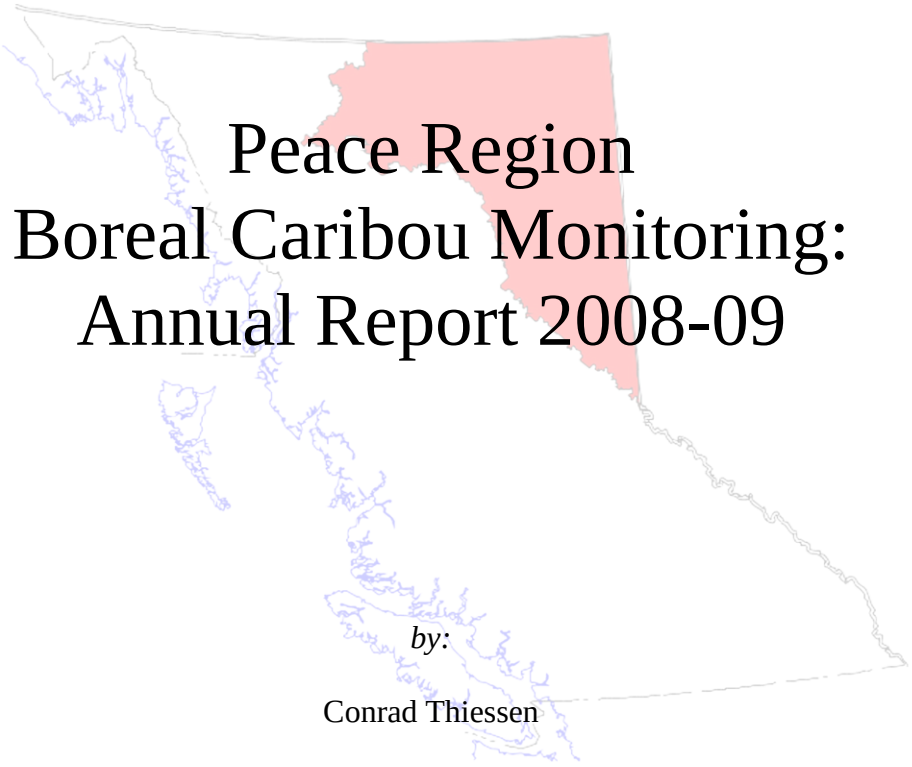

Peace Region Boreal Caribou Monitoring: Annual Report 2008-09

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May 2009

BRITISH COLUMBIA

TABLE OF CONTENTS

Executive Summary

The boreal ecotype of woodland caribou (*Rangifer tarandus caribou*) are Red Listed by the Province of British Columbia and designated as Threatened by the Committee on the Status of Endangered Wildlife in Canada. Industrial development in boreal caribou habitat in British Columbia has been increasing, especially in the oil and gas sector. In light of the current status of boreal caribou in Canada combined with the impacts to the populations from industrial development the BC Ministry of Environment initiated a monitoring project for boreal caribou in 2008. In March 2008 ten boreal caribou were fitted with VHF radio collars (5 in the Kiwigana core, 4 in the Parker Lake core, and 1 in the Capot Blanc core). Monthly relocations of the radio collars were conducted using fixed wing aircraft. A minimum number known alive was collected during the rut of October 2008. During the rut count 36 caribou were counted (25 in Parker Lake core, 10 in Kiwigana core, and 1 in the Capot Blanc core). For all animals counted there were 31.8 calves/100 cows and 31.8 bulls/100 cows. In March 2009 ten more collars were deployed (8 GPS and 2 VHF). There have been no mortalities of the collared caribou to date. Three wolves were collared (2 GPS, 1 VHF) in the Calender range in 2009.

Anthropogenic disturbance in boreal caribou ranges was evaluated by combining and buffering all industrial development (roads, seismic lines, pipe lines, well sites, and cutblocks) by 250 meters. The amount of disturbance relative to the size of caribou ranges and cores was examined. Of 15 core areas, 12 were found to be above the 61% threshold of anthropogenic disturbance as described by Sorensen et al. (2008). Of the four caribou ranges, three were above the 61% threshold. The 61% threshold represents the point where boreal caribou populations in Alberta had a negative population growth. While the models developed in Alberta have not been tested in British Columbia the high levels of disturbance found in many of the cores and ranges suggests the majority (5 of 6) of BC's boreal caribou herds are likely declining. The monitoring project we have initiated will gather data which can be used to inform land use decisions.

List of Figures

List of Tables

1 Introduction

1.1 Background

The boreal ecotype of woodland caribou (*Rangifer tarandus caribou*) is Red Listed by the Province of British Columbia and designated as Threatened by the Committee on the Status of Endangered Wildlife in Canada (Thomas and Gray 2002). The Conservation Framework developed by the British Columbia Ministry of Environment lists boreal caribou as a high priority species for the province. Increasing pressures from industrial activity (oil and gas exploration and development, forestry, and their associated impacts) are assumed to be influencing a decline in boreal caribou. This project was developed to monitor population size and composition to determine if changes are occurring within the population, and to provide data for developing habitat protection measures.

1.2 Objectives

The project was designed to initiate long-term monitoring of boreal caribou to examine trends in population size, adult and calf survival, and to refine range and core maps. This information will be used to examine changes in the population through time and with shifts in levels of industrial development. A further objective is to examine the role of predation in relation to industrial development and boreal caribou demographics.

2 Methods

2.1 Study Area

Boreal caribou in British Columbia occupy the extreme northeast corner of the province (Figure 1). The extent of boreal caribou, the herd ranges, and the core areas were determined using telemetry and computer modelling (Figure 2; Culling et al. 2004). Herd ranges were defined by Culling et al. (2004) as broad areas of known historical or assumed current use that supply resources necessary to support local populations of boreal caribou, and cores as areas of high current capability and suitability based on general habitat requirements and documented occurrence. Boreal caribou in British Columbia all inhabit the Boreal White and Black Spruce (BWBS) biogeoclimatic zone (Meidinger & Pojar 1991).

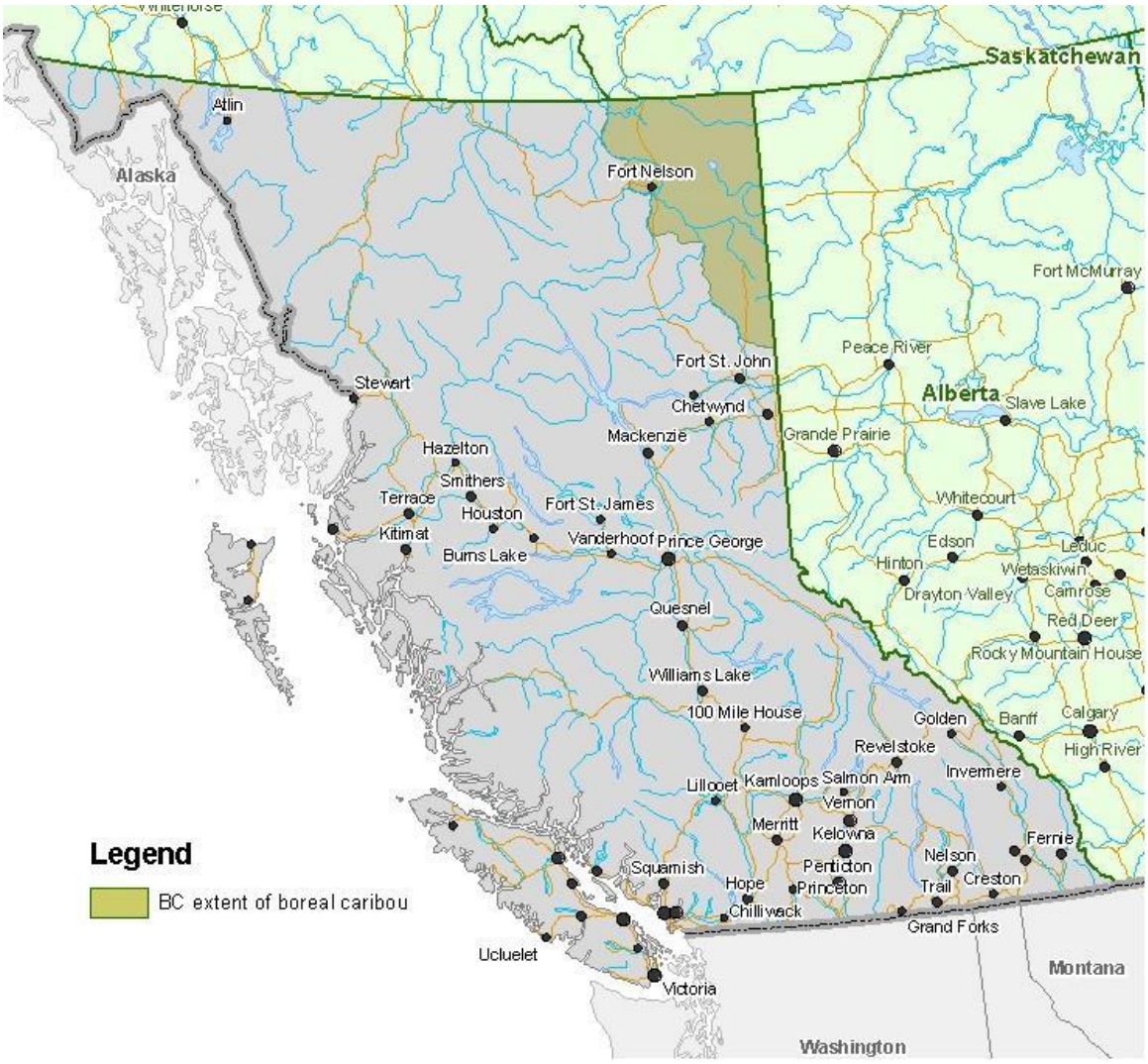

Figure 1 Extent of boreal caribou occurrence in British Columbia (modified from Culling et al. 2004).

