2016

BC Boreal Caribou Implementation Plan: Year IV (2015-2016) Field Activities Progress Report



Diane E. Culling, R.P. Bio., and Brad A. Culling, R.P. Bio.

Diversified Environmental Services Fort St. John, British Columbia

July 2016

BC Boreal Caribou Implementation Plan: Year IV (2015-2016) Field Activities Progress Report

Prepared for BC Oil and Gas Research and Innovation Society Victoria, BC

> Prepared by Diane E. Culling, R.P. Bio and Brad A. Culling, R.P. Bio Diversified Environmental Services Fort St. John, BC

> > July 2016

Acknowledgements

This project was initiated by the *Research and Effectiveness Monitoring Board* (REMB) and administered and funded through the BC Oil and Gas Research and Innovation Society (OGRIS; *formerly the* Science and Community Environmental Knowledge Fund (SCEK))¹. Direction was provided by REMB board members Megan Watters (MFLNRO) and Steve Wilson (EcoLogic Research). Thanks to Brian Thomson (OGRIS) for administering the project. Provincial Wildlife Veterinarian Dr. Helen Schwantje (MFLNRO) and Dr. Bryan Macbeth (University of Calgary) advised on the health aspects of the study.

British Columbia's boreal caribou ranges fall within the traditional lands of the Treaty 8 First Nations; we appreciate the continued support of the Treaty 8 Chiefs and Communities for this project. We, once again, enjoyed the capable assistance of Eva Needlay and William Needlay, of the Fort Nelson First Nation, during 2015-2016 field activities.

The project has benefitted from excellent aerial support since its inception in 2012. Thanks to Zonk Dancevik and Cam Allen, owners of Qwest Helicopters, Fort Nelson, and Dave Verbisky, owner of Trek Aerial Surveys, Fort St. John, for always accommodating our flying needs and providing us with top-notch pilots. Qwest pilot Tom Henderson was responsible for flying all caribou and wolf captures and late winter recruitment surveys in the winter of 2015-2016. Qwest pilots Tom Henderson and Blair Wilson flew mortality site investigations in 2015-2016. Fixed-wing telemetry flights were flown by Dave Verbisky, Jason Holland, and Emmanuel Cadieux of Trek.

John Cook (National Council for Air and Stream Improvement, Forest & Range Sciences Lab, La Grande, OR) participated in caribou and wolf capture. Ted Euchner and Mac Culling, of Diversified Environmental Services, and Matt Mumma (UNBC) also assisted in mortality site investigations.

Jason Shaw and Sharyn Alexander of Caslys Consulting, Victoria, provided GPS data support. Susan Cook of Prairie Diagnostic Services, University of Saskatchewan, Saskatoon, performed the serum progesterone analysis.

Cover photo - Processing caribou SCEK239, February 27, 2016 (photo by B. Culling).

¹The use of the term SCEK appears throughout this report for consistency with Year I to Year III progress reports.

EXECUTIVE SUMMARY

The boreal ecotype of woodland caribou (*hereafter*, boreal caribou) is listed as *Threatened* by the Committee on the Status of Endangered Wildlife in Canada and is on the provincial red list in British Columbia (BC). The *Implementation Plan for the Ongoing Management of Boreal Caribou* (*Rangifer tarandus caribou pop. 14*) *in British Columbia* (BCIP; MOE 2011) addresses provincial commitments to manage boreal caribou within the province.

Between December 2012 and March 2016, 240 individual boreal caribou were radio-collared in British Columbia's boreal caribou ranges as part of the BCIP. Several caribou were captured multiple times over the course of the project, for a total of 262 individual capture events. One capture-related mortality occurred in December 2014. Based on a total of 262 captures of 240 individual caribou, the overall capture-related mortality rate for the project was 0.38 %.

Field activities conducted in Year IV (May 1, 2015-April 30, 2016) included continued monthly fixed-wing telemetry monitoring flights and mortality site investigations, the deployment of additional radio-collars to maintain the sample of collared caribou and wolves, and a late winter caribou recruitment survey.

At the beginning of Year IV, a total of 155 radio-collared caribou were potentially active in BC's boreal caribou ranges, including 150 SCEK-collared caribou (*hereafter*, SCEK caribou), 3 animals previously collared by the BC Ministry of Forests, Lands, and Natural Resource Operations (MFLNRO), and 2 collared by Alberta Environment and Parks (AEP; formerly Alberta Sustainable Resource Development).

Eighteen SCEK caribou mortalities were detected and investigated between May 1, 2015 and April 30, 2016, including 14 cases of confirmed wolf predation. One caribou died in mid-summer of apparent poor condition/disease. Two caribou were shot in separate events, in September 2015 and April 2016, along the Coles Lake Road, which bisects peatland habitat in the Fortune Core Habitat Area (Core) of the Maxhamish Range. The circumstances surrounding both cases suggest that the animals were legally harvested by First Nations community members of nearby Fort Liard, NT. The cause of death for the remaining animal could not be determined.

The standardized annual finite survival rate for 168 adult females during the 12 month period between May 1, 2015 and April 30, 2016 was 0.87 ± 0.03 SE (95% C.I.= 0.83 to 0.93).

iv

Between February 16 and 27, 2016, we deployed 21 additional Vectronic GPS radio-collars on boreal caribou, including 6 animals recaptured to replace collars nearing the end of their battery life and 15 new caribou. Serum progesterone analysis indicated 20 of 21 (95%) adult female caribou captured in February 2016 were pregnant, with the 21st animal likely pregnant (progesterone 1.78 ng/ml).

In February 2016, we deployed 4 Lotek Iridium GPS wolf collars within 3 boreal caribou cores on 2 new and 2 recaptured animals, including a new pack located in the Chinchaga RRA.

Late winter recruitment surveys were conducted for all herds between March 14 and 30, 2016. A total of 728 boreal caribou (515 females, 108 males, 103 calves, 2 unclassified adults) were recorded in 129 groups, including 14 unmarked groups located incidentally and 9 groups (52 caribou) associated with SCEK caribou located north of the BC/NT border. Mean group size was 5.7 ± 3.4 SD (range 1 to 17). Overall calf recruitment to 10 months in March 2016 was 20 calves:100 cows, with calves representing 14% of the minimum count.

2012-2016 Project Summary

At the end of Year IV (April 30, 2016), 146 caribou collars remained active within BC's boreal caribou ranges. Excluding the Fort Nelson Core, the active collars represent between 16% and 32% of the minimum number of caribou counted by range during the 2016 recruitment survey.

Of 261 individual capture events of adult female caribou between December 2012 and March 2016, serum progesterone analysis confirmed the pregnancy status of 249 animals, with results for the remaining 12 animals inconclusive. Based on these 249 caribou, the overall pregnancy rate for the study was 89%.

The occurrence of winter ticks on boreal caribou is becoming increasingly common as the parasite appears to be undergoing a northward range expansion. Based on 262 individual capture events over 4 years, 79% of caribou had some degree of hair loss or breakage at the time of capture. Adult ticks were observed on 47 of 262 animals, including 4 caribou that had no sign of hair loss or breakage and 12 animals with only mild guard hair breakage. Adult ticks were found on 20 of 36 caribou (56%) with hair loss categorized as Severe or Extreme; all 20 animals were captured between late February and April 1. Hair loss resulting from rubbing to relieve tick-related irritation, as well as time and energy spent grooming over foraging, may affect boreal caribou condition, particularly during extended periods of

v

cold weather in late winter. Warble larvae were found on 9 of 262 caribou captured; all incidents were in late winter, between February 27 and April 1.

We investigated a total of 104 boreal caribou mortalities (88 SCEK, 7 MFLNRO, 9 uncollared) between commencement of BCIP monitoring in December 2012 and the end of April 2016, including 72 confirmed and 7 suspected incidents of wolf predation and 3 cases of wolverine predation. One caribou died accidentally, and 5 died as a result of poor condition or disease. Two caribou were harvested and the cause of death for the remaining 14 animals could not be determined.

Based on the 2016 overall recruitment (i.e., all ranges combined) of 20 calves:100 cows and the 2015-2016 standardized finite adult female survival rate of 0.87, lambda equals 0.97, suggesting the current status of BC's boreal caribou population is slightly declining.

Table of Contents

Acknowled	gementsiii								
EXECUTIVE	SUMMARY iv								
Table of	Table of Contents vii								
List o	List of Tablesix								
List o	f Figuresix								
List o	f Platesx								
1	INTRODUCTION1								
2	METHODS1								
2.1	Study Area1								
2.2	Capture and Collar Deployment4								
2.2.1	Caribou Capture4								
2.2.2	Wolf Capture5								
2.3	Telemetry Monitoring and Mortality Site Investigations6								
2.4	Late Winter Recruitment Survey7								
3	RESULTS7								
3.1	Year IV Capture and Collar Deployment7								
3.1.1	Year IV Caribou Capture7								
3.1.2	Year IV Wolf Telemetry and Collar Deployment9								
3.2	Year IV Telemetry Monitoring and Mortality Site Investigations10								
3.3	Year IV Caribou Late Winter Recruitment Survey12								
3.3.1	Incidental Observations18								
4	PROJECT SUMMARY AND DISCUSSION19								
4.1	Recommendations28								
REFERENC	ES								

APPENDICES
Appendix I: Boreal caribou capture and radio collar deployment summary, February 16-27, 2016,
(<i>n</i> =21)32
Appendix II: Pregnancy status of boreal caribou captured in northeastern British Columbia,
February 16-27, 2016 (n=21)
Appendix III: Wolf capture data (abridged), northeastern British Columbia, December 2015 to
March 2016 (<i>n</i> =4)34
Appendix IV: Chinchaga Range late winter recruitment survey, March 14, 2016
Appendix V: Chinchaga RRA late winter survey, March 28, 2016
Appendix VI: Snake-Sahtaneh Range late winter survey, March 23-24, 201640
Appendix VII: Calendar Range late winter survey, March 30, 201645
Appendix VIII: Maxhamish Range late winter survey, March 29-30, 2016
Appendix IX: Prophet Range late winter survey, March 28, 201651
Appendix X: Parker Range late winter survey, March 23, 201652
Appendix XI: Fort Nelson Core late winter survey, March 29, 2016

List of Tables

Table 1.	Results of 2016 boreal caribou late winter recruitment survey, including age-sex composition, calves per 100 cows, and group size by range, northeastern British Columbia, March 14-	
	30, 20161	4
Table 2.	Proportion of boreal caribou collared by range at the end of Year IV (April 30, 2016), based on	
	March 2016 recruitment survey minimum counts1	9
Table 3.	Age structure and neck circumference of radio-collared female boreal caribou by broad age	
	class, northeastern British Columbia, December 2012-February 2016 (n = 261)	0
Table 4.	Extent of hair breakage and rubbing observed on boreal caribou between December 17, 2012	
	and April 30, 2016, northeastern British Columbia (n=262)	2
Table 5.	Proportion of boreal caribou with adult winter tick infestation by hair loss category,	
	northeastern British Columbia, December 17, 2012 to February 27, 2016 (n=262) 2	2
Table 6.	Standardized finite annual survival of radio-collared adult female boreal caribou in	
	northeastern British Columbia, May 1, 2013 to April 30, 2016 (based on the Kaplan-Meier	
	staggered entry design)2	3
Table 7.	Comparison of annual calf recruitment (calves:100 cows) in boreal caribou ranges based on	
	March 2013 through March 2016 SCEK late winter surveys, northeastern British Columbia 2	8

List of Figures

Figure 1. Boreal caribou ranges and core habitat areas in British Columbia (from MOE 2010); proposed	1
Fort Nelson core habitat area (FN) not shown	3
Figure 2. Helicopter search lines and capture locations for 21 boreal caribou radio-collared in	
northeastern British Columbia between February 16-27, 2016.	8
Figure 3. Source of radio-collared boreal caribou mortality by month for Year IV, May 1, 2015 to	
April 30, 2016, northeastern British Columbia (n=18).	11
Figure 4. Helicopter flight lines and location of boreal caribou groups observed during late winter	
recruitment survey, northeastern British Columbia, March 14-30, 2016	13
Figure 5. Incidence of boreal caribou mortalities by month, northeastern British Columbia, November	
27, 2012 to April 30, 2016 (<i>n</i> =103)	24
Figure 6. Cause of boreal caribou deaths by year, northeastern British Columbia, November 27, 2012 t	0
April 30, 2016 (<i>n</i> =104)	24
Figure 7. Proportion of annual boreal caribou mortalities by cause of death for Year II (May 1, 2013-Ap	ril
30, 2014), Year III (May 1, 2014-April 30, 2015), and Year IV (May 1, 2015-April 30, 2016),	
northeastern British Columbia, (n=85)	26
Figure 8. Incidence of boreal caribou mortalities caused by wolves, by month, northeastern British	
Columbia, December 17, 2012 to April 30, 2016 (<i>n</i> =78)	26

List of Plates

Plate 1.	Examples of categories used to describe hair loss/breakage observed on boreal caribou
	captured in northeastern British Columbia between December 2012 and March 201621
Plate 2.	Maxhamish caribou BC1064; Mortality Investigation #001, December 18, 2012; Kiwigana Core
	(UTM 10.523249.6574077); laboratory necropsy results indicated caribou died of poor
	condition27
Plate 3.	Emaciated body of SCEK171; Mortality Investigation #092; July 16, 2015; Chinchaga RRA
	(UTM 10.598152 6411225)

1 INTRODUCTION

Boreal ecotype woodland caribou (population #14; Designatable Unit DU6) are red-listed in British Columbia (BC) and designated as *Threatened* under the federal *Species at Risk Act* (COSEWIC 2011, Environment Canada 2011). In 2010, the *Implementation Plan for the Ongoing Management of Boreal Caribou (Rangifer tarandus caribou pop. 14) in British Columbia* (BCIP) was prepared to address Provincial commitments to manage and/or recover species at risk under the *Accord for the Protection of Species at Risk in Canada* and the *Canada-British Columbia Agreement on Species at Risk* (MOE 2011). The BCIP outlines several objectives to allow long-term (50 years) recovery of boreal caribou populations, including: protecting and restoring habitat, managing the industrial footprint, establishing industry standard management practices, as well as mitigating effects of the industrial footprint by reducing predators and managing habitat conditions through fire suppression. These objectives are designed to provide measurable targets for action and evaluation to ensure population and distribution goals are being achieved.

As a component of the BCIP, 240 adult caribou (239F, 1M) were radio-collared in British Columbia's boreal caribou ranges between December 2012 and April 2016. Throughout Year IV (May 1, 2015 to April 30, 2016), the fate of these animals, as well as boreal caribou previously collared by the BC Ministry of Forests, Lands, and Natural Resource Operations (MFLNRO) and Alberta Environment and Parks (AEP), was monitored to track adult survival and calf recruitment.

