

# Caribou in Northern British Columbia

## An Assessment of Range Condition and Population Status



**DEBORAH CICHOWSKI,  
R. SCOTT McNAY AND  
JUSTINA C. RAY**

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*Cover Photos:*

Front cover: Northern Mountain Caribou in the Horseranch caribou range. (© Garth Lenz) Back cover: Carcross caribou foraging in high elevation alpine summer habitat in northern BC in June. (Donald Reid)

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# **CARIBOU IN NORTHERN BRITISH COLUMBIA:**

## **AN ASSESSMENT OF RANGE CONDITION AND POPULATION STATUS**

**Deborah Cichowski  
Caribou Ecological Consulting  
Box 3652, Smithers, B.C., V0J 2N0**

**R. Scott McNay  
Wildlife Infometrics Inc.  
Box 308, Mackenzie, B.C. V0J 2C0**

**Justina C. Ray  
Wildlife Conservation Society Canada  
344 Bloor Street West, Suite 204  
Toronto, Ontario, M5S 3A7**

**Funded by**





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## A Note About the Report

This report focusing on caribou and their ranges in northern British Columbia is a summary of available technical information only. A much broader understanding of caribou in northern British Columbia would be gained by the addition of Indigenous Knowledge, especially for long-term changes in population trend and distribution, for which only limited technical information is available.

This report benefitted from information provided to us by BC government biologists. We acknowledge that not all government biologists were able to provide a thorough review, and that interpretations of information presented in this report are our own.



# Summary

## Caribou in Northern British Columbia: An Assessment of Range Condition and Population Status.

Most populations of caribou (*Rangifer tarandus*) in southern British Columbia (BC) have undergone dramatic declines, especially in the last 10-20 years, with seven herds already extirpated and another ten having fewer than 50 individuals. By comparison, information available on caribou numbers in northern BC suggests that populations are typically larger than in the south, but recent population estimates are not available for many herds, and quantitative information on their range condition is lacking.



A bull caribou in high elevation alpine habitat in the Horseranch caribou range. (© Garth Lenz)

We know from abundant scientific information that caribou have a low tolerance for habitat disturbance, particularly from the combined impacts of anthropogenic (human-caused) habitat disturbance (e.g., from resource extraction activities and associated infrastructure) and fire, which results in changes to predator/prey dynamics. While not believed to be in as precarious a situation as their southern counterparts, there are still considerable concerns about the condition of northern caribou populations and their ranges, particularly due to: continued pressures from resource extraction activities, including mining, oil and gas exploration and development, and forest harvesting; roads associated with resource extraction, which can have wide impacts over large areas; and, limited information available about caribou population sizes and trends.

In this report we assess the level of anthropogenic habitat disturbance and fire combined as an indicator of the condition of individual herds and their ranges. We also discuss potential future habitat trends, and review and summarize available information on population sizes and trends. This report is a summary of available technical information only. A much

broad understanding of caribou in northern BC would be gained by the addition of Indigenous Knowledge.

Caribou in the Northern Mountain National Ecological Area (NMNEA) are currently listed as Special Concern under the federal *Species at Risk Act*. Although the Special Concern status does not invoke the general prohibitions under the Act as the current Threatened status of the caribou in the southern part of the province in the Southern Mountain National Ecological Area (SMNEA) does, the Special Concern listing indicates that they “may become a threatened or an endangered species because of a combination of biological characteristics and identified threats”.

We focused on a study area that covers 17 caribou ranges in the mountainous portion of northern BC that stretches from approximately 57° latitude to the Yukon border and that lies west of Fort Nelson. Six of those ranges extend north into Yukon. Although information on exact range boundaries was lacking for some ranges, boundaries were still sufficient to provide a coarse filter view of the level of habitat disturbance on those ranges.

We then adapted a methodology developed by Environment and Climate Change Canada (ECCC) that estimates the level of habitat disturbance on caribou ranges, to the information that was available in our study area. Those methods and data sources are described in full on page 6.

The national recovery strategy for Southern Mountain Caribou identified critical habitat as habitat with minimal disturbance in high elevation winter and summer caribou range as well as in low elevation summer range, and a maximum of 35% habitat disturbance in low elevation winter range and matrix. Matrix range consists of areas within and adjacent to the annual range that caribou may or may not use, but where habitat disturbance will affect caribou through far-reaching effects on predator/prey dynamics.

Because complete information on caribou range use was lacking for northern ranges, we categorised the thresholds as follows: 1) for low elevation areas where large-scale natural disturbances such as fire play a significant role in driving overall habitat disturbance, we adopted the 35% maximum disturbance threshold and 2) for high elevation areas where fire plays a minor role we adopted the minimal (close to 0%) threshold. Matrix range was then assigned to either group based on elevation.

Although these levels of disturbance are not an absolute threshold (i.e., caribou may struggle at lower levels of disturbance or may tolerate higher levels), they are a good guide to the point at which disturbance should trigger concerns for individual caribou ranges.

For each caribou range, we summarized the extent of: each individual type of habitat disturbance; all anthropogenic habitat disturbance combined; and, total habitat disturbance (all types of anthropogenic habitat disturbance combined, plus fire).

Total habitat disturbance (low plus high elevation ranges) makes up about 15% of the combined area of all 17 ranges, with nine ranges above 10%. The three ranges with the highest level of disturbance (Pink Mountain, Muskwa, Liard Plateau) are the three easternmost caribou ranges in the study area, with the majority of habitat disturbance within them in their eastern halves.

Total habitat disturbance in low elevation range equals or exceeds the 35% threshold in five adjacent ranges, including the three easternmost ranges (Liard Plateau, Muskwa, Pink Mountain) and the two southernmost ranges (Finlay, Thutade). Total habitat disturbance in low elevation range is between 20% and 35% on three ranges: Horseranch, Little Rancheria, and Tsenaglode. (We discuss the sources of disturbance, which varies between ranges, on page 7.)

Total habitat disturbance in high elevation range exceeds the minimal (i.e. close to 0%) threshold in all 17 caribou ranges. However, in seven ranges it is less than 5% and in three it is less than 3%. The highest levels of total habitat disturbance in high elevation range are in the Muskwa, Pink Mountain and Tsenaglode ranges.

Total habitat disturbance is higher in the 20 km and 30 km matrices surrounding all 17 caribou ranges combined, than in the caribou ranges themselves. The surrounding 20 km and 30 km matrices include more low elevation range (where habitat disturbance is more prevalent) than in the caribou ranges themselves.



*Caribou in low elevation habitat in the Muskwa caribou range in April.  
(Donald Reid)*

Future trends in levels of habitat disturbance (particularly anthropogenic) for these ranges are difficult to predict. Mineral and coal claims and leases, environmental assessment applications, and timber supply reviews indicate that interest exists in resource extraction activities in the region. Where and to what extent this development will happen is more difficult to predict.

With climate change, wildfires and forest insect outbreaks are also expected to increase. Overall, climate change is expected to result in longer fire seasons and increased fire intensity for this region.

For each caribou range, we also summarized population size and trend information from available technical reports, using information from the 2014 COSEWIC status report as a baseline and updating population size and trend information where more recent information was available. (See Appendix 3 for summaries of population information for individual caribou ranges.) We were only able to determine long-term population trends for four of the 17 populations. Two were increasing (Atlin and Carcross), and two were decreasing (Liard Plateau and Pink Mountain).



Of the two populations that are experiencing known long-term declines in numbers, Pink Mountain had the highest level of anthropogenic habitat disturbance and Liard Plateau had the highest level of fire disturbance across the total range. Those two populations were also two of the three with the highest levels of total habitat disturbance over the whole range, and among the five with the highest levels of total habitat disturbance in the low elevation portions of their ranges. This is consistent with studies that have linked federally-listed Boreal Caribou population condition to habitat disturbance, and with greater impacts on ranges where habitat disturbance was primarily due to anthropogenic habitat disturbance.

Our study points to the need for proactive action for caribou ranges in northern BC, to avoid the precarious situation that caribou in the southern part of the province are in. This will require a coordinated approach across all ranges in northern BC, making caribou conservation a priority and restricting anthropogenic disturbance from core areas. We know from experience in southern BC and other areas that recovering caribou populations once they are declining is very difficult and expensive, requires the application of multiple coordinated recovery actions, and has so far resulted in limited success. Recovery to self-sustaining population status as a result of recovery efforts in caribou ranges in southern BC has yet to be achieved. Further, habitat recovery, even with restoration, can take decades. In northern BC, we still have the ability to take simpler and much more effective steps to conserve caribou if we act now.

We provide the following recommendations to help shift the existing regulatory and policy regimes to ones that provide stronger limits on the amount and spatial extent of landscape disturbances generally and thereby lessen the risk of Northern Mountain Caribou becoming threatened or endangered. All eight recommendations will need to be implemented in keeping with the *BC Declaration on the Rights of Indigenous Peoples Act* (2020) and the Declaration on the Rights of Indigenous Peoples Act Action Plan.

1. Make caribou conservation a priority in northern BC.
2. To better ensure persistence of Northern Mountain Caribou in northern BC, manage all 17 populations and ranges together as a unit.
3. Develop and implement a better system for tracking and sharing data of anthropogenic habitat disturbance (and habitat recovery) for all natural resource extraction sectors to support cumulative effects analysis and management.
4. Protect caribou habitat to provide deliberate and sustained protection of key seasonal ranges and connectivity between populations.
5. Improve our understanding of seasonal range and habitat use, and seasonal range and habitat requirements for Northern Mountain Caribou in northern BC.
6. Develop and implement priorities for habitat restoration across all 17 ranges.
7. Improve monitoring of caribou population status.
8. Revise caribou range boundaries with best available information.

# Table of Contents

|                                                                                      |             |
|--------------------------------------------------------------------------------------|-------------|
| <b>Abbreviations .....</b>                                                           | <b>viii</b> |
| <b>Introduction .....</b>                                                            | <b>1</b>    |
| <b>Study Area .....</b>                                                              | <b>4</b>    |
| <b>Methods .....</b>                                                                 | <b>5</b>    |
| Caribou population and range use characteristics .....                               | 5           |
| Caribou range boundaries .....                                                       | 6           |
| Calculating habitat disturbance within caribou ranges to estimate range condition .. | 6           |
| Habitat disturbance categories and datasets .....                                    | 6           |
| Range categories and thresholds .....                                                | 8           |
| Range condition summaries .....                                                      | 11          |
| Population status.....                                                               | 11          |
| Caribou ranges .....                                                                 | 12          |
| <b>Results .....</b>                                                                 | <b>16</b>   |
| Range condition .....                                                                | 16          |
| Potential future habitat disturbance .....                                           | 25          |
| Population status .....                                                              | 29          |
| <b>Discussion .....</b>                                                              | <b>31</b>   |
| Patterns of habitat disturbance and population status .....                          | 34          |
| <b>Recommendations .....</b>                                                         | <b>38</b>   |
| <b>References .....</b>                                                              | <b>41</b>   |
| <b>Appendix 1. Amalgamating overlapping buffers .....</b>                            | <b>46</b>   |
| <b>Appendix 2. Summary of spatial layers used in the habitat</b>                     |             |
| <b>disturbance analysis .....</b>                                                    | <b>47</b>   |
| <b>Appendix 3. Range summaries .....</b>                                             | <b>49</b>   |
| <b>Appendix 4. Data limitations .....</b>                                            | <b>171</b>  |

## List of Tables

|                                                                                                                                                                                                                        |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>Table 1.</b> Current and recommended designations for caribou in British Columbia.                                                                                                                                  | 2  |
| <b>Table 2.</b> Categories of habitat disturbance used for assessing levels of habitat disturbance on caribou ranges that are wholly or partially in northern British Columbia.....                                    | 7  |
| <b>Table 3.</b> Habitat disturbance thresholds associated with critical habitat attributes for Southern Mountain Caribou that are applicable to “Northern Group” caribou (from EC 2014).....                           | 8  |
| <b>Table 4.</b> Range categories and habitat disturbance thresholds used for analysis of habitat disturbance on caribou ranges that are wholly or partially in northern British Columbia, adapted from EC (2014) ..... | 10 |

|                                                                                                                                                                                                                                                                                                                                                                     |    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>Table 5.</b> Potential boundary issues for caribou ranges that are wholly or partially in northern British Columbia.....                                                                                                                                                                                                                                         | 13 |
| <b>Table 6.</b> High and low elevation proportions (%), and total area of each caribou range and of the 20 km and 30 km matrix surrounding ranges for caribou ranges that are wholly or partially in northern British Columbia .....                                                                                                                                | 14 |
| <b>Table 7.</b> Proportion (%) of each caribou range, and of the 20 km and 30 km matrix surrounding ranges, consisting of fires <40 years old, total anthropogenic habitat disturbance, and total habitat disturbance (fires <40 years old + anthropogenic habitat disturbance), for caribou ranges that are wholly or partially in northern British Columbia ..... | 17 |
| <b>Table 8.</b> Proportion (%) of total range, low elevation range, and high elevation range consisting of fires <40 years old, total anthropogenic habitat disturbance, and total habitat disturbance (due to fires <40 years old + anthropogenic disturbance) on caribou ranges that are wholly or partially in northern British Columbia.....                    | 19 |
| <b>Table 9.</b> Proportion (%) of total area in each habitat disturbance category in caribou ranges that are wholly or partially in northern British Columbia .....                                                                                                                                                                                                 | 22 |
| <b>Table 10.</b> Proportion (%) of total low elevation range area in each habitat disturbance category in caribou ranges that are wholly or partially in northern British Columbia.....                                                                                                                                                                             | 23 |
| <b>Table 11.</b> Proportion (%) of total high elevation range area in each habitat disturbance category in caribou ranges that are wholly or partially in northern British Columbia.....                                                                                                                                                                            | 24 |
| <b>Table 12.</b> Projects listed on the BC Environmental Assessment Office (EAO) website for caribou ranges that a wholly or partially in northern British Columbia ..                                                                                                                                                                                              | 26 |
| <b>Table 13.</b> Population estimates and trends for caribou herds that are wholly or partially in northern British Columbia .....                                                                                                                                                                                                                                  | 30 |

## List of Figures

|                                                                                                                                                                                                                                                           |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>Figure 1.</b> Location of caribou ranges that are wholly or partially in northern British Columbia. The northwestern boundary of the Muskwa range and the northeastern boundary of the Rabbit range are partially overlain by the Alaska Highway ..... | 5  |
| <b>Figure 2.</b> The extent of low and high elevation ranges within each caribou range and within the 20-km and 30-km surrounding matrix for caribou ranges that are wholly or partially in northern British Columbia .....                               | 15 |
| <b>Figure 3.</b> Distribution of fire and anthropogenic habitat disturbance on caribou ranges that are wholly or partially in northern British Columbia .....                                                                                             | 16 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>Figure 4.</b> Caribou ranges that are wholly or partially in northern British Columbia with total habitat disturbance in high elevation range $\geq 5\%$ (orange) and $< 5\%$ (white) (top), and in low elevation range $\geq 35\%$ (orange), 20-34% (yellow) and $< 20\%$ (white) (bottom) .....                                                                                                                                                                                                     | 20 |
| <b>Figure 5.</b> Distribution of forest insect attack (mountain pine beetles, spruce beetles) from 2000 to 2017 in the British Columbia portion of caribou ranges that are wholly or partially in northern British Columbia .....                                                                                                                                                                                                                                                                        | 21 |
| <b>Figure 6.</b> Mineral and placer claims and leases, and coal licenses and leases, in and adjacent to the British Columbia portion of caribou ranges that are wholly or partially in northern British Columbia .....                                                                                                                                                                                                                                                                                   | 26 |
| <b>Figure 7.</b> Timber supply areas (TSAs) in British Columbia that overlap caribou ranges that are wholly or partially in northern British Columbia .....                                                                                                                                                                                                                                                                                                                                              | 28 |
| <b>Figure 8.</b> Total habitat disturbance (fire $< 40$ years + anthropogenic habitat disturbance) in the total range (top), low elevation portion of the range (centre) and high elevation portion of the range (bottom), for caribou ranges that are wholly or partially in northern British Columbia. See Table 13 for codes for caribou ranges. Symbol colours indicate population trend: green = stable or increasing; red = declining; grey = unknown .....                                        | 32 |
| <b>Figure 9.</b> Contribution of fires $< 40$ years (unbuffered) and anthropogenic disturbance (500 m buffer) to total habitat disturbance on the whole range (top), low elevation portion of the range (centre) and high elevation portion of the range (bottom), for caribou ranges that are wholly or partially in northern British Columbia. See Table 13 for codes for caribou ranges. Symbol colours indicate population trend: green = stable or increasing; red = declining; grey = unknown .... | 33 |



# Abbreviations

BC CDC: BC Conservation Data Centre

BC MFLNRORD: BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

DU: Designatable Units (from COSEWIC)

EC: Environment Canada (presently ECCC)

ECCC: Environment and Climate Change Canada (previously EC)

IWMS: Integrated Wildlife Management Strategy

NEA: National Ecological Area

NMNEA: Northern Mountain National Ecological Area

NMP: Northern Mountain Population (as defined by the NMNEA in EC 2012a)

SARA: *Species at Risk Act* (Canada)

SMNEA: Southern Mountain National Ecological Area

## **Biogeoclimatic zones:**

BAFA: Boreal Altai Fescue Alpine

BWBS: Boreal White and Black Spruce

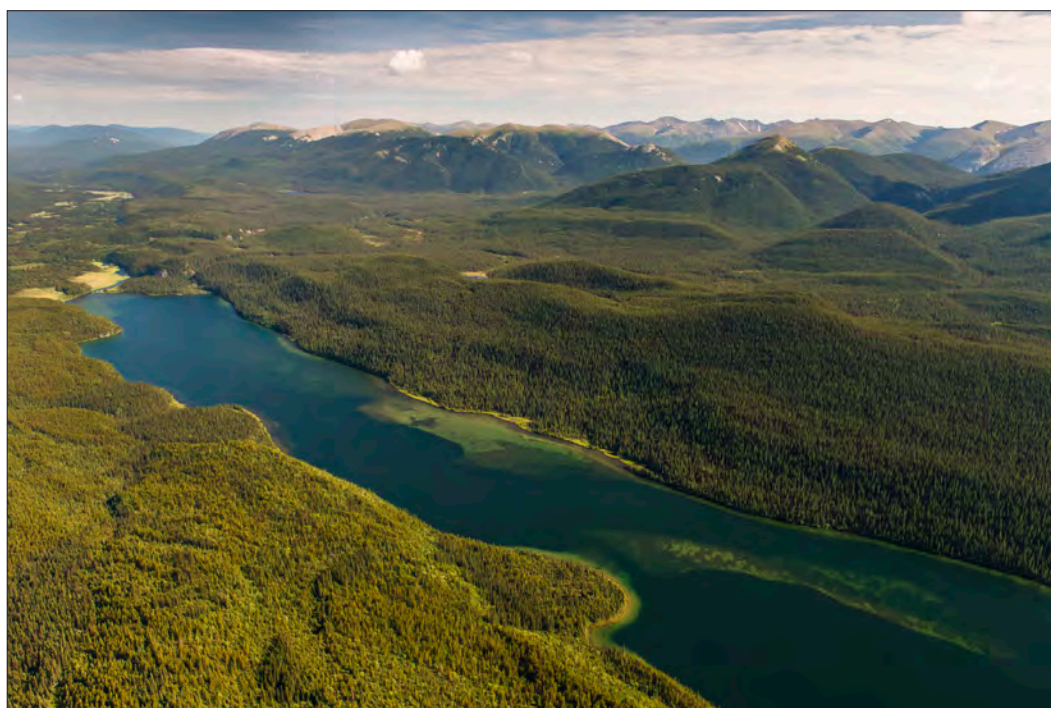
ESSF: Engelmann Spruce-Subalpine Fir

SBS: Sub-Boreal Spruce

SWB: Spruce-Willow-Birch

# Introduction

Most attention on caribou (*Rangifer tarandus*) in British Columbia (BC) has been focused in the southern part of the province, where many populations have undergone dramatic declines, especially in the last 10-20 years, with seven of 31 populations in southern BC currently considered extirpated, and another ten populations having fewer than 50 individuals (BC Caribou Recovery Program 2021). Considerably less is known about the condition of caribou populations and ranges in the mountainous region of northern BC (EC 2012a, COSEWIC 2014, BC Caribou Recovery Program 2021). Northern BC represents one of the last remaining landscapes in the province where the cumulative pressures from natural resource development remain relatively low. Yet continued interests in mineral development, oil and gas, and forestry, together with proposals for protection by Indigenous communities, demand better understanding of the status of sensitive and culturally-important wildlife like caribou, which can serve as barometers of change.



Landscape in the west-central portion of the Rabbit caribou range. (© Garth Lenz)

Together with a number of populations in Yukon and the Northwest Territories (NWT), caribou in northern BC are known as Northern Mountain Caribou – one of 11 caribou “designatable units”<sup>1</sup> recognized federally (COSEWIC 2014); in BC, they belong to the “northern” ecotype of caribou (IWMS 2004). These caribou live in areas where the snow is shallow enough during winter that they can dig through the snow, either in low elevation forests or on windswept alpine slopes, to feed on lichens and other forage growing on the ground (IWMS 2004). They may also eat lichens that grow on trees, both in low elevation forests and in higher elevation subalpine forests. During summer, these caribou prefer to use high elevation alpine and subalpine habitats, but also use low elevation habitat, especially when travelling between winter and summer ranges.

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<sup>1</sup> Designatable Units are recognized by COSEWIC as discrete and evolutionarily significant units of a taxonomic species.

Caribou in northern BC in the Northern Mountain National Ecological Area (NMNEA) are currently listed as Special Concern in Schedule 1 of the *Species at Risk Act*, while caribou in southern BC in the Southern Mountain National Ecological Area (SMNEA) are currently listed as Threatened (Table 1). In 2014, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) grouped mountain-dwelling caribou in western Canada into three Designatable Units (DUs): Northern Mountain (DU7), Central Mountain (DU8), and Southern Mountain (DU9) (COSEWIC 2014). The population numbers and trends for the Central Mountain and Southern Mountain DUs met the criteria for Endangered status, while Northern Mountain DU caribou were assessed as Special Concern (COSEWIC 2014, Ray et al. 2015). As of this writing, the Minister of Environment and Climate Change Canada (ECCC) had not yet implemented COSEWIC’s recommendations. The 2014 assessments were recently referred back to COSEWIC for further information or consideration due to uncertainties relating to DU delineation (including lack of inclusion of Indigenous Knowledge in delineating DUs), insufficient genetic information, and recent changes in population sizes of some herds (Government of Canada 2022). Therefore, current listings and designatable units for mountain-dwelling caribou on the *Species at Risk Act* (SARA) public registry do not reflect the latest COSEWIC assessments (Table 1). Regardless of when Schedule 1 of the *Species at Risk Act* is updated with COSEWIC’s 2014 status recommendations, the current status of mountain-dwelling caribou in the northern part of BC will remain Special Concern, which indicates that they “may become a threatened or an endangered species because of a combination of biological characteristics and identified threats”. As such, they are not subject to general prohibitions under the Act, nor is there any obligation to identify or protect critical habitat.

While there is ample evidence for predation as the main direct cause of boreal and mountain caribou population declines in Canada and of extirpation of many caribou populations (Seip 1992, Wittmer et al. 2005, Serrouya et al. 2011), habitat disturbance and loss from a combination of industrial activities and fire, which result in changes to predator/prey dynamics and to energy budgets, is considered the ultimate cause (Festa-Bianchet et al. 2011, Nagy-Reis et al. 2021). Increased habitat loss on caribou ranges has been linked to: reduced spatial separation between caribou and other prey or predators (Peters 2010);

**Table 1. Current and recommended designations for caribou in British Columbia.**

| Area             | Ecotype (IWMS 2004) <sup>1</sup> | Nationally Significant Population (COSEWIC 2002)/ Current SARA Designation <sup>1</sup> | Designatable Unit (COSEWIC 2014)/ 2014 COSEWIC Recommended Designation <sup>1</sup> | BC CDC population and Status (2017) <sup>1</sup> |
|------------------|----------------------------------|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------|
| Northeastern BC  | Boreal                           | Boreal (Threatened)                                                                     | Boreal (Threatened)                                                                 | Boreal (Red)                                     |
| Northern BC      | Northern                         | Northern Mountain (Special Concern)                                                     | Northern Mountain (Special Concern)                                                 | Northern Mountain (Blue)                         |
| North central BC |                                  | Southern Mountain (Threatened)                                                          |                                                                                     |                                                  |
| West central BC  |                                  |                                                                                         |                                                                                     |                                                  |
| East central BC  |                                  |                                                                                         |                                                                                     |                                                  |
| Southeastern BC  | Mountain                         |                                                                                         | Southern Mountain (Endangered)                                                      | Southern Mountain (Red)                          |

<sup>1</sup> CDC = Conservation Data Centre; COSEWIC = Committee on the Status of Endangered Wildlife in Canada; IWMS = Integrated Wildlife Management Strategy; SARA = *Species at Risk Act* (Canada)

reduced occupancy by caribou (Smith et al. 2000, Apps and McLellan 2006, Wittmer et al. 2007); reduced calf recruitment (McCarthy et al. 2011); displacement of caribou (Chubbs et al. 1993, Schaefer and Mahoney 2007, Weir et al. 2007); reduced adult caribou survival (Smith 2004, Wittmer et al. 2007); caribou population declines (Wittmer et al. 2007); and effects on caribou health (Ewacha et al. 2017, Bondo et al. 2018). Industrial activities can also affect caribou directly through impacts on forage lichens (Kranrod 1996, Sulyma 2001, Miège et al. 2001, Stevenson and Coxson 2007). For Boreal Caribou ranges, the degree of habitat disturbance (i.e., physical change to vegetation/land) on a range caused by human activities negatively affects the viability of caribou populations (EC 2011, Johnson et al. 2020).

Current survey information available on the status of caribou populations and their ranges in northern BC is limited, given the remoteness of the region and the relative infrequency of aerial surveys (EC 2012a, COSEWIC 2014). Although current population sizes are

typically larger than those in southern BC, recent estimates (<5 years old) are available for only 3 out of 17 populations of Northern Mountain Caribou in northern BC (BC Caribou Recovery Program 2021). For the other 14 populations, estimates are more than 5 years old or not available (surveys were conducted for purposes other than estimating population size). Habitat disturbance due to industrial activities and corresponding risk levels are



*Little Rancheria caribou in low elevation winter range. (Hilary Cooke)*

assumed to be lower for caribou ranges in northern BC than in the south. This report provides a compilation of the recent available information on levels of habitat disturbance and population status for 17 Northern Mountain Caribou ranges in northern BC, covering an area of approximately 16 million hectares.

The management plan for the Northern Mountain Caribou population (in the NMNEA) recommends mapping and evaluating current habitat availability in relation to habitat disturbance (human footprint, fire, forest disease outbreaks, access and development), hunting activity, and habitat connectivity, and also recommends conserving key habitats (EC 2012a). Because Special Concern species are not legally required to have critical habitat identified under SARA, the management plan does not provide specific direction related to habitat protection. By contrast, the federal recovery strategy for the threatened Southern Mountain Caribou “population” in southern BC does identify critical habitat for all herds, including nine herds that are members of the revised Northern Mountain Caribou designatable unit (EC 2014). For those “Northern Group” herds, effective protection of critical habitat includes a requirement to maintain a minimum of 65% undisturbed area within low elevation winter range and matrix (see Range categories and thresholds in Methods).

Our objectives with this technical report are:

1. to assess the levels of both fire and anthropogenic (human-caused) habitat disturbance on caribou ranges in northern BC using available GIS datasets;
2. to identify information gaps, data issues and potential future habitat trends; and,
3. to provide updated population information for caribou herds in northern BC where new survey data are available since the COSEWIC (2014) status assessment.

This report is a summary of available technical information only. A much broader understanding of caribou in northern BC would be gained by the addition of Indigenous Knowledge.

## Study Area

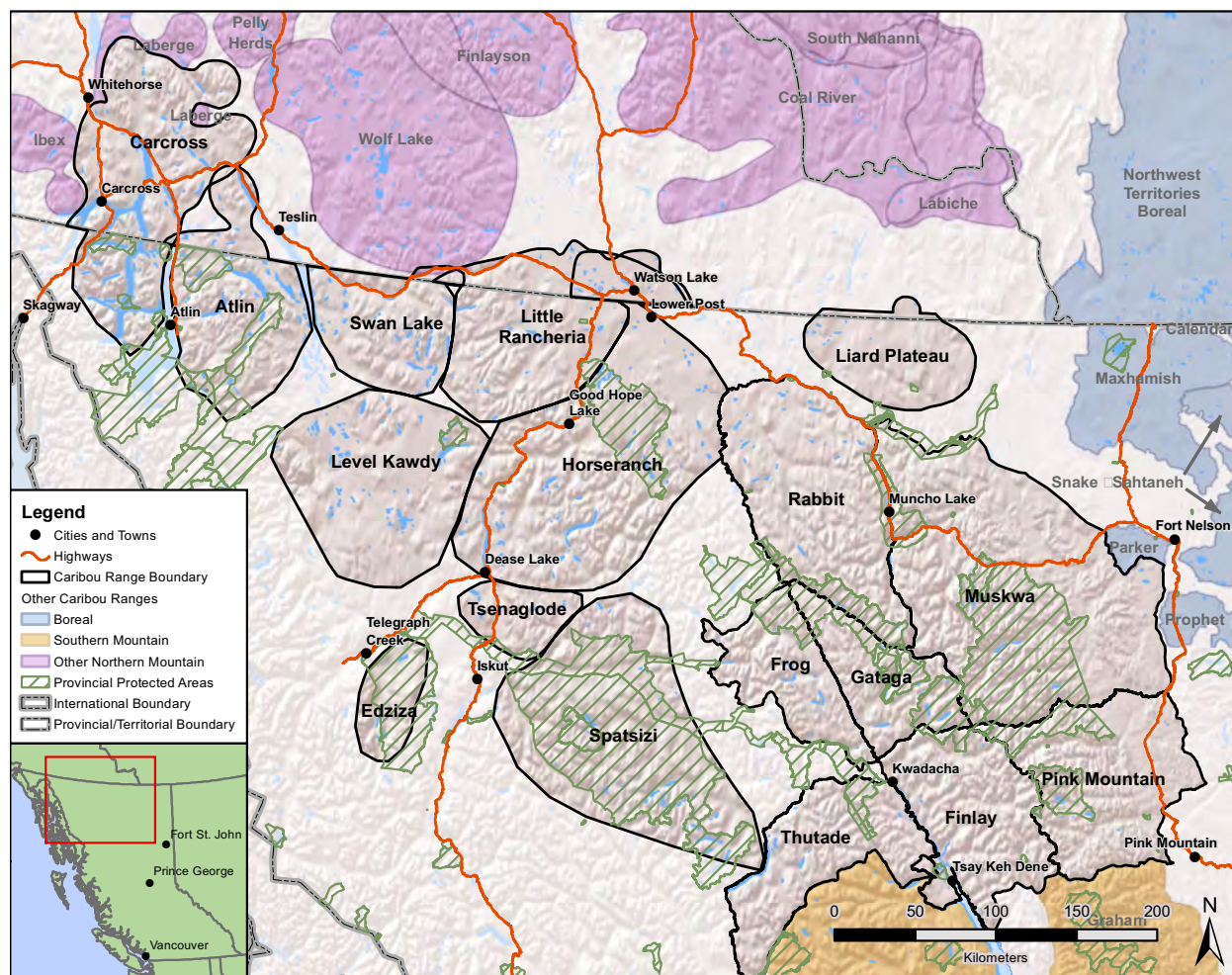
The study area includes 17 caribou ranges in the mountainous portion of northern BC north of approximately 57° latitude to the Yukon border and west of Fort Nelson, six of which overlap with Yukon (Figure 1):

- Carcross,
- Atlin,
- Swan Lake,
- Little Rancheria,
- Horseranch,
- Level Kawdy,
- Edziza,
- Tsenaglode,
- Spatsizi,
- Liard Plateau,
- Rabbit,
- Muskwa,
- Frog,
- Gataga,
- Pink Mountain,
- Finlay, and,
- Thutade.

Low elevation areas throughout the study area lie within the Boreal White and Black Spruce (BWBS) biogeoclimatic zone, other than in the southernmost portions of the Finlay, Atlin and Carcross ranges where low elevations are made up of the Sub-Boreal Spruce (SBS) zone (Meidinger and Pojar 1991). The Spruce-Willow-Birch (SWB) zone lies above the BWBS in most of the study area except in portions of the Finlay, Thutade, Frog, Gataga, Spatsizi, Mt Edziza, and Carcross ranges, where higher elevation forested areas consist of the Engelmann Spruce-Subalpine Fir (ESSF) zone. The Boreal Altai Fescue Alpine (BAFA) zone covers the highest elevation areas throughout the study area.



**Figure 1. Location of caribou ranges that are wholly or partially in northern British Columbia. The northwestern boundary of the Muskwa range and the northeastern boundary of the Rabbit range are partially overlain by the Alaska Highway.**



## Methods

### Caribou population and range use characteristics

We conducted interviews with regional Fish and Wildlife biologists and/or caribou specialists with the BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (BC MFLNRORD) and the Yukon Ministry of Environment to: assemble technical information collected on population size or trend for caribou in northern BC (including populations/ranges shared with Yukon) since the COSEWIC status report (2014); identify potential short-term (0-10 years) and long-term (10-50 years) industrial developments on and adjacent to caribou ranges to estimate potential future risks; and, identify seasonal ranges where possible. We also reviewed available reports and published literature to summarize existing technical information on caribou seasonal range use, population size and population trend. Our interpretations of this information are our own, and have not been reviewed in depth by government biologists.

## **Caribou range boundaries**

We talked to BC MFLNRORD regional biologists to assess whether any caribou range boundaries required adjusting prior to the analysis. Although regional biologists felt that new information merited some adjustments, they were unable to provide us with revised boundaries at this time, other than the addition of the Thutade range that covered a portion of the area between currently delineated ranges that had previously been considered to contain few caribou (see Sittler et al. 2015). Consequently, we used currently available BC caribou range boundaries, which were finalized in 2008, and the Thutade range boundary provided by BC MFLNRORD. For the Yukon portion of the ranges, we used range boundaries defined by Yukon (Hegel and Russell 2013).

## **Calculating habitat disturbance within caribou ranges to estimate range condition**

### ***Habitat disturbance categories and datasets***

To assess range condition as a function of levels of habitat disturbance on caribou ranges in northern BC, we used the following procedure, which is based on methods used by ECCC for Boreal Caribou (EC 2011), and for the identification of critical habitat for Boreal Caribou (EC 2012b) and Southern Mountain Caribou (EC 2014):

1. We categorized habitat disturbance (using provincially-available data layers) into categories that were consistent with those used by ECCC (Table 2, EC 2011, EC 2014).
2. For anthropogenic habitat disturbance, we applied a 500 m buffer around both area-based disturbances (e.g., clearcuts, mines) and linear disturbances (e.g., roads, seismic lines) (EC 2011, 2014). The 500 m buffer was not applied to reservoirs (e.g., Williston Lake).
3. For all types of anthropogenic habitat disturbance, we dissolved the buffer around each individual type of habitat disturbance with adjoining overlapping buffers of the same type of disturbance to eliminate “double-counting” of areas within overlapping buffers (see Appendix 1). Similarly, for all anthropogenic habitat disturbance combined, we dissolved the footprints of all types of anthropogenic habitat disturbance and buffers to eliminate double-counting overlapping disturbances and their buffers.
4. To calculate total habitat disturbance, we merged the total combined anthropogenic habitat disturbance layer with the total area of fires that were less than 40 years old. Any area that was subjected to both disturbance types was dissolved to prevent “double-counting” the area in the calculation of the total area affected by habitat disturbance. Consistent with ECCC methods, areas affected by forest insects were not included in the calculation of total habitat disturbance.

Other than forest harvesting, most anthropogenic habitat disturbance is considered permanent or semi-permanent, where vegetation has been permanently removed and is not undergoing “natural” vegetation succession or has not been actively restored (Table 2). Forest harvesting and “natural” disturbances are considered temporary habitat disturbances, where vegetation eventually recovers naturally or is actively restored following the initial disturbance.

**Table 2. Categories of habitat disturbance used for assessing levels of habitat disturbance on caribou ranges that are wholly or partially in northern British Columbia.**

| Habitat disturbance category                    | Habitat disturbance type               |                        |
|-------------------------------------------------|----------------------------------------|------------------------|
|                                                 | Permanent/ semi-permanent <sup>1</sup> | Temporary <sup>2</sup> |
| <b><i>Anthropogenic habitat disturbance</i></b> |                                        |                        |
| Settlement                                      | X                                      |                        |
| Agriculture                                     | X                                      |                        |
| Recreation                                      | X                                      |                        |
| Airstrip                                        | X                                      |                        |
| Reservoir                                       | X                                      |                        |
| Dam                                             | X                                      |                        |
| Powerline                                       | X                                      |                        |
| Road/trail                                      | X                                      |                        |
| Railroad                                        | X                                      |                        |
| Mine                                            | X                                      |                        |
| Oil/gas facility                                | X                                      |                        |
| Pipeline                                        | X                                      |                        |
| Oil/gas well                                    |                                        | X                      |
| Seismic line                                    |                                        | X                      |
| Forest harvesting                               |                                        | X                      |
| <b><i>Natural disturbance</i></b>               |                                        |                        |
| Fire                                            |                                        | X                      |
| Mountain pine beetle                            |                                        | X                      |
| Spruce bark beetle                              |                                        | X                      |
| Balsam bark beetle                              |                                        | X                      |

<sup>1</sup> The disturbed area is maintained as a permanent or long-lasting feature on the landscape where vegetation has been permanently removed and is not undergoing “natural” vegetation succession or has not been actively restored.

<sup>2</sup> The disturbed area is not maintained as a permanent or long-lasting feature; therefore, vegetation can re-establish following the initial disturbance either naturally or through restoration activities. Although we classified wells sites and seismic lines as temporary habitat disturbances, some of those disturbed sites are likely to require active restoration.

We assessed habitat disturbance levels by type within caribou ranges in northern BC using spatial data layers that were publicly available through the BC data warehouse and the BC Oil and Gas Commission’s data portal. An additional spatial dataset that was collected for a cumulative effects project in northwestern BC that included mine footprints and mining roads, was provided by BC MFLNRORD. For the six ranges that overlapped Yukon (Carcross, Atlin, Swan Lake, Little Rancheria, Horseranch, Liard Plateau), we accessed spatial habitat disturbance data for the Yukon portion of those ranges through the Geomatics Yukon FTP site. A detailed listing of data sources is included in Appendix 2. Apart from forest harvest, dates of most anthropogenic disturbances are not available.

For determining the occurrence of anthropogenic habitat disturbance, our methods differed from those of ECCC (EC 2011, 2012b, 2014) in that ECCC mapped anthropogenic habitat disturbances that could be detected using 1:50,000 scale Landsat satellite imagery (from 2008 to 2010) and using other sources of data to aid in categorizing the type of disturbance (EC 2011). On the other hand, our methods for assessing natural disturbances were similar to those of ECCC (2011) in using provincial spatial data layers to map fires. ECCC

(2011) limited the age of fires to less than 40 years because fire data were only available for a maximum of 40 years in some provinces. We also used fires up to 40 years of age in the calculation of total habitat disturbance (consistent with EC (2011)), but there was sufficient information to assess fires up to 50 years of age, so our summary tables included both fires less than 40 years (used by EC 2011) and fires less than 50 years.

Although we used spatial data layers to quantify and delineate anthropogenic habitat disturbance while ECCC (EC 2011, 2012b, ECCC 2014) identified anthropogenic habitat disturbance from 1:50,000 scale satellite photos, we expect that the distribution and relative levels of anthropogenic habitat disturbance on the landscape would be very similar using both methods.

We accessed spatial datasets in 2017. As a result, the 40-year fire dataset includes fires from 1978 to 2017, and the 50-year fire dataset includes fires from 1968 to 2017.

In addition, we calculated the area affected by mountain pine beetles (*Dendrotonus ponderosae*) and spruce beetles (*Dendroctonus rufipennis*) from 2000 to 2017 from spatial layers that were publicly available from the BC data warehouse. Area of forest insect attack is not included as part of the overall habitat disturbance calculation by ECCC (2014) and therefore we also do not include it in our calculation of habitat disturbance. However, we report it in our summary of levels of individual types of habitat disturbances because extensive mountain pine beetle attack is present in low elevation areas in the southeastern portion of the study area.

### **Range categories and thresholds**

To assess the significance of the level of habitat disturbance on caribou ranges in northern BC, we used the habitat disturbance thresholds identified for critical habitat that applied to the “Northern Group” of caribou in the federal recovery strategy for Southern Mountain Caribou (EC 2014) as a surrogate and adapted them to fit data that were available in our study. Of the four critical habitat attributes required by caribou to carry out life processes, three included habitat disturbance thresholds and one included a predator density threshold (Table 3). Matrix range consists of areas either within (Type 1) or surrounding (Type 2) caribou ranges where predator/prey dynamics influence predation on caribou within their annual range (EC 2014). Although caribou may not use these areas regularly, or use them less often than they use other parts of their range (such as during travel between seasonal ranges), habitat disturbance in matrix range will affect caribou through effects on predator/

**Table 3. Habitat disturbance thresholds associated with critical habitat attributes for Southern Mountain Caribou that are applicable to “Northern Group” caribou (from EC 2014).**

| Critical habitat attribute                       | Habitat disturbance threshold <sup>1</sup> |
|--------------------------------------------------|--------------------------------------------|
| High elevation winter and/or summer range        | Minimal (i.e. close to 0%)                 |
| Low elevation summer range                       | Minimal (i.e. close to 0%)                 |
| Low elevation winter range + Type 1 matrix range | 35%                                        |
| Type 2 matrix range <sup>3</sup>                 | NA <sup>4</sup>                            |

<sup>1</sup> Total habitat disturbance = anthropogenic habitat disturbance (including a 500 m buffer) + fire (no buffer)

<sup>2</sup> Type 1 matrix range = matrix range within the annual range (from EC 2014)

<sup>3</sup> Type 2 matrix range = matrix range surrounding annual range (from EC 2014)

<sup>4</sup> Threshold is a wolf density of < 3 wolves/1000 km (from EC 2014)



prey dynamics. Overall, critical habitat in the recovery strategy has been defined as minimal to no habitat disturbance in high elevation winter and/or summer range and in low elevation summer range, and a maximum of 35% habitat disturbance in low elevation winter range and matrix (Table 3).

The 35% habitat disturbance threshold for low elevation winter range + Type 1 matrix range is based on a meta-analysis that was conducted for Boreal Caribou ranges in Canada (EC 2011, EC 2014). Although a similar analysis for Southern Mountain Caribou is not available, the 35% habitat disturbance threshold was chosen as a reference level because low elevation winter ranges and matrix range in “Northern Group” caribou ranges are ecologically similar to Boreal Caribou ranges (EC 2014). That is, fire plays a significant role in natural disturbance dynamics in low elevation winter ranges and adjacent matrix range for “Northern Group” caribou, which is similar to the role of fire in natural disturbance dynamics in Boreal Caribou ranges (EC 2014).



*Top: Example of Horseranch and Little Rancheria caribou low elevation winter range with extensive mature coniferous forests. Bottom: During winter, caribou use open mature coniferous stands with an abundant ground cover of lichens (light colour). (Donald Reid)*

It is, however, important to stress that the threshold applied originally to identify critical habitat in the Boreal Caribou recovery strategy (EC 2012b) and then used to characterize Southern Mountain Caribou critical habitat (EC 2014) is a “management threshold” informed by science, i.e., an empirical relationship between landscape disturbance and population health, as indicated by recruitment (EC 2011). Because the “disturbance-recruitment relationship” is in reality characterized by a continuum of risk, and not an inflection point (Johnson and Ray 2021), the management threshold associated with critical habitat identification reflects a social decision accepting a 60% probability of persistence. In this report, we use habitat disturbance levels within caribou ranges relative to these thresholds to relate recent habitat conditions to the likelihood of population persistence derived from the critical habitat model (EC 2011).

To apply ECCC’s (EC 2014) habitat disturbance thresholds as a management indicator, we required information on individual critical habitat attributes for each range in northern BC. However, there was insufficient information for most caribou ranges in BC for MFLNRORD regional biologists to provide us with seasonal or matrix ranges. Therefore, we simplified the categories into “high elevation range” and “low elevation range” and applied habitat disturbance thresholds from ECCC (2014) that reflected natural disturbance dynamics (Table 4). That is, we used the 35% threshold for low elevation range where large



**Table 4. Range categories and habitat disturbance thresholds used for analysis of habitat disturbance on caribou ranges that are wholly or partially in northern British Columbia, adapted from EC (2014).**

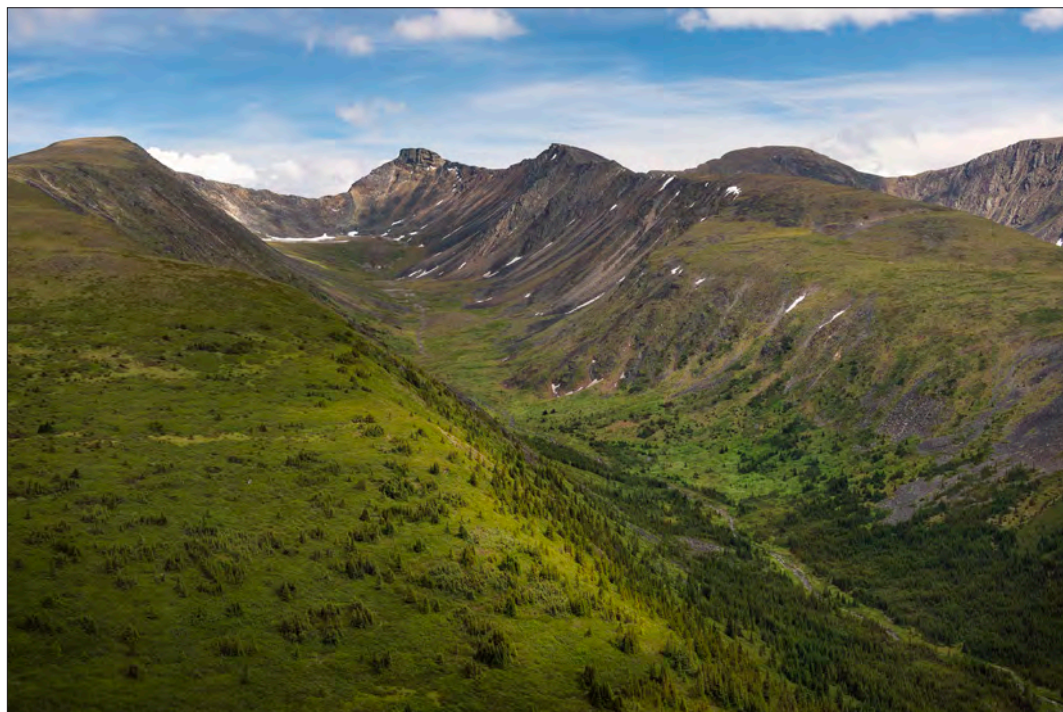
| Range category                    | Maximum habitat disturbance <sup>1</sup> |
|-----------------------------------|------------------------------------------|
| High elevation range <sup>2</sup> | Minimal (i.e. close to 0%)               |
| Low elevation range <sup>3</sup>  | 35%                                      |

<sup>1</sup> Habitat disturbance = anthropogenic habitat disturbance (including a 500 m buffer) + fire (no buffer)

<sup>2</sup> Includes high elevation Type 1 matrix range

<sup>3</sup> Includes low elevation Type 1 matrix range

scale natural disturbances such as fire play a significant role in driving overall habitat disturbance, and used the minimal (i.e. close to 0%) threshold for high elevation ranges where fire plays a minor role. Low elevation Type 1 matrix range is included in the “Low elevation range” category and High elevation Type 1 matrix range is included in the “High elevation range” category.



*High elevation alpine habitat in the Horseranch caribou range. (© Garth Lenz)*

In the absence of previously delineated high and low elevation ranges, we used the BAFA, ESSF and SWB biogeoclimatic zones to represent high elevation range, and the remaining area (BWBS and SBS zones) to represent low elevation range. We considered these reasonable ecological approximations that could be applied consistently across all ranges. High elevation ranges include areas above about 800-1200 m (depending on location within the study area), based on the lower boundary of the high elevation biogeoclimatic zones (Banner et al. 1993, DeLong 2004). For the Yukon portions of the six transboundary ranges, we estimated the extent of high elevation range using Yukon Territory’s Bioclimate Zones data set. We considered any area covered by the Boreal Alpine Tundra, Boreal High, or Boreal Subalpine zones to be high elevation range with the remainder (i.e. Boreal

Low) classed as low elevation range. Initially, for the Yukon portion of the caribou ranges, we attempted to approximate high elevation range by determining the average elevation of the boundary between the BWBS and SWB zones at the BC/Yukon boundary, but this approach did not capture the biogeoclimatic variability of the landscape as well as the bioclimate zone data did. Additionally, a small portion of the 30 km matrix (see below) extends into the state of Alaska (~40 850 ha). In that case, we approximated the high and low elevation zones using manual digitization based on Bing Maps imagery using the adjacent BC biogeoclimatic mapping as a guide. This was only feasible due to the small size of the area that needed to be mapped.

In addition to assessing habitat disturbance levels within currently-delineated caribou range boundaries in northern BC, we conducted similar assessments in areas surrounding each range within 20 km and within 30 km of each range boundary. The two distances provide options for assessing the level and types of habitat disturbance in matrix range that surrounds individual caribou ranges. The surrounding area also provides spatial context for where habitat disturbance is located if adjustments are made to caribou range boundaries in the future.

### ***Range condition summaries***

For each caribou range, for both high elevation and low elevation portions, we summarized:

- the extent of habitat disturbance due to: each type of anthropogenic habitat disturbance; and, each type of natural disturbance (fires <40 years, fires <50 years, forest insect attack);
- the extent of anthropogenic habitat disturbance for all types combined;
- the extent of total habitat disturbance (all types of anthropogenic habitat disturbance combined plus fires less than 40 years old); and,
- within 20 km and 30 km surrounding each caribou range, the extent of habitat disturbance due to: each type of habitat disturbance; all types of anthropogenic habitat disturbance combined; and, total habitat disturbance (including fire).

For the six transboundary caribou ranges, we summarized the habitat disturbance information described above for the BC portion of each range, and for the total area of each range (BC + Yukon).

We also summarized the information described above for individual ranges and for the aggregated area of all caribou ranges combined, including the extent of habitat disturbance within 20 km and 30 km surrounding each range and the aggregated area.

The results section contains roll-ups of information across all caribou ranges in the study area. Maps and summaries of information for individual caribou herds and their ranges are provided in Appendix 3.

### ***Population status***

For each caribou herd, we summarized population information from available technical reports. We used information from the 2014 COSEWIC status report (COSEWIC 2014) as a baseline and updated population size and trend information where more recent information was available. Detailed summaries for each caribou herd are provided in Appendix 3.

Where possible, we assessed population trend, based on consecutive population surveys or measures of calf recruitment (see detailed methods in Appendix 3). We explored the relationship between habitat disturbance levels on individual ranges to their corresponding population trends. Subsequent to our initial compilation of population information, the BC Caribou Recovery Program developed a summary of population size and trend information for all caribou populations in BC (BC Caribou Recovery Program 2021), which we checked against the estimates we derived. For population trend, we used long-term population trend information summarized from Appendix 3.

## **Caribou ranges**

We identified several potential issues with range boundaries in the study area (Table 5) including:

- the BC and Yukon boundaries for the six transboundary ranges did not line up, as they were derived independently in each jurisdiction;
- most range boundaries in northwestern BC were coarsely drawn, resulting in gaps between ranges that likely do not reflect actual gaps in distribution;
- discussions with BC MFLNRORD biologists, and telemetry and observation data suggest that:
  - some ranges may need to be expanded into areas that are currently not included in any caribou ranges;
  - distribution of several caribou populations overlap and therefore range boundaries should overlap in those areas;
- the large gap between caribou ranges in the centre of the study area is known to contain caribou (see Appendix 3: Range Summaries – Low density area) and may need to be incorporated into adjacent ranges, or added as new range(s); and,
- the Edziza caribou range is offset from the known range, excluding the eastern portion of the Mt Edziza mountain block.

We could not address these boundary issues at this time (see Caribou range boundaries); therefore, we used the currently available caribou boundaries.



*High elevation plateaus, such as the Spatsizi Plateau, are used by caribou during both summer and winter. (Deborah Cichowski)*

Approximately two-thirds of the combined area in currently-delineated caribou ranges in northern BC consists of high elevations as defined by the SWB, ESSF or BAFA biogeoclimatic zones (Table 6, Figure 2). The other third consists of low elevations, primarily in the BWBS. Within individual caribou ranges, the extent of high elevation range varies from 47% in the Little Rancheria range to 89% in the Frog, Thutade and Tsenaglude ranges.