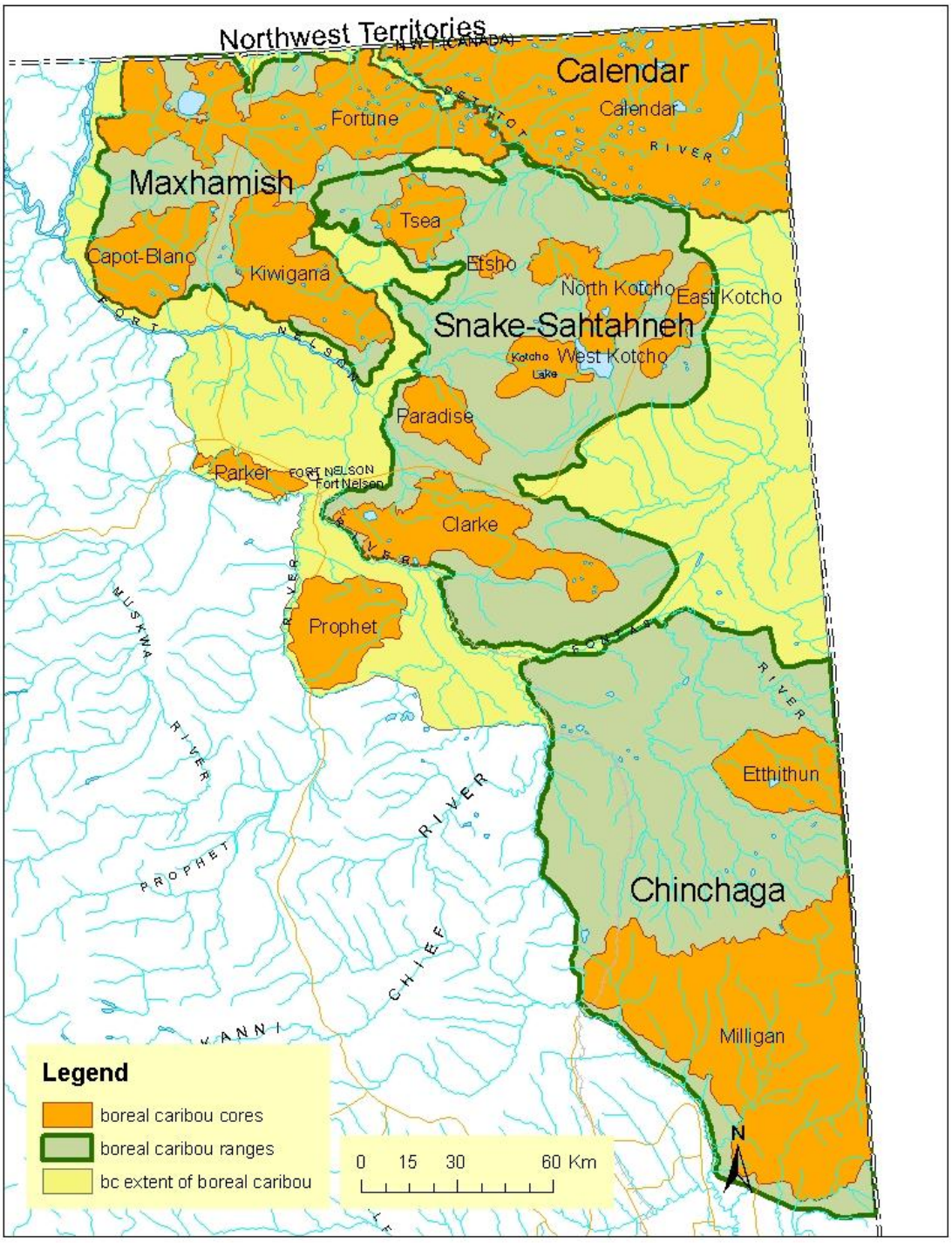

Figure 2 Boreal caribou extent, ranges and core areas in northeastern British Columbia (modified from Culling et al. 2004).

2.2 Capture and collaring

To increase efficiency of search time, only high quality winter habitats within the core areas were searched. These areas were generally large wetland complexes and margins of lakes. While boreal caribou inhabit forested areas during winter, they are much more difficult to observe and may be far from a suitable capture location.

Caribou were captured using a 4 barrel net gun (Margo Enterprises) fired from a Bell 206 Jet Ranger helicopter with experienced capture pilot and net-gunner. Animals were physically restrained using hobbles by 2-3 people. VHF or GPS collars were fitted on all animals captured and hair, blood and scat samples were collected. Only female caribou were targeted for capture. We deployed ATS (Advanced Telemetry Systems, Insanti, MN) GPS collars that were programmed to collect a location every 5 hours. Both VHF and GPS collars had mortality modes.

Wolves were chemically immobilized by firing a dart with Telazol from a Bell 206 Jet Ranger helicopter. Hair samples were collected from all wolves. GPS and VHF collars were deployed.

2.3 Collar relocations

Relocation flights were conducted once per month to determine location, mortality status and presence of calves with collared females. Not all cows were observed visually each flight. Efforts were made to relocate all collared animals. Information collected was radio frequency, latitude and longitude, mortality status (dead or alive), general location, presence of calf with collared female, and number of animals seen in group. Flights were conducted and data collected by Jim Hart of YYE Enterprises in Fort Nelson. Individual caribou movements were examined by creating minimum convex polygons around locations using Hawth's Tools version 3.27 (Beyer 2004).

2.4 Rut count

Boreal caribou generally distribute themselves across the landscape spatially segregated at low densities, however during the rutting period they aggregate in mixed gender groups. To obtain a minimum population count and determine herd composition we conducted an aerial survey of boreal caribou in core areas during the rut. We relocated collared animals using a Bell 206 Jet Ranger equipped with 2 antennas and a telemetry receiver. Once a collared animal was located we counted and classified all caribou associated with the marked animal. Caribou observed while searching for marked animals were also counted and classified. Caribou were classified according to level 3 RISC standards (Appendix 2): adult females (> 1 year old), calves (< 1 year old), immature bulls (RISC class 1 bulls), mature bulls (RISC class 2 and 3).

2.5 Industrial footprint in boreal caribou ranges

Anthropogenic disturbance in boreal caribou ranges and cores was quantified following Sorensen et al. (2008). All known industrial developments (seismic lines, roads, pipe lines, well pads, and cutblocks) were mapped and buffered by 250 meters on each side (500 meter total width on linear features) to create a disturbance layer (see Appendix 4 for list of data sources). The disturbance layer was then intersected with caribou ranges and cores, and area of disturbance calculated for each. We used the threshold of 61% anthropogenic disturbance described by Sorensen et al. (2008) as an indicator of decreasing λ for populations. The Sorensen et al. methodology specified combining anthropogenic disturbance with wild fire, while in this analysis we look explicitly at anthropogenic disturbance.

3 Results

3.1 Capture and collaring

Ten female boreal caribou were captured and collared in March 2008 and ten in March 2009 (Figure 3). In 2008 all collars fitted on caribou were VHF (very high frequency), and in 2009 a combination of eight GPS (global positioning system) and two VHF collars were deployed (Table 1). No injuries or fatalities occurred during capture efforts. The mean pursuit time prior to capture for caribou across both years was 4.1 minutes (n = 15 capture events, range 1 – 15 minutes, only a subsample of captures were timed)

Due to restricted funding in 2008 the search area and captures were restricted to the Parker Lake (4 females), Capot Blanc (1 female), and Kiwigana (5 females) core areas. In 2009 a much larger area was searched including Parker Lake (3 females), Capot Blanc (3 females), Kiwigana (2 females), Fortune (no captures), Prophet (2 females), and a portion of the Calender (no captures) core areas (Figure 2).

During the 2009 captures we chemically immobilized and collared three wolves from a pack of four in Calender range (Table 1; CALU1001, CALU1002, CALU1003). Two of the wolves were fitted with GPS collars and one with a VHF collar.

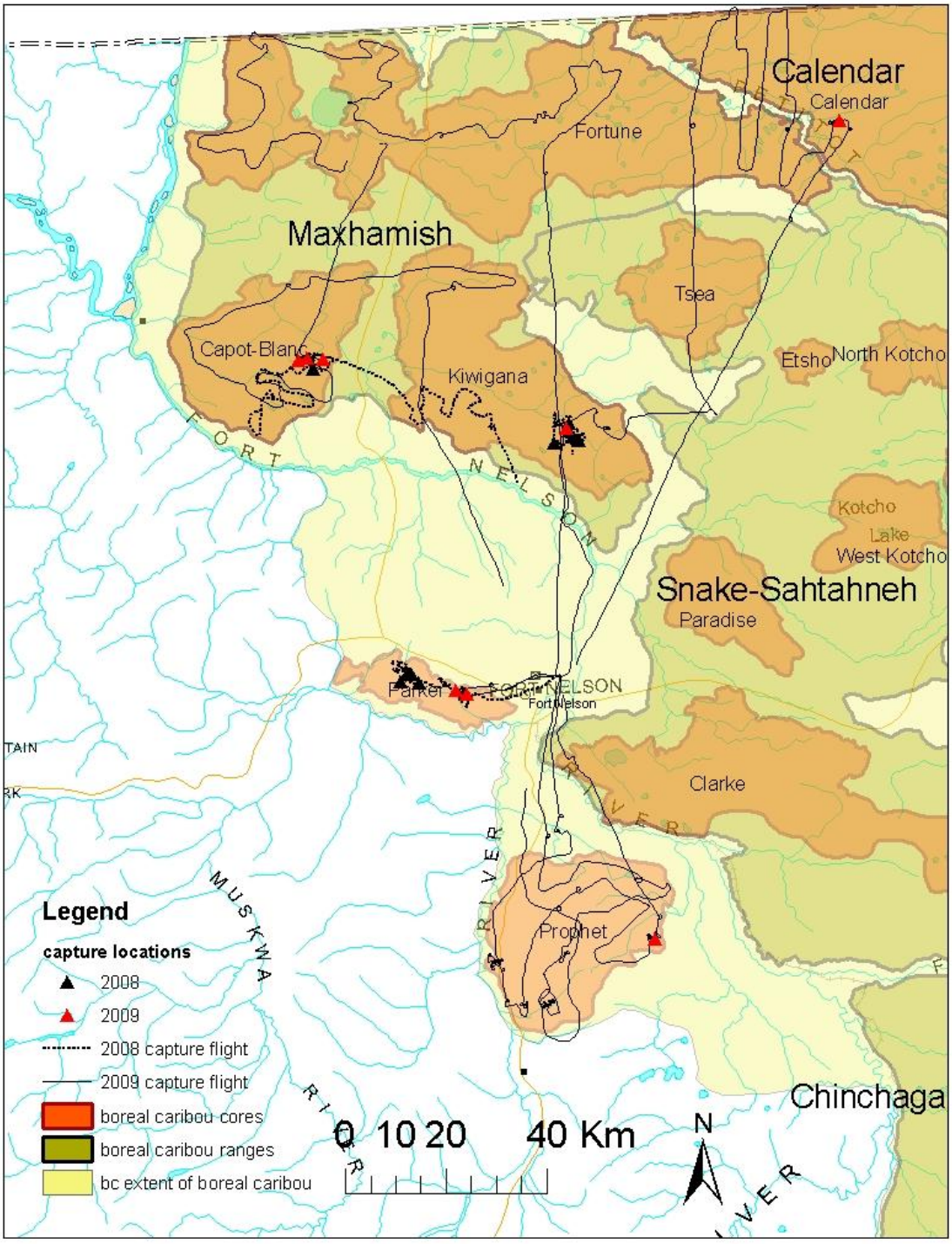

Figure 3 Capture locations and flight lines from March 2008 and 2009 boreal caribou captures.