This report provides details of field activities conducted during Year IV the of project, including monthly fixed-wing telemetry monitoring flights, mortality site investigations, maintenance of the sample of radio-collared caribou and wolves through the deployment of new collars, and a late winter recruitment survey. As well, results from Years I through IV (December 2012 to April 2016) of boreal caribou capture and radio-collar deployment are summarized.

2 METHODS

2.1 Study Area

Boreal caribou occur in the northeastern corner of BC, in an area bounded by the Northwest Territories (NT) border (N60° latitude) to the north, the Alberta (AB) border (W120° longitude) to the east, the

northern Rocky Mountain foothills to the west (roughly W124°), and the northern limit of the agricultural zone to the south (roughly N57°; Fig. 1). Four major boreal caribou ranges are currently delineated within BC, including the Chinchaga (CHIN), Snake-Sahtaneh (SNS), Calendar (CLN), and Maxhamish (MAX). An additional 3 smaller areas of boreal caribou occupancy are currently defined as the Prophet (PPH) and Parker (PRK) ranges (MOE 2010) and the proposed Fort Nelson Core (FN). Within the ranges, 17 associated core habitat areas² (*hereafter*, cores) are defined as areas of high current capability and suitability based on general habitat requirements (i.e., treed peatlands, terrestrial and arboreal lichen forage base; Culling et al. 2004).

The Chinchaga Range lies within the Boreal Plains (BOP) ecoprovince, with the remaining BC boreal ranges in the Taiga Plains (TAP) ecoprovince. All ranges are represented by the Boreal White and Black Spruce (BWBS) biogeoclimatic zone. The BC ranges are drained by several major tributaries of the Peace and Liard rivers, including the Beatton, Chinchaga, Fontas, Sikanni Chief, Fort Nelson, and Petitot rivers.

The establishment of *Resource Review Areas* (RRA) is one of several policy tools developed to support the management of BC's boreal caribou populations. In June 2010, 4 RRAs were established, including RRA-A, in the northwestern portion of the Chinchaga Range, RRA-B, which overlaps portions of the Prophet Range, and RRA-C and RRA-D, in the western and eastern portions of the Calendar Range, respectively (Fig. 2). For the field component of this project, the Chinchaga RRA (RRA-A) is typically treated as a separate entity from the Chinchaga Range as it is relatively remote from the main areas of caribou activity in the Milligan and Etthithun cores and is accessed via helicopter from Fort Nelson. A minimum 5-year moratorium on issuing new oil and gas tenures within RRAs was established in 2010, with the effectiveness of the measure evaluated in 2015; future management direction is pending.

²The 17 core habitat areas include Calendar, Prophet and Parker, which are considered both ranges and cores.



Figure 1. Boreal caribou ranges and core habitat areas in British Columbia (from MOE 2010); proposed Fort Nelson core habitat area (FN) not shown.

2.2 Capture and Collar Deployment

2.2.1 Caribou Capture

We based caribou and wolf capture operations out of the Fort St. John airport for the Milligan and Etthithun Cores of the Chinchaga Range and from the Fort Nelson airport for the Chinchaga RRA and all other ranges and cores.

Year IV collar deployment effort was focused on recapturing caribou to replace existing GPS radio-collars nearing the end of their battery life and rebalancing the sample of radio-collared animals in individual ranges. As in previous years, we looked for opportunities to deploy collars in areas outside established cores or where there is little existing information on caribou use.

We complied with British Columbia Resources Inventory Committee guidelines (RIC 1998a, RIC 1998b) for all caribou and wolf capture and handling protocols. We captured adult boreal caribou using a handheld net-gun fired from a Bell 206B Jet Ranger helicopter. We assigned a sequential identification number to each collared caribou in the field (e.g., SCEK001). An alphabetic suffix was added to existing animal ID numbers to identify SCEK-collared caribou recaptured for collar replacement (e.g., SCEK001B).

We fitted all caribou captured in Year IV with Vectronic Vertex Survey GlobalStar (Vectronic Aerospace, Berlin, Germany) GPS/satellite collars. The collars were factory programmed to acquire GPS fixes every 13 hours and transmit VHF signals from 0700-1900 hours (GMT-7). GPS/satellite collars were equipped with motion sensitive mortality sensors designed to transmit a satellite alert message as well as activate a distinctive VHF pulse pattern. We marked captured caribou with multi-coloured, plastic ear tags with contrasting coloured buttons to allow for subsequent identification in the event of recapture after collar detachment and to aid in identification of individuals during aerial surveys.

We collected hair, fecal, and blood samples from all caribou captured in Year IV. Nasal swabs were taken from a subsample of caribou to test for the herpes virus. We measured caribou neck circumference, mandible length, and hind foot and metatarsal length. We assigned caribou to broad age classes based on body size, antler configuration, and incisor wear. We examined caribou for evidence of parasites, including winter ticks (*Dermacentor albipictus*), warble fly (*Hypoderma* sp.) larvae, and *Besnoitia tarandi* cysts, as well as other signs of disease or injury.

4

We created a novel classification system to describe the occurrence and extent of hair loss and/or breakage, and assigned caribou to 5 categories, including: 1) None - no evidence of hair loss/breakage or exposed skin, 2) Mild - a few small to medium patches of guard hair breakage, 3) Moderate - several or large patches of hair loss/breakage but no exposed skin, 4) Severe - several or large patches of hair loss/breakage but no exposed skin, 4) Severe - several or large patches of hair loss/breakage with exposed skin, and 5) Extreme - extensive areas of hair loss/breakage with multiple or large areas of exposed skin.

We classified female antlers into 6 broad categories: 1) Bald, 2) Spike, 3) Branched-Small (small 2-3 pt), 4) Branched-Medium (tall/heavy 2 pt (> 25 cm tall) or 3-4 pt), 5) Branched-Large (tall/heavy 4 pt or \ge 5 pt), and 6) Atypical (one antler, stubby or deformed antlers).

We separated blood serum by centrifuge and sent a 1.5 ml serum sample to Prairie Diagnostic Services (University of Saskatchewan, Saskatoon, SK) for serum progesterone analysis. We delivered the remainder of the blood serum and all other samples collected to Dr. Helen Schwantje (MFLNRO) and Dr. Bryan Macbeth (University of Calgary).

Dr. John Cook (National Council for Air and Stream Improvement, Forest & Range Sciences Lab (NCASI), La Grande, OR) accompanied the capture crew for all 2016 capture sessions to assess caribou condition using ultrasonography and body condition score³ (Cook and Cook 2015).

2.2.2 Wolf Capture

We captured wolves by aerial darting from a Bell 206B Jet Ranger helicopter using 3 ml single-use darts loaded with 300 mg of Telazol[™] (Fort Dodge Animal Health, Fort Dodge, IA). Darts were placed in large muscles of the neck, shoulder, or rump and wolves were hazed toward suitable helicopter landing sites prior to becoming immobile. We assigned a sequential identification number to each collared wolf (e.g., BW001).

We fitted captured wolves with a Lotek Iridium TrackM GPS/satellite. Wolf GPS/satellite collars were programmed to acquire GPS fixes every 3 hours and were equipped with motion sensitive mortality

³At the commencement of the project, prior to Dr. Cook accompanying the capture crew for the first time, in January 2013, we based condition rating on Gerhart et al.'s (1996) body condition score based on palpation of ribs/ rump/withers. Condition was subjectively rated between 1 (emaciated) and 5 (obese).

sensors designed to transmit a satellite alert message as well as activate a distinctive VHF pulse pattern. GPS collars deployed in 2016 were also equipped with timer release mechanisms programmed to activate at either 85 or 104 weeks after deployment.

We assigned captured wolves to broad age classes, collected hair and blood samples, and measured neck circumference, body and total length, chest girth, and hind foot length.

2.3 Telemetry Monitoring and Mortality Site Investigations

We typically conducted fixed-wing telemetry monitoring flights on a monthly basis throughout Year IV to determine the approximate location and VHF beacon status of all boreal caribou and wolf collars believed to be active in the study area, including caribou collars deployed on behalf of BC OGRIS, caribou and wolf collars deployed on behalf of MFLNRO and BC OGRIS, and collars known to have entered BC's boreal caribou ranges from adjacent jurisdictions. In lieu of dedicated fixed-wing flights, between January and March 2016, we conducted telemetry monitoring by helicopter in conjunction with associated collar deployment activities (caribou, wolf, moose), mortality investigations, and the annual boreal caribou late winter recruitment survey.

We conducted ground-based site investigations as soon as reasonable following detection of a caribou mortality event through VHF signal status or transmitted GPS/satellite data. We determined the cause and approximate date of death, collected biological samples, and recovered the collar. We collected predator scat samples from mortality sites. All biological samples collected were forwarded to the Provincial Wildlife Veterinarian.

We estimated standardized annual adult survival rates for caribou using the Kaplan-Meier method staggered entry design, with standard error calculated using Greenwood's formula (Pollock et al. 1989; Krebs 1999, Krebs 2003).

Upon detection of a wolf mortality, we retrieved the radio-collar and attempted to determine cause of death. As determining the cause of death of collared wolves was not a BCIP priority, in months where only wolf mortalities were detected, we deferred the site visit and collar retrieval until the next caribou mortality detection.

2.4 Late Winter Recruitment Survey

We conducted late-winter composition surveys in all boreal caribou ranges to estimate annual calf recruitment. We used telemetry to locate all radio-collared caribou from a Bell 206B helicopter. We classified all caribou in each group by sex and age using criteria defined by the Resources Inventory Standards Committee (RIC 2002), including females (>1 year), males (>1 year), calves, and mature males. We reduced helicopter disturbance (i.e., approach distance) to caribou groups by using image-stabilizing binoculars to classify animals and identify individual caribou by ear tag colour combination. We augmented the sample of SCEK and MFLNRO collars by locating and classifying groups associated with radio-collared animals from adjacent jurisdictions found within the BC search area and included incidental sightings of unmarked caribou groups. Recruitment was expressed as the number of calves alive at 10 months of age per 100 females and as the percentage of calves in the population.

3 RESULTS

3.1 Year IV Capture and Collar Deployment

3.1.1 Year IV Caribou Capture

We deployed 21 new Vectronic Vertex GPS radio-collars on boreal caribou during 6 capture sessions between February 16 and 27, 2016, including 6 caribou recaptured to replace collars nearing the end of their battery life and 15 new animals (Appendix I). Five of the recaptures were original SCEK caribou and the sixth (SCEK231/BC1009) was collared in the Kiwigana Core of the Maxhamish Range by MFLNRO in March 2008. No serious injuries or capture-related caribou mortalities occurred during the February 2016 capture sessions.

Caribou collar distribution by range and core, and helicopter search lines flown during the February 2016 capture sessions are shown in Figure 4. As in previous years, we searched for caribou in the Paradise, Etsho, and Shush cores, and the eastern portion of the Fortune Core multiple times, as well as the Shekelie drainage, during winter 2015-2016. Older tracks indicated caribou had spent time in these areas in early winter.



Figure 2. Helicopter search lines and capture locations for 21 boreal caribou radio-collared in northeastern British Columbia between February 16-27, 2016.

SCEK038 was originally captured in the Milligan Core of the Chinchaga Range in January 2013. We attempted to retrieve and replace the aging radio-collar in the winter of 2014-2015, however, the caribou was consistently found in habitats not suitable for net-gun capture. In February 2015, the collar released at the end of its battery life; the caribou was then considered retired from the project. On February 19, 2016, we captured an uncollared caribou in the Milligan core, identified it as SCEK038 based on its colour-coded ear tag, and fitted it with a new GPS radio-collar (ID: SCEK038B).

In March 2014, we recaptured adult male Snake-Sahtaneh caribou BC1037, which had originally been collared by MFLNRO in March 2010, and replaced its existing VHF collar with an ATS Iridium collar (ID: SCEK173/BC1037). The Iridium collar ceased transmitting GPS data in July 2015 and the VHF signal was last detected in October 2015. We searched for the caribou in the Snake-Sahtaneh and adjacent ranges throughout fall and winter of 2015-2016, including during telemetry flights and capture and survey sessions, however we were unable to detect its VHF beacon or get a visual on the animal. It is assumed that the battery has now expired.

Serum progesterone analysis indicated 20 of 21 (95%) adult female caribou captured in February 2016 were pregnant (serum progesterone range 2.63-7.25 ng/ml), with the 21st animal assessed as being likely pregnant (progesterone 1.78 ng/ml; Appendix II). Seven of 21 caribou had a calf at heel at the time of the February 2016 capture and were also pregnant; 1 animal was still lactating and the other 6 showed evidence of having lactated in recent months (i.e., clear fluid in the udder).

Adult winter ticks were found on 16 of 21 caribou captured in February 2016, with warble fly larvae found on 1 animal. Ticks were found on 2 of 3 caribou that had no sign of hair loss or breakage and 5 of 7 with mild guard hair breakage. Ticks were found on 6 of 8 caribou with moderate hair breakage and rubbing, but no exposed skin, as well as all 3 caribou that had severe hair loss/breakage (i.e., patches of exposed skin).

John Cook (NCASI) used ultrasonography to assess caribou body condition for all 21 caribou captured in February 2016 (Cook and Cook, *unpubl. data*).

3.1.2 Year IV Wolf Telemetry and Collar Deployment

As in Year III, efforts to replace failed collars in marked wolf packs and to locate new packs in priority areas were hampered by poor capture conditions and unfavourable tracking conditions resulting from low snow accumulations and frequent dramatic freeze-thaw cycles (e.g., daytime highs up to +9°c in

January and +12°c in March). We searched for new unmarked wolf packs in the Clarke Core and Chinchaga RRA and attempted to recapture/replace malfunctioning GPS collars in the Fortune Pack.

We deployed 4 Lotek Iridium GPS wolf collars within 3 boreal caribou cores, including 2 new animals and 2 recaptures (Appendix III). On February 25, we recaptured Kwokullie male BW024 to replace its Lotek Iridium collar and deployed a second collar on a new Kwokullie wolf (female BW052). The pack was incidentally located at a caribou kill site on a small lake in the North Kotcho Core of the Snake-Sahtaneh Range. On February 26, we tracked an uncollared pack of 3 wolves in the Chinchaga RRA and deployed a new collar on an older, battle-scarred male (BW053). This animal moved southwest of the RRA boundary several days later and did not return. On February 27, we recaptured Elleh Pack female BW038 in the Clarke Core and replaced her failed Vectronic GPS collar. We were unable to locate any additional packs in the Clarke Core and Chinchaga RRA despite considerable search effort, including search time spent on related activities (i.e., moose capture, moose recruitment survey, and caribou capture and recruitment survey).

