



TECHNICAL REPORT

Herd Boundary Refinement for the Chase, Spatsizi, and Frog Caribou Herds in North-central British Columbia: Year End Report 2013 HCTF Project #7-394

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INTRODUCTION

Background

Woodland caribou (*Rangifer tarandus caribou*) in British Columbia (BC) occur in 52 herds that have been identified, delineated spatially, and monitored on a somewhat regular basis (McNay and Hamilton 2010). However, there are still interstitial areas within the distribution of caribou in BC where caribou are of an unknown status or considered to be in a “zone of trace occurrence” (ZTO). The most significant ZTO in north-central BC is east of Thutade Lake and along the headwaters of the Finlay River (Heard and Vagt 1998, McNay and Hamilton 2010). There are five previously delineated herds sharing common boundaries with the ZTO: Spatsizi, Frog, Gataga, Finlay, and Chase (Figure 1). The significance of that particular ZTO was revealed after recent surveys during which the number of caribou found using the area exceeded the number of caribou in many of the delineated herds in BC (McNay and Hamilton 2010, McNay 2011). Although caribou have been hunted by First Nations in this area for decades (McKay 1997), the caribou that occur there have not been identified as a specific herd nor have they been associated with any other previously delineated herd; hence, there is little documentation of the range used or of the status of the caribou population in the area.

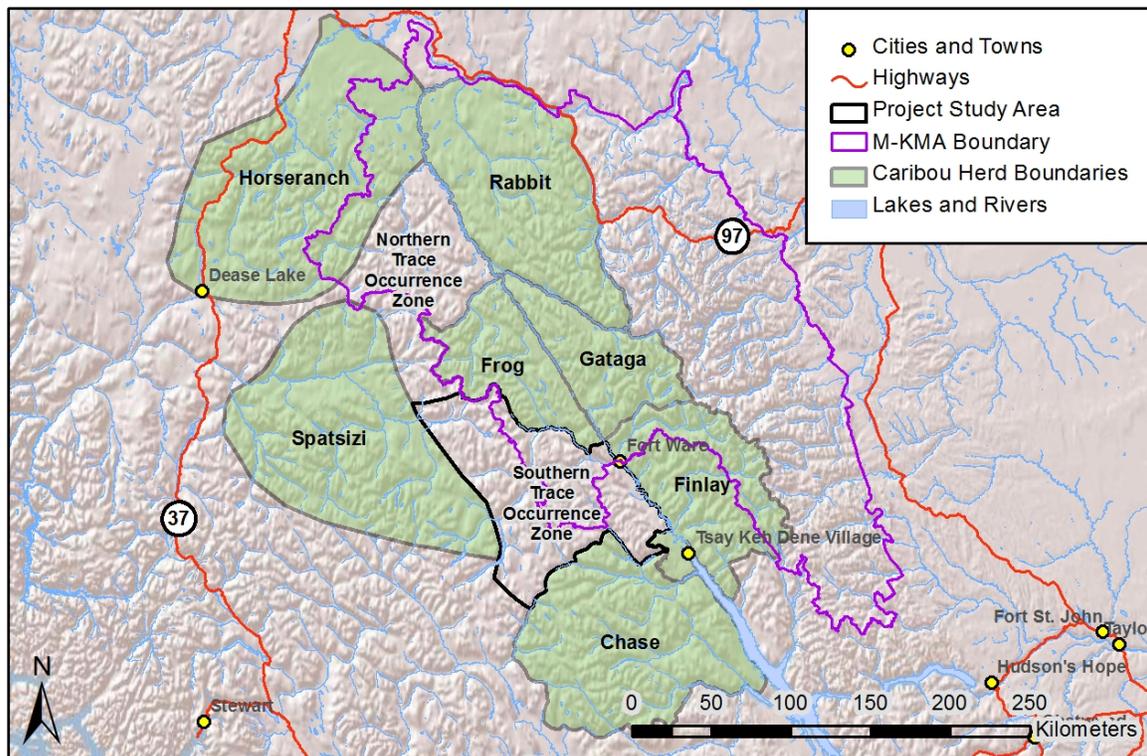


Figure 1. Location of the Thutade - Upper Finlay River study area (i.e., the southern trace occurrence zone) in north-central British Columbia. Purple boundary is the Muskwa-Kechika Management Area.

The work reported here describes a summary of the data collected from GPS collared caribou and the second of two intensive population surveys conducted for caribou in the southern portion of the zone of trace occurrence. The knowledge gained from these data will be used with information gathered from the previous surveys to improve the baseline delineation of range used by caribou, and improve the current tally of caribou numbers. Outcomes of this information include a more explicit rationale for conservation measures provided by the provincial government and First Nations as well as an expression of baseline conditions for use by industrial proponents seeking to develop natural resources in the area. Our objectives were to conduct a classified total count of caribou and general observations of other ungulate by recording the location, number, age class, and sex of all caribou observed and other species in particular; mountain goat (*Oreamnos americanus*), Stone's sheep (*Ovis dalli stonei*), and moose (*Alces alces*).

Reconnaissance-level surveys were conducted in parts of the ZTO in 1990, 1991, 2003, and 2007 (Table 1). Each of those surveys was restricted in extent and associated with an assessment of potential impacts from a copper/gold mine in the south eastern part of the study area. In 2009 observations of caribou were made coincidentally as part of a Stone's sheep population survey (Pers. Comm.; Conrad Thiessen, BC Ministry of Environment, Fort St. John; February 11, 2011) and as part of an extensive exploratory search for caribou (MacDonald et al. 2009) conducted in the northern and south-western parts of the ZTO. We estimate that a minimum of 301 caribou were likely to have been observed during reconnaissance and directed surveys in the entire ZTO from 1990 through to 2009 (Table 1).

Table 1. Number of caribou observed during aerial surveys conducted from 1990 to 2009, in the vicinity of the Thutade - Upper Finlay River area (i.e., the southern trace occurrence zone) in north-central British Columbia. (Survey units are shown in **Error! Reference source not found.**).