**Table 5. Potential boundary issues for caribou ranges that are wholly or partially in northern British Columbia.**

| Potential boundary issue                                                                                                                   | Carcross | Atlin | Swan Lake | Little Rancheria | Horseshoe | Level Kaudy | Edziza | Tsenaglade | Spatsizi | Liard Plateau | Rabbit | Muskwa | Pink Mountain | Gataga | Frog | Finlay | Thutade |
|--------------------------------------------------------------------------------------------------------------------------------------------|----------|-------|-----------|------------------|-----------|-------------|--------|------------|----------|---------------|--------|--------|---------------|--------|------|--------|---------|
| BC/Yukon caribou range boundaries do not line up                                                                                           | X        | X     | X         | X                | X         |             |        |            |          | X             |        |        |               |        |      |        |         |
| Range boundaries coarsely drawn resulting in gaps between ranges                                                                           | X        | X     | X         | X                | X         | X           |        | X          | X        |               |        |        |               |        |      |        |         |
| Telemetry and observation data suggest boundaries should be expanded into some areas that are currently not included in any caribou ranges |          |       |           |                  |           |             |        |            | X        |               |        |        |               |        | X    |        |         |
| Telemetry data suggest overlap between adjacent ranges                                                                                     |          |       | X         | X                | X         | X           |        | X          | X        |               |        |        | X             |        |      | X      |         |
| The large gap between caribou ranges in the centre of the study area is known to contain caribou                                           |          |       |           |                  | X         |             |        | X          | X        |               | X      |        |               |        | X    |        |         |
| Boundaries coarse and offset from known range use                                                                                          |          |       |           |                  |           |             | X      |            |          |               |        |        |               |        |      |        |         |
| Available information insufficient to evaluate issues with boundaries                                                                      |          |       |           |                  |           |             |        |            |          |               | X      |        |               | X      | X    |        |         |

**Table 6. High and low elevation proportions (%), and total area of each caribou range and of the 20 km and 30 km matrix surrounding ranges for caribou ranges that are wholly or partially in northern British Columbia.**

|                            | Range                      |                             |                  | 0-20 km matrix surrounding range |                             |                  |                                            | 0-30 km matrix surrounding range |                             |                  |                                            |
|----------------------------|----------------------------|-----------------------------|------------------|----------------------------------|-----------------------------|------------------|--------------------------------------------|----------------------------------|-----------------------------|------------------|--------------------------------------------|
|                            | Low elevation <sup>1</sup> | High elevation <sup>2</sup> | Total Range (ha) | Low elevation <sup>1</sup>       | High elevation <sup>2</sup> | Total Range (ha) | % of matrix in adjacent range <sup>3</sup> | Low elevation <sup>1</sup>       | High elevation <sup>2</sup> | Total Range (ha) | % of matrix in adjacent range <sup>3</sup> |
| Atlin (Total)              | 40.3                       | 59.7                        | 858 401          | 54.2                             | 45.8                        | 959 801          | 35.7 (NM)                                  | 53.0                             | 47.0                        | 1 516 826        | 41.0 (NM)                                  |
| Atlin (BC only)            | 41.9                       | 58.1                        | 695 385          | 62.8                             | 37.2                        | 566 293          | 30.7 (NM)                                  | 59.9                             | 40.1                        | 893 837          | 37.2 (NM)                                  |
| Carcross (Total)           | 40.7                       | 59.3                        | 1 273 592        | 32.7                             | 67.3                        | 1 203 133        | 41.2 (NM)                                  | 29.5                             | 70.5                        | 1 870 606        | 41.6 (NM)                                  |
| Carcross (BC only)         | 49.0                       | 51.0                        | 324 060          | 36.2                             | 63.8                        | 413 599          | 20.4 (NM)                                  | 30.7                             | 69.3                        | 632 286          | 25.6 (NM)                                  |
| Edziza                     | 27.3                       | 72.7                        | 235 185          | 36.4                             | 63.6                        | 514 300          | 0                                          | 39.6                             | 60.4                        | 865 688          | 0.2 (NM)                                   |
| Finlay                     | 24.1                       | 75.9                        | 817 094          | 23.8                             | 76.2                        | 982 244          | 62.7 (NM)<br>22.1 (SM)                     | 20.9                             | 79.1                        | 1 525 168        | 60.4 (NM)<br>25.6 (SM)                     |
| Frog                       | 11.3                       | 88.7                        | 504 069          | 22.9                             | 77.1                        | 885 050          | 41.0 (NM)                                  | 21.5                             | 78.5                        | 1 392 243        | 63.1 (NM)                                  |
| Gataga                     | 22.3                       | 77.7                        | 500 703          | 18.7                             | 81.3                        | 845 787          | 92.3 (NM)                                  | 16.4                             | 83.6                        | 1 352 795        | 90.6 (NM)                                  |
| Horseranch (Total)         | 47.3                       | 52.7                        | 1 945 173        | 51.4                             | 48.6                        | 1 473 971        | 57.2 (NM)                                  | 48.5                             | 51.5                        | 2 272 285        | 57.3 (NM)                                  |
| Horseranch (BC only)       | 42.9                       | 57.1                        | 1 779 688        | 45.8                             | 54.2                        | 1 195 352        | 63.3 (NM)                                  | 43.8                             | 56.2                        | 1 807 609        | 65.7 (NM)                                  |
| Level Kawdy                | 14.3                       | 85.7                        | 1 135 902        | 36.8                             | 63.2                        | 921 841          | 36.6 (NM)                                  | 36.5                             | 63.5                        | 1 477 004        | 41.5 (NM)                                  |
| Liard Plateau (Total)      | 48.9                       | 51.1                        | 520 304          | 74.2                             | 25.8                        | 690 962          | 8.9 (NM)                                   | 76.2                             | 23.8                        | 1 128 170        | 15.8 (NM)                                  |
| Liard Plateau (BC only)    | 49.1                       | 50.9                        | 475 350          | 91.5                             | 8.5                         | 435 358          | 14.2 (NM)                                  | 89.9                             | 10.1                        | 696 906          | 25.6 (NM)                                  |
| Little Rancheria (Total)   | 53.4                       | 46.6                        | 1 055 816        | 45.3                             | 54.7                        | 1 054 289        | 58.5 (NM)                                  | 42.7                             | 57.3                        | 1 662 553        | 60.6 (NM)                                  |
| Little Rancheria (BC only) | 46.0                       | 54.0                        | 698 569          | 41.2                             | 58.8                        | 612 209          | 83.3 (NM)                                  | 41.6                             | 58.4                        | 957 387          | 85.7 (NM)                                  |
| Muskwa                     | 41.8                       | 58.2                        | 2 158 213        | 56.6                             | 43.4                        | 1 481 104        | 54.4 (NM)<br>9.9 (Boreal)                  | 56.0                             | 44.0                        | 2 281 006        | 56.4 (NM)<br>8.4 (B)                       |
| Pink Mountain              | 34.8                       | 65.2                        | 957 542          | 45.7                             | 54.3                        | 1 067 608        | 53.3 (NM)<br>15.2 (SM)                     | 44.1                             | 55.9                        | 1 669 138        | 51.4 (NM)<br>15.0 (SM)<br>0.1 (Boreal)     |
| Rabbit                     | 31.7                       | 68.3                        | 1 179 409        | 47.9                             | 52.1                        | 1 093 947        | 64.7 (NM)                                  | 45.1                             | 54.9                        | 1 721 485        | 67.5 (NM)                                  |
| Spatsizi                   | 17.7                       | 82.3                        | 1 565 613        | 9.3                              | 90.7                        | 1 169 526        | 22.6 (NM)                                  | 9.5                              | 90.5                        | 1 848 437        | 27.1 (NM)                                  |
| Swan Lake (Total)          | 23.2                       | 76.8                        | 585 080          | 26.1                             | 73.9                        | 748 067          | 68.7 (NM)                                  | 25.0                             | 75.0                        | 1 212 853        | 73.7 (NM)                                  |
| Swan Lake (BC only)        | 24.3                       | 75.7                        | 557 190          | 32.0                             | 68.0                        | 472 321          | 71.6 (NM)                                  | 30.5                             | 69.5                        | 753 031          | 77.4 (NM)                                  |
| Thutade                    | 11.2                       | 88.8                        | 711 930          | 27.0                             | 73.0                        | 1 033 466        | 30.6 (NM)<br>27.9 (SM)                     | 25.2                             | 74.8                        | 1 619 076        | 33.2 (NM)<br>26.7 (SM)                     |
| Tsenaglude                 | 11.2                       | 88.8                        | 247 008          | 35.0                             | 65.0                        | 521 447          | 58.8 (NM)                                  | 35.0                             | 65.0                        | 876 415          | 61.9 (NM)                                  |
| All Ranges (Total)         | 32.1                       | 67.9                        | 16 049 860       | 44.5                             | 55.5                        | 7 214 147        | –                                          | 44.2                             | 55.8                        | 9 919 904        | –                                          |
| All Ranges (BC only)       | 30.8                       | 69.1                        | 14 537 257       | 46.3                             | 53.7                        | 5 557 502        | –                                          | 46.0                             | 54.0                        | 7 383 130        | –                                          |

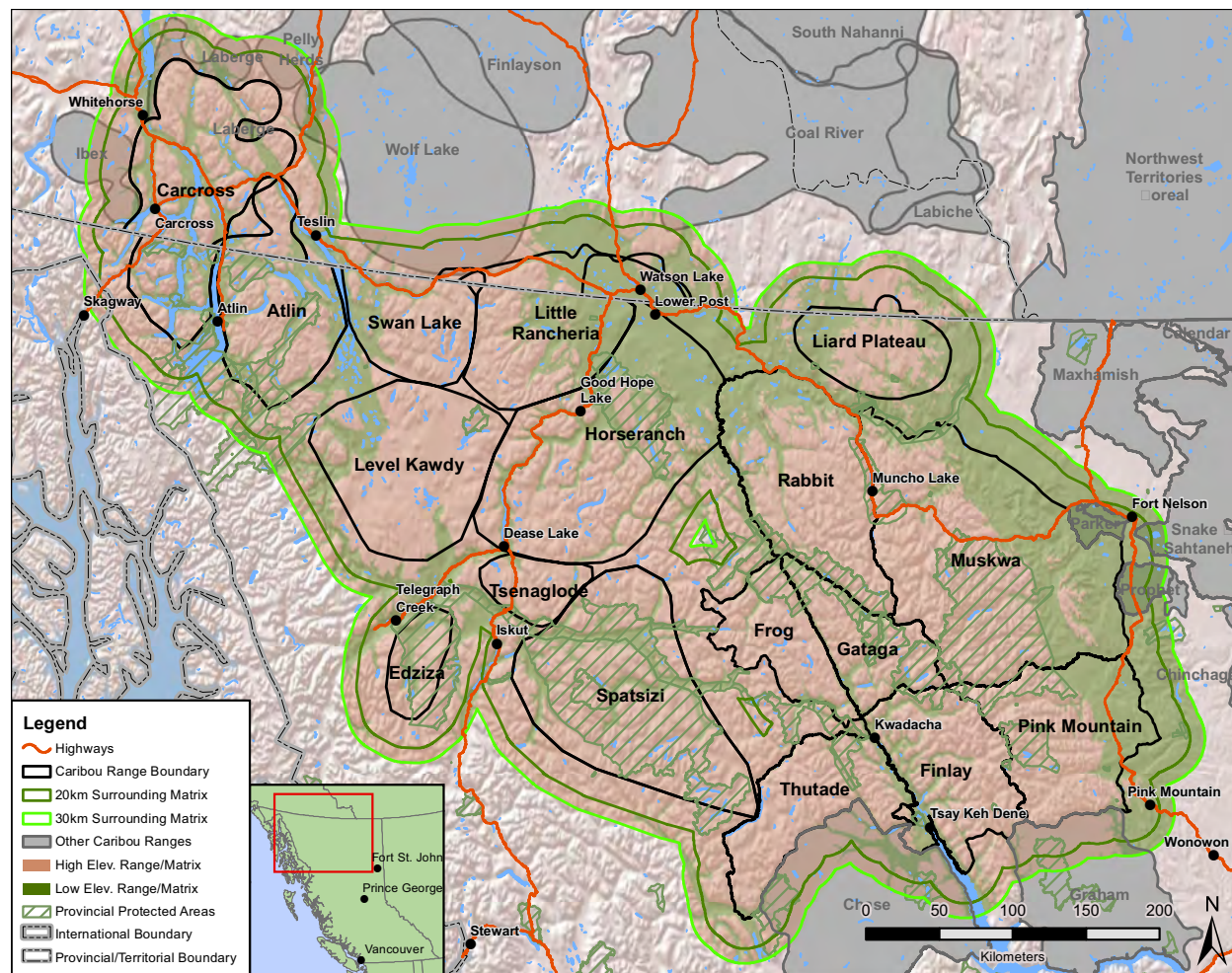
<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA



**Figure 2. The extent of low and high elevation ranges within each caribou range and within the 20-km and 30-km surrounding matrix for caribou ranges that are wholly or partially in northern British Columbia.**



The matrix range surrounding the combined area of caribou ranges in northern BC contains more low elevation areas than the caribou ranges themselves (Table 6). High elevations make up 56% of the surrounding matrix range within both 20 km and 30 km of the combined range boundary, and vary from 9-10% for the BC portion of the Liard Plateau range to 91% for the Spatsizi range.

Most caribou ranges in northern BC lie adjacent to other caribou ranges and overlap in some areas (Figure 2). The Edziza range is the only caribou range where the 20 km and 30 km surrounding matrices do not overlap with any other caribou ranges, although they overlap 20 km and 30 km surrounding matrices of other ranges (Table 6).

Otherwise, between 9% and 92% of the 20 km surrounding matrix, and between 16% and 91% of the 30 km surrounding matrix overlap adjacent ranges. The majority of the overlap occurs with other Northern Mountain National Ecological Area (NEA) ranges, but some also occurs with Boreal NEA and Southern Mountain NEA ranges (Table 6, see Figure 1).

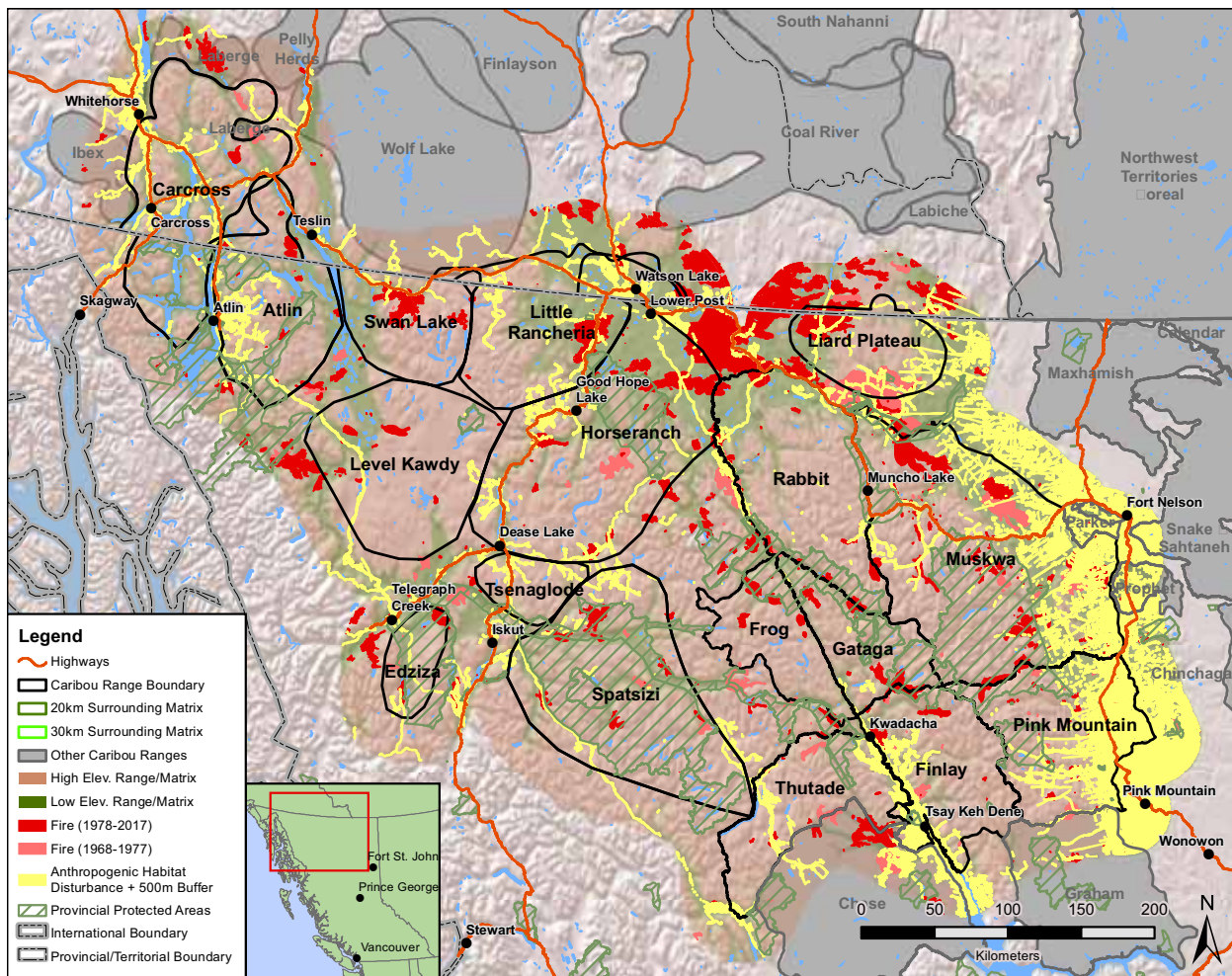
# Results

## Range condition

Total habitat disturbance (anthropogenic + 500 m buffer, and fires <40 years old) makes up about 15% of the area in all 17 caribou ranges combined (Table 7). Nine of the 17 ranges each contain more than 10% habitat disturbance. The three caribou ranges with the highest levels of habitat disturbance (Pink Mountain, Muskwa, Liard Plateau) are the three easternmost caribou ranges in the study area, with the majority of habitat disturbance located in the eastern portions of their ranges (Figure 3). The lowest levels of total habitat disturbance (<8% disturbance) are in the Frog, Gataga, Level Kawdy, Rabbit and Spatsizi ranges, and in the BC portion of the Carcross range (Table 7).

The amount of anthropogenic habitat disturbance is greater than the amount of fire in most (8/9) ranges with >10% habitat disturbance (Table 7). Fire plays a larger role in driving total habitat disturbance levels in ranges with <10% habitat disturbance, where half (4/8) of the ranges contain more fire than anthropogenic habitat disturbance (Table 7).

**Figure 3. Distribution of fire and anthropogenic habitat disturbance on caribou ranges that are wholly or partially in northern British Columbia.**





**Table 7. Proportion (%) of each caribou range, and of the 20 km and 30 km matrix surrounding ranges, consisting of fires <40 years old, total anthropogenic habitat disturbance, and total habitat disturbance (fires <40 years old + anthropogenic habitat disturbance), for caribou ranges that are wholly or partially in northern British Columbia.**

|                            | Range      |                |                           |                                        | 0-20 km matrix surrounding range |                |                           |                                        | 0-30 km matrix surrounding range |                |                           |                                        |
|----------------------------|------------|----------------|---------------------------|----------------------------------------|----------------------------------|----------------|---------------------------|----------------------------------------|----------------------------------|----------------|---------------------------|----------------------------------------|
|                            | Area       | Fire <40 years | Total Anthro. Disturbance | Total <sup>1</sup> Habitat Disturbance | Area                             | Fire <40 years | Total Anthro. Disturbance | Total <sup>1</sup> Habitat Disturbance | Area                             | Fire <40 years | Total Anthro. Disturbance | Total <sup>1</sup> Habitat Disturbance |
| Atlin (Total)              | 858 401    | 1.9            | 9.6                       | 11.5                                   | 959 801                          | 1.7            | 5.0                       | 6.6                                    | 1 516 826                        | 1.8            | 4.3                       | 6.0                                    |
| Atlin (BC only)            | 695 385    | 0.8            | 10.7                      | 11.5                                   | 566 293                          | 2.5            | 3.3                       | 5.7                                    | 893 837                          | 2.4            | 2.8                       | 5.2                                    |
| Carcross (Total)           | 1 273 592  | 0.4            | 8.4                       | 8.8                                    | 1 203 133                        | 1.9            | 10.7                      | 12.5                                   | 1 870 606                        | 1.6            | 9.6                       | 11.1                                   |
| Carcross (BC only)         | 324 060    | 0              | 2.6                       | 2.6                                    | 413 599                          | 0.2            | 10.4                      | 10.5                                   | 632 286                          | 0.1            | 10.4                      | 10.5                                   |
| Edziza                     | 235 185    | 4.8            | 5.1                       | 9.5                                    | 514 300                          | 4.2            | 6.4                       | 9.9                                    | 865 688                          | 3.3            | 7.7                       | 10.6                                   |
| Finlay                     | 817 094    | 3.3            | 13.3                      | 16.1                                   | 982 244                          | 5.7            | 15.5                      | 20.8                                   | 1 525 168                        | 5.4            | 13.3                      | 18.4                                   |
| Frog                       | 504 069    | 4.2            | 0.1                       | 4.3                                    | 885 050                          | 3.5            | 2.0                       | 5.3                                    | 1 392 243                        | 3.7            | 2.4                       | 5.6                                    |
| Gataga                     | 500 703    | 5.1            | 1.7                       | 6.8                                    | 845 787                          | 5.8            | 1.2                       | 6.9                                    | 1 352 795                        | 6.1            | 2.3                       | 8.0                                    |
| Horseranch (Total)         | 1 945 173  | 5.7            | 9.2                       | 14.4                                   | 1 473 971                        | 12.1           | 10.4                      | 21.0                                   | 2 272 285                        | 12.5           | 8.6                       | 19.7                                   |
| Horseranch (BC only)       | 1 779 688  | 5.9            | 7.0                       | 12.5                                   | 1 195 352                        | 12.7           | 10.4                      | 21.4                                   | 1 807 609                        | 12.0           | 8.6                       | 19.0                                   |
| Level Kawdy                | 1 135 902  | 1.4            | 1.6                       | 3.0                                    | 921 841                          | 4.4            | 5.1                       | 9.4                                    | 1 477 004                        | 3.6            | 6.5                       | 9.9                                    |
| Liard Plateau (Total)      | 520 304    | 11.6           | 11.0                      | 20.9                                   | 690 962                          | 21.8           | 14.4                      | 33.2                                   | 1 128 170                        | 23.6           | 13.4                      | 33.7                                   |
| Liard Plateau (BC only)    | 475 350    | 10.4           | 11.1                      | 19.9                                   | 435 358                          | 16.1           | 20.0                      | 32.3                                   | 696 906                          | 17.8           | 19.2                      | 32.5                                   |
| Little Rancheria (Total)   | 1 055 816  | 5.4            | 11.7                      | 16.1                                   | 1 054 289                        | 6.7            | 10.3                      | 16.4                                   | 1 662 553                        | 10.8           | 8.3                       | 18.4                                   |
| Little Rancheria (BC only) | 698 569    | 6.7            | 7.0                       | 12.5                                   | 612 209                          | 5.7            | 11.0                      | 15.9                                   | 957 38                           | 9.1            | 8.5                       | 16.7                                   |
| Muskwa                     | 2 158 213  | 8.4            | 19.4                      | 25.8                                   | 1 481 104                        | 5.1            | 29.1                      | 32.7                                   | 2 281 006                        | 4.4            | 29.3                      | 32.5                                   |
| Pink Mountain              | 957 542    | 2.2            | 33.9                      | 35.4                                   | 1 067 608                        | 3.2            | 34.1                      | 36.7                                   | 1 669 138                        | 4.7            | 34.7                      | 37.9                                   |
| Rabbit                     | 1 179 409  | 3.6            | 3.6                       | 6.7                                    | 1 093 947                        | 13.2           | 8.4                       | 19.7                                   | 1 721 485                        | 15.6           | 7.2                       | 20.8                                   |
| Spatsizi                   | 1 565 613  | 2.4            | 3.3                       | 5.5                                    | 1 169 526                        | 0.8            | 6.6                       | 7.2                                    | 1 848 437                        | 0.8            | 5.8                       | 6.4                                    |
| Swan Lake (Total)          | 585 080    | 6.2            | 3.5                       | 9.4                                    | 748 067                          | 0.7            | 6.0                       | 6.7                                    | 1 212 853                        | 0.8            | 4.8                       | 5.5                                    |
| Swan Lake (BC only)        | 557 190    | 6.5            | 3.0                       | 9.2                                    | 472 321                          | 0.9            | 2.8                       | 3.7                                    | 753 031                          | 1.0            | 1.9                       | 2.9                                    |
| Thutade                    | 711 930    | 1.8            | 10.1                      | 11.3                                   | 1 033 466                        | 4.7            | 13.1                      | 17.3                                   | 1 619 076                        | 3.0            | 11.6                      | 14.3                                   |
| Tsenaglude                 | 247 008    | 0              | 11.4                      | 11.4                                   | 521 447                          | 3.3            | 12.3                      | 15.2                                   | 876 415                          | 3.4            | 10.3                      | 13.4                                   |
| All Ranges (Total)         | 16 049 860 | 4.2            | 9.9                       | 13.6                                   | 7 214 147                        | 6.5            | 15.7                      | 21.5                                   | 9 919 904                        | 7.1            | 16.3                      | 22.5                                   |
| All Ranges (BC only)       | 14 537 257 | 4.4            | 9.7                       | 13.5                                   | 5 557 502                        | 6.0            | 17.7                      | 22.8                                   | 7 383 130                        | 6.0            | 19.5                      | 24.4                                   |

<sup>1</sup> Total habitat disturbance takes into account overlap between fire and anthropogenic habitat disturbance (anthropogenic habitat disturbance includes a 500 m buffer). Therefore, the amount of total habitat disturbance is less than the sum of the two types of habitat disturbance on ranges where overlaps between fire and anthropogenic habitat disturbance occur. Grey shading indicates ranges with >10% total habitat disturbance.

Total habitat disturbance is higher in the surrounding 20 km and 30 km matrices than in the caribou ranges themselves for all 17 caribou ranges combined (Table 7). Overall, the surrounding 20 km and 30 km matrices include more low elevation range than the caribou ranges (see Table 6).

In all 17 caribou ranges, the level of total and anthropogenic habitat disturbance is higher in low elevation range than in high elevation range (Table 8). The percent of area affected by fires <40 years is higher in low elevation range than in high elevation range in most (13/17) caribou ranges (Table 8). The extent of anthropogenic habitat disturbance is higher than the extent of fire disturbance in low elevation range in 10 of 17 ranges, and in high elevation range in 11 of 17 ranges (Table 8).

In all 17 caribou ranges combined, total habitat disturbance is 30% in low elevation range, and 8% in high elevation range (Table 8). Total habitat disturbance in high elevation range exceeds the “Minimal (i.e. close to 0%)” threshold in all 17 caribou ranges; in seven ranges it is less than 5%, and in three less than 3%. The highest level of total habitat disturbance in high elevation range is in the Muskwa, Pink Mountain and Tsenaglade ranges (Table 8). Total habitat disturbance in low elevation range equals or exceeds the 35% threshold in five adjacent ranges including the three easternmost ranges (Liard Plateau, Muskwa, Pink Mountain) and the two southernmost ranges (Finlay, Thutade; Table 8, Figure 3, Figure 4). Total habitat disturbance in low elevation range is between 20% and 35% on three ranges: Horseranch, Little Rancheria, and Tsenaglade.

For most caribou ranges, the majority of fires were <40 years of age, except in the Liard Plateau range where over half of the fires <50 years of age were 40-50 years old (Table 9, Figure 3). Forest insect disturbance levels were most prominent in the Finlay and Thutade ranges (Table 9, Figure 5), most of which was due to mountain pine beetles (*Dendroctonus ponderosae*). Disturbances caused by forest insects were also present in the Pink Mountain, Frog and Gataga ranges, but to a lesser extent. Although we do not provide information on balsam bark beetles (*Dryocoetes confusus*), they are present throughout the study area.



Seismic lines in the eastern portion of the Pink Mountain caribou range. (Satellite image from Google Earth)

Linear features (e.g., roads, trails, seismic lines and pipelines), primarily roads/trails, were the most prominent anthropogenic habitat disturbance on all caribou ranges (Table 9), at both high and low elevations (Table 10, Table 11). From the spatial data layers we were using, there was a high degree of overlap

between roads and trails, therefore we were unable to distinguish between those two types of linear features using spatial layers. Also, roads and trails varied from hiking/horse trails to paved highways, resulting in a wide range of types of access that we were not able to distinguish between. There was also overlap between seismic lines and roads/trails.

**Table 8. Proportion (%) of total range, low elevation range, and high elevation range consisting of fires <40 years old, total anthropogenic habitat disturbance, and total habitat disturbance (due to fires <40 years old + anthropogenic disturbance) on caribou ranges that are wholly or partially in northern British Columbia.**

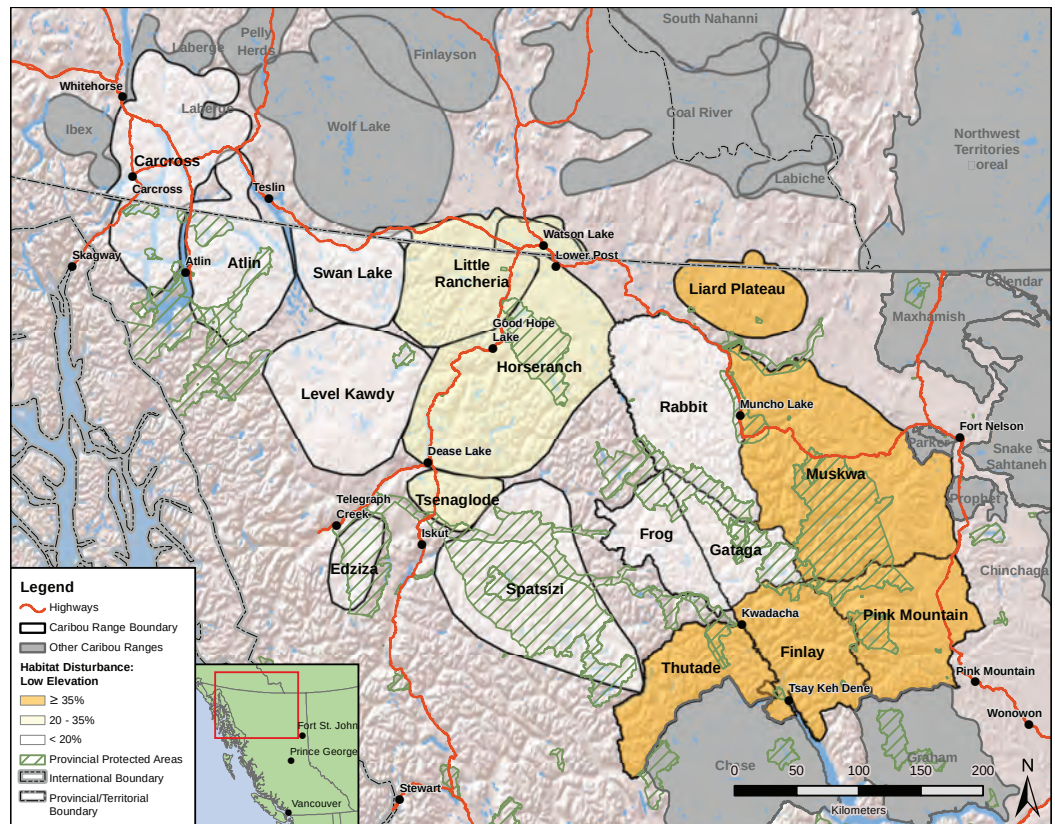
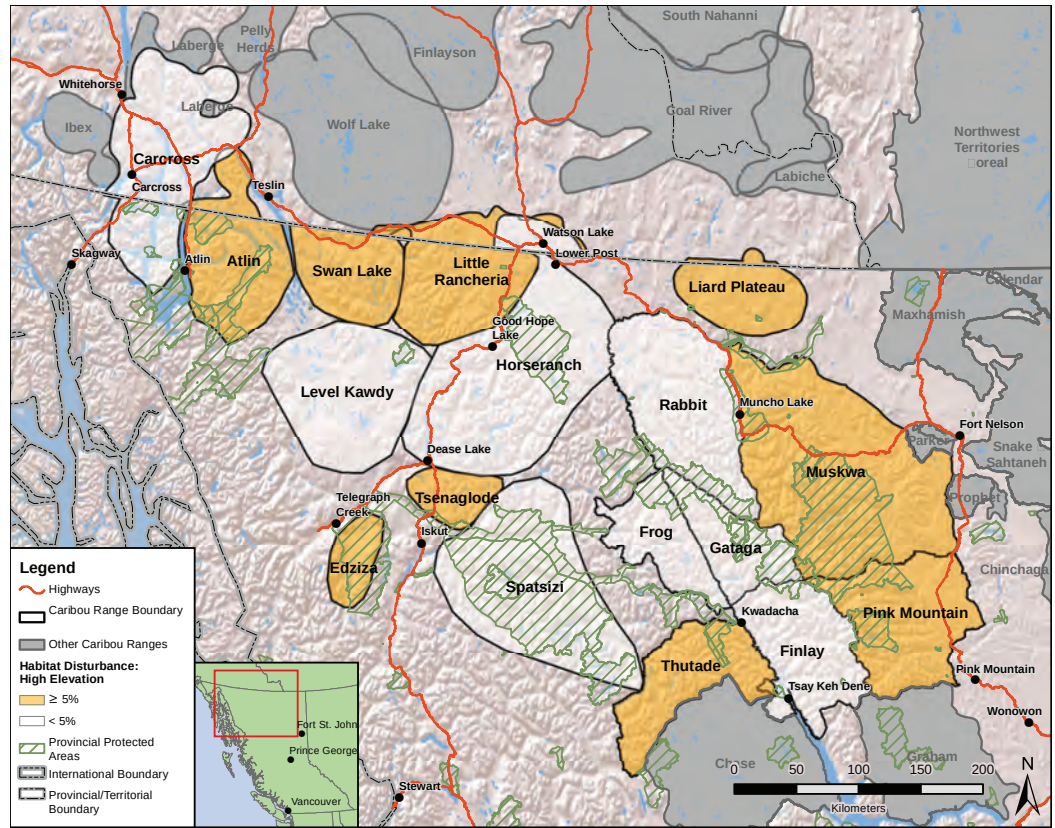
|                            | Total <sup>1</sup> |                |                                   |                                        | Low elevation <sup>1</sup> |                |                                   |                                        | High elevation <sup>1</sup> |                |                                   |                                        |
|----------------------------|--------------------|----------------|-----------------------------------|----------------------------------------|----------------------------|----------------|-----------------------------------|----------------------------------------|-----------------------------|----------------|-----------------------------------|----------------------------------------|
|                            | Area (ha)          | Fire <40 years | Total Anthro. Habitat Disturbance | Total <sup>2</sup> Habitat Disturbance | Area (ha)                  | Fire <40 years | Total Anthro. Habitat Disturbance | Total <sup>2</sup> Habitat Disturbance | Area (ha)                   | Fire <40 years | Total Anthro. Habitat Disturbance | Total <sup>2</sup> Habitat Disturbance |
| Atlin (Total)              | 858 401            | 1.9            | 9.6                               | 11.5                                   | 346 303                    | 4.0            | 14.2                              | 18.2                                   | 512 097                     | 0.5            | 6.5                               | 7.0                                    |
| Atlin (BC only)            | 695 385            | 0.8            | 10.7                              | 11.5                                   | 291 045                    | 1.6            | 14.3                              | 15.9                                   | 404 341                     | 0.2            | 8.1                               | 8.3                                    |
| Carcross (Total)           | 1 273 592          | 0.4            | 8.4                               | 8.8                                    | 518 781                    | 0.2            | 17.9                              | 18.1                                   | 754 811                     | 0.5            | 2.0                               | 2.5                                    |
| Carcross (BC only)         | 324 060            | 0              | 2.6                               | 2.6                                    | 158 865                    | 0              | 5.0                               | 5.0                                    | 165 196                     | 0              | 0.2                               | 0.2                                    |
| Edziza                     | 235 185            | 4.8            | 5.1                               | 9.5                                    | 64 255                     | 10.5           | 7.3                               | 17.8                                   | 170 929                     | 2.7            | 4.2                               | 6.4                                    |
| Finlay                     | 817 094            | 3.3            | 13.3                              | 16.1                                   | 197 112                    | 7.1            | 46.7                              | 51.9                                   | 619 983                     | 2.1            | 2.7                               | 4.8                                    |
| Frog                       | 504 069            | 4.2            | 0.1                               | 4.3                                    | 57 099                     | 10.9           | 1.1                               | 12.0                                   | 446 969                     | 3.4            | 0                                 | 3.4                                    |
| Gataga                     | 500 703            | 5.1            | 1.7                               | 6.8                                    | 111 491                    | 10.7           | 5.3                               | 16.0                                   | 389 212                     | 3.6            | 0.6                               | 4.2                                    |
| Horseranch (Total)         | 1 945 173          | 5.7            | 9.2                               | 14.4                                   | 920 489                    | 10.7           | 15.2                              | 24.9                                   | 1 024 684                   | 1.1            | 3.8                               | 4.9                                    |
| Horseranch (BC only)       | 1 779 688          | 5.9            | 7.0                               | 12.5                                   | 762 958                    | 12.3           | 11.4                              | 22.7                                   | 1 016 730                   | 1.2            | 3.7                               | 4.9                                    |
| Level Kawdy                | 1 135 902          | 1.4            | 1.6                               | 3.0                                    | 161 995                    | 3.4            | 3.8                               | 7.1                                    | 973 907                     | 1.1            | 1.2                               | 2.3                                    |
| Liard Plateau (Total)      | 520 304            | 11.6           | 11.0                              | 20.9                                   | 254 275                    | 22.6           | 15.1                              | 34.3                                   | 266 029                     | 1.1            | 7.2                               | 8.2                                    |
| Liard Plateau (BC only)    | 475 350            | 10.4           | 11.1                              | 19.9                                   | 233 434                    | 20.1           | 15.6                              | 32.5                                   | 241 916                     | 1.0            | 6.9                               | 7.8                                    |
| Little Rancheria (Total)   | 1 055 816          | 5.4            | 11.7                              | 16.1                                   | 563 685                    | 9.7            | 15.9                              | 23.8                                   | 492 131                     | 0.5            | 6.8                               | 7.2                                    |
| Little Rancheria (BC only) | 698 569            | 6.7            | 7.0                               | 12.5                                   | 321 110                    | 14.5           | 8.0                               | 19.7                                   | 377 459                     | 0.2            | 6.2                               | 6.4                                    |
| Muskwa                     | 2 158 213          | 8.4            | 19.4                              | 25.8                                   | 901 281                    | 11.3           | 39.4                              | 46.2                                   | 1 256 932                   | 6.3            | 5.1                               | 11.1                                   |
| Pink Mountain              | 957 542            | 2.2            | 33.9                              | 35.4                                   | 332 894                    | 2.2            | 71.8                              | 72.3                                   | 624 647                     | 2.2            | 13.7                              | 15.7                                   |
| Rabbit                     | 1 179 409          | 3.6            | 3.6                               | 6.7                                    | 374 007                    | 8.4            | 8.2                               | 15.2                                   | 805 402                     | 1.4            | 1.4                               | 2.8                                    |
| Spatsizi                   | 1 565 613          | 2.4            | 3.3                               | 5.5                                    | 277 677                    | 7.4            | 4.2                               | 11.0                                   | 1 287 936                   | 1.3            | 3.1                               | 4.4                                    |
| Swan Lake (Total)          | 585 080            | 6.2            | 3.5                               | 9.4                                    | 135 756                    | 6.4            | 8.2                               | 13.9                                   | 449 324                     | 6.1            | 2.1                               | 8.1                                    |
| Swan Lake (BC only)        | 557 190            | 6.5            | 3.0                               | 9.2                                    | 135 228                    | 6.5            | 8.0                               | 13.9                                   | 421 963                     | 6.5            | 1.4                               | 7.8                                    |
| Thutade                    | 711 930            | 1.8            | 10.1                              | 11.3                                   | 79 848                     | 7.3            | 47.6                              | 50.4                                   | 632 082                     | 1.1            | 5.4                               | 6.3                                    |
| Tsenaglude                 | 247 008            | 0              | 11.4                              | 11.4                                   | 27 740                     | 0              | 29.5                              | 29.5                                   | 219 268                     | 0              | 9.1                               | 9.1                                    |
| All Ranges (Total)         | 16 049 860         | 4.2            | 9.9                               | 13.6                                   | 5 158 612                  | 8.5            | 22.4                              | 29.3                                   | 10 891 248                  | 2.2            | 4.0                               | 6.1                                    |
| All Ranges (BC only)       | 14 537 257         | 4.4            | 9.7                               | 13.5                                   | 4 482 822                  | 9.2            | 22.3                              | 29.6                                   | 10 045 117                  | 2.3            | 4.1                               | 6.3                                    |

<sup>1</sup> Total range, low elevation range and high elevation range include only the area within a caribou herd's range and do not include the 20 km or 30 km surrounding matrix.

<sup>2</sup> Total habitat disturbance takes into account overlap between fire and anthropogenic habitat disturbance (anthropogenic habitat disturbance includes a 500 m buffer). Therefore, the amount of total habitat disturbance is less than the sum of the two types of habitat disturbance on ranges where overlaps between fire and anthropogenic habitat disturbance occur. For low elevation range, orange shading indicates ranges with ≥35% total habitat disturbance and yellow shading indicates ranges with 20-34% total habitat disturbance. For High elevation range, orange shading indicated ranges with ≥5% total habitat disturbance.



Figure 4. Caribou ranges that are wholly or partially in northern British Columbia with total habitat disturbance in high elevation range  $\geq 5\%$  (orange) and  $< 5\%$  (white) (top), and in low elevation range  $\geq 35\%$  (orange), 20-34% (yellow) and  $< 20\%$  (white) (bottom).



**Table 9. Proportion (%) of total area in each habitat disturbance category in caribou ranges that are wholly or partially in northern British Columbia.**

|                            | Caribou Range Area (ha) | Habitat disturbance category <sup>1,2</sup> |                |                |            |             |          |                   |     |      |              |      |          |           |          |      |         |            |       |                             |                               |
|----------------------------|-------------------------|---------------------------------------------|----------------|----------------|------------|-------------|----------|-------------------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|-------------------------------|
|                            |                         | Fire <40 years                              | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Forest harvesting | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road/Trail <sup>3</sup> |
| Atlin (Total)              | 858 401                 | 1.9                                         | 2.0            | 0              | 0          | 0           | 0        | 0.2               | 0   | 1.7  | 0            | 0    | 0        | 0         | 0        | 8.7  | 0.1     | 0.1        | 3.8   | 3.2                         | 9.3                           |
| Atlin (BC only)            | 695 385                 | 0.8                                         | 0.9            | 0              | 0          | 0           | 0.1      | 0.2               | 0   | 2.1  | 0            | 0    | 0        | 0         | 0        | 10.1 | 0.1     | 0.1        | 3.6   | 3.3                         | 10.4                          |
| Carcross (Total)           | 1 273 592               | 0.4                                         | 0.9            | 0              | 0          | 0.1         | 0        | 0.8               | 0   | 0.4  | 0            | 0    | 0.7      | 0.6       | 0.7      | 4.5  | 0.1     | 1.1        | 7.3   | 4.1                         | 7.7                           |
| Carcross (BC only)         | 324 060                 | 0                                           | 0              | 0.1            | 0          | 0           | 0        | 0.1               | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 2.3  | 0       | 0          | 2.0   | 1.8                         | 2.5                           |
| Edziza                     | 235 185                 | 4.8                                         | 5.7            | 0              | 0          | 0           | 0.1      | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 5.1  | 0       | 0.1        | 0     | 0                           | 5.1                           |
| Finlay                     | 817 094                 | 3.3                                         | 4.3            | 16.6           | 0          | 0           | 0.1      | 9.5               | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 12.1 | 0       | 0.1        | 0     | 0                           | 12.1                          |
| Frog                       | 504 069                 | 4.2                                         | 4.4            | 2.3            | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 0.1  | 0       | 0          | 0     | 0                           | 0.1                           |
| Gataga                     | 500 703                 | 5.1                                         | 5.3            | 1.4            | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 1.7  | 0       | 0          | 0     | 0                           | 1.7                           |
| Horseranch (Total)         | 1 945 173               | 5.7                                         | 6.8            | 0              | 0          | 0           | 0        | 1.8               | 0   | 0.6  | 0            | 0    | 0        | 0         | 0        | 6.8  | 0.1     | 0.4        | 2.5   | 1.3                         | 8.0                           |
| Horseranch (BC only)       | 1 779 688               | 5.9                                         | 7.2            | 0              | 0          | 0           | 0        | 0                 | 0   | 0.6  | 0            | 0    | 0        | 0         | 0        | 6.5  | 0.1     | 0.3        | 1.0   | 0.6                         | 6.9                           |
| Level Kawdy                | 1 135 902               | 1.4                                         | 1.5            | 0              | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 1.2  | 0       | 0          | 0.9   | 0.6                         | 1.6                           |
| Liard Plateau (Total)      | 520 304                 | 11.6                                        | 23.4           | 0              | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0.3       | 0        | 7.2  | 2.6     | 0.2        | 4.8   | 2.6                         | 9.3                           |
| Liard Plateau (BC only)    | 475 350                 | 10.4                                        | 23.4           | 0              | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0.4       | 0        | 7.9  | 2.8     | 0.3        | 4.3   | 2.9                         | 9.2                           |
| Little Rancheria (Total)   | 1 055 816               | 5.4                                         | 5.4            | 0              | 0          | 0.1         | 0        | 3.8               | 0   | 0.3  | 0            | 0    | 0        | 0         | 0        | 6.9  | 0.2     | 0.3        | 7.2   | 4.7                         | 9.4                           |
| Little Rancheria (BC only) | 698 569                 | 6.7                                         | 6.7            | 0              | 0          | 0           | 0        | 0.2               | 0   | 0.2  | 0            | 0    | 0        | 0         | 0        | 6.6  | 0.1     | 0          | 4.0   | 3.7                         | 6.9                           |
| Muskwa                     | 2 158 213               | 8.4                                         | 11.2           | 0              | 0          | 0.1         | 0        | 2.1               | 0   | 0    | 0.4          | 0.5  | 0.1      | 0         | 0        | 14.5 | 7.4     | 0.1        | 1.1   | 0.8                         | 14.8                          |
| Pink Mountain              | 957 542                 | 2.2                                         | 3.5            | 3.2            | 0          | 0.2         | 0        | 0.9               | 0   | 0    | 3.7          | 2.6  | 2.6      | 0         | 0        | 25.7 | 20.4    | 0.2        | 1.4   | 1.3                         | 25.8                          |
| Rabbit                     | 1 179 409               | 3.6                                         | 4.0            | 0              | 0          | 0           | 0.1      | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 3.4  | 0       | 0          | 0.5   | 0.4                         | 3.5                           |
| Spatsizi                   | 1 565 613               | 2.4                                         | 3.0            | 0              | 0          | 0           | 0        | 0                 | 0   | 0.3  | 0            | 0    | 0        | 0         | 0        | 3.2  | 0.1     | 0.1        | 0     | 0                           | 3.2                           |
| Swan Lake (Total)          | 585 080                 | 0.7                                         | 1.1            | 0              | 0          | 0.2         | 0        | 0                 | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 3.0  | 0.1     | 0.1        | 5.4   | 2.5                         | 5.9                           |
| Swan Lake (BC only)        | 557 190                 | 6.5                                         | 6.5            | 0              | 0          | 0           | 0        | 0                 | 0   | 0.1  | 0            | 0    | 0        | 1.0       | 0        | 2.6  | 0       | 0.1        | 1.9   | 1.6                         | 2.9                           |
| Thutade                    | 711 930                 | 1.8                                         | 3.1            | 7.9            | 0          | 0.1         | 0.1      | 4.8               | 0   | 0    | 0            | 0    | 0        | 0.6       | 0.1      | 9.5  | 0       | 0.1        | 0     | 0                           | 9.5                           |
| Tsenaglude                 | 247 008                 | 0                                           | 0              | 0              | 0.3        | 0           | 0        | 0                 | 0.1 | 0.1  | 0            | 0    | 0        | 0         | 0        | 11.0 | 0       | 0.4        | 0     | 0                           | 11.0                          |
| All Ranges (Total)         | 16 049 860              | 4.2                                         | 4.2            | 1.5            | 0          | 0           | 0        | 1.3               | 0   | 0.3  | 0.3          | 0.2  | 0.2      | 0.1       | 0.1      | 7.8  | 2.3     | 0.2        | 1.9   | 1.3                         | 8.4                           |
| All Ranges (BC only)       | 14 537 257              | 4.4                                         | 4.4            | 1.6            | 0          | 0           | 0        | 1.1               | 0   | 0.2  | 0.3          | 0.2  | 0.2      | 0.1       | 0        | 8.0  | 2.6     | 0.1        | 1.1   | 0.9                         | 8.2                           |

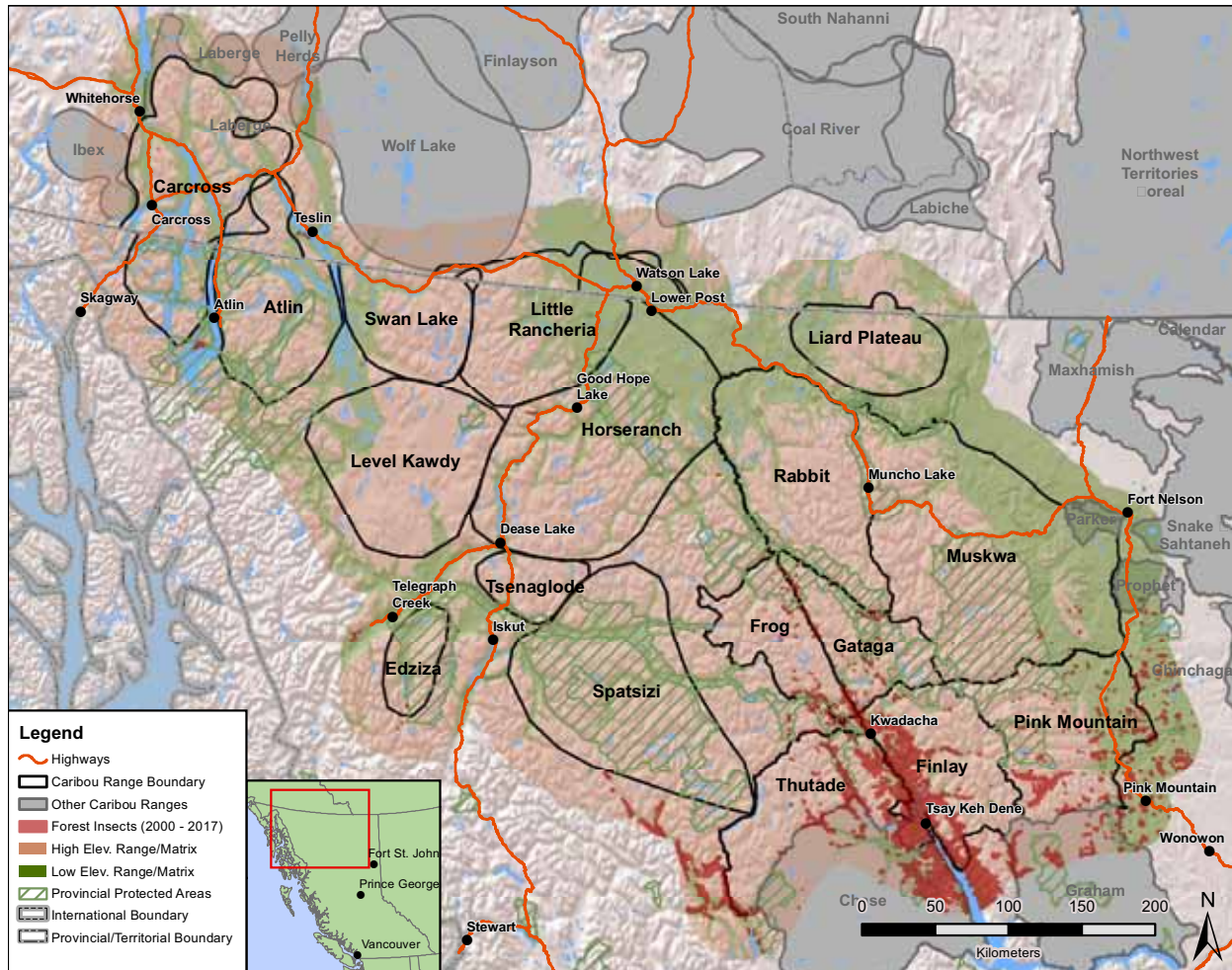
<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a “settlement” polygon will overlap with a “road” polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of “Total anthropogenic habitat disturbance” (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, “Total habitat disturbance” (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbance (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> “Road and trail” indicates the portions of the “Road” and “Trail” categories that were identified as both a road and a trail; “Total Road/Trail” is the combined total of roads and trails and accounts for overlap between the two categories.



**Figure 5. Distribution of forest insect attack (mountain pine beetles, spruce beetles) from 2000 to 2017 in the British Columbia portion of caribou ranges that are wholly or partially in northern British Columbia.**



Seismic lines contributed to anthropogenic habitat disturbance in the Pink Mountain and Muskwa ranges, and to a lesser extent in the Liard Plateau range (Table 9, Figure 3). Only the Pink Mountain and Muskwa ranges contained oil facilities and wells, while pipeline right-of-ways were located in the Pink Mountain, Muskwa and Carcross ranges (Table 9).

The proportion of the total caribou range affected by forest harvesting was highest in the Finlay and Thutade ranges, and covered one-third of the low elevation range in both caribou ranges (Table 9, Table 10). After linear features, forest harvesting was the next highest contributor of anthropogenic habitat disturbance in the Finlay, Thutade, Horseranch and Little Rancheria ranges (Table 9). Forest harvesting in the Horseranch and Little Rancheria ranges is primarily located in the Yukon portion of their ranges.

The footprint from mining activity was the next highest contributor of anthropogenic habitat disturbance in the Atlin range, after linear disturbances, and contributed to anthropogenic habitat disturbance to a lesser extent in the Carcross, Horseranch, Little Rancheria, Swan Lake, Spatsizi and Tsenaglade ranges (Table 9). Although we were not able to distinguish between roads/trails that were constructed for mining and those constructed for other purposes using our dataset, mining activity was commonly associated with road networks, especially in the Atlin caribou range.

**Table 10. Proportion (%) of total low elevation range area in each habitat disturbance category in caribou ranges that are wholly or partially in northern British Columbia.**

|                            | Low Elevation<br>Range Area<br>(ha) | Habitat disturbance category <sup>1,2</sup> |                |                |            |             |          |                   |     |      |              |      |          |           |          |      |         |            |       |                             |                               |
|----------------------------|-------------------------------------|---------------------------------------------|----------------|----------------|------------|-------------|----------|-------------------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|-------------------------------|
|                            |                                     | Fire <40 years                              | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Forest harvesting | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road/Trail <sup>3</sup> |
| Atlin (Total)              | 346 303                             | 4.0                                         | 4.2            | 0              | 0          | 0           | 0.1      | 0.5               | 0   | 1.6  | 0            | 0    | 0        | 0         | 0        | 12.5 | 0.2     | 0.2        | 6.9   | 5.6                         | 13.9                          |
| Atlin (BC only)            | 291 045                             | 1.6                                         | 1.8            | 0              | 0          | 0           | 0.1      | 0.5               | 0   | 1.8  | 0            | 0    | 0        | 0         | 0        | 13.4 | 0.3     | 0.2        | 5.8   | 5.3                         | 13.9                          |
| Carcross (Total)           | 518 781                             | 0.2                                         | 0.8            | 0              | 0          | 0.3         | 0        | 1.9               | 0   | 0.9  | 0            | 0    | 1.7      | 1.5       | 1.7      | 10.5 | 0.1     | 2.7        | 15.3  | 9.6                         | 16.3                          |
| Carcross (BC only)         | 158 865                             | 0                                           | 0              | 0.1            | 0          | 0           | 0        | 0.3               | 0.1 | 0.3  | 0            | 0    | 0        | 0         | 0        | 4.6  | 0       | 0          | 3.9   | 3.6                         | 5.0                           |
| Edziza                     | 64 255                              | 10.5                                        | 10.7           | 0              | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 7.3  | 0       | 0          | 0     | 0                           | 7.3                           |
| Finlay                     | 197 112                             | 7.1                                         | 9.6            | 41.5           | 0.1        | 0           | 0.5      | 32.7              | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 43.2 | 0       | 0.4        | 0     | 0                           | 43.2                          |
| Frog                       | 57 099                              | 10.9                                        | 11.5           | 12.5           | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 1.1  | 0       | 0          | 0     | 0                           | 1.1                           |
| Gataga                     | 111 491                             | 10.7                                        | 11.2           | 4.1            | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 5.3  | 0       | 0          | 0     | 0                           | 5.3                           |
| Horseranch (Total)         | 920 489                             | 10.7                                        | 11.4           | 0              | 0          | 0.1         | 0.1      | 3.7               | 0   | 0.7  | 0            | 0    | 0        | 0         | 0        | 10.3 | 0.3     | 0.8        | 5.3   | 2.7                         | 12.9                          |
| Horseranch (BC only)       | 762 958                             | 12.3                                        | 13.0           | 0              | 0          | 0           | 0.1      | 0.1               | 0   | 0.6  | 0            | 0    | 0        | 0         | 0        | 10.2 | 0.2     | 0.6        | 2.3   | 1.3                         | 11.3                          |
| Level Kawdy                | 161 995                             | 3.4                                         | 3.6            | 0              | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 3.0  | 0       | 0          | 3.3   | 2.6                         | 3.8                           |
| Liard Plateau (Total)      | 254 275                             | 22.6                                        | 33.7           | 0              | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0.7       | 0        | 11.0 | 3.2     | 0.4        | 6.4   | 4.4                         | 12.9                          |
| Liard Plateau (BC only)    | 233 434                             | 20.1                                        | 32.2           | 0              | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0.7       | 0        | 11.9 | 3.4     | 0.5        | 6.2   | 4.8                         | 13.2                          |
| Little Rancheria (Total)   | 563 685                             | 9.7                                         | 9.7            | 0              | 0          | 0.1         | 0        | 6.9               | 0   | 0.3  | 0            | 0    | 0        | 0         | 0        | 8.2  | 0.4     | 0.5        | 9.8   | 6.2                         | 11.8                          |
| Little Rancheria (BC only) | 321 110                             | 14.5                                        | 14.5           | 0              | 0          | 0           | 0        | 0.5               | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 7.3  | 0.2     | 0          | 5.0   | 4.4                         | 7.9                           |
| Muskwa                     | 901 281                             | 11.3                                        | 16.9           | 0              | 0          | 0.2         | 0.1      | 5.0               | 0   | 0    | 1.0          | 1.2  | 0.2      | 0         | 0        | 28.1 | 17.3    | 0.1        | 1.4   | 0.7                         | 28.8                          |
| Pink Mountain              | 332 894                             | 2.2                                         | 3.6            | 2.7            | 0          | 0.7         | 0.1      | 2.5               | 0   | 0.1  | 9.8          | 6.5  | 7.6      | 0         | 0        | 57.6 | 46.5    | 0.4        | 1.0   | 0.9                         | 57.6                          |
| Rabbit                     | 374 007                             | 8.4                                         | 9.1            | 0.1            | 0          | 0.1         | 0.1      | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 7.9  | 0       | 0.1        | 1.2   | 1.0                         | 8.2                           |
| Spatsizi                   | 277 677                             | 7.4                                         | 9.5            | 0              | 0          | 0           | 0        | 0.1               | 0   | 0.2  | 0            | 0    | 0        | 0         | 0        | 4.1  | 0       | 0.3        | 0     | 0                           | 4.1                           |
| Swan Lake (Total)          | 135 756                             | 1.7                                         | 3.2            | 0              | 0          | 0           | 0        | 0.2               | 0   | 0.3  | 0            | 0    | 0        | 0         | 0        | 2.5  | 0       | 0.1        | 3.8   | 2.4                         | 3.9                           |
| Swan Lake (BC only)        | 135 228                             | 6.5                                         | 6.5            | 0              | 0          | 0           | 0        | 0                 | 0   | 0.4  | 0            | 0    | 0        | 3.8       | 0        | 7.2  | 0       | 0.2        | 6.1   | 5.5                         | 7.8                           |
| Thutade                    | 79 848                              | 7.3                                         | 8.3            | 33.0           | 0          | 0           | 0.2      | 33.5              | 0   | 0    | 0            | 0    | 0        | 0         | 0.8      | 44.5 | 0       | 0.4        | 0     | 0                           | 44.5                          |
| Tsenaglude                 | 27 740                              | 0                                           | 0              | 0              | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 28.9 | 0       | 3.9        | 0     | 0                           | 28.9                          |
| All Ranges (Total)         | 5 158 612                           | 8.5                                         | 8.5            | 2.5            | 0          | 0.1         | 0.1      | 3.8               | 0   | 0.4  | 0.8          | 0.6  | 0.7      | 0.3       | 0.2      | 17.2 | 6.3     | 0.6        | 4.4   | 2.9                         | 18.7                          |
| All Ranges (BC only)       | 4 482 822                           | 9.2                                         | 9.2            | 2.8            | 0          | 0.1         | 0.1      | 3.3               | 0   | 0.3  | 0.9          | 0.7  | 0.6      | 0.2       | 0        | 18.2 | 7.2     | 0.3        | 2.3   | 1.8                         | 18.7                          |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic habitat disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbance (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.



**Table 11. Proportion (%) of total high elevation range area in each habitat disturbance category in caribou ranges that are wholly or partially in northern British Columbia.**

|                            | High Elevation<br>Range Area (ha) | Habitat disturbance category <sup>1,2</sup> |                |                |            |             |          |                   |     |      |              |      |          |           |          |      |         |            |       |                             |                               |
|----------------------------|-----------------------------------|---------------------------------------------|----------------|----------------|------------|-------------|----------|-------------------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|-------------------------------|
|                            |                                   | Fire <40 years                              | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Forest harvesting | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road/Trail <sup>3</sup> |
| Atlin (Total)              | 512 097                           | 0.5                                         | 0.5            | 0              | 0          | 0           | 0        | 0                 | 0   | 1.8  | 0            | 0    | 0        | 0         | 0        | 6.1  | 0       | 0          | 1.7   | 1.5                         | 6.3                           |
| Atlin (BC only)            | 404 341                           | 0.2                                         | 0.3            | 0              | 0          | 0           | 0        | 0                 | 0   | 2.3  | 0            | 0    | 0        | 0         | 0        | 7.7  | 0       | 0          | 2.0   | 1.9                         | 7.8                           |
| Carcross (Total)           | 754 811                           | 0.5                                         | 1.0            | 0              | 0          | 0           | 0        | 0                 | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 0.3  | 0.1     | 0          | 1.8   | 0.3                         | 1.8                           |
| Carcross (BC only)         | 165 196                           | 0                                           | 0              | 0              | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 0.1  | 0       | 0          | 0.2   | 0.1                         | 0.2                           |
| Edziza                     | 170 929                           | 2.7                                         | 3.8            | 0              | 0          | 0           | 0.1      | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 4.2  | 0       | 0.1        | 0     | 0                           | 4.2                           |
| Finlay                     | 619 983                           | 2.1                                         | 2.6            | 8.7            | 0          | 0           | 0        | 2.1               | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 2.1  | 0       | 0          | 0     | 0                           | 2.1                           |
| Frog                       | 446 969                           | 3.4                                         | 3.5            | 1.0            | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 0    | 0       | 0          | 0     | 0                           | 0                             |
| Gataga                     | 389 212                           | 3.6                                         | 3.6            | 0.7            | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 0.6  | 0       | 0          | 0     | 0                           | 0.6                           |
| Horseranch (Total)         | 1 024 684                         | 1.1                                         | 2.7            | 0              | 0          | 0           | 0        | 0.1               | 0   | 0.6  | 0            | 0    | 0        | 0         | 0        | 3.6  | 0       | 0.1        | 0     | 0                           | 3.6                           |
| Horseranch (BC only)       | 1 016 730                         | 1.2                                         | 2.8            | 0              | 0          | 0           | 0        | 0                 | 0   | 0.6  | 0            | 0    | 0        | 0         | 0        | 3.7  | 0       | 0.1        | 0     | 0                           | 3.7                           |
| Level Kawdy                | 973 907                           | 1.1                                         | 1.1            | 0              | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 0.9  | 0       | 0          | 0.5   | 0.3                         | 1.2                           |
| Liard Plateau (Total)      | 266 029                           | 1.1                                         | 13.6           | 0              | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 3.6  | 2.0     | 0          | 3.2   | 0.9                         | 5.9                           |
| Liard Plateau (BC only)    | 241 916                           | 1.0                                         | 14.9           | 0              | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 4.0  | 2.2     | 0.1        | 2.4   | 1.0                         | 5.4                           |
| Little Rancheria (Total)   | 492 131                           | 0.5                                         | 0.5            | 0              | 0          | 0           | 0        | 0.1               | 0   | 0.3  | 0            | 0    | 0        | 0         | 0        | 5.4  | 0.1     | 0          | 4.3   | 3.1                         | 6.6                           |
| Little Rancheria (BC only) | 377 459                           | 0.2                                         | 0.2            | 0              | 0          | 0           | 0        | 0                 | 0   | 0.4  | 0            | 0    | 0        | 0         | 0        | 5.9  | 0.1     | 0          | 3.1   | 3.0                         | 6.1                           |
| Muskwa                     | 1 256 932                         | 6.3                                         | 7.1            | 0              | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 4.8  | 0.3     | 0.1        | 0.8   | 0.8                         | 4.8                           |
| Pink Mountain              | 624 647                           | 2.2                                         | 3.4            | 3.5            | 0          | 0           | 0        | 0                 | 0   | 0    | 0.3          | 0.5  | 0        | 0         | 0        | 8.8  | 6.6     | 0.1        | 1.6   | 1.5                         | 8.9                           |
| Rabbit                     | 805 402                           | 1.4                                         | 1.6            | 0              | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 1.3  | 0       | 0          | 0.3   | 0.2                         | 1.4                           |
| Spatsizi                   | 1 287 936                         | 1.3                                         | 1.6            | 0              | 0          | 0           | 0        | 0                 | 0   | 0.4  | 0            | 0    | 0        | 0         | 0        | 3.0  | 0.1     | 0.1        | 0     | 0                           | 3.0                           |
| Swan Lake (Total)          | 449 324                           | 0.4                                         | 0.4            | 0              | 0          | 0.3         | 0        | 0                 | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 3.2  | 0.1     | 0.1        | 5.9   | 2.6                         | 6.6                           |
| Swan Lake (BC only)        | 421 963                           | 6.5                                         | 6.5            | 0              | 0          | 0           | 0        | 0                 | 0   | 0    | 0            | 0    | 0        | 0.1       | 0        | 1.1  | 0       | 0.1        | 0.6   | 0.3                         | 1.3                           |
| Thutade                    | 632 082                           | 1.1                                         | 2.4            | 4.8            | 0.1        | 0.2         | 0.1      | 1.2               | 0   | 0    | 0            | 0    | 0        | 0.6       | 0        | 5.1  | 0       | 0          | 0     | 0                           | 5.1                           |
| Tsenaglode                 | 219 268                           | 0                                           | 0              | 0              | 0.3        | 0           | 0        | 0                 | 0.1 | 0.1  | 0            | 0    | 0        | 0         | 0        | 8.8  | 0       | 0          | 0     | 0                           | 8.8                           |
| All Ranges (Total)         | 10 891 248                        | 2.2                                         | 2.2            | 1.0            | 0          | 0           | 0        | 0.2               | 0   | 0.2  | 0            | 0    | 0        | 0         | 0        | 3.3  | 0.5     | 0          | 0.8   | 0.5                         | 3.6                           |
| All Ranges (BC only)       | 10 045 117                        | 2.3                                         | 2.3            | 1.1            | 0          | 0           | 0        | 0.2               | 0   | 0.2  | 0            | 0    | 0        | 0         | 0        | 3.5  | 0.5     | 0          | 0.6   | 0.5                         | 3.6                           |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a “settlement” polygon will overlap with a “road” polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of “Total anthropogenic habitat disturbance” (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, “Total habitat disturbance” (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbance (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> “Road and trail” indicates the portions of the “Road” and “Trail” categories that were identified as both a road and a trail; “Total Road/Trail” is the combined total of roads and trails and accounts for overlap between the two categories.