Table 1 Capture data for female boreal caribou captured in the winters of 2008 and 2009. Sample types are H = hair, B = blood, S = scat.

Date	Caribou ID	Freq.	Sex	Age	Collar Type	Ear Tag #	Latitude	Longitude	Herd Core	Samples	Group size
06-Mar-08	BC1000	151.460	Female	adult	VHF		58.85448	-123.09835	Parker	H,S	
06-Mar-08	BC1001	151.782	Female	adult	VHF		58.83514	-123.06144	Parker	H,S	4; 2 cows, 2 calves
06-Mar-08	BC1002	151.678	Female	adult	VHF		58.83971	-123.12659	Parker	H,S	2 cows
06-Mar-08	BC1003	151.880	Female	adult	VHF		58.85183	-123.08798	Parker	H,S	2 cows
06-Mar-08	BC1004	151.899	Female	adult	VHF		59.40330	-123.38749	Capot-Blanc	H,S	10; mostly cows, some bulls, no calves seen
07-Mar-08	BC1005	151.861	Female	adult	VHF		59.26109	-122.49307	Kiwigana	H,S	3; 1 cows, 1 calf, 1 yearling
07-Mar-08	BC1006	151.821	Female	adult	VHF		59.25552	-122.47290	Kiwigana	H,S	2 cows
07-Mar-08	BC1007	151.620	Female	adult	VHF		59.28538	-122.50221	Kiwigana	H,S	6; 4 cow, 2 bulls
07-Mar-08	BC1008	151.740	Female	adult	VHF		59.25265	-122.55601	Kiwigana	H,S	9 cows
07-Mar-08	BC1009	151.701	Female	adult	VHF		59.27245	-122.50237	Kiwigana	H,S	7 cows
12-Feb-09	BC1010	149.678	female	adult	GPS	384	58.81124	-122.90028	Parker	H,B	4; 1 cow, 3 bulls
12-Feb-09	BC1011	149.780	female	adult	GPS	382	58.81698	-122.91761	Parker	B	9; 6 cows, 3 bulls
12-Feb-09	BC1012	149.255	female	adult	GPS	385	58.81976	-122.93520	Parker	H,B	2; 2 cows
13-Feb-09	BC1013	149.352	female	adult	GPS	32	59.42007	-123.35015	Capot Blanc	H,B,S	15
13-Feb-09	BC1014	148.040	female	adult	VHF	36	59.42296	-123.40639	Capot Blanc	H,B,S	15
13-Feb-09	BC1015	148.109	female	adult	VHF	29	59.41933	-123.43444	Capot Blanc	H,B,S	7; 5 cows, 1 calf, 1 bull
14-Feb-09	CALU1001	149.597	male	adult	GPS		59.79781	-121.49419	Calender	H	4 wolves
14-Feb-09	CALU1002	150.272	female	adult	GPS		59.79781	-121.49419	Calender	H	4 wolves
14-Feb-09	CALU1003	148.142	female	adult	VHF		59.79781	-121.49419	Calender	H	4 wolves
14-Feb-09	BC1016	149.330	female	adult	GPS	55	59.27705	-122.51365	Kiwigana	H,B,S	2
14-Feb-09	BC1017	149.779	female	adult	GPS	53	59.27705	-122.51365	Kiwigana	H,B,S	5; 3 cows, 1 calf, 1 bull
15-Feb-09	BC1018	149.320	female	adult	GPS	332	58.35940	-122.29662	Prophet	H,B,S	8; 5 cows, 3 males
15-Feb-09	BC1019	149.668	female	adult	GPS	72	58.35940	-122.29662	Prophet	H,B,S	8; 5 cows, 3 males

3.2 Collar relocations

Caribou collared in March 2008 were relocated four times over the past year. Once during the 2008 rut count and three times during fixed-wing aerial telemetry relocation flights in November, January, and March(Appendix 4). Caribou collared in March 2009 were relocated once by fixed-wing telemetry flight in the same month that they were collared. Fixed-wing flights were not conducted in December 2008 or February 2009 due to adverse weather conditions. Each fixed-wing flight was approximately 3.5 hours in duration during which all, or the majority, of the collared animals were relocated.

Within the Kiwigana core all seven caribou were captured in the south – east portion, and the majority of relocations occurred within the core area (Figure 4). Two caribou moved out of the core, but stayed within the delineation of the Maxhamish range.

In 2008 only one caribou was collared within the Capot Blanc core, and this animal has not moved more than 2 km from its original location (Figure 5). The collar is not transmitting a mortality signal, but we suspect the animal may not be alive. In 2009 an additional three animals were collared, two with VHF and one with a GPS collar. All the animals were captured in the west central portion of the core and none of the movements recorded left the core area or the vicinity of the captures.

Four VHF collars were deployed on caribou in the Parker core in 2008. The movements of these animals were restricted to within the core area, except during the rut survey when two animals were located south of the Muskwa River outside of the core and presumed area of occupation of boreal caribou (Figure 6). In 2009 three caribou from the Parker core were fitted with GPS collars.

Two caribou were collared with GPS collars in the Prophet core in 2009. One of these individuals did not move far from the original capture location, while the second animal moved approximately 20 km outside of the Prophet core, but remained within the known extent of boreal caribou (Figure 7).

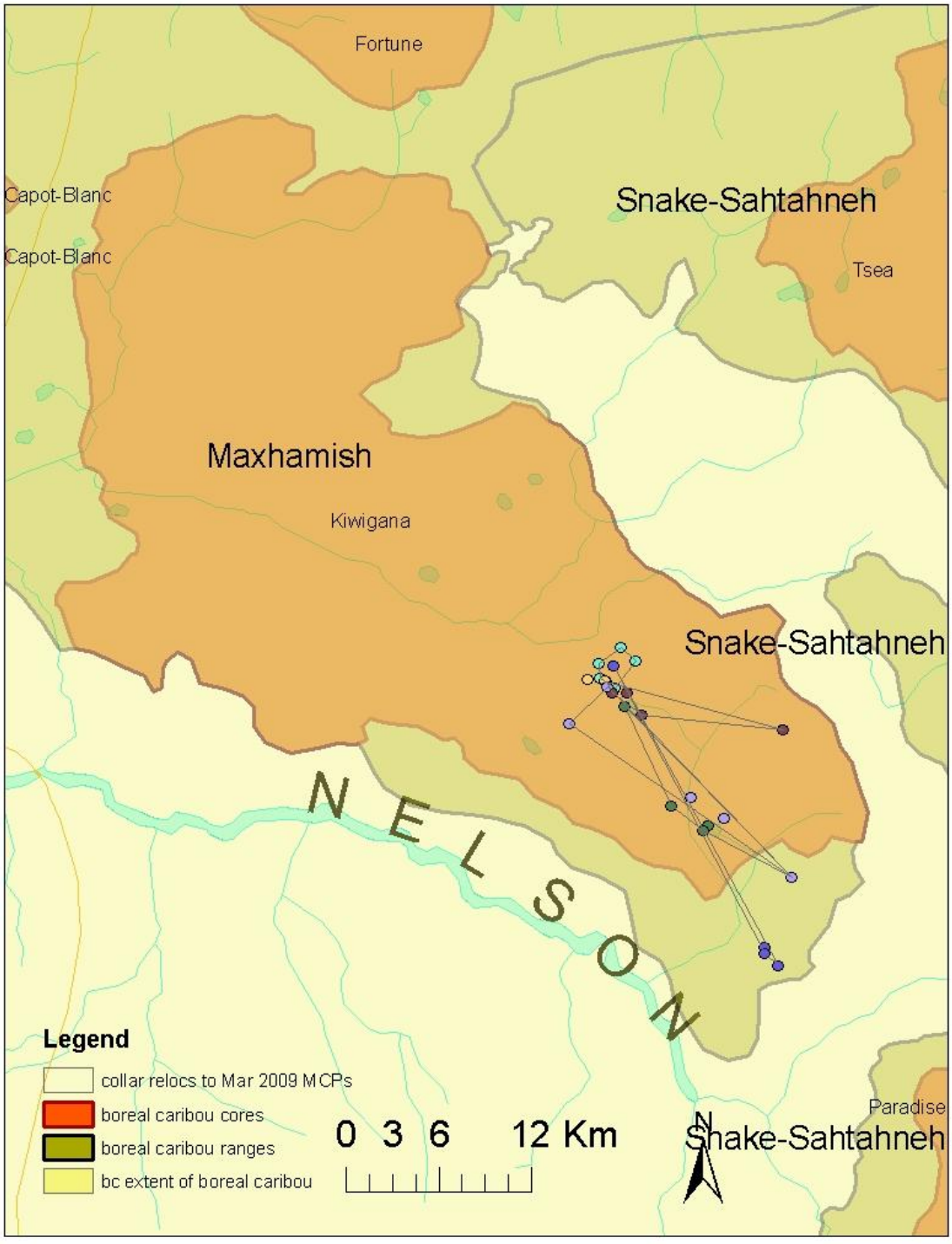

Figure 4 Capture and telemetry locations (with minimum convex polygons) for collared boreal caribou from the Kiwigana Core between March 2008 and March 2009. Each caribou is represented by a different colored circle.