Source	Year	Month	Total Caribou	Survey Unit	Comment
MacDonald*	2009	Apr	80	T12	same day; spatially distinct
Thiessen	2009	Feb-Mar	125	north	5 different days; spatially distinct
McNay	2009	Mar	22 ^a	C11	Same day; spatially distinct
Turney	2007	Jun	52	T02	11 different days
Turney	2005	Feb	15	T02	same day; estimated from tracks
Turney	2005	Apr	15	T02	3 days; estimated from tracks
Turney	2003	Sep	17	T02	3 days; estimated from tracks
Ritchie	1991	Sep	5	C13	same day; spatially distinct
			48 ^b	T02	same day; spatially distinct
			41 ^b	west	same day; spatially distinct
Ritchie	1990	Oct	7 ^b	C13	same day; spatially distinct
			15	T02	same day; spatially distinct

* Survey was conducted in a directed, extensive manner and should not be considered reconnaissance-level.

^a not used towards the estimate of total caribou in the "trace occurrence" zone since the unit is wholly within the Chase herd area

^b used as an estimate of the minimum number of caribou occupying the specific survey unit.

In October 2010, we conducted an extensive population survey. The results of that survey suggested that the previous reconnaissance-level surveys were not suitable to accurately estimate actual population abundance, as almost every survey unit (with the exception of one; C13) had a higher number of individuals counted than previously recorded. In total, the 2010 surveys resulted in 470 individual caribou observations, 60 of which were calf caribou; 13% of the observed population. 216 of the observed caribou were within the trace occurrence zone and the remaining caribou were within either the Chase or Spatsizi herd areas.

Rationale and Objectives

Since 1999, Government and forest licensees based in the Mackenzie TSA have invested greatly (> \$7 million) in the development of information for the purposes of improving conservation of caribou and their habitat in north-central BC. The work has led to large sets of collected data on habitats and habitat use by caribou, moose, and wolves and comprehensive modeling of seasonal range values for caribou (McNay 2011). The study reported here helps close a gap where information on caribou was historically lacking; the gap having been recognized previously as a priority for management action (McNay and Hamilton 2010). The caribou in the study area have been identified as a valued ecosystem component by Tse Keh Nay First Nations (a collaborative planning team consisting of the Tsay Keh Dene, Takla Lake First Nations, and Kwadacha communities). Caribou are also recognized as a species of concern by the Council on the Status of Endangered Wildlife in Canada (COSEWIC, Thomas and Gray 2002).

The objectives of this study are to:

- use data collected to refine herd boundaries for the Chase, Spatsizi, Frog and Finlay herds; and,
- make recommendations for protection of caribou habitat through the Forest and Range Practices Act and the Oil and Gas Activities Act.

The short-term results of the project will be a better understanding of caribou distribution, habitat and population status in an area where limited information was available, and where caribou were previously considered to exist in only trace occurrences.

The long-term results of the project will include recommendations for the protection of caribou habitat, and availability of information needed for assessing risks associated with proposed industrial and other human activities as they arise. The long-term benefits for the TKN First Nations and the BC government include an increased knowledge base of how caribou observed in a “trace occurrence” area contribute to the provincial inventory. The long term results of the project for Au Rico Gold will include a more thorough understanding of the cumulative environmental and socio-economic effects of mining in the Omineca Mountain Region, as well as a more comprehensive understanding of caribou distribution in the area. This will allow for effective follow-up monitoring to accurately assess any effects of mine development on local populations.

STUDY AREA

The study area is in the general vicinity of Thutade Lake and north as far as the upper Finlay River area overlapping the Muskwa-Kechika Management Area. Hence, the study was considered to occur in, and was named as, the Thutade - Upper Finlay River area. The area is situated within the Cassiar Ranges Ecosection and the Southern Boreal Plateau Ecosection of the Boreal Mountains and Plateaus Ecoregion. The delineated caribou herd areas adjacent to the ZTO are: the Frog herd to the north, the Rabbit and Gataga herds to the north-east, the Finlay herd to the east, the Chase herd to the south, and the Spatsizi herd to the west (Figure 1; Heard and Vagt 1998, McNay and Hamilton 2010).

The Cassiar Ranges Ecosection is comprised of rugged mountainous terrain, while the Southern Boreal Plateau Ecosection consists of several deeply incised plateaus with extensive rolling alpine and willow/birch habitats (Demarchi 1996). Biogeoclimatic units in the area are the Spruce-Willow-Birch (SWBmk and mks) in the valley bottoms ranging from approximately 1100 m elevation up to 1300 m where the Alpine-Tundra (ATun) begins and rises to over 2200 m elevation (Meidinger and Pojar 1991). Forest types are dominated by subalpine fir (*Abies lasiocarpa*) at higher elevations but consist of relatively even distribution of subalpine fir, lodgepole pine (*Pinus contorta*), and white spruce (*Picea glauca*) at lower elevations¹. Large portions of the landscape (greater than 35%) are non-forested alpine areas.

Surrounding Caribou Herds

Chase Herd

The Chase Recovery Plan Area (RPA) is 1,733,039 ha, situated in steep mountainous terrain ranging in elevation from 671 to 2466 m, and has four major watersheds including the Ingenika, Osilinka, Swannell and Mesilinka Rivers (Figure 1). It is roughly bounded in the north by the most northerly portion of the Finlay River, in the west by Thutade, Sustut and Driftwood rivers, in the south by Ominicetla Creek, back end of Osilinka River, headwater of Wasi and Flegezand creeks, and in the east by the Williston Reservoir. At low- to mid-elevations, the area is dominated by the BWBSdk1 and SBSmk2 subzone variants, and at mid- to high-elevations the ESSFmv3 subzone variant predominates. The Alpine Tundra (At) prevails above the tree line.

The population was estimated to be between 500-900 caribou in 1996 (Heard and Vagt 1998, Zimmerman *et al.* 2002) but later refined to 475 (McNay *et al.* 2009). Regulated hunting of mature bull caribou occurs in the Chase study area for 12 weeks beginning every August 15th. Hunting by aboriginal people is permitted throughout the entire study area.

¹ Province of BC, Vegetation Resources Information (VRI) home page at <http://www.for.gov.bc.ca/hts/vri/index.html>, cover types evaluated using VRI from Land and Resource Data Warehouse (LRDW) found at <http://www.lrdw.ca/>.