The highest contribution of settlements to overall habitat disturbance levels was in the Yukon portion of the Carcross range, and the highest contribution of powerlines was in the Swan Lake range (Table 9). Agriculture, airstrips, railroads, reservoirs and dams played relatively minor roles in all caribou ranges (Table 9).

Roads/trails, mines and seismic lines were located in both low elevation and high elevation portions of the ranges, while forest harvesting, oil facilities, wells, pipeline right-of-ways, powerlines, settlements, agriculture, airstrips, and railroads were located primarily in low elevation ranges (Table 10, Table 11).

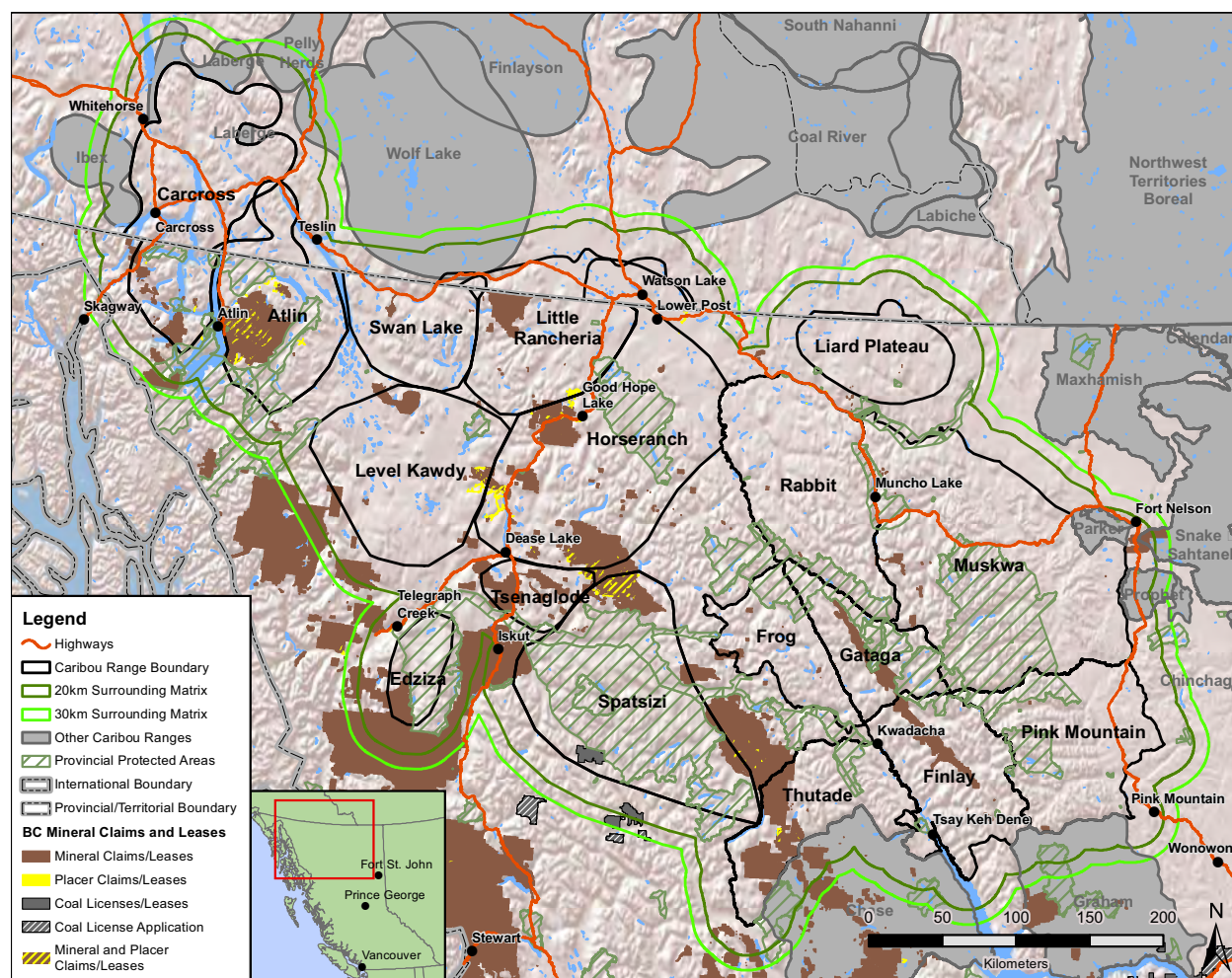
The main anthropogenic habitat disturbances in high elevation ranges other than roads/trails were seismic lines (Liard Plateau and Pink Mountain), mining (Atlin), and forest harvesting (Finlay, Thutade; Table 11).

## **Potential future habitat disturbance**

Mineral exploration and mining activities, forest harvesting, oil and gas exploration and development, and road networks associated with industrial activities all have the potential to increase within Northern Mountain Caribou ranges assessed in this report. Natural resources in northern BC are viewed as key contributors to the provincial economy. Much employment and business activity in the region is driven, directly and indirectly, by natural resource extraction activities, and figures prominently in plans for future prosperity of the region (e.g., Initiatives Prince George Development Corporation and Northern Development Initiative Trust 2020). However, it is not always possible to predict where, and at what intensity, industrial activities are most likely to occur in the future. For example, while mining claims provide a good indication of areas of potential interest for mineral exploration activities (Figure 6), it is not possible to use this information to predict the location of viable ore deposits and which mines will ultimately be developed. While information on mining projects for which environmental assessment processes have been initiated can be used to predict potential location of mines, by the time projects enter these processes, they are already advanced in planning and feasibility studies.

The BC Environmental Assessment Office lists a number of mining projects that have initiated environmental assessment processes in caribou ranges and their surrounding matrix (Table 12). Two of the projects were withdrawn in 2016 and the certificate for one project expired in 2017. Two projects in the Spatsizi caribou range (Kutcho) and 20 km matrix (Arctos Anthracite) are listed as in the pre-application phase. The Arctos Anthracite (metallurgical coal) project is located just outside the southwestern boundary of the Spatsizi caribou range in the Klappan area, and includes a 147-km extension to an existing railway. In 2015, the Province of BC acquired the coal licenses in the Klappan to allow for time for the Province and the Tahltan Nation to develop a shared vision for the Klappan (Government of BC 2015). As part of the agreement, Fortune Minerals and POSCO Canada have a 10-year option to buy back the licenses after the Province and the Tahltan Nation have agreed on the shared vision. The Kutcho project lies within the northern portion of the Spatsizi caribou range and includes upgrading approximately 40 km and realigning approximately 80 km of the Jade-Boulder road (which currently supports seasonal use for industrial activities) to a one lane radio-controlled road supporting year-round use. One project in the Finlay caribou range was approved prior to the Environmental Assessment Act but development did not proceed. A certificate was issued for the Galore Creek open

**Figure 6. Mineral and placer claims and leases, and coal licenses and leases, in and adjacent to the British Columbia portion of caribou ranges that are wholly or partially in northern British Columbia.**



**Table 12. Projects listed on the BC Environmental Assessment Office (EAO) website for caribou ranges that a wholly or partially in northern British Columbia.**

| Range    | Zone         | Project           | Type                                        | EAO Stage                    |
|----------|--------------|-------------------|---------------------------------------------|------------------------------|
| Atlin    | Range        | Ruby Creek        | Open pit molybdenum mine and mill           | Certificate expired 2017     |
| Edziza   | Range        | Schaft Creek      | Open pit copper-gold-molybdenum-silver mine | Withdrawn 2016               |
|          | 30 km matrix | Galore Creek      | Open pit copper-gold-silver mine            | Certificate issued 2007      |
| Spatsizi | Range        | Kutcho            | Underground copper-zinc mine                | Pre-application <sup>1</sup> |
|          | 20 km matrix | Arctos Anthracite | Open pit coal mine                          | Pre-application <sup>1</sup> |
| Finlay   | Range        | Stronsay          | Open pit lead-zinc mine                     | Pre-EA Act approval          |
| Thutade  | Range        | Sustut            | Open pit copper mine                        | Withdrawn 2016               |

<sup>1</sup> There are no time limits on the pre-application phase (BC Environmental Assessment Office 2020)



pit copper-gold-silver mine in 2007, but the mine has not been developed yet. The Galore Creek project is located in the southwestern portion of the 30 km matrix surrounding the Edziza range. The Northwest Transmission Line from Terrace to the Iskut area, which was completed in 2014, is expected to support development of new mines in northwestern BC (BC Hydro 2014).



*Forest harvest cutblocks in the Thutade caribou range, west of Kwadacha. (© Garth Lenz)*

Future oil and gas and forestry development are both likely to be focused in and around areas of current or past activity. Oil and gas development (conventional and nonconventional) is currently concentrated in the Western Sedimentary Basin of northeastern BC, which overlaps the Liard Plateau, Muskwa and Pink Mountain caribou ranges; expansion of activities is expected to continue within that area (Government of BC 2022a). The Bowser Basin and Whitehorse trough are interior basins with identified coal, oil and gas potential in northwestern BC (Government of BC 2022a). In 2012, the Province of BC reached a tripartite agreement with the Tahltan Central Council and Shell Canada in which Shell Canada ceased exploration activities for natural gas and relinquished its tenures in the Klappan area within the Bowser Basin (Government of BC 2012), which overlaps the western portion of the Spatsizi caribou range. The Province of BC also committed to not issuing future petroleum and natural gas tenure in the area.

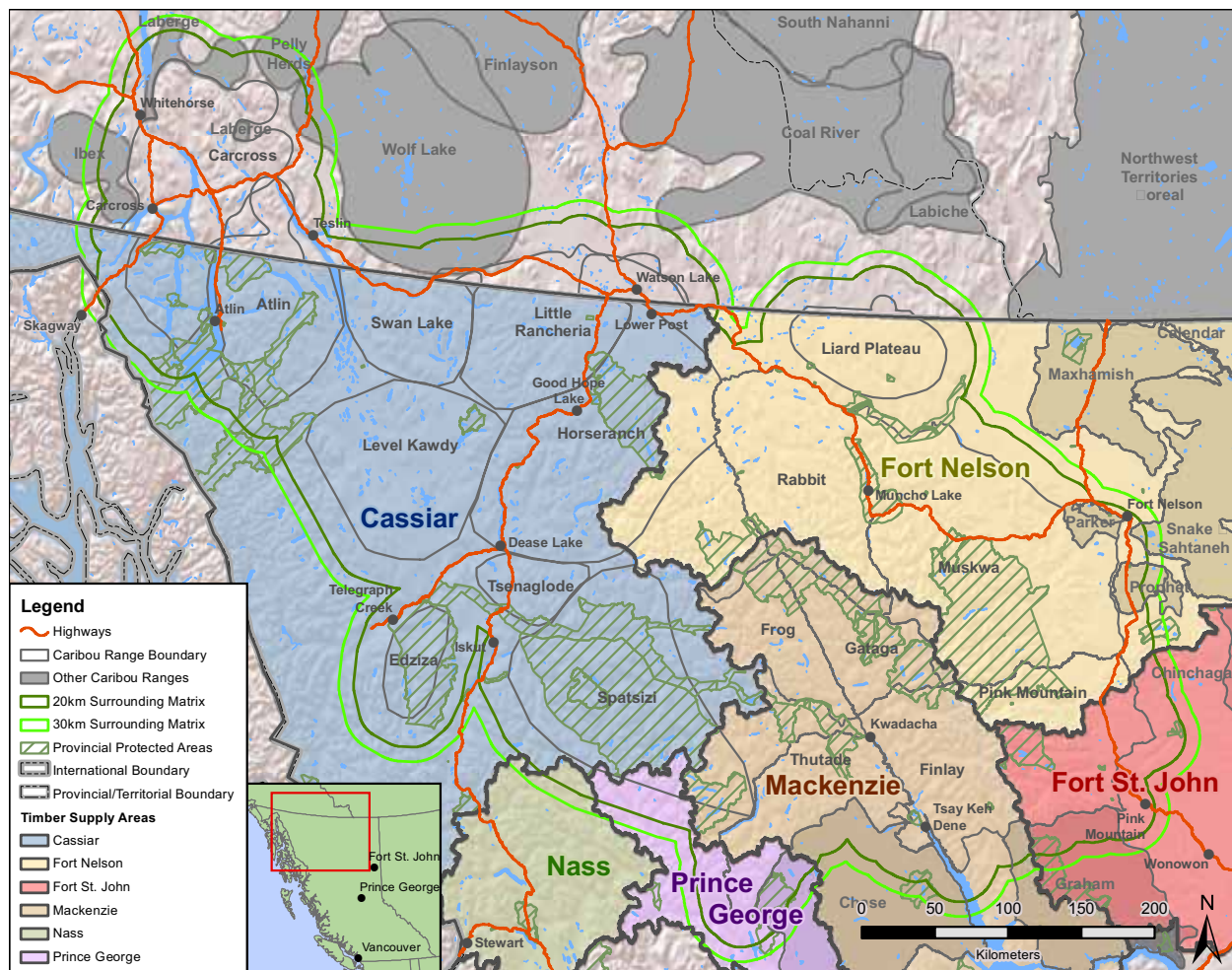
Natural gas pipelines that have been discussed or proposed in BC are all located outside the study area (Government of BC 2019), but potential routes for an “Alberta to Alaska Railway” freight rail line project have been proposed in the northerneastern part of the region near the Yukon border (Van Horne Institute 2015) in the Rabbit, Liard Plateau, Horseranch and Little Rancheria ranges and surrounding matrix.



The study area overlaps portions of six timber supply areas (TSAs) (Figure 7). In 2014, the allowable annual cut (AAC) in the Mackenzie TSA was increased, with the intent of targeting MPB-killed stands (Nicholls 2015a). Areas currently considered operable in the Mackenzie TSA include low elevation areas in the Thutade and Finlay caribou ranges (BC MFLNRD 2020). In the recent AAC determination in the Fort St John TSA, the AAC remained unchanged, but a limit was set on the harvest level within the ‘core’ of the TSA, effectively directing more harvesting into the ‘periphery’ (Nicholls 2018), which includes the Pink Mountain caribou range. Forest harvesting has not yet occurred in the western part of the Pink Mountain caribou range because this area is in the Muskwa-Kechika Management Area and prior to harvesting requires approved landscape unit objectives, which have not yet been developed (Nicholls 2018). However, increased harvesting in the eastern portion of the range could occur as a result of increased harvesting pressure in the ‘periphery’.

Most of the caribou ranges and surrounding matrix in the western part of the study area are located in the Cassiar TSA and to a lesser extent in the northern portions of the Nass and Prince George TSAs (Figure 7). The five operable areas in the Cassiar TSA are generally focused around existing road networks (BC MFLNRD 2013) and overlap portions of all caribou ranges in northwestern BC except Carcross. Commercial forest harvesting is not permitted in virtually all of the Carcross caribou range and portions of the Atlin caribou

**Figure 7. Timber supply areas (TSAs) in British Columbia that overlap caribou ranges that are wholly or partially in northern British Columbia.**



range in the BC portion of the ranges, outside of protected areas (Government of BC 2014). Although the more remote 'Iskut B' area, which includes parts of the Level Kawdy, Horseranch, Tsenaglade and Spatsizi caribou ranges, was not included in the timber harvesting landbase (THLB) in the current AAC determination, it could be reconsidered for inclusion in the next determination that is due to be completed in 2025 (Nicholls 2015b). Forest harvesting was recently deferred for 20 years in the Sacred Headwaters zone in the Klappan area (Tahltan Central Government and Province of BC 2019). Most of the portion of the Nass TSA that overlaps matrix that surrounds caribou ranges in our study area was excluded from the THLB in the recent timber supply review due to the high cost of access development into the area (BC MFLNRORD 2019). In the Prince George TSA, potential new connector roads could make forest harvesting more viable in more remote portions of the TSA (Nicholls 2017), such as in the northern portion that overlaps caribou ranges and surrounding matrix in our study area.

In addition to potential future anthropogenic habitat disturbance, with climate change, wildfires and forest insect outbreaks are expected to increase (Price et al. 2013, Wotton et al. 2016). In northern BC, mean summer and winter temperature are predicted to increase and mean summer and winter precipitation are expected to increase slightly with an overall decrease in precipitation falling as snow (Foord 2016, Wang et al. 2016, Zhang et al. 2019). However, the increase in precipitation is likely not sufficient to balance increased evaporation due to increased temperatures (Foord 2016, Wotton et al. 2016). Overall, climate change is expected to result in longer fire seasons and increased fire intensity (Wotton et al. 2016).

Climate change is also expected to result in changes to ecological conditions. In our study area, by 2100, climatic conditions in the high elevation Spruce-Willow-Birch and low elevation Boreal White and Black Spruce biogeoclimatic zones are expected to transition to climatic conditions associated with the Engelmann Spruce-Subalpine Fir and Sub-Boreal Spruce zones respectively, with some lower elevations in the southern and western portions of the study area transitioning to the Interior Cedar Hemlock zone and a potentially novel zone at some lower elevations in the northeast and north-central portions of the study area (Wang et al. 2016).

## **Population status**

Table 13 summarizes population size and trends for caribou herds in northern BC. Current population trend assessed during this study (increasing, stable, declining) was based on three or more calf recruitment surveys conducted within the last 9 years (1 generation). Of the 17 currently-defined caribou herds in northern BC, current and long-term trend (over 2-3 generations) is unknown for most (13) herds, decreasing for two herds, and increasing for two herds (Table 13). Although numerous composition surveys (i.e., for sex and age) have been conducted for several herds since aerial surveys began in the late 1960s, information on current population size and current and long-term population trend is lacking because: 1) for most herds, few or no population surveys have been conducted that can be used to compare population size over time; 2) the majority of composition surveys for most herds were conducted in the 1970s and 1980s, and/or during 3-5 year duration radio-telemetry studies in the 1990s and early 2000s, making population trend inferred from calf recruitment indices from those surveys out of date; and 3) since 2010, very few or no surveys have been conducted for most herds although there has been an increase in effort for some herds in the last 3-5 years (see Appendix 3).

**Table 13. Population estimates and trends for caribou herds that are wholly or partially in northern British Columbia.**

| Range <sup>1</sup> |    | Estimate <sup>1</sup>  | Survey year | Current trend <sup>2</sup> | Long-term trend <sup>2</sup> | Total Habitat Disturbance <sup>3</sup><br>(Anthropogenic habitat disturbance with 500m buffer + fires <40 years) |                |             |
|--------------------|----|------------------------|-------------|----------------------------|------------------------------|------------------------------------------------------------------------------------------------------------------|----------------|-------------|
|                    |    |                        |             |                            |                              | Low elevation                                                                                                    | High elevation | Total Range |
| Atlin              | AT | 1527 <sup>4</sup>      | 2018        | Stable or increase         | Increase                     | 18.2                                                                                                             | 7.0            | 11.5        |
| Carcross           | CA | 775 <sup>5</sup>       | 2007        | Increase                   | Increase                     | 18.1                                                                                                             | 2.5            | 8.8         |
| Edziza             | ED | 151 <sup>6</sup>       | 2006        | Unknown                    | Unknown                      | 17.8                                                                                                             | 6.4            | 9.5         |
| Finlay             | FI | 96 <sup>7</sup>        | 2020        | Unknown                    | Unknown                      | 51.9                                                                                                             | 4.8            | 16.1        |
| Frog               | FR | 245 <sup>8,9</sup>     | 2001        | Unknown                    | Unknown                      | 12.0                                                                                                             | 3.4            | 4.3         |
| Gataga             | GA | 265 <sup>8,10</sup>    | 2000        | Unknown                    | Unknown                      | 16.0                                                                                                             | 4.2            | 6.8         |
| Horseranch         | HO | 800-1000 <sup>11</sup> | 2000        | Unknown                    | Unknown                      | 24.9                                                                                                             | 4.9            | 14.4        |
| Level Kawdy        | LK | 1538                   | 1998        | Unknown                    | Unknown                      | 7.1                                                                                                              | 2.3            | 3.0         |
| Liard Plateau      | LP | 131                    | 2020        | Unknown                    | Decrease                     | 34.3                                                                                                             | 8.2            | 20.9        |
| Little Rancheria   | LR | 800-1600               | 1999        | Unknown                    | Unknown                      | 23.8                                                                                                             | 7.2            | 16.1        |
| Muskwa             | MU | 917                    | 2004        | Unknown                    | Unknown                      | 46.2                                                                                                             | 11.1           | 25.8        |
| Pink Mountain      | PM | 533 <sup>12</sup>      | 2021        | Decrease                   | Decrease                     | 72.3                                                                                                             | 15.7           | 35.4        |
| Rabbit             | RA | 1300 <sup>13</sup>     | 2007        | Unknown                    | Unknown                      | 15.2                                                                                                             | 2.8            | 6.7         |
| Spatsizi           | SP | 2681                   | 1994        | Unknown                    | Unknown                      | 11.0                                                                                                             | 4.4            | 5.5         |
| Swan Lake          | SL | 600-800                | 2007        | Unknown                    | Unknown                      | 13.9                                                                                                             | 8.1            | 9.4         |
| Thutade            | TH | 114 <sup>8</sup>       | 2019        | Unknown                    | Unknown                      | 50.4                                                                                                             | 6.3            | 11.3        |
| Tsenaglude         | TS | 450-650 <sup>14</sup>  | 2022        | Unknown                    | Unknown                      | 29.5                                                                                                             | 9.1            | 11.4        |

<sup>1</sup> All population estimates were derived from surveys (and extrapolated in most cases).

<sup>2</sup> Recent trend based on evaluation of data collected during the most recent generation (9 years – see COSEWIC 2014); Long-term trend based on data collected over 2-3 generations (18-27 years); see data summarized in Appendix 3

<sup>3</sup> For transboundary caribou ranges, total habitat disturbance is for the total range (BC + Yukon); see Table 8

<sup>4</sup> From BC Caribou Recovery Program (2021); confidence interval: 1077-1927

<sup>5</sup> 2007 population estimate includes Yukon's Laberge herd (Caribou Recovery Program 2021); confidence interval: 642-935; Carcross population estimate based on a 2019 survey is currently being prepared (Thiessen, pers. comm.)

<sup>6</sup> The most recent estimate was based on a survey conducted in March 2006; since then 23 caribou were counted in October 2017 (see Appendix 3) and less than 30 have been counted during surveys in the last few years (N. MacLean, pers. comm.)

<sup>7</sup> From Klaczek and Anderson (2020); confidence interval: 65-127

<sup>8</sup> Grey lettering indicates number of caribou counted during the survey and does not represent a population estimate

<sup>9</sup> In March 2020, 114 caribou were counted during a composition survey (A. Pelletier pers. comm.; see Appendix 3)

<sup>10</sup> In March 2007, 138 caribou were counted during a sheep survey in a portion of the Gataga range; see Appendix 3

<sup>11</sup> Since 2000, 514 caribou were counted in Feb/Mar 2009 and 133 were counted during a composition survey in fall 2015; see Appendix 3

<sup>12</sup> From BC Caribou Recovery Program (2021); confidence interval: 333-879

<sup>13</sup> Since 2007, 362 caribou were counted in 2021 (BC Caribou Recovery Program 2021)

<sup>14</sup> From Tahltan Wildlife Department (pers. comm. 2022); based on minimum counts during seasonal composition surveys from 2020 to 2022

There is some indication that historical numbers of caribou were larger in northern BC than they are today. Francis & Nishi (2015) mention oral history that indicates that caribou in southern Yukon prior to the Klondike Gold Rush were much more numerous (in the thousands) and widespread than today, and that there was a significant commercial harvest during the Klondike Gold Rush. Also, as a result of wide-scale wolf poisoning programs that were conducted in BC in the 1950s and early 1960s (Hoffos 1987, BC MFLNRO 2014), caribou populations were likely higher in the 1960s and 1970s than they are currently.

Total habitat disturbance (anthropogenic + natural) was highest in the two caribou ranges with declining populations over the long term (Pink Mountain, Liard Plateau) and in the Muskwa range with an unknown population trend (Figure 8). The same general pattern was evident in the low elevation portion of caribou ranges, except that the Muskwa, Thutade and Finlay ranges (all with unknown population trends) were also included in the five ranges with the highest levels of habitat disturbance. Total habitat disturbance in high elevation range was also highest in the two ranges with declining populations and in the Muskwa range (Figure 8). Levels of total habitat disturbance in the total, low and high elevation ranges for the two populations with increasing long-term trends were intermediate relative to other ranges (Figure 8).

Of the two populations that are experiencing known long-term declines in numbers, Pink Mountain had the highest level of anthropogenic habitat disturbance and Liard Plateau had the highest level of fire disturbance across the total range (Figure 9). The Pink Mountain caribou range also had the highest level of anthropogenic habitat disturbance in its low elevation and high elevation ranges of all 17 ranges in northern BC (Figure 9). Levels of both fire and anthropogenic habitat disturbances were much lower in high elevation range, with both declining populations included in three ranges with the highest levels of anthropogenic disturbance (Figure 9).

## Discussion

Our study represents the latest effort to bring together various sources of information to provide an updated status assessment of range and population condition for 17 Northern Mountain Caribou herds in BC. The picture that emerges is one whereby most caribou ranges in the region are affected to some degree by various agents of human and natural habitat disturbance. Meanwhile, our knowledge of population trends in the face of changing circumstances is largely unknown.

Further, some range boundaries did not fully or accurately represent the distribution of caribou. For example, the currently delineated Edziza caribou range is offset in a way that it does not contain the entire mountain block that the Edziza caribou herd occupies. Also, for a number of herds there is insufficient information to delineate range-specific seasonal



*Muskwa caribou near Muncho Lake in April. (Donald Reid)*



Figure 8. Total habitat disturbance (fire<40 years + anthropogenic habitat disturbance) in the total range (top), low elevation portion of the range (centre) and high elevation portion of the range (bottom), for caribou ranges that are wholly or partially in northern British Columbia. See Table 13 for codes for caribou ranges. Symbol colours indicate population trend: green = stable or increasing; red = declining; grey = unknown.

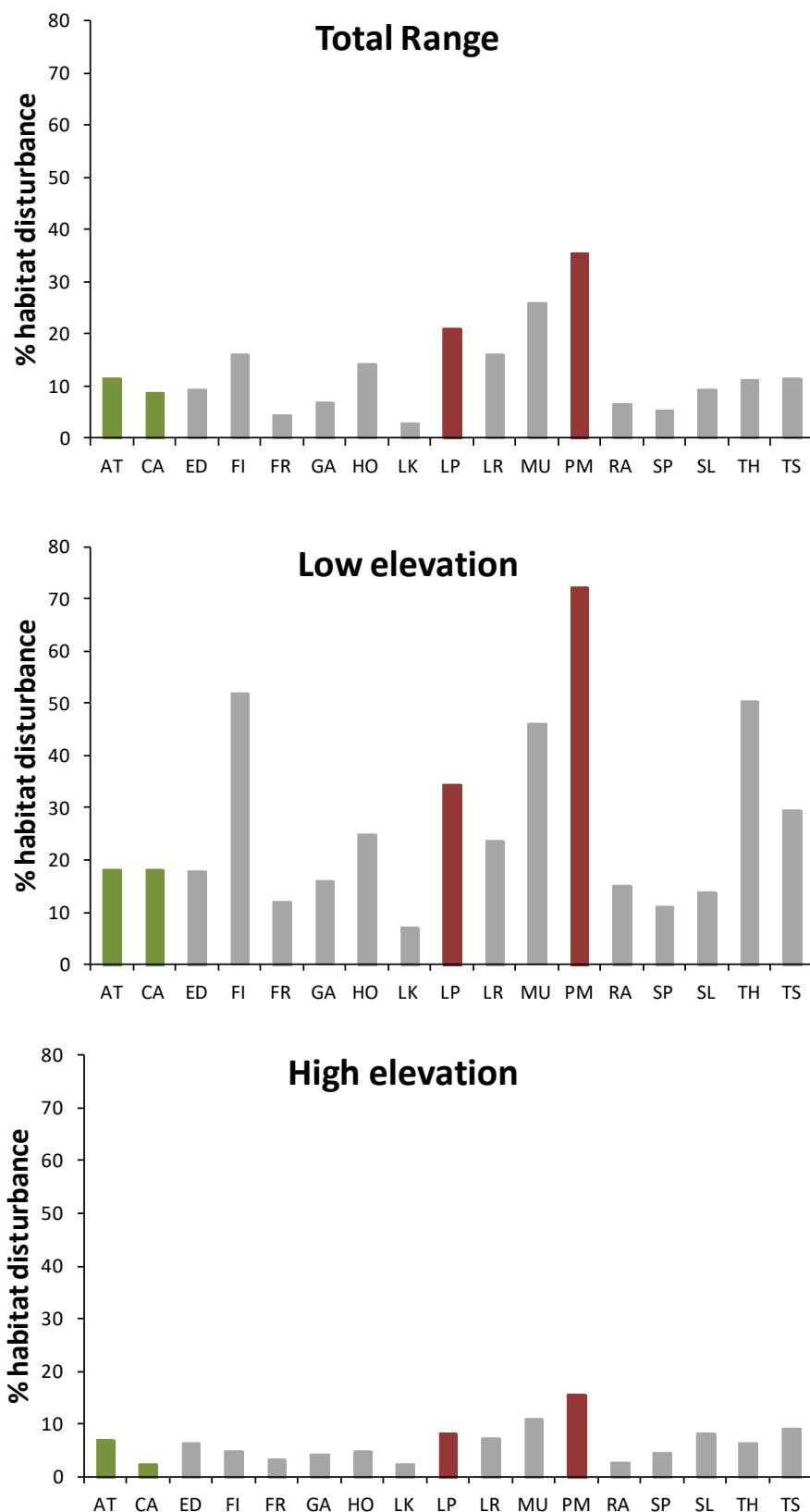
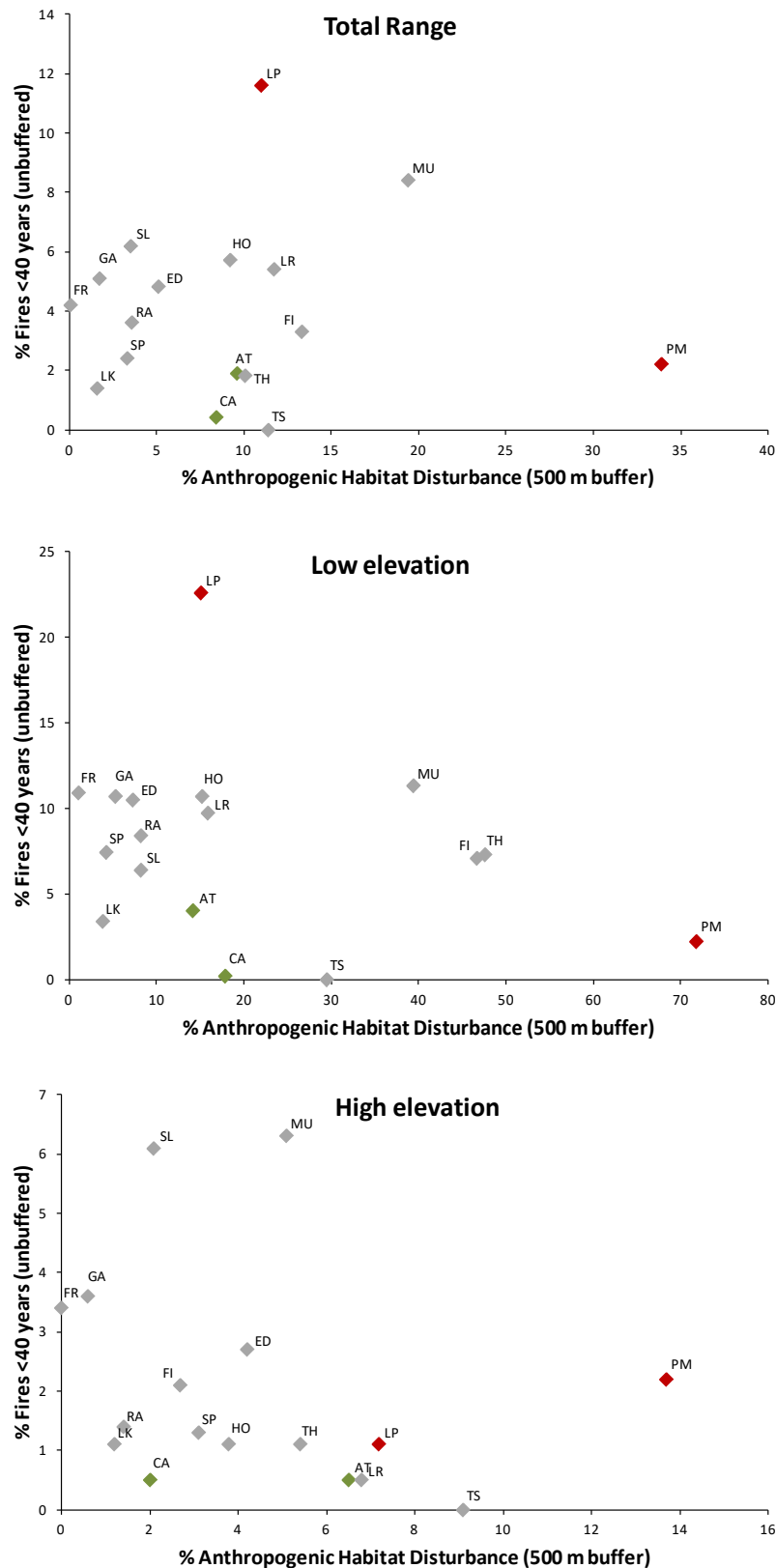


Figure 9. Contribution of fires <40 years (unbuffered) and anthropogenic disturbance (500 m buffer) to total habitat disturbance on the whole range (top), low elevation portion of the range (centre) and high elevation portion of the range (bottom), for caribou ranges that are wholly or partially in northern British Columbia. See Table 13 for codes for caribou ranges. Symbol colours indicate population trend: green = stable or increasing; red = declining; grey = unknown.



ranges. Instead, we used biogeoclimatic zones as a coarse filter approach for distinguishing between low elevation and high elevation ranges, which could potentially result in overestimation of the extent of one or the other.

Accurate range boundaries are necessary to tailor management actions to individual herds and to address their annual and seasonal needs. Range boundaries should not necessarily be expected to remain static, and regular monitoring will be needed to make appropriate amendments to caribou range boundaries, a number of which currently require revisions. Although revised range and seasonal range boundaries would result in different habitat disturbance levels for individual ranges than those presented in this report, the distribution of existing habitat disturbance would not change, nor do we expect the relative levels of habitat disturbance across individual ranges to change. That is, the ranges that currently contain the highest levels of habitat disturbance would still contain the highest levels of habitat disturbance even if boundaries are adjusted. With the inclusion of 20 km and 30 km matrices around each range and around the total area of all the ranges, we have a complete picture of the current distribution of habitat disturbance across all ranges that should also encompass most, if not all, boundary adjustments within the area.

## **Patterns of habitat disturbance and population status**

Although we encountered uncertainties with caribou range boundaries (see above) and other data limitations (see Appendix 4), some distinct patterns of habitat disturbance across the 17 caribou ranges were evident:

- the highest levels of habitat disturbance across the total range were in the Pink Mountain (35%), Muskwa (26%), and Liard Plateau (21%) ranges;
- the lowest levels of habitat disturbance across the total range were in the Frog (4%), Gataga (7%), Level Kawdy (3%), Rabbit (7%) and Spatsizi (6%) ranges;
- total habitat disturbance levels equal or exceed the 35% management threshold on low elevation ranges in five ranges: Liard Plateau, Muskwa, Pink Mountain, Finlay, and Thutade;
- roads and trails were the dominant type of anthropogenic habitat disturbance on all ranges in both high and low elevation ranges;
- other types of anthropogenic habitat disturbance were important in individual ranges including:
  - forest harvesting in the Finlay, Thutade, Horseranch, and Little Rancheria ranges;
  - mines in the Atlin range;
  - seismic lines in the Pink Mountain, Muskwa, and Liard Plateau ranges; and,
  - oil facilities and wells in the Pink Mountain and Muskwa ranges;
- mines and seismic lines were located in both low elevation and high elevation portions of ranges, although seismic lines were more abundant at low elevations than at high elevations;

- forest harvesting, oil facilities, wells, pipelines, powerlines, settlements, agriculture, airstrips and railroads were located primarily in low elevation portions of ranges; and,
- in caribou ranges with <10% total habitat disturbance, fire was the dominant type of habitat disturbance on the landscape, while anthropogenic habitat disturbance played a larger role in caribou ranges with >10% total habitat disturbance.

The role of potential future habitat disturbance must also be considered when assessing the current level of habitat disturbance on caribou ranges in northern BC. Given the reality of a warming climate, wildfires and forest insect outbreaks will also increase. Caribou avoid burns, especially during winter, and therefore increased fire frequency and severity will result in increased levels of winter habitat loss in the short to medium term (Palm et al. 2022). Fire could also potentially contribute to ecological changes. For example, in boreal forests, regeneration following fire in some black spruce (*Picea mariana*) stands has been found to favour deciduous canopy species because of complete or partial failure of black spruce to regenerate soon after the fire (Baltzer et al. 2021). Following fire, any permanent changes to ecosystem condition that negatively affects the ability of the ecosystem to support lichens, the primary winter food source for caribou, may effectively remove portions of caribou habitat from the range.



*Top: Roads and other linear features increase mortality risk from predation, collisions, and hunting. (Maria Leung) Bottom: Example of a wildfire that burned 30,212 ha in the Swan Lake caribou range in 2004 (Oliver Holt).*

Planning for increases in natural disturbances will be important when considering potential future cumulative habitat disturbance from anthropogenic activities, especially for ranges where disturbance levels already exceed or are nearing habitat management thresholds. Although strategic land use plans cover most of the study area, they are focused on resource management rather than conservation outcomes. Regulatory processes related to the management of natural resources have generally occurred on a sector or project-specific basis (Council of Canadian Academies 2019). This makes it challenging to implement a cumulative effects approach that will be necessary to safeguard caribou and other wide-ranging and sensitive species in the face of environmental change.



While amount of habitat disturbance is an important indicator for assessing the level of potential impacts on caribou, spatial distribution of habitat disturbance also needs to be considered. Even low levels of habitat disturbance could result in significant impacts if they occur in sensitive habitats. For example, an active mine or large exploration camp that is located in important calving range, even if it is serviced by a single road, could lead to increased mortality risk if access to calving range is improved for predators and/or caribou are displaced into habitats with higher predation risk. Due to limited information available on seasonal ranges in many of the caribou ranges, we were not able to assess the significance of spatial distribution of habitat disturbance in each range.

Although population size and trend data are limited for the 17 caribou ranges in northern BC, the two populations that were identified as declining over the long term were two of the three with the highest levels of habitat disturbance over the whole range, and among the five with the highest levels of habitat disturbance in the low elevation portions of their ranges. These results are consistent with studies that have linked Boreal Caribou population condition to habitat disturbance (e.g. EC 2011, Rudolph et al. 2017, Johnson et al. 2020). Reid et al. (2013) found that population growth rate models based on habitat disturbance developed for Boreal Caribou reasonably approximated population status of the Carcross caribou population, but were limited by their inability to deal with seasonal ranges and permanent shrub or sparsely vegetated habitats. Johnson et al. (2020) found that Boreal Caribou populations were more vulnerable on ranges where habitat disturbance was primarily due to anthropogenic habitat disturbance. Although Boreal Caribou models may not be useful in predicting population growth rates for Northern Mountain Caribou, our results suggest that where population trend information is available, that higher levels of habitat disturbance, especially anthropogenic, are associated with declining population trends.

Both herds with increasing population trends (i.e. Carcross and Atlin) are part of the Southern Lakes Caribou Recovery Program, which, since 1993, in Yukon, has included elimination of licensed hunting and a voluntary cessation of hunting by First Nations. The Southern Lakes area is the most densely populated portion of Yukon, and overhunting was thought to be the main cause of caribou declines (Farnell 2009). Following the elimination of Yukon harvests, and along with continued intense fire suppression in Yukon, populations increased (Farnell 2009), and appear to have continued to increase (see Table 13). Levels of anthropogenic disturbance and access in most of the other caribou ranges in our study area (except for the northeastern and southeastern ranges) is currently lower than in the Southern Lakes area, and therefore current potential for overhunting in those ranges is also likely lower.

Management actions focused on mountain-dwelling caribou in western Canada have often been initiated once populations have already declined or been reduced to small numbers, necessitating intensive measures (Ray et al. 2015, Johnson et al. 2015, Palm et al. 2020). Many Northern Mountain Caribou ranges in northern BC remain in relatively intact condition, but habitat disturbance is higher on some ranges, especially the southern and eastern-most ranges. Habitat disturbance in the five caribou ranges in the eastern and southeastern portion of the study area (Liard Plateau, Muskwa, Pink Mountain, Finlay, Thutade) is already at high levels, which increases the importance of ranges with currently lower levels of habitat disturbance and strengthens the case for proactive attention. Special

Concern species are defined under SARA as those that “may become threatened or endangered because of a combination of biological characteristics and identified threats”. One of three purposes of the Act is “to manage species of special concern to prevent them from becoming endangered or threatened”.

In southern BC, many caribou populations are declining, in some places dramatically, and becoming increasingly isolated as habitat disturbance continues to increase in and adjacent to their ranges (Palm et al. 2020; Nagy-Reis et al. 2021). By contrast, there is a unique opportunity to conserve caribou in northern BC while large areas of intact range with minimal or no anthropogenic habitat disturbances still remain. In this region, conserving caribou will require a coordinated approach across all ranges; making caribou conservation a priority; and, restricting anthropogenic habitat disturbance from core areas. The existing system of provincial protected areas protects portions of a number of the 17 caribou ranges in this study, but important habitat for Northern Mountain Caribou is not well represented in the eastern portion of the study area (Weaver 2019).



*Dune Za Keyih Provincial Park in northern BC includes portions of the Frog, Gataga and Rabbit caribou ranges, and a portion of the low density area. (© Garth Lenz)*

We know from experience that recovering caribou populations once they are declining is very difficult and expensive, requires the application of multiple coordinated recovery actions, and so far has resulted in limited success. In BC, recovery efforts involving two or more recovery actions (i.e. predator management, maternity penning, primary prey management, habitat restoration) have helped to avoid extirpation of some herds (BC Caribou Recovery Program 2019; Serrouya et al. 2019), but recovery to self-sustaining populations has yet to be achieved. Complete restoration of caribou habitat will take decades even with concerted effort because of the lag time between when restoration activities occur, and when disturbed (and even subsequently restored) areas are mature enough to become

less attractive to other ungulates, and to start exhibiting characteristics of preferred caribou habitat (e.g., lichens for forage, canopies for snow interception). Therefore, not disturbing habitat in the first place is the most effective method for conserving caribou and their habitat in both the short and long terms.

## Recommendations

The federal Special Concern status of Northern Mountain Caribou (including those in Yukon and the NWT) required the development of a management plan under SARA, which was issued 10 years ago (EC 2012a). That plan recommended a series of management actions under eight objectives that called for coordinated actions with a goal “to prevent the NMP<sup>2</sup> from becoming threatened or endangered, by having responsible agencies cooperatively work together to care for caribou and their habitat.” Although the federal Minister of the Environment is obliged under SARA to monitor the implementation of this plan and formally assess progress every five years, to our knowledge this has not occurred to date. Although the BC government acknowledges growing concerns with the condition of Northern Mountain Caribou populations (Government of BC 2022b), the conservation of these herds remains to be reliant only on sector-specific habitat management “tools”.

Within this context, we offer the following recommendations to help shift the existing regulatory and policy regimes to ones that provide stronger limits on the amount and spatial extent of landscape disturbances generally (Yahey v British Columbia, 2021) and thereby lessen the risk of Northern Mountain Caribou becoming threatened or endangered (EC 2012a). In view of the BC *Declaration on the Rights of Indigenous Peoples Act* (2020) and the province’s Declaration on the Rights of Indigenous Peoples Act Action Plan (Government of BC 2022c), all First Nations having Traditional Territories overlapping the ranges of Northern Mountain Caribou in northern BC will need to be consulted to garner input of knowledge about caribou and on how Indigenous-led conservation efforts could improve future conditions for Northern Mountain Caribou in northern BC.

- 1. Make caribou conservation a priority.** Among wildlife species in northern BC, caribou are one of the most sensitive to the cumulative impacts of anthropogenic and natural habitat disturbances. Caribou habitat is defined by extensive areas of mature and undisturbed landscapes (COSEWIC 2014) and many areas in northern BC are relatively undisturbed. Monitoring, managing and protecting habitat for caribou today will be essential if we want to avoid the need to conduct intensive and expensive recovery actions in the future, which may result in only limited success and require a long-term commitment. While there are important information gaps, caribou are well-studied relative to other less-visible elements of biodiversity, and management efforts that successfully maintain caribou populations should also better preserve animal assemblages (Bichet et al. 2016).

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<sup>2</sup> NMP = Northern Mountain Population as defined by the Northern Mountain National Ecological Area (see EC 2012a)

2. **To better ensure persistence of Northern Mountain Caribou in northern BC, manage all 17 populations and ranges together as a unit**, such that the land management and habitat disturbances on one caribou range are considered in terms of their implications to the whole system, rather than just to the individual caribou population and range. Managing all populations as one unit will also foster a stronger focus on maintaining connectivity between ranges.
3. **Develop and implement a better system for tracking and sharing data of anthropogenic habitat disturbance (and habitat recovery) for all natural resource extraction sectors, to support cumulative effects analysis and management.** Currently, availability and accuracy of spatial and temporal data for anthropogenic habitat disturbances varies among natural resource sectors and among different types of habitat disturbances. As a result of *Yahey v British Columbia* (2021), requirements for conducting cumulative effects assessments are potentially expanding beyond only those for Environmental Assessments for major projects. A reliable source of consistent and readily available information on anthropogenic habitat disturbances will be essential for enabling all industrial sectors to assess cumulative effects on caribou in northern BC.
4. **Protect caribou habitat to provide deliberate and sustained protection of key seasonal ranges and connectivity between populations.** There are a number of existing Indigenous-led, and other proposals for protected areas (e.g., Kaska Dena Council 2019, Weaver 2019) that address protection of important caribou habitat. Where feasibility of protected areas is limited, use areas of temporary (e.g., 30 years) deferrals from industrial use to conserve sufficient habitat (e.g., 300,000 ha) to maintain caribou herds in a self-sustaining condition. Temporary deferral areas could be opened to industrial interests once adjacent disturbed areas have been fully restored to conditions suitable for use by caribou.
5. **Improve our understanding of caribou seasonal range and habitat use, and seasonal range and habitat requirements.** A better understanding of seasonal range and habitat use and requirements is essential to clarify understanding of the implications of habitat disturbances on those seasonal ranges and for assessing and managing cumulative effects. Information should be gathered in an approach that considers all forms of available knowledge and information together. The approach should include two phases: 1) immediately compile all currently available information to update our understanding; and, 2) collect and analyze more technical information and/or more Indigenous Knowledge as needed.
6. **Develop and implement priorities for habitat restoration across all 17 ranges** using results from this study. To determine priorities, an approach could be used similar to that used in the tactical plans for restoration of habitat for the Northern and Southern Groups of Southern Mountain Caribou (Cichowski et al. 2021a,b).



7. **Improve monitoring of caribou population status** through more extensive and regular population surveys to support assessment of habitat disturbance effects on populations.
  - Develop a monitoring strategy for all 17 ranges that enables consistent survey efforts so that trends can be evaluated over time.
  - Adopt standards and a protocol for collecting population data, including methods for calculating population estimates, data that should be included in reports (e.g. survey composition numbers, adult mortality rates for radio-collared caribou studies [including information on how they were calculated]), and a schedule for data collection and reporting.
8. **Revise caribou range boundaries** where needed to better reflect currently available information on caribou distribution and re-run habitat disturbance analyses using the updated range boundaries.
  - Revise total range boundaries (where needed) and delineate seasonal ranges using both technical information and Indigenous Knowledge.
  - If knowledge gaps still exist, revise portions of boundaries where information is sufficient to do so based on best available information and acknowledge that additional boundary revisions may be needed once additional information is collected.
  - Once caribou range boundaries and range-specific seasonal ranges have been updated, compare the spatial dataset to satellite imagery to identify any potential missing habitat disturbances.
9. **Enhance the spatial dataset collected for this study** so that linear features can be measured by length. We were unable to do so because the data, collected from multiple sources, did not distinguish among types of linear features, not all features were represented in their entirety, and some features were duplicated many times. Having a measure of length would help in tactical plans for habitat restoration.

# References

- Apps, C., and B. McLellan. 2006. Factors influencing the dispersion and fragmentation of endangered mountain caribou populations. *Biological Conservation* 130:84-97.
- Baltzer, J.L. et al. 2021. Increasing fire and the decline of fire adapted black spruce in the boreal forest. *PNAS* 2021 Vol. 118 No. 45 e2024872118.
- Banner, A., W. MacKenzie, S. Haeussler, S. Thomson, J. Pojar and R. Trowbridge. 1993. A field guide to site identification and interpretation for the Prince Rupert Forest Region. Research Branch, BC Ministry of Forests, Victoria, B.C. Land Management Handbook No. 26.
- Bichet, O., A. Dupuch, C. Hébert, H. Le Borgne and D. Fortin. 2018. Maintaining animal assemblages through single-species management: the case of threatened caribou in boreal forest. *Ecol. Appl.* 26: 612–623.
- Bondo, K.J, H. Schwantje, B. J. Macbeth, and S. Kutz. 2018. British Columbia boreal caribou health program final report: (November 1, 2013 – December 31, 2017). British Columbia Oil and Gas Research and Innovation Society, Victoria, BC.
- BC CDC (B.C. Conservation Data Centre). 2017. BC Species and Ecosystems Explorer. BC Ministry of Environment, Victoria, B.C. (accessed November 2017).
- BC Caribou Recovery Program. 2019. B.C. Provincial Caribou Recovery Program Annual Report 2018/19. BC Caribou Recovery Program, BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development, Victoria, B.C.
- BC Caribou Recovery Program. 2021. Population estimates for caribou herds of British Columbia - October 2021. Province of BC. [https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/wildlife-wildlife-habitat/caribou/bc\\_caribou\\_herds\\_population\\_estimates.pdf](https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/wildlife-wildlife-habitat/caribou/bc_caribou_herds_population_estimates.pdf) (accessed December 2021).
- BC Environmental Assessment Office. 2020. 2002 Act Environmental Assessment Process. <https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/environmental-assessments/the-environmental-assessment-process/2002-act-environmental-assessment-process> (accessed December 2020).
- BC Hydro. 2014. New transmission line ready to power Northwest B.C - News Release. BC Hydro. [https://www.bchydro.com/news/press\\_centre/news\\_releases/2014/new-transmission-line-ready-to-power-northwest-bc.html](https://www.bchydro.com/news/press_centre/news_releases/2014/new-transmission-line-ready-to-power-northwest-bc.html)
- BC Ministry of Forests, Lands and Natural Resource Operations. 2014. Management plan for the grey wolf (*Canis lupus*) in British Columbia. BC Ministry of Forests, Lands and Natural Resource Operations, Victoria, B.C.
- BC Ministry of Forests, Lands and Natural Resource Operations (BC MFLNRO). 2013. Cassiar TSA Timber Supply Analysis Public Discussion Paper. BC Ministry of Forests, Lands and Natural Resource Operations, Victoria, B.C.
- BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (BC MFLNRORD). 2019. Nass Timber Supply Area Timber Supply Review Data Package. BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development, Terrace, BC.
- BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (BC MFLNRORD). 2020. Mackenzie Timber Supply Area Timber Supply Review Data Package. BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development, Mackenzie, BC.
- Chubbs, T., L. Keith, S. Mahoney and M. McGrath. 1993. Responses of woodland caribou (*Rangifer tarandus caribou*) to clear-cutting in east-central Newfoundland. *Can. J. Zool.* 71(3):487-493.
- Cichowski, D., R.S. McNay, and V. Brumovsky. 2021a. A tactical plan for restoration of habitat for the Southern Group of Southern Mountain Caribou. Wildlife Infometrics Inc. Report No. 742. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.
- Cichowski, D., R.S. McNay, and V. Brumovsky. 2021b. A tactical plan for restoration of habitat for the Northern Group of Southern Mountain Caribou. Wildlife Infometrics Inc. Report No. 743. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.