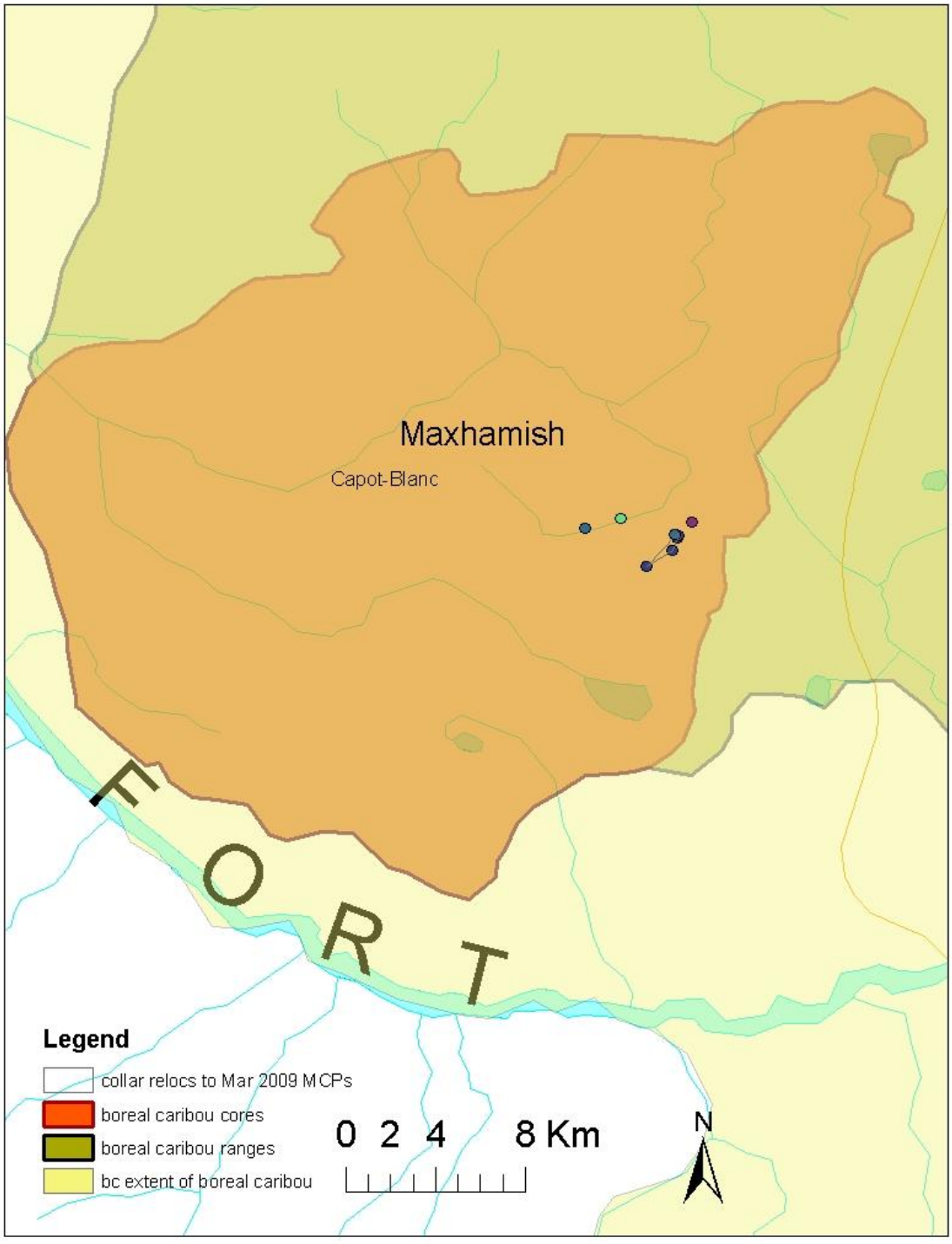

Figure 5 Capture and telemetry locations (with minimum convex polygons) for collared boreal caribou from the Capot-Blanc Core between March 2008 and March. Each caribou is represented by a different colored circle.

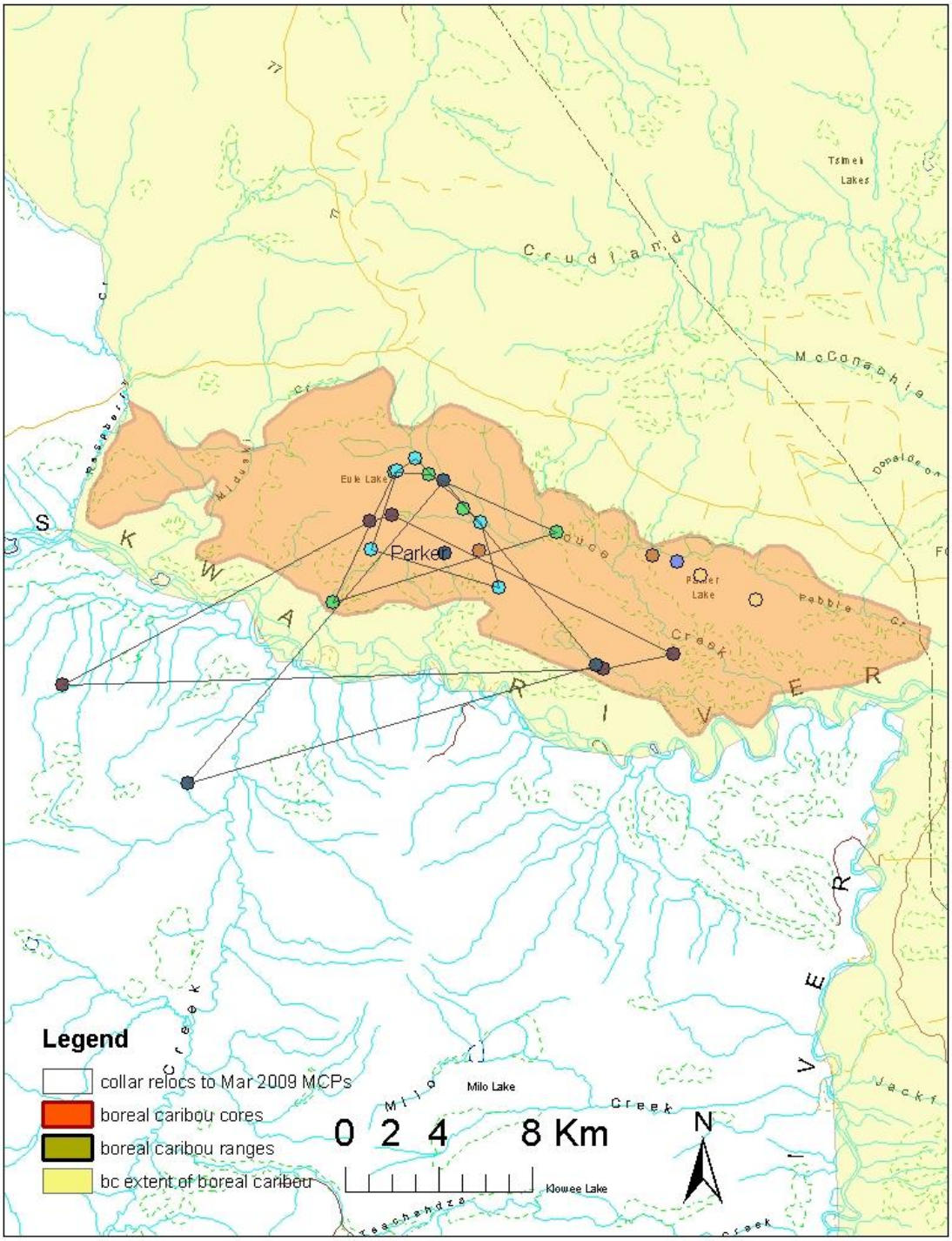

Figure 6 Capture and telemetry locations (with minimum convex polygons) for collared boreal caribou from the Parker Lake Core between March 2008 and March 2009. Each caribou is represented by a different colored circle.

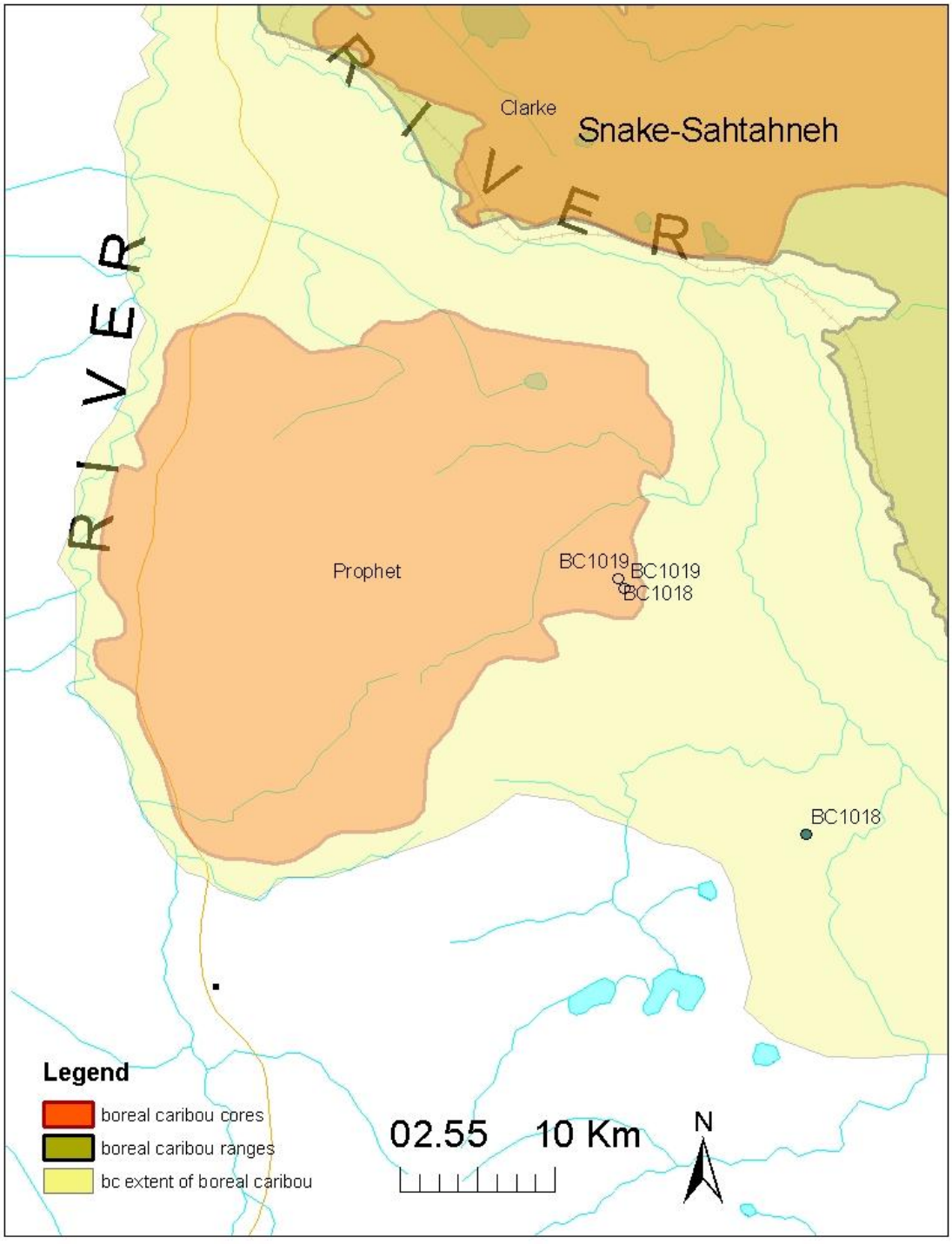

Figure 7 Capture and telemetry locations for the two collared boreal caribou from the Prophet Core between February and March 2009. Each caribou is represented by a different colored circle.