Finlay Herd

The Finlay RPA is 817,500 ha, and is bounded in the north by the Kwadacha River, in the west by the Finlay River and the Finlay Reach of the Williston Reservoir, in the south by the Ospika River and the Ospika Arm of the Williston Reservoir, and in the east by the Rocky Mountains. The central and eastern part of the Akie is dominated by the Northern Rocky Mountains; consequently it is characterized by steep terrain, and has a broad elevation range. It contains several large drainages including the Kwadacha, Akie, and Ospika Rivers. The area is dominated by the BWBS dry cool Stikine variant (BWBSdk1), while at mid- to high-elevations the ESSF moist very cold Graham (ESSFmv4) and the SWB moist cool (SWBmk) variants predominate. The Williston Reservoir shoreline and the lower Ospika River valley bottom are dominated by the SBS moist cool Williston variant (SBSmk2). The AT prevails above the tree line.

In 1996, the Finlay herd was estimated to be 200 to 400 caribou (Heard and Vagt 1998).

Frog Herd

The Frog RPA is 503,856 ha, and the caribou here live in rugged country ranging in elevation from about 750m to 220m. The area is located in the upper Kechika River drainage and is characterized by BWBS, SBS and AT above treeline.

Herd and Vagt (1998) speculated that there were about 150 animals in the herd (which included the Gataga herd) in the mid-nineties. This herd is extremely remote and is so far unaffected by roads, agriculture or timber harvest but the area in the past has been and likely in the future will be considered for hard rock mining and bulldozer ripping.

Spatsizi Herd

The Spatsizi RPA is 1,562,786 ha, and the majority of the herd resides within the Spatsizi Wilderness Park in north western British Columbia. The terrain is primarily mountainous, but the rugged relief in many areas of the park gives way to wide open alpine plateaus and wide glacier-shaped valleys favored by caribou. The area boasts many rivers and lakes (Boonstra and Sinclair 1982).

The Spatsizi caribou herd was considered stable in 1996 with an estimated population of 2200 caribou (Heard and Vagt 1998). More recently, on request by the British Columbia Mountain Caribou Recovery Team a two day survey was conducted in October of 2010 and a total of 671 caribou were counted within Spatsizi park, but did not encompass the entire range of this herd (Williams and Marshall 2010). These caribou were all observed between 1600m and 2000m.

METHODS

Survey Methods

Survey blocks

Prior to the 2010 survey, priority areas were delineated from the southern ZTO, and the study area was stratified into survey units (**Error! Reference source not found.**). The units were generally constructed such that groups of mountain ranges that exemplify high-elevation habitat were amalgamated to create individual polygons, often separated by naturally occurring barriers. Boundaries of the units tended to follow rivers or other topographic features resulting in 17 survey units for the southern ZTO; 13 survey units delineated in 2010 (i.e. T1 to T13) and 4 previously delineated survey units (i.e. C12, C13, C14, and F15-Part) (**Error! Reference source not found.**). The previously delineated survey units were delineated in 2006 as part of the Omineca Northern Caribou project and were included to the southern ZTO since caribou from the Chase and Finlay herds were rarely encountered in these units. Delineation of the study area in this manner allowed us to identify sub-regions of caribou occurrence within the larger ZTO. The sub-divisions also create spatial reference that we can use at the end of the project when we submit our proposal to refine the existing herd boundaries. In 2012, 4 other survey units were added resulting in 21 survey units. Of

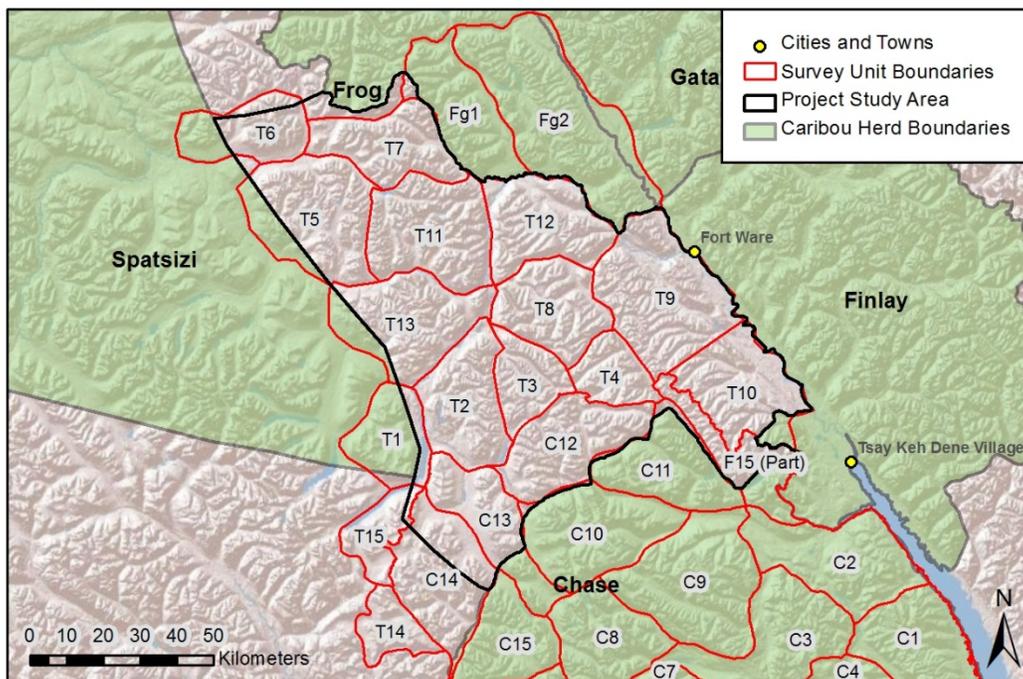


Figure 2. Survey units delineated for the Thutade - Upper Finlay River study area (i.e., the southern trace occurrence zone) and the ones previously delineated when conducting caribou Chase Herd study (C12, C13, C14, and F15), in north-central British Columbia

these 4 new units, 2 were located inside the Frog herd boundary and 2 just south of our most southerly ZTO boundary. These extra units were generated from the GPS

locations received from satellite collar data downloads and were delineated to include all areas in which we could potentially encounter collared caribou.

In October of 2012, reconnaissance effort was spent in 10 of the total 21 survey units (Figure 3); 5 were fully completed (C12, C13, T2, T14, T15), 3 were partially completed (C14, T3, T12), and 2 (Fg1, Fg2) were quickly scrutinized to investigate the potential to encounter caribou. These units were flown over a 5 day period during which the selection was strategically placed on the units with higher potential to encounter caribou. This selection was necessary due to insufficient resources and time, full details of this survey can be found in Rudichuk et al. (2013).