3.2 Year IV Telemetry Monitoring and Mortality Site Investigations

At the beginning of Year IV on May 1, 2015, 155 radio-collared caribou were potentially active within BC's boreal caribou ranges, including 150 SCEK caribou (5 ATS Iridium, 61 Vectronic, 12 Lotek LifeCycle, 72 Lotek VHF), 3 VHF MFLNRO caribou, and 2 VHF AEP caribou.

We detected and investigated 18 radio-collared caribou mortalities during Year IV. All 18 were original SCEK caribou, collared between December 2012 and April 2015. Seven and 6 mortalities occurred in the Snake-Sahtaneh and Maxhamish ranges, respectively.

Fourteen of 18 (78%) collared caribou mortalities investigated in Year IV were confirmed wolf predation. While there was abundant bear sign at the mortality site of SCEK073 (VHF), investigated in September 2015, we could not determine whether death was due to predation or the caribou died and was later scavenged by a bear. Two caribou were harvested on the Coles Lake Road, which bisects peatland habitat in the Fortune Core of the Maxhamish Range. SCEK179 and SCEK087 were shot while crossing the road in September 2015 and April 2016, respectively. In both cases, the radio collars were cut off and left in prominent places and the carcasses removed whole. The proximity to the Liard Highway and the fact that in both cases no attempt was made to conceal the site suggests that these were legal harvests by First Nations community members from Fort Liard, Northwest Territories. One caribou

(SCEK171) died of apparent poor condition/disease. The emaciated animal was found in July 2015, less than 12 hrs after death as evident by the internal body temperature.

No radio-collared caribou mortalities occurred between early December 2015 and mid-March 2016 (Fig. 3). In contrast, 5 caribou deaths occurred in late winter, including 1 VHF mortality discovered during the March 2016 recruitment survey and 4 mortalities detected and investigated in April 2016. Four of these mortalities were due to wolf predation and the fifth was due to human harvest; there were no cases of collared caribou dying from poor condition during this period.



Figure 3. Source of radio-collared boreal caribou mortality by month for Year IV, May 1, 2015 to April 30, 2016, northeastern British Columbia (*n*=18).

Four GPS collars ceased transmitting GPS data and VHF beacons during the year and are assumed to have failed. These include Milligan caribou SCEK034 (last heard December 2015), Milligan SCEK055 (last heard February 2016), Fortune SCEK085 (last heard February 2016), and Kotcho bull SCEK173/BC1037 (last heard October 2015). In addition, the VHF beacon of AEP caribou AB149.391 was last heard in October 2015 and is assumed to have exceeded its battery life.

Twenty-one new collars were deployed during the year, including 15 on new caribou and 6 recapture/replacements. One VHF-collared caribou of unknown origin (UNKN148.230) was discovered

in the Tsea Core in 2015 while scanning an active wolf collar frequency; this animal was subsequently identified as BC1028, collared by MFLNRO prior to 2012.

At the end of Year IV (April 30, 2016), a total of 146 radio-collared caribou (143 SCEK, 3 MFLNRO) were assumed active within or adjacent to BC's boreal caribou ranges.

The standardized annual finite survival rate for 168 adult female⁴ caribou active during the 12 month period between May 2015 and April 2016 was 0.87 ± 0.03 SE (95% C.I.= 0.84 to 0.93).

Detailed results of Year IV (May 1, 2015 to April 30, 2016) mortality investigations are found in mortality investigation summary reports No. 21 to 28 (DES 2015, DES 2016).

3.3 Year IV Caribou Late Winter Recruitment Survey

We conducted late winter recruitment surveys on all herds between March 14 and 30, 2016 (Appendices IV to XI). Figure 4 shows helicopter flight lines flown and location of caribou groups encountered during the 2016 late winter recruitment survey. Results of the survey are presented in Table 1. Daily weather conditions and visibility were good throughout the March survey. Daytime temperatures varied considerably both between and within individual survey days, from a low of -13°C on the morning of March 23 (Parker survey) to +12°C on the afternoon of March 29. There was 100% snow cover throughout the survey, with snow depths ranging between 26-50 cm. Unseasonably warm temperatures occurred toward the end of March, which resulted in rapidly diminishing snow cover during the last few days of the survey. Packed snow conditions resulting from frequent freeze-thaw cycles throughout the winter of 2015-2016, coupled with the high daily temperatures experienced during the survey, contributed to relatively few incidental observations of unmarked groups.

One hundred fifty-six caribou collars (152 SCEK, 3 MFLNRO, 1 AEP) were potentially active prior to the start of the 2016 recruitment survey. We detected and investigated 1 collared caribou mortality during the survey (Fortune caribou SCEK078 (VHF)). Three SCEK caribou (Milligan SCEK029; Milligan SCEK034, Kotcho SCEK173) and 1 AEP caribou (Chinchaga AB149.391) were not located. Therefore, a total of 151 radio-collared adult female caribou actively contributed to the survey.

⁴Excluding adult male SCEK173/BC1037.



Figure 4. Helicopter flight lines and location of boreal caribou groups observed during late winter recruitment survey, northeastern British Columbia, March 14-30, 2016.

-	Classification ¹					Total		Total No.	Min	Max	Mean Group Size
Range	F	М	Cf	UA	MM ²	Caribou Observed	Calves:100 Cows	Groups	Group Size	Group Size	(± SD)
Chinchaga	122	12	21	0	7	155	17 calves:100 cows	24	2	14	6.5 ± 3.2
Chinchaga RRA	28	5	6	0	2	39	21 calves:100 cows	5	2	12	7.8 ± 4.9
Snake-Sahtaneh	196	49	35	0	41	280	18 calves:100 cows	50	1	17	5.6 ± 3.3
Calendar (All) ³	72	14	19	2	7	107	26 calves:100 cows	18	1	13	5.9 ± 3.7
Calendar (BC only) ⁴	(44)	(7)	(14)	(0)	(1)	(65)	n/a	n/a	n/a	n/a	n/a
Maxhamish	58	25	17	0	19	100	29 calves:100 cows	23	1	9	4.3 ± 2.5
Prophet	13	1	2	0	1	16	15 calves:100 cows	3	2	9	5.3 ± 3.5
Parker	20	1	3	0	1	24	15 calves:100 cows	4	1	16	6.0 ± 6.8
Fort Nelson	6	1	0	0	0	7	n/a ⁵	2	2	5	3.5 ± 2.1
Total_All Groups ⁶	515	108	103	2	77	728	20 calves:100 cows	129	1	17	5.7 ± 3.4
Minimum Count BC Caribou ⁷	487	101	98	0	72	686	n/a	n/a	n/a	n/a	n/a

Table 1. Results of 2016 boreal caribou late winter recruitment survey, including age-sex composition, calves per 100 cows, and groupsize by range, northeastern British Columbia, March 14-30, 2016.

¹ F - Adult Females M - Adult Males Cf - Calves UA - Unclassified Adults MM - Mature Males

² Mature males defined as Class II or III bulls (RIC 2002)

³ Includes all groups associated with SCEK-collared caribou, including 9 groups (52 caribou) found in the Northwest Territories

⁴ Includes all groups found within the Calendar Range plus 9 SCEK caribou collared in Calendar but found in the Northwest Territories at time of survey and SCEK135's calf

⁵ Ranges with less than 10 caribou observed excluded

⁶ Includes all groups associated with SCEK-collared caribou, including groups found in Alberta and the Northwest Territories

⁷ Includes all groups found within BC plus 9 SCEK caribou collared in Calendar but found in the Northwest Territories at time of survey and SCEK135's calf

During the March 14-30 survey, we observed a total of 728 boreal caribou in 129 groups, including 515 adult females (F), 108 adult males (M), 103 calves (Cf), and 2 unclassified adults (U). Nine radio-collared Calendar caribou were located north of the BC/NT border in 9 groups, totalling 52 caribou. Thirteen unmarked groups (54 caribou) were located incidentally, including 3 groups in the Chinchaga Range (18 caribou), 8 in the Snake-Sahtaneh (30 caribou), 1 in Maxhamish (3 caribou), and 1 in Parker (3 caribou). Overall mean group size, including 9 groups found in the Northwest Territories, was 5.7 ± 3.4 SD (range 1 to 17). Overall recruitment to 10 months was 20 calves:100 cows, with calves comprising 14% of the minimum count (Table 1). When excluding uncollared animals associated with the 9 SCEK collared caribou and 1 calf located north of the BC/NT border during the survey, we had a total minimum count of 686 caribou (487F, 101M, 98 Cf) for all ranges combined. Although it is assumed that boreal caribou immediately north of the border are contiguous with the BC Calendar population, it is unknown if SCEK-collared animals located in the NT during the survey moved there temporarily as groups or joined groups of caribou normally resident in the NT portion of the range.

Twenty-nine of 36 caribou captured during the previous winter (December 8, 2014-April 1, 2015) and known to be pregnant, based on serum progesterone analysis, were alive and located during the March 2016 recruitment survey. Six of these 29 animals successfully raised a calf to ten months of age during 2015-2016, with the calf status of a seventh caribou undetermined.

Chinchaga Range

In February 2016, prior to the survey, we deployed 3 new Vectronic GPS radio-collars in the Milligan Core of the Chinchaga Range, including 2 collars on new caribou and SCEK038B, which was incidentally recaptured after being retired from the study in February 2015. Twenty-seven collared caribou were potentially active in the Chinchaga Range prior to the start of the recruitment survey, including 26 SCEK and 1 AEP (AB149.391) animals.

We surveyed the Milligan and Etthithun cores on March 14, 2016. AB149.391's radio frequency was not heard and the collar is presumed to have reached the end of its battery life. SCEK029 (VHF) was not heard in the Milligan or Etthithun cores on March 14, nor during the Chinchaga RRA survey (March 28).⁵ A total of 25 active collars contributed to the survey (22 Milligan, 3 Etthithun).

⁵SCEK029's VHF beacon was heard on normal mode in the Milligan Core on the April 2016 telemetry flight.

We counted 155 caribou (122F, 12M, 21Cf) in 24 groups in the Milligan and Etthithun cores combined, including 3 uncollared groups encountered incidentally (Table 1, Appendix IV). Three of 24 groups contained multiple radio-collared caribou. One group of ten caribou contained 5 collars, including 1 unidentified animal with an older VHF collar and a yellow right ear tag. A second group included SCEK033B and an unidentified animal with an older VHF collar and no ear tags, which may possibly have been AB149.391. The third group (7 caribou) included 2 SCEK-collared animals. Mean group size was 6.5 ± 3.2 SD (range 2-14). We calculated a ratio of 17 calves:100 cows for the Milligan and Etthithun cores of the Chinchaga Range, combined.

Chinchaga RRA

In February 2016, prior to the survey, we deployed 3 new Vectronic GPS radio-collars in the Chinchaga RRA, including 2 collars on new caribou and 1 recaptured animal (SCEK170B). We located all 11 SCEK caribou active in the Chinchaga RRA during the March 28, 2016 survey.

We counted 39 caribou (28F, 5M, 6Cf) in 5 groups, (Table 1, Appendix V). Four of 5 groups found contained multiple radio-collared caribou, including 2 groups with 3 collared animals each. We did not find any unmarked groups. Mean group size was 7.8 ± 4.9 SD (range 2-12), with a ratio of 21 calves:100 cows for the RRA.

Snake-Sahtaneh Range

In February 2016, prior to the survey, we deployed 6 Vectronic GPS radio-collars on new caribou in the Snake-Sahtaneh Range, including 2 in Clarke, 1 in Tsea, 2 in East Kotcho, and 1 in North Kotcho. On March 23-24, 2016, we located 51 of 52 SCEK-collared caribou potentially active in the Snake-Sahtaneh Range; SCEK173/BC1037 was not found. In addition, SCEK064, which was collared in the Kiwigana Core of the Maxhamish Range in Feb 2013, was located in the Tsea Core. The VHF beacon on SCEK111's Vectronic collar was transmitting a mortality signal but the caribou was confirmed to be alive.

We counted 280 caribou (196F, 49M, 35Cf) in 50 groups, including 8 unmarked groups encountered incidentally (Table 1, Appendix VI). Radio-collared caribou were well distributed within the Snake-Sahtaneh Range in March 2016, with 40 of 50 groups having a single collared animal, and 10 groups having 2 collars each. Mean group size was 5.6 ± 3.3 SD (range 1-17). We calculated a ratio of 18 calves:100 cows for the Snake-Sahtaneh Range.

Five groups were located outside the Snake-Sahtaneh defined cores, including 4 incidentally observed unmarked groups between the North Kotcho and West Kotcho cores and 1 marked group. SCEK219, which was collared in West Kotcho in February 2015, was located between Tsea and Kiwigana in a group of 6 caribou (4F, 2M) including an unidentified VHF-collared caribou with no ear tags.

Calendar Range

In February 2016, prior to the survey, we deployed 2 new Vectronic GPS radio-collars in the Calendar Range, including 1 new caribou and 1 recaptured animal (SCEK181B). Twenty SCEK-collared caribou were potentially active in the Calendar Range immediately prior to the start of the survey on March 30, 2016.⁶ All 20 caribou were located and contributed to the recruitment survey. No additional unmarked groups were found.

We counted a total of 107 caribou (72F, 14M, 19Cf, 2U) in 18 groups, including 9 SCEK caribou found in 9 different groups (52 caribou) in the Northwest Territories (Table 1, Appendix VII). The overall mean group size was 5.9 ± 3.7 SD (range 1-13), with a ratio of 26 calves:100 cows.

SCEK135 was the only one of 9 SCEK caribou located in the NT with a calf at heel. Counting all caribou found within the BC Calendar Range and only the 9 SCEK females and 1 calf found in the NT, a total of 65 caribou (44 females, 7 males, 14 calves) were recorded.

SCEK185, which had been located in Calendar RRA-C in the March 2015 survey, was found in Calendar RRA-D in the 2016 survey. No caribou were found in Calendar RRA-C during the 2016 survey.

Maxhamish Range

In February 2016, prior to the survey, we deployed 5 new Vectronic GPS radio-collars in the Maxhamish Range, including 2 on new caribou and 3 on animals recaptured to replace collars at the end of their battery life (SCEK066B, SCEK169B, SCEK231/BC1009). We located all 28 collared caribou potentially active in the Maxhamish Range during the March 29-30, 2016 survey, including 26 SCEK and 2 FNLRO collars. Fortune caribou SCEK078 (VHF) was heard transmitting on mortality mode on March 29; a site investigation revealed the animal had been killed by wolves. Kiwigana caribou SCEK064 was found in the Tsea Core on March 24, during the Snake-Sahtaneh survey.