- COSEWIC. 2002. 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. xi + 98 p.
- COSEWIC. 2014. COSEWIC assessment and status report on the caribou *Rangifer tarandus*, Northern Mountain population, Central Mountain population and Southern Mountain population in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxii + 113pp.
- Council of Canadian Academies 2019. *Greater Than the Sum of Its Parts: Toward Integrated Natural Resource Management in Canada*. Ottawa (ON): The Expert Panel on the State of Knowledge and Practice of Integrated Approaches to Natural Resource Management in Canada. Available from: <https://cca-reports.ca/reports/the-state-of-knowledge-and-practice-of-integrated-approaches-to-natural-resource-management-in-canada/>
- DeLong, C. A field guide to site identification and interpretation for the north central portion of the Northern Interior Forest Region. 2004. Research Branch, BC Ministry of Forests, Victoria, B.C. Land Management Handbook No. 54.
- Environment Canada. 2011c. Scientific assessment to inform the identification of critical habitat for woodland caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada: 2011 update. Ottawa, Ontario, Canada. 102p + appendices.
- Environment Canada. 2012a. Management Plan for the Northern Mountain Population of Woodland Caribou (*Rangifer tarandus caribou*) in Canada. Species at Risk Act Management Plan Series. Environment Canada, Ottawa.
- Environment Canada. 2012b. Recovery Strategy for the Woodland Caribou, Boreal population (*Rangifer tarandus caribou*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa.
- Environment Canada. 2014. Recovery Strategy for the Woodland Caribou, Southern Mountain population (*Rangifer tarandus caribou*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. viii + 103pp.
- Ewacha, M., J. Roth, W.G. Anderson, D. Brannen, and D. Dupont. 2017. Disturbance and chronic levels of cortisol in boreal woodland caribou. *J. Wildl. Manage.* 81:1266-1275; DOI: 10.1002/jwmg.21288
- Farnell, R. 2009. Three Decades of Caribou Recovery Programs in Yukon: A Paradigm Shift in Wildlife Management. Technical Report MRC 09 01, Yukon Department of Environment, Whitehorse. ([https://open.yukon.ca/sites/default/files/caribou\\_recovery\\_programs.pdf](https://open.yukon.ca/sites/default/files/caribou_recovery_programs.pdf))
- Festa-Bianchet, M., J. Ray, S. Boutin, S. Côté, and A. Gunn. 2011. Conservation of caribou (*Rangifer tarandus*) in Canada: an uncertain future. *Can. J. Zool.* 89:419-434.
- Foord, V. 2016. Climate patterns, trends and projections for the Omineca, Skeena, and Northeast Natural Resource Regions, British Columbia. Prov. B.C., Victoria, B.C. Tech. Rep. 097. [www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr097.htm](http://www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr097.htm)
- Francis, S., and J. Nishi. 2015. Range assessment as a cumulative effects management tool: Assessment of the Carcross caribou herd range in Yukon. Prepared for Environment Yukon. Yukon Fish and Wildlife Branch Report MRC-15-01, Whitehorse, Yukon, Canada.
- Government of BC. 2022a. Sedimentary Basins of B.C. <https://www2.gov.bc.ca/gov/content/industry/natural-gas-oil/petroleum-geoscience/sedimentary-basins-of-bc>
- Government of BC. 2022b. Northern Mountain Caribou. <https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/wildlife/wildlife-conservation/caribou/north-mountain-caribou>.
- Government of BC. 2019. Export facilities and pipelines map April 2019. Environmental Assessment Office, Government of British Columbia, Victoria, B.C. <https://www2.gov.bc.ca/gov/content/industry/natural-gas-oil/lng/lng-projects>
- Government of BC. 2015. Agreement secures opportunity for progress on shared vision for Klappan. News Release: 2015MEM0011-000617. <https://archive.news.gov.bc.ca/Default.aspx?archive=2013-2017>
- Government of BC. 2014. Atlin-Taku Resource Management and Forest Retention Areas Order. Order in Council No. 473. Province of British Columbia, Victoria, B.C.
- Government of BC. 2012. Agreement brings resolution to gas tenure in Northwest. News Release: 2012EMNG0073-002054. [https://archive.news.gov.bc.ca/releases/news\\_releases\\_2009-2013/2012EMNG0073-002054.pdf](https://archive.news.gov.bc.ca/releases/news_releases_2009-2013/2012EMNG0073-002054.pdf)

- Government of Canada. 2022. Canada Gazette Part II Vol. 156, No. 4. Queen's Printer for Canada, Ottawa, Ontario.
- Hegel, T. and K. Russell. 2013. Status of northern mountain caribou (*Rangifer tarandus caribou*) in Yukon, Canada. *Rangifer*, 33, Special Issue No. 21:59-70.
- Hoffos, R. 1987. Wolf management in British Columbia: the public controversy. BC Ministry of Environment and Parks, Victoria, B.C. Wildlife Bulletin No. B-52.
- Initiatives Prince George Development Corporation and Northern Development Initiative Trust. 2020. Northern British Columbia: A Vision For Prosperity. <https://bcbc.com/reports-and-research/northern-british-columbia-a-vision-for-prosperity>
- IWMS (Identified Wildlife Management Strategy). 2004. Woodland Caribou Account. BC Ministry of Water, Land and Air Protection – Biodiversity Branch, Victoria, B.C.
- Johnson, C., and J. C. Ray. 2021. The challenge and opportunity of applying ecological thresholds to environmental assessment decision making. Chapter 9 in: J. Blakely and D. Franks, eds. *Cumulative Impact Assessment Handbook*. Edward Elgar Publishing Ltd..
- Johnson, C., L. Ehlers and D. Seip. 2015. Witnessing extinction – Cumulative impacts across landscapes and future loss of an evolutionarily significant unit of woodland caribou in Canada. *Biological Conservation* 186:176-186. <http://dx.doi.org/10.1016/j.biocon.2015.03.012>
- Johnson, C-A., G. Sutherland, E. Neave, M. Leblond, P. Kirby, C. Superbie and P. McLoughlin. 2020. Science to inform policy: linking population dynamics to habitat for a threatened species in Canada. *Journal of Applied Ecology* 57:1314-1327.
- Kaska Dean Council. 2019. Kaska Dena News: Spring/Summer 2019. Kaska Dena Council, Lower Post, B.C.
- Kranrod, K. 1996. Effects of timber harvesting methods on terrestrial lichens and understory plants in west-central Alberta. 1996. MSc thesis. University of Alberta, Edmonton, Alberta.
- McCarthy, S., R. Weladji, C. Doucet and P. Saunders. 2011. Woodland caribou calf recruitment in relation to calving/post-calving landscape composition. *Rangifer* 31(1):35-47.
- Meidinger, D., and Pojar, J. (eds.). 1991. Ecosystems of British Columbia. British Columbia Ministry of Forests, Research Branch, Special Report Series 6. <https://www.for.gov.bc.ca/hfd/pubs/Docs/Srs/Srs06.pdf>
- Miège, D.; Armleder, H.; Waterhouse, M.; Goward, T.. 2001. A pilot study of silvicultural systems for northern caribou winter range: lichen response. Res. Br., BC Min. For., Victoria, B.C. Work. Pap. 56/2001.
- Nagy-Reis, M., M. Dickie, A. Calvert, M. Hebblewhite, D. Hervieux, D. Seip, S. Gilbert, O. Venter, C. DeMars, S. Boutin and R. Serrouya. 2021. Habitat loss accelerates for the endangered woodland caribou in western Canada. *Conservation Science and Practice*. 2021:e347. <https://doi.org/10.1111/csp2.437>
- Nicholls, D. 2018. Fort St. John Timber Supply Area Rationale for Allowable Annual Cut (AAC) Determination. BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development, Victoria, B.C.
- Nicholls, D. 2017. Prince George Timber Supply Area Rationale for Allowable Annual Cut (AAC) Determination. BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development, Victoria, B.C.
- Nicholls, D. 2015a. Mackenzie Timber Supply Area Rationale for Allowable Annual Cut Determination (amended January 6, 2015). BC Ministry of Forests, Lands and Natural Resource Operations, Victoria, B.C.
- Nicholls, D. 2015b. Cassiar Timber Supply Area Rationale for Allowable Annual Cut Determination. BC Ministry of Forests, Lands and Natural Resource Operations, Victoria, B.C.
- Palm E.C., S. Fluker, H.K. Nesbitt, A.L. Jacob, and M. Hebblewhite. 2020. The long road to protecting critical habitat for species at risk: The case of southern mountain woodland caribou. *Conservation Science and Practice* 2:e219
- Palm, E.C., J.J. Sutor, K. Joly, J.D. Herriges, A.P. Kelly, D. Hervieux, K.L.M. Russell, T.W. Bentzen, N.C. Larter, and M. Hebblewhite. 2022. Increasing fire frequency and severity will increase habitat loss for a boreal forest indicator species. *Ecological Applications*. <https://doi.org/10.1002/eap.2549>



- Peters, W. 2010. Resource selection and abundance estimation of moose: implications for caribou recovery in a human altered landscape. M.Sc. Thesis. University of Montana, Missoula, Montana, USA. 104p.
- Price, D., R. Alfaro, K. Brown, M. Flannigan, R. Fleming, E. Hogg, M. Dirardin, T. Lakusta, M. Johnston, D. McKenney, J. Pedlar, T. Stratoon, R. Sturrock, I. Thompson, J. Trofymow, and L. Venier. 2013. Anticipating the consequences of climate change for Canada's boreal forest ecosystems. *Environ. Rev.* 21:322-365.
- Ray, J., D. Cichowski, M-H. St-Laurent, C. Johnson, S. Petersen and I. Thompson. 2015. Conservation status of caribou in the western mountains of Canada: Protections under the Species at Risk Act, 2002-2014. *Rangifer*, 35, Special Issue No. 23:49-80.
- Reid, D., S. Francis, and T. Antoniuk. 2013. Application of herd viability models for boreal woodland caribou (*Rangifer tarandus caribou*) to a northern mountain caribou herd. *Canadian Wildlife Biology and Management* 2: 67-79.
- Rudolph, T., P. Drapeau, L. Imbeau, V. Brodeur, S. Légaré and M-H. St-Laurent. 2017. Demographic responses of boreal caribou to cumulative disturbances highlight elasticity of range-specific tolerance thresholds. *Biodivers. Conserv.* DOI 10.1007/s10531-017-1292-1
- Schaefer, J.A., and S.P. Mahoney. 2007. Effects of progressive clearcut logging on Newfoundland caribou. *J. Wildl. Manage.* 71:1753-1757.
- Seip, D.R. 1992. Factors limiting woodland caribou populations and their interrelationships with wolves and moose in southeastern British Columbia. *Can. J. Zool.* 70:1494–1503.
- Serrouya R., D.R. Seip, D. Hervieux, B.n. McLellan, R.S. McNay, R. Steenweg, D.C. Heard, M. Hebblewhite, M. Gillingham, and S. Boutin. 2019. Saving endangered species using adaptive management. *Proceedings of the National Academy of Sciences* 116:6181.
- Serrouya R., B.N. McLellan, S. Boutin, D.R. Seip and S.E. Nielsen. 2011. Developing a population target for an overabundant ungulate for ecosystem restoration. *J. Appl. Ecol.* 48:935–942.
- Sittler, K., R.S. McNay, and L. Giguere. 2015. Herd boundary refinement for the Chase, Spatsizi, and Frog caribou herds in north-central British Columbia: Final Report 2012-2015. HCTF Project #7-394. Wildlife Infometrics Inc. Report N. 499. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.
- Smith, K. 2004 Woodland caribou demography and persistence relative to landscape change in west-central Alberta. M.Sc. thesis, University of Alberta. Edmonton, AB.
- Smith, K., Janet Ficht, D. Hobson, T. Sorensen, and D. Hervieux. 2000. Winter distribution of woodland caribou in relation to clear-cut logging in west-central Alberta. *Can. J. Zool.* 78:1433-1440.
- Stevenson, S., and D. Coxson. 2007. Arboreal forage lichens in partial cuts – a synthesis of research results from British Columbia, Canada. *Rangifer*, Special Issue No. 17: 155-165.
- Sulyma, R.G. 2001. Towards an understanding of the management of pine-lichen woodlands in the Omineca Region of British Columbia. MSc. Thesis. University of Northern British Columbia, Prince George, B.C. 99p.
- Tahltan Central Government and Province of BC. 2019. Klappan Plan. Tahltan Central Government, Dease Lake, B.C. and Province of BC, Victoria, B.C. [https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/consulting-with-first-nations/first-nations/klappan\\_plan.pdf](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/consulting-with-first-nations/first-nations/klappan_plan.pdf)
- Van Horne Institute. 2015. Alberta to Alaska Railway Pre-Feasibility Study. Van Horne Institute, Calgary, AB. <http://www.a2arail.com/downloads/alberta-to-alaska-railway-pre-feasibility-study.pdf>
- Wang, T., A. Hamann, D. Spittlehouse and C. Carroll. 2016. Locally downscaled and spatially customizable climate data for historical and future periods for North America. *PLoS One*, 11, 30156720.
- Weaver, J. 2019. The Greater Muskwa-Kechika: building a better network for protecting wildlife and wildlands. Wildlife Conservation Society Canada Conservation Report No. 13. Toronto, Ontario, Canada.
- Weir, J., S. Mahoney, B. McLaren and S. Ferguson. 2007. Effects of mine development on woodland caribou *Rangifer tarandus* distribution. *Wildl. Biol.* 13:66-74.
- Wittmer, H.U., A.R.E. Sinclair and B.N. McLellan. 2005. The role of predation in the decline and extirpation of woodland caribou. *Oecologia* 144:257–267.
- Wittmer, H., B. McLellan, R. Serrouya and C. Apps. 2007. Changes in landscape composition influence the decline of a threatened woodland caribou population. *Journal of Applied Ecology* 76:568-579.

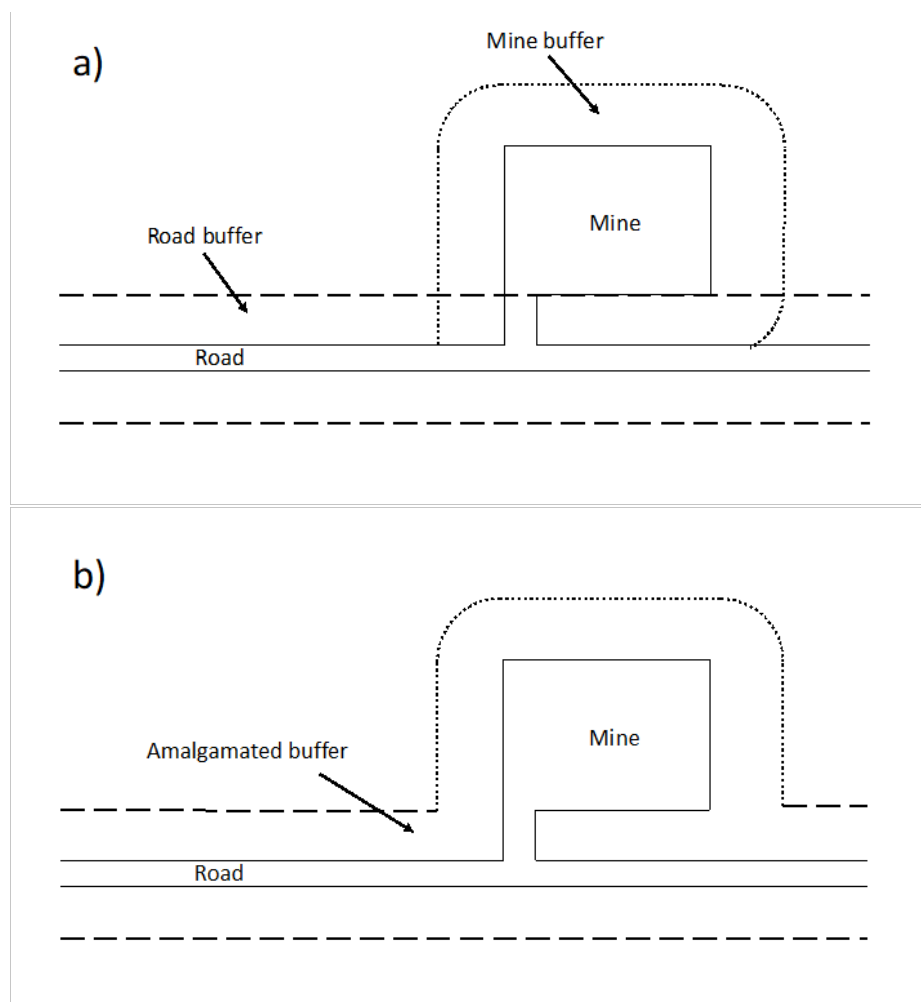
Wotton, B., M. Flannigan and G. Marshall. 2017. Potential climate change impacts on fire intensity and key wildfire suppression thresholds in Canada. *Environ. Res. Lett.* 12 (2017) 095003. <https://doi.org/10.1088/1748-9326/aa7e6e>

Yahey v British Columbia. 2021. BCSC 1287 (CanLII), <https://canlii.ca/t/jgpbr>.

Zhang, X., G. Flato, M. Kirchmeier-Young, L. Vincent, H. Wan, X. Wang, R. Rong, J. Fyfe, G. Li, and V.V. Kharin. 2019. Changes in temperature and precipitation across Canada; Chapter 4 *in* Bush, E. and D.S. Lemmen (Eds.). *Canada's Changing Climate Report*. Government of Canada, Ottawa, Ontario. pp. 112-193.

## Appendix 1. Amalgamating overlapping buffers

The following two illustrations show a) individual buffers around individual anthropogenic habitat disturbances resulting in overlaps of portions of those buffers, and b) the amalgamated buffer, which is the result of dissolving the portions of the boundaries of individual buffers that lie within the combined buffer area.



## Appendix 2. Summary of spatial layers used in the habitat disturbance analysis

Table A1. Spatial data sources for low versus high elevation range lines.

| Name                               | Notes                                                                                                                                                                                                                  | Source                                                                                                                                                                                          |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| u_bc_bec_v10_170412_Clip_Dissolve2 | High Elevation zones were selected: BAFA, CMA, ESSF, MH, SWB                                                                                                                                                           | <a href="https://catalogue.data.gov.bc.ca/dataset/biogeoclimatic-ecosystem-classification-bec-map">https://catalogue.data.gov.bc.ca/dataset/biogeoclimatic-ecosystem-classification-bec-map</a> |
| u_AK_HighLow                       | Small portion of the study area 30km buffer is in Alaska (40,847ha, 0.16%), high and low elevation areas were approximated with hand-digitization based on Bing Maps imagery using the adjacent BEC mapping as a guide | digitized from Bing Maps imagery                                                                                                                                                                |
| u_YT_HighLow_S05_erase             | Good partner to BEC for areas north of 60N, selected Boreal High, Boreal Subalpine, and Boreal Alpine Tundra classes to approximate high-elevation range                                                               | <a href="ftp://ftp.geomaticsyukon.ca/GeoYukon/Biophysical/Bioclimate_Zones_and_Subzones/">ftp://ftp.geomaticsyukon.ca/GeoYukon/Biophysical/Bioclimate_Zones_and_Subzones/</a>                   |



Table A2. Spatial data sources for habitat disturbances.

| Layer                                                 | Class              | Data Type | Used in Project | Description                                                                                                                                                                                                                                                                        | Source                                                                                                        |
|-------------------------------------------------------|--------------------|-----------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Raw_YT_Agriculture_Land_Dispositions                  | Agriculture        | Polygon   | Yes             | Agricultural footprints in YT                                                                                                                                                                                                                                                      | ftp://ftp.geomaticsyukon.ca/GeoYukon/Land_Tenure/Agriculture_Land_Dispositions/                               |
| Raw_BC_btm_agriculture                                | Agriculture        | Polygon   | Yes             | Agricultural footprints in BC                                                                                                                                                                                                                                                      | https://catalogue.data.gov.bc.ca/dataset/baseline-thematic-mapping-present-land-use-version-1-spatial-layer   |
| Raw_BC_airports_point                                 | Airstrip           | Point     | For Reference   | Locations of airstrips in BC                                                                                                                                                                                                                                                       | https://catalogue.data.gov.bc.ca/dataset/bc-airports/resource/03fdc03b-5487-4a2e-b7e3-a82e53d-b9ea1           |
| Raw_BC_airports_point                                 | Airstrip           | Point     | Yes             | Locations of airstrips in BC                                                                                                                                                                                                                                                       | features are either digitized from Bing Maps imagery or copied from 'urban' features in BTM mapping           |
| Raw_YT_Forest_Openings_Pre_1990                       | Cutblocks          | Polygon   | Yes             | Cutblocks pre-1990 in YT                                                                                                                                                                                                                                                           | ftp://ftp.geomaticsyukon.ca/GeoYukon/Forestry/Forest_Openings_Pre_1990/                                       |
| Raw_YT_Forest_Openings                                | Cutblocks          | Polygon   | Yes             | post-1990 cutblocks in YT                                                                                                                                                                                                                                                          | ftp://ftp.geomaticsyukon.ca/GeoYukon/Forestry/Forest_Openings/                                                |
| Raw_BC_consolidated_cutblocks_171123                  | Cutblocks          | Polygon   | Yes             | Harvested areas in BC                                                                                                                                                                                                                                                              | https://catalogue.data.gov.bc.ca/dataset/harvested-areas-of-bc-consolidated-cutblocks-                        |
| Raw_YT_dams                                           | Dam                | Line      | Yes             | Locations of dams in YT                                                                                                                                                                                                                                                            | 2 features digitized from Bing maps imagery                                                                   |
| Raw_BC_dams                                           | Dam                | Line      | Yes             | Locations of dams in BC                                                                                                                                                                                                                                                            | https://catalogue.data.gov.bc.ca/dataset/b-c-dams/resource/c361739f-5514-457f-866a-b832ebaf06b3               |
| Raw_YT_Placer_Land_Use_Permits_50k                    | Mining             | Polygon   | Yes             | Placer mining land permits, active and expired                                                                                                                                                                                                                                     | ftp://ftp.geomaticsyukon.ca/GeoYukon/Mining/Placer_Land_Use_Permits_50k/                                      |
| Raw_YT_Gravel_Pits_25k                                | Mining             | Point     | No              | Locations of gravel pits associated with roads, not polygonal and doesn't add a lot of area, might not contribute much over roads alone                                                                                                                                            | ftp://ftp.geomaticsyukon.ca/GeoYukon/Transportation/Gravel_Pits_25k/                                          |
| Raw_YT_Cultural_Features_Mining_Areas_50k             | Mining             | Polygon   | Yes             | Mining perimeters on the landscape, mostly gravel pits                                                                                                                                                                                                                             | ftp://ftp.geomaticsyukon.ca/GeoYukon/Culture_and_Heritage/Cultural_Features_Polygon_50k/                      |
| Raw_BC_SKE_MineFP_Jan2018                             | Mining             | Polygon   | Yes             | Mine footprints in NW BC digitized by Blair Ells BC FLNRO                                                                                                                                                                                                                          | N/A                                                                                                           |
| Raw_BC_btm_mining                                     | Mining             | Polygon   | Yes             | Mine footprints in BC                                                                                                                                                                                                                                                              | https://catalogue.data.gov.bc.ca/dataset/baseline-thematic-mapping-present-land-use-version-1-spatial-layer   |
| u_veg_comp_lyr_r1_poly_abiotic_disturbance_only       | NaturalAbiotic     | Polygon   | Yes             | VRI derived abiotic disturbance                                                                                                                                                                                                                                                    | https://catalogue.data.gov.bc.ca/dataset/vri-forest-vegetation-composite-polygons-and-rank-1-layer            |
| Raw_YT_Forest_Health_Abiotic_Disturbance              | NaturalAbiotic     | Polygon   | Yes             | Abiotic forest disturbance in YT (e.g. flooding, windthrow, etc.)                                                                                                                                                                                                                  | https://www.for.gov.bc.ca/ftp/HFP/external/lpublish/Aerial_Overview/2016/                                     |
| Raw_YT_Forest_Health_Aerial_Overview_Pest_Disturbance | NaturalPest        | Polygon   | Yes             | Forest pest disturbance in YT (records go back to 1994, none in our area before 2009 for bark beetles with a severe or very severe infestation rating)                                                                                                                             | ftp://ftp.geomaticsyukon.ca/GeoYukon/Forestry/Forest_Health_Aerial_Overview_50k/                              |
| Raw_BC_Forest_Health_Aerial_Overview_Pest_Disturbance | NaturalPest        | Polygon   | Yes             | Forest pest disturbance in BC, annual layers combined and any bark beetle polygon (FHF = IBB, IBM, or IBS) with a severe or very severe infestation level was considered a disturbance, records go back to 1999, no records meeting criteria show up in the study area before 2000 | https://www.for.gov.bc.ca/ftp/HFP/external/lpublish/Aerial_Overview/                                          |
| Raw_YT_Utilities_Pipelines_50k                        | Oil and Gas        | Line      | Yes             | Pipelines in YT, buffered by 15m (30m width) to closely simulate right-of-way to allow combination into single layer with BC data                                                                                                                                                  | ftp://ftp.geomaticsyukon.ca/GeoYukon/Utilities_and_Communication/Utilities_Line_50k/                          |
| Raw_YT_Oil_and_Gas_Wells_50k                          | Oil and Gas        | Point     | Yes             | Locations of oil and gas well heads, points buffered by 50m to approximate clearings as per EC well site procedure                                                                                                                                                                 | ftp://ftp.geomaticsyukon.ca/GeoYukon/Oil_and_Gas/Oil_and_Gas_Wells_50k/                                       |
| Raw_BC_well_surface_hole_locations_permitted          | Oil and Gas        | Point     | Yes             | Oil and gas well surface hole locations, points buffered by 50m to approximate clearings as per EC well site procedure                                                                                                                                                             | https://data-bcogc.opendata.arcgis.com/datasets/9149cb556e694617970a5774621af8be_0                            |
| Raw_BC_sump_locations                                 | Oil and Gas        | Point     | Yes             | Oil and gas sump locations in BC, points buffered by 50m to approximate clearings as per EC well site procedure                                                                                                                                                                    | https://data-bcogc.opendata.arcgis.com/datasets/01df1e822ff84ddc8d4808e68b322101_0                            |
| Raw_BC_Pipeline_Rights_of_Way_Permitted               | Oil and Gas        | Polygon   | Yes             | Oil and gas pipelines in BC                                                                                                                                                                                                                                                        | https://data-bcogc.opendata.arcgis.com/datasets/6434890915cd4d25817037c0600040b1_1                            |
| Raw_BC_Geophysical_Ancillary_Points                   | Oil and Gas        | Point     | No              | Oil and gas ancillary geophysical point locations (e.g. clearings)                                                                                                                                                                                                                 | https://data-bcogc.opendata.arcgis.com/datasets/7fd246f6c212469eb07acf6467b2f8bd_0                            |
| Raw_BC_Facility_Locations_Pre2016                     | Oil and Gas        | Point     | Yes             | Oil and gas facility point locations in BC, points buffered by 50m to approximate clearings as per EC well site procedure                                                                                                                                                          | https://data-bcogc.opendata.arcgis.com/datasets/e2014a76454545abb0509afa2444876b_0                            |
| Raw_BC_Associated_and_Ancillary_Areas_Permitted       | Oil and Gas        | Polygon   | Yes             | Oil and gas ancillary features in BC (e.g. campsites, workspaces, deck sites, etc.)                                                                                                                                                                                                | https://data-bcogc.opendata.arcgis.com/datasets/bbd1f8029a949fb9ce6012f32111e31_1                             |
| Raw_YT_Railroads_50k_Canvec                           | Railway            | Line      | Yes             | Railroads in YT                                                                                                                                                                                                                                                                    | ftp://ftp.geomaticsyukon.ca/GeoYukon/Transportation/Railroads_50k_Canvec/                                     |
| Raw_BC_NRWN_tracks_bc_Clip                            | Railway            | Line      | Yes             | Railroads in BC                                                                                                                                                                                                                                                                    | http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_nrwn_rfn/bc/                                        |
| Raw_YT_Reservoirs                                     | Reservoir          | Polygon   | Yes             | Locations of man-made water reservoirs in YT                                                                                                                                                                                                                                       | 2 features digitized from Bing maps imagery                                                                   |
| Raw_BC_Reservoirs                                     | Reservoir          | Polygon   | Yes             | Locations of man-made water reservoirs in BC                                                                                                                                                                                                                                       | https://catalogue.data.gov.bc.ca/dataset/freshwater-atlas-lakes/resource/9595d129-03cc-40bb-b216-6ce3a1337143 |
| Raw_YT_Vegetation_Inventory_Roads_40k                 | Roads              | Line      | Yes             | Forestry roads in YT                                                                                                                                                                                                                                                               | ftp://ftp.geomaticsyukon.ca/GeoYukon/Forestry/Vegetation_Inventory_Roads_40k/                                 |
| Raw_YT_Roads_National_Road_Network                    | Roads              | Line      | Yes             | Federal NRN road network in YT and BC                                                                                                                                                                                                                                              | ftp://ftp.geomaticsyukon.ca/GeoYukon/Transportation/Roads_National_Road_Network/                              |
| Raw_YT_Bridges_25k                                    | Roads              | Point     | No              | point location of bridges in YT                                                                                                                                                                                                                                                    | ftp://ftp.geomaticsyukon.ca/GeoYukon/Transportation/Bridges_25k/                                              |
| Raw_YT_Blocked_Road_Passages_National_Road_Network    | Roads              | Point     | No              | impassable points on existing roads in YT                                                                                                                                                                                                                                          | ftp://ftp.geomaticsyukon.ca/GeoYukon/Transportation/Blocked_Road_Passages_National_Road_Network/              |
| Raw_BC_u_FTN_RD_SGM_line_Clip                         | Roads              | Line      | Yes             | Forest tenure road segments in BC                                                                                                                                                                                                                                                  | https://catalogue.data.gov.bc.ca/dataset/forest-tenure-road-segment-lines                                     |
| Raw_BC_SKE_Roads_Jan2018                              | Roads              | Line      | Yes             | Mining Roads digitized by Blair Ells BC FLNRO                                                                                                                                                                                                                                      | N/A                                                                                                           |
| Raw_BC_Petroleum_Development_Roads_Pre2006_Clip       | Roads              | Line      | Yes             | Petroleum development roads in BC approved pre-20061030                                                                                                                                                                                                                            | https://data-bcogc.opendata.arcgis.com/datasets/5861465cbe5649de93d521117cdf3a6a_0                            |
| Raw_BC_OGC_Road_Segments_Permitted_Clip               | Roads              | Line      | Yes             | Road centre-lines associated with oil and gas approved after 20061030                                                                                                                                                                                                              | https://data-bcogc.opendata.arcgis.com/datasets/b073031723eb44578e1e881939757fe2_0                            |
| Raw_BC_DRA_Transport_Line_Clip                        | Roads              | Line      | Yes             | Roads in BC                                                                                                                                                                                                                                                                        | https://catalogue.data.gov.bc.ca/dataset/digital-road-atlas-dra-master-partially-attributed-roads             |
| Raw_YT_Oil_and_Gas_Seismic_Lines                      | Seismic            | Line      | Yes             | Seismic lines in YT                                                                                                                                                                                                                                                                | ftp://ftp.geomaticsyukon.ca/GeoYukon/Oil_and_Gas/Oil_and_Gas_Seismic_Lines/                                   |
| Raw_YT_Cut_Lines_50k_Canvec                           | Seismic            | Line      | Yes             | Cut lines in YT                                                                                                                                                                                                                                                                    | ftp://ftp.geomaticsyukon.ca/GeoYukon/Transportation/Cut_Lines_50k_Canvec/                                     |
| Raw_BC_Geophysical_Plans_20022006                     | Seismic            | Line      | Yes             | Seismic lines in BC                                                                                                                                                                                                                                                                | https://data-bcogc.opendata.arcgis.com/datasets/c27b9f1a3754436cb7816b27ece5cb28_0                            |
| Raw_BC_Geophysical_Plans_19962004                     | Seismic            | Line      | Yes             | Seismic lines in BC                                                                                                                                                                                                                                                                | https://data-bcogc.opendata.arcgis.com/datasets/81d619920b6848e9a3f0f0201d126cae_0                            |
| Raw_BC_Geophysical_Lines_Permitted                    | Seismic            | Line      | Yes             | Seismic lines in BC                                                                                                                                                                                                                                                                | https://data-bcogc.opendata.arcgis.com/datasets/bd0a685c1f614b4b89ace6564e5e3cc4_0                            |
| Raw_YT_Yukon_Communities                              | Settlements        | Point     | For Reference   | Locations of Yukon Communities                                                                                                                                                                                                                                                     | ftp://ftp.geomaticsyukon.ca/GeoYukon/Reference/Yukon_Communities/                                             |
| Raw_YT_Places_1M                                      | Settlements        | Point     | For Reference   | Locations of communities across the study area                                                                                                                                                                                                                                     | ftp://ftp.geomaticsyukon.ca/GeoYukon/Base/Places_1M/                                                          |
| Raw_YT_Municipal_Boundaries                           | Settlements        | Polygon   | No              | Municipal boundaries in YT, poor reflection of developed area                                                                                                                                                                                                                      | ftp://ftp.geomaticsyukon.ca/GeoYukon/Land_Planning/Municipal_Boundaries/                                      |
| Raw_YT_Cultural_Features_Camps_50k                    | Settlements        | Polygon   | Yes             | Camps in YT                                                                                                                                                                                                                                                                        | ftp://ftp.geomaticsyukon.ca/GeoYukon/Culture_and_Heritage/Cultural_Features_Polygon_50k/                      |
| Raw_YT_Cultural_Features_BuiltUp_Areas_50k            | Settlements        | Polygon   | Yes             | Built up areas in YT e.g. dumps, buildings, runways, etc., digitized 29 missing features noticed in the vicinity of Whitehorse                                                                                                                                                     | ftp://ftp.geomaticsyukon.ca/GeoYukon/Culture_and_Heritage/Cultural_Features_Polygon_50k/                      |
| Raw_YT_Community_Boundaries                           | Settlements        | Polygon   | For Reference   | Community boundaries in YT                                                                                                                                                                                                                                                         | ftp://ftp.geomaticsyukon.ca/GeoYukon/Land_Planning/Community_Boundaries/                                      |
| Raw_YT_Communities_and_Subdivisions_Surveyed          | Settlements        | Polygon   | Yes             | Built up areas in YT e.g. subdivisions                                                                                                                                                                                                                                             | ftp://ftp.geomaticsyukon.ca/GeoYukon/Land_Tenure/Communities_and_Subdivisions_Surveyed/                       |
| Raw_BC_btm_urban                                      | Settlements        | Polygon   | Yes             | Footprint for human occupation                                                                                                                                                                                                                                                     | https://catalogue.data.gov.bc.ca/dataset/baseline-thematic-mapping-present-land-use-version-1-spatial-layer   |
| Raw_YT_Whitehorse_Trails_10k                          | Trails             | Line      | Yes             | Trails in and around Whitehorse                                                                                                                                                                                                                                                    | ftp://ftp.geomaticsyukon.ca/GeoYukon/Transportation/Whitehorse_Trails_10k/                                    |
| Raw_YT_Trails_50k_Canvec                              | Trails             | Line      | Yes             | Trails in YT                                                                                                                                                                                                                                                                       | ftp://ftp.geomaticsyukon.ca/GeoYukon/Transportation/Trails_50k_Canvec/                                        |
| Raw_YT_Trails_50k                                     | Trails             | Line      | Yes             | Trails in YT                                                                                                                                                                                                                                                                       | ftp://ftp.geomaticsyukon.ca/GeoYukon/Transportation/Trails_50k/                                               |
| RAW_BC_Trails_FTN_REC_LN                              | Trails             | Line      | Yes             | Trails in BC                                                                                                                                                                                                                                                                       | https://catalogue.data.gov.bc.ca/dataset/forest-tenure-recreation-lines                                       |
| Raw_YT_Utilities_Transmission_Line_50k                | Transmission Lines | Line      | Yes             | Electricity transmission lines in YT                                                                                                                                                                                                                                               | ftp://ftp.geomaticsyukon.ca/GeoYukon/Utilities_and_Communication/Hydro_Energy/                                |
| Raw_YT_Utilities_Polygon_50k                          | Transmission Lines | Polygon   | No              | Transformer station outside of Whitehorse, only one feature in a residential area, inconsequential                                                                                                                                                                                 | ftp://ftp.geomaticsyukon.ca/GeoYukon/Utilities_and_Communication/Utilities_Polygon_50k/                       |
| RAW_BC_u_bc_transmission_lines_Clip                   | Transmission Lines | Line      | Yes             | Electricity transmission lines in BC                                                                                                                                                                                                                                               | https://catalogue.data.gov.bc.ca/dataset/bc-transmission-lines                                                |
| Raw_YT_Fire_History                                   | Wildfire           | Polygon   | Yes             | Wildfire boundaries in YT <=40 years old, and <=50 years old (evaluated separately)                                                                                                                                                                                                | ftp://ftp.geomaticsyukon.ca/GeoYukon/Biophysical/Fire_History/                                                |
| Raw_BC_u_mofr_fire_polygons                           | Wildfire           | Polygon   | Yes             | Wildfire boundaries in BC <=40 years old, and <=50 years old (evaluated separately)                                                                                                                                                                                                | https://catalogue.data.gov.bc.ca/dataset/fire-perimeters-historical                                           |
| Raw_BC_C_FIRE_PLY_2017_clip                           | Wildfire           | Polygon   | Yes             | Current wildfire boundaries in BC from 2017                                                                                                                                                                                                                                        | https://catalogue.data.gov.bc.ca/dataset/bc-wildfire-fire-perimeters-current-internal                         |

## Appendix 3. Range summaries

Range summaries are provided for each of the 17 caribou ranges and the low density area, and include the following information:

- range use summary;
- population size;
- population trend;
- boundary issues; and,
- range condition (habitat disturbance).

The intent of the range use summary is to provide some context for interpreting the significance of low elevation and high elevation portions of the range. Where available, information on population size and trend is summarized to aid in estimating population condition in order to compare range condition (i.e. level of habitat disturbance) with population condition.

### Range use summary

The range use summary includes seasonal range use, location of seasonal ranges, and, for transboundary ranges, percent of range in BC. Where possible, summaries of seasonal range location and use were based on information from radio-collared caribou studies. We also used information from aerial surveys and interviews with local biologists, especially for ranges where there was no or limited radio-collared caribou information available.

### Population size

Population size estimates provided in this summary include only population estimates that were based on survey data (see individual range summaries for a description of methods for determining each population estimate). In the past, due to a lack of information on caribou distribution and numbers, many population estimates were based on expert opinion. We do not include those estimates here.

### Population trend

Three potential methods can be used to assess population trend based on:

- estimated population size from surveys;
- population growth rate based on additions into the population (calf recruitment) and losses (adult mortality); and,
- calf recruitment.

For ranges with two or more population estimates, population trend can be inferred from the difference between the two population size estimates.

Another method is to calculate the population growth rate using data collected on calf recruitment (usually based on surveys) and adult mortality (usually based on mortality rate of radio-collared caribou).

The third method is based on calf recruitment data. Bergerud (1996) recommends a late winter calf recruitment rate of 15% calves to achieve population stability. In Yukon, although additional calf mortality is expected through the winter, an average fall calf survival ratio of 20 to 25 calves/100 cows is considered sufficient to support a stable population growth rate (Environment Yukon 2016). In the Spatsizi caribou range, Hatler (1987) found that fall counts in traditional alpine rutting grounds were biased against calves, and possibly bulls. In west-central BC, Cichowski (1990) found some evidence of the bias against calves for the Tweedsmuir-Entiako caribou population, but not for the Itcha-Ilgachuz-Rainbow population. Consequently, it may be possible that this bias exists for some populations in northern BC in addition to the Spatsizi population. But, because Yukon assesses calf recruitment based on calf/cow ratios from fall surveys, fall calf/100 cow ratios should

be a reliable measure of calf recruitment at least for the transboundary populations. We assess and discuss calf recruitment data for each range individually.

Where we had access to data sheets or data summaries that provided composition for each group, we used only those groups where all, or at least a significant portion of the group was classified when calculating calf/100 cow ratios from surveys. Where we did not have access to group-specific data, we used the classified caribou portion of the total survey to calculate ratios. For surveys where ratios were calculated using methods other than using numbers counted during the survey (e.g. stratified random block surveys), we provide the ratios presented in the original report. In some cases, where there were errors in addition or in numbers used to calculate ratios in an original report, we recalculated ratios and footnoted any difference from the original report.

We provide three measures of calf recruitment: % calves, calves/100 adults and calves/100 cows. Although there is no specified threshold for calves/100 adults, many surveys, especially those conducted in late winter, did not distinguish between adult females and adult males. One limitation of the calves/100 adults ratio is that it does not account for the variation in the proportion of adult females and males among surveys. To calculate calf:100 cow ratios, we used only data where caribou were classified at a minimum as bulls, cows and calves. To calculate % calves and calves/100 adults, we used only data where caribou were classified at a minimum as adults and calves. We also provide the number of classified caribou that each ratio is based on.

## **Boundary issues**

Known boundary issues were described for ranges where boundary issues were identified.

## **Range condition (habitat disturbance)**

To characterize each caribou range, we summarized:

- the percent of each caribou range, 20 km matrix and 30 km matrix consisting of the low elevation and high elevation portions; and,
- the percent of the 20 km matrix and 30 km matrix surrounding the range that overlaps adjacent ranges.

For habitat disturbance in each caribou range, we summarized:

- the extent of habitat disturbance due to each category of anthropogenic habitat disturbance, fires <40 years, fires <50 years, and forest insect attack;
- the extent of habitat disturbance due to all types of anthropogenic habitat disturbance combined; and,
- the extent of total habitat disturbance (all types of anthropogenic habitat disturbance combined and fires less than 40 years old).

The extent of each type of habitat disturbance, all anthropogenic habitat disturbance combined, and total habitat disturbance were calculated for:

- total range, high elevation portion of the range, and low elevation portion of the range; and,
- 20 km matrix and 30 km matrix surrounding the range.

For the six transboundary caribou ranges, we also summarized the habitat disturbance information described above for the BC portion of each range, and for the total area of each range (BC + Yukon).

## **Note on a previous summary of Peace caribou range population data**

Population data for the caribou ranges in the Peace Region portion of our study area (Liard Plateau, Rabbit, Muskwa, Pink Mountain, Gataga, Frog) had been summarized previously by Duncan (2009). During the data compilation phase of the COSEWIC status report (COSEWIC 2014) and this current review, a number of errors were found in these data summaries.

We recommend that the population size and calf recruitment data presented in Duncan (2009) not be used.

# Carcross

## Range use summary

During winter, caribou are found primarily in low elevation mature pine and pine/spruce forests, with the core of the winter range located in Yukon. During summer, caribou move into high elevation habitats in both the Yukon and BC portions of the range. The BC portion of the range is used primarily during summer.

| Season      | Overview of Habitat and Range Use                                                                                                                                                                                                                                                                                                                                                                                             | Source                                                                      |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Winter      | <ul style="list-style-type: none"> <li>Primarily low elevation forests (&lt;1200 m)</li> <li>Primarily mature lodgepole pine and pine/spruce habitats with open tree canopies with abundant terrestrial lichens</li> <li>Most of the low elevation winter range is located in Yukon</li> <li>There has been some radio-collared caribou use during winter in the northern portion of the BC portion of their range</li> </ul> | Francis and Nishi (2015)<br>Florkiewicz (2008)<br>Florkiewicz et al. (2007) |
| Summer      | <ul style="list-style-type: none"> <li>Primarily high elevation alpine/subalpine habitat (&gt;1200 m)</li> <li>The BC portion of the Carcross caribou range is used primarily during summer</li> </ul>                                                                                                                                                                                                                        | Francis and Nishi (2015)<br>Florkiewicz (2008)<br>Florkiewicz et al. (2007) |
| Migration   | <ul style="list-style-type: none"> <li>Primarily low elevation routes</li> </ul>                                                                                                                                                                                                                                                                                                                                              | Francis and Nishi (2015)                                                    |
| Total Range | <ul style="list-style-type: none"> <li>25% of the range is located in BC</li> <li>75% of the range is located in Yukon</li> </ul>                                                                                                                                                                                                                                                                                             |                                                                             |

## Population size

Population surveys conducted between 1997 and 2007 indicate an increasing population trend (Florkiewicz 2008). A population survey was conducted in 2019 but preliminary results have not yet been released (C. Thiessen, pers. comm.). Prior to that, the most recent survey was in October 2015; 720 caribou were counted during a fall composition survey of all alpine areas within the Yukon and BC portions of the range (Jessup and Drury 2015) suggesting population stability.

| Year | Population estimate | Number counted | Method                  | Reliability           | Source                                            |
|------|---------------------|----------------|-------------------------|-----------------------|---------------------------------------------------|
| 2007 | 775 <sup>1</sup>    | 429            | Distance sampling       | High <sup>2</sup>     | Environment Yukon unpub. data; Florkiewicz (2008) |
| 2003 | 750 <sup>1</sup>    | 474            | Distance sampling       | Moderate <sup>2</sup> | Environment Yukon unpub. data; Florkiewicz (2008) |
| 1997 | 403 <sup>1</sup>    | 272            | Stratified Random Block | High <sup>2</sup>     | Environment Yukon unpub. data; Florkiewicz (2008) |

<sup>1</sup> From COSEWIC (2014)

<sup>2</sup> From Florkiewicz 2008

## Population trend

Environment Yukon has conducted fall composition surveys annually in the Carcross caribou range since 1992.

Between 1992 and 2018, ratios of calves/100 cows were below 20 to 25 calves/100 cows (the level considered sufficient to support a stable population growth rate [Environment Yukon 2016]), during only six of the 27 years (2000, 2002, 2004, 2005, 2009, 2010). It is unknown whether fall surveys of rutting areas in the Carcross caribou range are biased against calves as detected in the Spatsizi caribou range (Hatler 1987), however, the calves/100 cows ratio suggests at least a stable population even if the surveys were biased against calves. Calf/100 cows ratios were at or above 20 to 25 calves/100 cows for the last eight years (2011 to 2018).

Calf recruitment tends to be higher in the southern part of the range, but a mechanism for this difference has not yet been determined (Jessup and Drury 2015).

The annual adult female survival rate for 49 radio-collared caribou in the Carcross caribou population averaged 89% over a 12-year period, and the annual growth rate averaged 5.8% per year from 1997 to 2008 (Florkiewicz 2008).

Data from population surveys and fall composition counts suggest that the population is currently stable or increasing, and that it has increased since the 1990s.

## Boundary issues

- The BC portion of the boundary is coarsely drawn and does not necessarily incorporate physical features where relevant.
- The BC and Yukon boundaries do not line up on the western side of the range.

## Range condition

Within the current BC and Yukon Carcross caribou range boundaries, habitat disturbance covers 9%, 3% and 18% of the total, high elevation and low elevation portions of the range, respectively. In the BC portion of the range, habitat disturbance covers 3%, <1% and 5% of the total, high elevation and low elevation portions of the range respectively, indicating that most habitat disturbance is in the Yukon portion of the range. The primary disturbance in the whole range is roads/trails, followed by settlements (Carcross, and the areas surrounding Whitehorse and Carcross), forest harvesting, infrastructure associated with supporting settlements (pipeline right-of ways, powerlines, railroads), and mines. Most habitat disturbance in the Yukon portion of the range is concentrated around the settlement areas in the western portion of the range. Fires <40 years make up a very small component of the disturbance footprint (<1%) in the total range, and the BC portion of the range contains no fires <40 years.

The 20 km and 30 km surrounding matrix contain slightly higher levels of habitat disturbance, primarily due to additional settlement areas (Whitehorse and the surrounding area to the north) and some additional wildfires.

Although our analysis does not include fires from 2018 to 2021, the only fire in the BC portion of the Carcross caribou range or surrounding matrix during this period was a 1,200 ha fire at the south end of Tagish Lake in 2019, which was located partially in the caribou range and partially in the surrounding matrix.



## Carcross

| Year           | Month                | % calves <sup>1</sup> | Calves/<br>100 adults <sup>1</sup> | Calves/<br>100 cows <sup>2</sup> | Total<br>Counted <sup>3</sup> | Total classified <sup>4</sup> |                       | Source <sup>5</sup>            |
|----------------|----------------------|-----------------------|------------------------------------|----------------------------------|-------------------------------|-------------------------------|-----------------------|--------------------------------|
|                |                      |                       |                                    |                                  |                               | Calves+<br>Adults             | Calves+<br>Cows+Bulls |                                |
| Fall           |                      |                       |                                    |                                  |                               |                               |                       |                                |
| 2018           | Fall <sup>6</sup>    | 12                    | 14                                 | 20                               | 378                           | 376                           | 376                   | Environment Yukon, unpub. data |
| 2017           | Fall <sup>6</sup>    | 13                    | 15                                 | 23                               | 598                           | 585                           | 585                   | Environment Yukon, unpub. data |
| 2016           | Fall <sup>6</sup>    | 17                    | 20                                 | 28                               | 657                           | 657                           | 657                   | Environment Yukon, unpub. data |
| 2015           | Fall <sup>7</sup>    | 12                    | 13                                 | 20                               | 600                           | 600                           | 600                   | Environment Yukon, unpub. data |
| 2015           | Oct 2-11             | 16                    | 19                                 | 26                               | 120                           | 120                           | 120                   | Williams and Dixon (2016)      |
| 2015           | Oct 2-5 <sup>7</sup> | 12                    | 14                                 | 21                               | 720                           | 720                           | 720                   | Jessup and Drury (2016)        |
| 2014           | Fall <sup>6</sup>    | 16                    | 19                                 | 27                               | 461                           | 461                           | 461                   | Environment Yukon, unpub. data |
| 2013           | Fall <sup>6</sup>    | 15                    | 17                                 | 23                               | 490                           | 489                           | 489                   | Environment Yukon, unpub. data |
| 2012           | Fall <sup>6</sup>    | 16                    | 20                                 | 28                               | 304                           | 304                           | 304                   | Environment Yukon, unpub. data |
| 2011           | Fall <sup>6</sup>    | 15                    | 17                                 | 26                               | 250                           | 250                           | 250                   | Environment Yukon, unpub. data |
| 2010           | Fall <sup>6</sup>    | 12 <sup>2</sup>       | 14                                 | 16                               | 199                           | 145                           | 145                   | Environment Yukon, unpub. data |
| 2009           | Fall <sup>6</sup>    | 9                     | 10                                 | 14                               | 278                           | 278                           | 278                   | Environment Yukon, unpub. data |
| 2008           | Fall <sup>6</sup>    | 13                    | 14                                 | 22                               | 151                           | 151                           | 151                   | Environment Yukon, unpub. data |
| 2007           | Fall <sup>6</sup>    | 14                    | 16                                 | 25                               | 472                           | 466                           | 466                   | Environment Yukon, unpub. data |
| 2006           | Fall <sup>6</sup>    | 20                    | 26                                 | 37                               | 309                           | 305                           | 305                   | Environment Yukon, unpub. data |
| 2005           | Fall <sup>6</sup>    | 12                    | 13                                 | 18                               | 399                           | 397                           | 397                   | Environment Yukon, unpub. data |
| 2004           | Fall <sup>6</sup>    | 11                    | 13                                 | 19                               | 457                           | 457                           | 457                   | Environment Yukon, unpub. data |
| 2003           | Fall <sup>6</sup>    | 13                    | 15                                 | 23                               | 424                           | 424                           | 424                   | Environment Yukon, unpub. data |
| 2002           | Fall <sup>6</sup>    | 11                    | 13                                 | 17                               | 332                           | 332                           | 332                   | Environment Yukon, unpub. data |
| 2001           | Fall <sup>6</sup>    | 15                    | 18                                 | 30                               | 323                           | 320                           | 320                   | Environment Yukon, unpub. data |
| 2000           | Fall <sup>6</sup>    | 11                    | 13                                 | 19                               | 641                           | 641                           | 641                   | Environment Yukon, unpub. data |
| 1999           | Fall <sup>6</sup>    | 18                    | 21                                 | 33                               | 443                           | 440                           | 440                   | Environment Yukon, unpub. data |
| 1998           | Fall <sup>6</sup>    | 15                    | 18                                 | 27                               | 502                           | 498                           | 498                   | Environment Yukon, unpub. data |
| 1997           | Fall <sup>6</sup>    | 17                    | 20                                 | 29                               | 452                           | 452                           | 452                   | Environment Yukon, unpub. data |
| 1996           | Fall <sup>6</sup>    | 15                    | 18                                 | 26                               | 255                           | 255                           | 255                   | Environment Yukon, unpub. data |
| 1995           | Fall <sup>6</sup>    | 18                    | 23                                 | 33                               | 442                           | 440                           | 440                   | Environment Yukon, unpub. data |
| 1994           | Fall <sup>6</sup>    | 22                    | 29                                 | 42                               | 439                           | 435                           | 435                   | Environment Yukon, unpub. data |
| 1993           | Fall <sup>6</sup>    | 18                    | 22                                 | 38                               | 33                            | 33                            | 33                    | Environment Yukon, unpub. data |
| 1992           | Fall <sup>6</sup>    | 13                    | 14                                 | 22                               | 144                           | 144                           | 144                   | Environment Yukon, unpub. data |
| Calving/summer |                      |                       |                                    |                                  |                               |                               |                       |                                |
| 1990           | July                 | 34                    | 50                                 | -                                | (179)                         | 179                           |                       | Schultze (1990)                |

<sup>1</sup> % calves and calves/100 adults calculated based on data in Environment Yukon, unpubl. data

<sup>2</sup> Calves/100 cows from Environment Yukon, unpubl. data

<sup>3</sup> Numbers in parentheses indicate surveys where caribou were not a primary focus

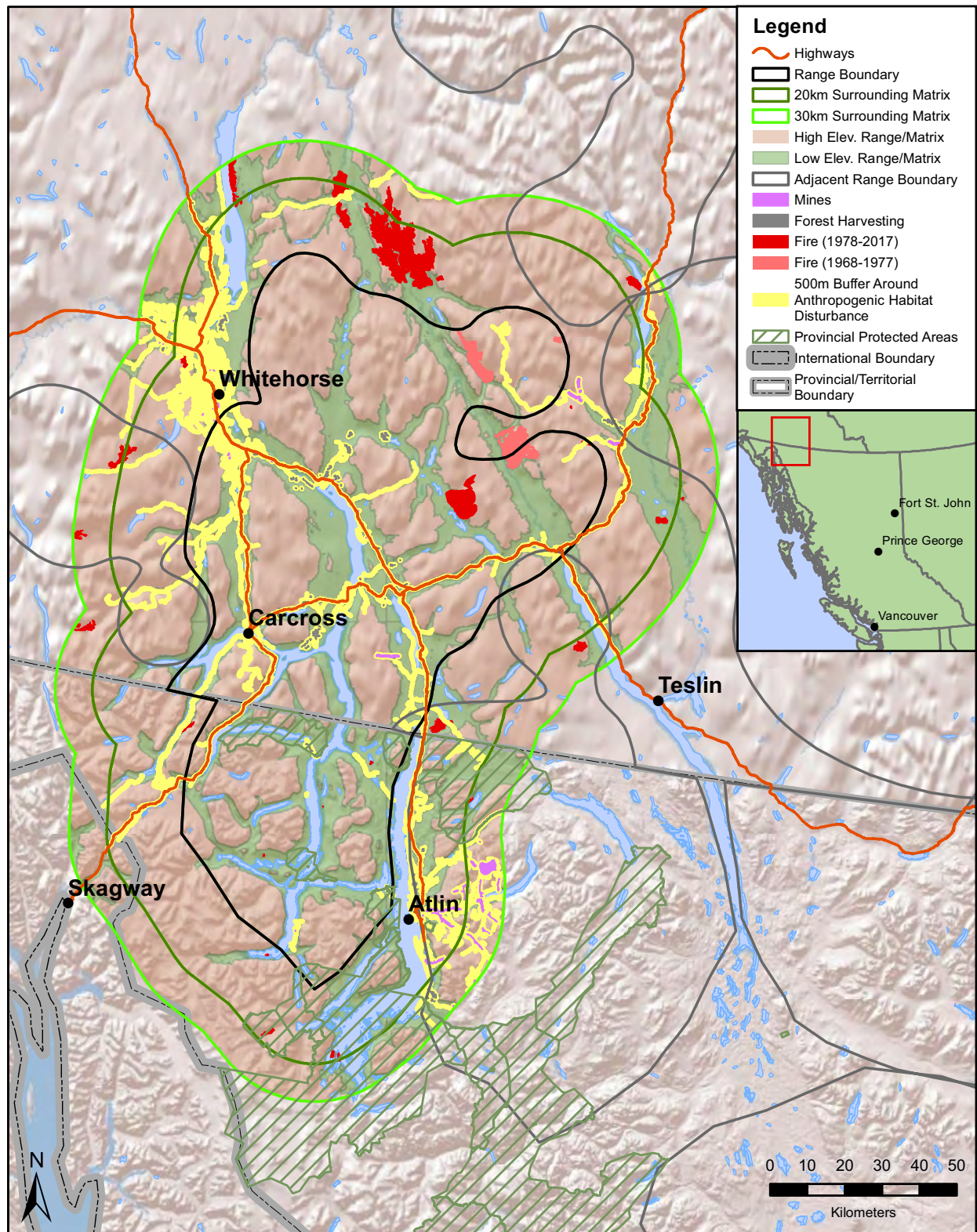
<sup>4</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

<sup>5</sup> All surveys conducted by helicopter

<sup>6</sup> Surveys were conducted in the Yukon portion of the range in the fall but exact dates were not provided

<sup>7</sup> In 2015, the survey area in Yukon was expanded to include the entire range. In addition, the BC portion of the range was also surveyed and another 120 caribou were counted for a total of 720 caribou across their whole range (Jessup and Drury 2016). The expanded survey area has not been consistently surveyed since 2015 (K. Russell, pers. comm. 2019)

## Carcross



## Carcross

|                                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|----------------------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Total Range                      |                    |                               |                                |                                               |
| Range                            | 1 273 592          | 40.7                          | 59.3                           | -                                             |
| 0-20 km matrix surrounding range | 1 203 133          | 32.7                          | 67.3                           | 41.2 (NM)                                     |
| 0-30 km matrix surrounding range | 1 870 606          | 29.5                          | 70.5                           | 41.6 (NM)                                     |
| BC only                          |                    |                               |                                |                                               |
| Range                            | 324 060            | 49.0                          | 51.0                           | -                                             |
| 0-20 km matrix surrounding range | 413 599            | 36.2                          | 63.8                           | 20.4 (NM)                                     |
| 0-30 km matrix surrounding range | 632 286            | 30.7                          | 69.3                           | 25.6 (NM)                                     |

<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA

# Carcross: Total Range (BC + Yukon)

|                | Range Area<br>(ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                               |               |                                        |
|----------------|--------------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|-------------------------------|---------------|----------------------------------------|
|                |                    | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road/Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                               |               |                                        |
| Total          | 1 273 592          | 0.4                                  | 0.9            | 0              | 0          | 0.1         | 0        | 0.8      | 0   | 0.4  | 0            | 0    | 0.7      | 0.6       | 0.7      | 4.5  | 0.1     | 1.1        | 7.3   | 4.1                         | 7.7                           | 8.4           | 8.8                                    |
| High elevation | 754 811            | 0.5                                  | 1.0            | 0              | 0          | 0           | 0        | 0        | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 0.3  | 0.1     | 0          | 1.8   | 0.3                         | 1.8                           | 2.0           | 2.5                                    |
| Low elevation  | 518 781            | 0.2                                  | 0.8            | 0              | 0          | 0.3         | 0        | 1.9      | 0   | 0.9  | 0            | 0    | 1.7      | 1.5       | 1.7      | 10.5 | 0.1     | 2.7        | 15.3  | 9.6                         | 16.3                          | 17.9          | 18.1                                   |
| Matrix 0-20 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                               |               |                                        |
| Total          | 1 203 133          | 1.9                                  | 2.2            | 0.1            | 0          | 0.4         | 0        | 0.3      | 0   | 0.8  | 0            | 0    | 0.4      | 0.7       | 0.5      | 6.1  | 0.8     | 1.2        | 8.1   | 4.1                         | 10.1                          | 10.7          | 12.5                                   |
| High elevation | 810 008            | 1.3                                  | 1.5            | 0.1            | 0          | 0.2         | 0        | 0        | 0   | 0.3  | 0            | 0    | 0.1      | 0         | 0.3      | 2.1  | 0.2     | 0          | 3.7   | 1.1                         | 4.6                           | 4.8           | 6.0                                    |
| Low elevation  | 393 125            | 3.2                                  | 3.7            | 0.2            | 0          | 0.9         | 0.1      | 1.0      | 0.1 | 1.8  | 0            | 0    | 0.9      | 2.0       | 0.9      | 14.4 | 2.1     | 3.6        | 17.4  | 10.3                        | 21.5                          | 22.7          | 25.8                                   |
| Matrix 0-30 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                               |               |                                        |
| Total          | 1 870 606          | 1.6                                  | 1.8            | 0.1            | 0          | 0.3         | 0        | 0.3      | 0   | 0.9  | 0            | 0    | 0.2      | 0.6       | 0.3      | 5.8  | 0.5     | 0.8        | 6.7   | 3.5                         | 9.1                           | 9.6           | 11.1                                   |
| High elevation | 1 318 771          | 1.2                                  | 1.3            | 0.1            | 0          | 0.1         | 0        | 0        | 0   | 0.7  | 0            | 0    | 0.1      | 0         | 0.2      | 2.6  | 0.1     | 0          | 2.9   | 0.9                         | 4.6                           | 4.8           | 5.9                                    |
| Low elevation  | 551 642            | 2.6                                  | 3.0            | 0.1            | 0          | 0.8         | 0.1      | 0.9      | 0   | 1.6  | 0            | 0    | 0.7      | 1.9       | 0.6      | 13.5 | 1.6     | 2.6        | 15.8  | 9.5                         | 19.7                          | 21.0          | 23.5                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a “settlement” polygon will overlap with a “road” polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of “Total anthropogenic disturbance” (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, “Total habitat disturbance” (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> “Road and trail” indicates the portions of the “Road” and “Trail” categories that were identified as both a road and a trail; “Total Road/Trail” is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

# Carcross: BC only

|                | Range Area (ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|-----------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                 | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 324 060         | 0                                    | 0              | 0.1            | 0          | 0           | 0        | 0.1      | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 2.3  | 0       | 0          | 2.0   | 1.8                         | 2.5                              | 2.6           | 2.6                                    |
| High elevation | 165 196         | 0                                    | 0              | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 0.1  | 0       | 0          | 0.2   | 0.1                         | 0.2                              | 0.2           | 0.2                                    |
| Low elevation  | 158 865         | 0                                    | 0              | 0.1            | 0          | 0           | 0        | 0.3      | 0.1 | 0.3  | 0            | 0    | 0        | 0         | 0        | 4.6  | 0       | 0          | 3.9   | 3.6                         | 5.0                              | 5.0           | 5.0                                    |
| Matrix 0-20 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 413 599         | 0.2                                  | 0.2            | 0.4            | 0          | 0           | 0.1      | 0.3      | 0   | 1.2  | 0            | 0    | 0.8      | 0         | 1.2      | 9.6  | 0.3     | 0.4        | 4.8   | 4.3                         | 10.1                             | 10.4          | 10.5                                   |
| High elevation | 263 797         | 0.2                                  | 0.2            | 0.4            | 0          | 0           | 0        | 0        | 0   | 0.5  | 0            | 0    | 0.3      | 0         | 1.0      | 4.0  | 0       | 0.1        | 1.7   | 1.2                         | 4.5                              | 4.6           | 4.8                                    |
| Low elevation  | 149 803         | 0.1                                  | 0.2            | 0.4            | 0          | 0           | 0.2      | 0.7      | 0   | 2.5  | 0            | 0    | 1.7      | 0         | 1.7      | 19.4 | 0.6     | 0.8        | 10.3  | 9.6                         | 20                               | 20.5          | 20.6                                   |
| Matrix 0-30 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 632 286         | 0.1                                  | 0.1            | 0.3            | 0          | 0           | 0.1      | 0.3      | 0   | 1.9  | 0            | 0    | 0.5      | 0         | 0.8      | 9.6  | 0.2     | 0.2        | 3.9   | 3.5                         | 10                               | 10.4          | 10.5                                   |
| High elevation | 437 918         | 0.1                                  | 0.1            | 0.2            | 0          | 0           | 0        | 0        | 0   | 1.7  | 0            | 0    | 0.2      | 0         | 0.6      | 5.8  | 0       | 0.1        | 1.6   | 1.2                         | 6.2                              | 6.4           | 6.5                                    |
| Low elevation  | 194 359         | 0.1                                  | 0.2            | 0.3            | 0          | 0           | 0.2      | 1.0      | 0   | 2.5  | 0            | 0    | 1.3      | 0         | 1.3      | 18.1 | 0.5     | 0.6        | 9.2   | 8.6                         | 18.7                             | 19.3          | 19.4                                   |

- <sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).
- <sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a “settlement” polygon will overlap with a “road” polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of “Total anthropogenic disturbance” (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, “Total habitat disturbance” (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).
- <sup>3</sup> “Road and trail” indicates the portions of the “Road” and “Trail” categories that were identified as both a road and a trail; “Total Road/Trail” is the combined total of roads and trails and accounts for overlap between the two categories.
- <sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.