In November 2013, effort was spent in 2 survey units (T8 and T11) in one day (Figure 3). One of which, T11 had never been surveyed for caribou before. T8 had been surveyed before but we decided to resurvey this block because there were no caribou detected in the previous survey. We did not have time or funds to properly survey unit T5 but we did fly over the unit and quickly scrutinized the potential to encounter caribou based on available suitable habitat.

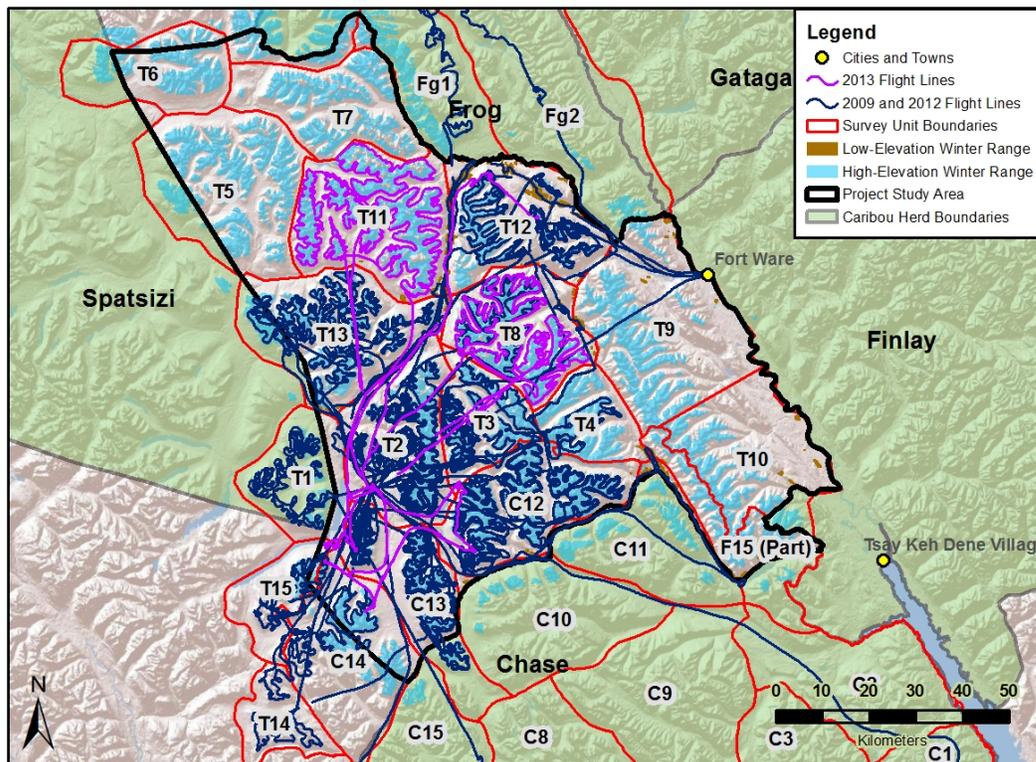


Figure 3. Flight lines during an aerial surveys conducted in and around the Thutade - Upper Finlay River study area (i.e., the southern zone of trace occurrence), in north-central British Columbia, from 2009-2012 (blue lines) and the two blocks surveyed in 2013 (purple lines).

Survey techniques

Population survey techniques and data collection protocols adhered to BC Resource Inventory Standards Committee guidelines for aerial ungulate inventories British

Columbia Ministry of Sustainable Resource Management (BC MSRM 2002). The survey was conducted using a Bell 206 helicopter operated by a pilot who was experienced with flying in rugged mountainous terrain. The crew members accompanying the pilots consisted of one navigator and two observers. To ensure efficient sampling, the navigator directed the pilot to take a direct flight approach towards and through areas delineated as most likely to contain high-value caribou range. This was facilitated using real-time flight tracking based on digital resultant maps of high-elevation winter range that had been previously constructed with modeling methods similar to those described by McNay et al. (2006). In general, the specific range attributes searched included:

- High-elevation winter range characterized by windswept rolling alpine; and,
- High-elevation open subalpine fir forests.

The survey was undertaken according to level-two classifications standards (BC MSRM 2002). During the survey, if multiple groups of animals were encountered in relatively close proximity to each other they were considered separate groups if they were greater than 250 m apart, occurred in different habitats, or displayed different group characteristics or behaviours. Metadata collected for each animal observation included: project name, study area, crew names, survey and census type, date, general location, and general weather conditions. Detailed information for each observation contained: animal identification if marked, species, observation time, group number, group size, gender (if possible), age class, activities, location type, UTM co-ordinates, habitat type, approximate sinking depth in snow (if present), snow cover, and other marked animals in the group (if present).

The navigator used a laptop computer with ArcView® (Environmental Systems Research Institute, Redlands, California) and DNR Garmin² to navigate during the survey and record the flight path. Aircraft speed was held between 60-80 mph depending on relative visibility and the type of terrain encountered. Height-above-ground ranged from 100-300 m depending on openness, tree density, and safety considerations.

Data Management

All data forms were previously approved by the Ministry of Environment and resulting digital data sets were produced in a format, and with appropriate codes, suitable for incorporation into the Wildlife Species Inventory³ (WSI) database.

Collected data were managed digitally and original data sheets archived for safety purposes. Observations were entered into a relational database (Wildlife Information Management System: WIMS, Terra Cognita Software Systems Inc., Prince George, BC). Digital data have been backed-up, archived for safety against accidental data loss, and provided on digital media to the client.

² <http://www.dnr.state.mn.us/mis/gis/tools/arcview/extensions/DNRGarmin/DNRGarmin.html>

³ See <http://www.env.gov.bc.ca/wildlife/wsi/index.htm>

Animal Collaring and GPS Data

We purchased 30 collars, 15 satellite iridium GPS collars (ATS model G2110E) and 15 VHF collars. Our intent was to deploy 1 Sat and 1 VHF collar in each of the 14 southern most survey units in the study area. We were able to deployed 15 Sat and 3 VHF over 2 years (2012 and 2013). Details on these activities are provided in a technical report by MacDonald and McNay (2013). The following is the protocol used:

Animals were caught using a net-propelled (modified) shotgun, fired from a helicopter while hovering above the animal. If possible, the helicopter landed close to the captured animal and immediately shut down. In situations where it is impossible for the helicopter to land and shut down, the crew was dropped-off and the helicopter left the capture site to find a suitable landing place (away from the captured site to avoid extra stress on the caribou). The chase of these animals during capture never exceeded the Resource Inventory Committee (RIC) guidelines for the Live Animal Capture and Handling Guidelines (BC MELP 1998).