3.3 Rut count

The rut count was conducted on October 16, 2008 in the Parker, Kiwigana, and Capot-Blanc cores (Figure 8). A total of 36 caribou were counted between the 3 cores (Table 2). Within, and near, the Parker core 25 caribou were counted (16 adult females, 4 calves, 2 immature males, and 3 mature males). Within, and near, the Kiwigana core 10 caribou were counted (5 adult females, 3 calves, and 2 mature males). Within the Capot Blanc core 1 collared female was observed. For all caribou counted there were 31.8 calves/100 cows and 31.8 bulls/100 cows (n = 36). For the 25 caribou counted in the Parker core there were 25.0 calves/100 cows and 31.3 bulls/100 cows. In the Kiwigana core there were 60.0 calves/100 cows and 40.0 bulls/100 cows, however it was a small sample size of 10 caribou.
Nine of the 11 groups of caribou counted were found by locating a collared animal, while two groups did not have any collared animals and were counted incidentally while searching for collared animals.

Table 2 Results of October 2008 boreal caribou rut count in north east British Columbia.

Waypoint	Boreal Caribou Core	Total	Cow	Calf	Immature Male	Mature Male	Found with aid of collared animal	Radio collared animals in group
001	Parker Lake	10	5	4		1	Y	151.782
002	Parker Lake	2			2		N	none
003	Parker Lake	5	4			1	N	none
004	Parker Lake	1	1				Y	151.678
005	Parker Lake	4	3			1	Y	151.880
006	Parker Lake	3	3				Y	151.460
007	Kiwigana	2	1	1			Y	151.861
008	Kiwigana	1	1				Y	151.740
009	Kiwigana	3	1	1		1	N	151.821
010	Kiwigana	4	2	1		1	Y	151.701
012	Capot Blanc	1	1				Y	151.899

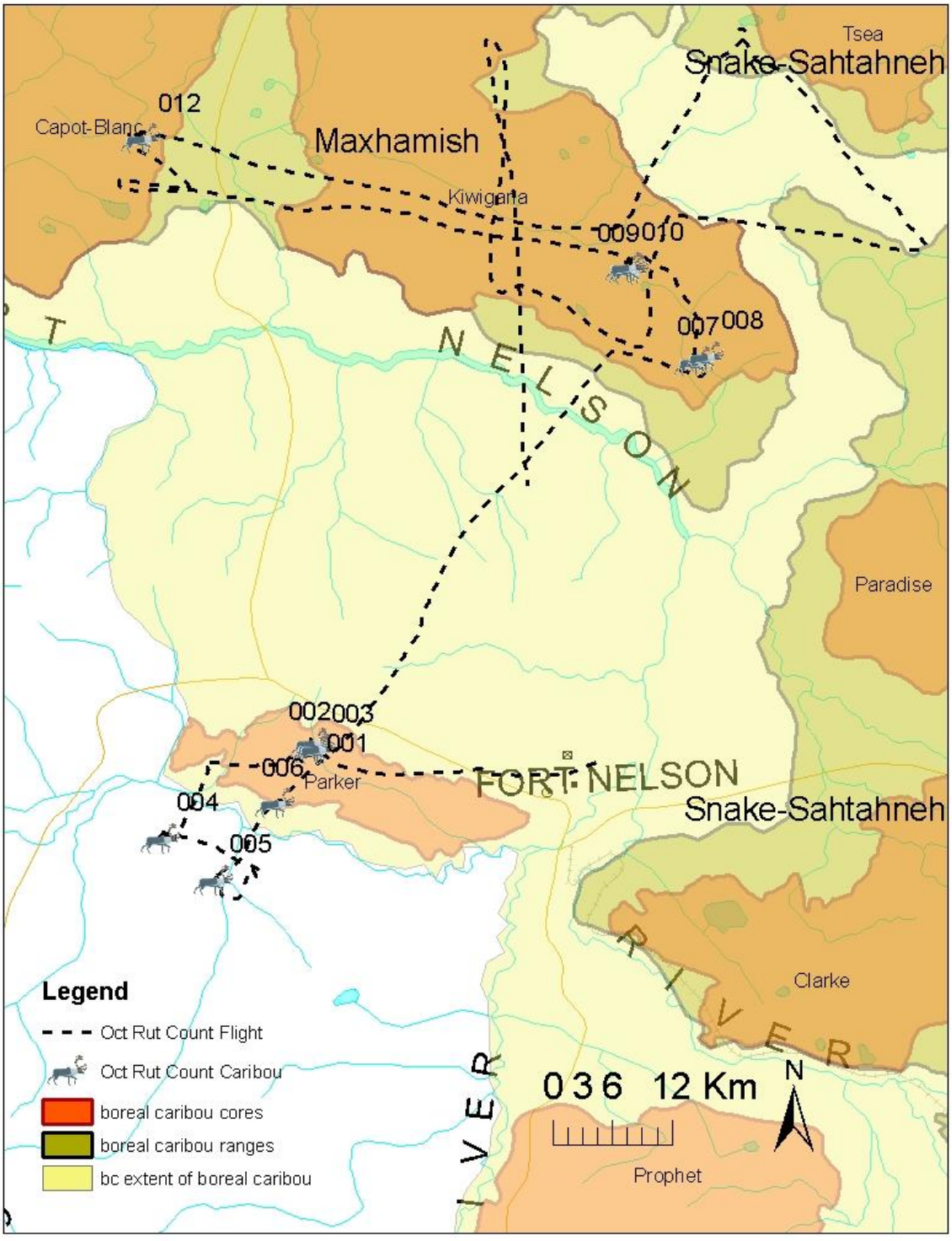

Figure 8 Flight route during the October 2008 boreal caribou rut count in northeast British Columbia. Labels beside caribou symbols are waypoint numbers associated with Table 2.

3.4 Industrial footprint

Three of the four caribou ranges (Figure 9) had greater than 61% anthropogenic disturbance (Table 3). Maxhamish, the fourth range, was close to the 61% threshold at 56.7% anthropogenic disturbance.

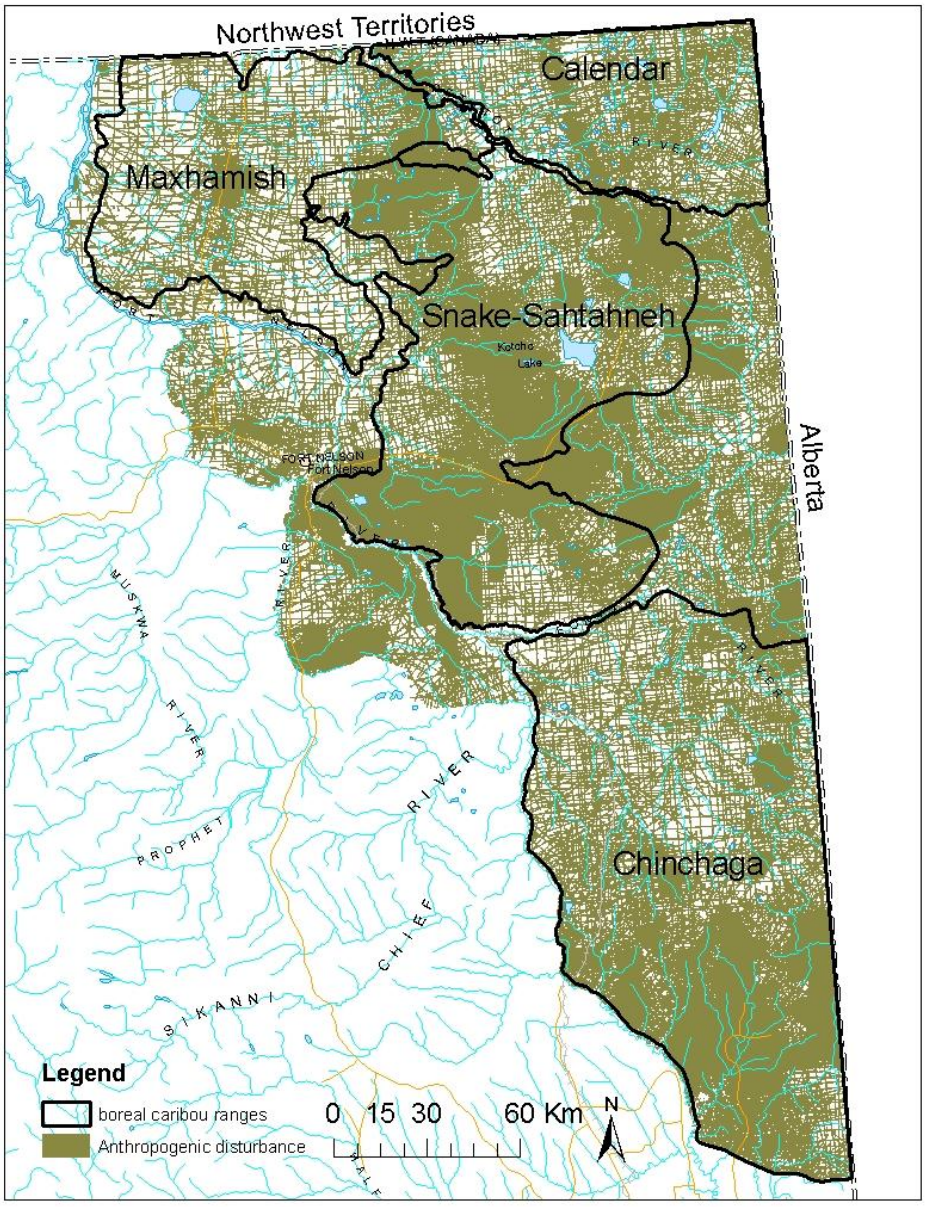

Figure 9 Anthropogenic disturbance in British Columbia boreal caribou ranges. Disturbance layer consists of all known seismic lines, roads, cut blocks, well sites, and pipelines buffered by 250 meters.