⁶Excluding SCEK184, whose ATS Iridium collar malfunctioned in fall 2014, shortly after deployment; the collar frequency is still scanned for during all field activities in and adjacent to the Calendar Range.

We counted a total of 100 caribou (58F, 25M, 17 calves) in 23 groups (Table 1, Appendix VIII), including 1 uncollared group. Mean group size was 4.3 ± 2.5 SD (range 1-9), with a ratio of 29 calves:100 cows for the Maxhamish Range.

Prophet Range

All 5 active SCEK-collared Prophet caribou were located during the March 28 survey. We counted a total of 16 caribou (13F, 1M, 2Cf) in 3 groups (Table 1, Appendix IX). No uncollared groups were found. Mean group size was 5.3 ± 3.5 SD (range 2-9), with a ratio of 15 calves:100 cows for the range.

Parker Range

In February 2016, prior to the survey, we deployed 2 Vectronic GPS radio-collars on new animals in the Parker Range. We located all 7 SCEK caribou potentially active in the range during the March 23, 2016 survey. We counted 24 caribou (20F, 1M, 3Cf) in 4 groups, including 1 unmarked group encountered incidentally (Table 1, Appendix X). Mean group size was 6.0 ± 6.8 SD (range 1-16), with a ratio of 15 calves:100 cows.

Fort Nelson Core

We located all 3 SCEK caribou that were active in the Fort Nelson Core during the March 29, 2016 survey. We counted 7 caribou (6F, 1M) in 2 groups (Table 1, Appendix XI). Mean group size was 3.5 ± 2.1 SD (range 2-5). The small sample of collars available to locate groups is insufficient to estimate calf recruitment for the core.

3.3.1 Incidental Observations

Incidental observations made during the March 14-30, 2016 boreal caribou recruitment survey are found in the individual range survey results in Appendices IV to XI. Thirty-four uncollared moose (20 unclassified adults, 7 females, 1 male, and 6 calves) were observed incidentally within all ranges combined. Concurrent with the caribou survey, 55 additional radio-collared moose were located using telemetry, including 15 in the Clarke Core (12 collared females, 2 uncollared females, and 1 uncollared calf), 20 in the Fortune Core (13 collared females and 7 uncollared calves), and 20 in the Chinchaga RRA (12 collared females, 4 uncollared females, 1 collared and 2 uncollared bulls, and 1 uncollared calf; *reported in* Culling and Culling 2016). Sixteen wood bison were recorded in the Chinchaga Range. One lynx was found feeding on the carcass of a radio-collared moose in the Chinchaga RRA, as well as 1 lynx and a pack of wolves (Elleh Pack) in the Snake-Sahtaneh Range, 1 marten in the Maxhamish Range, and

3 uncollared wolves within 100 m of 2 collared caribou in mature closed canopy forest in the Prophet Range. Several flocks of sharp-tailed grouse were seen throughout the survey.

4 PROJECT SUMMARY AND DISCUSSION

We deployed radio-collars on 240 (239F, 1M) individual boreal caribou between December 17, 2012 and February 27, 2016. Several caribou were captured multiple times over the course of the project to replace radio-collars approaching the end of their battery life. Including caribou that had been initially captured and collared by MFLNRO, 45 and 2 animals were captured twice and 3 times, respectively, for a total of 262 individual capture events. Six collars failed or reached the end of the battery life prior to being recaptured, including SCEK034, SCEK042, SCEK055, SCEK085, SCEK173/BC1037 (male), and SCEK184.

One capture mortality occurred during the project; based on a total of 262 captures of 240 individual caribou, the overall capture mortality rate for the project was 0.38 %.

At the end of Year IV, 146 caribou collars were active within BC's boreal caribou ranges. Excluding the Fort Nelson Core, the active collars represent between 16% and 32% of the minimum number of caribou counted by range during the 2016 recruitment survey (Table 2).

	CHIN	CHIN- RRA	SNS	CAL^1	MAX	РРН	PRK	FN	Total
Total Caribou Observed	155	39	280	65	100	16	24	7	686
No. Collars Active April 30, 2016	25	11	49	20	26	5	7	3	146
% of Min Count ² Collared	16 %	28 %	18 %	31 %	26 %	32 %	29 %	43 %	21 %

Table 2. Proportion of boreal caribou collared by range at the end of Year IV (April 30, 2016), based onMarch 2016 recruitment survey minimum counts.

¹ Minimum count based on caribou in Calendar Range on March 30, 2016 and 10 caribou in NT (9 SCEK-collared caribou + 1 calf)

² Minimum count from March 2016 survey

The majority of caribou were estimated to be mature adults (5 - 10 years old) at the time of capture (Table 3). A suite of body measurements was collected during caribou capture (MFLNRO database), including neck circumference, which provides valuable information for planning future telemetry

projects. Mean neck circumference for 261 female boreal caribou was 53 cm (range 46-60 cm). The single male boreal caribou in the data set (SCEK173/BC1037) had a neck circumference of 48 cm when first collared as a yearling by MFLNRO in March 2010 (BC MFLNRO, *unpubl data*) and 63 cm when recaptured to replace the original collar in March 2014.

Broad Age Class	Sample	Neck Circumference (cm)					
	Size	Mean	Minimun	Maximun			
Sub-adult (1-3 yrs)	19	49.1 ± 1.7 SD	46	52			
Young Adult	77	52.0 ± 2.6 SD	46	58			
Mature Adult	134	53.2 ± 2.3 SD	48	59			
Old Adult	31	55.2 ± 2.9 SD	51	60			
Average	261	52.8 ± 2.8 SD	46	60			

Table 3. Age structure and neck circumference of radio-collared female boreal caribou by broad age class, northeastern British Columbia, December 2012-February 2016 (n = 261).

Plate 1 shows examples of categories used to define the extent of hair loss and rubbing observed. Based on 262 individual capture events, 79% of boreal caribou had some degree of hair loss or breakage at the time of capture (Table 4). Fifteen of 69 (22%) animals captured between March 1 and April 1 fell into the Extreme category (i.e., extensive areas of hair loss/breakage with multiple or large areas of exposed skin). Winter ticks (nymphs and adult stages) were found on 18% of caribou captured (Table 5). Adult ticks were found on 46 of 262 caribou captured, including, 20 of 36 (56%) animals with hair loss categorized as Severe or Extreme; all 20 animals were captured between late February and April 1.

Warble larvae were found on 9 of 262 caribou captured; all incidents were in late winter, between February 27 and April 1.

Based on over 15 years of caribou capture in boreal caribou ranges in BC and the Deh Cho and South Slave regions of the NT, the occurrence of winter ticks on caribou is becoming increasingly common, as the parasite appears to be undergoing a northward range expansion (B. Culling and D. Culling, *pers. observ*). Hair loss from rubbing to relieve tick-related irritation, as well as time and energy spent grooming over foraging, may result in thermal stress and higher metabolic demands that could affect boreal caribou condition, particularly during extended periods of cold weather in late winter.



None - no evidence of hair loss/breakage or exposed skin (SCEK026; January 2013)



Moderate - several or large patches of hair loss/breakage but no exposed skin (SCEK048; January 2013)



Extreme - extensive areas of hair loss/breakage with multiple or large areas of exposed skin (SCEK134; February 2013)



Mild - a few small to medium patches of guard hair breakage (SCEK019; January 2013)



Severe - several or large patches of hair loss/breakage with exposed skin (SCEK061; January 2013)



Extreme - extensive areas of hair loss/breakage with multiple or large areas of exposed skin (SCEK224; April 2015)

Plate 1. Examples of categories used to describe hair loss/breakage observed on boreal caribou captured in northeastern British Columbia between December 2012 and March 2016.

Dango	Hair Loss Category						
Kange	None	Mild	Moderate	Mod-Sev	Severe	Extreme	TOLAT
Chinchaga	16	22	12	2	5	1	58
Chinchaga RRA	4	3	0	0	0	0	7
Snake-Sahtaneh	14	31	24	3	9	3	84
Calendar	5	10	14	1	6	1	37
Maxhamish	10	8	16	3	8	1	46
Prophet	2	4	4	1	0	0	11
Parker	2	6	2	0	2	0	12
Fort Nelson Core	1	4	2	0	0	0	7
Total	54	88	74	10	30	6	262

Table 4. Extent of hair breakage and rubbing observed on boreal caribou between December 17, 2012 and April 30, 2016, northeastern British Columbia (*n*=262).

Table 5. Proportion of boreal caribou with adult winter tick infestation by hair loss category,northeastern British Columbia, December 17, 2012 to February 27, 2016 (n=262).

Winter Ticks Found	Hair Loss Category							
	None	Mild	Moderate	Mod-Sev	Severe	Extreme	TULAI	
Yes	4	12	8	3	17	3	47	
No	50	76	63	7	11	0	207	
Not Found but Assumed Present	0	0	3	0	2	3	8	
Total	54	88	74	10	30	6	262	
% of Total With Ticks	7	14	11	30	57	50	18	

Of 261 individual capture events of adult female caribou between December 2012 and March 2016, serum progesterone analysis confirmed 221 animals were pregnant, 28 were not pregnant, 3 were likely pregnant, and the pregnancy status of 9 animals was inconclusive. Based on the 249 animals whose status was confirmed, the overall pregnancy rate for the study was 89%.

Caribou Survival and Mortality

We investigated a total of 104 boreal caribou mortalities (88 SCEK, 7 MFLNRO, 9 uncollared) between the commencement of BCIP monitoring in December 2012 and the end of April 2016, including one animal (BC1006) that was fitted with a VHF collar in March 2008 by MFLNRO and died on an unknown date prior to December 2012 and MFLNRO caribou BC1064, which was detected and investigated on December 18, 2012, but GPS data indicated died on November 27. The 9 uncollared caribou were encountered incidentally in mid to late winter of the first year of the project (February to April 2013). In addition to the documented higher adult mortality rate in Year I, the relatively high encounter rate with unmarked caribou mortalities was assumed to be partially the result of greater field presence in the initial year of the project, when over 160 radio-collars were deployed, combined with atypical late winter/spring snow conditions (deep crusted snow), which restricted caribou movements but allowed wolves to move throughout core caribou habitat with little effort. Standardized annual finite survival was lowest in this year of the project (Table 6).

Table 6. Standardized finite annual survival of radio-collared adult female boreal caribou in northeastern British Columbia, May 1, 2013 to April 30, 2016 (based on the Kaplan-Meier staggered entry design).

Year ¹	Time Period	Number of Individuals Radio-Collared in Entire Time Period	Finite Survival Rate
II	May 1, 2013 - April 30, 2014	209	0.73 ± 0.03 SE (95% C.I.= 0.67 to 0.80)
ш	May 1, 2014 - April 30, 2015	180	0.86 ± 0.03 SE (95% C.I.= 0.81 to 0.91)
IV	May 1, 2015 - April 30, 2016	168	0.87 ± 0.03 SE (95% C.I.= 0.84 to 0.93)

¹ Year 1 of the project included the winter capture season of December 2012 to March 2013, as well as April 2013.

Of the 103 mortalities investigated where the month of death could be determined, 38 (37%) occurred between March and July 2013, following the unusually long winter of 2012-2013. Annually, the lowest number of mortalities occurred in late fall-early winter (November through January), with the highest typically between March and July (Fig. 5).

Figure 6 shows the cause of death of 104 boreal caribou mortality site investigations conducted between December 2012 and April 30, 2016, including 72 confirmed and 7 suspected incidents of wolf predation. Wolverine predation accounted for 3 additional predation deaths, one caribou died accidentally, and 5 died as a result of poor condition or disease. Two caribou were shot in the Fortune



Columbia, November 27, 2012 to April 30, 2016 (*n*=103).



Figure 6. Cause of boreal caribou deaths by year, northeastern British Columbia, November 27, 2012 to April 30, 2016 (*n*=104).

Core in separate events in September 2015 and April 2016. The cause of death for the remaining 14 animals could not be determined. Confirmed or suspected predation was the cause of death in over 70% of cases in each of the 3 full years of data collection (Fig. 7). Wolf predation of boreal caribou was typically highest in late winter and spring, between March and May (Fig. 8). The 3 incidences of wolverine predation of caribou occurred in February and March.

Four of 5 confirmed caribou deaths resulting from poor condition or disease occurred in the first year of the study, including 3 radio-collared caribou and 1 incidental observation of an uncollared animal. The circumstances surrounding these deaths varied from one animal that appears to have simply bedded down and died (Plate 2) to cases where the state of the vegetation at the mortality site indicated the animal had suffered a relatively violent non-predation death (Plate 3).

Calf Recruitment and Population Trend

Environment Canada (2008) suggests recruitment of 28 calves:100 cows is required for population stability, however high adult survival may partially offset low recruitment. Year IV calf recruitment to 10 months for all herds combined was 20 calves:100 cows, with calves comprising 14% of the population. Recruitment varied from 15 calves:100 cows in the Prophet and Parker ranges to 29 calves:100 cows in the Maxhamish Range.

Table 7 compares annual calf recruitment over the course of the study (Culling and Culling 2013, 2014, 2015). While March recruitment is improved over the previous 2 years, the overall estimate still falls short of Environment Canada's threshold. Based on the 2016 overall recruitment of 20 calves:100 cows and a 2015-2016 standardized finite adult female survival rate of 0.87, lambda equals 0.97, suggesting the current status of BC's boreal caribou population is slightly declining.

Caribou Movements

BC's Calendar Range is contiguous with boreal caribou habitat in the Deh Cho Region of the NT and the Bistcho boreal caribou range of AB. Movements displayed by radio-collared caribou underscore the inter-jurisdictional character of the Calendar Range, as well as the difficulties associated with attempting to determine minimum population size and trend. For example, during the March 2016 recruitment survey, Calendar caribou SCEK112 and SCEK113 were found in separate groups, approximately 10 km and 4 km north of the BC/NT border, respectively. In contrast, in the March 2015 survey, SCEK112 was located in the BC portion of the Shekelie drainage and SCEK113 was in Alberta, at the headwaters of the

25



Figure 7. Proportion of annual boreal caribou mortalities by cause of death for Year II (May 1, 2013-April 30, 2014), Year III (May 1, 2014-April 30, 2015), and Year IV (May 1, 2015-April 30, 2016), northeastern British Columbia, (*n*=85).



Figure 8. Incidence of boreal caribou mortalities caused by wolves, by month, northeastern British Columbia, December 17, 2012 to April 30, 2016 (*n*=78).