Following capture, experienced animal handlers restrained the caribou manually using hobbles and blindfolded it while removing the net. Handling was done as quickly as possible without sudden movements and loud noise. One handler's primary responsibility was maintaining restraint on the caribou, making sure the blindfold stayed in place, and ensuring that the animal's breathing ability was not compromised. The second handler was responsible for placing the radio-collar and collecting any required biotic samples (e.g., blood and hair), and recording essential information. Biological samples and body measurements were collected when possible (e.g. good capture location, animal responding calmly, favorable weather condition, etc). Hobbles were then removed and the animal was released.

Capture techniques used were designed to minimize stress to the animal at all times, and handling times were under 15 mins. Capture sessions occurred in late March 2012 and 2013 and were timed to avoid disturbing the female caribou during their 3rd trimester.

Mortality Site Investigations

Site investigations were conducted as soon as possible after first receiving mortality download from the GPS collars or a mortality signal from the VHF collars. Site investigations included determination of the time of death as well as cause of death. Time of death, was estimated by downloaded locations as well as subjectively determined by the investigator according to evidence at the site (e.g., a qualitative assessment of relative moisture content of the remains) or by investigating patterns in the radio-telemetry data leading up to the first observation of a mortality signal. When sufficient remains occurred at the site, we conducted partial necropsies, took photos for subsequent inspection, and collected any evidence of the source of mortality. Death was classified as one of four causes: (1) accident/nutrition (including incidents involving vehicles, avalanches, starvation- and disease-related mechanisms), (2) human (including hunting and capture myopathy), (3) predation (including wolf, wolverine, lynx or grizzly bear), or (4) unknown. Kills made by wolverine or lynx are generally recognized by substantial head and/or neck injury and by feeding signs consisting of burrowing into the carcass. Kills made by wolves are generally scattered in a wide area

around the site while remains of caribou killed by bears are buried or signs of the hide peeled back. Other evidence at the site, or lack of evidence, was used to help substantiate cause of death such as track patterns, condition of surrounding vegetation, and hair and scat samples were recorded. Malnutrition can be identified by examination of the bone marrow; red, gelatinous bone marrow indicating malnutrition (Cheatum 1949).

Individual Annual Range Analysis

For each animal we defined the annual range size (km²) based on two metrics: minimum convex polygons (conservative estimate) and 95% kernel estimates around the GPS locations using the Hawth's tools extension in ArcGIS (ESRI 2011; ArcGIS Desktop: Release 10. Environmental Systems Research Institute).

First Nations Database Info Methods

First Nations have traditionally used this area for hunting caribou (McKay 1997) and retain a rich knowledge of how caribou historically used the area. This knowledge was collected as an activity under the seed funding year and has been archived in a database held by the TKN⁴. We continue to work with TKN and are awaiting access to this database, but there have been recent administration changes within TKN and we are not as hopeful to gain access. As a result, we are planning a trip up to Tsay Key this summer to interview elders ourselves.

Herd Boundary Refinement

The objective was to improve our knowledge about caribou use of ranges within the ZTO as a way to infer connection (or lack thereof) with adjacent, defined herd areas. For example, if we observed linkages then the outcome would be to re-delineate current herd boundaries to encompass the known linkages. If there were no linkages, the outcome would be to delineate a new herd area. Originally, we planned to use statistics for fidelity and affinity of collared caribou to adjacent herd areas: We have amended this to include a visual inspection of annual ranges and animal movements to infer an affiliation to adjacent herds as most often these were very obvious.

We proposed two potential outcomes for refinements to the surrounding herds to incorporate caribou in the southern ZTO which we will likely amend based on discussion with government and First Nations.

RESULTS

Survey

In the survey conducted in 2012, we encountered caribou in every unit surveyed except T14, in which we only encountered moose; 2 adult female and 1 unknown adult. Within

⁴ Pers. Comm.; Derek Ingram, Land and Resources Director, Tsay Keh Dene, Prince George, BC; 120716.

those 9 survey units, we encountered 32 spatially distinct groups (Figure 4) representing 186 individual caribou (Table 2). The largest group we encountered consisted of 25 animals (survey unit T12).

In 2013, we only encountered 6 caribou during our survey of 2 blocks (T11 and T8). We considered these two blocks as having very low quality habitat for caribou. The mountains in these blocks were very rugged and more suited to mountain goats.

Ancillary observations recorded during the survey included mountain goats and moose.

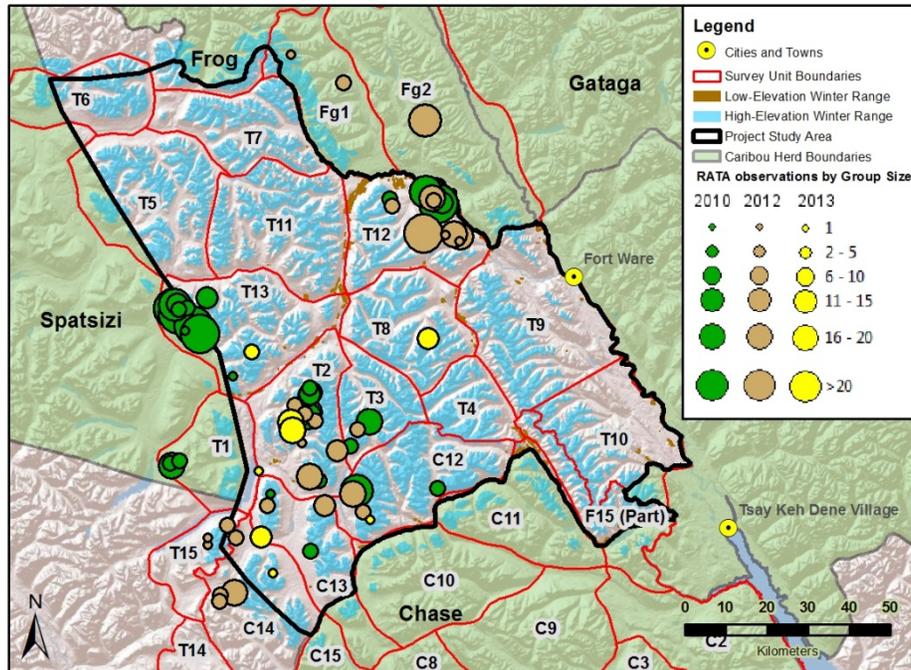


Figure 4. Location of caribou groups identified during aerial surveys and incidental observations during retrieval of collars and other work in the Thutade - Upper Finlay River study area in 2010 (green), 2012 (brown), and 2013 (yellow). Group size is shown by the size of the circle, the larger the circle the more caribou.