# Atlin

## Range use summary

During summer, Atlin caribou are found mostly at high elevations throughout the range. During winter, habitat use can range from high elevation windswept alpine slopes to low elevation forests, where they use primarily lodgepole pine/lichen complexes and spruce/fir forests. Most of the range lies in BC, including most of the winter range and summer range. The Yukon portion of the range is used primarily during winter.

| Season      | Overview of Habitat and Range Use                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Source                                                  |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| Winter      | <ul style="list-style-type: none"> <li>Low elevation forests</li> <li>High elevation windswept alpine slopes</li> <li>At low elevations, primarily lodgepole pine/lichen complexes, spruce/fir forests, low elevation river valleys</li> <li>Most of the winter range is located in BC</li> <li>Known wintering areas include the area west of Gladys Lake and the area around the Silver Salmon River</li> <li>The Yukon portion of the range is primarily used during winter</li> </ul> | Polfus et al. (2011)<br>M. Williams, pers. comm. (2018) |
| Summer      | <ul style="list-style-type: none"> <li>Primarily high elevation alpine/subalpine habitat</li> <li>Most of the summer range is located in BC</li> </ul>                                                                                                                                                                                                                                                                                                                                    | Polfus et al. (2011)<br>M. Williams, pers. comm. (2018) |
| Total Range | <ul style="list-style-type: none"> <li>81% of the range is located in BC</li> <li>19% of the range is located in Yukon</li> </ul>                                                                                                                                                                                                                                                                                                                                                         |                                                         |

## Population size

The current population estimate of 1527 caribou was based on a mark-resight survey conducted in the Atlin caribou range in October 2018 (Thiessen 2018). The Atlin caribou range was surveyed three times and the proportion of the radio-collared caribou seen during the survey was used to estimate the total population size. The two previous surveys were stratified random block surveys that were conducted on the winter range in 2007 and 1999. Marshall (2007a) suggested that in 2007 (and potentially in 1999) the population size may have been under-estimated based on distribution of caribou during the survey.

The current population estimate is higher than the estimates in 2007 and 1999, suggesting that the population is increasing (Thiessen 2018).

| Date | Population estimate | Number counted   | Method                        | Reliability | Source                           |
|------|---------------------|------------------|-------------------------------|-------------|----------------------------------|
| 2018 | 1527                | 642 <sup>1</sup> | Mark/Re-sight                 | High        | Thiessen pers. comm <sup>1</sup> |
| 2007 | 777 <sup>2</sup>    | 463              | Stratified Random Block (SRB) | High        | Marshall (2007a)                 |
| 1999 | 809 <sup>3</sup>    | 486              | Stratified Random Block       | High        | Marshall (1999a)                 |

<sup>1</sup> Mark/Re-sight using the proportion of the 26 radio-collared caribou seen during the survey to correct for total caribou not seen during the survey; three surveys were conducted with 507, 621 and 642 caribou counted during each survey

<sup>2</sup> The estimate generated by the SRB survey was 555, then a sightability correction factor of 1.4 was applied to correct for caribou not seen during the survey, resulting in a total population estimate of 777

<sup>3</sup> The estimate generated by the SRB survey was 508, then a sightability correction factor of 1.4 was applied to correct for caribou not seen during the survey, resulting in a total population estimate of 809

## Population trend

A radio-collared caribou study was conducted on the Atlin caribou population from 1995 to 2001. Many of the spring (June), fall (October/November) and late winter (March/April) composition surveys were conducted as part of that study. Composition information prior to and subsequent to the radio-collared caribou study was sometimes collected during surveys for other species.

Although the calf/100 cows ratio from the October 2018 composition survey was below 20 to 25 calves/100 cows, which is considered sufficient to support a stable population growth rate (Environment Yukon 2016), the previous fall survey in 2015 and all seven of the fall surveys with sufficient sample sizes conducted between 1984 and 2007 were within or above the 20 to 25 calves/100 cows range. It is unknown whether fall surveys of rutting areas in the Atlin caribou range are biased against calves as detected in the Spatsizi caribou range (Hatler 1987).

Of the six late winter surveys with sufficient sample sizes conducted between 1995 and 2007, the last four (1997, 1999, 2003, 2007) had calf recruitment estimates that were at or above 15% calves recommended by Bergerud (1996) to achieve population stability.

No information on adult survival or population growth rate (based on adult mortality and calf recruitment) was readily available from the radio-collared caribou study.

Both the fall and winter calf recruitment data suggest that the Atlin caribou population was stable or increasing between at least 1997 and 2007, and in 2015, which supports the increase in estimated population size derived from population surveys. However, the most current ratio of 19 calves/100 cows ratio from the October 2018 survey suggests that calf recruitment may not have been sufficient to support a stable or increasing population that year.

## Boundary Issues

- The BC portion of the boundary is coarsely drawn resulting in gaps between the Atlin and Swan Lake caribou ranges. It is unclear whether the gap between the Atlin and Level Kawdy caribou ranges is due to the coarsely drawn boundaries or to an actual gap in distribution.
- The BC and Yukon boundaries do not line up.

## Range condition

Within the current BC and Yukon Atlin caribou range boundaries, habitat disturbance covers 12%, 7% and 18% of the total, high elevation and low elevation portions of the range respectively. The primary disturbance is roads/trails, followed by fire and mining activity. Most of the habitat disturbance from roads/trails and mining activity is located in the BC portion of the range. Roads/trails include the Alaska Hwy, the Atlin Road, and industrial roads associated primarily with mining activities in BC. Within the current range boundary, fire disturbance <40 years (up to and including 2016) is largely absent. Habitat disturbance is lower in the 20 km and 30 km matrix surrounding the range, primarily due to less disturbance from roads/trails.

Although our analysis does not include fires from 2018 to 2021, there were no fires >1 ha in the BC portion of the Atlin caribou range and surrounding matrix during those four years.

Atlin

| Year           | Month | % calves <sup>1</sup> | Calves/ 100 adults <sup>1</sup> | Calves/100 cows <sup>1</sup> | Total Counted <sup>2</sup> | Total classified <sup>3</sup> |                    | Source <sup>4</sup>                 |
|----------------|-------|-----------------------|---------------------------------|------------------------------|----------------------------|-------------------------------|--------------------|-------------------------------------|
|                |       |                       |                                 |                              |                            | Calves+ Adults                | Calves+ Cows+Bulls |                                     |
| Winter         |       |                       |                                 |                              |                            |                               |                    |                                     |
| 2008           | Apr   |                       |                                 |                              | 22                         |                               |                    | Marshall (2008)                     |
| 2007           | Feb   | 15                    | 16                              | 21 <sup>5</sup>              | 463                        | 462                           | 462                | Marshall (2007a) (SRB) <sup>6</sup> |
| 2006           | Mar   | 13 <sup>7,8</sup>     | 15 <sup>7,8</sup>               | 17 <sup>7,8</sup>            | 96                         | 94                            | 94                 | Marshall (2006)                     |
| 2003           | Mar   | 20                    | 25                              | 32                           | 401                        | 401                           | 401                | Marshall (2003)                     |
| 2000           | Mar   | 8 <sup>7,9</sup>      | 9 <sup>7,9</sup>                | -                            | 258                        | 258 <sup>8</sup>              |                    | Marshall (2000a)                    |
| 1999           | Mar   | 16                    | 19                              | 29 <sup>5</sup>              | 486                        | 486                           | 460                | Marshall (1999a) (SRB) <sup>6</sup> |
| 1998           | Mar   | 12 <sup>7</sup>       | 13 <sup>7</sup>                 | 20 <sup>7</sup>              | 110                        | 110                           | 107                | Marshall (1998)                     |
| 1997           | Mar   | 16                    | 19                              | 22                           | 210                        | 210                           | 206                | Marshall (1997a)                    |
| 1996           | Mar   | 7                     | 7                               | 8                            | 196                        | 196                           | 196                | Marshall (1996)                     |
| 1995           | Mar   | 13                    | 15                              | 17                           | 109                        | 109                           | 109                | Marshall (1995a)                    |
| 1980           | Mar   | 12                    | 13                              | -                            | 257                        | 257                           | 257                | Hodson (1980a)                      |
| 1979           | Mar   |                       |                                 |                              | 346                        |                               |                    | Hodson (1979a)                      |
| 1977           | Dec   |                       |                                 |                              | 64                         | 9                             | 9                  | Stephen (1977) <sup>10</sup>        |
| 1977           | Feb   |                       |                                 |                              | 45                         |                               |                    | Hatler (1977a)                      |
| Fall           |       |                       |                                 |                              |                            |                               |                    |                                     |
| 2018           | Oct   | 9 <sup>11</sup>       | 12 <sup>11</sup>                | 19 <sup>11</sup>             | 514                        | N/A                           |                    | Thiessen (2018) (MR) <sup>6</sup>   |
| 2015           | Oct   | 14                    | 16                              | 26                           | 446                        | 446                           | 446                | Williams and Dixon (2016)           |
| 2007           | Oct   | 14                    | 16                              | 23                           | 366                        | 360                           | 360                | Marshall (2007b)                    |
| 2001           | Oct   | 19                    | 23                              | 33                           | 601                        | 601                           | 528                | Marshall (2001)                     |
| 2000           | Nov   | 14                    | 16                              | 24                           | 542                        | 542                           | 542                | Marshall (2000c)                    |
| 1999           | Oct   | 19                    | 24                              | 37                           | 676                        | 676                           | 641                | Marshall (1999b)                    |
| 1998           | Oct   | 20                    | 26                              | 40                           | 672                        | 672                           | 630                | Marshall (1999a)                    |
| 1997           | Nov   | 11 <sup>7</sup>       | 12 <sup>7</sup>                 | 15 <sup>7</sup>              | 66                         | 66                            | 65                 | Marshall (1997d)                    |
| 1997           | Oct   |                       |                                 |                              | 93                         |                               |                    | Marshall (1997c) (FW)               |
| 1995           | Oct   | 14                    | 16                              | 24                           | 476                        | 475                           | 475                | Marshall (1995b)                    |
| 1984           | Sep   | 14                    | 16                              | 25                           | 196                        | 196                           | 196                | Marshall (1984)                     |
| 1979           | Oct   | 31 <sup>12</sup>      | 45 <sup>12</sup>                | 55 <sup>12</sup>             | 56                         | 55                            | 55                 | Hodson (1979b)                      |
| 1977           | Nov   | 19 <sup>12</sup>      | 24 <sup>12</sup>                | 25 <sup>12</sup>             | 36                         | 36                            | 36                 | Hatler (1977b)                      |
| 1977           | Oct   | 19 <sup>12</sup>      | 23 <sup>12</sup>                | -                            | 86                         | 86                            |                    | Bergerud (1978) (FW)                |
| 1974           | Nov   | 16 <sup>12</sup>      | 18 <sup>12</sup>                | 27 <sup>12</sup>             | 111                        | 58                            | 58                 | Hatler (1974)                       |
| Calving/summer |       |                       |                                 |                              |                            |                               |                    |                                     |
| 2000           | June  | 22 <sup>7</sup>       | 29 <sup>7</sup>                 | 57 <sup>7</sup>              | 130                        | 130                           | 85                 | Marshall (2000b)                    |
| 1998           | June  | 28                    | 40                              | 60                           | 306                        | 306                           | 285                | Marshall (1999a)                    |
| 1997           | June  | 25                    | 33                              | 91                           | 160                        | 160                           | 105                | Marshall (1997b)                    |
| 1982           | July  |                       |                                 |                              | (10)                       | 10                            |                    | Jones (1982) <sup>10</sup>          |
| 1980           | June  | 40                    | 67                              | 68                           | (287)                      | 285                           | 283                | Hodson (1980b)                      |
| 1977           | Aug   | 17                    | 20                              | -                            | 148                        | 148                           |                    | Bergerud (1978) (GR)                |
| 1975           | Aug   |                       |                                 |                              | (6)                        |                               |                    | Hazelwood (1975)                    |

<sup>1</sup> Calf ratios are based on totals in each age/sex class because data detailing composition of groups were not available so we could not eliminate groups where some animals were unclassified

<sup>2</sup> Numbers in parentheses indicate surveys where caribou were not the primary focus

<sup>3</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

<sup>4</sup> All surveys were conducted by helicopter unless indicated as a fixed-wing (FW) or ground (GR) survey

<sup>5</sup> The calf/100 cows ratio was derived from the SRB strata and therefore differs slightly from just dividing the total calves by total cows; the other two ratios were based on totals counted

<sup>6</sup> Surveys conducted to estimate population size: MR=Mark/Re-sight; SRB=Stratified Random Block

<sup>7</sup> Marshall recommends caution when assessing numbers and ratios due to sample size limitations

<sup>8</sup> Poor survey conditions

<sup>9</sup> Ratios assume that 233 unclassified animals were unclassified adults.

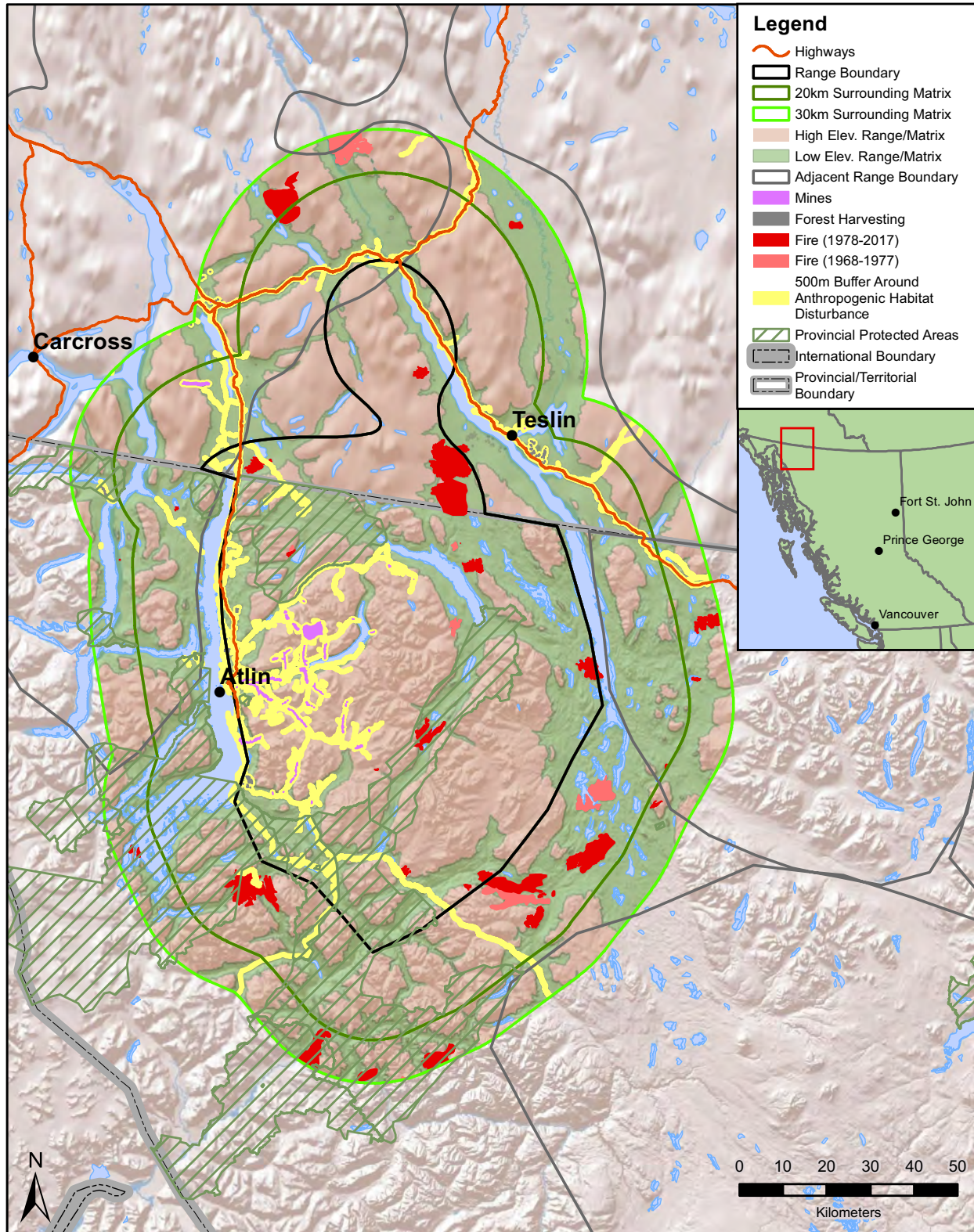
<sup>10</sup> Calf ratios not included due to low sample size.

<sup>11</sup> % calves, calves/100 adults and # caribou counted from C. Thiessen (pers. comm.)

<sup>12</sup> Ratios should be interpreted cautiously due to small sample sizes of classified caribou.



## Atlin



## Atlin

|                                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|----------------------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Total Range                      |                    |                               |                                |                                               |
| Range                            | 858 401            | 40.3                          | 59.7                           | -                                             |
| 0-20 km matrix surrounding range | 959 801            | 54.2                          | 45.8                           | 35.7 (NM)                                     |
| 0-30 km matrix surrounding range | 1 516 826          | 53.0                          | 47.0                           | 41.0 (NM)                                     |
| BC only                          |                    |                               |                                |                                               |
| Range                            | 695 385            | 41.9                          | 58.1                           | -                                             |
| 0-20 km matrix surrounding range | 566 293            | 62.8                          | 37.2                           | 30.7 (NM)                                     |
| 0-30 km matrix surrounding range | 893 837            | 59.9                          | 40.1                           | 37.2 (NM)                                     |

<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA



## Atlin Total Range (BC + Yukon)

|                | Range Area<br>(ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|--------------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                    | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 858 401            | 1.9                                  | 2.0            | 0              | 0          | 0           | 0        | 0.2      | 0   | 1.7  | 0            | 0    | 0        | 0         | 0        | 8.7  | 0.1     | 0.1        | 3.8   | 3.2                         | 9.3                              | 9.6           | 11.5                                   |
| High elevation | 512 097            | 0.5                                  | 0.5            | 0              | 0          | 0           | 0        | 0        | 0   | 1.8  | 0            | 0    | 0        | 0         | 0        | 6.1  | 0       | 0          | 1.7   | 1.5                         | 6.3                              | 6.5           | 7.0                                    |
| Low elevation  | 346 303            | 4.0                                  | 4.2            | 0              | 0          | 0           | 0.1      | 0.5      | 0   | 1.6  | 0            | 0    | 0        | 0         | 0        | 12.5 | 0.2     | 0.2        | 6.9   | 5.6                         | 13.9                             | 14.2          | 18.2                                   |
| Matrix 0-20 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 959 801            | 1.7                                  | 2.3            | 0.2            | 0          | 0           | 0        | 0.3      | 0   | 0.3  | 0            | 0    | 0        | 0.1       | 0        | 3.7  | 0       | 0.3        | 3.9   | 2.9                         | 4.8                              | 5.0           | 6.6                                    |
| High elevation | 439 383            | 0.8                                  | 1.0            | 0.3            | 0          | 0           | 0        | 0        | 0   | 0.2  | 0            | 0    | 0        | 0         | 0        | 1.1  | 0       | 0          | 1.2   | 0.8                         | 1.4                              | 1.6           | 2.3                                    |
| Low elevation  | 520 417            | 2.4                                  | 3.4            | 0.2            | 0          | 0           | 0        | 0.5      | 0   | 0.4  | 0            | 0    | 0        | 0.1       | 0        | 5.9  | 0.1     | 0.5        | 6.3   | 4.6                         | 7.6                              | 8.0           | 10.2                                   |
| Matrix 0-30 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 516 826          | 1.8                                  | 2.5            | 0.1            | 0          | 0           | 0        | 0.2      | 0   | 0.2  | 0            | 0    | 0        | 0.2       | 0        | 3.0  | 0       | 0.2        | 3.4   | 2.4                         | 4.1                              | 4.3           | 6.0                                    |
| High elevation | 712 146            | 1.2                                  | 1.5            | 0.2            | 0          | 0           | 0        | 0        | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 0.8  | 0       | 0          | 1.3   | 0.6                         | 1.5                              | 1.6           | 2.8                                    |
| Low elevation  | 804 675            | 2.3                                  | 3.3            | 0.1            | 0          | 0           | 0        | 0.4      | 0   | 0.3  | 0            | 0    | 0        | 0.3       | 0        | 5.1  | 0.1     | 0.4        | 5.3   | 4.0                         | 6.3                              | 6.7           | 8.9                                    |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

## Atlin: BC Only

|                | Range<br>Area (ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|--------------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                    | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 695 385            | 0.8                                  | 0.9            | 0              | 0          | 0           | 0.1      | 0.2      | 0   | 2.1  | 0            | 0    | 0        | 0         | 0        | 10.1 | 0.1     | 0.1        | 3.6   | 3.3                         | 10.4                             | 10.7          | 11.5                                   |
| High elevation | 404 341            | 0.2                                  | 0.3            | 0              | 0          | 0           | 0        | 0        | 0   | 2.3  | 0            | 0    | 0        | 0         | 0        | 7.7  | 0       | 0          | 2.0   | 1.9                         | 7.8                              | 8.1           | 8.3                                    |
| Low elevation  | 291 045            | 1.6                                  | 1.8            | 0              | 0          | 0           | 0.1      | 0.5      | 0   | 1.8  | 0            | 0    | 0        | 0         | 0        | 13.4 | 0.3     | 0.2        | 5.8   | 5.3                         | 13.9                             | 14.3          | 15.9                                   |
| Matrix 0-20 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 566 293            | 2.5                                  | 3.6            | 0.4            | 0          | 0           | 0        | 0.1      | 0   | 0.1  | 0            | 0    | 0        | 0.1       | 0        | 3.1  | 0       | 0.1        | 2.0   | 1.8                         | 3.2                              | 3.3           | 5.7                                    |
| High elevation | 210 390            | 1.2                                  | 1.5            | 0.5            | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 1.2  | 0       | 0          | 0.8   | 0.7                         | 1.3                              | 1.3           | 2.4                                    |
| Low elevation  | 355 903            | 3.4                                  | 4.9            | 0.2            | 0          | 0           | 0        | 0.1      | 0   | 0.1  | 0            | 0    | 0        | 0.2       | 0        | 4.2  | 0       | 0.2        | 2.7   | 2.5                         | 4.4                              | 4.4           | 7.7                                    |
| Matrix 0-30 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 893 837            | 2.4                                  | 3.1            | 0.2            | 0          | 0           | 0        | 0.1      | 0   | 0.1  | 0            | 0    | 0        | 0.2       | 0        | 2.7  | 0       | 0.1        | 1.8   | 1.7                         | 2.8                              | 2.8           | 5.2                                    |
| High elevation | 358 775            | 1.3                                  | 1.5            | 0.3            | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 0.8  | 0       | 0          | 0.5   | 0.5                         | 0.8                              | 0.8           | 2.1                                    |
| Low elevation  | 535 057            | 3.1                                  | 4.2            | 0.2            | 0          | 0           | 0        | 0.2      | 0   | 0.1  | 0            | 0    | 0        | 0.4       | 0        | 3.9  | 0       | 0.2        | 2.7   | 2.5                         | 4.1                              | 4.2           | 7.2                                    |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

# Swan Lake

## Range use summary

During winter, caribou can be found in low elevation forests and on windswept alpine slopes, and during summer caribou mostly use high elevation habitats. Distribution of Swan Lake caribou overlaps with neighbouring ranges with evidence of winter use in the Little Rancheria low elevation winter range, and evidence of summer use in the Level-Kawdy range.

| Season      | Overview of Habitat and Range Use                                                                                                                                                                                                                                              | Source                                             |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| Winter      | <ul style="list-style-type: none"><li>• Low elevation forests</li><li>• High elevation windswept alpine slopes</li><li>• Known wintering areas include one along the Alaska Highway</li><li>• Some caribou winter in the Little Rancheria low elevation winter range</li></ul> | Williams (2009)<br>M. Williams, pers. comm. (2014) |
| Summer      | <ul style="list-style-type: none"><li>• Mostly high elevation habitats</li><li>• One caribou moved into the Level-Kawdy caribou range for calving and summer</li></ul>                                                                                                         | Williams (2009)<br>M. Williams, pers. comm. (2014) |
| Total Range | <ul style="list-style-type: none"><li>• 95% of the range is located in BC</li><li>• 5% of the range is located in Yukon</li></ul>                                                                                                                                              |                                                    |

## Population size

The only population estimate for the Swan Lake caribou population based on survey data is from 2007. Based on 442 caribou counted during a fall composition survey in October 2007, the Swan Lake caribou population was estimated at 600-800 caribou (Williams 2009). Although the minimum count and population estimate were considered reliable at the time, they are now out of date. Since 2007, 333 caribou were counted during a fall composition survey in 2015 (C. Thiessen, pers. comm. 2020).

| Year | Population estimate | Number counted | Method                        | Reliability | Source          |
|------|---------------------|----------------|-------------------------------|-------------|-----------------|
| 2007 | 600-800             | 442            | Minimum count + extrapolation | Mod-High    | Williams (2009) |

## Population trend

Fall (October) and late winter (March/April) composition surveys were conducted from 2005 to 2008 as part of a study of radio-collared caribou (Williams 2009).

Three of the four fall calf/100 cow ratios from 2005 to 2015, including the most recent survey in 2015, were above 20 to 25 calves/100 cows, which is considered sufficient to support a stable population growth rate (Environment Yukon 2016). It is unknown whether fall surveys of rutting areas in the Swan Lake caribou range are biased against calves as detected in the Spatsizi caribou range (Hatler 1987); however, the calves/100 cows ratio suggests a stable population in three of the four years even if the surveys were biased against calves.

Only one of the three late winter calf recruitment estimates from 2006 and 2008 were at or above 15% calves recommended by Bergerud (1996) to achieve population stability.

No information on adult survival or population growth rate (based on adult mortality and calf recruitment) was readily available from the radio-collared caribou study.

Of the most recent composition surveys conducted, evidence from October surveys suggests that calf recruitment may support a stable or increasing population trend, but data from March surveys suggests that it may be declining. However, other than the 2015 survey, these indicators of population trend are at least 13 years old and are too old to use for inferring current population trend.

There is not enough information to determine a current or long-term population trend.

## Swan Lake

| Year   | Month | % calves <sup>1</sup> | Calves/ 100 adults <sup>1</sup> | Calves/100 cows <sup>1</sup> | Total Counted | Total classified <sup>2</sup> |                    | Source <sup>3</sup>      |
|--------|-------|-----------------------|---------------------------------|------------------------------|---------------|-------------------------------|--------------------|--------------------------|
|        |       |                       |                                 |                              |               | Calves+ Adults                | Calves+ Cows+Bulls |                          |
| Winter |       |                       |                                 |                              |               |                               |                    |                          |
| 2008   | Apr   | 14                    | 16                              | 19                           | 236           | 236                           | 236                | Williams (2009)          |
| 2007   | Mar   | 14                    | 17                              | 24                           | 468           | 359                           | 359                | Williams (2009)          |
| 2006   | Mar   | 23                    | 30                              | 42                           | 129           | 129                           | 129                | Williams (2009)          |
| Fall   |       |                       |                                 |                              |               |                               |                    |                          |
| 2015   |       | 16                    | 19                              | 27                           | 333           | NA <sup>4</sup>               | NA <sup>4</sup>    | C. Thiessen, pers. comm. |
| 2007   | Oct   | 16                    | 19                              | 27                           | 442           | 442                           | 442                | Williams (2009)          |
| 2006   | Oct   | 12                    | 13                              | 18                           | 340           | 340                           | 340                | Williams (2009)          |
| 2005   | Oct   | 17                    | 21                              | 28                           | 247           | 247                           | 247                | Williams (2009)          |
| 1977   | Oct   | 13                    | 14                              | –                            | 56            | 56                            | –                  | Bergerud (1978) (FW)     |

<sup>1</sup> Calf ratios based on groups where all caribou were classified to the degree required for the calculation of the ratio

<sup>2</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

<sup>3</sup> All surveys conducted by helicopter unless indicated as a fixed-wing (FW) or ground (GR) survey

<sup>4</sup> Not available

## Boundary Issues

- The range boundary is coarsely drawn resulting in gaps between the Swan Lake caribou range and the Atlin, Level Kawdy and Little Rancheria caribou ranges.
- The BC/Yukon range boundaries do not line up.
- Telemetry data suggest that Swan Lake caribou also use areas within the Horseranch caribou range.

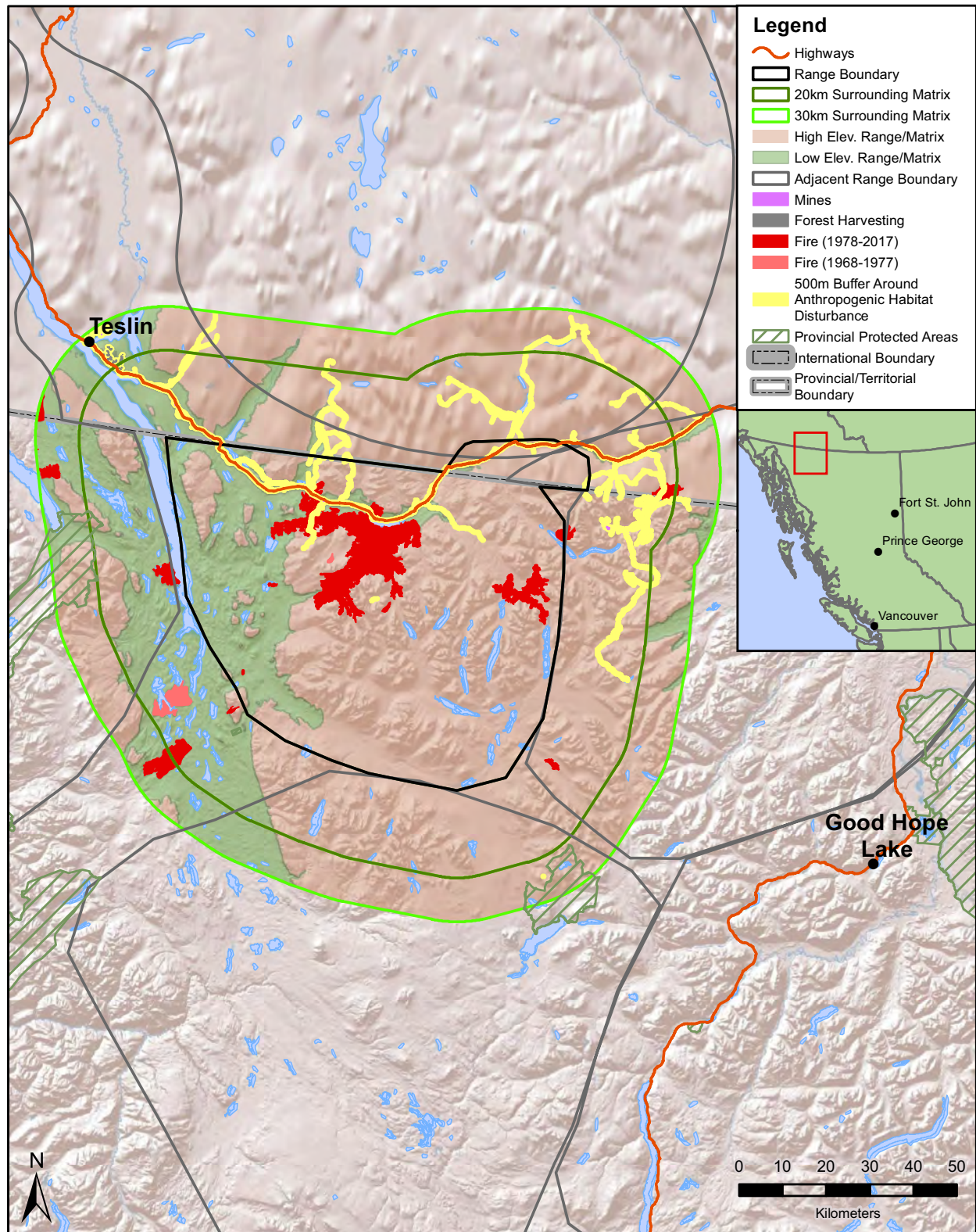
## Range condition

Within the current BC and Yukon Swan Lake caribou range boundaries, habitat disturbance covers 9%, 8% and 14% of the total, high elevation and low elevation portions of the range respectively. The primary habitat disturbance is fire, followed by roads/trails and powerlines. The main road/trail in the Swan Lake caribou range is the Alaska Highway. Most of the area burned within the range was due to a 30,000 ha fire along and south of the Alaska Highway in 2004. Roads/trails is the primary habitat disturbance in the 20 km and 30 km matrix surrounding the range.

Although our analysis does not include fires from 2018 to 2021, there were no fires >1 ha in the BC portion of the Swan Lake caribou range and surrounding matrix during those four years.



## Swan Lake





## Swan Lake

|                                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|----------------------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Total Range                      |                    |                               |                                |                                               |
| Range                            | 585 080            | 23.2                          | 76.8                           | -                                             |
| 0-20 km matrix surrounding range | 748 067            | 26.1                          | 73.9                           | 68.7 (NM)                                     |
| 0-30 km matrix surrounding range | 1 212 853          | 25.0                          | 75.0                           | 73.7 (NM)                                     |
| BC only                          |                    |                               |                                |                                               |
| Range                            | 557 190            | 24.3                          | 75.7                           | -                                             |
| 0-20 km matrix surrounding range | 472 321            | 32.0                          | 68.0                           | 71.6 (NM)                                     |
| 0-30 km matrix surrounding range | 753 031            | 30.5                          | 69.5                           | 77.4 (NM)                                     |

<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA

## Swan Lake: Total Range (BC and Yukon)

|                | Range Area<br>(ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|--------------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                    | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 585 080            | 6.2                                  | 6.2            | 0              | 0          | 0           | 0        | 0        | 0   | 0.1  | 0            | 0    | 0        | 1.0       | 0        | 2.9  | 0       | 0.1        | 2.5   | 2.0                         | 3.4                              | 3.5           | 9.4                                    |
| High elevation | 449 324            | 6.1                                  | 6.1            | 0              | 0          | 0           | 0        | 0        | 0   | 0.1  | 0            | 0    | 0        | 0.1       | 0        | 1.6  | 0       | 0.1        | 1.3   | 0.9                         | 2.1                              | 2.1           | 8.1                                    |
| Low elevation  | 135 756            | 6.4                                  | 6.4            | 0              | 0          | 0           | 0        | 0        | 0   | 0.4  | 0            | 0    | 0        | 3.8       | 0        | 7.3  | 0       | 0.3        | 6.2   | 5.6                         | 7.9                              | 8.2           | 13.9                                   |
| Matrix 0-20 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 748 067            | 0.7                                  | 1.1            | 0              | 0          | 0.2         | 0        | 0        | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 3.0  | 0.1     | 0.1        | 5.4   | 2.5                         | 5.9                              | 6.0           | 6.7                                    |
| High elevation | 553 034            | 0.4                                  | 0.4            | 0              | 0          | 0.3         | 0        | 0        | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 3.2  | 0.1     | 0.1        | 5.9   | 2.6                         | 6.6                              | 6.6           | 7.0                                    |
| Low elevation  | 195 033            | 1.7                                  | 3.2            | 0              | 0          | 0           | 0        | 0.2      | 0   | 0.3  | 0            | 0    | 0        | 0         | 0        | 2.5  | 0       | 0.1        | 3.8   | 2.4                         | 3.9                              | 4.1           | 5.8                                    |
| Matrix 0-30 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 212 853          | 0.8                                  | 1.0            | 0              | 0          | 0.2         | 0        | 0.1      | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 2.2  | 0.1     | 0.1        | 4.2   | 1.8                         | 4.6                              | 4.8           | 5.5                                    |
| High elevation | 909 855            | 0.3                                  | 0.3            | 0              | 0          | 0.2         | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 2.1  | 0       | 0.1        | 4.5   | 1.6                         | 4.9                              | 5.0           | 5.2                                    |
| Low elevation  | 302 993            | 2.4                                  | 3.4            | 0              | 0          | 0           | 0        | 0.5      | 0   | 0.3  | 0            | 0    | 0        | 0         | 0        | 2.5  | 0.1     | 0.2        | 3.5   | 2.4                         | 3.6                              | 4.1           | 6.4                                    |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

## Swan Lake: BC only

|                | Range Area (ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|-----------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                 | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 557 190         | 6.5                                  | 6.5            | 0              | 0          | 0           | 0        | 0        | 0   | 0.1  | 0            | 0    | 0        | 1.0       | 0        | 2.6  | 0       | 0.1        | 1.9   | 1.6                         | 2.9                              | 3.0           | 9.2                                    |
| High elevation | 421 963         | 6.5                                  | 6.5            | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0.1       | 0        | 1.1  | 0       | 0.1        | 0.6   | 0.3                         | 1.3                              | 1.4           | 7.8                                    |
| Low elevation  | 135 228         | 6.5                                  | 6.5            | 0              | 0          | 0           | 0        | 0        | 0   | 0.4  | 0            | 0    | 0        | 3.8       | 0        | 7.2  | 0       | 0.2        | 6.1   | 5.5                         | 7.8                              | 8.0           | 13.9                                   |
| Matrix 0-20 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 472 321         | 0.9                                  | 1.5            | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 2.7  | 0.1     | 0          | 2.2   | 2.1                         | 2.8                              | 2.8           | 3.7                                    |
| High elevation | 321 120         | 0.3                                  | 0.3            | 0              | 0          | 0           | 0        | 0        | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 3.9  | 0.1     | 0          | 3.2   | 3.0                         | 4.1                              | 4.1           | 4.4                                    |
| Low elevation  | 151 201         | 2.2                                  | 4.2            | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 0.1  | 0       | 0          | 0.1   | 0.1                         | 0.1                              | 0.1           | 2.3                                    |
| Matrix 0-30 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 753 031         | 1.0                                  | 1.4            | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 1.8  | 0.1     | 0          | 1.4   | 1.4                         | 1.9                              | 1.9           | 2.9                                    |
| High elevation | 522 997         | 0.2                                  | 0.2            | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 2.6  | 0.1     | 0          | 2.1   | 1.9                         | 2.7                              | 2.7           | 2.9                                    |
| Low elevation  | 230 034         | 2.9                                  | 4.2            | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 0    | 0       | 0          | 0     | 0                           | 0                                | 0             | 3.0                                    |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

# Little Rancheria

## Range use summary

During summer, caribou are found mostly at high elevations in the Cassiar Mountains between the Little Rancheria and Blue rivers in BC. The Little Rancheria River and Blue River valleys are used during spring and fall migration. During winter, caribou use low elevation forests with the main core winter range centred in the Liard River/Little Rancheria River area in Yukon, and they also use winter range in the area around the Dease River in BC. Portions of the low elevation winter range in Yukon and BC overlap with the Horseranch caribou low elevation winter range. Little Rancheria, Swan Lake and Level Kawdy caribou may also use the low elevation wintering area in BC.

| Season      | Overview of Habitat and Range Use                                                                                                                                                                                                                                                                                                                                                                                                                             | Source                                                                                                                                                       |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Winter      | <ul style="list-style-type: none"> <li>Low elevation forests</li> <li>Open pine/lichen forests, mixed conifer forests, black spruce bogs</li> <li>Core wintering areas are located in both Yukon (main core wintering area) and BC</li> <li>Shared winter range with Horseranch some years (also some Swan Lake and Level Kawdy caribou)</li> <li>Use of the core of the low elevation winter range is higher during late winter than early winter</li> </ul> | Farnell and McDonald (1990)<br>Florkiewicz et al. (2003)<br>M. Williams pers comm. (2014)<br>Jex (2013)<br>Marshall et al. unpubl. data<br>MacLean, in prep. |
| Summer      | <ul style="list-style-type: none"> <li>Mostly high elevation alpine habitat</li> <li>Most summer range (calving, post-calving, rut) is in the Cassiar Mountains in BC between the Little Rancheria and Blue rivers</li> </ul>                                                                                                                                                                                                                                 | Farnell and McDonald (1990)<br>Florkiewicz et al. (2003)<br>Marshall et al. unpubl. data<br>MacLean, in prep.                                                |
| Migration   | <ul style="list-style-type: none"> <li>Stream and river courses and associated wetlands</li> <li>Closed-canopy stands along highway corridors as caribou travel to key highway crossing points</li> <li>Main travel corridor parallels the Little Rancheria River</li> <li>Spring migration primarily in the Little Rancheria and Blue River valleys</li> <li>Fall migration primarily in the Little Rancheria valley</li> </ul>                              | Florkiewicz et al. (2003)<br>Marshall et al. unpubl. data<br>MacLean, in prep.                                                                               |
| Total Range | <ul style="list-style-type: none"> <li>66% of the range is located in BC</li> <li>34% of the range is located in Yukon</li> </ul>                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                              |

## Population size

The current population estimate of 800-1600 caribou was based on a stratified random block survey conducted on the Horseranch and Little Rancheria caribou low elevation winter ranges in March 1999 (Marshall et al., unpubl. data). A total of 1109 caribou were counted during the survey and the population estimate in the survey area was  $1262 \pm 13\%$  (Marshall 1999). Based on two estimates of the proportion of radio-collared caribou seen during the survey, sightability correction factors (SCFs) of 1.44 and 1.48 were calculated resulting in a total survey estimate of 1817 and 1866. Based on SCFs calculated for this survey and for surveys in Yukon, Marshall (1999) concluded that an SCF of 1.4 was appropriate and conservative, which resulted a total population estimate of 1767. However, the estimate included both Horseranch and Little Rancheria caribou and it was difficult to determine what proportion of the total estimate belonged to the Horseranch or Little Rancheria populations (Marshall 1999). Because there were no other reliable population estimates for the Little Rancheria caribou population at the time, the portion of the total population estimate that belonged to the Little Rancheria caribou population was estimated using the radio-collared caribou sample.

| Date | Population estimate   | Number counted | Method                  | Reliability           | Source                       |
|------|-----------------------|----------------|-------------------------|-----------------------|------------------------------|
| 1999 | 800-1600 <sup>1</sup> | –              | Stratified Random Block | Moderate <sup>2</sup> | Marshall (1999)              |
| 1988 | 681 <sup>3</sup>      | 339            | Stratified Random Block | High                  | Farnell and MacDonald (1990) |

<sup>1</sup> A stratified random block survey was conducted on the winter range in March 1999. The total estimate was 1817-1836 with +/-13% (90% CI). Radio-collared caribou from both the Horseranch and Little Rancheria subpopulations were present in the survey area so the estimates for each subpopulation were based on the radio-collared sample.

<sup>2</sup> Although reliability of a population estimate from a stratified random block survey is high, there was less certainty around the calculation of the proportion of caribou in that survey that belonged to the Little Rancheria population, reducing the reliability of the population estimate to moderate

<sup>3</sup> The survey area in 1988 was smaller than the survey area in 1999

In 1988, the Little Rancheria caribou population was estimated at 681 caribou based on a stratified random block survey (Farnell and MacDonald 1990). However the survey area was smaller than those in 1999 and it is unknown whether there were Horseranch caribou present. It is unclear whether the difference between the 1999 estimate and the 1988 estimate was due to a change in numbers, differing survey areas or differences in caribou distribution and populations using the survey area (Marshall 1999). Therefore, we are unable to infer population trend based on the two population estimates.

The most recent population estimate for the Little Rancheria caribou population of 800-1600 caribou based on the March 1999 survey is now over 20 years old. Since 1999, the highest number of caribou counted during a survey was 842 in fall 2004 (Marshall 2004, see Population trend below), although that information is now 17 years old.

## Population trend

Spring (June), fall (October/November) and late winter (March/April) composition surveys were conducted from 1996 to 2002 as part of a study of radio-collared caribou (Marshall et al., unpubl. data). Spring (July) and Fall (October) composition surveys were also conducted in 1985 and 1986 as part of an earlier study on radio-collared caribou (Farnell and MacDonald 1990).

The most recent calves/100 cows ratio from fall 2015 was within the 20 to 25 calves/100 cows considered sufficient to support a stable population growth rate (Environment Yukon 2016). However, the sample size was low relative to the estimated population size (C. Thiessen, pers. comm.), and may not adequately represent the calves/100 cows ratio for the whole population. All nine fall calves/100 cows ratios from 1985 to 2004 were also above 20 to 25 calves/100 cows. It is unknown whether fall surveys of rutting areas in the Little Rancheria caribou range are biased against calves as detected in the Spatsizi caribou range (Hatler 1987), however, the calves/100 cows ratios suggested a stable population even if the surveys were biased against calves.

Although all six fall surveys from 1996 to 2001 suggested a stable or potentially increasing population trend, only three of the six late winter calf recruitment estimates were at or above 15% calves recommended by Bergerud (1996) to achieve population stability.

Early calf survival based on surveys conducted during calving and early summer is not appropriate for use in estimating population trend because it does not account for late summer and winter mortality. For the Little Rancheria caribou, calf ratios in 1985 and 1985 were generally lower than those from 1997 to 2001, presumably because they were based on surveys conducted in July rather than June, and would have accounted for more calf mortality.



## Little Rancheria

| Year           | Month            | % calves <sup>1</sup> | Calves/ 100 adults <sup>1</sup> | Calves/100 cows <sup>1</sup> | Total Counted | Total classified <sup>2</sup> |                    | Source <sup>3</sup>                   |
|----------------|------------------|-----------------------|---------------------------------|------------------------------|---------------|-------------------------------|--------------------|---------------------------------------|
|                |                  |                       |                                 |                              |               | Calves+ Adults                | Calves+ Cows+Bulls |                                       |
| Winter         |                  |                       |                                 |                              |               |                               |                    |                                       |
| 2001           | Mar              | 12                    | 13                              | -                            | 172           | 172                           |                    | Marshall et al, unpubl. data          |
| 2000           | Mar              | 19                    | 23                              | -                            | 240           | 240                           |                    | Marshall et al, unpubl. data          |
| 1999           | Mar              | 14                    | 16                              | -                            | 501           | 501                           |                    | Marshall et al, unpubl. data          |
| 1998           | Apr              | 10                    | 11                              | -                            | 168           | 168                           |                    | Marshall et al, unpubl. data          |
| 1997           | Apr              | 17                    | 21                              | -                            | 153           | 153                           |                    | Marshall et al, unpubl. data          |
| 1988           | Mar/Apr          | 19 <sup>4</sup>       |                                 | 30 <sup>4</sup>              | 338           | 338                           | 326                | Farnell and McDonald (1990)           |
| Fall           |                  |                       |                                 |                              |               |                               |                    |                                       |
| 2015           | Fall             | 15                    | 18                              | 23                           | 189           | NA                            | NA                 | C. Thiessen, pers. comm. <sup>5</sup> |
| 2004           | Fall             | 17                    | 21                              | 30                           | 842           | 842                           | 842                | Marshall (2004)                       |
| 2001           | Nov <sup>6</sup> | 29                    | -                               | 52 <sup>7</sup>              | 229           |                               |                    | Marshall et al, unpubl. data          |
| 2000           | Oct <sup>6</sup> | 18                    | -                               | 30 <sup>7</sup>              | 502           |                               |                    | Marshall et al, unpubl. data          |
| 1999           | Oct <sup>6</sup> | 25                    | -                               | 44 <sup>7</sup>              | 470           |                               |                    | Marshall et al, unpubl. data          |
| 1998           | Nov <sup>6</sup> | 26                    | -                               | 51 <sup>7</sup>              | 321           |                               |                    | Marshall et al, unpubl. data          |
| 1997           | Oct <sup>6</sup> | 17                    | -                               | 28 <sup>7</sup>              | 259           |                               |                    | Marshall et al, unpubl. data          |
| 1996           | Oct <sup>6</sup> | 15                    | -                               | 27 <sup>7</sup>              | 293           |                               |                    | Marshall et al, unpubl. data          |
| 1986           | Oct              | 17                    | 21                              | 28                           | 233           | 233                           | 233                | Farnell and McDonald (1990)           |
| 1985           | Oct              | 17                    | 20                              | 28                           | 145           | 145                           | 145                | Farnell and McDonald (1990)           |
| 1977           | Oct              | 4                     | 4                               | -                            | 384           | 384                           |                    | Bergerud 1978 (FW) <sup>8</sup>       |
| Calving/Summer |                  |                       |                                 |                              |               |                               |                    |                                       |
| 2001           | June             | 34                    | 52                              | 59                           | 150           | 150                           | 150                | Marshall et al, unpubl. data          |
| 2000           | June             | 35                    | 54                              | 56                           | 177           | 177                           | 173                | Marshall et al, unpubl. data          |
| 1999           | June             | 33                    | 49                              | 74                           | 292           | 292                           | 240                | Marshall et al, unpubl. data          |
| 1998           | June             | 27                    | 37                              |                              | 63            | 63                            | 40                 | Marshall et al, unpubl. data          |
| 1997           | June             | 16                    | 19                              |                              | 80            | 80                            | 64                 | Marshall et al, unpubl. data          |
| 1986           | July             | 18                    | 21                              | 28                           | 170           | 170                           | 170                | Farnell and McDonald (1990)           |
| 1985           | July             | 24                    | 31                              | 41                           | 115           | 115                           | 115                | Farnell and McDonald (1990)           |

<sup>1</sup> Calf ratios were based on totals in each age/sex class (except as otherwise indicated) because data detailing composition of groups were not available so we could not eliminate groups where some animals were unclassified

<sup>2</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

<sup>3</sup> All surveys were conducted by helicopter unless indicated as a fixed-wing (FW) or ground (GR) survey

<sup>4</sup> Calf ratios provided; classification data not available; note low sample size relative to population size

<sup>5</sup> Reported % calves and calves/100 cows are based on stratified random block survey calculations and not on the number of caribou in each sex/age class counted during the survey

<sup>6</sup> No age/sex class data provided in the unpublished report; calf/100 cow ratios calculated using Jackknife analysis (Marshall et al. unpubl data)

<sup>7</sup> calf/100 cow ratios were calculated using Jackknife analysis and were based on only groups where all caribou were classified (Marshall et al. unpubl data)

<sup>8</sup> Also counted 60 caribou (of which 2 were calves) on September 28; he assumed this group was not counted both days but suggested it could be a possibility; if not double-counted, total = 444 of which 16 are calves (4% calves)

From the radio-collared caribou study from October 1996 to March 2002, annual survival rate of adult female caribou (N=35) ranged from 81% to 94% and annual survival rate of adult males (N=7) ranged from 53% to 100% (Marshall et al., unpubl. data). Survival rate of adult females during the 1985-87 radio-collared caribou study was 81% (N=11) but the authors felt that the sample size was too small to draw any conclusions (Farnell and MacDonald 1990). No data on population rate of change ( $\lambda$ ) were summarized in either study.

Indicators of population trend based on calf recruitment may not adequately represent the current condition due to small sample size (2015) and length of time since earlier surveys were conducted. For the composition surveys conducted between 1996 and 2004, evidence from October surveys suggests that calf recruitment may have supported a stable or increasing population trend, but data from March surveys is less conclusive. Regardless, these indicators of population trend are at least 17 years old and are too old to use for inferring current population trend.

## **Boundary Issues**

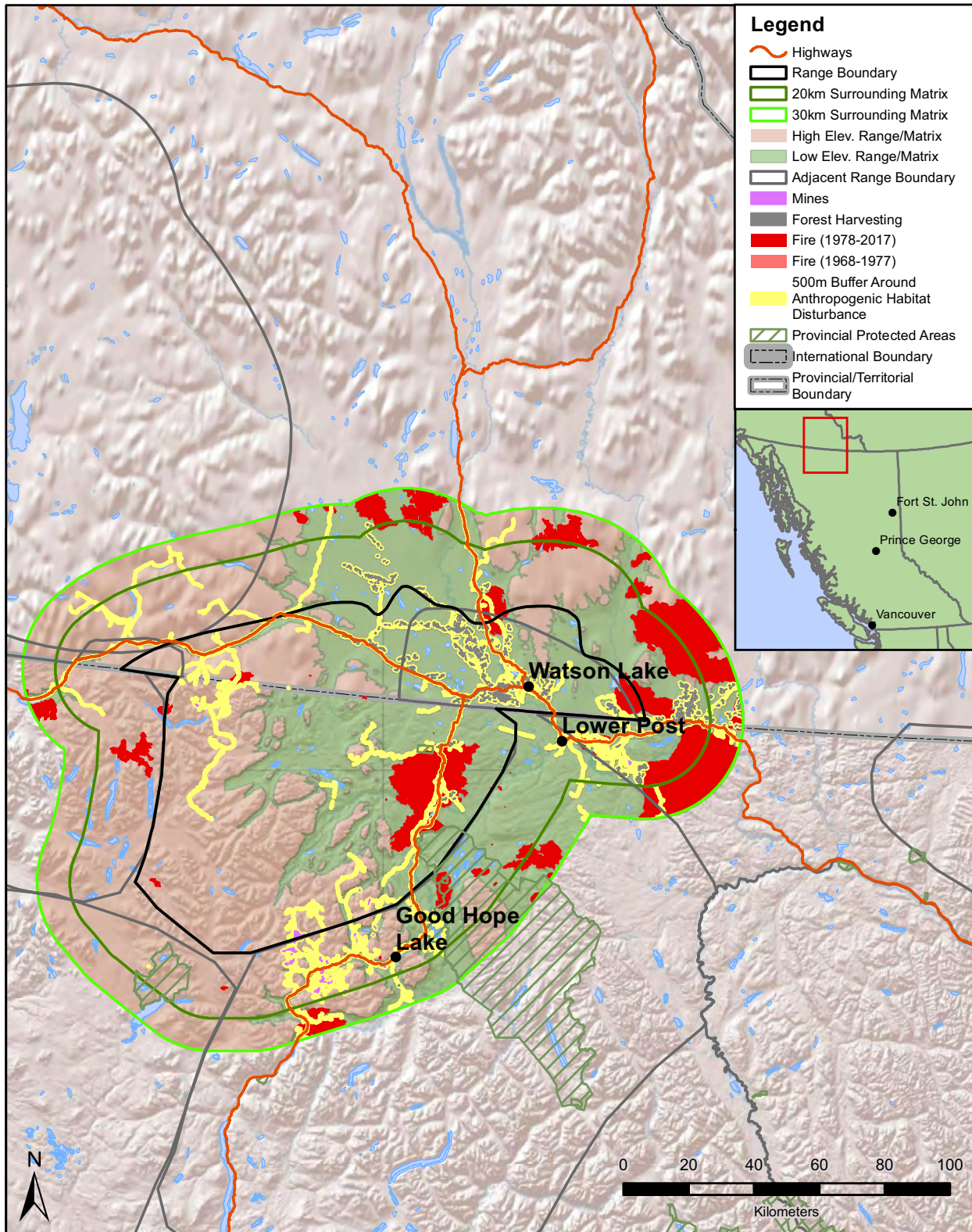
- The range boundary is coarsely drawn resulting in gaps between the Little Rancheria caribou range and the Swan Lake and Level Kaudy caribou ranges.
- The BC/Yukon range boundaries do not line up.
- Telemetry data suggest overlap between the Little Rancheria and Horseranch caribou ranges.

## **Range condition**

Within the current BC and Yukon Little Rancheria caribou range boundaries, habitat disturbance covers 16%, 7% and 24% of the total, high elevation and low elevation portions of the range respectively. Primary disturbances are roads/trails, fire and forest harvesting, all three of which are more prevalent at low elevations than at high elevations. Forest harvesting is located primarily in the Yukon portion of the range, with 54% of the harvested area > 30 years old. Roads/trails include the Stewart-Cassiar Highway in BC, the Alaska Hwy and Robert Campbell Highway in Yukon, and industrial roads associated primarily with mining activities in BC and forest harvesting in Yukon. Within the current range boundary, fire disturbance (up to and including 2016) is largely due to the 2010 and 2011 fires along the Stewart-Cassiar Highway. Habitat disturbance is slightly higher in the 20 km and 30 km matrix surrounding the range, with a greater contribution of fire in the area east of Watson Lake and Lower Post, and additional habitat disturbance due to roads and mining activity in the area west of Good Hope Lake.

Our analysis does not include fires from 2018 to 2021. Although fire disturbance was minimal in most caribou ranges in northern BC during those years, in 2018, there was a 2,500 ha fire in the caribou range, and in 2018 there were two large fires and one smaller fire totalling about 263,000 ha which partially overlapped the portion of the 20 km and 30 km surrounding matrix in the area south of the Liard River and southeast of the Dease River.