Plate 2. Maxhamish caribou BC1064; Mortality Investigation #001, December 18, 2012; Kiwigana Core (UTM 10.523249.6574077); laboratory necropsy results indicated caribou died of poor condition.



Plate 3. Emaciated body of SCEK171; Mortality Investigation #092; July 16, 2015; Chinchaga RRA (UTM 10.598152 6411225).

Table 7. Comparison of annual calf recruitment (calves:100 cows) in boreal caribou ranges based onMarch 2013 through March 2016 SCEK late winter surveys, northeastern British Columbia.

Range	March 2013	March 2014	March 2015	March 2016
Chinchaga Range ¹	14 calves:100 cows	10 calves:100 cows	9 calves:100 cows	18 calves:100 cows
Milligan and Etthithun	12 calves:100 cows	7 calves:100 cows	9 calves:100 cows	17 calves:100 cows
Chinchaga RRA	33 calves:100 cows	19 calves:100 cows	8 calves:100 cows	21 calves:100 cows
Snake-Sahtaneh	24 calves:100 cows ²	11 calves:100 cows	18 calves:100 cows	18 calves:100 cows
Calendar (All) ³	35 calves:100 cows	13 calves:100 cows	22 calves:100 cows	26 calves:100 cows
Maxhamish	28 calves:100 cows	10 calves:100 cows	21 calves:100 cows	29 calves:100 cows
Prophet	19 calves:100 cows	10 calves:100 cows	0 calves:100 cows	15 calves:100 cows
Parker	4 calves:100 cows	32 calves:100 cows	8 calves:100 cows	15 calves:100 cows
Fort Nelson	0 calves:100 cows ³	0 calves:100 cows ³	n/a ⁴	n/a ⁴
Total	21 calves:100 cows ³	12 calves:100 cows	15 calves:100 cows ³	20 calves:100 cows ³

¹ Milligan and Etthithun cores and the Chinchaga RRA combined

² Adjusted for SCEK173/BC1037

³ All groups with SCEK-collared caribou (including NT and AB) and all incidentally observed unmarked groups

⁴ Ranges with less than 10 caribou observed excluded

Shekelie River. Seven additional radio-collared Calendar caribou were located in the NT during the March 2016 survey. In the previous survey (March 2015), 5 of these animals were within the BC Calendar Range, 1 was near Trainor Lake, NT, 40 km north of the BC/NT border, and 1 was in the North Kotcho Core of the Snake-Sahtaneh Range. During the April 2016 telemetry flight, 1 month following the March 2016 survey, 7 of 20 Calendar caribou detected were in the North Kotcho Core of the Snake-Sahtaneh Range.

4.1 **Recommendations**

Deploying GPS/satellite collars on a limited sample of mature males would provide insight into movement between ranges and cores and provide a more accurate minimum count.

REFERENCES

- Cook, J., and R. Cook. 2015. Nutritional condition of caribou in northern British Columbia, 2012 2015, and southern Northwest Territories, 2015: annual progress report: 8 June 2015. National Council for Air and Stream Improvement, La Grande, OR.
- COSEWIC. 2011. Designatable units for Caribou (*Rangifer tarandus*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 88 pp.
- Culling, B. A., and D. E. Culling. 2016. BC Ministry of Forests Lands and Natural Resource Operations: Boreal Moose Recruitment Survey, March 23-29, 2016. Prepared for Ministry of Forests Lands and Natural Resource Operations, Fort St. John, BC. 6 pp + appendices.
- Culling, D., Culling, B., Backmeyer, R., and Antoniuk, T. 2004. Interim oil and gas industry guidelines for boreal caribou ranges in northeastern British Columbia. Fort St John, BC, British Columbia Oil and Gas Commission. 31 pp + attachments (map).
- Culling, D.E., and B.A. Culling. 2013. BC Boreal Caribou Implementation Plan: 2012-13 collar deployment and late winter recruitment survey. Prepared for BC Science and Community Environmental Knowledge Fund, Victoria, BC. 29 pp + appendices.
- Culling, D.E., and B.A. Culling. 2014. BC Boreal Caribou Implementation Plan: 2013-2014 field activities progress report. Prepared for BC Science and Community Environmental Knowledge Fund, Victoria, BC. 22 pp + appendices.
- Culling, D.E., and B.A. Culling. 2015. BC Boreal Caribou Implementation Plan: Year III (2014-2015) field activities progress report. Prepared for BC Science and Community Environmental Knowledge Fund SCEK, Victoria, BC. 28 pp + appendices.
- DES (Diversified Environmental Services). 2015. Mortality investigation summary reports No. 21-26 (April 2015 through Dec 2015). Prepared for Oil and Gas Research and Innovation Society, Victoria, BC.
- DES (Diversified Environmental Services). 2016. Mortality investigation summary reports No. 27-28 (January 2016 through April 2016). Prepared for Oil and Gas Research and Innovation Society, Victoria, BC.
- Environment Canada. 2011. Recovery strategy for the woodland caribou, boreal population (*Rangifer tarandus caribou*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa.
- Gerhart, K.L., R.G. White, R.D. Cameron, and D.E. Russell. 1996. Estimating fat content of caribou from body condition scores. J. Wildlife Manage 60(4):713-718.
- Krebs, C.J. 1999. Ecological methodology. 2nd Edition. Addison-Wesley Educational Publishers, Inc., Menlo Park, CA. 620pp.

- Krebs, C. J. 2003. Programs for ecological methodology, v 6.1.1, 2nd Ed. Harper & Row Publishers, New York, NY.
- MOE (Ministry of Environment). 2010. Science update for the boreal caribou (*Rangifer tarandus caribou* pop. 14) in British Columbia. Victoria, BC. 54 pp.
- MOE (Ministry of Environment). 2011. Implementation plan for the ongoing management of Boreal Caribou (*Rangifer tarandus caribou* pop. 14) in British Columbia. Victoria, BC. 17 pp.
- Pollock, K.H., S.R. Winterstein, C.M. Bunck, and P.D. Curtis. 1989. Survival analysis in telemetry studies: the staggered entry design. J. Wildl. Manage. 53(1):7-15.
- RIC (Resources Inventory Committee). 1998a. Live animal capture and handling guidelines for wild mammals, birds, amphibians & reptiles. Standards for Components of British Columbia's Biodiversity No. 3. Version 2. Resources Inventory Branch, Ministry of Environment, Lands and Parks, Victoria, BC.
- RIC (Resources Inventory Committee). 1998b. Wildlife radio-telemetry. Standards for components of British Columbia's biodiversity No. 5. Version 2. Resources Inventory Branch, Ministry of Environment, Lands and Parks, Victoria, BC.
- RIC (Resources Inventory Committee). 2002. Aerial-based inventory methods for selected ungulates: bison, mountain goat, mountain sheep, moose, elk, deer and caribou. Standards for Components of British Columbia's Biodiversity No. 32, Version 2. Resources Inventory Branch, Ministry of Environment, Lands and Parks, Victoria, BC.

APPENDICES

	`	/·				
Animal ID	Capture Event No.	First Collared by	Herd	Core	Capture Date (dd/mm/yy)	Comment
SCEK225	01	SCEK	МАХ	СРВ	16-Feb-16	
SCEK066B	02	SCEK	ΜΑΧ	СРВ	16-Feb-16	Recaptured to replace Lotek VHF collar deployed on caribou when it was a yearling in February 2013
SCEK169B	02	SCEK	ΜΑΧ	KWG	16-Feb-16	Recaptured to replace ATS Iridium collar deployed in February 2014
SCEK226	01	SCEK	CHIN	MLL	19-Feb-16	
SCEK038B	02	SCEK	CHIN	МШ	19-Feb-16	Original collar deployed in January 2013, released and was retrieved on Feb 27 2015 and caribou was "retired" from study; caribou was randomly recaptured and collared a second time on Feb 19, 2016
SCEK227	01	SCEK	CHIN	MLL	19-Feb-16	
SCEK228	01	SCEK	SNS	ESK	24-Feb-16	
SCEK229	01	SCEK	SNS	ESK	24-Feb-16	
SCEK230	01	SCEK	SNS	NRK	24-Feb-16	
SCEK231/ BC1009	02	MFLNRO	MAX	KWG	24-Feb-16	Recaptured to replace expired Lotek VHF collar deployed in KWG in March 2008 by MFLNRO
SCEK232	01	SCEK	ΜΑΧ	KWG	25-Feb-16	
SCEK233	01	SCEK	SNS	TSE	25-Feb-16	
SCEK181B	02	SCEK	CAL	CAL	25-Feb-16	Recaptured to replace ATS Iridium collar deployed in March 2014
SCEK234	01	SCEK	CAL	CAL	25-Feb-16	
SCEK235	01	SCEK	CHIN RRA	CHIN RRA	26-Feb-16	
SCEK170B	02	SCEK	CHIN RRA	CHIN RRA	26-Feb-16	Recaptured to replace ATS Iridium collar deployed in March 2014
SCEK236	01	SCEK	CHIN RRA	CHIN RRA	26-Feb-16	
SCEK237	01	SCEK	PRK	PRK	27-Feb-16	
SCEK238	01	SCEK	PRK	PRK	27-Feb-16	
SCEK239	01	SCEK	SNS	СЦК	27-Feb-16	
SCEK240	01	SCEK	SNS	СЦК	27-Feb-16	

Appendix I: Boreal caribou capture and radio collar deployment summary, February 16-27, 2016, (n=21).

Animal ID	Herd	Core	Sample Date (dd/mm/yy)	Broad Age Class ¹	Calf at Heel	Progesterone (ng/ml)	Pregnant ²
SCEK225	MAX	СРВ	16-Feb-16	YA	Ν	6.04	PR
SCEK066B	MAX	СРВ	16-Feb-16	YA	Ν	2.63	PR
SCEK169B	MAX	KWG	16-Feb-16	OA	Y	7.25	PR
SCEK226	CHIN	MLL	19-Feb-16	MA	Y	3.32	PR
SCEK038B	CHIN	MLL	19-Feb-16	MA	Y	6.15	PR
SCEK227	CHIN	MLL	19-Feb-16	OA	Ν	6.13	PR
SCEK228	SNS	ESK	24-Feb-16	YA	Ν	5.47	PR
SCEK229	SNS	ESK	24-Feb-16	MA	Y	3.40	PR
SCEK230	SNS	NRK	24-Feb-16	MA	Ν	3.20	PR
SCEK231/ BC1009	MAX	KWG	24-Feb-16	OA	Ν	3.11	PR
SCEK232	MAX	KWG	25-Feb-16	OA	Ν	4.88	PR
SCEK233	SNS	TSE	25-Feb-16	MA	Unk	4.37	PR
SCEK181B	CAL	CAL	25-Feb-16	MA	Ν	2.66	PR
SCEK234	CAL	CAL	25-Feb-16	MA	Y	3.20	PR
SCEK235	CHIN RRA	CHIN RRA	26-Feb-16	MA	Y	6.27	PR
SCEK170B	CHIN RRA	CHIN RRA	26-Feb-16	OA	Ν	6.64	PR
SCEK236	CHIN RRA	CHIN RRA	26-Feb-16	YA	Ν	3.85	PR
SCEK237	PRK	PRK	27-Feb-16	MA	Ν	3.86	PR
SCEK238	PRK	PRK	27-Feb-16	MA	Ν	1.78	LP
SCEK239	SNS	CLK	27-Feb-16	MA	Ν	3.41	PR
SCEK240	SNS	CLK	27-Feb-16	MA	Y	4.54	PR

Appendix II: Pregnancy status of boreal caribou captured in northeastern British Columbia, February 16-27, 2016 (*n*=21).

¹ JUV - 2 yrs and under; YA - Young Adult 3 to 5 years; MA - Mature Adult 5 to 10 years; OA - Old Adult > 10 years

² PR - Pregnant NP - Not Pregnant LP - Likely Pregnant

Wolf ID	Capt No.	Pack	Territory ¹	No. Wolves Observ	Date Collared	Collar Type	Ear Tag	Sex	Colour	Age Class	East	North	Comments
BW024B	2	Kwokullie	NRK	3	25-Feb-16	Lotek Iridium	Yellow Left/ Pink Button	М	Grey	A	626616	6578497	Re-captured and replaced failed Lotek GPS collar 149.280
BW052	1	Kwokullie	NRK	3	25-Feb-16	Lotek Iridium	Blue Left/ Purple Button	F	Grey	OA	626617	6578497	New wolf in Kwokullie Pack
BW053	1	Kahntah	CHIN RRA	3	26-Feb-16	Lotek Iridium	Blue Left/ Yellow Button	Μ	Black	OA	615888	6441001	New pack; older male - very battle scarred, including several fresh wounds on face; 3 black wolves in pack
BW038B	2	Elleh	CLR	5	27-Feb-16	Lotek Iridium	None	F	Black	A	556579	6502267	Re-captured and replaced Vectronics GPS collar 149.340 (failed March 2015; collar does not appear damaged)

Appendix III: Wolf capture data (abridged), northeastern British Columbia, December 2015 to March 2016 (*n*=4).