Collared Animals and Individual Annual Ranges

In March 2013, we collared an additional 12 caribou (9 GPS and 3 VHF) and currently, as of December 05 2013, a total of 20,845 locations have been downloaded from 15 GPS collared caribou (Table 3).

The largest annual range used by a female caribou was 5,278 km² (using MCP) and 651 km² (using KDE; Figure 5). This caribou had large seasonal movements, moving from the south near the Chase herd to the north into the Spatsizi herd where she died along the Spatsizi River.

Caribou Mortalities

Mortality investigations were conducted on 5 collared caribou (4 Sat and 1 Vhf). Upon investigation, one collar had malfunctioned and prematurely released. Three caribou died of predation, 2 from wolves and 1 likely from a lynx. One caribou died below the high water mark along the banks of the Stikine River and most of the evidence had been washed away only 2 scapulas were found. Interestingly, the collar of this caribou was Table 2. Number and density of caribou observed during an aerial surveys conducted in and around the Thutade - Upper Finlay River study area in north-central British Columbia. Surveys occurred in October 2012 (C12, C13, C14, Fg1, Fg2, T2, T3, T12, T15) and November 2013 (T11, T8).

Survey Unit	Area <i>km²</i>	Total Caribou	Density <i>#/1000km²</i>	Number of Calves	Calves as % of Total
C12	686	15	21.9	2	13.3
C13*	613	8	13.1	0	0
C14*	809	16	19.8	1	6.3
Fg1*	115	3	26.1	1	33.3
Fg2*	754	18	23.9	2	11.1
T2	732	40	54.6	7	14.8
T3	391	3	7.7	1	33.3
T12	727	75	103.2	10	13.3
T15*	308	8	26.0	1	12.5
T11	896	0	0	0	0
T8	637	6	9.4	1	16.7
Total	6668	192	Average 27.8	26	14.1

*Polygon partially or wholly outside trace occurrence zone (Figure 4)

Table 3. Annual range size (km²) using minimum convex polygons (MCP) and 95% kernel density estimates (KDE) from locations of 15 GPS collared individual female caribou in the Thutade - Upper Finlay River study area in north-central British Columbia.

ID	MCP (km²)	95% KDE (km²)	# of points
C293T	697	345	2376
C294T	1027	400	2367
C296T	2745	551	1885
C298T	1113	406	2415
C295T	655	214	2339
C297T	5278	651	2325
C302T	589	169	922
C305T	477	254	1026
C301T	1421	292	1040
C306T	557	247	1007

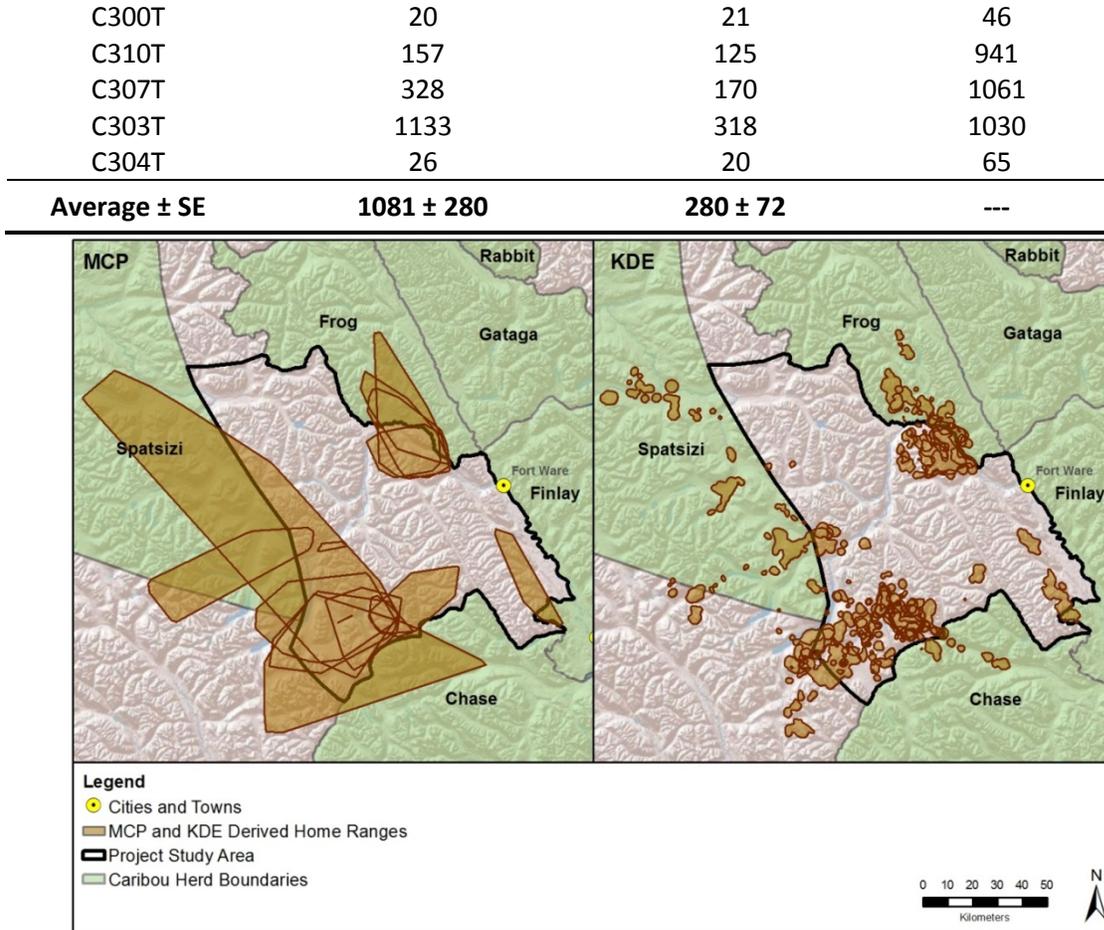


Figure 5. Annual range (km²) size of 15 GPS collared female caribou, in the Thutade - Upper Finlay River study area.

found unmarred (no chew marks or damage to the pin) approximately 250m up on the bank. We were unable to conclude the cause of death.