## Little Rancheria



## Little Rancheria

|                                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|----------------------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Total Range                      |                    |                               |                                |                                               |
| Range                            | 1 055 816          | 53.4                          | 46.6                           | -                                             |
| 0-20 km matrix surrounding range | 1 054 289          | 45.3                          | 54.7                           | 58.5 (NM)                                     |
| 0-30 km matrix surrounding range | 1 662 553          | 42.7                          | 57.3                           | 60.6 (NM)                                     |
| BC only                          |                    |                               |                                |                                               |
| Range                            | 698 569            | 46.0                          | 54.0                           | -                                             |
| 0-20 km matrix surrounding range | 612 209            | 41.2                          | 58.8                           | 83.3 (NM)                                     |
| 0-30 km matrix surrounding range | 957 387            | 41.6                          | 58.4                           | 85.7 (NM)                                     |

<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA

## Little Rancheria: Total Range (BC and Yukon)

|                | Range Area<br>(ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|--------------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                    | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 055 816          | 5.4                                  | 5.4            | 0              | 0          | 0.1         | 0        | 3.8      | 0   | 0.3  | 0            | 0    | 0        | 0         | 0        | 6.9  | 0.2     | 0.3        | 7.2   | 4.7                         | 9.4                              | 11.7          | 16.1                                   |
| High elevation | 492 131            | 0.5                                  | 0.5            | 0              | 0          | 0           | 0        | 0.1      | 0   | 0.3  | 0            | 0    | 0        | 0         | 0        | 5.4  | 0.1     | 0          | 4.3   | 3.1                         | 6.6                              | 6.8           | 7.2                                    |
| Low elevation  | 563 685            | 9.7                                  | 9.7            | 0              | 0          | 0.1         | 0        | 6.9      | 0   | 0.3  | 0            | 0    | 0        | 0         | 0        | 8.2  | 0.4     | 0.5        | 9.8   | 6.2                         | 11.8                             | 15.9          | 23.8                                   |
| Matrix 0-20 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 054 289          | 6.7                                  | 6.7            | 0              | 0          | 0.2         | 0        | 2.1      | 0   | 0.7  | 0            | 0    | 0        | 0.2       | 0        | 6.8  | 0.6     | 0.3        | 4.1   | 2.3                         | 8.6                              | 10.3          | 16.4                                   |
| High elevation | 576 889            | 2.5                                  | 2.5            | 0              | 0          | 0.3         | 0        | 0.4      | 0   | 0.7  | 0            | 0    | 0        | 0.1       | 0        | 3.6  | 0       | 0.2        | 2.6   | 0.9                         | 5.3                              | 5.8           | 8.4                                    |
| Low elevation  | 477 400            | 11.8                                 | 11.8           | 0.1            | 0          | 0           | 0        | 4.1      | 0   | 0.8  | 0            | 0    | 0        | 0.3       | 0        | 10.6 | 1.3     | 0.5        | 5.9   | 4.0                         | 12.5                             | 15.6          | 26.0                                   |
| Matrix 0-30 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 662 553          | 10.8                                 | 10.8           | 0              | 0          | 0.1         | 0        | 1.6      | 0   | 0.5  | 0            | 0    | 0        | 0.2       | 0        | 5.4  | 0.4     | 0.2        | 3.4   | 1.8                         | 6.9                              | 8.3           | 18.4                                   |
| High elevation | 952 326            | 5.1                                  | 5.1            | 0              | 0          | 0.2         | 0        | 0.2      | 0   | 0.4  | 0            | 0    | 0        | 0         | 0        | 2.5  | 0       | 0.1        | 2.1   | 0.6                         | 4.0                              | 4.3           | 9.5                                    |
| Low elevation  | 710 221            | 18.4                                 | 18.5           | 0              | 0          | 0           | 0        | 3.5      | 0   | 0.6  | 0            | 0    | 0        | 0.3       | 0        | 9.2  | 0.9     | 0.3        | 5.2   | 3.5                         | 10.9                             | 13.6          | 30.3                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.



## Little Rancheria: BC only

|                | Range Area (ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|-----------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                 | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 698 569         | 6.7                                  | 6.7            | 0              | 0          | 0           | 0        | 0.2      | 0   | 0.2  | 0            | 0    | 0        | 0         | 0        | 6.6  | 0.1     | 0          | 4.0   | 3.7                         | 6.9                              | 7.0           | 12.5                                   |
| High elevation | 377 459         | 0.2                                  | 0.2            | 0              | 0          | 0           | 0        | 0        | 0   | 0.4  | 0            | 0    | 0        | 0         | 0        | 5.9  | 0.1     | 0          | 3.1   | 3.0                         | 6.1                              | 6.2           | 6.4                                    |
| Low elevation  | 321 110         | 14.5                                 | 14.5           | 0              | 0          | 0           | 0        | 0.5      | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 7.3  | 0.2     | 0          | 5.0   | 4.4                         | 7.9                              | 8.0           | 19.7                                   |
| Matrix 0-20 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 612 209         | 5.7                                  | 5.8            | 0.1            | 0          | 0           | 0        | 0.7      | 0   | 1.1  | 0            | 0    | 0        | 0.1       | 0        | 10   | 0.9     | 0.5        | 3.3   | 2.6                         | 10.6                             | 11.0          | 15.9                                   |
| High elevation | 359 681         | 1.6                                  | 1.6            | 0              | 0          | 0           | 0        | 0        | 0   | 1.0  | 0            | 0    | 0        | 0.1       | 0        | 4.5  | 0       | 0.3        | 0.7   | 0.4                         | 4.8                              | 5.0           | 6.6                                    |
| Low elevation  | 252 527         | 11.7                                 | 11.7           | 0.1            | 0          | 0           | 0.1      | 1.6      | 0   | 1.4  | 0            | 0    | 0        | 0.1       | 0        | 17.8 | 2.3     | 0.8        | 6.9   | 5.8                         | 18.9                             | 19.5          | 29.1                                   |
| Matrix 0-30 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 957 387         | 9.1                                  | 9.1            | 0              | 0          | 0           | 0        | 0.5      | 0   | 0.8  | 0            | 0    | 0        | 0.2       | 0        | 7.9  | 0.6     | 0.3        | 2.6   | 2.1                         | 8.3                              | 8.5           | 16.7                                   |
| High elevation | 559 140         | 1.6                                  | 1.6            | 0              | 0          | 0           | 0        | 0        | 0   | 0.6  | 0            | 0    | 0        | 0.1       | 0        | 3.0  | 0       | 0.2        | 0.5   | 0.2                         | 3.2                              | 3.3           | 5.0                                    |
| Low elevation  | 398 241         | 19.7                                 | 19.7           | 0.1            | 0          | 0           | 0.1      | 1.1      | 0   | 1.0  | 0            | 0    | 0        | 0.3       | 0        | 14.7 | 1.4     | 0.5        | 5.5   | 4.8                         | 15.4                             | 15.8          | 33.2                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

# Horseranch

## Range use summary

During summer, caribou are found mostly at high elevations in the Horseranch and Cassiar Mountains. During winter, caribou use low elevation forests with the core centred along the Dease River in BC, and high elevation alpine/subalpine habitat in the Horseranch Range. Horseranch caribou also winter in low elevation forests in the Liard River/Little Rancheria River area in Yukon, where they overlap with the Little Rancheria caribou winter range. Little Rancheria, Swan Lake and Level Kawdy caribou may also use the core low elevation wintering area in BC.

| Season      | Overview of Habitat and Range Use                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Source                                                                               |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Winter      | <ul style="list-style-type: none"> <li>In BC, primarily winter in low elevation forests along the Dease River, and at higher elevations in the Horseranch Range.</li> <li>May also be wintering in northeastern portion of their range</li> <li>Caribou also winter in low elevation areas in Yukon, south and west of Watson Lake, which overlaps with the Little Rancheria winter range</li> <li>The main BC wintering area may also be used by Little Rancheria, Swan Lake and Level Kawdy caribou</li> <li>Use of the core of the low elevation winter range in BC is higher during late winter than early winter</li> </ul> | M. Williams, pers. comm. (2014)<br>Marshall et al. unpubl. data<br>MacLean, in prep. |
| Summer      | <ul style="list-style-type: none"> <li>High elevation habitats in the Horseranch Range and Cassiar Mountains</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | M. Williams, pers. comm. (2014)<br>Marshall et al. unpubl. data<br>MacLean, in prep. |
| Migration   | <ul style="list-style-type: none"> <li>Spring migration from winter range to Horseranch Mountain then onto alpine areas in the Cassiar Ranges ecosection</li> <li>Fall migration from rutting habitats in the Cassiar Ranges ecosection to Horseranch Mountain then onto winter range in the Liard Basin</li> </ul>                                                                                                                                                                                                                                                                                                              | Marshall et al. unpubl. data<br>MacLean, in prep.                                    |
| Total Range | <ul style="list-style-type: none"> <li>91% of the range is located in BC</li> <li>9% of the range is located in Yukon</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                      |

## Population size

The current population estimate of 800-1000 caribou was based on a fall survey conducted in 2000, where 806 caribou were counted (Marshall et al., unpubl. data).

| Year | Population estimate | Number counted | Method                        | Reliability | Source                        |
|------|---------------------|----------------|-------------------------------|-------------|-------------------------------|
| 2000 | 800-1000            | 806            | Minimum Count + Extrapolation | High        | Marshall et al., unpubl. data |

A stratified random block survey was conducted on the Horseranch and Little Rancheria caribou low elevation winter ranges in March 1999. A total of 1109 caribou were counted during the survey and the population estimate in the survey area was  $1262 \pm 13\%$  (Marshall 1999). Based on two estimates of the proportion of radio-collared caribou seen during the survey, sightability correction factors (SCFs) of 1.44 and 1.48 were calculated resulting in a total survey estimate of 1817 and 1866. Based on SCFs calculated for this survey and for surveys in Yukon, Marshall (1999) concluded that an SCF of 1.4 was appropriate and conservative, which resulted a final population estimate of 1767. However, the estimate includes both Horseranch and Little Rancheria caribou and it was difficult to determine what proportion of the total estimate belonged to the Horseranch or Little Rancheria populations (Marshall 1999). Therefore, the Horseranch caribou population estimate was based on the October 2000 survey instead.

Another stratified random block survey was conducted in the Horseranch range in October 1996. A total of 162 caribou were counted, but no population estimates or a confidence interval were provided in the original report (results summarized in Marshall 1996).

Neither the March 1999 nor October 1996 stratified random block surveys provided reliable population estimates specifically for the Horseranch caribou population.

The only population estimate for the Horseranch caribou population of 800-1000 caribou based on the October 2000 survey is now over 20 years old. Since 2000, the highest number of caribou counted during a survey in the Horseranch caribou range was 514 in February/March 2009 (see Population trend below), although the survey did not cover the whole range (Thiessen 2009, BC MFLNRORD unpubl. data).

## Population trend

Spring (June), fall (October/November) and late winter (March/April) composition surveys were conducted from 1996 to 2002 as part of a study of radio-collared caribou (Marshall et al., unpubl. data). Fall composition surveys were also conducted from 1978 to 1987 as part of a study on effects of wolf predation on caribou and other ungulates (Elliott 1985, 1986, Bergerud and Elliott 1986, 1998). Wolves were removed: from the Horseranch Mountains area in late winter (March/April) in 1978, 1979, 1980 and 1985; from nearby areas in 1982 and 1983; and, from an area that partially overlapped with the Horseranch caribou range in 1984 (Bergerud and Elliot 1998).

From 1978 to 1987, fall calf/100 cow ratios were within or above 20 to 25 calves/100 cows, which is considered sufficient to support a stable population growth rate (Environment Yukon 2016), only during years when full or partial wolf control was conducted (1978, 1979, 1980, 1984, 1985) and in 1986 and 1987, the two years following the end of the wolf control program. During the radio-collared caribou study from 1996 to 2001, fall calves/100 cows ratios were within or above 20-25 calves/100 cows in four of the six years. The four most recent fall ratios (2000, 2001, 2004, 2015) were all within or above that range. However, the sample size in 2015 was low relative to the estimated population size (C. Thiessen, pers. comm.), and may not adequately represent the calves/100 cows ratio for the whole population. It is unknown whether fall surveys of rutting areas in the Horseranch caribou range are biased against calves as detected in the Spatsizi caribou range (Hatler 1987), however, the calves/100 cows ratios from the three most recent fall surveys with adequate sample sizes suggest that calf recruitment was sufficient to support a stable population growth rate in the early 2000s even if the surveys were biased against calves.

Horseranch

| Year           | Month            | % calves <sup>1</sup> | Calves/ 100 adults <sup>1</sup> | Calves/100 cows <sup>1</sup> | Total Counted <sup>2</sup> | Total classified <sup>3</sup> |                    | Source <sup>4</sup>                   |
|----------------|------------------|-----------------------|---------------------------------|------------------------------|----------------------------|-------------------------------|--------------------|---------------------------------------|
|                |                  |                       |                                 |                              |                            | Calves+ Adults                | Calves+ Cows+Bulls |                                       |
| Winter         |                  |                       |                                 |                              |                            |                               |                    |                                       |
| 2009           | Feb/Mar          | 9                     | 10                              | 12                           | 514 <sup>5</sup>           | 507                           | 507                | MFLNRORD unpubl. data <sup>5</sup>    |
| 2001           | Mar              | 15                    | 18                              | -                            | 278                        | 278                           |                    | Marshall et al. unpubl. data          |
| 2000           | Mar              | 17                    | 20                              | -                            | 257                        | 257                           |                    | Marshall et al. unpubl. data          |
| 1999           | Mar              | 7                     | 8                               | -                            | 471                        | 471                           |                    | Marshall et al. unpubl. data          |
| 1998           | Apr              | 7                     | 8                               | -                            | 259                        | 259                           |                    | Marshall et al. unpubl. data          |
| 1997           | Apr              | 11                    | 12                              | -                            | 120                        | 120                           |                    | Marshall et al. unpubl. data          |
| 1974           | Mar              |                       |                                 |                              | 225                        |                               |                    | Bergerud 1978 (FW?) <sup>6</sup>      |
| Fall           |                  |                       |                                 |                              |                            |                               |                    |                                       |
| 2015           | Fall             | 14                    | 16                              | 22                           | 133                        | NA                            | NA                 | C. Thiessen, pers. comm. <sup>7</sup> |
| 2004           | Fall             | 14                    | 17                              | 26                           | 266                        | 266                           | 266                | Marshall 2004                         |
| 2001           | Nov <sup>8</sup> | 19                    | -                               | 30 <sup>9</sup>              | 505                        |                               |                    | Marshall et al. unpubl. data          |
| 2000           | Oct <sup>8</sup> | 15                    | -                               | 24 <sup>9</sup>              | 806                        |                               |                    | Marshall et al. unpubl. data          |
| 1999           | Oct <sup>8</sup> | 9                     | -                               | 13 <sup>9</sup>              | 385                        |                               |                    | Marshall et al. unpubl. data          |
| 1998           | Nov <sup>8</sup> | 13                    | -                               | 20 <sup>9</sup>              | 580                        |                               |                    | Marshall et al. unpubl. data          |
| 1997           | Oct <sup>8</sup> | 13                    | -                               | 18 <sup>9</sup>              | 390                        |                               |                    | Marshall et al. unpubl. data          |
| 1996           | Oct              | 20                    | 26                              | 40                           | 162                        | 162                           | 162                | Marshall 1996 <sup>10</sup>           |
| 1987           | Oct              |                       |                                 | 44 <sup>11</sup>             |                            |                               |                    | Bergerud and Elliott 1998             |
| 1986           | Oct              |                       |                                 | 24 <sup>11</sup>             |                            |                               |                    | Bergerud and Elliott 1998             |
| 1985           | Oct              | 26                    | 35                              | 51 <sup>12</sup>             | 274                        | 274                           | 274                | Elliott 1986                          |
| 1984           | Oct              | 16                    | 19                              | 24 <sup>12</sup>             | 209                        | 209                           | 209                | Elliott 1985                          |
| 1983           | Oct              | 6                     | 6                               | 8 <sup>12</sup>              | 250                        | 250                           | 250                | Bergerud and Elliott 1986             |
| 1982           | Oct              | 4                     | 4                               | 7 <sup>12</sup>              | 337                        | 337                           | 337                | Bergerud and Elliott 1986             |
| 1981           | Oct              | 11                    | 12                              | 18                           | 329                        | 329                           | 329                | Bergerud and Elliott 1986             |
| 1980           | Oct              | 16                    | 19                              | 27 <sup>12</sup>             | 311                        | 311                           | 311                | Bergerud and Elliott 1986             |
| 1979           | Oct              | 17                    | 21                              | 25 <sup>12</sup>             | 274                        | 274                           | 274                | Bergerud and Elliott 1986             |
| 1978           | Oct              | 17                    | 20                              | 24 <sup>12</sup>             | 263                        | 263                           | 263                | Bergerud and Elliott 1986             |
| 1977           | Oct              | 6                     | 7                               | -                            | 237                        | 237                           |                    | Bergerud 1978 (FW)                    |
| Calving/summer |                  |                       |                                 |                              |                            |                               |                    |                                       |
| 2001           | June             | 27                    | 37                              | 71 <sup>9</sup>              | 141                        | 141                           | 132                | Marshall et al. unpubl. data          |
| 2000           | June             | 26                    | 35                              | 39 <sup>9</sup>              | 78                         | 78                            | 77                 | Marshall et al. unpubl. data          |
| 1999           | June             | 20                    | 25                              | 42 <sup>9</sup>              | 121                        | 121                           | 101                | Marshall et al. unpubl. data          |
| 1998           | June             | 7                     | 8                               | -                            | 43                         | 43                            |                    | Marshall et al. unpubl. data          |
| 1997           | June             | 25                    | 34                              |                              | 59                         | 59                            |                    | Marshall et al. unpubl. data          |
| 1963           | July/Aug         |                       |                                 |                              | (3)                        |                               |                    | Mundy 1963 <sup>13</sup> (GR)         |

<sup>1</sup> Calf ratios were based on totals in each age/sex class (except as otherwise indicated) because data detailing composition of groups were not available so we could not eliminate groups where some animals were unclassified

<sup>2</sup> Numbers in parentheses indicate surveys where caribou were not the primary focus

<sup>3</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

<sup>4</sup> All surveys were conducted by helicopter unless indicated as a fixed-wing (FW) or ground (GR) survey

<sup>5</sup> Total number differs from COSEWIC (2014) because an error was discovered and the correct total included here; data for total survey was presented in Thiessen (2009) but did not include a summary of the Horseranch-only portion

<sup>6</sup> Bergerud (1978) reported that D. Spalding observed 225 caribou on Horseranch Mtn on March 22, 1974 but does not provide information on what type of survey was conducted; we presume it may have been from a fixed-wing

<sup>7</sup> Calf ratios provided; classification data not available; note low sample size relative to population size

<sup>8</sup> No age/sex class data provided in the unpublished report; calf/100 cow ratios calculated using Jackknife analysis (Marshall et al. unpubl data)

<sup>9</sup> calf/100 cow ratios were calculated using Jackknife analysis and were based on only groups where all caribou were classified (Marshall et al. unpubl data)

<sup>10</sup> Marshall (1996) summary (Ca-8) of a report by J. Elliott. The survey was described as a stratified random block but no population estimate or confidence intervals were provided in the original report.

<sup>11</sup> No sample size or classification data provided

<sup>12</sup> Wolves were removed from the Horseranch Mountains area the previous winter (March/April) in 1978, 1979, 1980 and 1985; wolves were removed from nearby areas in 1982 and 1983; wolves were removed from an area with some overlap with the Horseranch caribou range in 1984 (Bergerud and Elliott 1998)

<sup>13</sup> Ground surveys conducted based at Eaglehead Lake

Of the six late winter surveys conducted, three were at or above 15% calves recommended to achieve population stability (Bergerud 1996). Calf recruitment from the most recent late winter survey in 2009 was 9% (Thiessen 2009). That survey was conducted for both caribou and Stone's sheep and did not include the whole Horseranch caribou range (Thiessen 2009).

From the radio-collared caribou study (October 1996 to March 2002), annual survival rate of adult female caribou (N=27) ranged from 78% to 100% and annual survival rate of adult males (N=10) ranged from 60% to 100% (Marshall et al., unpubl. data). No data on population rate of change ( $\lambda$ ) were summarized.

Indicators of population trend based on calf recruitment may not adequately represent the current condition due to small sample size (2015) and length of time since earlier surveys were conducted. For the four fall surveys conducted between 2000 and 2009, evidence suggests that calf recruitment may support a stable or increasing population trend (2000, 2001, 2004) or may not (2009). Regardless, these indicators of population trend are at least 12 years old and are too old to use for inferring current population trend.

## **Boundary Issues**

- The range boundary is coarsely drawn resulting in gaps between the Horseranch caribou ranges, and the Level Kawdy, Tsenaglade and Spatsizi caribou ranges.
- The BC/Yukon range boundaries do not line up.
- Telemetry data suggest overlap between adjacent ranges including Little Rancheria, Swan Lake, Level Kawdy and Tsenaglade.
- The large gap between caribou ranges in the centre of the study area (between the Horseranch, Spatsizi, Rabbit, Frog and Thutade caribou ranges) is known to contain caribou.
- For the Horseranch caribou range, the BC and Yukon portions of the range were connected by only a point on the BC side. We therefore widened the point on the BC side slightly to create a single polygon for the combined range.

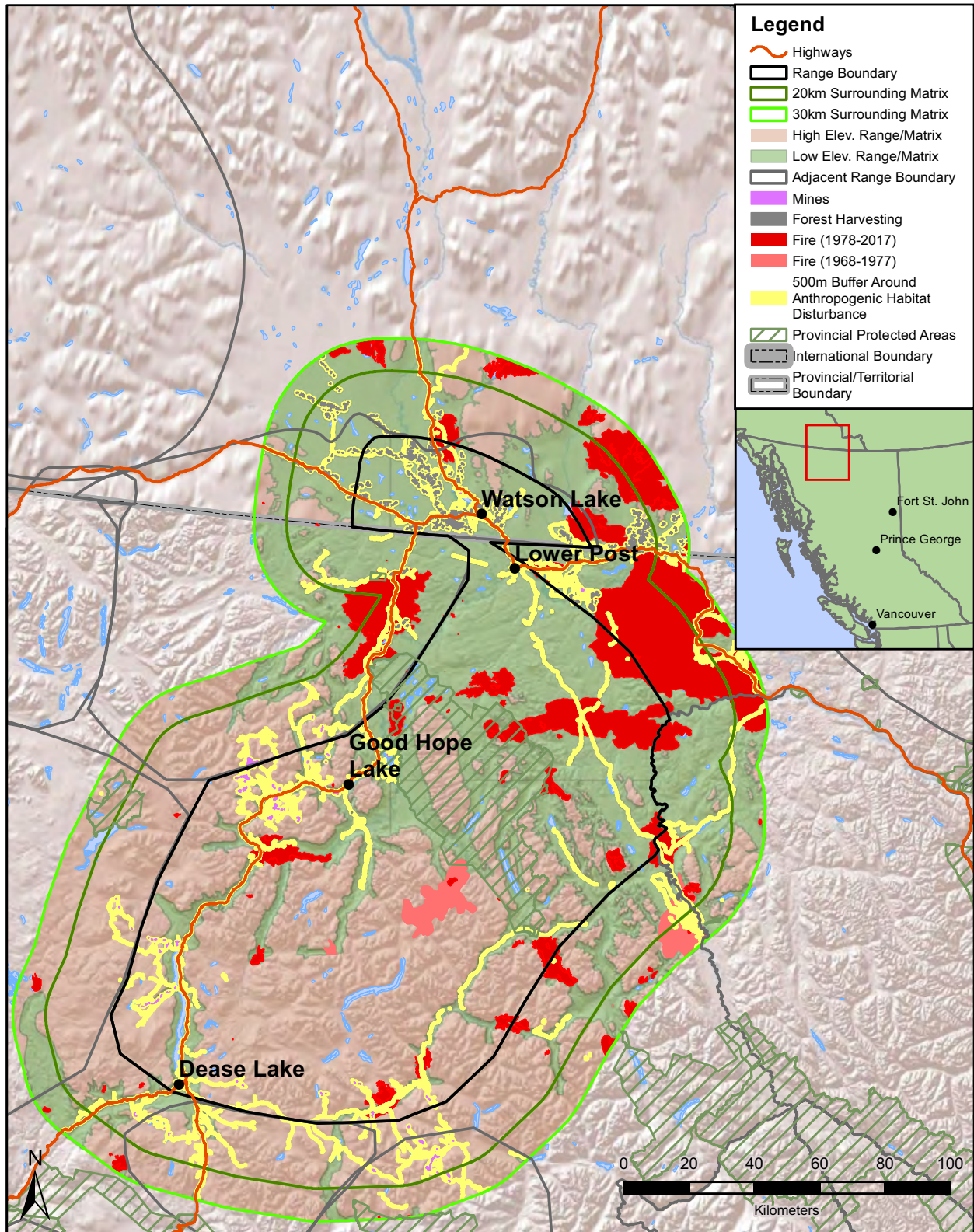
## **Range condition**

Within the current BC and Yukon Horseranch caribou range boundaries, habitat disturbance covers 14%, 5% and 25% of the total, high elevation and low elevation portions of the range respectively. Primary disturbances are roads/trails and fire, both of which are more prevalent at low elevations than at high elevations. Forest harvesting also contributes to habitat disturbance at low elevations, primarily in the Yukon portion of the range. Roads/trails include the Stewart-Cassiar Highway in BC, the Alaska Hwy and Robert Campbell Highway in Yukon, and industrial roads associated primarily with mining activities in BC and forest harvesting in Yukon. Fire plays a slightly higher role in habitat disturbance in the 20 km and 30 km surrounding matrix, especially in the areas to the northwest and northeast of the Horseranch caribou range in BC.

Our analysis does not include fires from 2018 to 2021. Although fire disturbance was minimal in most caribou ranges in northern BC during those years, in 2018 there were two large wildfires and one smaller fire totaling about 263,000 ha that were almost entirely contained within the northeastern portion of the Horseranch caribou range in the area south of the Liard River and southeast of the Dease River. Therefore, fire and total habitat disturbance in the caribou range are currently higher than what we have calculated in this report.



## Horseranch



## Horseranch

|                                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|----------------------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Total Range                      |                    |                               |                                |                                               |
| Range                            | 1 945 173          | 47.3                          | 52.7                           | -                                             |
| 0-20 km matrix surrounding range | 1 473 971          | 51.4                          | 48.6                           | 57.2 (NM)                                     |
| 0-30 km matrix surrounding range | 2 272 285          | 48.5                          | 51.5                           | 57.3 (NM)                                     |
| BC only                          |                    |                               |                                |                                               |
| Range                            | 1 779 688          | 42.9                          | 57.1                           | -                                             |
| 0-20 km matrix surrounding range | 1 195 352          | 45.8                          | 54.2                           | 63.3 (NM)                                     |
| 0-30 km matrix surrounding range | 1 807 609          | 43.8                          | 56.2                           | 65.7 (NM)                                     |

<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA

## Horseranch: Total Range (BC and Yukon)

|                | Range Area<br>(ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|--------------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                    | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 945 173          | 5.7                                  | 6.8            | 0              | 0          | 0           | 0        | 1.8      | 0   | 0.6  | 0            | 0    | 0        | 0         | 0        | 6.8  | 0.1     | 0.4        | 2.5   | 1.3                         | 8.0                              | 9.2           | 14.4                                   |
| High elevation | 1 024 684          | 1.1                                  | 2.7            | 0              | 0          | 0           | 0        | 0.1      | 0   | 0.6  | 0            | 0    | 0        | 0         | 0        | 3.6  | 0       | 0.1        | 0     | 0                           | 3.6                              | 3.8           | 4.9                                    |
| Low elevation  | 920 489            | 10.7                                 | 11.4           | 0              | 0          | 0.1         | 0.1      | 3.7      | 0   | 0.7  | 0            | 0    | 0        | 0         | 0        | 10.3 | 0.3     | 0.8        | 5.3   | 2.7                         | 12.9                             | 15.2          | 24.9                                   |
| Matrix 0-20 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 473 971          | 12.1                                 | 12.5           | 0              | 0          | 0           | 0        | 1.7      | 0   | 0.4  | 0            | 0    | 0        | 0.1       | 0        | 8.5  | 0.4     | 0.1        | 2.9   | 2.3                         | 9.1                              | 10.4          | 21.0                                   |
| High elevation | 716 138            | 0.7                                  | 0.8            | 0              | 0.1        | 0           | 0        | 0.3      | 0   | 0.7  | 0            | 0    | 0        | 0         | 0        | 7.1  | 0       | 0          | 0.1   | 0.1                         | 7.1                              | 7.6           | 8.3                                    |
| Low elevation  | 757 833            | 22.8                                 | 23.4           | 0              | 0          | 0           | 0        | 2.9      | 0   | 0.2  | 0            | 0    | 0        | 0.2       | 0        | 9.9  | 0.7     | 0.1        | 5.5   | 4.4                         | 11.0                             | 13.0          | 32.9                                   |
| Matrix 0-30 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 2 272 285          | 12.5                                 | 13.2           | 0              | 0          | 0           | 0        | 1.4      | 0   | 0.3  | 0            | 0    | 0        | 0.1       | 0        | 7.0  | 0.3     | 0.1        | 2.4   | 2.0                         | 7.5                              | 8.6           | 19.7                                   |
| High elevation | 1 169 719          | 3.0                                  | 3.3            | 0              | 0.1        | 0           | 0        | 0.2      | 0   | 0.4  | 0            | 0    | 0        | 0         | 0        | 5.2  | 0       | 0          | 0.1   | 0.1                         | 5.2                              | 5.5           | 8.5                                    |
| Low elevation  | 1 102 563          | 22.6                                 | 23.8           | 0              | 0          | 0           | 0        | 2.6      | 0   | 0.2  | 0            | 0    | 0        | 0.1       | 0        | 9.0  | 0.6     | 0.1        | 4.8   | 3.9                         | 10                               | 11.8          | 31.7                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

## Horseranch: BC only

|                | Range Area<br>(ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|--------------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                    | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 779 688          | 5.9                                  | 7.2            | 0              | 0          | 0           | 0        | 0        | 0   | 0.6  | 0            | 0    | 0        | 0         | 0        | 6.5  | 0.1     | 0.3        | 1.0   | 0.6                         | 6.9                              | 7.0           | 12.5                                   |
| High elevation | 1 016 730          | 1.2                                  | 2.8            | 0              | 0          | 0           | 0        | 0        | 0   | 0.6  | 0            | 0    | 0        | 0         | 0        | 3.7  | 0       | 0.1        | 0     | 0                           | 3.7                              | 3.7           | 4.9                                    |
| Low elevation  | 762 958            | 12.3                                 | 13.0           | 0              | 0          | 0           | 0.1      | 0.1      | 0   | 0.6  | 0            | 0    | 0        | 0         | 0        | 10.2 | 0.2     | 0.6        | 2.3   | 1.3                         | 11.3                             | 11.4          | 22.7                                   |
| Matrix 0-20 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 195 352          | 12.7                                 | 13.2           | 0              | 0.1        | 0           | 0        | 0.5      | 0   | 0.5  | 0            | 0    | 0        | 0         | 0        | 9.8  | 0.4     | 0.1        | 2.6   | 2.3                         | 10.2                             | 10.4          | 21.4                                   |
| High elevation | 648 400            | 0.4                                  | 0.6            | 0              | 0.1        | 0           | 0        | 0        | 0   | 0.7  | 0            | 0    | 0        | 0         | 0        | 7.7  | 0       | 0          | 0.2   | 0.2                         | 7.7                              | 8.0           | 8.4                                    |
| Low elevation  | 546 952            | 27.2                                 | 28.2           | 0              | 0          | 0           | 0        | 1.0      | 0   | 0.2  | 0            | 0    | 0        | 0         | 0        | 12.3 | 0.9     | 0.2        | 5.6   | 4.9                         | 13.0                             | 13.3          | 36.8                                   |
| Matrix 0-30 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 807 609          | 12.0                                 | 13.0           | 0              | 0          | 0           | 0        | 0.3      | 0   | 0.4  | 0            | 0    | 0        | 0         | 0        | 8.2  | 0.3     | 0.1        | 2.2   | 2.0                         | 8.4                              | 8.6           | 19.0                                   |
| High elevation | 1 015 426          | 0.7                                  | 1.1            | 0              | 0.1        | 0           | 0        | 0        | 0   | 0.5  | 0            | 0    | 0        | 0         | 0        | 5.7  | 0       | 0          | 0.1   | 0.1                         | 5.7                              | 5.8           | 6.6                                    |
| Low elevation  | 792 180            | 26.6                                 | 28.2           | 0              | 0          | 0           | 0        | 0.7      | 0   | 0.2  | 0            | 0    | 0        | 0         | 0        | 11.4 | 0.7     | 0.2        | 4.9   | 4.4                         | 11.9                             | 12.1          | 35.0                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

# Level Kawdy

## Range use summary

During summer, caribou are found mostly at high elevations in the Level Mountain and Kawdy ranges. Fidelity to rutting areas is high. During winter, caribou primarily use low elevation forests along the Kawdy and Teslin rivers, but some caribou use high elevation alpine/subalpine habitat and some caribou have wintered in the Little Rancheria, Horseranch and Swan Lake caribou low elevation winter ranges. Individual caribou may use different winter ranges in different years. Migration routes between winter and summer ranges include low elevation forested areas and appear to be well defined.

| Season      | Overview of Habitat and Range Use                                                                                                                                                                                                                                                                                                                                                  | Source                         |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Winter      | <ul style="list-style-type: none"><li>Primarily in low elevation forests along the Kawdy and Teslin Rivers</li><li>Some wintering in Little Rancheria low elevation winter range</li><li>Some wintering at low elevation in the Swan Lake range</li><li>Some caribou used different winter ranges in different years</li><li>Some use of high elevation alpine/subalpine</li></ul> | Jex (2013)<br>Kerckhoff (2013) |
| Summer      | <ul style="list-style-type: none"><li>High elevation habitats in the Level Mountain and Kawdy ranges</li><li>Some caribou calve in the Kawdy and rut on Level Mountain</li><li>Some caribou calve and rut in the Kawdy</li><li>Some calving/summer locations extend into the western portion of the Horseranch caribou range</li></ul>                                             | Jex (2013)                     |
| Migration   | <ul style="list-style-type: none"><li>Consistently used travel routes including low elevation forested areas</li></ul>                                                                                                                                                                                                                                                             | Jex (2013)                     |
| Total Range | <ul style="list-style-type: none"><li>radio-collared caribou have used portions of the Swan Lake, Little Rancheria and Horseranch caribou ranges</li></ul>                                                                                                                                                                                                                         | Jex (2013)                     |

## Population size

The current population estimate of 1538 caribou was based on a total count of the Level Mountain and Kawdy Plateau areas conducted in October 1998 (Marshall 1999). A total of 1398 caribou were counted, and it was assumed that 90% of the caribou were seen during the survey, resulting in the total population estimate of 1538 (Marshall 1999).

| Date | Population estimate | Number counted | Method                        | Reliability | Source          |
|------|---------------------|----------------|-------------------------------|-------------|-----------------|
| 1998 | 1538                | 1398           | Minimum count + extrapolation | High        | Marshall (1999) |

Prior to 1998, a population estimate of 1250 caribou was based on a survey conducted in 1982 (see Marshall 1999). A total of 760 caribou were counted during the October 1982 survey (see Population trend below). However, we did not have any information about how the estimate of 1250 was calculated and therefore were not able to assess the reliability of the estimate, and have not included it in the list of population estimates.

Prior to the 1998 population survey, the most caribou counted during a survey was 1363 caribou counted during a fixed-wing survey in 1977 (see Population trend below). Since 1998, the most caribou counted during a survey was 1086 counted in October 2011 (see Population trend below).



## Population trend

In the Level/Kawdy caribou range, most composition surveys were conducted in the fall, except for the two most recent surveys (2012, 2013) that were conducted in winter.

Four of the five fall calves/100 cows ratios between 1983 to 2011, and three of the four most recent fall calves/100 cows ratios (1998 to 2011) were at or above 20 to 25 calves/100 cows, which is considered sufficient to support a stable population growth rate (Environment Yukon 2016). It is unknown whether fall surveys of rutting areas in the Level Kawdy caribou range are biased against calves as detected in the Spatsizi caribou range (Hatler 1987), however, the calves/100 cows ratio suggests a stable population even if the survey is biased against calves.

Although adults were not classified during fall surveys prior to 1983, % calves ranged from 6% in 1977, 1981 and 1982 to 24% in 1978. Bergerud and Elliott (1986) suggest that calf survival was higher during years of early snow melt (1978, 1980), and during years with lower wolf numbers (1978, 1980).

One of the two most recent late winter calf recruitment surveys was at or above 15% calves recommended by Bergerud (1996) to achieve population stability.

No information on adult survival or population growth rate (based on adult mortality and calf recruitment) was readily available from the radio-collared caribou study.

Of the six most recent composition surveys conducted, four suggest that calf recruitment was sufficient to support a stable or increasing population trend, while calf recruitment in the other two surveys were close to levels considered sufficient.

Regardless, these indicators of population trend are at least 8 years old and are too old to use to infer current population trend.

## Boundary Issues

- The range boundary is coarsely drawn resulting in gaps between the Level Kawdy range and Atlin, Little Rancheria, Horseranch and Tsenaglade ranges.
- Telemetry data suggest Level Kawdy caribou also use areas within Swan Lake, Little Rancheria and Horseranch caribou ranges.

## Range condition

Within the current Level Kawdy caribou range boundaries, habitat disturbance covers 3%, 2% and 7% of the total, high elevation and low elevation portions of the range respectively. The only disturbances within the range boundary are roads/trails and fire, both of which are more prevalent at low elevations than at high elevations. The linear feature running through the western portion of the range is the old Telegraph Trail, which sees some snowmobile use. Habitat disturbance levels are slightly higher in the 20 km and 30 km matrix surrounding the range, with roads/trails and fire the primary disturbances. Other habitat disturbances in the matrix include settlement (Dease Lake) and mines.

Our analysis does not include fires from 2018 to 2021. Although fire disturbance was minimal in most caribou ranges in northern BC during those years, in 2018 there was a small (3,500 ha) fire in the caribou range, and a 120,000 ha fire that affected the southernmost portion of the 20 km and 30 km matrix.

## Level Kawdy

| Year           | Month             | % calves <sup>1</sup> | Calves/ 100 adults <sup>1</sup> | Calves/100 cows <sup>1</sup> | Total Counted <sup>2</sup> | Total classified <sup>3</sup> |                    | Source <sup>4</sup>                         |
|----------------|-------------------|-----------------------|---------------------------------|------------------------------|----------------------------|-------------------------------|--------------------|---------------------------------------------|
|                |                   |                       |                                 |                              |                            | Calves+ Adults                | Calves+ Cows+Bulls |                                             |
| Winter         |                   |                       |                                 |                              |                            |                               |                    |                                             |
| 2013           | Mar               | 17                    | 20                              | 30                           | 272                        | 272                           | 272                | Kerkhoff (2013)                             |
| 2012           | Feb               | 13                    | 16                              | 21                           | 164                        | 149                           | 149                | Jex (2012)                                  |
| Fall           |                   |                       |                                 |                              |                            |                               |                    |                                             |
| 2011           | Oct               | 17                    | 27                              | 35                           | 1086                       | 1086                          | 1086               | Jex (2011)                                  |
| 2002           | Nov               | 17                    | 20                              | 29                           | 164                        | 164                           | 164                | Marshall (2002)                             |
| 1999           | Oct               | 12                    | 14                              | 19                           | 864                        | 820                           | 820                | Marshall (1999)                             |
| 1998           | Oct               | 19                    | 24                              | 40                           | 1398                       | 1346                          | 1346               | Marshall (1999)                             |
| 1983           | Oct               | 15                    | 17                              | 24                           | 312                        | 312                           | 312                | van Drimmelen (1983)                        |
| 1983           | Sept              |                       |                                 |                              | 769                        |                               |                    | van Drimmelen (1983) (FW)                   |
| 1982           | Fall <sup>5</sup> | 6                     | 7                               | -                            | 760                        | 491                           |                    | Bergerud & Elliott (1986) (FW) <sup>6</sup> |
| 1981           | Fall <sup>5</sup> | 6 <sup>7</sup>        | 6 <sup>7</sup>                  | -                            | 108 <sup>7</sup>           | 108 <sup>7</sup>              |                    | Bergerud & Elliott (1986) (FW) <sup>6</sup> |
| 1980           | Fall <sup>5</sup> | 17                    | 20                              | -                            | 378                        | 378                           |                    | Bergerud & Elliott (1986) (FW) <sup>6</sup> |
| 1979           | Fall <sup>5</sup> | 11                    | 12                              | -                            | 833                        | 833                           |                    | Bergerud & Elliott (1986) (FW) <sup>6</sup> |
| 1978           | Fall <sup>5</sup> | 24                    | 31                              | -                            | 412                        | 412                           |                    | Bergerud & Elliott (1986) (FW) <sup>6</sup> |
| 1977           | Oct               | 6                     | 6                               | -                            | 228                        | 228                           |                    | Hatler in Bergerud (1978)                   |
| 1977           | Sept              | 5                     | 5                               | -                            | 1363                       | 1155                          |                    | Bergerud (1978) (FW)                        |
| Calving/summer |                   |                       |                                 |                              |                            |                               |                    |                                             |
| 1981           | June              | 28                    | 39                              | 39                           | 61                         | 61                            | 61                 | Bergerud & Elliott (1986) (GR) <sup>8</sup> |
| 1980           | June              | 42                    | 73                              | 73                           | 69                         | 69                            | 69                 | Bergerud & Elliott (1986) (GR) <sup>8</sup> |
| 1979           | June              | 22                    | 28                              | 28                           | 87                         | 87                            | 87                 | Bergerud & Elliott (1986) (GR) <sup>8</sup> |
| 1978           | June              | 33                    | 49                              | 49                           | 55                         | 55                            | 55                 | Bergerud & Elliott (1986) (GR) <sup>8</sup> |
| 1963           | July              | 0                     | 0                               |                              | (63)                       | 43                            |                    | Mundy (1963 )(GR) <sup>9</sup>              |

<sup>1</sup> Calf ratios were based on totals in each age/sex class (except as otherwise indicated) because data detailing composition of groups were not available so we could not eliminate groups where some animals were unclassified

<sup>2</sup> Numbers in parentheses indicate surveys where caribou were not the primary focus

<sup>3</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

<sup>4</sup> All surveys were conducted by helicopter unless indicated as a fixed-wing (FW) or ground (GR) survey

<sup>5</sup> No information on month/day of survey were provided

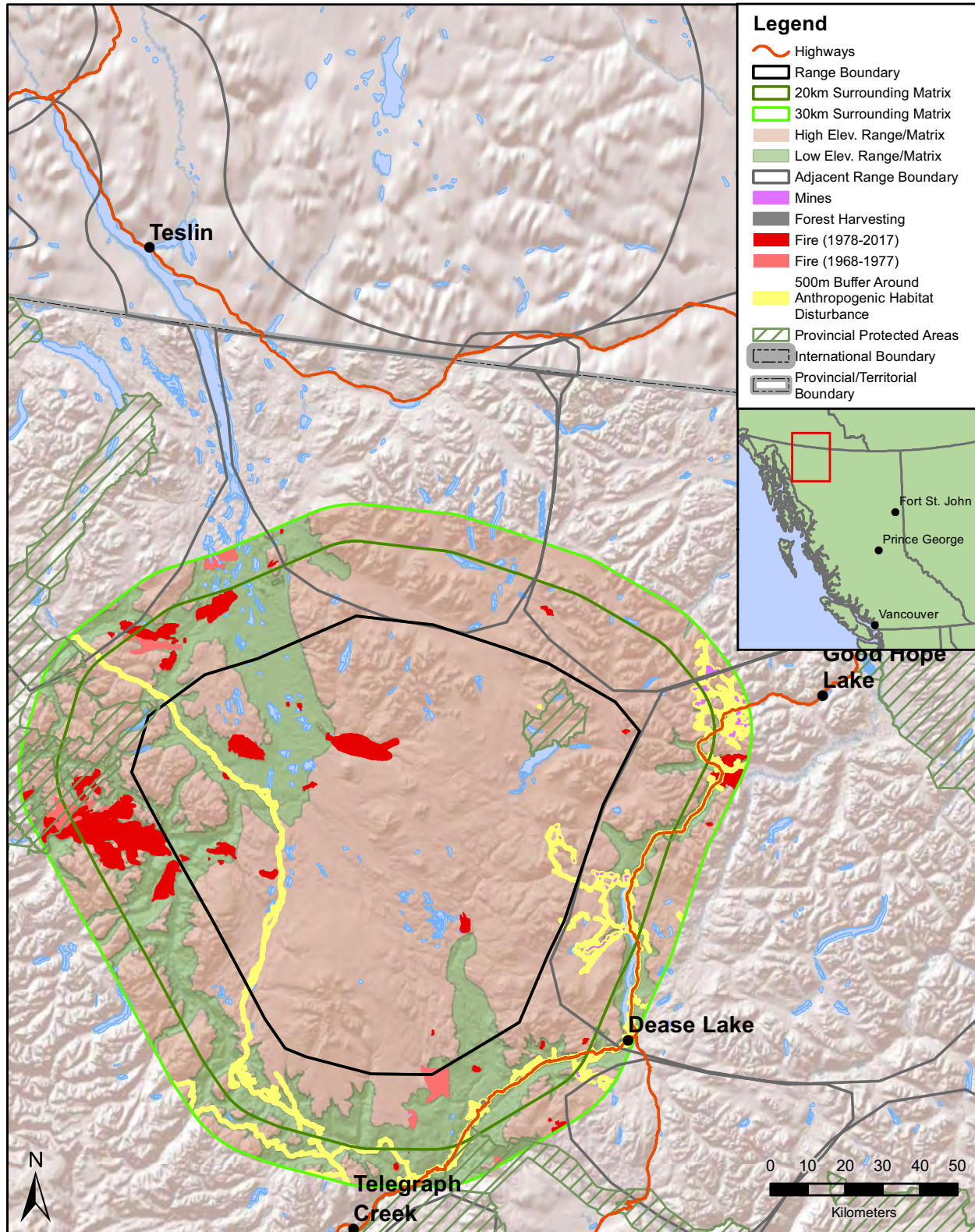
<sup>6</sup> Aircraft assumed to be fixed-wing because methods indicated that adults were not sexed during fixed-wing surveys and all adults in these surveys were 'unclassified adults'

<sup>7</sup> Level Mountain only

<sup>8</sup> Ground surveys conducted June 9-15 each year on Level Mountain; only data for cows and calves were reported

<sup>9</sup> Ground surveys around Pyrrhotite Lake and Ketchum Lake

## Level Kawdy



## Level Kawdy

|                                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|----------------------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Total Range                      |                    |                               |                                |                                               |
| Range                            | 1 135 902          | 14.3                          | 85.7                           | -                                             |
| 0-20 km matrix surrounding range | 921 841            | 36.8                          | 63.2                           | 36.6 (NM)                                     |
| 0-30 km matrix surrounding range | 1 477 004          | 36.5                          | 63.5                           | 41.5 (NM)                                     |

<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA

## Level Kawdy

|                | Range<br>Area (ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|--------------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                    | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 135 902          | 1.4                                  | 1.5            | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 1.2  | 0       | 0          | 0.9   | 0.6                         | 1.6                              | 1.6           | 3.0                                    |
| High elevation | 973 907            | 1.1                                  | 1.1            | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 0.9  | 0       | 0          | 0.5   | 0.3                         | 1.2                              | 1.2           | 2.3                                    |
| Low elevation  | 161 995            | 3.4                                  | 3.6            | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 3.0  | 0       | 0          | 3.3   | 2.6                         | 3.8                              | 3.8           | 7.1                                    |
| Matrix 0-20 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 921 841            | 4.4                                  | 5.4            | 0              | 0          | 0           | 0        | 0        | 0   | 0.4  | 0            | 0    | 0        | 0         | 0        | 4.9  | 0       | 0.1        | 0.9   | 0.8                         | 4.9                              | 5.1           | 9.4                                    |
| High elevation | 582 435            | 1.1                                  | 1.5            | 0              | 0          | 0           | 0        | 0        | 0   | 0.4  | 0            | 0    | 0        | 0         | 0        | 2.9  | 0       | 0.1        | 0.6   | 0.5                         | 3.0                              | 3.0           | 4.1                                    |
| Low elevation  | 339 406            | 10                                   | 12.0           | 0.1            | 0          | 0           | 0        | 0.1      | 0   | 0.5  | 0            | 0    | 0        | 0         | 0        | 8.2  | 0       | 0.1        | 1.4   | 1.3                         | 8.3                              | 8.5           | 18.5                                   |
| Matrix 0-30 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 477 004          | 3.6                                  | 4.6            | 0              | 0          | 0           | 0        | 0        | 0   | 0.6  | 0            | 0    | 0        | 0         | 0        | 6.3  | 0       | 0.2        | 0.9   | 0.8                         | 6.3                              | 6.5           | 9.9                                    |
| High elevation | 937 534            | 1.0                                  | 1.6            | 0              | 0.1        | 0           | 0        | 0        | 0   | 0.6  | 0            | 0    | 0        | 0         | 0        | 3.3  | 0       | 0.1        | 0.4   | 0.4                         | 3.3                              | 3.5           | 4.6                                    |
| Low elevation  | 539 463            | 8.0                                  | 9.9            | 0.1            | 0          | 0           | 0.1      | 0.1      | 0   | 0.5  | 0            | 0    | 0        | 0         | 0        | 11.4 | 0       | 0.5        | 1.7   | 1.6                         | 11.5                             | 11.7          | 19.3                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a “settlement” polygon will overlap with a “road” polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of “Total anthropogenic disturbance” (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, “Total habitat disturbance” (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> “Road and trail” indicates the portions of the “Road” and “Trail” categories that were identified as both a road and a trail; “Total Road/Trail” is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.



# Edziza

## Range use summary

There is limited information about seasonal habitat and range use of Edziza caribou other than locations from surveys. During summer, caribou are found throughout alpine areas in Mt. Edziza Park. During winter, caribou are found primarily in the northern part of the park, both in alpine areas and in the forested areas around Buckley Lake. Relative use of alpine areas varies between winters (see Population trend below). Four caribou were collared with GPS radio-collars in 2002, which provided about 1 year of data.

| Season      | Overview of Habitat and Range Use                                                                                                                  | Source                 |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Winter      | <ul style="list-style-type: none"><li>Limited information</li><li>Alpine areas or forested areas in the northern part of Mt. Edziza Park</li></ul> | Various flight reports |
| Summer      | <ul style="list-style-type: none"><li>Limited information</li><li>Alpine areas in Mt. Edziza Park</li></ul>                                        | Various flight reports |
| Total Range |                                                                                                                                                    |                        |

## Population size

The current population estimate of 151 caribou was based on a total count survey of alpine areas in Mt. Edziza Park in March 2006 (Marshall 2006). The only survey conducted since 2006 was in October 2017 when 23 caribou were seen (Grant 2018).

| Date | Population estimate | Number counted | Method        | Reliability | Source          |
|------|---------------------|----------------|---------------|-------------|-----------------|
| 2006 | 151                 | 151            | Minimum count | High        | Marshall (2006) |

Numerous surveys have been conducted in the Edziza caribou range, mostly in the 1970s and 1980s (see Population trend below). The highest number of caribou counted was during winter surveys in 1982 (106), 2002 (142) and 2006 (151). However, there have also been several winter surveys when no caribou were seen (e.g. 1978, 1983, 1984). In the Spatsizi caribou range, relative use of alpine areas varied between winters depending on snow conditions, with a large proportion of the population found above treeline during only one of four winters (Hatler 1986, 1987).

Number of caribou counted during fall surveys in the Edziza caribou range has also been variable, which may depend on survey timing. In 1983, Sather (1983) counted 66 caribou during a helicopter survey on October 7, but saw no caribou during fixed-wing surveys on September 27, September 30 and October 12. On October 28 that year, 50 caribou were seen during a fixed-wing survey (Osmond-Jones 1983). Weather conditions may influence caribou distribution during the fall (Hatler 1987).

Due to the lack of range-specific information on potential variability of Edziza caribou seasonal range use, we do not make any inferences about population size based on counts of high elevation areas, other than that there are no fewer caribou in the population than what was counted during the survey. A better understanding of seasonal range use based on radio-collared caribou would aid in interpreting differences in numbers counted during surveys.

The population estimate for the Edziza caribou population of 151 caribou based on the March 2006 survey is now over 15 years old.

## Population trend

Although numerous surveys have been conducted in the Edziza caribou range, mostly in the 1970s and 1980s, caribou were classified in less than half of the surveys conducted, and sample sizes were low in many surveys.

Of the four fall surveys with calves/100 cows ratios available, calves/100 cows ranged from 0 in 1978 and 1979 to 30 calves/100 cows in 2017, although sample sizes were less than 40 caribou in all but the 1983 survey (18 calves/100 cows). It is unknown whether fall surveys of rutting areas in the Edziza caribou range are biased against calves as detected in the Spatsizi caribou range (Hatler 1987). However, the 30 calves/100 cows in the most recent survey in 2017 is above 20 to 25 calves/100 cows, which is considered sufficient to support a stable population growth rate (Environment Yukon 2016), although the ratio is based on only 23 caribou.

Percent calves during winter surveys has also been highly variable. Calves made up 7% of the total caribou counted during the most recent winter survey in 2006, which is below 15% calves recommended by Bergerud (1996) to achieve population stability.

There are insufficient data to infer a current population trend for the Edziza caribou population based on calf recruitment. During the only recent survey, which was conducted in October 2017, only 23 caribou were counted and therefore the calves/100 cows ratio should be interpreted with caution (Grant 2018).

## Boundary Issues

- The range boundary is coarsely drawn and offset from the known range.
- The known area of use by Edziza caribou centres around the Mt. Edziza mountain block. The current Edziza caribou range boundary is offset to the west such that it does not include the eastern portion of the Mt. Edziza mountain block, and the boundary extends west of Mess Creek to encompass high elevation areas west of Mess Creek that the caribou are not known to use.

## Range condition

Within the current Edziza caribou range boundaries, habitat disturbance covers 10%, 6% and 18% of the total, high elevation and low elevation portions of the range respectively. Primary disturbances are roads/trails and fire, both of which are more prevalent at low elevations than at high elevations. Roads/trails include the Telegraph Trail through the range, and access to Schaft Creek in the southwest portion of the currently-drawn range. Most of the fires in the range have occurred in the last 10 years, including a 9,300 ha fire in the northeastern part of the range and a 3,100 ha fire in the Mess Creek area. Roads/trails (including the Telegraph Creek Road) and fire are also the primary habitat disturbances in 20 km and 30 km matrix surrounding the range, although agriculture, settlements and mines also contribute.

Our analysis does not include fires from 2018 to 2021. Several large fires in the Telegraph Creek area in 2018 burned portions of the Edziza caribou range and surrounding matrix. An 11,000 ha fire in the Mess Creek area and a 2,500 ha fire east of Buckley Lake are located entirely within the currently-delineated range. The largest 121,000 ha fire did not overlap much with the currently-delineated range, but did affect a large portion of the 20 km and 30 km matrix northwest of the range.