¹ NRK - North Kotcho CHIN RRA - Chinchaga RRA CLR - Clarke ² P - Pup YA - Young Adult A - Adult OA - Old Adult

Appendix IV: Chinchaga Range late winter recruitment survey, March 14, 2016 Animal Observation Form – Boreal Caribou 2016 Late Winter Recruitment Survey

Survey: Late Winter Recruitment

Page: 1/3

Project: SCEK Boreal Caribou Observation Date: March 14, 2016

Obs Day: 1/1 Wind Time **Cloud Cover** Precip Snow Depth (cm) Snow Cover Temp Start (March 14) 08:25 Unbroken 15 knots - 8 C 31-50 76-100 % None - 3 C End (March 14) 15:15 Unbroken 8 knots None Days since 5 cm Snow: < 3 Navigator/Observer: Brad Culling Recorder/Observer: Diane Culling Pilot/Observer: Tom Henderson Observer: Ernie Napoleon (DRFN) Grp Classification Grp Core¹ BEU² Caribou ID Туре Calf Zone East North Comments # Tot F Μ Uncl Juv mm SCEK026B MLL GPS 3 3 2 0 0 0 655568 6300033 No 1 10 BB 2 SCEK027 VHF 2 3 0 0 0 659722 6296358 BB MLL Yes 1 10 Not found in MLL or ETT; also SCEK029 MLL VHF n/a searched in Chinchaga RRA Grp includes 5 collared VHF 0 0 animals, including an unid old SCEK032 MLL No 14 10 10 0 0 10 629145 6354118 ΒL VHF collar (yellow right ear tag) Grp includes unid old VHF SCEK033B MLL GPS 8 7 0 1 0 0 639248 6362047 collar (no ear tag)- possibly No 24 10 ΒL AB149.391 SCEK035 MLL VHF (14) dupl 629145 6354118 5 collars in group No dupl dupl dupl dupl dupl 10 ΒL 7 SCEK036B MLL GPS 21 8 0 1 0 0 10 612885 6369529 BL Yes First captured Jan 2013, collar released Feb 2015, incidentally 0 SCEK038B MLL GPS 4 2 1 1 0 10 648170 6292539 BΒ Yes 0 recaptured and re-collared Feb 2016 SCEK040 ETT GPS 8 6 5 0 0 0 10 662590 6405097 BB Adjacent to lease No 1 SCEK041 MLL VHF No 15 7 4 0 3 0 0 10 627353 6347800 BB Grp included SCEK198

Study Area: Chinchaga Range

Project: SCEK Boreal CaribouSurvey: Late Winter RecruitmentStudy Area:Observation Date: March 14, 2016

Caribau ID	Corro ¹	Turne	Calf	Grp	Grp	rp Classification Zone Zone				Feet	Newth		Commonto		
Caribou iD	Core	туре	Cali	#	Tot	F	М	Juv	Uncl	mm	Zone	East	North	BEO	Comments
SCEK053	MLL	VHF	No	13	5	5	0	0	0	0	10	625808	6351132	BB	
SCEK054	MLL	VHF	No	23	12	10	1	1	0	0	10	639087	6363459	BL	
SCEK055	MLL	GPS	No	17	2	2	0	0	0	0	10	622950	6349695	BB	
SCEK057	MLL	VHF	No	20	5	5	0	0	0	0	10	609753	6364218	BB	
SCEK059	MLL	VHF	No	(14)	dupl	dupl	dupl	dupl	dupl	dupl	10	629145	6354118	BB	5 collars in group
SCEK060	MLL	VHF	No	18	2	2	0	0	0	0	10	611850	6361411	BL	
SCEK061	MLL	VHF	No	11	10	8	1	1	0	1	10	635703	6336561	BB	
SCEK195	ETT	GPS	No	6	10	8	1	1	0	0	10	651357	6410119	BB	
SCEK196	MLL	GPS	No	22	4	2	2	0	0	1	10	628012	6352103	BB	
SCEK197	MLL	GPS	No	(14)	dupl	dupl	dupl	dupl	dupl	dupl	10	629145	6354118	BL	5 collars in group
SCEK198	MLL	GPS	Yes	(15)	dupl	dupl	dupl	dupl	dupl	dupl	10	627353	6347800	BB	Grp included SCEK041
SCEK201	MLL	GPS	No	1	8	6	0	2	0	0	10	667675	6295856	BB	
SCEK223	MLL	GPS	No	19	14	10	3	1	0	2	10	606619	6356538	BL	
SCEK224	ETT	GPS	Yes	7	5	3	0	2	0	0	10	649999	6414012	BL	Collar retrieved from mortality SCEK199 in March 2015 and redeployed on SCEK224 on April 1 2015
SCEK226	MLL	GPS	Yes	5	6	5	0	1	0	0	10	664373	6313302	BB	
SCEK227	MLL	GPS	No	16	7	7	0	0	0	0	10	635857	6336944	BL	May have lost ear tag (blue right)
AB149.391	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Not heard; C1

Study Area: Chinchaga Range

Page: 2/3

Page: 3/3

Study Area: Chinchaga Range Project: SCEK Boreal Caribou Survey: Late Winter Recruitment Observation Date: March 14, 2016

Caribau ID	Correl	Turne	Calf	Grp	Grp	p Classification					70.00	Fast	Newth		Commonto
Caribou ID	Core	туре	Cali	#	Tot	F	М	Juv	Uncl	mm	Zone	East	North	BEU	Comments
Unid #1	MLL	VHF	No	(14)	dupl	dupl	dupl	dupl	dupl	dupl	10	629145	6354118	BL	Unidentified VHF collar (yellow right ear tag); 5 collared caribou in group
Unid #2	MLL	VHF	Yes	(24)	dupl	dupl	dupl	dupl	dupl	dupl	10	639248	6362047	BL	Unidentified older VHF collar (no ear tags); C1
Uncoll #1	MLL	n/a	n/a	9	8	5	2	1	0	2	10	642756	6325704	TR	On cutline
Uncoll #2	MLL	n/a	n/a	10	5	3	0	2	0	0	10	635857	6336944	BB	
Uncoll #3	MLL	n/a	n/a	12	5	3	1	1	0	1	10	626620	6350481	BB	
Obs #		UTM	-		Chinchaga Range Additional Observations										
1	10.6704	462.62967	58	Flor	ck of shar	ptail gro	ouse								
2	10.6632	211.62945	23	Mo	ose x 2 a	dults (oi	n lease)								
3	10.6543	385.62996	,33	Мо	ose x 5 a	dults									
4	10.6612	288.63014	.42	Мо	ose x 1 a	dult									
5	10.661	736.64112	.78	Mo	ose x 2 a	dults									
6	10.662	304.63937	68	Bisc	on x 16 (E	tthithu	n)								
7	10.643	588.63203	38	Мо	Moose x 2 (1F, 1cf)										
					Comments										
C1	Unidentified VH	collared o	caribou (r	no ear tag	gs) in grou	up #24 c	could po	ssibly b	e failed A	B149.39	1				

¹ MLL - Milligan, ETT - Etthithun ² Broad Ecosystem Unit (BEU): BB - Black Spruce Bog BL - Black Spruce-Lodgepole Pine TR - Cutline

Appendix V: Chinchaga RRA late winter survey, March 28, 2016 Animal Observation Form – Boreal Caribou 2016 Late Winter Recruitment Survey

Page: 1/2

Project: SCEK Boreal Caribou Obs Date: March 28, 2016

Obs Day: 1/1 Time Cloud Cover Wind Temp Precip Snow Depth Snow Cover Start (March 28) 08:40 Clear 15 knots + 5 C None 26-50 cm 76-100 % Days since 5 cm Snow: < 14 days End (March 28) 14:30 (C1) Clear 20 knots + 10 C None

Study Area: Chinchaga RRA

Navigator/Observer: Brad Culling

Recorder/Observer: Diane Culling

Survey: Late Winter Recruitment

Pilot/Observer: Tom Henderson

Observer: Eva Needlay (FNFN)

Caribau ID	Free	Turno	Calf	Grp	Grp		С	lassifica	tion		7000	Fast	North		Commonto
Caribou ID	Freq	туре	Cali	#	Tot	F	М	Juv	Uncl	mm	Zone	East	North	BEO	Comments
SCEK048	Chin RRA	VHF	No	1	11	9	1	1	0	1	10	614366	6461556	BL	Grp included SCEK215 and SCEK235
SCEK142	Chin RRA	GPS	No	4	12	8	1	3	0	0	10	589322	6456934	BL	Grp included SCEK172 and SCEK214
SCEK170B	Chin RRA	GPS	No	2	2	2	0	0	0	0	10	609433	6461381	BB	Recaptured to replace ATS 149.404 on Feb 26 2016; grp included SCEK189
SCEK172	Chin RRA	GPS	No	(4)	dupl	dupl	dupl	dupl	dupl	dupl	10	589322	6456934	BL	Grp included SCEK142 and SCEK214
SCEK189	Chin RRA	GPS	No	(2)	dupl	dupl	dupl	dupl	dupl	dupl	10	609433	6461381	BB	Grp included SCEK170B
SCEK213	Chin RRA	GPS	No	3	11	7	2	2	0	1	10	596130	6458070	BA	Grp included SCEK236
SCEK214	Chin RRA	GPS	Yes	(4)	dupl	dupl	dupl	dupl	dupl	dupl	10	589322	6456934	BL	Group included SCEK142 and SCEK172

Page: 2/2

Project: SCEK Boreal Caribou

Survey: Late Winter Recruitment

Study Area: Chinchaga RRA

Obs Date:	March 28, 2016
-----------	----------------

Caribou	LD Coro ¹	Core ¹ Type		Grp	Grp		С	lassifica	ation		Zono	East	North		Commonts
Caribou	ID Core	Type	Call	#	Tot	F	М	Juv	Uncl	mm	Zone	EdSL	NOTUT	BEU	Comments
SCEK21	L5 Chin RRA	GPS	No	(1)	dupl	dupl	dupl	dupl	dupl	dupl	10	614366	6461556	BL	Grp included SCEK048 and SCEK235
SCEK21	L6 Chin RRA	GPS	No	5	3	2	1	0	0	0	10	635327	6441743	BB	VHF not heard since April 2015; GPS activity normal
SCEK23	35 Chin RRA	GPS	No	(1) dupl dupl dupl dupl dupl dupl dupl formula formula											Collared Feb 26 2016; grp included SCEK048 and SCEK215
SCEK23	36 Chin RRA	GPS	No	(3) dupl dupl dupl dupl dupl dupl 10 596130 6458070 BA Collared Feb 26 2016; grp included SCEK213										Collared Feb 26 2016; grp included SCEK213	
Obs #	UT	м								Chincha	aga RRA A	dditional Obs	ervations		
1	10.621145	.6433084		Lynx ob	oserved s	cavengi	ing the (carcass	of radio-c	collared r	noose WL	.H ID 15-5641			
2	n/	а		See cor	nment C	1									
								C	Comment	S					
C1	Survey interrupted	between 1	.1:35 hrs	s and 14:12 hrs.											
C2	There were no incic females accompany found dead; a lynx	lental obse /ing a colla was scaver	ervations red femanging the	rvations of moose during the Chinchaga RRA survey, but 20 moose were located using telemetry, including 12 radio-collared females, 4 uncollared ed female; 1 collared and 2 uncollared males accompanying a collared female, and 1 uncollared calf. A 13th radio-collared female moose was ging the carcass. Locations of these animals are presented in Culling and Culling 2016.											

¹ RRA-A - Chinchaga RRA
² Broad Ecosystem Unit (BEU): BA - Boreal White Spruce-Trembling Aspen BB - Black Spruce Bog BL - Black Spruce-Lodgepole Pine

Appendix VI: Snake-Sahtaneh Range late winter survey, March 23-24, 2016 Animal Observation Form – Boreal Caribou 2016 Late Winter Recruitment Survey

Page: 1/5

Project: SCEK Boreal Caribou Obs Date: March 23-24, 2016

Survey: Late Winter Recruitment

Study Area: Snake-Sahtaneh Range

Obs Day: 1/2	Time	Cloud Cover	Wind	Temp	Precip	Snow Depth	Snow Cover
Start (March23)	12:20	Unbroken	5 knots	- 10 C	Snow (Light)	26 - 50cm	76-100 %
End (March23)	16:30	Unbroken	5 knots	- 7 C	None	Days since 5 cr	m Snow: < 1/2
Obs Day: 2/2	Time	сс	Wind	Temp	Precip	Snow Depth	Snow Cover
Start (March 24)	08:26	Unbroken	8 knots	- 11 C	None	26 - 50 cm	76-100 %
End (March 24)	16:15	> 50 %	10 knots	- 5 C	None	Days since 5 d	cm Snow: < 3

Navigator/O	bserver: Brad	Culling		Recorde	er/Obser	ver: D	iane Cu	ulling		Pilot/Ob	oserver: To	m Henderso	n	Observer: Eva Needley (FNFN)	
Caribou ID	Core ¹	Туре	Calf	Grp #	Grp Tot		C	lassifica	ition		Zone	East	North	BEU ²	Comments
					100	F	M	Juv	Unc	mm					
SCEK019	CLR	VHF	No	16	1	1	0	0	0	0	10	564869	6501335	BB	
SCEK020B	CLR	GPS	No	12	5	5	0	0	0	0	10	569643	6499312	BB	
SCEK024	CLR	VHF	No	18	10	8	2	0	0	2	10	565542	6500995	BB	
SCEK025	CLR	VHF	No	14	5	5	0	0	0	0	10	562663	6500714	BB	
SCEK064	TSE	VHF	No	47	13	12	1	0	0	1	10	554555	6596837	BB	Caribou collared in KWG Core of Maxhamish Range in Feb 2013, grp included SCEK127
SCEK068	CLR	VHF	No	1	4	2	2	0	0	1	10	539692	6512168	BB	Collared in Paradise
SCEK070	CLR	VHF	No	19	1	1	0	0	0	0	10	565841	6501134	BB	
SCEK071	WSK	GPS	No	22	5	3	2	0	0	2	10	585714	6548652	BB	
SCEK079B	TSE	GPS	No	45	12	10	2	0	0	2	10	553422	6591947	BB	Grp included SCEK131
SCEK081	TSE	VHF	Yes	49	9	7	1	1	0	1	10	559324	6593320	BB	

Project: SCEK Boreal Caribou

Survey: Late Winter Recruitment

Study Area: Snake-Sahtaneh Range

Obs Date: March 23-24, 2016

Caribau ID	Cara ¹	Turne	Calf	Grp	Grp		C	lassifica	ation		7	Feet	North		Commonto
Caribou ID	Core	туре	Cali	#	Tot	F	М	Juv	Unc	mm	Zone	East	North	BEO	Comments
SCEK082	TSE	VHF	Yes	46	7	4	2	1	0	1	10	553316	6592566	BB	
SCEK088	NRK	VHF	No	39	6	5	1	0	0	1	10	634237	6557363	BB	Grp included SCEK105
SCEK089	NRK	VHF	No	33	5	4	1	0	0	1	10	591875	6585736	BB	Grp included SCEK186
SCEK090	NRK	VHF	Und	32	10	7	0	3	0	0	10	597785	6579177	BB	
SCEK091	WSK	VHF	No	36	4	4	0	0	0	0	10	614365	6588327	BB	
SCEK092	NRK	VHF	Yes	38	4	2	0	2	0	0	10	616110	6591934	BL	
SCEK096	CLR	VHF	No	11	12	6	3	3	0	1	10	569513	6498613	BB	Collared in WSK, moved to CLR; grp included SCEK218
SCEK097B	NRK	GPS	No	37	8	6	1	1	0	1	10	602960	6585926	BB	Grp included SCEK182
SCEK100B	ESK	GPS	No	42	7	5	1	1	0	1	10	634735	6552319	BB	
SCEK102	ESK	VHF	Yes	41	3	2	0	1	0	0	10	630766	6561976	BB	
SCEK103	ESK	VHF	No	40	6	2	2	2	0	2	10	631187	6561262	BB	Grp included SCEK204
SCEK105	NRK	VHF	No	(39)	dupl	dupl	dupl	dupl	dupl	dupl	10	634237	6557363	BB	Grp included SCEK088
SCEK111	NRK	GPS	Und	26	6	3	1	2	0	1	10	597405	6564800	BB	VHF transmitting mortality signal but caribou alive (C1)
SCEK127	TSE	VHF	No	(47)	dupl	dupl	dupl	dupl	dupl	dupl	10	554555	554555	BB	Grp included SCEK064
SCEK131	TSE	VHF	No	(45)	dupl	dupl	dupl	dupl	dupl	dupl	10	553422	6591947	BB	Grp included SCEK079B
SCEK132	TSE	VHF	Yes	43	6	3	2	1	0	2	10	557374	6588344	BB	Grp included SCEK132