During the capture session in March 2013, 9 wolves were observed feeding on 3 freshly killed caribou in the high alpine. The observers reported that the wolves were sinking deep into the snow. Recently (2013-12-31), two satellite collars went on mortality, but no investigations have been done to date.

Herd Boundary Refinement

We developed 2 different scenarios for redefining herd boundaries and/or defining new herd boundaries for the caribou within the “southern zone of trace occurrence” (Figure 6). For the final year of the project we will provide these draft scenarios to Tse Key Dene and regional biologist in the Skeena, Omenica and Peace regions and will continue to redefine these boundaries based on feedback for the final draft.

Scenario 1 - expansion of current ranges

This approach incorporated the caribou within the southern ZTO into existing herds by expanding the current herd boundaries (Figure 6). Depending on the legislative restraints of developing 'new caribou herds', expansion of current herd boundaries might be a simpler more efficient approach.

We had several caribou that were collared in the central part of the southern ZTO that traveled long distances (up to 143 kms away) northwest into the Spatsizi herd, for this reason we expanded the Spatsizi herd boundary to the south east. Similar to the Spatsizi

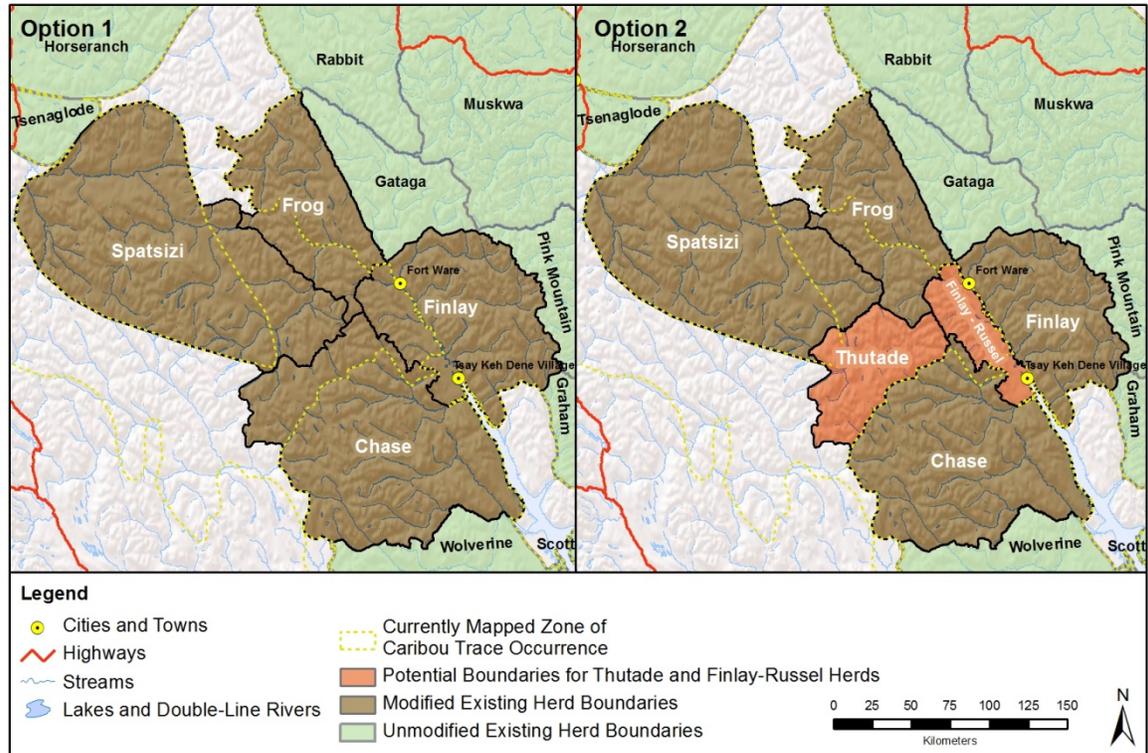


Figure 6. Potential herd boundary refinements to incorporate caribou within the southern zone of trace occurrence into a herd. Option 1 resulted from expanding current herd boundaries and option 2 resulted from creating a new herd.

herd, we observed several collared female caribou south of the Frog herd move north into the Frog herd at certain times of the year leading to the southern expansion of the Frog herd. The Chase boundary was expanded to the north to incorporate the caribou residing in this area as a few of the collared individuals moved south into the Chase herd several times a year. Unfortunately we only had one collared caribou just west of the Finlay River in the Finlay-Russel Mountains. In scenario 1 we expanded the herd boundary west across the Finlay River to incorporate the caribou in this area

Scenario 2 – New Herds

In this scenario, smaller new herds were developed to incorporate caribou that may exhibit different behaviors (i.e., Finlay-Russel) or require different management measures (i.e., Thutade).

Again in this scenario, we expanded the Spatsizi herd boundary west to incorporate the caribou that move east-west through the large plateaus, but we did not extend the border to the south. Instead to the south we proposed a new herd be established called the Thutade herd. The Frog boundary remained the same in both scenarios, as it was very obvious that the caribou that reside to the south of the boundary move north into the Frog herd. During our 2010 and 2012 surveys, block T12 (south of the Frog herd) had some of the highest counts and largest groups of caribou. In this scenario, there were no changes to the Chase or the Finlay caribou herds boundary. We propose a new herd be delineated for the caribou that reside on the west side of the Finlay, “Finlay-Russell” herd. This would happen if for example, the caribou on the west side of the Finlay do not cross over to the east side (or vice versa) and/or they exhibit different behaviors (migratory vs resident).

Thutade and Finlay-Russell Herds

Two new herds have been proposed in this scenario. The first is the Thutade, which encompasses the caribou that reside to the north of the Chase caribou and southeast of the Spatsizi caribou. Some of the caribou in this area make relatively small movements annually not moving out of the areas, while others make larger movements. The second herd is the Finlay-Russell, and it encompasses the caribou on the west side of the Finlay River in the Russel range. It is difficult to know with our current data if these animals move across the Finlay to the east.