Table 3 Area (km^2) of boreal caribou ranges and anthropogenic disturbance within them, and the percent area impacted by disturbance. Ranges sorted from low to high percent impact. Bold numbers indicate ranges above the 61% threshold.

Range	Range area	Disturbance area	% Impacted
Maxhamish	7095	4020	56.7
Calendar	4962	3533	**71.2**
Chinchaga	13979	11012	**78.8**
Snake-Sahtahneh	11980	10043	**83.8**

Within the boreal caribou core areas (Figure 10) 12 of the 15 cores had anthropogenic disturbance levels above the 61% threshold (Table 4). The remaining three core areas all had greater than 50% disturbance. The range of disturbance levels was from 51.8% (Capot-Blanc core) to 96.0% (Tsea core).

Table 4 Area (km^2) of boreal caribou cores and anthropogenic disturbance within them, and the percent area impacted by disturbance. Core areas sorted from low to high percent impact. Bold numbers indicate ranges above the 61% threshold.

Core	Core area	Disturbance area	% Impacted
Capot-Blanc	875	453	51.8
Kiwigana	1301	678	52.1
Fortune	2662	1589	59.7
Etsho	62	38	**61.9**
Parker	224	152	**67.9**
Calendar	4962	3533	**71.2**
Paradise	403	289	**71.8**
North Kotcho	748	554	**74.0**
Etthithun	822	620	**75.4**
Prophet	915	716	**78.2**
East Kotcho	318	272	**85.4**
Milligan	4929	4560	**92.5**
Clarke	1381	1292	**93.5**
West Kotcho	362	342	**94.4**
Tsea	472	453	**96.0**

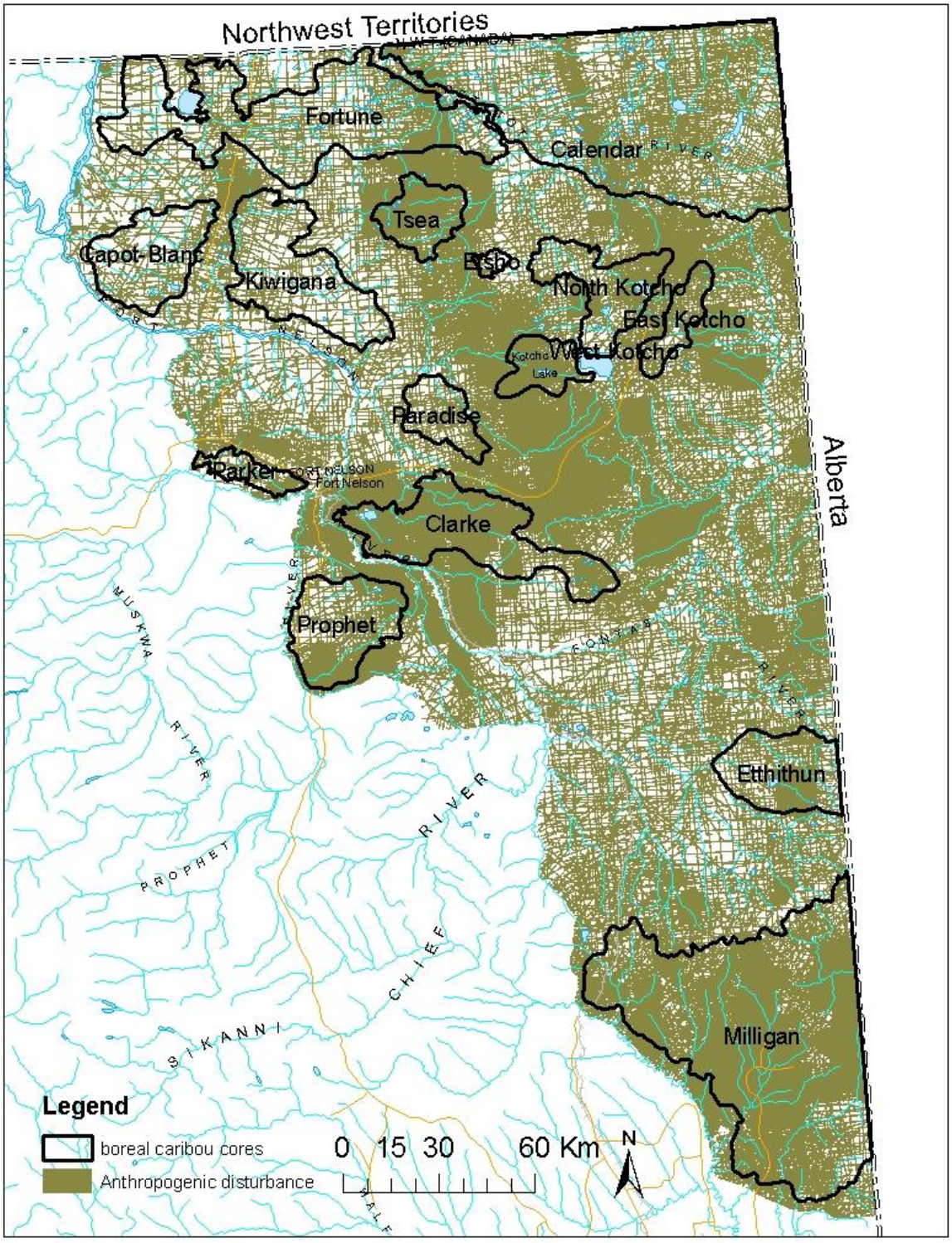

Figure 10 Anthropogenic disturbance in British Columbia boreal caribou cores. Disturbance layer consists of all known seismic lines, roads, cut blocks, well sites, and pipelines buffered by 250 meters.

4 Discussion

Effort was made to locate and collar caribou in the Fortune core area, however we were unable to locate any caribou groups. Our lack of success can partially be attributed to the size of the Fortune core, which is very large (2662 km^2), and the fact that we had less than one day of flight time allocated to searching the area. We received anecdotal reports from workers in the area that caribou are seen in the summer months south of Maxhamish Lake. It will be a priority for 2009/10 to collar caribou within the Fortune core.

The majority of collared caribou relocations were within core areas described by Culling et al. (2004), however two animals from the Parker core moved beyond the core area and assumed extent of boreal caribou in British Columbia. The two caribou moved south of the Muskwa River which was previously the boundary delineated for boreal caribou. The Parker core boundaries were developed using modelling based on collared caribou from other ranges in British Columbia and the data collected in this study can be used to refine the Parker core, as more data is collected it will be necessary to extend the range of the Parker Lake core south of the Muskwa River. No other movements of caribou collared from this project were to areas other than expected based on the work of Culling et al. (2004).

None of the collared caribou were known to have died during the first year of the study. One collar has been relocated in the same vicinity since it was deployed, but is not on mortality mode. It is possible the collar is malfunctioning and will be investigated.

Boreal caribou are very difficult to census accurately, however having a large number of collared animals allowed us to locate groups during the rut to obtain a minimum count. Caribou in the Parker Lake core had never been enumerated before, so the count of 25 was the best data collected to date, and provided the highest number of caribou known to be in the core. Given the size of the other core areas searched during the October rut count our numbers do not accurately represent the size of the population. Although population size estimates were not accurate, the classification data was useful for determining demography of the animals counted. The number of calves per 100 adult cows (31.8) was above the threshold of 28.9 calves:100 females for minimum recruitment to allow population persistence as outlined by Environment Canada (2008), however the count was not conducted in March which would be the true representation of calf recruitment. Given the small sample size used to calculate the calf:cow ratios our confidence in these numbers are lower than if more animals were observed. A priority for the coming year will be to conduct a March survey to determine over wintering success of calves and possibly a population estimate depending on funding.

The Horn River Basin planning area (Figure 11), which is completely within boreal caribou range, is an area of increasing interest and development for industry due to the large volumes of natural gas present within its boundaries. Record breaking sales of mineral tenures occurred throughout 2007 and 2008 (MEMPR 2007) indicating strong interest in the area by the oil and gas industry. Until recently, the gas was unavailable due to technological constraints, however new technology has allowed these resources to be

exploited. The Horn River Basin planning area as delineated in November 2008 was 7107 km^2 in area. Similar to the analysis used for boreal caribou cores and ranges, the level of anthropogenic disturbance within the Horn River Basin was examined. Of the 7107 km^2, over 63% (4489 km^2) of the area has already been disturbed by industry (Figure 11). There are three boreal caribou core areas within the Horn River Basin boundary, the Fortune, Kiwigana, and Tsea (Figure 12). The Tsea core has the highest level of anthropogenic disturbance of all cores in British Columbia, however the Kiwigana and Fortune are currently the least affected by industrial development.

The model developed by Sorensen et al. (2008) was based on data collected from boreal caribou in Alberta and has not been tested in British Columbia. However, given the close proximity of the research conducted in Alberta and the similarity of the habitats examined, a precautionary approach would suggest that similar effects are being experienced by boreal caribou in British Columbia. In order for boreal caribou to persist within the Horn River Basin, and British Columbia, the level of disturbance within the Maxhamish range, which includes the Kiwigana and Fortune core areas, should not be increased beyond 61%, and efforts should be made to restore habitat in highly effected ranges.