Page: 2/5

Project: SCEK Boreal Caribou 0

Survey: Late Winter Recruitment

Study Area: Snake-Sahtaneh Range

-,	
Obs Date: March 23-24, 2016	

Caribou ID	Coro ¹	Tuno	Calf	Grp	Grp		C	lassificat	tion		7000	Eact	North		Commonts
Caribou ib	Core	Type	Call	#	Tot	F	М	Juv	Unc	mm	20116	EdSt	NOTUT	DEU	comments
SCEK145	CLR	VHF	No	31	3	2	1	0	0	1	10	594756	6575989	BL	Collared in CLR, moved to Kotcho in 2015, returned to CLR
SCEK148	CLR	VHF	No	6	3	2	0	1	0	0	10	589394	6467132	BL	
SCEK149	CLR	VHF	Yes	20	2	1	0	1	0	0	10	575200	6504826	BB	
SCEK150	CLR	VHF	Yes	3	11	7	3	1	0	3	10	588804	6488780	BB	
SCEK152	CLR	VHF	No	10	5	3	2	0	0	2	10	570698	6499123	TR	On cutline
SCEK153	CLR	VHF	No	2	4	2	2	0	0	1	10	530384	6496948	BL	
SCEK156	CLR	VHF	No	9	4	3	1	0	0	1	10	568065	6493886	BL	Grp included SCEK240
SCEK157	CLR	VHF	No	13	4	4	0	0	0	0	10	548003	6491788	BB	Grp included SCEK239
SCEK173	n/a	GPS	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	10	n/a	n/a	n/a	Bull; collar replaced Feb 2014 (originally BC1037); GPS data ceased, VHF signal not detected throughout winter 2015-2016
SCEK182	NRK	GPS	No	(37)	dupl	dupl	dupl	dupl	dupl	dupl	10	602960	6585926	BB	Grp included SCEK097B
SCEK186	NRK	GPS	No	(33)	dupl	dupl	dupl	dupl	dupl	dupl	10	591875	6585736	BB	Grp included SCEK089
SCEK187	NRK	GPS	No	34	6	4	1	1	0	1	10	605352	6568105	BB	
SCEK191	CLR	GPS	No	8	7	7	0	0	0	0	10	584383	6467475	BL	
SCEK192	CLR	GPS	No	7	17	11	3	3	0	1	10	584758	6464981	BB	
SCEK193	CLR	GPS	Yes	21	4	2	0	2	0	0	10	562995	6506197	BB	
SCEK204	ESK	GPS	Yes	(40)	dupl	dupl	dupl	dupl	dupl	dupl	10	631187	6561262	BB	Grp included SCEK103
SCEK209	котсно	GPS	No	24	7	5	2	0	0	2	10	596341	6568073	BB	

Project: SCEK Boreal Caribou

Survey: Late Winter Recruitment

Study Area: Snake-Sahtaneh Range

Obs Date: March 23-24, 2016

Caribou ID	Coro ¹	Tuno	Calf	Grp	Grp		Cl	assificat	ion		7000	Fact	North		Commonts
Caribou ID	Core	туре	Cair	#	Tot	F	М	Juv	Unc	mm	Zone	East	NOrth	BEO	Comments
SCEK218	CLR	GPS	No	(11)	dupl	dupl	dupl	dupl	dupl	dupl	10	569513	6498613	BB	Grp included SCEK096
SCEK219	OS	GPS	No	50	6	4	2	0	0	2	10	538631	6579843	BB	Collared in WSK; located between TSE and KWG; grp includes BC1028
SCEK220	CLR	GPS	No	5	2	2	0	0	0	0	10	582512	6485002	BB	
SCEK228	ESK	GPS	No	29	2	2	0	0	0	0	10	597817	6564843	BB	Collared Feb 24 2016
SCEK229	ESK	GPS	Yes	35	7	4	2	1	0	1	10	611363	6578129	BB	Collared Feb 24 2016
SCEK230	NRK	GPS	No	30	7	6	0	1	0	0	10	594815	6561862	BB	Collared Feb 24 2016
SCEK233	TSE	GPS	No	(43)	dupl	dupl	dupl	dupl	dupl	dupl	10	557374	6588344	BB	Grp included SCEK132
SCEK239	CLR	GPS	No	(13)	dupl	dupl	dupl	dupl	dupl	dupl	10	548003	6491788	BB	Collared Feb 27 2016; grp included SCEK157
SCEK240	CLR	GPS	No	(9)	dupl	dupl	dupl	dupl	dupl	dupl	10	568065	6493886	BL	Collared Feb 27 2016; grp included SCEK156
BC1028	OS	VHF	No	(50)	dupl	dupl	dupl	dupl	dupl	dupl	10	538631	6579843	BB	Group found between TSE and KWG; grp includes SCEK219; MFLNRO collar BC1028 is on same frequency as Nexen wolf BW047; BC1028 collared in March 26, 2012
Uncoll#1	CLR	n/a	n/a	4	2	1	0	1	0	0	10	582457	6485152	LS	On edge of lake in black spruce bog
Uncoll#2	CLR	n/a	n/a	15	5	2	1	2	0	1	10	562617	6500317	BB	

Page: 4/5

Page: 5/5

Project: SCEK Boreal Caribou Survey: Late Winter Recruitment Obs Date: March 23-24, 2016

Classification Grp Grp Core¹ BEU² Caribou ID Calf Zone East North Comments Type # Tot F Μ Juv Unc mm 5 5 6501502 Uncoll#3 CLR n/a n/a 17 0 0 0 0 10 564722 BB OS Uncoll#4 n/a n/a 23 3 1 1 1 0 1 10 596504 6567391 BB Between NRK and WSK OS Uncoll#5 n/a n/a 25 4 3 0 1 0 0 10 597983 6565336 BB Between NRK and WSK OS Uncoll#6 n/a n/a 27 4 3 0 1 0 0 10 598025 6565286 BB Between NRK and WSK 0 597391 Uncoll#7 OS n/a n/a 28 2 1 1 0 1 10 6564863 BB Between NRK and WSK TSE 48 5 2 3 0 0 3 552830 6591980 BB Uncoll#8 n/a n/a 10 Snake-Sahtaneh Range Additional Observations Obs # UTM Observation Obs # UTM Observation Flock of sharp-tailed grouse 10.539930.6513861 10.565711.6500960 1 Lvnx x 1 10 2 Moose x 2 (1F + calf); uncollared 10.533395.6497825 11 10.566557.6505662 Moose x 2 (1F + calf); uncollared 3 10.535627.6499822 Moose x 2 (1F + calf); uncollared 12 10.582626.6513349 Moose x 1 adult; uncollared (bedded) 5 10.544299.6491331 Flock of sharp-tailed grouse 13 10.597114.6567699 Moose x 1 adult; uncollared 6 Elleh Pack wolves; all 3 collars working 10.594484.6568424 Moose x 1 adult: uncollared 10.573401.6489615 14 7 10.545798.6496501 Moose x 1M; uncollared 15 10.633094.6559824 Moose x 1 adult; uncollared 8 10.558288.6493009 Moose x 2 (1F + calf); uncollared 16 10.635390.6552537 Moose x 2 adults: uncollared 9 10.558272.6493589 Moose x 1F: uncollared 17 10.566096.6581745 Moose x 1 adult: uncollared Comments C1 VHF transmitting mortality signal but caribou alive (C2); started transmitting on normal mode after several minutes Fifteen additional moose were located in the Clarke Core using telemetry, including 12 radio-collared females, 2 uncollared females accompanying a collared female, and 1 uncollared C2 calf. Locations of these animals are presented in Culling and Culling 2016.

Study Area: Snake-Sahtaneh Range

¹ CLR - Clarke PRD - Paradise WSK - West Kotcho ESK - East Kotcho NRK - North Kotcho TSE - Tsea OS - Outside core

² Broad Ecosystem Unit (BEU): BB - Black Spruce Bog BL- Black Spruce-Lodgepole Pine LP - Lodgepole Pine LS - Small Lake TR - Trail (cutline)

Appendix VII: Calendar Range late winter survey, March 30, 2016 Animal Observation Form – Boreal Caribou 2016 Late Winter Recruitment Survey

Page: 1/3

Project: SCEK Boreal Caribou Obs Date: March 30, 2016

Obs Day: 1/1 Time Cloud Cover Wind Temp Precip Snow Depth Snow Cover Start (March 30) 15 knots 26-50 (C1) 09:25 > 50% + 2 C None 76-100 % 15 knots End (March 30) 15:23 > 50% + 2 C Days since 5 cm Snow: < 14 None

Study Area: Calendar Range

Navigator/Observer: Brad Culling

Recorder/Observer: Diane Culling

Survey: Late Winter Recruitment

Pilot/Observer: Tom Henderson

Observer: Eva Needley (FNFN)

Caribou ID	Core ¹	Type	Calf	Grp	Grp		С	lassifica	tion		Zone	East	North	BEU ²	Comments
Caribou iD		.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Cuii	#	Tot	F	М	Juv	Uncl	mm	_0.10	2000		520	
SCEK107	CAL	VHF	No	1	13	9	2	2	0	0	10	598808	6641193	TR	Grp included SCEK120; on cutline through closed-canopy mature spruce; was in NT during March 2015 survey
SCEK108	n/a	VHF	No	14	3	3	0	0	0	0	10	665184	6658208	BL	Located ~ 4 km north of BC-NT border; was south of the Petitot River during March 2015 survey
SCEK112	n/a	VHF	No	11	4	3	1	0	0	0	10	623488	6663653	BB	Located ~ 10 km north of BC- NT border; was at headwaters of Shekelie drainage (BC) during March 2015 survey
SCEK113	n/a	VHF	No	15	3	3	0	0	0	0	10	665256	6658185	BB	Located ~ 4 km north of BC-NT border; was at headwaters of Shekelie drainage (AB) during March 2015 survey
SCEK119	n/a	GPS	Yes	4	2	1	0	1	0	0	10	608894	6645104	BB	Typically spends summer in NT
SCEK120	CAL	VHF	Yes	(1)	dupl	dupl	dupl	dupl	dupl	dupl	10	598808	6641193	TR	Grp included SCEK107; on cutline through closed-canopy mature spruce
SCEK122	n/a	VHF	No	9	4	4	0	0	0	0	10	617320	6666909	BL	Located ~ 13 km north of BC- NT border

Page: 2/3

Project: SCEK Boreal Caribou Obs Date: March 30, 2016 Survey: Late Winter Recruitment

Study Area: Calendar Range

Commente		Newth	Feet	7		ion	assificat	C		Grp	Grp	Calf	Turne	Corro ¹	Caribou ID
Comments	BEO	North	East	Zone	mm	Uncl	Juv	М	F	Tot	#	Cali	туре	Core	Caribou ID
	BB	6654351	604939	10	1	2	1	1	3	7	3	No	VHF	CAL	SCEK123
Located ~ 24 km north of BC- NT border at headwaters of Calendar Creek; caribou regularly moves between BC and NT (as far north as Trainor Lake)	BL	6677486	652322	10	1	0	2	1	4	7	13	No	VHF	n/a	SCEK125
Located ~ 20 km north of BC- NT border	BB	6672708	610642	10	1	0	2	1	5	8	8	No	GPS	n/a	SCEK126B
Was south of Petitot during March 2015 survey	BB	6640893	599726	10	0	0	1	0	1	2	2	Yes	VHF	CAL	SCEK134
Located ~ 18 km north of BC- NT border at headwaters of Calendar Creek; collared in CAL but moves between NRK, CAL, and NT	BB	6672073	644989	10	0	0	1	0	2	3	12	Yes	GPS	n/a	SCEK135
Grp included SCEK181B	BB	6624815	622376	10	0	0	1	0	2	3	7	Yes	GPS	CAL	SCEK136B
Located ~ 18 km north of BC- NT border; was south of Petitot during March 2015 survey	BB	6663138	623328	10	3	0	0	3	10	13	10	No	VHF	n/a	SCEK137
	BL	6638411	611187	10	0	0	2	1	4	7	5	Yes	GPS	CAL	SCEK146B
Was south of Petitot during March 2015 survey	BB	6632318	643183	10	1	0	2	1	5	8	17	No	GPS	CAL	SCEK180
Recaptured to replace ATS 149.565 on Feb 25 2016; grp included SCEK136B	BB	6624815	622376	10	dupl	dupl	dupl	dupl	dupl	dupl	(7)	No	GPS	CAL	SCEK181B

Page: 3/3

Project: SCEK Boreal Caribou

Survey: Late Winter Recruitment

Study Area: Calendar Range

Obs Date: March 30, 201

	e a , .	-0.00	
6			

Caribou		Tuno	Calf	Grp	Grp		Cla	assificati	on		7000	Fact	North	DELI ²	Commonts
Caribou	ID Core	туре	Call	#	Tot	F	М	Juv	Uncl	mm	Zone	EdSL	North	BEU	comments
SCEK18	3 CAL	GPS	No	6	9	6	1	2	0	0	10	597173	6625609	BL	Was south of Petitot during March 2015 survey
SCEK18	EK184 n/a GPS n/a n/a n/a n/a n/a		n/a	n/a	n/a	n/a	n/a	n/a	n/a	Not found; caribou fitted with refurbished collar in March 2014, collar malfunctioned - not heard/no GPS data transmitted since Sept 2014					
SCEK18	5 (RRA-D)	GPS	No	18 10 6 2 2 0 0 10 658916 6639048 BB											
SCEK23	4 CAL	GPS	No	16	1	1	0	0	0	0	10	643275	6632698	BB	Collared Feb 25 2016
Obs #	UT	M								Calendar	Range Addi	tional Obse	rvations		
1	10.594412	2.6635533		Moose	e kill; only	/ hair rer	nained								
2	2 10.616286.6666661 Flock of sharptail grouse														
3	10.581160).6628167		Petito	t Pack Wo	olf BW03	2 (150.2	40) mort	ality site	2					
				•				С	omment	S					
C1	Snow receded ver	y rapidly t	hroughou	t day											