## Edziza

| Year          | Month   | % calves <sup>1</sup> | Calves/ 100 adults <sup>1</sup> | Calves/100 cows <sup>1</sup> | Total <sup>2</sup> Counted | Total classified <sup>3</sup> |                    | Source <sup>4</sup>               |
|---------------|---------|-----------------------|---------------------------------|------------------------------|----------------------------|-------------------------------|--------------------|-----------------------------------|
|               |         |                       |                                 |                              |                            | Calves+ Adults                | Calves+ Cows+Bulls |                                   |
| Winter        |         |                       |                                 |                              |                            |                               |                    |                                   |
| 2006          | Mar     | 7                     | 8                               | 11                           | 151                        | 151                           | 151                | Marshall (2006)                   |
| 2002          | Dec     |                       |                                 |                              | 142                        |                               |                    | Marshall (2002) in Grant (2018)   |
| 1996          | Mar     |                       |                                 |                              | (0)                        |                               |                    | Cichowski (1996)                  |
| 1988          | Jan     |                       |                                 |                              | (3)                        |                               |                    | Jones (1988)                      |
| 1984          | Mar     |                       |                                 |                              | (0)                        |                               |                    | Jones (1984)                      |
| 1984          | Feb     |                       |                                 |                              | (0) <sup>5</sup>           |                               |                    | Osmond-Jones (1984b) <sup>5</sup> |
| 1983          | Mar     |                       |                                 |                              | 13                         |                               |                    | Jones (1983)                      |
| 1983          | Feb     |                       |                                 |                              | 0                          |                               |                    | Hatler (1983) (FW)                |
| 1982          | Mar 16  |                       |                                 |                              | 106                        |                               |                    | Hatler (1982) (FW)                |
| 1982          | Mar 2   | 25                    | 33                              |                              | 76                         | 76                            | -                  | Jones (1982)                      |
| 1982          | Jan     |                       |                                 |                              | (16)                       |                               |                    | Van Drimmelen (1982)              |
| 1980          | Mar     | 12                    | 14                              |                              | 50                         | 50                            | -                  | Hatler (1980)                     |
| 1979          | Feb     | 2                     | 2                               | -                            | (43)                       | 43                            |                    | Hatler (1979b)                    |
| 1979          | Jan     | 14                    | 17                              | 30                           | 21                         | 21                            | 21                 | Hatler (1979a)                    |
| 1978          | Mar     | 0                     | 0                               | -                            | 18                         | 18                            |                    | Hatler (1978a)                    |
| 1978          | Feb     |                       |                                 |                              | 0                          |                               |                    | Hodson (1978)                     |
| 1977          | Mar     |                       |                                 |                              | (58)                       |                               |                    | Hatler (1977a) (FW)               |
| 1976          | Mar     | 8                     | 9                               | -                            | (61)                       | 61                            |                    | Hatler (1976)                     |
| 1973          | Mar     |                       |                                 |                              | (0)                        |                               |                    | Luckhurst (1973) (FW)             |
| 1972          | Feb     |                       |                                 |                              | (67)                       |                               |                    | Harper (1972)                     |
| Fall          |         |                       |                                 |                              |                            |                               |                    |                                   |
| 2017          | Oct     | 13                    | 15                              | 30                           | 23                         | 23                            | 23                 | Grant (2018)                      |
| 1983          | Oct 28  |                       |                                 |                              | 50                         |                               |                    | Osmond-Jones (1983) (FW)          |
| 1983          | Oct 7   | 11                    | 12                              | 18                           | 66 <sup>6</sup>            | 66                            | 66                 | Sather (1983) <sup>6</sup>        |
| 1979          | Oct     | 0                     | 0                               | 0                            | 34                         | 34                            | 34                 | Hazelwood (1979)                  |
| 1978          | Oct     | 0                     | 0                               | 0                            | (6)                        | 6                             | 6                  | Hatler (1978d) (FW)               |
| 1977          | Oct     | 3                     | 3                               | -                            | (37)                       | 37                            |                    | Hatler (1977c)                    |
| Spring/Summer |         |                       |                                 |                              |                            |                               |                    |                                   |
| 1985          | July    |                       |                                 |                              | (4)                        |                               |                    | Hatler and Hazelwood (1985)       |
| 1981          | Aug     |                       |                                 |                              | (3)                        |                               |                    | Stewart (1981)                    |
| 1979          | May     |                       |                                 |                              | 0                          |                               |                    | Hatler (1979c)                    |
| 1978          | July    | 0                     | 0                               | 0                            | (24)                       | 24                            | 24                 | Hatler (1978c) <sup>7</sup>       |
| 1977          | Sept    |                       |                                 |                              | (0)                        |                               |                    | Hodson (1977) (GR)                |
| 1977          | Jul/Aug | 17                    | 20                              | -                            | (12)                       | 12                            |                    | Hatler (1977b) (GR)               |
| 1975          | Aug     |                       |                                 |                              | (0)                        |                               |                    | Hazelwood (1975) (GR)             |

<sup>1</sup> Calf ratios were based on groups where all caribou were classified to the degree required for the calculation of the ratio

<sup>2</sup> Numbers in parentheses indicate surveys where caribou were not the primary focus

<sup>3</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

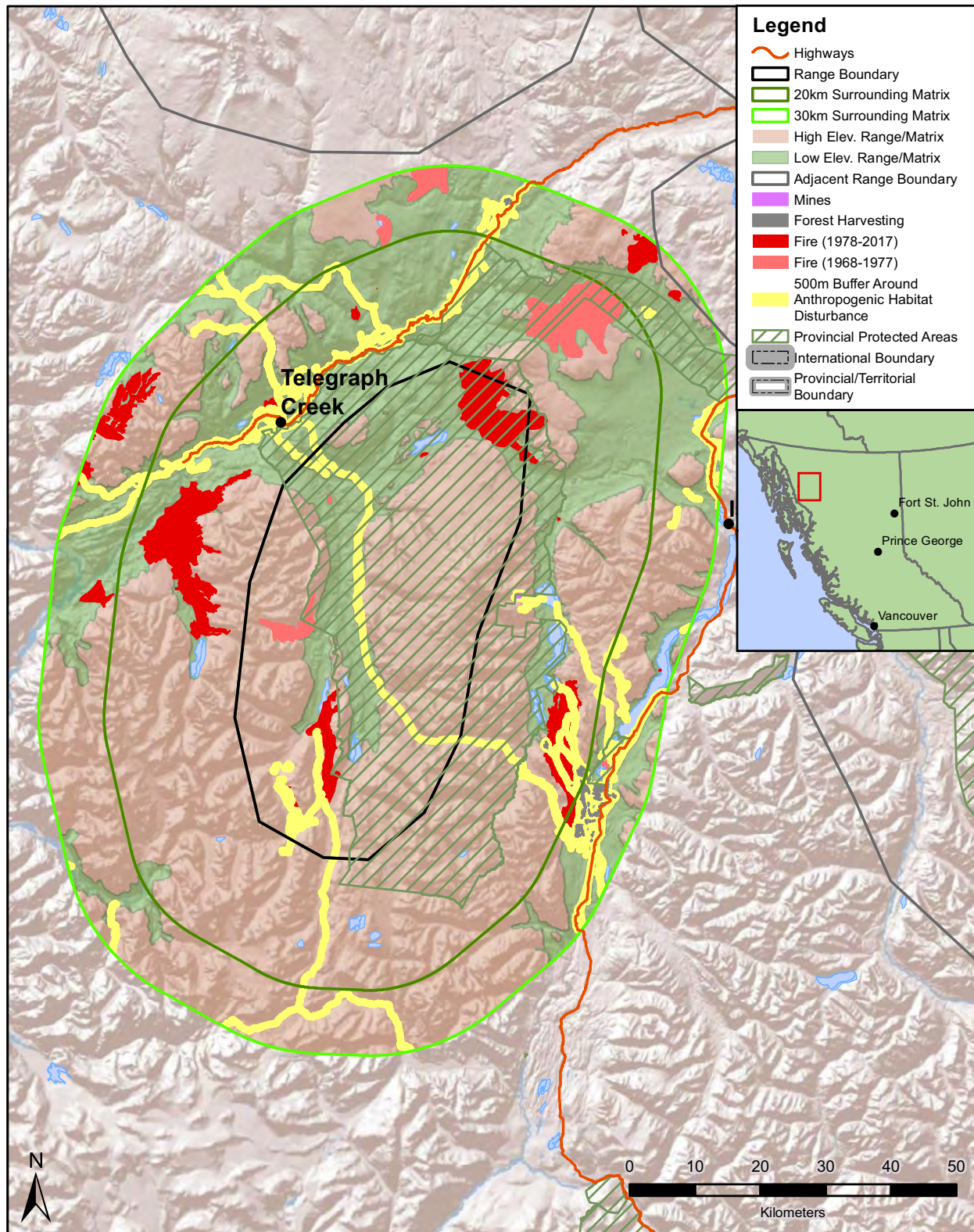
<sup>4</sup> All surveys were conducted by helicopter unless indicated as a fixed-wing (FW) or ground (GR) survey

<sup>5</sup> No caribou were seen during this Feb 14 helicopter survey for sheep or during fixed-wing surveys for caribou on Feb 13, Feb 26 or Mar 14 (Osmond-Jones 1984a,b,c,d)

<sup>6</sup> 66 caribou were seen during this Oct 7 helicopter survey but none were seen during fixed-wing surveys on Sept 27, Sept 30 or Oct 12

<sup>7</sup> Two caribou were seen during ground observations July 31-August 5, 1978 (Hatler 1978b)

## Edziza





## Edziza

|                                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|----------------------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Total Range                      |                    |                               |                                |                                               |
| Range                            | 235 185            | 27.3                          | 72.7                           | -                                             |
| 0-20 km matrix surrounding range | 514 300            | 36.4                          | 63.6                           | 0                                             |
| 0-30 km matrix surrounding range | 865 688            | 39.6                          | 60.4                           | 0.2 (NM)                                      |

<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA



## Edziza

|                | Range Area (ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|-----------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                 | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 235 185         | 4.8                                  | 5.7            | 0              | 0          | 0           | 0.1      | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 5.1  | 0       | 0.1        | 0     | 0                           | 5.1                              | 5.1           | 9.5                                    |
| High elevation | 170 929         | 2.7                                  | 3.8            | 0              | 0          | 0           | 0.1      | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 4.2  | 0       | 0.1        | 0     | 0                           | 4.2                              | 4.2           | 6.4                                    |
| Low elevation  | 64 255          | 10.5                                 | 10.7           | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 7.3  | 0       | 0          | 0     | 0                           | 7.3                              | 7.3           | 17.8                                   |
| Matrix 0-20 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 514 300         | 4.2                                  | 6.2            | 0              | 0          | 0.3         | 0.1      | 0.2      | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 6.2  | 0       | 0.2        | 0.6   | 0.6                         | 6.2                              | 6.4           | 9.9                                    |
| High elevation | 327 334         | 2.6                                  | 3.2            | 0              | 0          | 0           | 0        | 0.1      | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 2.9  | 0       | 0          | 0.4   | 0.4                         | 2.9                              | 3.0           | 5.1                                    |
| Low elevation  | 186 966         | 6.9                                  | 11.3           | 0              | 0          | 0.8         | 0.2      | 0.5      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 12.0 | 0       | 0.6        | 0.9   | 0.9                         | 12.1                             | 12.3          | 18.2                                   |
| Matrix 0-30 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 865 688         | 3.3                                  | 4.9            | 0.1            | 0          | 0.2         | 0        | 0.7      | 0   | 0    | 0            | 0    | 0        | 0.5       | 0        | 7.4  | 0       | 0.2        | 0.7   | 0.6                         | 7.4                              | 7.7           | 10.6                                   |
| High elevation | 523 271         | 2.4                                  | 2.8            | 0              | 0          | 0           | 0        | 0        | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 3.4  | 0       | 0          | 0.3   | 0.3                         | 3.4                              | 3.5           | 5.6                                    |
| Low elevation  | 342 409         | 4.8                                  | 8.0            | 0.3            | 0          | 0.5         | 0.1      | 1.6      | 0   | 0    | 0            | 0    | 0        | 1.2       | 0        | 13.5 | 0       | 0.6        | 1.2   | 1.2                         | 13.5                             | 14.2          | 18.3                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

# Tsenaglade

## Range use summary

Tsenaglade caribou spend most of their time year-round in high elevation alpine habitat and subalpine habitat (Spruce-Willow-Birch biogeoclimatic zone) based on telemetry data from a study of radio-collared female caribou initiated in April 2019 (Tahltan Wildlife Department, pers. comm. 2022). During summer and rut, caribou are found primarily in high elevation alpine and subalpine habitats throughout the Dome Mountain, Dark Mountain, Three Sister Range, and Hotailuh Range areas. During winter, caribou are found in high elevation areas in the Dome Mountain, Dark Mountain, Three Sister Range, and Hotailuh Range areas and are often seen in the Gnat Pass area along the Stewart-Cassiar Highway. However, some individuals have been found wintering on Horseranch Mountain, in low elevation pine forests in the Liard Basin, and in the Spatsizi caribou winter range. During spring migration, caribou use habitats at all elevations. During calving, female caribou are found predominantly in alpine habitats. Previous radio-telemetry locations and observations for other caribou populations indicate overlap in range use by Tsenaglade, Horseranch and Spatsizi caribou.

| Season             | Overview of Habitat and Range Use                                                                                                                                                                                                                                                                                                                                                                                                   | Source                                                                       |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Winter             | <ul style="list-style-type: none"> <li>Primarily high elevation habitats in the Dome Mountain, Dark Mountain, Three Sister Range, and Hotailuh Range areas</li> <li>Some individuals have mixed with other herds and have been found wintering on Horseranch Mountain, in open glacial fluvial pine forests in the Liard Basin in the Horseranch/Little Rancheria winter range, and in the Spatsizi caribou winter range</li> </ul> | Tahltan Wildlife Department, pers. comm. (2020, 2022)                        |
| Summer             | <ul style="list-style-type: none"> <li>Alpine and subalpine habitat throughout summer and fall throughout the Dome Mountain, Dark Mountain, Three Sister Range, and Hotailuh Range areas</li> <li>The Dome Mountain, Dark Mountain and upper Turnagain River areas are located within the currently drawn Horseranch caribou range</li> </ul>                                                                                       | Tahltan Wildlife Department, pers. comm. (2020)<br>Thiessen and Grant (2020) |
| Spring and calving | <ul style="list-style-type: none"> <li>During spring, low elevation forested habitats in the upper Tanzilla, McBride, and upper Turnagain drainages</li> <li>Calving is predominantly in alpine habitats</li> </ul>                                                                                                                                                                                                                 | Tahltan Wildlife Department, pers. comm. (2020)                              |
| Total Range        | <ul style="list-style-type: none"> <li>The core of the Tsenaglade caribou range is in the Dark Mountain, Dome Mountain, Three Sisters Range, Hotailuh Range, and Gnat Pass areas within the Upper Tanzilla, McBride, and Upper Turnagain drainages</li> </ul>                                                                                                                                                                       | Tahltan Wildlife Department, pers. comm. (2020)                              |

## Population size

The current population estimate of 450 to 650 caribou was based on minimum counts during composition surveys conducted from 2019 to 2022 (Tahltan Wildlife Department, pers. comm. 2022). A mark-resight population survey was conducted in October 2021, but analyses of results are still preliminary (Tahltan Wildlife Department, pers. comm. 2022).

| Date | Population estimate | Number counted | Method                                    | Reliability | Source                                         |
|------|---------------------|----------------|-------------------------------------------|-------------|------------------------------------------------|
| 2022 | 450-650             | –              | Minimum counts during composition surveys | –           | Tahltan Wildlife Department pers. comm. (2022) |

## Population trend

The calves/100 cows ratio from the October 2017 survey was within the range of 20 to 25 calves/100 cows, which is considered sufficient to support a stable population growth rate (Environment Yukon 2016). It is unknown whether fall surveys of rutting areas in the Tsenaglade caribou range are biased against calves as detected in the Spatsizi caribou range (Hatler 1987), however, the calves/100 cows ratio suggests a stable population even if the survey is biased against calves. Calf recruitment during the 2015 late winter survey was 15% calves, which was recommended by Bergerud (1996) to achieve population stability. However, that survey is more than five years old and may not represent the current condition.

During the post-calving survey in July 2020, the Tahltan Wildlife Department observed 26 calves/100 cows, but part of the survey was conducted in an area of overlap with the Horseranch caribou range and it is unknown how many of the caribou observed there belonged to the Tsenaglade or Horseranch populations (Tahltan Wildlife Department, pers. comm. 2020). Additional composition surveys have been conducted during post-calving (June/July), fall (October) and late winter (March) since the July 2020 survey but analyses of results are still preliminary.

In 1985, wolves were removed from the Horseranch caribou range in the area adjacent to the northeastern portion of the Tsenaglade caribou range (Bergerud and Elliott 1998), which may have potentially influenced population trend of the Tsenaglade caribou population that year.

There is insufficient technical information to determine current or long-term population trend for the Tsenaglade caribou population.

### Tsenaglade

| Year                 | Month   | % calves <sup>1</sup> | Calves/ 100 adults <sup>1</sup> | Calves/100 cows <sup>1</sup> | Total Counted <sup>2</sup> | Total classified <sup>3</sup> |                    | Source <sup>4</sup>                       |
|----------------------|---------|-----------------------|---------------------------------|------------------------------|----------------------------|-------------------------------|--------------------|-------------------------------------------|
|                      |         |                       |                                 |                              |                            | Calves+ Adults                | Calves+ Cows+Bulls |                                           |
| Winter               |         |                       |                                 |                              |                            |                               |                    |                                           |
| 2015                 | Feb     | 15 <sup>5</sup>       | 17 <sup>5</sup>                 | 27                           | 534 <sup>6</sup>           | 274                           | 174                | Thiessen and Grant (2020)                 |
| Fall                 |         |                       |                                 |                              |                            |                               |                    |                                           |
| 2017                 | Oct     | 15                    | 18                              | 25                           | 227 <sup>7</sup>           | 227                           | 227                | Thiessen and Grant (2020)                 |
| Calving/early summer |         |                       |                                 |                              |                            |                               |                    |                                           |
| 2020                 | July    |                       | 21                              | 26                           | 375 <sup>8</sup>           | 375                           |                    | Tahltan Wildlife Department, unpubl. data |
| 1963                 | Jul/Aug | 25                    | 33                              | -                            | (28)                       | 28                            |                    | Mundy (1963) (GR)                         |

<sup>1</sup> Calf ratios were based on groups where all caribou were classified to the degree required for the calculation of the ratio

<sup>2</sup> Numbers in parentheses indicate surveys where caribou were not the primary focus

<sup>3</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

<sup>4</sup> All surveys were conducted by helicopter unless indicated as a fixed-wing (FW) or ground (GR) survey

<sup>5</sup> Extrapolated from data presented in Thiessen and Grant (2020)

<sup>6</sup> Area surveyed included a small portion of the alpine winter range as an extension of a moose survey

<sup>7</sup> Survey area included only a portion of the range

<sup>8</sup> Part of the survey was conducted in an area of overlap with the Horseranch caribou range and it is unknown how many of the caribou observed there belonged to the Tsenaglade or Horseranch populations

## Boundary Issues

- The range boundary is coarsely drawn resulting in gaps between the Tsenaglade caribou range, and Horseranch and Spatsizi caribou ranges.
- Radio-telemetry data suggest that the Tsenaglade caribou range overlaps with at least the Horseranch and Spatsizi caribou ranges.

## Range condition

Within the current Tsenaglade caribou range boundary, habitat disturbance covers 11%, 9% and 30% of the total, high elevation and low elevation portions of the range respectively. Habitat disturbance in the low elevation portion of the range is nearing the 35% disturbance threshold for critical habitat in the recovery strategy for southern mountain caribou (Environment Canada 2014). The primary habitat disturbance within the range is roads/trails with some contribution from settlements, mines, dams and reservoirs. Roads/trail and settlements are located primarily in the low elevation portion of the range, while mines, dams and reservoirs are located in the high elevation portion. The main roads/trails are the Stewart-Cassiar Highway, and portions of the Jade/Boulder Road and associated industrial roads. There are no fires <40 years in the range. Habitat disturbance makes up a higher proportion of the 20 km and 30 km surrounding matrix than the range, with roads/trails, fire, mines and settlements (Dease Lake, Iskut) also contributing.

Our analysis does not include fires from 2018 to 2021. A fire in 2018 affected a very small portion of the west end of the 30 km surrounding matrix. Otherwise there was no fire activity in the range or in the surrounding matrix during those years.

### Tsenaglade

|                                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|----------------------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Total Range                      |                    |                               |                                |                                               |
| Range                            | 247 008            | 11.2                          | 88.8                           | -                                             |
| 0-20 km matrix surrounding range | 521 447            | 35.0                          | 65.0                           | 58.8 (NM)                                     |
| 0-30 km matrix surrounding range | 876 415            | 35.0                          | 65.0                           | 61.9 (NM)                                     |

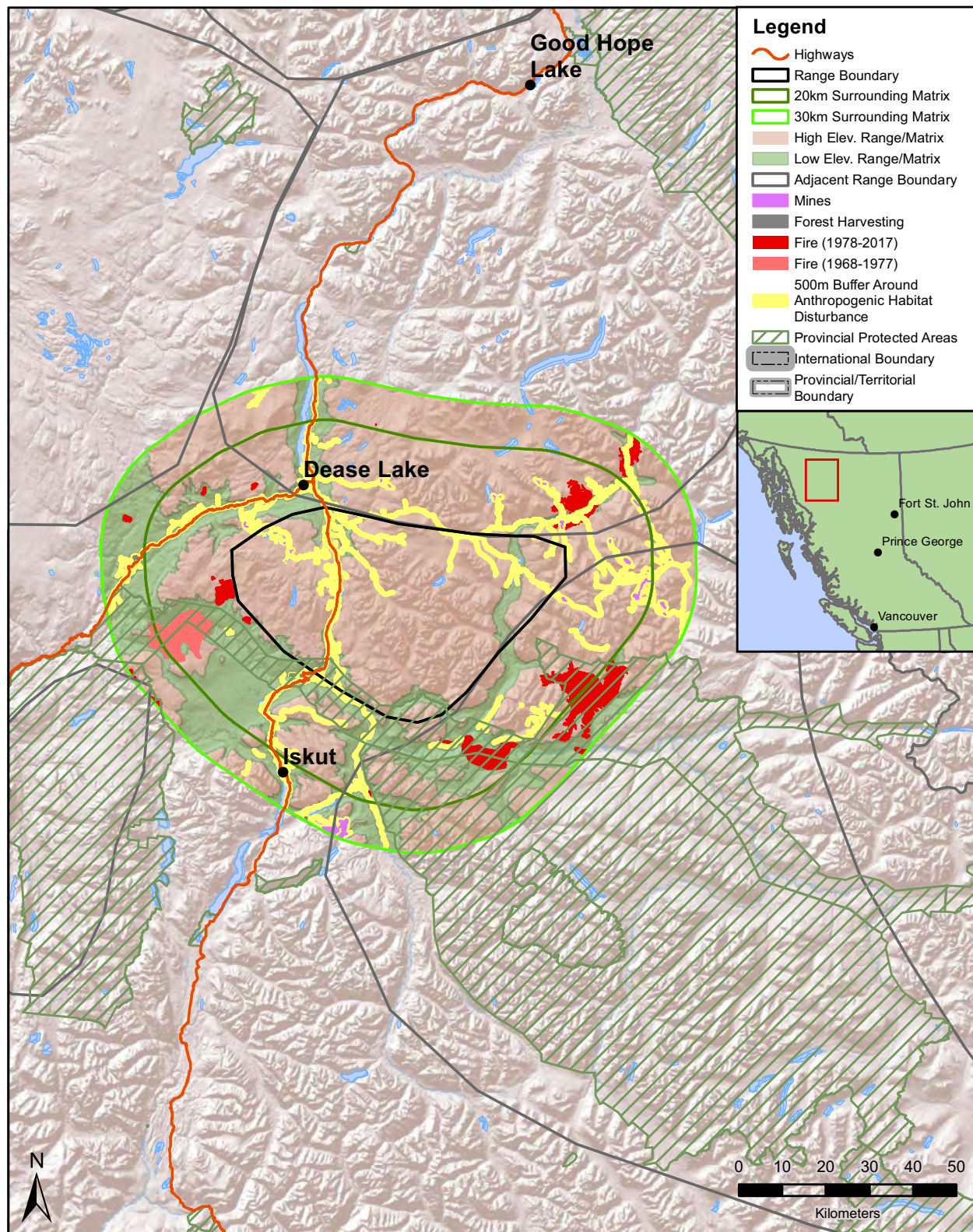
<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA



## Tsenaglude





## Tsenaglade

|                | Range Area (ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|-----------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                 | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 247 008         | 0                                    | 0              | 0              | 0.3        | 0           | 0        | 0        | 0.1 | 0.1  | 0            | 0    | 0        | 0         | 0        | 11.0 | 0       | 0.4        | 0     | 0                           | 11.0                             | 11.4          | 11.4                                   |
| High elevation | 219 268         | 0                                    | 0              | 0              | 0.3        | 0           | 0        | 0        | 0.1 | 0.1  | 0            | 0    | 0        | 0         | 0        | 8.8  | 0       | 0          | 0     | 0                           | 8.8                              | 9.1           | 9.1                                    |
| Low elevation  | 27 740          | 0                                    | 0              | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 28.9 | 0       | 3.9        | 0     | 0                           | 28.9                             | 29.5          | 29.5                                   |
| Matrix 0-20 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 521 447         | 3.3                                  | 5.0            | 0              | 0          | 0           | 0.1      | 0.1      | 0   | 0.8  | 0            | 0    | 0        | 0         | 0        | 12.2 | 0       | 0.5        | 0.1   | 0.1                         | 12.2                             | 12.3          | 15.2                                   |
| High elevation | 338 924         | 2.5                                  | 3.0            | 0              | 0          | 0           | 0        | 0        | 0   | 1.1  | 0            | 0    | 0        | 0         | 0        | 9.8  | 0       | 0          | 0     | 0                           | 9.8                              | 9.8           | 12.2                                   |
| Low elevation  | 182 522         | 4.8                                  | 8.7            | 0              | 0          | 0           | 0.2      | 0.2      | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 16.6 | 0       | 1.4        | 0.2   | 0.2                         | 16.6                             | 16.8          | 20.8                                   |
| Matrix 0-30 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 876 415         | 3.4                                  | 4.6            | 0              | 0          | 0           | 0.1      | 0.2      | 0   | 0.8  | 0            | 0    | 0        | 0         | 0        | 10.1 | 0       | 0.4        | 0     | 0                           | 10.1                             | 10.3          | 13.4                                   |
| High elevation | 569 638         | 2.2                                  | 2.6            | 0              | 0          | 0           | 0        | 0.1      | 0   | 1.1  | 0            | 0    | 0        | 0         | 0        | 7.8  | 0       | 0          | 0     | 0                           | 7.8                              | 7.9           | 10.1                                   |
| Low elevation  | 306 776         | 5.5                                  | 8.2            | 0              | 0          | 0           | 0.2      | 0.4      | 0   | 0.2  | 0            | 0    | 0        | 0         | 0        | 14.5 | 0       | 1.2        | 0.1   | 0.1                         | 14.5                             | 14.7          | 19.5                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

# Spatsizi

## Range use summary

During most winters, caribou use low elevation forested habitat primarily in the northern portion of their range along the Stikine River. In some winters, caribou use windswept alpine slopes on the Spatsizi Plateau, Eaglenest Mountains, Gladys Lake Ecological Reserve, and mountains around the Dawson River. During spring migration, caribou use mostly low elevation forested areas. Calving occurs at high elevations generally above 1500 m, but some caribou are also found below treeline during calving. Caribou are highly dispersed in summer with some caribou moving to areas in almost all directions beyond Spatsizi Plateau Wilderness Park boundaries. Although traditional high elevation rutting areas are located in the Caribou Mountain, Tomias Mountain and Edozadelly/Lawyers Pass areas, many caribou rut in other areas throughout their range.

| Season      | Overview of Habitat and Range Use                                                                                                                                                                                                                                                                                                                                                                                                                            | Source                             |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| Winter      | <ul style="list-style-type: none"> <li>Low elevation forested habitat primarily in the Stikine River and Kehlechoa River areas</li> <li>During some winters, windswept alpine slopes on the Spatsizi Plateau, Eaglenest Mountains, Gladys Lake Ecological Reserve, and mountains around the Dawson River</li> </ul>                                                                                                                                          | Hatler (1986a)<br>Cichowski (1994) |
| Summer      | <ul style="list-style-type: none"> <li>Calving occurs primarily above 1500 m but some caribou are also found below treeline</li> <li>Caribou are highly dispersed during calving and summer</li> <li>Traditional high elevation rutting areas include the Caribou Mountain, Tomias Mountain and Edozadelly/Lawyers Pass areas</li> <li>Rut occurs throughout the range at all elevations</li> <li>Late fall use primarily in subalpine shrub zone</li> </ul> | Hatler (1986a)                     |
| Migration   | <ul style="list-style-type: none"> <li>Spring migration primarily in low elevation forested areas</li> </ul>                                                                                                                                                                                                                                                                                                                                                 | Hatler (1986a)                     |
| Total Range |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                    |

## Population size

The current population estimate of 2681 caribou was based on a total count survey in high elevation habitat in the Spatsizi caribou range in March 1994 (Cichowski 1994). During some winters, a large portion of the Spatsizi caribou population is found on windswept alpine slopes, presumably in response to snow conditions (Hatler 1986a), which appeared to be the case during the March 1994 survey. Because it is hard to predict when these conditions will occur, it is difficult to plan surveys to coincide with those conditions (Hatler 1987).

| Date | Population estimate | Number counted | Method                        | Reliability | Source           |
|------|---------------------|----------------|-------------------------------|-------------|------------------|
| 1994 | 2681                | 2145           | Minimum count + extrapolation | High        | Cichowski (1994) |

<sup>1</sup> The estimate was calculated assuming that 80% of the caribou were seen during the March 1994 survey.

Prior to 1994, the highest numbers of caribou counted during fall surveys were 1267 in 1976, 2469 in 1977, 1126 in 1980, 1075 in 1982 and 1041 in 1984 (see Population trend below). All surveys were conducted primarily in Spatsizi Plateau Wilderness Park except the 1977 survey, which also included areas to the northeast of the park (Hatler 1977).

From 1976 to 1986 (over a span of 11 years), 20 surveys were conducted in the Spatsizi caribou range, 16 of which focused specifically on caribou (see Population trend below). Hatler (1987) concluded that data collected on numbers and composition of caribou up to 1986 were not adequate to assess changes in population size. Since 1986 (over a span of 34 years), only 3 surveys have been conducted specifically for caribou in the Spatsizi caribou range (see Population trend below), with only the 1994 conducted to determine a population estimate.

The most recent population estimate for the Spatsizi caribou population of 2681 caribou based on the March 1994 survey is now over 27 years old. Since 1994, the highest number of caribou counted during a survey was 1336 in fall 2017 (Thiessen and Grant 2019, see Population trend below). The 2017 survey was a fall composition survey that included areas northeast of Spatsizi Park, and was not intended for estimating population size.

## **Population trend**

From 1976 to 1982, all five fall surveys with calves/100 cows ratios were below the 20 to 25 calves/100 cows level that is considered sufficient to support a stable population growth rate (Environment Yukon 2016). The six most recent fall calf/cow ratios (1983-1986, 2010, 2017) were at or above 20 to 25 calves/100 cows.

In all six late winter surveys conducted (3 targeting caribou and 3 where caribou were not the target species) where caribou were classified to at least adults and calves, calf recruitment estimates were above 15% calves recommended by Bergerud (1996) to achieve population stability.

During the three years when survey data were available in both fall and late winter for the same cohort of calves (i.e. October 1978 and January/February 1979; October 1980 and January 1981; October 1981 and February/March 1982), percent calves was significantly higher during late winter surveys than during fall surveys (Hatler 1987), suggesting that either fall surveys were biased against calves or that winter surveys were biased for calves. Based on data from radio-collared caribou, Hatler (1987) concluded that fall surveys conducted between 1976 and 1986 were “biased in terms of population composition, and unreliable as indicators of population trend.”

From the radio-collared caribou study from November 1980 to October 1984, annual survival rate of adult female caribou ranged from 57% to 96% and averaged 87% (Hatler 1986). No data on population rate of change ( $\lambda$ ) were summarized.

In 1985, wolves were removed from the Horseranch caribou range in the area adjacent to the northern portion of the Spatsizi caribou range (Bergerud and Elliott 1998), which may have potentially influenced population trend of the Spatsizi caribou population that year. Wolves were also removed from smaller areas slightly more distant to the northeastern portion of the Spatsizi caribou range in 1982, 1983 and 1984 (Bergerud and Elliott 1998).

Hatler (1986a; p. 146) suggested that the Spatsizi caribou population had likely increased at least in 1983 and 1984. Calves/100 cows ratios were at or above 20 to 25 calves/100 cows those two years. Despite potential biases against calves during fall surveys, calves/100 cows during the two most recent fall surveys (2010, 2018) were at or above 20 to 25 calves/100 cows, and percent calves during the three most recent late winter surveys (1988, 1994, 2003) were above 15% calves. Although the 2018 fall survey suggests a stable population, it is the only recent survey available to assess current population trend, and therefore there is not enough information to determine current population trend. Although calf survival was consistently high in all fall and late winter surveys conducted since 1988, there is not enough information to determine a long-term population trend.

Spatsizi

| Year          | Month   | % calves <sup>1</sup> | Calves/ 100 adults <sup>1</sup> | Calves/100 cows <sup>1</sup> | Total <sup>2</sup> Counted | Total classified <sup>3</sup> |                    | Source <sup>4</sup>            |
|---------------|---------|-----------------------|---------------------------------|------------------------------|----------------------------|-------------------------------|--------------------|--------------------------------|
|               |         |                       |                                 |                              |                            | Calves+ Adults                | Calves+ Cows+Bulls |                                |
| Winter        |         |                       |                                 |                              |                            |                               |                    |                                |
| 2003          | Mar     | 18                    | 22                              | 32                           | (725)                      | 725                           | 725                | Marshall (2005)                |
| 1994          | Mar     | 16                    | 19                              | -                            | 2145                       | 2145                          |                    | Cichowski (1994)               |
| 1993          | Mar     |                       |                                 |                              | (465)                      |                               |                    | Cichowski (1993)               |
| 1988          | Jan/Feb | 19                    | 24                              | 33                           | (105)                      | 105                           | 83                 | Jones (1988)                   |
| 1983          | Feb/Mar |                       |                                 |                              | (0)                        |                               |                    | Jones (1983)                   |
| 1982          | Feb/Mar | 16                    | 18                              | -                            | 438                        | 438                           |                    | Jones (1982a)                  |
| 1981          | Jan     | 20                    | 25                              | -                            | 405                        | 405                           |                    | Hatler (1981a)                 |
| 1979          | Jan/Feb | 24                    | 31                              | 31                           | (108)                      | 88                            | 48                 | Hatler (1979b)                 |
| 1979          | Jan     |                       |                                 |                              | (44)                       | 11                            | 11                 | Hatler (1979a)                 |
| 1973          | Mar     |                       |                                 |                              | (645)                      |                               |                    | Luckhurst (1973)               |
| 1972          | Feb     |                       |                                 |                              | (400)                      |                               |                    | Harper (1972)                  |
| 1962          | Mar     |                       |                                 |                              | (110+)                     |                               |                    | Hartman (1962a) (FW)           |
| Fall          |         |                       |                                 |                              |                            |                               |                    |                                |
| 2017          | Oct     | 15                    | 19                              | 25                           | 1336                       | 1334                          | 1334               | Grant and Thiessen (2018)      |
| 2010          | Nov     | 13                    | 15                              | 20                           | 671                        | 671                           | 671                | Marshall and Williams (2010)   |
| 1986          | Oct     | 15                    | 17                              | 25                           | 884                        | 884                           | 802                | Hatler (1986b)                 |
| 1985          | Oct     | 12                    | 14                              | 21                           | 693                        | 693                           | 633                | Jones (1985)                   |
| 1984          | Oct     | 13                    | 15                              | 27                           | 1041                       | 1041                          | 713                | Jones (1984)                   |
| 1983          | Oct     | 15                    | 17                              | 24                           | 446                        | 446                           | 446                | Sather (1983)                  |
| 1982          | Nov     | 15                    | 17                              | -                            | 206                        | 196                           |                    | Hatler (1982) in Hatler (1987) |
| 1982          | Oct     | 9                     | 10                              | 14                           | 1075                       | 1075                          | 1075               | Jones (1982b)                  |
| 1981          | Oct     | 8                     | 8                               | 12 <sup>5</sup>              | 457                        | 457                           | 457                | Jones (1981)                   |
| 1980          | Oct     | 13                    | 14                              | -                            | 1126                       | 1126                          |                    | Jones (1980)                   |
| 1979          | Oct     | 7                     | 7                               | 9                            | 215                        | 215                           | 215                | Eastman (1979) <sup>6</sup>    |
| 1979          | Oct     | 10                    | 11                              | 15                           | 438                        | 438                           | 284                | Hazelwood (1979)               |
| 1978          | Oct     | 13                    | 15                              | -                            | 820                        | 526                           |                    | Hatler (1978) (FW)             |
| 1977          | Oct     | 8                     | 9                               | -                            | 2469                       | 2318                          |                    | Hatler (1977)                  |
| 1976          | Sept    | 6                     | 7                               | 9                            | 1267                       | 671                           | 671                | Hatler (1976c)                 |
| Spring/Summer |         |                       |                                 |                              |                            |                               |                    |                                |
| 1985          | July    | 28                    | 40                              |                              | (226)                      | 226                           |                    | Hatler and Hazelwood (1985)    |
| 1984          | July    | 24                    | 32                              | 53 <sup>7</sup>              | (188)                      | 171                           | 90                 | Hatler and Hazelwood (1984)    |
| 1976          | Aug     |                       |                                 |                              | (32)                       |                               |                    | Hatler (1976b)                 |
| 1976          | July    | 2                     | 2                               | -                            | 366                        | 366                           |                    | Hatler (1976a)                 |
| 1963          | Jul/Aug | 25                    | 32                              |                              | (167)                      | 147                           |                    | Mundy (1963) (GR)              |
| 1962          | Aug     | 25                    | 33                              | -                            | (117)                      | 117                           |                    | Hartman (1962b) (FW)           |
| 1959          | Jul/Aug | 3                     | 3                               | -                            | (151)                      | 151                           |                    | Guiguet (1959) (GR)            |

<sup>1</sup> Calf ratios were based on groups where all caribou were classified to the degree required for the calculation of the ratio

<sup>2</sup> Numbers in parentheses indicate surveys where caribou were not the primary focus

<sup>3</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

<sup>4</sup> All surveys were conducted by helicopter unless indicated as a fixed-wing (FW) or ground (GR) survey

<sup>5</sup> Although Jones (1981) does not provide all classification data, Hatler (1981b) does. From Table 6 in Hatler (1987), calves/100 cows = 11.5 with N=305 cows. For that calculation, # of cows includes unclassified adults.

<sup>6</sup> We recalculated total numbers from Eastman's (1978) datasheet (Total= 215: 43 bulls, 156 cows, 2 UA, 14 calves), which differed from the numbers he summarized in the written part of the report

<sup>7</sup> Excludes unclassified adults which were mostly adult females and small bulls; Hatler and Hazelwood (1984) calculated % calves excluding bulls and including unclassified adults, as 30.2%

## Boundary Issues

- The range boundary is coarsely drawn resulting in gaps between the Spatsizi caribou range and the Tsenaglode, Horseranch, and Thutade caribou ranges.
- Telemetry and other location data suggest that boundaries should be expanded into some areas that are not included in the Spatsizi caribou range.
- Radio-telemetry data (~ 1 year) suggest that the Tsenaglode caribou range overlaps with at least the Spatsizi and Horseranch caribou ranges.
- The large gap between caribou ranges in the centre of the study area (between the Spatsizi, Horseranch, Rabbit, Frog and Thutade caribou ranges) is known to contain caribou.

Sittler et al. (2015) recommended extending the southeastern portion of the Spatsizi caribou range based on data collected from caribou radio-collared in the area of low density just southeast of the Spatsizi caribou range.

## Range condition

Within the current Spatsizi caribou range boundary, habitat disturbance covers 6%, 4% and 11% of the total, high elevation and low elevation portions of the range respectively. Primary disturbances are roads/trails, fire and seismic lines, all three of which are more prevalent at low elevations than at high elevations. Roads/trails include the Klappan Rail Grade in the western portion of the range, and industrial roads associated with mining in the northern and southeastern portions of the range. Fires <40 years are distributed throughout the range. Habitat disturbance is slightly higher in the 20 km and 30 km matrix surrounding the range.

Our analysis does not include fires from 2018 to 2021. There were no substantial fires recorded in the Spatsizi caribou range or surrounding matrix in those four years other than a 7,500 ha fire in Spatsizi Plateau Wilderness Park just south of the Stikine River in the Cullivan Creek area.

### Spatsizi

|                                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|----------------------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Total Range                      |                    |                               |                                |                                               |
| Range                            | 1 565 613          | 17.7                          | 82.3                           | -                                             |
| 0-20 km matrix surrounding range | 1 169 526          | 9.3                           | 90.7                           | 22.6 (NM)                                     |
| 0-30 km matrix surrounding range | 1 848 437          | 9.5                           | 90.5                           | 27.1 (NM)                                     |

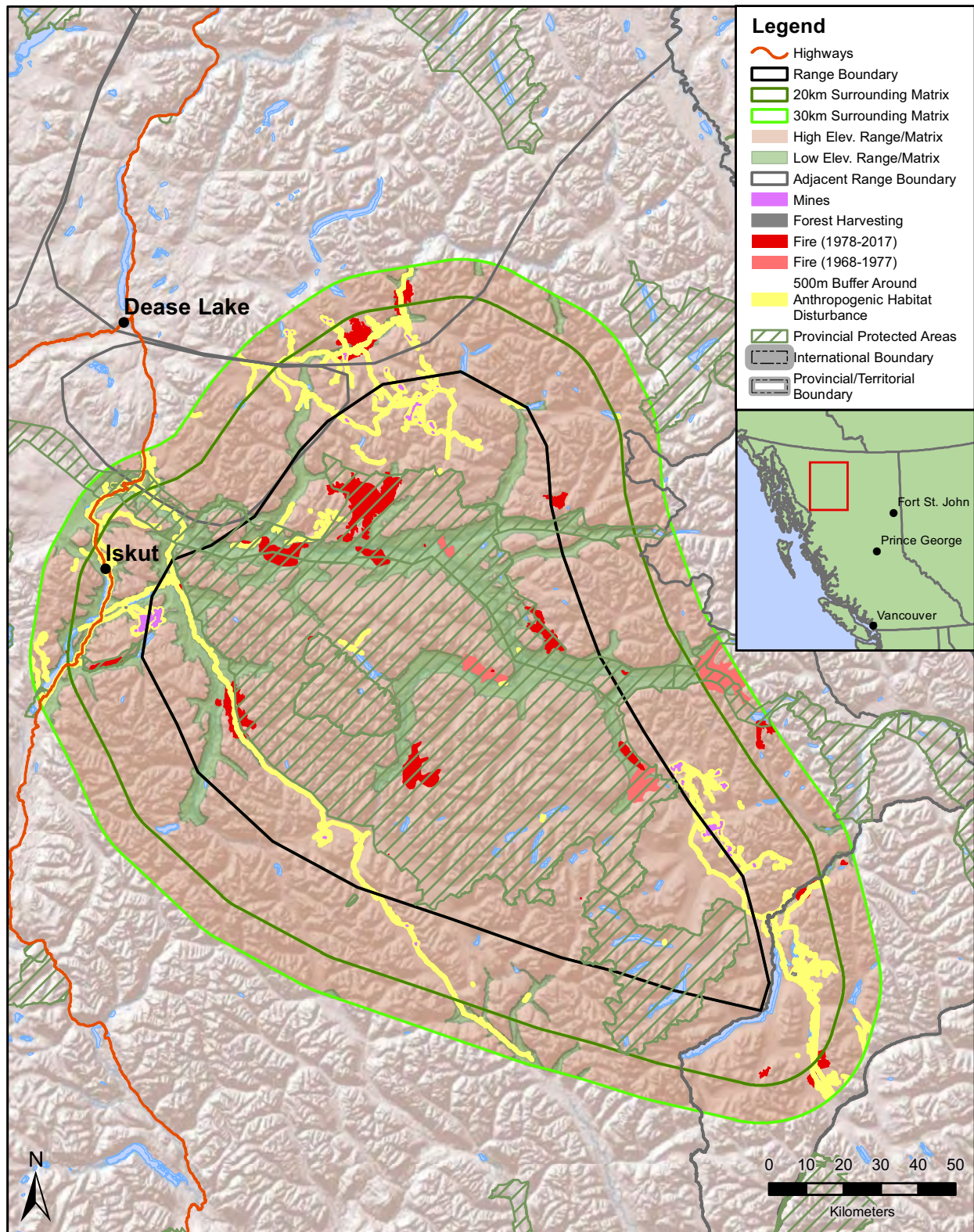
<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA



## Spatsizi



## Spatsizi

|                | Range Area<br>(ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|--------------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                    | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 565 613          | 2.4                                  | 3.0            | 0              | 0          | 0           | 0        | 0        | 0   | 0.3  | 0            | 0    | 0        | 0         | 0        | 3.2  | 0.1     | 0.1        | 0     | 0                           | 3.2                              | 3.3           | 5.5                                    |
| High elevation | 1 287 936          | 1.3                                  | 1.6            | 0              | 0          | 0           | 0        | 0        | 0   | 0.4  | 0            | 0    | 0        | 0         | 0        | 3.0  | 0.1     | 0.1        | 0     | 0                           | 3.0                              | 3.1           | 4.4                                    |
| Low elevation  | 277 677            | 7.4                                  | 9.5            | 0              | 0          | 0           | 0        | 0.1      | 0   | 0.2  | 0            | 0    | 0        | 0         | 0        | 4.1  | 0       | 0.3        | 0     | 0                           | 4.1                              | 4.2           | 11.0                                   |
| Matrix 0-20 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 169 526          | 0.8                                  | 0.8            | 0.5            | 0          | 0           | 0.1      | 0        | 0   | 0.6  | 0            | 0    | 0        | 0.4       | 0        | 6.4  | 0       | 0.1        | 0     | 0                           | 6.4                              | 6.6           | 7.2                                    |
| High elevation | 1 060 530          | 0.6                                  | 0.6            | 0.4            | 0          | 0           | 0        | 0        | 0   | 0.6  | 0            | 0    | 0        | 0.2       | 0        | 5.2  | 0       | 0.1        | 0     | 0                           | 5.2                              | 5.4           | 5.9                                    |
| Low elevation  | 108 996            | 2.9                                  | 2.9            | 1.5            | 0          | 0.3         | 0.2      | 0.2      | 0   | 0.2  | 0            | 0    | 0        | 1.5       | 0        | 18.1 | 0       | 0.7        | 0     | 0                           | 18.1                             | 18.7          | 20.1                                   |
| Matrix 0-30 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 848 437          | 0.8                                  | 1.3            | 0.8            | 0          | 0.1         | 0        | 0        | 0   | 0.4  | 0            | 0    | 0        | 0.4       | 0        | 5.6  | 0       | 0.2        | 0     | 0                           | 5.6                              | 5.8           | 6.4                                    |
| High elevation | 1 672 770          | 0.6                                  | 1.0            | 0.5            | 0          | 0.1         | 0        | 0        | 0   | 0.4  | 0            | 0    | 0        | 0.2       | 0        | 4.2  | 0       | 0.1        | 0     | 0                           | 4.2                              | 4.3           | 4.8                                    |
| Low elevation  | 175 662            | 2.6                                  | 4.8            | 3.8            | 0          | 0.2         | 0.1      | 0.2      | 0   | 0.1  | 0            | 0    | 0        | 1.7       | 0        | 19.7 | 0       | 1.0        | 0     | 0                           | 19.7                             | 20.2          | 21.6                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

# Liard Plateau

## Range use summary

During winter, caribou use primarily high elevation alpine and high elevation mature forests close to alpine areas. Some use of low elevation forested habitat also occurs, especially during early winter. Calving occurs in alpine habitat but some caribou also calve below treeline. Most caribou rut in high elevation habitat. The core of the Liard Plateau caribou range is the Caribou Range plateau.

| Season      | Overview of Habitat and Range Use                                                                                                                                                                                     | Source                               |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| Winter      | <ul style="list-style-type: none"> <li>High elevation windswept alpine slopes and high elevation mature forests</li> <li>Some winter use in low elevation forested habitat, especially during early winter</li> </ul> | Powell (2006)<br>McNay et al. (2014) |
| Summer      | <ul style="list-style-type: none"> <li>Mostly high elevation habitats</li> <li>Some use of forested areas during calving</li> </ul>                                                                                   | Powell (2006)<br>McNay et al. (2014) |
| Migration   | <ul style="list-style-type: none"> <li>Move from higher elevations in summer to lower elevation in early winter and back to higher elevation in late winter.</li> </ul>                                               | McNay et al. (2014)                  |
| Total Range | <ul style="list-style-type: none"> <li>91% of the range is located in BC</li> <li>9% of the range is located in Yukon</li> <li>The Caribou Range plateau is the core of the range (Powell 2006)</li> </ul>            |                                      |

## Population size

The highest number of caribou counted in the Liard Plateau caribou range was 425 ( $\pm 50$ ) during a Canada Land Inventory flight in February 1975 (McNay et al. 2014). In 2005, the population was estimated at less than 200 caribou, based on the number of caribou counted during a fall composition survey and during the capture session in 2002 (Powell 2006). In 2010 and 2011, the highest number of caribou counted during composition survey each year was 173 and 159 respectively (McNay et al. 2014). The highest recent count was 131 caribou in October 2020.

| Date | Population estimate | Number counted | Method                        | Reliability | Source                    |
|------|---------------------|----------------|-------------------------------|-------------|---------------------------|
| 2020 | –                   | 131            | Minimum count                 |             | A. Pelletier, pers. comm. |
| 2011 | –                   | 159            | Minimum count                 |             | McNay et al. (2014)       |
| 2010 | –                   | 173            | Minimum count                 |             | McNay et al. (2014)       |
| 2005 | <200                | 141            | Minimum count + Extrapolation | High        | Powell (2006)             |
| 1975 | –                   | 425            | Minimum count                 |             | McNay et al. (2014)       |

## Population trend

In all four late winter surveys conducted where caribou were classified to at least adults and calves, calf recruitment estimates were below 15% calves recommended by Bergerud (1996) to achieve population stability.

Between 2005 and 2020, the calves/100 cows ratio for one of the four fall surveys was at the low end of the 20 to 25 calves/100 cows level that is considered sufficient to support a stable population growth rate (Environment Yukon 2016), while the other three, including the most recent in 2020, were well below that level. It is unknown whether fall surveys of rutting areas in the Liard Plateau caribou range are biased against calves as detected in the Spatsizi caribou range (Hatler 1987).



## Liard Plateau

| Year                 | Month              | % calves <sup>1</sup> | Calves/ 100 adults <sup>1</sup> | Calves/100 cows <sup>1</sup> | Total <sup>2</sup> Counted | Total classified <sup>3</sup> |                    | Source <sup>4</sup>             |
|----------------------|--------------------|-----------------------|---------------------------------|------------------------------|----------------------------|-------------------------------|--------------------|---------------------------------|
|                      |                    |                       |                                 |                              |                            | Calves+ Adults                | Calves+ Cows+Bulls |                                 |
| <i>Winter</i>        |                    |                       |                                 |                              |                            |                               |                    |                                 |
| 2017                 | Mar                | 8                     | 9                               | 21                           | 87 <sup>5</sup>            | 87                            | 52                 | A. Pelletier, pers. comm.       |
| 2011                 | Mar                | 7                     |                                 | 10                           | 159 <sup>6</sup>           |                               |                    | McNay et al. (2014)             |
| 2010                 | Feb                | 4                     | 4                               | 4                            | 81                         | 81                            | 81                 | Thiessen (2010)                 |
| 2002                 | Feb                |                       |                                 |                              | <200 <sup>7</sup>          |                               |                    | Powell (2006)                   |
| 1978                 | Feb                | 10                    | 12                              | -                            | 68 <sup>8</sup>            | 68                            |                    | Bergerud (1978) (FW)            |
| 1975                 | Feb                |                       |                                 |                              | (425) <sup>9</sup>         |                               |                    | CLI in McNay et al. (2014) (FW) |
| <i>Fall</i>          |                    |                       |                                 |                              |                            |                               |                    |                                 |
| 2020                 | Oct                | 4                     | 4                               | 10                           | 131                        | 131                           | 70                 | A. Pelletier, pers. comm        |
| 2011                 | Oct                | 5                     |                                 | 7                            | 120 <sup>6</sup>           |                               |                    | McNay et al. (2014)             |
| 2010                 | Oct                | 7                     |                                 | 10                           | 173 <sup>6</sup>           |                               |                    | McNay et al. (2014)             |
| 2005                 | Fall <sup>10</sup> | 14                    | 16                              | 20                           | 141                        | 141                           | 141                | Powell (2006)                   |
| 1977                 | Oct                | 10                    | 11                              | -                            | 93                         | 93                            |                    | Bergerud (1978) (FW)            |
| <i>Spring/Summer</i> |                    |                       |                                 |                              |                            |                               |                    |                                 |
| 2011                 | July               | 17                    |                                 | 24                           | 117 <sup>6</sup>           |                               |                    | McNay et al. (2014)             |
| 2010                 | June               | 12                    |                                 |                              | 94 <sup>6</sup>            |                               |                    | McNay et al. (2014)             |
| 1977                 | Aug                | 18                    | 22                              | 29                           | 22                         |                               |                    | Bergerud (1978) (GR)            |
| 1975                 | July               |                       |                                 |                              | >200 <sup>11</sup>         |                               |                    | Bergerud (1978) (Unk)           |

<sup>1</sup> Calf ratios were based on totals in each age/sex class (except as otherwise indicated) because data detailing composition of groups were not always available so we could not eliminate groups where some animals were unclassified

<sup>2</sup> Numbers in parentheses indicate surveys where caribou were not the primary focus

<sup>3</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

<sup>4</sup> All surveys were conducted by helicopter unless indicated as a fixed-wing (FW) or ground (GR) survey

<sup>5</sup> Low cloud prevented classification of all caribou

<sup>6</sup> No classification data provided; only ratios are provided

<sup>7</sup> Estimated number of caribou seen by J. Adamczewski during the capture session

<sup>8</sup> Plateau thoroughly searched; no information provided on weather or sighting conditions

<sup>9</sup> Canada Land Inventory (CLI) flight summarized by McNay et al. (2014); map shows 3 groups (75, 250, 100); A. Stewart indicated the total number was likely 425±50 (McNay et al. 2014)

<sup>10</sup> No survey date provided

<sup>11</sup> Number of caribou seen by J. Elliott and B. Webster July 13-18 but no details provided on how the survey was conducted or on classification

However, late winter calf recruitment estimates are also low, consistent with the low fall calves/100 cows ratios. Although calf recruitment has been low, between December 2010 and October 2011 (22 months), survival rate of radio-collared adult female caribou was 95% (McNay et al. 2014). If adult female survival rate has continued to be high, there may have been sufficient calf recruitment to compensate for adult female mortality.

In the absence of recent information on adult survival, calf recruitment in 2017 and 2020 suggests that currently, the population may be declining.

Population trend based on the number of caribou counted during surveys is more difficult to interpret. The highest number of caribou counted was 425 in 1975, following a period of wolf control (McNay et al. 2014). Since then, numbers of caribou counted during surveys have all been less than 200. The number counted during late winter surveys has been variable and may not be useful for assessing population trend. In 2010, 81 caribou were counted in late winter and then 159 were counted in late winter the following year. The 2011 survey was based on caribou seen

with radio-collared caribou, which may have resulted in more caribou seen. Alternatively, 2011 may have been a year when a higher proportion of caribou were using habitats where they were more visible (e.g. high elevation open habitats). If either or both cases existed in 2011, the count of 87 caribou in 2017 may not be indicative of a decline. Counts during fall surveys have also been variable, but over 100 caribou were counted during the four most recent surveys.

The number of caribou counted during the CLI survey in 1975 and the number of caribou counted during surveys conducted since 2000, suggest a decrease in the population over the long term.

## Boundary Issues

- The BC/Yukon range boundaries do not line up.

The width of the BC portion of the range boundary at the Yukon border is approximately 70 km, while the width of Yukon portion of the range is approximately 10 km.

## Range condition

Within the current Liard Plateau caribou range boundary, habitat disturbance covers 20%, 8% and 34% of the total, high elevation and low elevation portions of the range respectively. Primary disturbances are fires, roads/trails, and seismic lines, all three of which are more prevalent at low elevations than at high elevations. Fires <40 years are most prevalent in the northwestern portion of the range, with one fire from 1982 covering 42,000 ha. Overall habitat disturbance is higher in the 20 km and 30 km matrix surrounding the range than in the range itself.

Our analysis does not include fires from 2018 to 2021, however, there were no substantial fires recorded in the BC portion of the Liard Plateau caribou range or the surrounding matrix in those four years.

### Liard Plateau

|                                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|----------------------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Total Range                      |                    |                               |                                |                                               |
| Range                            | 520 304            | 48.9                          | 51.1                           | -                                             |
| 0-20 km matrix surrounding range | 690 962            | 74.2                          | 25.8                           | 8.9 (NM)                                      |
| 0-30 km matrix surrounding range | 1 128 170          | 76.2                          | 23.8                           | 15.8 (NM)                                     |
| BC only                          |                    |                               |                                |                                               |
| Range                            | 475 350            | 49.1                          | 50.9                           | -                                             |
| 0-20 km matrix surrounding range | 435 358            | 91.5                          | 8.5                            | 14.2 (NM)                                     |
| 0-30 km matrix surrounding range | 696 906            | 89.9                          | 10.1                           | 25.6 (NM)                                     |

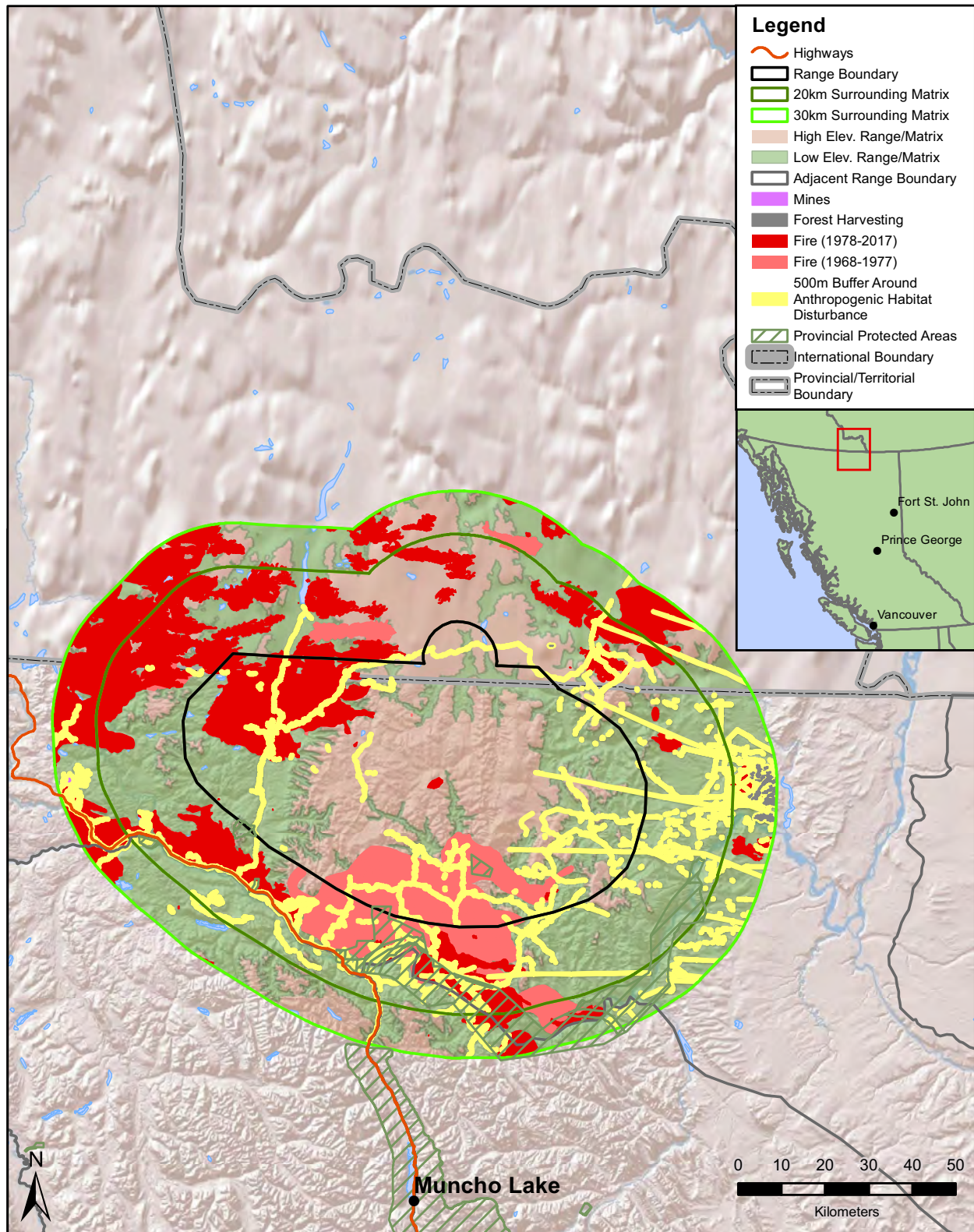
<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA



## Liard Plateau



## Liard Plateau: Total Range (BC and Yukon)

|                | Range Area (ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|-----------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                 | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 520 304         | 11.6                                 | 23.4           | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0.3       | 0        | 7.2  | 2.6     | 0.2        | 4.8   | 2.6                         | 9.3                              | 11.0          | 20.9                                   |
| High elevation | 266 029         | 1.1                                  | 13.6           | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 3.6  | 2.0     | 0          | 3.2   | 0.9                         | 5.9                              | 7.2           | 8.2                                    |
| Low elevation  | 254 275         | 22.6                                 | 33.7           | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0.7       | 0        | 11.0 | 3.2     | 0.4        | 6.4   | 4.4                         | 12.9                             | 15.1          | 34.3                                   |
| Matrix 0-20 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 690 962         | 21.8                                 | 30.2           | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0.1  | 0        | 0         | 0        | 9.9  | 5.2     | 0.3        | 4.6   | 2.1                         | 12.4                             | 14.4          | 33.2                                   |
| High elevation | 177 933         | 20.1                                 | 26.6           | 0              | 0          | 0           | 0        | 0.1      | 0   | 0    | 0            | 0.2  | 0        | 0         | 0        | 1.5  | 2.7     | 0          | 3.4   | 0.2                         | 4.7                              | 5.3           | 24.6                                   |
| Low elevation  | 513 029         | 22.4                                 | 31.4           | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0.1  | 0        | 0         | 0        | 12.7 | 6.0     | 0.4        | 5.0   | 2.7                         | 15.0                             | 17.6          | 36.2                                   |
| Matrix 0-30 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 128 170       | 23.6                                 | 29.5           | 0              | 0          | 0           | 0        | 0.6      | 0   | 0    | 0            | 0.1  | 0        | 0         | 0        | 8.9  | 5.5     | 0.2        | 4.2   | 2.2                         | 11.0                             | 13.4          | 33.7                                   |
| High elevation | 268 985         | 20.3                                 | 25.1           | 0              | 0          | 0           | 0        | 0.1      | 0   | 0    | 0            | 0.1  | 0        | 0         | 0        | 1.0  | 2.2     | 0          | 2.3   | 0.1                         | 3.1                              | 4.0           | 23.6                                   |
| Low elevation  | 859 182         | 24.6                                 | 30.9           | 0              | 0          | 0           | 0        | 0.7      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 11.4 | 6.5     | 0.3        | 4.9   | 2.8                         | 13.5                             | 16.3          | 36.8                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

## Liard Plateau: BC only

|                | Range Area (ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|-----------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                 | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 475 350         | 10.4                                 | 23.4           | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0.4       | 0        | 7.9  | 2.8     | 0.3        | 4.3   | 2.9                         | 9.2                              | 11.1          | 19.9                                   |
| High elevation | 241 916         | 1.0                                  | 14.9           | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 4.0  | 2.2     | 0.1        | 2.4   | 1.0                         | 5.4                              | 6.9           | 7.8                                    |
| Low elevation  | 233 434         | 20.1                                 | 32.2           | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0.7       | 0        | 11.9 | 3.4     | 0.5        | 6.2   | 4.8                         | 13.2                             | 15.6          | 32.5                                   |
| Matrix 0-20 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 435 358         | 16.1                                 | 27.8           | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0.1  | 0        | 0         | 0        | 15.6 | 6.4     | 0.5        | 4.8   | 3.3                         | 17.1                             | 20.0          | 32.3                                   |
| High elevation | 36 801          | 6.8                                  | 29.4           | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0.3  | 0        | 0         | 0        | 7.1  | 3.2     | 0          | 1.2   | 0.8                         | 7.4                              | 9.1           | 15.2                                   |
| Low elevation  | 398 557         | 16.9                                 | 27.7           | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0.1  | 0        | 0         | 0        | 16.4 | 6.7     | 0.5        | 5.1   | 3.5                         | 18.0                             | 21.0          | 33.9                                   |
| Matrix 0-30 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 696 906         | 17.8                                 | 25.9           | 0              | 0          | 0           | 0        | 0.9      | 0   | 0    | 0            | 0.1  | 0        | 0         | 0        | 14.4 | 7.2     | 0.3        | 5.2   | 3.5                         | 16.2                             | 19.2          | 32.5                                   |
| High elevation | 70 402          | 5.0                                  | 16.9           | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0.1  | 0        | 0         | 0        | 3.8  | 1.7     | 0          | 0.7   | 0.5                         | 4.0                              | 4.9           | 9.5                                    |
| Low elevation  | 626 504         | 19.3                                 | 26.9           | 0              | 0          | 0           | 0        | 1.0      | 0   | 0    | 0            | 0.1  | 0        | 0         | 0        | 15.6 | 7.8     | 0.4        | 5.7   | 3.8                         | 17.5                             | 20.8          | 35.1                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

# Rabbit

## Range use summary

The only information available about range use by Rabbit caribou is from aerial surveys. Caribou have been found in high elevation alpine habitat during both winter and summer during surveys. No information is available about use of other habitats.

| Season      | Overview of Habitat and Range Use                                                      | Source                                      |
|-------------|----------------------------------------------------------------------------------------|---------------------------------------------|
| Winter      | <ul style="list-style-type: none"><li>High elevation windswept alpine slopes</li></ul> | Thiessen (2008)<br>BC MFLNRORD unpubl. data |
| Summer      | <ul style="list-style-type: none"><li>High elevation alpine</li></ul>                  | BC MFLNRORD unpubl. data                    |
| Migration   |                                                                                        |                                             |
| Total Range |                                                                                        |                                             |

## Population size

The current population estimate of 1300 caribou was based on the number of caribou counted during a sheep survey in high elevation habitat in the Rabbit caribou range in March 2007 (Thiessen 2008). A total of 1133 caribou were counted and it was assumed that not all caribou in the range were seen during the survey, which resulted in an estimate of 1300 caribou.

| Date | Population estimate | Number counted | Method                        | Reliability | Source                                     |
|------|---------------------|----------------|-------------------------------|-------------|--------------------------------------------|
| 2007 | 1300                | 1133           | Minimum count + Extrapolation | High        | BC MFLNRORD unpubl data<br>Thiessen (2008) |

Prior to 2007, 636 caribou were counted during a survey in March 2000, and 265 caribou were counted during a mountain goat survey in June 1996 (see Population trend below). However, there was no information available on the area covered during either of those surveys and therefore it is unknown whether the number of caribou counted during those surveys was representative of the whole range. Also, the total number of caribou counted in the Rabbit range in June 1996 that we present here differs from the total reported elsewhere. In our total, we only include the 265 caribou that were counted in the Rabbit caribou range; the other 89 caribou counted during that survey were in the Muskwa caribou range. Since 2007, 362 caribou were counted during a composition survey in 2021 (Caribou Recovery Program 2021).