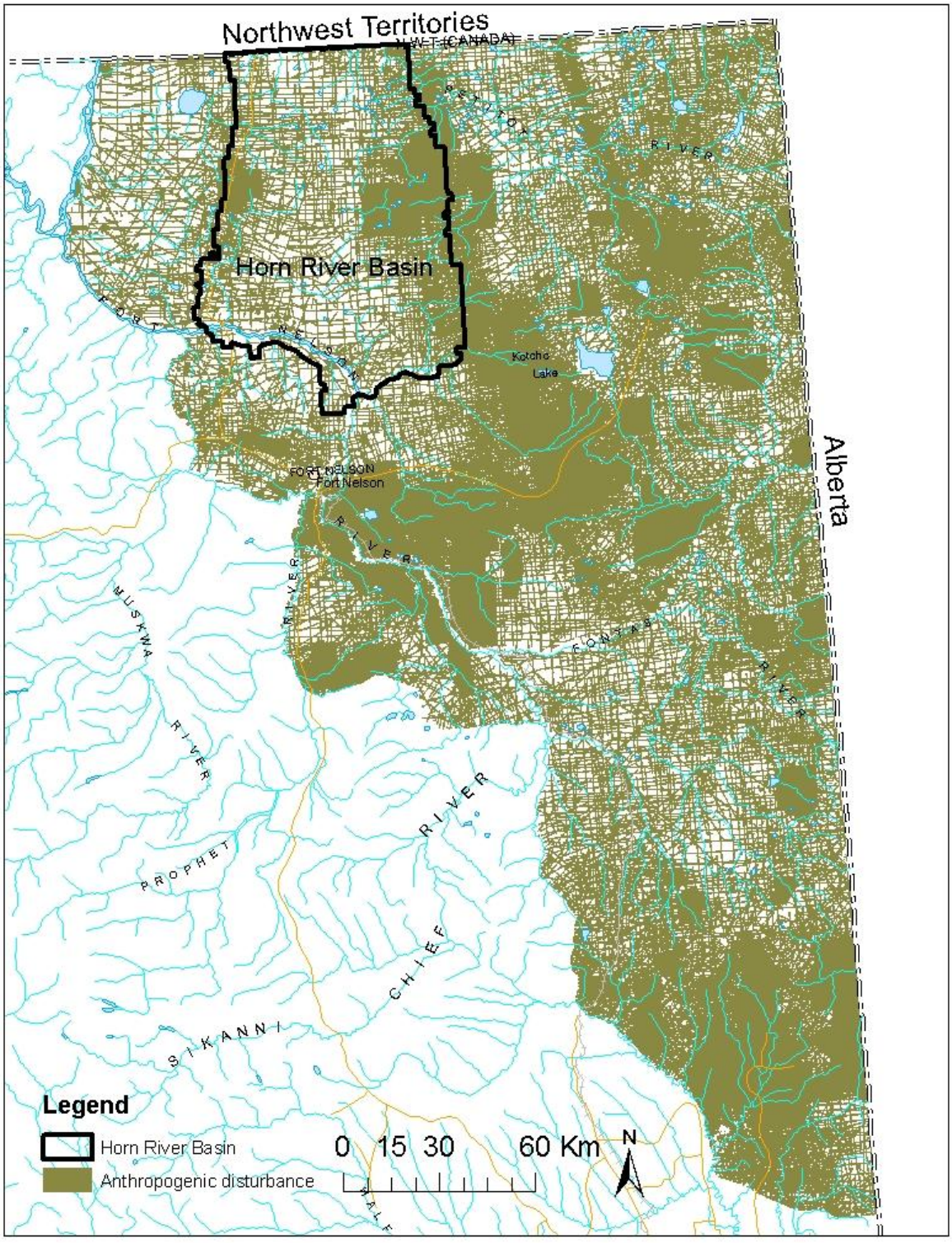

Figure 11 Anthropogenic disturbance within the Horn River Basin planning area. Disturbance layer consists of all known seismic lines, roads, cut blocks, well sites, and pipelines buffered by 250 meters.

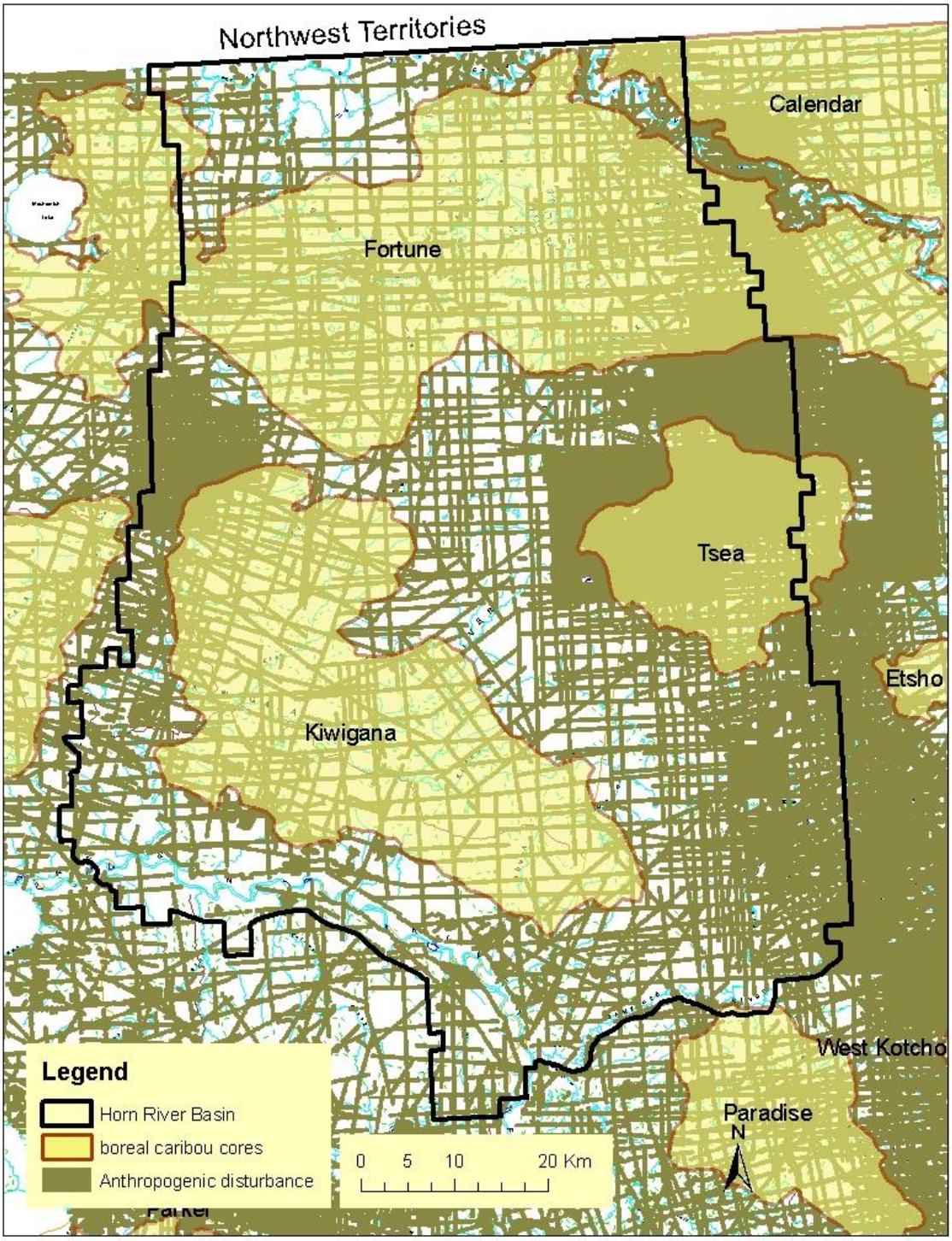

Figure 12 Locations of boreal caribou core areas within the Horn River Basin planning area, overlaid on anthropogenic disturbance layer.

5 Acknowledgements

Funding for this work was provided by the Ministry of Energy, Mines, and Petroleum Resources Environmental Stewardship Program. Capture work was conducted by Ministry of Environment wildlife biologists Rob Woods and Conrad Thiessen and pilot Cameron Allen of Qwest Helicopters Inc. Fixed wing telemetry was conducted by Jim Hart of YYE Enterprises in Fort Nelson. Nick Baccante, Gerald Kuzyk, and Dale Seip provided comments on draft versions of this report.

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7 Appendices

Appendix 1. Rut count data sheet.

Boreal Caribou Monitoring Rut Count

Pilot:_____
FL:_____
RL:_____
RR:_____

Date:_____ start:_____
stop:_____

Cloud Cover (/10):_____ Temp (°C):_____ Wind (kph):_____
Days since snow:_____ Snow Depth: (cm):___ Snow cover (%):_____

Comments:_____

Caribou WPT	Total	COW	CALF	Bulls I	Bulls Mature	Bulls Unclass bull	unk sex/age	found because of collar?	radio radio collars present (freqs)
Total									
Other Spp.									

MULE DEER

MOOSE

WHITE-TAIL

Appendix 2. RISC classification of caribou.

Juvenile	Calf	antlers (if any) are short (spikes) with velvet; darker body and smaller than adults
Female	Cow	small antlers 2-3 times the ear length; black vulval patch
Male	Yearling/Class 1	small antlers which are 2-3x the ear length; similar to females, but no vulval patch
	Class 2	antlers larger than females; antlers are lighter and smaller than Class III bulls; antlers without shovels
	Class 3	large, heavy-beamed antlered males; antlers with many points and a palmated brow tine; may have shovel with few points, but heavy beams

Appendix 3. Timeline of field activities.

March 2008 – 10 VHF collars deployed on boreal caribou
October 2008 – Rut count
November 2008 – Fixed-wing relocation flight
January 2009 – Fixed-wing relocation flight
March 2009 – Fixed-wing relocation flight
March 2009 – 8 GPS and 2 VHF collars deployed on caribou, 2 GPS and 1 VHF collar deployed on wolves

Appendix 4. Data sources for industrial footprint analysis.

Downloaded from OGC ftp site (ftp://www.ogc.gov.bc.ca/outgoing/OGC_Data/) on November 6, 2008:

Well sites: awsh_bc

Seismic: Agphys2002_2006, Agphys1996_2004, Ageo_bc

Roads: Aapr_bc, Apdr_bc, Syd_road

Pipelines: Apipe_gdm

Horn River Basin: Aten_hrb

Downloaded from Integrated Land Management Bureau Land and Resource Data Warehouse (http://www.lrdw.ca/) on November 14, 2008.

Forestry roads: WHSE_FOREST_TENURE.FTEN_ROAD_LINES

Forestry cutblocks: WHSE_FOREST_TENURE.FTEN_CUT_BLOCK_POLYGONS

Other linear features: WHSE_BASEMAPPING.TRIM_MISCELLANEOUS_LINES

Appendix 5. Collar relocation data for boreal caribou in north-east BC for March 2008 to March 2009. For the Observer column RW = Rob Woods, CT = Conrad Thiessen, JH = Jim Hart.