DISCUSSION

Based on previous exploratory and reconnaissance-level surveys (McNay 2011)⁵, we now know there is a significant number of caribou in the southern ZTO. We also know that there are no conservation measures in place for these caribou. Defining herd boundaries to include these animals will afford a basis for protection (i.e., a defined management unit) but does not automatically mean the animals are protected from risk posed by industrial development or other land uses.

The 2 refinements we proposed adopted two different strategies. The first was to create larger herd boundaries and thus spreading the management protection of the adjacent herds to the caribou without any delineation. The disadvantage of this method is that smaller pockets of spatially separated caribou are aggregated within the larger herd boundary and the management needs of these caribou are diluted into the needs of the larger herd. Consequently, if a small group is on the brink of extirpation, it will likely not have an effect on the larger herd. The second approach was to delineate new smaller

⁵ McNay, R.S. 2011. Fall Population Survey of Woodland Caribou in the Thutade – Upper Finlay River Area of North-central British Columbia. Wildlife Infometrics Inc. Report No. 383. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.

herds within the southern ZTO. The advantage here is that the management protection allotted to these areas will be better able to address the needs of the smaller groups. We can think of no particular disadvantage of this latter approach.

Animal movements are an important metric for consideration for defining herd boundaries, but administrative and management needs of the caribou also need to be considered. For example, the caribou in the “Thutade” herd in the future could face a high amount of landscape change due industrial development and the issues associated with these changes will likely be different than those of the Spatsizi herd or Chase herd. During discussion with First Nations and Government related to the herd boundary refinements, all of these issues need to be considered and discussed.

LITERATURE CITED

- BC MELP (Minsitry of Environment, Lands and Parks Resources Inventory Branch). 1998. Live Animal Capture and Handling Guidelines for Wild Mammals, Birds, Amphibians and Reptiles. Standards for Componenets of British Columbia's Biodiversity No.3. Version 2. BC Resources Inventory Committee, Ministry of Sustainable Resource Management, Victoria, British Columbia, Canada. 49 pp.
- BC MSRM (Ministry of Sustainable Resource Management). 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. BC Resources Inventory Committee, Ministry of Sustainable Resource Management, Victoria, British Columbia, Canada. 91 pp.
- Boonstra, R. and A.R.E. Sinclair. 1982. Seasonal distribution and major movements patterns of caribou and moose in the Spatsizi Wilderness Area, British Columbia. Ecological reserves collection #223, Government of British Columbia, Victoria, BC.
- Cheatum, E. L. 1949. Bone marrow as an index of malnutrition in deer. N.Y. State Conserv. 3:19-22.
- Demarchi, D. A. 1996. An introduction to the ecoregions of British Columbia. BC Ministry of Environment, Lands and Parks. Victoria, BC.
- Heard, D.C. and K.L. Vagt. 1998. Caribou in British Columbia: a 1996 status report. Rangifer, Special Issue No. 10:117-123.
- MacDonald, F.P. and R.S. McNay. 2013. Herd Boundary Refinement for the Chase, Spatsizi, and Frog Caribou Herds in North-central British Columbia: Capture and Collaring - HCTF Project #7-394. Wildlife Infometrics Inc. Report No. 440. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada
- MacDonald, F., L. Giguere., and R.S. McNay. 2009. Late-winter habitat and its use by caribou in the Upper Pelly and Finlay-Russell portion of the Muskwa-Ketchika Management Area. Wildlife Infometrics Inc. Report No. 318. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada
- McKay, B. 1997. Valleau Creek caribou study. Unpubl. Ms., British Columbia Ministry of Water, Land, and Air Protection, Prince George, B.C. 26pp.
- McNay, R.S. 2011 An expert-based modeling approach to inform strategic and operational land management decisions for the recovery of woodland caribou. Pp. 131-152 In Perera, A.H., D.A. Drew, and C. Johnson (Eds.) Expert knowledge and its application in landscape ecology. Springer, New York.
- McNay, R.S. and D. Hamilton. 2010. A strategy for management of caribou (*Rangifer tarandus caribou*) in British Columbia. Unpubl. Rep., British Columbia Min. of Forests, Lands, and Natural Resource Operations, Prince George, BC.60pp.
- McNay, R.S., R. Sulyma, and L. Giguere. 2009. Abundance and distribution of woodland caribou in the Wolverine and Chase recovery plan areas. Wildlife

Infometrics Inc. Report No. 319. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.

McNay, R.S., B.G. Marcot, V. Brumovsky, and R. Ellis. 2006. A Bayesian approach to evaluating habitat suitability for woodland caribou in north-central British Columbia. *Can. J. For. Res.* 36:3117-3133.

Meidinger, D., and J. Pojar. 1991. *Ecosystems of British Columbia*. BC Ministry Of Forests. Special Report Series 6. Victoria BC.

Rudichuk, K.R., R.S. McNay. and L. Giguere 2013. Herd Boundary Refinement for the Chase, Spatsizi, and Frog Caribou Herds in North-central British Columbia: Calf Recruitment Survey - HCTF Project #7-394. Wildlife Infometrics Inc. Report No. 441. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.

Thomas, D. C., and D. R. Gray. 2002. Update COSEWIC status report on the woodland caribou *Rangifer tarandus caribou* in Canada. Pages 1-98 in COSEWIC assessment and update status report on the woodland caribou *Rangifer tarandus caribou* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, ON.

Williams, M, and R. Marshall. 2010. Ca-33 Spatsizi Caribou herd survey. Unpubl. Rep., British Columbia of Ministry of Forests, Lands, and Natural Resource Operations, Smithers, BC.

Zimmerman, K.L., R.S. McNay, L. Giguere, S. Walshe, G.A. Keddie, L. Wilson, K. Schmidt, P.E. Hengeveld, A.M. Doucette. 2002. Aerial-based Census Results for Caribou and Moose in the Mackenzie Timber Supply Area, March 2002. Wildlife Infometrics Inc. Report No. 44. 31 pp plus appendices.

APPENDIX A. Selected photographs from the survey

Step, rugged mountains with deep snow typical of lower value winter range for caribou



Tracks of caribou on wind swept mountain typical of high value winter range for caribou



Caribou at alpine mining exploration site



Searching for released collar



Caribou mortality



Scapula found in the snow at an older caribou mortality site



Other encountered species - moose observed foraging in alpine



Other encountered species - mountain goats in the rocks