¹ CLN - Calendar Range excluding RRA-C and RRA-D (central portion)
² Broad Ecosystem Unit (BEU): BB - Black Spruce Bog BL - Black Spruce-Lodgepole Pine LS - Small Lake TR - Trail (including cutline)

Appendix VIII: Maxhamish Range late winter survey, March 29-30, 2016 Animal Observation Form – Boreal Caribou 2016 Late Winter Recruitment Survey

Page: 1/3

Project: SCEK Boreal Caribou Obs Date: March 29-30, 2016

Survey: Late Winter Recruitment

Study Area: Maxhamish Range

Obs	Day: 1/2		Time		Cloud Co	over		w	ind		Temp	Precip	Snow Depth		w Depth	Snow Cover	
Start	(March 29)		09:04		> 50	%		15	knots		+ 9 C	None		51	-75 (C1)	76-100 %	
End ((March 29)		17:25		> 50	%	20)-30 knc	ots (gustir	ng)	+ 12 C	None			Days sinc	e 5 cm Snow: < 14	
Obs	5 Day: 2/2		Time		СС			W	ind		Temp	Precip		Sno	w Depth	Snow Cover	
Start	(March 30)		17:14		> 50	%		15	knots		+ 3 C	None			31-50	76-100 %	
End ((March 30)		18:30		> 50	%		15	knots		+ 4C	None			Days sinc	e 5 cm Snow: < 14	
Navigator/Ol	bserver: Brad	Culling		Record	er/Obser	ver: D	iane Cu	ulling		Pilot/0	Observer:	Tom Hende	rson		Observer: Eva Needley (F		
Cariban ID	C = 1	.	C-If	Grp	Grp		С	Classifica	ition		7	E		Nextle		Commente	
Caribou ID	Caribou ID Core ¹		e Cair	#	Tot	F	М	Juv	Uncl	mm	Zone	East		North	BEO	Comments	
SCEK004	FRT	VHF	No	6	3	2	0	1	0	0	10	45744	457441		BL	Collared in KWG in December 2012	
SCEK005B	OS	GPS	No	5	1	1	0	0	0	0	10	48260	9	6613015	BB	Collared in KWG in December 2012; located between CPB and FRT in March 2016 survey	
SCEK007B	СРВ	GPS	No	3	5	5	0	0	0	0	10	46306	1	6585441	BB	Grp included BC1014	
SCEK062	KWG	VHF	No	23	7	5	1	1	0	1	10	49945	6	6587970	BL		
SCEK066B	СРВ	VHF	No	2	6	3	2	1	0	1	10	46994	2	6569262	BP		
SCEK076	СРВ	VHF	Yes	1	2	1	0	1	0	0	10	46980	4	6577916	BB		
SCEK078	FRT	VHF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	10	46157	1	6628342	BA	Mortality (MI #100); wolf kill	
SCEK085	FRT	GPS	No	11	3	2	1	0	0	1	10	53109	0	6626490	BB	Grp included SCEK175	
SCEK086	FRT	VHF	Yes	15	6	4	0	2	0	0	10	55682	1	6597726	UV	On lease	

Page: 2/3

Project: SCEK Boreal Caribou Survey: Late Winter Recruitment Obs Date: March 29-30, 2016

Classification Grp Grp BEU^2 Core¹ Caribou ID Type Calf East North Zone Comments # Tot F Μ Juv Uncl mm SCEK087 0 0 FRT VHF 17 0 0 512440 6626657 No 1 1 10 BB SCEK128 FRT VHF 5 4 0 1 0 0 518001 Grp included SCEK177 10 10 6622495 BB No Grp included SCEK178 and 9 SCEK129 FRT VHF Yes 14 5 2 2 0 2 10 548923 6624301 BB SCEK221 SCEK164 FRT VHF 12 5 3 1 0 1 10 540390 6621807 BB 1 Yes SCEK168 KWG GPS 19 8 5 0 3 0 0 535683 6567500 ΒL No 10 SCEK169B KWG GPS 22 2 1 0 1 0 0 510942 6571364 Yes 10 BB SCEK175 FRT GPS (11) dupl 10 531090 6626490 Grp included SCEK085 No dupl dupl dupl dupl dupl BB 8 2 0 0 SCEK176 FRT GPS No 6 4 1 10 493882 6637564 BL Grp included SCEK208 SCEK177 FRT GPS (10) dupl dupl dupl dupl dupl dupl 10 518001 6622495 BB Grp included SCEK128 No Grp included SCEK129 and SCEK178 FRT GPS No (14) dupl dupl dupl dupl dupl dupl 10 548923 6624301 BB SCEK221 SCEK205 FRT GPS 9 7 4 2 1 0 2 10 518115 6622213 No BB 3 2 0 0 0 SCEK206 FRT GPS Yes 13 1 10 540496 6622124 BB SCEK208 493882 FRT GPS No (8) dupl dupl dupl dupl dupl dupl 10 6637564 ΒL Grp included SCEK176 3 0 0 SCEK211 KWG GPS No 18 4 1 2 10 535709 6568507 TF Tamarack wetland Grp included SCEK129 and SCEK221 GPS 548923 FRT No (14) dupl dupl dupl dupl dupl dupl 10 6624301 BB SCEK178 SCEK225 0 0 0 0 454343 6584666 CPB GPS No 4 1 1 10 BB Collared Feb 16, 2016

Study Area: Maxhamish Range

Page: 3/3

Project: SCEK Boreal Caribou Survey: Late Winter Recruitment Obs Date: March 29-30, 2016

Caribau		_1	Turne	Calf	Grp	Grp		C	Classifica	ation		7	Feet	Newth		Commente
Caribou	ID Cor	e	туре	Cali	#	Tot	F	М	Juv	Uncl	mm	Zone	East	North	BEO	Comments
SCEK23 BC100	1/ 9 КW	G	GPS	No	21	4	1	3	0	0	3	10	520656	6566192	BB	Recaptured to replace VHF 151.701 on Feb 24, 2016
SCEK2	32 KW	G	GPS	No	20	1	1	0	0	0	0	10	533943	6564230	BB	Collared Feb 25, 2016
BC101	4 CP	В	VHF	No	(3)	dupl	dupl	dupl	dupl	dupl	dupl	10	463061	6585441	BB	Grp included SCEK007B
BC103	3 FR	Г	VHF	No	16	8	2	5	1	0	2	10	525820	6620418	BB	
Uncoll	#1 FR	Г	n/a	n/a	7	3	0	3	0	0	3	10	494233	6636714	UV	On lease in Sb peatland (photos)
							Γ	ervations								
Obs #		ι	JTM									Obse	ervation			
1	10	.4699	54.6569399	Э	Mar	ten in ma	ature lo	dgepole	e pine/s	oruce for	est					
2	10	.5200	81.656651	7	Мос	ose x 2 ur	ncollare	d adults	5							
3	10	.5627:	11.6610662	2	Мос	ose x 2 (1	uncolla	red fen	nale and	l 1 calf)						
	Comments															
C1	Snow melting	quick	ly through	out Day 1	(temper	ature at i	midday	+ 16 C)	; snow	pack rece	eded visib	ly				
C2	SCEK064 was	collar	ed in Kiwig	ana in Fet	oruary 20	013; locat	ted in Ts	sea Cor	e of Sna	ke-Sahta	neh Rang	e during Mar	ch 2016 surv	ey (SNS Group	#47)	
C3	Twenty addit are presented	onal n I in Cu	noose were Iling and C	e located i ulling 201	in and ac 6.	Jjacent to	o the Fo	rtune C	ore usir	ng teleme	etry, inclu	ding 13 radio	-collared fer	nales and 7 un	collared cal	ves. Locations of these animals

Study Area: Maxhamish Range

 ¹ CPB - Capot-Blanc FRT - Fortune KWG - Kiwigana OS - Outside core
² Broad Ecosystem Unit (BEU): BA - Boreal White Spruce-Trembling Aspen BB - Black Spruce Bog BP - Boreal White Spruce-Lodgepole Pine BL - Black Spruce-Lodgepole Pine UV - Unvegetated

Appendix IX: Prophet Range late winter survey, March 28, 2016 Animal Observation Form – Boreal Caribou 2016 Late Winter Recruitment Survey

Survey: Late Winter Recruitment

Page: 1/1

Project: SCEK Boreal Caribou Obs Date: March 28, 2016

Obs Day: 1/1 Time **Cloud Cover** Wind Temp Precip Snow Depth Snow Cover + 16 C (C1) Start (March 28) 11:45 > 50 % 10 knots None 26-50 cm 76-100 % End (March 28) 12:40 > 50 % 10 knots + 16 C Days since 5 cm Snow: < 14 days None Navigator/Observer: Brad Culling Recorder/Observer: Diane Culling Pilot/Observer: Tom Henderson Observer: Eva Needlay (FNFN)

Study Area: Prophet Range

Cariba		Coro ¹	Turne	Calf	Grp	Grp		C	lassifica	tion		7000	Fact	North		Commonto
Caribo	iu iD	Core	туре	Call	#	Tot	F	М	Juv	Uncl	mm	20119	EdSL	North	BEU	comments
SCEK	045	РРН	VHF	No	2	5	4	1	0	0	1	10	541301	6452641	BB	Grp included SCEK049
SCEK	049	РРН	VHF	No	(2)	dupl	dupl	dupl	dupl	dupl	dupl	10	541301	6452641	BB	Grp included SCEK045
SCEK	051	РРН	VHF	Yes	3	9	7	0	2	0	0	10	575941	6452452	BB	
SCEK1	61B	РРН	GPS	No	1	2	2	0	0	0	0	10	544734	6454697	BL	Grp included SCEK217; 3 wolves within 100 m of group
SCEK2	217	РРН	GPS	No	(1)	dupl	dupl	dupl	dupl	dupl	dupl	10	544734	6454697	BL	Grp included SCEK161B; 3 wolves within 100 m of group
Obs #		UTM									Prophet	Range Addit	ional Observa	tions		
1		10. 544734.4	454697		3 wolves	in matur	e conife	rous foi	rest with	nin 100 m	n of grou	p #1				
									Additio	nal Com	ments					
C1	Temp	erature at grou	nd level +	16 C; at	300 m agl	+ 8 C										

¹ PPH - Prophet Range

² Broad Ecosystem Unit (BEU): BB - Black Spruce Bog BL - Black Spruce-Lodgepole Pine

Appendix X: Parker Range late winter survey, March 23, 2016 Animal Observation Form – Boreal Caribou 2016 Late Winter Recruitment Survey

Survey: Late Winter Recruitment

Page: 1/1

Project: SCEK Boreal Caribou Obs Date: March 23, 2016

Obs	5 Day: 1/1		Time		Cloud	Cover		Wir	nd		Temp	F	Precip	Snow	Depth	Snow Cover
Start	(March 23)		11:08		Unbr	oken		5 kn	ots		- 13 C	Lig	ht Snow	26	-50	76-100 %
End	(March 23)		12:16		Unbr	oken		5 kn	ots		-10 C		None		Days since 5	cm Snow: < 1/2
Navigat	or/Observer:	Brad	Culling		Record	ler/Obse	erver: Di	iane Cull	ling	Pi	ot/Obse	rver: To	m Henderso	on	Observer:	Eva Needley (FNFN)
Cariba		1	Turno	Calf	Grp	Grp		Cl	assificati	on		7000	Fact	North		Commonte
Canbo	u id Cor	e	туре	Call	#	Tot	F	М	Juv	Uncl	mm	Zone	EdSL	NOTUT	BEU	Comments
SCEKO	010 PR	K	VHF	No	4	4	4	0	0	0	0	10	491497	6521330	BL	Grp included SCEK237
SCEKO)12 PR	K	VHF	No	3	16	12	1	3	0	1	10	485967	6525839	BL	4 collars in group
SCEKO)15 PR	K	VHF	No	(3)	(dupl)	(dupl)	(dupl)	(dupl)	(dupl)	(dupl)	10	485967	6525839	BL	4 collars in group
SCEK0:	16B PR	K	GPS	Und	(3)	(dupl)	(dupl)	(dupl)	(dupl)	(dupl)	(dupl)	10	485967	6525839	BL	4 collars in group
SCEK1	194 PR	K	GPS	No	(3)	(dupl)	(dupl)	(dupl)	(dupl)	(dupl)	(dupl)	10	485967	6525839	BL	4 collars in group
SCEK2	237 PR	ĸ	GPS	No	(4)	(dupl)	(dupl)	(dupl)	(dupl)	(dupl)	(dupl)	10	491497	6521330	BL	Collared Feb 2016; grp includes SCEK010
SCEK2	238 PR	K	GPS	No	1	1	1	0	0	0	0	10	493045	6523543	BB	Collared Feb 2016
Uncoll	l #1 n/	a	n/a	n/a	2	3	3	0	0	0	0	10	539930	6513861	BL	
Obs #	Obs # UTM										Parker Ra	nge Addit	ional Observ	ations		
C1 10.486658.6527630					Moose	x 1 adult										
	C1 10.486658.6527630															

Study Area: Parker Range

¹ PRK - Parker Range
² Broad Ecosystem Unit (BEU): BB - Black Spruce Bog

Appendix XI: Fort Nelson Core late winter survey, March 29, 2016 Animal Observation Form – Boreal Caribou 2016 Late Winter Recruitment Survey

Obs Date: March 29, 2016 Obs Day: 1/1 Time Cloud Cover Wind Temp Precip Snow Depth Snow Cover Start (March 29) 08:35 > 50 % Light (5 knots) +9C None 36-50 76-100 % End (March 29) 08:57 > 50 % Light (5 knots) + 10 C None Days since 5 cm Snow: < 14 Recorder/Observer: Diane Culling Pilot/Observer: Tom Henderson Navigator/Observer: Brad Culling Observer: Eva Needley (FNFN) Classification Grp Grp $Calf^2$ BEU³ Core¹ Туре Zone East North Comments # Tot F Μ Uncl Juv mm FΝ GPS No 2 2 2 0 0 0 0 10 501845 6557841 ΒL Mature closed-canopy spruce FN GPS No 1 5 4 1 0 0 0 10 522615 6538227 BB FN GPS No (2) dupl dupl dupl dupl dupl dupl 10 501845 6557841 ΒL Mature closed-canopy spruce

Study Area: Fort Nelson Core

Obs # UTM Fort Nelson Core Additional Observations 1 Comments C1

¹ FN - Fort Nelson Core

² Und - calf status undetermined

Project: SCEK Boreal Caribou

Caribou ID

SCEK009B

SCEK166

SCEK167

³ Broad Ecosystem Unit (BEU): BB - Black Spruce Bog

Page: 1/1

Survey: Late Winter Recruitment