Date	Flight	Frequency	Caribou ID	Status	With calf	Visual	Lat	Long	Group size	Observer	Comments
16-Oct-08	2008 rut count	151.460	BC1000	alive	no	yes	58.80690	-123.17346	3	RW,CT	
16-Oct-08	2008 rut count	151.782	BC1001	alive	yes	yes	58.86073	-123.10771	8	RW,CT	
16-Oct-08	2008 rut count	151.678	BC1002	alive	no	yes	58.77933	-123.37575	1	RW,CT	
16-Oct-08	2008 rut count	151.880	BC1003	alive	no	yes	58.73981	-123.28576	3	RW,CT	
16-Oct-08	2008 rut count	151.899	BC1004	alive	unknown	no	59.41402	-123.36283		RW,CT	
16-Oct-08	2008 rut count	151.861	BC1005	alive	yes	yes	59.18957	-122.40554	2	RW,CT	
16-Oct-08	2008 rut count	151.821	BC1006	alive	yes	yes	59.27627	-122.51227	2	RW,CT	
16-Oct-08	2008 rut count	151.620	BC1007		unknown	no				RW,CT	not located on this flight
16-Oct-08	2008 rut count	151.740	BC1008	alive	no	yes	59.19383	-122.38670	1	RW,CT	
16-Oct-08	2008 rut count	151.701	BC1009	alive	yes	yes	59.27846	-122.51848	4	RW,CT	
16-Nov-08	Nov 08 fixed wing	151.460	BC1000	alive	unknown	yes	58.83007	-123.00563	7	JH	
16-Nov-08	Nov 08 fixed wing	151.782	BC1001	alive	yes	yes	58.82657	-123.14370	4	JH	
16-Nov-08	Nov 08 fixed wing	151.678	BC1002	alive	unknown	yes	58.83743	-122.14370	6	JH	
16-Nov-08	Nov 08 fixed wing	151.880	BC1003		unknown	no				JH	Not located on this flight
16-Nov-08	Nov 08 fixed wing	151.899	BC1004	alive	unknown	no	59.41565	-123.36310		JH	
16-Nov-08	Nov 08 fixed wing	151.861	BC1005	alive	unknown	yes	59.15762	-122.31305	10	JH	with 151.740
16-Nov-08	Nov 08 fixed wing	151.821	BC1006	alive	unknown	no	59.24293	-122.31545		JH	
16-Nov-08	Nov 08 fixed wing	151.620	BC1007	alive	unknown	no	59.11722	-122.34852		JH	
16-Nov-08	Nov 08 fixed wing	151.740	BC1008	alive	unknown	yes	59.15762	-122.31305	10	JH	
16-Nov-08	Nov 08 fixed wing	151.701	BC1009	alive	unknown	yes	59.28762	-122.47708	2	JH	probably cow with calf
17-Jan-09	Jan 08 fixed wing	151.460	BC1000	alive	no	yes	58.85612	-123.12390	1	JH	SE side Evie Lake
17-Jan-09	Jan 08 fixed wing	151.782	BC1001	alive	unknown	yes	58.81003	-123.04971	3	JH	between Evie and Parker Lakes
17-Jan-09	Jan 08 fixed wing	151.678	BC1002	alive	unknown	yes	58.77691	-122.97530	10	JH	in same group as 151.880
17-Jan-09	Jan 08 fixed wing	151.880	BC1003	alive	unknown	yes	58.77889	-122.98100	10	JH	in same group as 151.678
17-Jan-09	Jan 08 fixed wing	151.899	BC1004	alive	unknown	no	59.41487	-123.36196		JH	timber very close to previous relocation
17-Jan-09	Jan 08 fixed wing	151.861	BC1005	alive	unknown	no	59.20192	-122.44484		JH	in the timber
17-Jan-09	Jan 08 fixed wing	151.821	BC1006	alive	unknown	no	59.26936	-122.48831		JH	
17-Jan-09	Jan 08 fixed wing	151.620	BC1007	alive	unknown	no	59.11431	-122.34918		JH	in light timber, no tracks seen
17-Jan-09	Jan 08 fixed wing	151.740	BC1008	alive	unknown	yes	59.20693	-122.42229	5	JH	light timber, at least 5 in group

17-Jan-09	Jan 08 fixed wing	151.701	BC1009	alive	yes	yes	59.28687	-122.51859	2	JH	
19-Mar-09	Mar 09 fixed wing	151.460	BC1000	alive	unknown	no	58.84087	-123.07434		JH	SE of Evie Lake
19-Mar-09	Mar 09 fixed wing	151.782	BC1001	alive	unknown	no	58.85641	-123.12164		JH	SE of Evie Lake
19-Mar-09	Mar 09 fixed wing	151.678	BC1002	alive	unknown	no	58.78143	-122.92349		JH	S of Parker Lake
19-Mar-09	Mar 09 fixed wing	151.880	BC1003	alive	unknown	no	58.82424	-123.08894		JH	SE of Evie Lake
19-Mar-09	Mar 09 fixed wing	151.899	BC1004	alive	unknown	no	59.40942	-123.36722		JH	at or very near last location
19-Mar-09	Mar 09 fixed wing	151.861	BC1005	alive	unknown	no	59.18696	-122.41105		JH	Kiwigana
19-Mar-09	Mar 09 fixed wing	151.821	BC1006	alive	unknown	no	59.26935	-122.50510		JH	Kiwigana
19-Mar-09	Mar 09 fixed wing	151.620	BC1007	alive	unknown	no	59.10671	-122.33389		JH	Kiwigana
19-Mar-09	Mar 09 fixed wing	151.740	BC1008	alive	unknown	no	59.27282	-122.51073		JH	Kiwigana
19-Mar-09	Mar 09 fixed wing	151.701	BC1009	alive	unknown	no	59.29546	-122.49354		JH	Kiwigana
19-Mar-09	Mar 09 fixed wing	149.678	BC1010	alive	unknown	no	58.80099	-122.86034		JH	SE of Parker Lake
19-Mar-09	Mar 09 fixed wing	149.780	BC1011							JH	not located at or near capture site
19-Mar-09	Mar 09 fixed wing	149.255	BC1012	alive	unknown	no	58.82446	-123.06357		JH	SE of Evie Lake
19-Mar-09	Mar 09 fixed wing	149.350	BC1013	alive	unknown	no	59.41554	-123.36483		JH	N of Patry Lake
19-Mar-09	Mar 09 fixed wing	148.040	BC1014	alive	unknown	no	59.41554	-123.36483		JH	N of Patry Lake
19-Mar-09	Mar 09 fixed wing	148.109	BC1015	alive	unknown	no	59.41554	-123.36483		JH	N of Patry Lake
19-Mar-09	Mar 09 fixed wing	149.330	BC1016	alive	unknown	no	59.27795	-122.53284		JH	Kiwigana
19-Mar-09	Mar 09 fixed wing	149.779	BC1017	alive	unknown	no	59.27795	-122.53284		JH	Kiwigana
19-Mar-09	Mar 09 fixed wing	149.320	BC1018	alive	unknown	no	58.20595	-122.10485		JH	NE of Klua Lakes;
19-Mar-09	Mar 09 fixed wing	149.668	BC1019	alive	unknown	no	58.35384	-122.28927		JH	no signal heard until 11:25
19-Mar-09	Mar 09 fixed wing	149.597	CALU1001								not searched for on this flight
19-Mar-09	Mar 09 fixed wing	150.272	CALU1002								not searched for on this flight
19-Mar-09	Mar 09 fixed wing	148.142	CALU1003								not searched for on this flight

Appendix 6. Photos of boreal caribou range in British Columbia.

Plate 1. Undisturbed boreal caribou habitat within the Horn River Basin planning area, October 2008.

Plate 2. Industry camp in boreal caribou range in British Columbia, October 2008.

Plate 3. Drilling rig in boreal caribou range in British Columbia, October 2008.

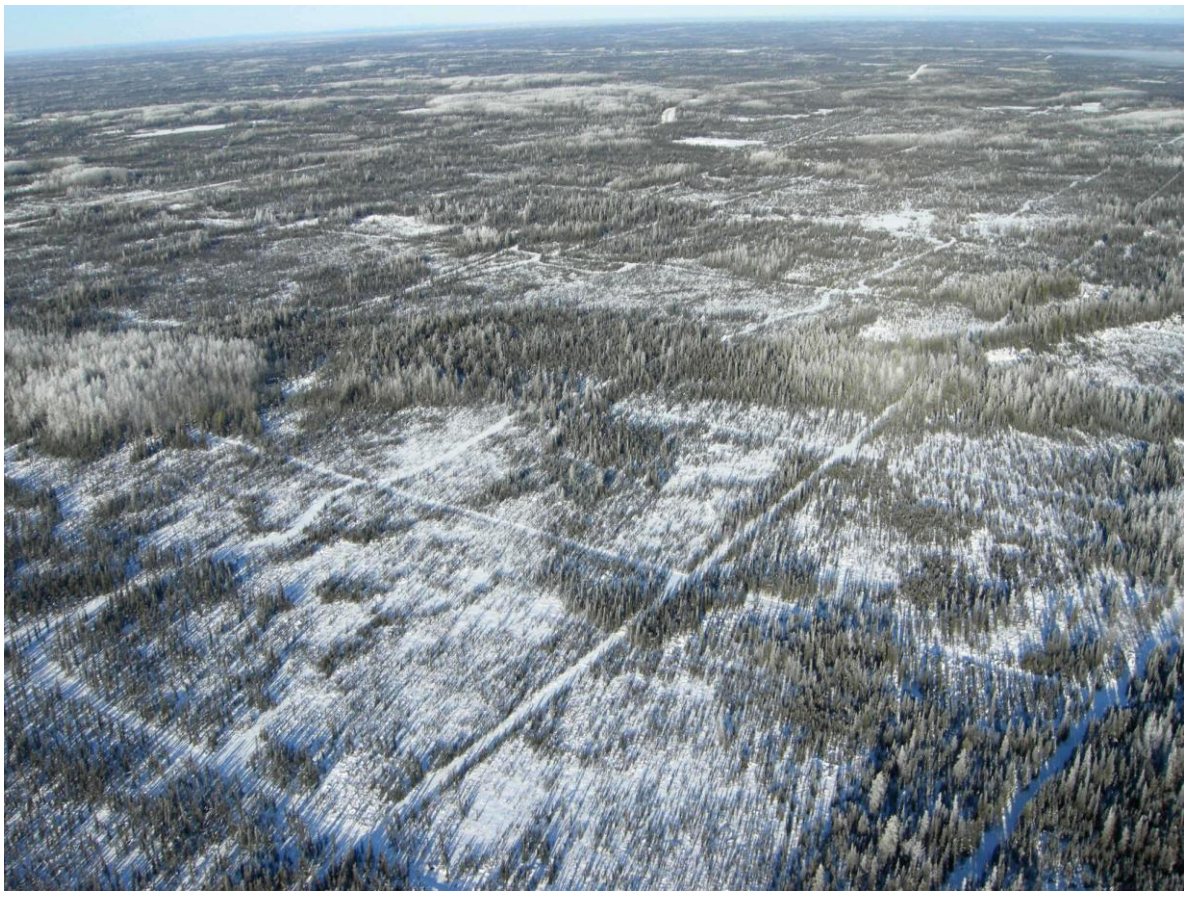

Plate 4. Existing linear disturbance within the Horn River Basin planning area, March 2009.