In the future, any potential differences between the number of caribou counted in future surveys and the 2007 survey need to be interpreted with caution. In the nearby Spatsizi caribou range, relative use of alpine areas varied between winters depending on snow conditions (Hatler 1986, 1987). A large proportion of the population was found above treeline during only one of four winters (Hatler 1986). It is unknown whether caribou in the Rabbit range exhibit winter habitat/range use patterns similar to those of Spatsizi caribou, and if they do, whether the 2007 survey was conducted in a year when most of the caribou were using alpine habitat. A better understanding of seasonal range use based on radio-collared caribou would aid in interpreting the number of caribou counted during future surveys.

The most recent population estimate of 1300 caribou for the Rabbit caribou range based on the March 2007 survey is now almost 15 years old and out of date.

## Population trend

Few surveys have been conducted in the Rabbit caribou range from which to infer population trend from. Only three winter surveys have been conducted with reasonable sample sizes (2000, 2007, 2021). Of those three, calf recruitment was above 15% calves recommended by Bergerud (1996) to achieve population stability, during the two most recent survey in (2007, 2021). The 2007 survey was conducted almost 15 years ago and does not necessarily represent current population trend. Although the 2021 recruitment survey suggests at least a stable population, it is the only recent survey available to assess current population trend, and therefore there is not enough information to determine current population trend.

Bergerud (1978) indicated that “R. Sorensen reported that in 1965 he counted 423 animals in this herd.” However, Bergerud (1978) did not provide any details about how (aerial vs ground), where (what portion of the range), when (summer, fall, winter), or over what period of time the count was conducted so it is difficult to make any inferences about population size or trend based on the information provided for this count.

### Rabbit

| Year   | Month   | % calves <sup>1</sup> | Calves/ 100 adults <sup>1</sup> | Calves/100 cows <sup>1</sup> | Total <sup>2</sup> Counted | Total classified <sup>3</sup> |                    | Source <sup>4</sup>                          |
|--------|---------|-----------------------|---------------------------------|------------------------------|----------------------------|-------------------------------|--------------------|----------------------------------------------|
|        |         |                       |                                 |                              |                            | Calves+ Adults                | Calves+ Cows+Bulls |                                              |
| Winter |         |                       |                                 |                              |                            |                               |                    |                                              |
| 2021   |         | 19                    |                                 |                              | 362                        |                               |                    | Caribou Recovery Program 2021                |
| 2007   | Mar     | 16                    | 19                              |                              | (1133) <sup>5</sup>        | 1036                          |                    | BC MFLNRORD unpubl. data <sup>5</sup>        |
| 2001   | Feb     | 19                    | 23                              | 32                           | 54 <sup>6</sup>            | 54                            | 54                 | BC MFLNRORD unpubl. data                     |
| 2000   | Mar     | 11                    | 13                              |                              | 636                        | 636                           |                    | BC MFLNRORD unpubl. data                     |
| 1978   | Feb     | 0                     | 0                               |                              | 22                         | 18                            |                    | Bergerud (1978) (FW) <sup>7</sup>            |
| 1976   | Jan-Feb | 11                    | 12                              |                              | 47                         | 47                            |                    | Elliott in Bergerud (1978) (FW) <sup>8</sup> |
| Summer |         |                       |                                 |                              |                            |                               |                    |                                              |
| 1996   | June    | 18                    | 22                              |                              | (265) <sup>9</sup>         | 265                           |                    | BC MFLNRORD unpubl. data                     |

<sup>1</sup> Calf ratios were based on totals in each age/sex class (except as otherwise indicated) because data detailing composition of groups were not always available so we could not eliminate groups where some animals were unclassified

<sup>2</sup> Numbers in parentheses indicate surveys where caribou were not the primary focus

<sup>3</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

<sup>4</sup> All surveys were conducted by helicopter unless indicated as a fixed-wing (FW) or ground (GR) survey

<sup>5</sup> Number of caribou counted during the Stone's sheep survey were reported in Thiessen (2008), but numbers in the report were not broken down by caribou range and therefore the number counted in the Rabbit caribou range was summarized from BC MFLNRORD unpublished data

<sup>6</sup> These caribou were previously included in the number of caribou counted in the Gataga caribou range portion of this survey; however, a closer examination of the data during our project revealed that they were counted in the Rabbit caribou range; another 39 caribou were counted in the Gataga caribou range and 245 in the Frog caribou range

<sup>7</sup> Includes caribou counted in the Muncho Lake Herd and Rabbit River Herd; in the Rabbit River area, an additional 31 caribou were seen by B. Webster MOE that winter in an area not searched by Bergerud (an additional 22 were seen by BC Hydro but may have been duplicates of those seen by B. Webster; and 17 including 1 calf were seen by B. Kjos but no details on where or when and potentially may have been some duplication of Bergerud's sightings)

<sup>8</sup> Aircraft not specified – assumed FW

<sup>9</sup> Caribou counted during a mountain goat survey; note: this total may differ from the total for this survey reported elsewhere because we only include the 265 caribou that were counted in the Rabbit caribou range; another 89 caribou were counted in the Muskwa caribou range during this survey (see Muskwa)



## Boundary Issues

- The large gap between caribou ranges in the centre of the study area (between the Rabbit, Horseranch, Spatsizi, Frog and Thutade caribou ranges) is known to contain caribou.

## Range condition

Within the current Rabbit caribou range boundary, habitat disturbance covers 7%, 3% and 15% of the total, high elevation and low elevation portions of the range respectively. Primary disturbances are roads/trails and fire, both of which are more prevalent at low elevations than at high elevations. Roads/trails include the Alaska Highway, which forms the northeastern border of the range, and are located primarily near the range boundary. There are few fires <40 years in the range itself, but several large fires are located within the 20 km and 30 km surrounding matrix. The levels of both fires <40 years and anthropogenic habitat disturbance are higher in the 20 km and 30 km matrix surrounding the range than in the range itself.

Our analysis does not include fires from 2018 to 2021. There were two large fires in the northwestern portion of the surrounding matrix in 2018, but did not affect much area in the range itself. Part of the area covered by those fires overlaps another large fire from 2015.

### Rabbit

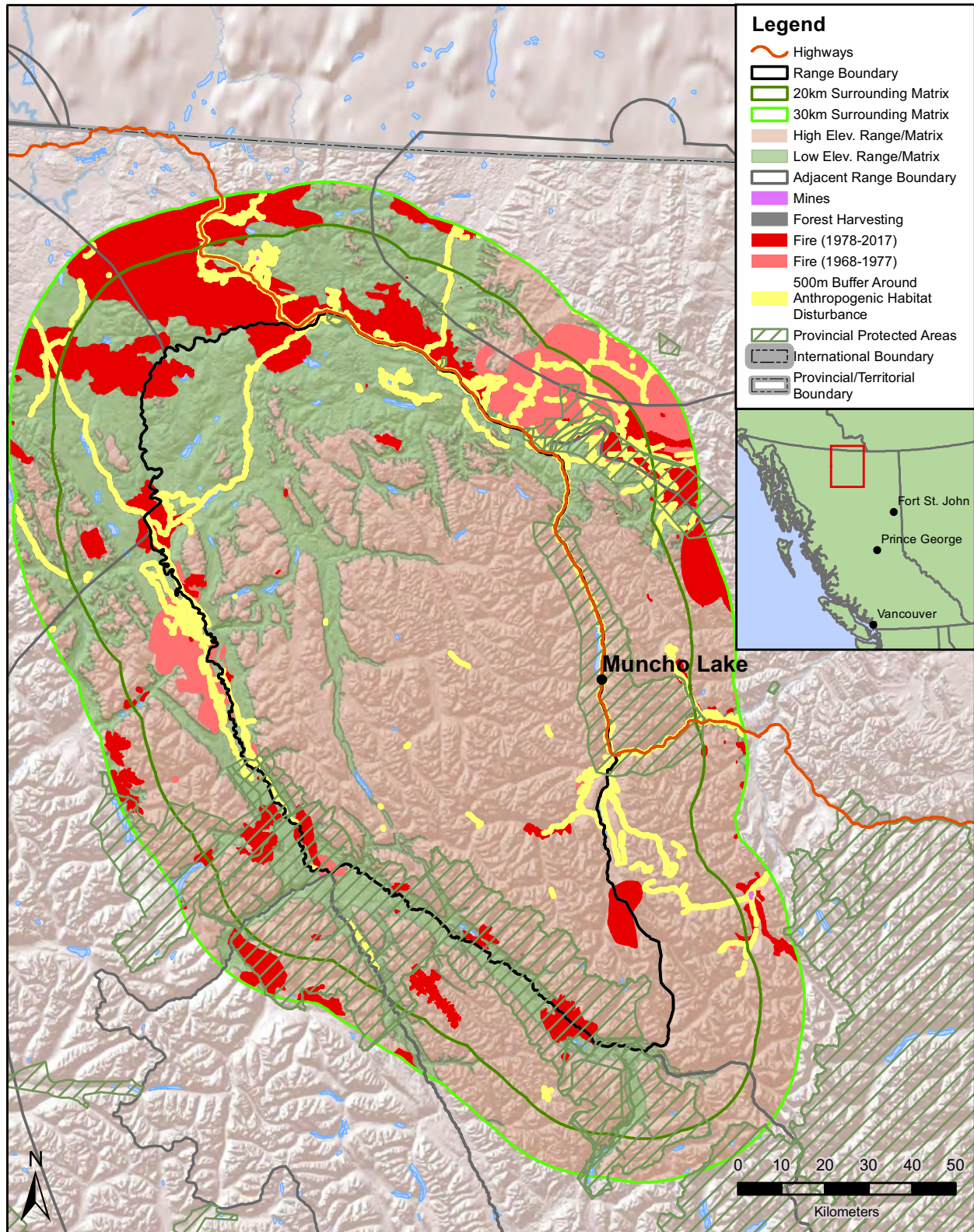
|                                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|----------------------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Total Range                      |                    |                               |                                |                                               |
| Range                            | 1 179 409          | 31.7                          | 68.3                           | -                                             |
| 0-20 km matrix surrounding range | 1 093 947          | 47.9                          | 52.1                           | 64.7 (NM)                                     |
| 0-30 km matrix surrounding range | 1 721 485          | 45.1                          | 54.9                           | 67.5 (NM)                                     |

<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA

## Rabbit



## Rabbit

|                | Range Area (ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|-----------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                 | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 179 409       | 3.6                                  | 4.0            | 0              | 0          | 0           | 0.1      | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 3.4  | 0       | 0          | 0.5   | 0.4                         | 3.5                              | 3.6           | 6.7                                    |
| High elevation | 805 402         | 1.4                                  | 1.6            | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 1.3  | 0       | 0          | 0.3   | 0.2                         | 1.4                              | 1.4           | 2.8                                    |
| Low elevation  | 374 007         | 8.4                                  | 9.1            | 0.1            | 0          | 0.1         | 0.1      | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 7.9  | 0       | 0.1        | 1.2   | 1.0                         | 8.2                              | 8.2           | 15.2                                   |
| Matrix 0-20 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 093 947       | 13.2                                 | 19.9           | 0.2            | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 7.7  | 0.4     | 0.1        | 2.2   | 1.7                         | 8.3                              | 8.4           | 19.7                                   |
| High elevation | 570 481         | 2.4                                  | 5.4            | 0.1            | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 4.3  | 0       | 0          | 0.9   | 0.9                         | 4.4                              | 4.4           | 6.7                                    |
| Low elevation  | 523 466         | 25.0                                 | 35.7           | 0.4            | 0          | 0           | 0        | 0        | 0   | 0.1  | 0            | 0    | 0        | 0         | 0        | 11.5 | 0.9     | 0.1        | 3.7   | 2.6                         | 12.5                             | 12.7          | 34.0                                   |
| Matrix 0-30 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 721 485       | 15.6                                 | 22.0           | 0.2            | 0          | 0           | 0        | 0        | 0   | 0.1  | 0            | 0    | 0        | 0.1       | 0        | 6.6  | 0.5     | 0.1        | 2.0   | 1.6                         | 7.0                              | 7.2           | 20.8                                   |
| High elevation | 944 682         | 4.4                                  | 8.5            | 0.1            | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 3.1  | 0       | 0.1        | 0.7   | 0.7                         | 3.2                              | 3.2           | 7.4                                    |
| Low elevation  | 776 801         | 29.2                                 | 38.4           | 0.3            | 0          | 0.1         | 0.1      | 0        | 0   | 0.1  | 0            | 0    | 0        | 0.2       | 0        | 10.8 | 1.1     | 0.2        | 3.6   | 2.6                         | 11.8                             | 12.1          | 37.1                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

# Muskwa

## Range use summary

During calving, adult female caribou are found almost exclusively in high elevation alpine areas (Tripp et al. 2006, BC MFLNRORD in prep.). Caribou are also found primarily in high elevation habitat during summer and fall, but there is also some use of forested areas at lower elevations. During winter, caribou are found in both high elevation alpine habitat and to a lesser extent in forested areas (Tripp et al. 2006, BC MFLNRORD in prep.). The greatest use of high elevation alpine habitat is during calving and greatest use of forested habitat is during winter. Low elevation pine-lichen forests were limited in extent in the 2000-2004 study area (Tripp et al. 2006).

One caribou that was radio-collared in the Parker Boreal Caribou range in winter 2013, moved into the mountains in the Muskwa caribou range during calving in 2013 and 2015 but not in 2014 (Watters and DeMars 2016). It is unclear whether this was a Boreal Caribou that had calved in the Muskwa caribou range for two years, or a Muskwa caribou that wintered in the Parker caribou range each winter and calved in the Parker Boreal Caribou range during one of three years.

| Season      | Overview of Habitat and Range Use                                                                                                                                                                                                                                                                                                                       | Source                                        |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| Winter      | <ul style="list-style-type: none"><li>Primarily high elevation windswept alpine slopes</li><li>Some winter use (up to 39%) in forested habitat adjacent to alpine</li></ul>                                                                                                                                                                             | Tripp et al. (2006)<br>BC MFLNRORD (in prep.) |
| Summer      | <ul style="list-style-type: none"><li>Calving is typically in high elevation alpine habitat</li><li>The highest use of alpine habitat is during calving</li><li>Summer and fall use is mostly in high elevation habitats and to a lesser extent in forested areas</li><li>Caribou moved in a generally northeasterly direction to fall ranges</li></ul> | Tripp et al. (2006)<br>BC MFLNRORD (in prep.) |
| Migration   |                                                                                                                                                                                                                                                                                                                                                         |                                               |
| Total Range |                                                                                                                                                                                                                                                                                                                                                         |                                               |

## Population size

For the Muskwa caribou, we include only the two population estimates based on the number counted during the October 2001 and July 2004 surveys. There have been other population estimates reported that we do not include, because the estimates were based on expert opinion or there was insufficient data to support the population estimates.

The most recent population estimate of 917 caribou for the Muskwa range was based on a survey conducted in 2004. The highest number of caribou counted in the Muskwa caribou range was 658 caribou during a fall caribou survey in 2001 from a study on radio-collared caribou between October 2000 and June 2004 (Tripp et al. 2006; see Population trend below). Prior to 2001, the highest number counted was 399 in 1978 (see Population trend below).

COSEWIC (2014) provided an estimate of 1000 caribou based on a 738 caribou counted during a sheep survey in 2007. However, since then an error was found in the database in which data for Muskwa was duplicated and the correct number of caribou seen during that survey was 369 and not 738 (BC MFLNRORD, unpubl. data). We therefore do not include the 2007 as a population estimate here.

In addition, we found an error in how population estimates were calculated in Tripp et al. (2006) report (see below). Subsequently, BC MFLNRORD used data from the July 2004 survey from that project and recalculated the population estimate as 917 (A. Pelletier, pers. comm.)



| Date | Population estimate <sup>1</sup> | Number counted | Method        | Reliability | Source                    |
|------|----------------------------------|----------------|---------------|-------------|---------------------------|
| 2004 | 917                              | 516            | Mark/re-sight | Moderate    | A. Pelletier, pers. comm. |

<sup>1</sup> COSEWIC (2014) provided an estimate of 1000 caribou based on a 738 caribou counted during a sheep survey in 2007. However, since then an error was found in the database in which data for Muskwa was duplicated; the correct number of caribou seen during that survey was 369 and not 738. We therefore do not include the 2007 as a population estimate here (see Population trend).

Tripp et al. (2006) used the proportion of radio-collared caribou seen during spring (June), fall (October) and late winter (February/March) surveys from October 2000 to June 2004 to calculate a relocation index that was then applied to the number of caribou counted during the survey. The relocation index was the proportion of caribou not seen during the survey, added to 1. For example, in June 2001, 23 of 26 radio-collared caribou were seen during the survey, which meant that 11% or a proportion of 0.11 were not seen. The relocation index was calculated as  $1 + 0.11$  or 1.11, which was multiplied by the total count of 471 to result in a population estimate of 522. The standard (and mathematically correct) method for mark/re-sight calculations is to apply the proportion of radio-collared caribou seen to the number counted during the survey (Krebs 1989). For June 2001, 23/26 or 89% of the radio-collared caribou were seen during the survey and therefore it is assumed that 89% of the population was counted during the survey. The number counted during the survey was 471, which is 89% of 532. Although the two estimates (522 vs 532) do not differ substantially, as the proportion of radio-collared caribou seen decreases, this difference increases. For example, in October 2001, when 7 of 26 radio-collared caribou were seen and 658 caribou were counted, the population estimates were 1138 using Tripp et al.'s (2006) calculations, and 2444 using the proportion method. As the proportion of radio-collared caribou seen during a survey decreases, so does the reliability of the estimate; that is the confidence limits around an estimate based only 27% of the marked animals seen will be very wide. Tripp et al. (2006) do not provide confidence limits around their estimates. Due to the error in calculating population estimates in Tripp et al. (2006), we do not include population estimates from that report but use MFLNRORD's estimate of 917 based on the recalculation of data from the June 2004 survey.

Bergerud and Elliott (1998) provide a population estimate of 3000 caribou in 1990, which appears to be based on a late winter survey in 1990. However, they do not provide any data from that survey to support the estimate. The only data provided on a late winter survey for caribou in 1990 show that 212 cows were classified and that there were 17.5 calves/100 cows based on the classified cow sample (Bergerud and Elliott 1998). Given insufficient information, we do not include the 1990 estimate in the list of population estimates here.

## Population trend

Of the three most recent late winter surveys, the calf recruitment estimate from the March 2017 survey was below 15% calves recommended by Bergerud (1996) to achieve population stability, while the March 2018 and 2020 calf recruitment estimates were above 15%. However, the 2018 calf recruitment estimate is based on a small sample size and potentially may not represent calf recruitment for the whole population.

From 2001 to 2003, late winter calf recruitment was above 15% in one of three years (Tripp et al. 2006). From 1977 to 1987, calf recruitment was at or above 15% in four of six years with the highest level (21% in 1985) the year following wolf removal and the second highest level 2 years following wolf removal (20% in 1987), although calf recruitment estimates were also above 15% in 1979 and 1980, prior to wolf removal.

During fall surveys in 2002 and 2003, calves/100 cows ratios were within the 20 to 25 calves/100 cows range, which is considered sufficient to support a stable population growth rate (Environment Yukon 2016). Calves/100 cows ratios were well above those levels in 1985 and 1987 after wolf control was conducted the previous winters. It is unknown whether fall surveys of rutting areas in the Muskwa caribou range are biased against calves as detected in the Spatsizi caribou range (Hatler 1987), however, even if that is the case, the two most recent fall surveys suggest that calf recruitment was sufficient to support a stable population growth rate in the early 2000s.



Muskwa

| Year           | Month               | % calves <sup>1</sup> | Calves/ 100 adults <sup>1</sup> | Calves/100 cows <sup>1</sup> | Total <sup>2</sup> Counted | Total classified <sup>3</sup> |                    | Source <sup>4</sup>                           |
|----------------|---------------------|-----------------------|---------------------------------|------------------------------|----------------------------|-------------------------------|--------------------|-----------------------------------------------|
|                |                     |                       |                                 |                              |                            | Calves+ Adults                | Calves+ Cows+Bulls |                                               |
| Winter         |                     |                       |                                 |                              |                            |                               |                    |                                               |
| 2020           | Mar                 | 18                    | 23                              | 33                           | 141                        | 141                           | 136                | A. Pelletier, pers. comm.                     |
| 2018           | Mar                 | 21                    | 26                              | 31                           | 92                         | 92                            | 92                 | A. Pelletier, pers. comm.                     |
| 2017           | Mar                 | 12                    | 14                              | 20                           | 177                        | 177                           | 161                | A. Pelletier, pers. comm.                     |
| 2007           | Mar                 | 15                    | 19                              | -                            | (369) <sup>5</sup>         | 176                           |                    | BC MFLNRORD unpubl. data                      |
| 2003           | Mar                 | 12                    | 13                              | 18                           | 234                        | 234                           | 226                | Tripp et al. (2006)                           |
| 2002           | Feb                 | 14                    | 17                              | 26                           | 210                        | 210                           | 201                | Tripp et al. (2006)                           |
| 2001           | Mar                 | 16                    | 20                              | 30                           | 457                        | 457                           | 435                | Tripp et al. (2006)                           |
| 2001           | Jan                 | 12                    | 14                              | -. <sup>6</sup>              | 252                        | 252                           |                    | Tripp et al. (2006)                           |
| 1990           | Winter <sup>7</sup> |                       |                                 | 18 <sup>7</sup>              | 249 <sup>7</sup>           |                               | 249 <sup>7</sup>   | Bergerud and Elliott (1998)                   |
| 1987           | Mar                 | 20                    | 25                              | 31                           | 331                        | 331                           | 331                | Elliott (1987)                                |
| 1985           | Feb/Mar             | 21 <sup>8</sup>       | 27 <sup>8</sup>                 | -                            | 324                        | 324                           |                    | Elliott (1985)                                |
| 1980           | Winter <sup>9</sup> | 17                    | 21                              | -                            | 328                        | 328                           |                    | Elliott (1980)                                |
| 1979           | Winter <sup>9</sup> | 18                    | 22                              | -                            | 71                         | 71                            |                    | Elliott (1980)                                |
| 1978           | Feb                 | 11                    | 12                              | -                            | 399                        | 369                           |                    | Bergerud (1978) (FW) <sup>10</sup>            |
| 1977           | Feb                 | 13                    | 15                              | -                            | 219                        | 179                           |                    | Elliott in Bergerud (1978) (FW) <sup>11</sup> |
| Fall           |                     |                       |                                 |                              |                            |                               |                    |                                               |
| 2003           | Oct                 | 14                    | 16                              | 25                           | 411                        | 411                           | 395                | Tripp et al. (2006)                           |
| 2002           | Oct                 | 12                    | 14                              | 21                           | 516                        | 516                           | 515                | Tripp et al. (2006)                           |
| 2001           | Oct                 | -. <sup>12</sup>      | -. <sup>12</sup>                | -. <sup>12</sup>             | 658                        |                               |                    | Tripp et al. (2006)                           |
| 2000           | Oct                 | -. <sup>12</sup>      | -. <sup>12</sup>                | -. <sup>12</sup>             | 288                        |                               |                    | Tripp et al. (2006)                           |
| 1987           | Fall                | -                     | -                               | 65 <sup>7,8</sup>            | 186 <sup>7</sup>           |                               | 186 <sup>7</sup>   | Bergerud and Elliott (1998)                   |
| 1985           | Oct                 | 26 <sup>8</sup>       | 35 <sup>8</sup>                 | 52 <sup>8</sup>              | 192                        | 192                           | 192                | Elliott (1986)                                |
| 1983           | Oct                 | 20                    | 26                              | -                            | 123                        | 123                           |                    | Elliott (1984)                                |
| Calving/summer |                     |                       |                                 |                              |                            |                               |                    |                                               |
| 2017           | July                | 22                    | 28                              | 33                           | (281)                      | 281                           | 277                | A. Pelletier, pers. comm.                     |
| 2004           | June                | 22                    | 28                              | 42                           | 516                        | 516                           | 506                | Tripp et al. (2006)                           |
| 2003           | June                | 16                    | 19                              | 31                           | 520                        | 520                           | 505                | Tripp et al. (2006)                           |
| 2002           | June                | 25                    | 34                              | -. <sup>6</sup>              | 401                        | 401                           |                    | Tripp et al. (2006)                           |
| 2001           | June                | 27                    | 37                              | -. <sup>6</sup>              | 471                        | 471                           |                    | Tripp et al. (2006)                           |
| 1996           | June                | 20                    | 25                              | 47                           | (89) <sup>13</sup>         | 89                            | 61                 | BC MFLNRORD unpubl. data                      |

<sup>1</sup> Calf ratios were based on totals in each age/sex class (except as otherwise indicated) because data detailing composition of groups were not available so we could not eliminate groups where some animals were unclassified

<sup>2</sup> Numbers in parentheses indicate surveys where caribou were not the primary focus

<sup>3</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

<sup>4</sup> All surveys were conducted by helicopter unless indicated as a fixed-wing (FW) or ground (GR) survey

<sup>5</sup> The total differs from COSEWIC (2014) because since then an error was found in the database in which data for Muskwa was duplicated; the correct number of caribou seen during that survey was 369; the number of caribou counted during the Stone's sheep survey were reported in Thiessen (2008) but numbers in the report were not broken down by caribou range and therefore the number counted in the Muskwa caribou range was summarized from BC MFLNRORD unpublished data

<sup>6</sup> We did not calculate calves/100 cows because the proportion of unclassified adults was high

<sup>7</sup> Sex/age class numbers were not reported in Bergerud and Elliott (1998). In this table, the number classified is the number of cows (reported) plus the number of calves (derived by multiplying the calf/100 cow ratio by the number of cows); no other survey data or the survey date were provided by Bergerud and Elliott (1998)

<sup>8</sup> Wolves were removed from the Muskwa area the previous winter 1983/84 (partial; Elliott 1984), 1984/85 (total; Elliott 1985), and 1986/87 (total; Elliott 1987). (Note: there were no wolves removed in 1985/86 (Elliott 1986)).

<sup>9</sup> No survey dates specified other than late winter; includes combined area of Macdonald-Racing and Toad River

<sup>10</sup> Compiled from several areas including Muncho Lake, Racing River, Tuchodi River, Kluachesi Lake and Toad River

<sup>11</sup> Toad River area only; aircraft not specified – assumed Helicopter

<sup>12</sup> Calves were not distinguished from yearlings in October 2000 and October 2001

<sup>13</sup> Caribou counted in the Muskwa caribou range portion of WMU7-51 during a mountain goat survey; these groups were previously lumped in with the Rabbit caribou range

It is not clear what the survey areas were for fall 1987 or winter 1990 based on information in Bergerud and Elliott (1998). The fall 1983, fall 1985 and winter 1987 survey areas were described in Elliott (1984), Elliott (1986) and Elliott (1987) respectively and lie entirely within the Muskwa caribou range. However, the map in Bergerud and Elliott (1998) shows the caribou survey area (presumably for all caribou surveys discussed) in what appears to be the Pink Mountain caribou range. We assumed that the fall 1987 and winter 1990 survey areas were the same as those for fall 1983, fall 1985 and winter 1987 and not as indicated on the map in Bergerud and Elliott (1998).

The numbers in our table do not necessarily match numbers in Bergerud and Elliott (1998). Bergerud and Elliott (1998) provided calves/100 cows ratios for Muskwa for 1979, 1980 and 1985. Although adults were not classified during those surveys, they assumed that cows made up two-thirds of the total adult count. Also, for the 1979 and 1980 surveys, it appears that they included surveys from the Prophet River area in their totals (based on data summarized in Elliott 1980), which were conducted the previous fall and therefore likely resulted in overestimates of the calves/100 cows ratios since over-winter mortality was not incorporated. This is especially problematic for late winter calf recruitment in 1979, which is based on 71 caribou counted in the Macdonald-Racing and Toad River areas in late winter, but the majority of caribou (219) were counted in the Prophet River area in fall 1978 (Elliott 1980). In our analysis, we only include the Macdonald-Racing and Toad River area surveys in the Muskwa caribou range, which were both conducted during winter, and we have included the Prophet River area in the Pink Mountain caribou range, where both surveys (Prophet River, Pink Mountain-Halfway) were conducted in the fall. Also, we do not include calves/100 cows ratios for the 1979, 1980 or 1985 Muskwa winter surveys because adults were not classified to bulls and cows, and we chose not to make assumptions about the proportion of cows in the adult sample.

Tripp et al. (2006) provide three full years of adult female mortality rates: 17% (Oct 2000 to Sept 2001); 22% (Oct 2001 to Sept 2002); and, 7% (Oct 2002 to Sept 2003). No data on population growth rate based on adult mortality and calf recruitment was readily available.

Of the three recent late winter calf recruitment surveys, one (2017) suggests and decreasing population trend, and two (2018, 2020) suggest a stable or increasing population, although sample size in 2018 was low. There is not enough information to determine a consistent recent population trend, nor a long-term population trend.

## **Boundary Issues**

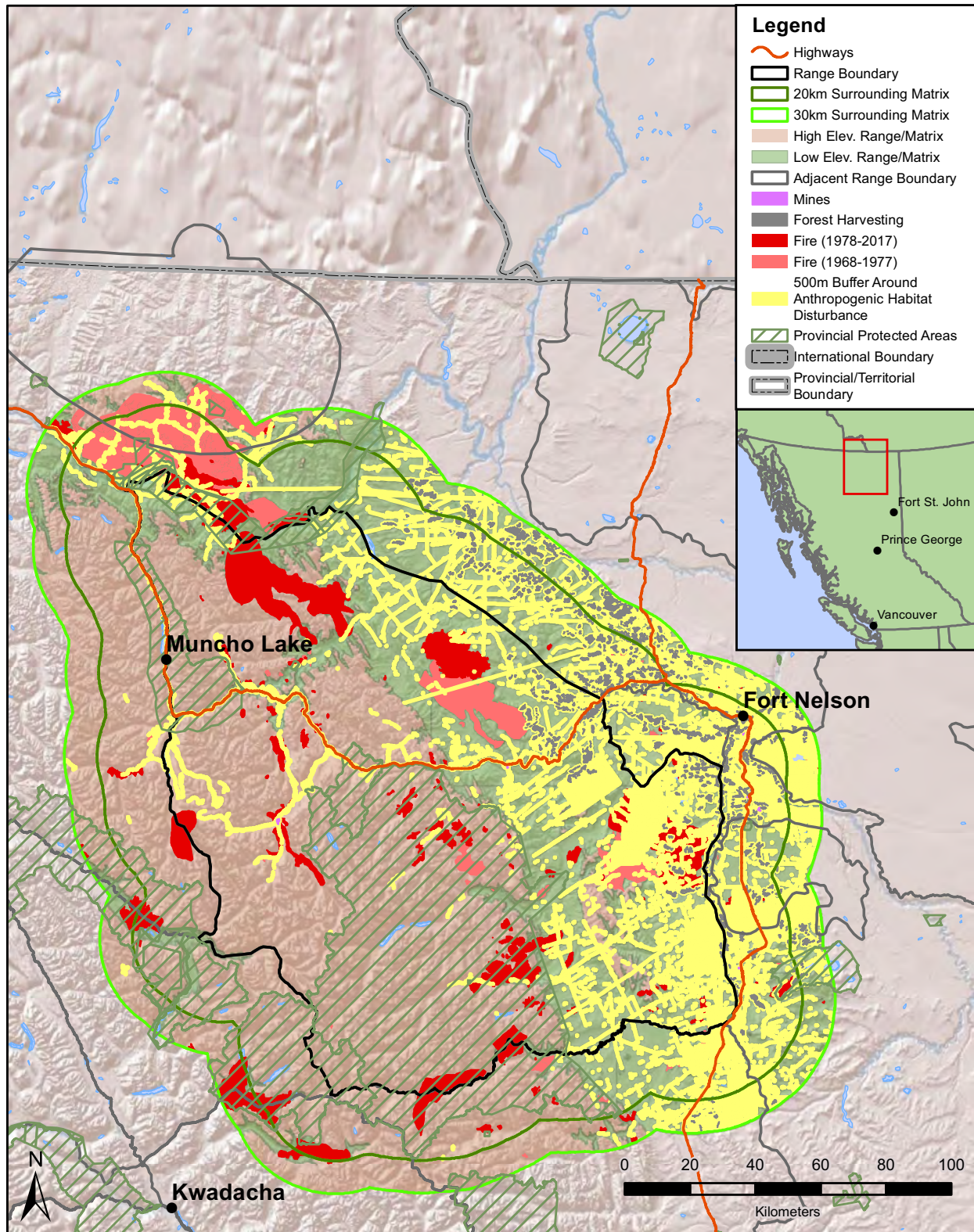
There were no boundary issues identified, however, the level of caribou use in the eastern portion of the range (e.g. east of the Muskwa and Dunedin rivers) may need to be assessed.

## **Range condition**

Within the current Muskwa caribou range boundary, habitat disturbance covers 25%, 11% and 46% of the total, high elevation and low elevation portions of the range respectively. Habitat disturbance in the low elevation portion of the range is over the 35% disturbance threshold for critical habitat in the recovery strategy for southern mountain caribou (Environment Canada 2014). Primary disturbances are roads/trails, seismic lines, fire and forest harvesting, all four of which are more prevalent at low elevations than at high elevations. Roads/trails primarily include the Alaska Highway, and industrial roads associated with oil and gas and forest harvesting activity in the eastern and northeastern portions of the range. Fires <40 years are distributed throughout the range. Habitat disturbance is higher in the 20 km and 30 km matrix surrounding the range, especially in the area to the northeast of the range. The western portion of the range, where most of the caribou activity has been recorded, and the 20 km and 30 km matrices to the west of the range, contain low levels of anthropogenic habitat disturbance.

Our analysis does not include fires from 2018 to 2021, however, there were no significant fires recorded in the Muskwa caribou range or in the surrounding matrix in those four years.

## Muskwa



## Muskwa

|                                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|----------------------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Total Range                      |                    |                               |                                |                                               |
| Range                            | 2 158 213          | 41.8                          | 58.2                           | -                                             |
| 0-20 km matrix surrounding range | 1 481 104          | 56.6                          | 43.4                           | 54.4 (NM)<br>9.9 (Boreal)                     |
| 0-30 km matrix surrounding range | 2 281 006          | 56.0                          | 44.0                           | 56.4 (NM)<br>8.4 (Boreal)                     |

<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA



## Muskwa

|                | Range Area (ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|-----------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                 | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 2 158 213       | 8.4                                  | 11.2           | 0              | 0          | 0.1         | 0        | 2.1      | 0   | 0    | 0.4          | 0.5  | 0.1      | 0         | 0        | 14.5 | 7.4     | 0.1        | 1.1   | 0.8                         | 14.8                             | 19.4          | 25.8                                   |
| High elevation | 1 256 932       | 6.3                                  | 7.1            | 0              | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 4.8  | 0.3     | 0.1        | 0.8   | 0.8                         | 4.8                              | 5.1           | 11.1                                   |
| Low elevation  | 901 281         | 11.3                                 | 16.9           | 0              | 0          | 0.2         | 0.1      | 5.0      | 0   | 0    | 1.0          | 1.2  | 0.2      | 0         | 0        | 28.1 | 17.3    | 0.1        | 1.4   | 0.7                         | 28.8                             | 39.4          | 46.2                                   |
| Matrix 0-20 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 481 104       | 5.1                                  | 11.9           | 0.3            | 0          | 0.3         | 0        | 7.1      | 0   | 0.1  | 1.2          | 1.5  | 0.3      | 0.3       | 0.2      | 22.3 | 13.3    | 0.5        | 1.4   | 1.0                         | 22.7                             | 29.1          | 32.7                                   |
| High elevation | 643 167         | 3.7                                  | 8.6            | 0.1            | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 2.1  | 0       | 0.1        | 0.4   | 0.3                         | 2.2                              | 2.3           | 5.9                                    |
| Low elevation  | 837 937         | 6.2                                  | 14.4           | 0.4            | 0          | 0.5         | 0        | 12.6     | 0   | 0.1  | 2.1          | 2.7  | 0.5      | 0.5       | 0.4      | 37.7 | 23.4    | 0.8        | 2.2   | 1.5                         | 38.4                             | 49.7          | 53.3                                   |
| Matrix 0-30 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 2 281 006       | 4.4                                  | 10             | 0.4            | 0          | 0.2         | 0.1      | 7.2      | 0   | 0    | 1.1          | 1.5  | 0.4      | 0.2       | 0.2      | 22.5 | 13.5    | 0.4        | 1.4   | 1.0                         | 22.9                             | 29.3          | 32.5                                   |
| High elevation | 1 003 803       | 3.0                                  | 7.4            | 0.1            | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 1.8  | 0       | 0          | 0.4   | 0.4                         | 1.8                              | 1.9           | 4.8                                    |
| Low elevation  | 1 277 194       | 5.4                                  | 12.1           | 0.6            | 0          | 0.4         | 0.1      | 12.9     | 0   | 0.1  | 2.1          | 2.7  | 0.7      | 0.4       | 0.4      | 38.9 | 24.0    | 0.6        | 2.1   | 1.5                         | 39.4                             | 50.9          | 54.3                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.



# Pink Mountain

## Range use summary

During winter, Pink Mountain caribou are found in high elevation alpine and high elevation forested habitat in the western portion of the range, and in low elevation forested habitat in the eastern portion of the range. Currently, there are no reports that discuss variability in winter habitat and winter range use between years with different winter conditions. Calving occurs primarily at higher elevations in the foothills in the eastern portion of the range, or in the higher mountains in the western portion. During summer, caribou use primarily high elevations but may move down in elevation in the fall.

| Season      | Overview of Habitat and Range Use                                                                                                                                                                                                                                                                                                                                                                       | Source                                                                                         |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Winter      | <ul style="list-style-type: none"> <li>Two wintering strategies <ul style="list-style-type: none"> <li>High elevation alpine or forests in the western portion of the range</li> <li>Low elevation forested habitat in the eastern portion of the range</li> </ul> </li> <li>At low elevations, caribou have been found in mature black spruce and pine stands, and mature black spruce bogs</li> </ul> | Parker and Gustine (2007)<br>Gustine and Parker (2008)<br>MFLNRORD (in prep.)<br>Hansen (2017) |
| Summer      | <ul style="list-style-type: none"> <li>Calving occurs primarily in high elevation alpine and subalpine habitat</li> </ul>                                                                                                                                                                                                                                                                               | Parker and Gustine (2007)<br>BC MFLNRORD (in prep.)                                            |
| Migration   | <ul style="list-style-type: none"> <li>Lower elevations</li> </ul>                                                                                                                                                                                                                                                                                                                                      | BC MFLNRORD (in prep.)                                                                         |
| Total Range |                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                |

Radio-collared caribou data suggests overlap between the Finlay and Pink Mountain caribou seasonal ranges (Zimmerman et al. 2002, Woods and McNay 2018, Klaczek and Anderson 2020). Based on 120 caribou collared in the Finlay and Pink Mountain caribou ranges from 1999 to 2005, 18 (11%) used both ranges (Woods and McNay 2018). Three caribou collared in the Finlay caribou range in March 2017 moved to the Pink Mountain area in June 2017 and remained in the Pink Mountain area the following winter (Klaczek 2018). A fourth radio-collared caribou also moved to the Pink Mountain area the following year (Klaczek and Anderson 2020).

## Population size

The current population estimate of 1275 caribou is based on an aerial survey in high elevation habitat in the Pink Mountain caribou range in March 1993 (BC MFLNRORD, unpubl. data). This estimate is now over 25 years old. Since 1993, the highest numbers of caribou counted during surveys were 377 in 2000 and 323 in 2017 (see Population trend below). Many of the surveys conducted since 1993 were not intended as total count population surveys and did not include the whole caribou range. Also, most of the surveys were conducted in alpine habitat during winter, and because some caribou winter in lower elevation habitat in the eastern portion of their range, not all caribou would have been targeted during those surveys.

| Date | Population estimate | Number counted | Method        | Reliability    | Source                   |
|------|---------------------|----------------|---------------|----------------|--------------------------|
| 1993 | 1275                | 1275           | Minimum count | Moderate/ High | BC MFLNRORD unpubl. data |

## Population trend

Only two surveys have been conducted in the Pink Mountain caribou range during fall (1978, 1979). Because cows and bulls were lumped together as unclassified adults, we could not calculate calves/100 cows ratios to assess whether they were at or above 20 to 25 calves/100 cows, which is considered sufficient to support a stable population growth rate (Environment Yukon 2016).

Almost all of the surveys conducted in the Pink Mountain caribou range have been conducted during late winter. Of the 11 surveys conducted between 1976 and 2018 where calves were distinguished from adults, calf recruitment estimates for five surveys were above 15% calves recommended by Bergerud (1996) to achieve population stability. Calf recruitment estimates from the most recent survey (2018) suggests the population is likely stable, but estimates from the two previous surveys (2016, 2017) suggest that the population is declining.

It is not possible to evaluate population trend based on number of animals counted during surveys, given lack of information on effort for older surveys, and variability in seasonal range use. Bergerud (1978) suggested that the population decreased by 94% from 2675 in 1969 to 151 in 1978. However, the 1969 survey was from the Canada Land Inventory (CLI) survey in 1969 that included a much larger area; only 1125 caribou were counted during the CLI survey in 1969 in an area comparable to the area surveyed in 1978 (Bergerud 1978). Bergerud (1978) described conditions during the 1969 CLI survey as a period of extreme cold weather and temperature inversions, and deeper snow than the 1968 CLI survey, when 564 caribou were counted in the area comparable to the 1978 survey area. Any difference between the number counted during the 1968 CLI survey and 1969 CLI survey would have been more likely due to variation in winter conditions, and not to a doubling of the caribou population. The 1969 survey may have also been conducted during a winter with conditions that resulted in a large portion of the population using high elevation alpine areas. In the nearby Spatsizi caribou range, winter conditions resulted in most of the radio-collared caribou using windswept alpine slopes in only one of four years of the study (Hatler 1986). It is therefore possible that the 1969 CLI survey was conducted in a year when most of the caribou were using alpine habitat, while the 1978 survey may have been conducted during a year when many caribou were using lower elevation forested areas. Caribou in the Pink Mountain area use both high elevation alpine areas and lower elevation forested areas during winter (Parker and Gustine 2008, BC MFLNRORD in prep.). While we question the decline estimate of 94%, we can't rule out a decline. Also, there is a strong likelihood that populations were at higher levels then following wide-scale wolf poisoning programs in the 1950s and early 1960s (Hoffos 1987, BC MFLNRO 2014).

No information on adult survival or population growth rate (based on adult mortality and calf recruitment) was readily available from radio-collared caribou studies.

Two surveys (1994, 1995) included the area between the Halfway River and Cypress Creek, which is in the Graham caribou range. For those two surveys, we only included caribou groups that were counted in the Pink Mountain caribou range.

## Pink Mountain

| Year   | Month              | % calves <sup>1</sup> | Calves/ 100 adults <sup>1</sup> | Calves/100 cows <sup>1</sup> | Total <sup>2</sup> Counted | Total classified <sup>3</sup> |                    | Source <sup>4</sup>                           |
|--------|--------------------|-----------------------|---------------------------------|------------------------------|----------------------------|-------------------------------|--------------------|-----------------------------------------------|
|        |                    |                       |                                 |                              |                            | Calves+ Adults                | Calves+ Cows+Bulls |                                               |
| Winter |                    |                       |                                 |                              |                            |                               |                    |                                               |
| 2018   | Mar                | 16                    | 19                              | 23                           | 237                        | 237                           | 237                | A. Pelletier, pers. comm.                     |
| 2017   | Mar                | 10                    | 11                              | 17                           | 323                        | 323                           | 322                | Hansen (2017)                                 |
| 2016   | Feb                | 9                     | 10                              | 15                           | 252                        | 252                           | 207                | A. Pelletier, pers. comm.                     |
| 2008   | Feb                | 19                    | 24                              | 30                           | 242                        | 242                           | 242                | Goddard (2009)                                |
| 2007   | Mar                |                       |                                 |                              | (266) <sup>5</sup>         |                               |                    | BC MFLNRORD unpubl. data <sup>5</sup>         |
| 2002   | Feb/Mar            | 11                    | 12                              | –                            | 133                        | 131                           |                    | Zimmerman et al. (2002)                       |
| 2000   | Mar                | 10                    | 11                              | 12                           | 377                        | 377                           | 377                | BC MFLNRORD unpubl. data <sup>6</sup>         |
| 1995   | Feb                | 8                     | 9                               | 14                           | 270 <sup>7</sup>           | 261                           | 260                | BC MFLNRORD unpubl. data                      |
| 1994   | Jan/Feb            | 18                    | 23                              | 27                           | 152 <sup>8</sup>           | 152                           | 152                | BC MFLNRORD unpubl. data                      |
| 1993   | Feb                | 10                    | 11                              | 14                           | 1275 <sup>9</sup>          | 1275                          | 1275               | BC MFLNRORD unpubl. data                      |
| 1978   | Feb                | 16                    | 20                              |                              | 151                        | 151                           |                    | Bergerud (1978) (FW) <sup>10</sup>            |
| 1976   | Dec                | 16                    | 19                              |                              | 186                        | 186                           |                    | Elliott in Bergerud (1978) (FW) <sup>11</sup> |
| 1969   | Jan                |                       |                                 |                              | (2675) <sup>12</sup>       |                               |                    | CLI in Bergerud (1978) (FW) <sup>12</sup>     |
| 1968   | Feb/Mar            |                       |                                 |                              | (1018) <sup>13</sup>       |                               |                    | CLI in Bergerud (1978) (FW) <sup>13</sup>     |
| Fall   |                    |                       |                                 |                              |                            |                               |                    |                                               |
| 1979   | Fall <sup>14</sup> | 15                    | 18                              |                              | 389                        | 389                           |                    | Elliott (1980)                                |
| 1978   | Fall <sup>14</sup> | 24                    | 32                              | –                            | 430                        | 430                           |                    | Elliott (1980)                                |

<sup>1</sup> Calf ratios were based on totals in each age/sex class (except as otherwise indicated) because data detailing composition of groups were not always available so we could not eliminate groups where some animals were unclassified

<sup>2</sup> Numbers in parentheses indicate surveys where caribou were not the primary focus

<sup>3</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

<sup>4</sup> All surveys were conducted by helicopter unless indicated as a fixed-wing (FW) or ground (GR) survey

<sup>5</sup> Number of caribou counted during the Stone's sheep survey were reported in Thiessen (2008), but numbers in the report were not broken down by caribou range and therefore the number counted in the Pink Mountain caribou range was summarized from BC MFLNRORD unpublished data

<sup>6</sup> Aircraft not specified; assumed helicopter

<sup>7</sup> MFLNRORD unpubl. data indicates that the survey was conducted in the Pink Mtn area; although not all groups have location data, of the ones that do, several groups totaling 63 caribou were counted in the Graham caribou range; based on location data, 270 caribou were counted in the Pink Mountain caribou range and 63 were counted in the Graham caribou range; aircraft not specified, assumed helicopter

<sup>8</sup> MFLNRORD unpubl. data indicates that the survey was conducted between the Prophet River and Cypress Creek; based on location data, 152 caribou were counted in the Pink Mountain caribou range and 112 were counted in the Graham caribou range; aircraft not specified, assumed helicopter

<sup>9</sup> MFLNRORD unpubl. data indicates that the survey was conducted between the Prophet and Halfway rivers (but there is no location data) so the whole survey was conducted within the Pink Mountain caribou range; aircraft not specified, assumed helicopter

<sup>10</sup> Survey area included the area between the Sikanni Chief and Halfway rivers

<sup>11</sup> Survey conducted by Elliott in the vicinity of Pink Mountain but no details of exact survey area other than it did not include the area west of Marion Lake; aircraft not specified - assumed FW

<sup>12</sup> Canada Land Inventory (CLI) data summarized by Bergerud 1978; partial map included in that report - survey area appears to be within the current Pink Mountain caribou range boundary; 1125 caribou counted within the area comparable to the area covered during the February 1978 survey (Bergerud 1978)

<sup>13</sup> Canada Land Inventory (CLI) data summarized by Bergerud 1978; survey area not specified; aircraft not specified – assumed FW; 564 caribou counted within the area comparable to the area covered during the February 1978 survey (Bergerud 1978)

<sup>14</sup> No survey dates specified other than fall; includes combined area of Pink Mountain-Halfway and Prophet River

## Boundary Issues

- Recent telemetry data suggest overlap between Pink Mountain and Finlay caribou ranges.

Radio-collared caribou data suggests overlap between the Finlay and Pink Mountain caribou seasonal ranges (Zimmerman et al. 2002, Woods and McNay 2018, Klaczek and Anderson 2020). However, Woods and McNay (2018) analyzed radio-telemetry data from 1999 to 2005 from caribou collared in both the Finlay and Pink Mountain ranges, and although some caribou used both ranges, they concluded that the current boundaries were biologically relevant and that no boundary refinements were needed.

## Range condition

Within the current Pink Mountain caribou range boundary, habitat disturbance covers 35%, 16% and 72% of the total, high elevation and low elevation portions of the range respectively. Primary disturbances are seismic lines and roads/trails with the bulk of habitat disturbance in the lower elevation portion of the range. Roads/trails include the Alaska Highway, and industrial roads associated with petroleum exploration and development, and forest harvesting. Other habitat disturbance includes oil facilities, wells, pipelines, forest harvesting, fire, and forest insects. The eastern portion of the range is highly impacted by anthropogenic habitat disturbance. Fires <40 years are distributed throughout the range. Total habitat disturbance levels in the 20 km and 30 km matrix surrounding the range are similar to within the range, however, levels of petroleum infrastructure (facilities, wells, pipelines) and forest harvesting are higher.

Habitat disturbance in the low elevation portion of the range is well over the 35% disturbance threshold for critical habitat in the recovery strategy for southern mountain caribou (Environment Canada 2014).

Our analysis does not include fires from 2018 to 2021, however, there were only two small fires recorded in the Pink Mountain caribou range in 2021 (3,500 ha, 6,400 ha) and one in 2018 (1,600 ha). There were no substantial fires in the surrounding matrix in those four years.

### Pink Mountain

|                                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|----------------------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Total Range                      |                    |                               |                                |                                               |
| Range                            | 957 542            | 34.8                          | 65.2                           | -                                             |
| 0-20 km matrix surrounding range | 1 067 608          | 45.7                          | 54.3                           | 53.3 (NM)<br>15.2 (SM)                        |
| 0-30 km matrix surrounding range | 1 669 138          | 44.1                          | 55.9                           | 51.4 (NM)<br>15.0 (SM)<br>0.1 (Boreal)        |

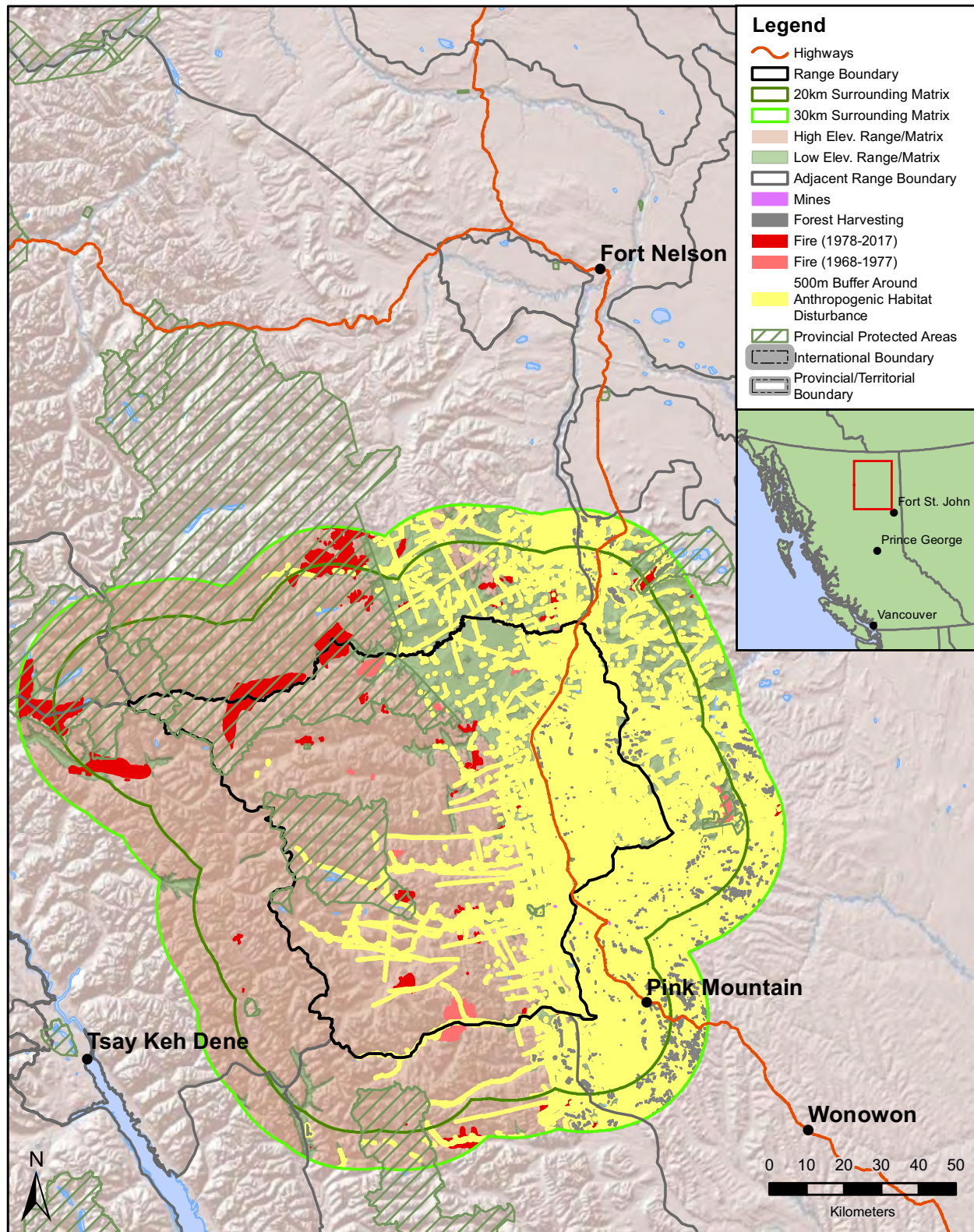
<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA



## Pink Mountain





## Pink Mountain

|                | Range Area (ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|-----------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                 | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 957 542         | 2.2                                  | 3.5            | 3.2            | 0          | 0.2         | 0        | 0.9      | 0   | 0    | 3.7          | 2.6  | 2.6      | 0         | 0        | 25.7 | 20.4    | 0.2        | 1.4   | 1.3                         | 25.8                             | 33.9          | 35.4                                   |
| High elevation | 624 647         | 2.2                                  | 3.4            | 3.5            | 0          | 0           | 0        | 0        | 0   | 0    | 0.3          | 0.5  | 0        | 0         | 0        | 8.8  | 6.6     | 0.1        | 1.6   | 1.5                         | 8.9                              | 13.7          | 15.7                                   |
| Low elevation  | 332 894         | 2.2                                  | 3.6            | 2.7            | 0          | 0.7         | 0.1      | 2.5      | 0   | 0.1  | 9.8          | 6.5  | 7.6      | 0         | 0        | 57.6 | 46.5    | 0.4        | 1.0   | 0.9                         | 57.6                             | 71.8          | 72.3                                   |
| Matrix 0-20 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 067 608       | 3.2                                  | 3.9            | 2.0            | 0          | 1.3         | 0.1      | 4.2      | 0   | 0.1  | 7.2          | 5.1  | 4.6      | 0         | 0        | 28.1 | 20.8    | 0.2        | 0.8   | 0.4                         | 28.4                             | 34.1          | 36.7                                   |
| High elevation | 596 411         | 3.4                                  | 3.9            | 1.0            | 0          | 0           | 0        | 0.6      | 0   | 0    | 1.0          | 0.5  | 0.7      | 0         | 0        | 3.7  | 2.1     | 0          | 1.0   | 0.4                         | 4.3                              | 4.9           | 8.2                                    |
| Low elevation  | 471 197         | 3.0                                  | 4.0            | 3.4            | 0          | 3.0         | 0.2      | 8.8      | 0   | 0.2  | 15.0         | 10.9 | 9.5      | 0         | 0        | 58.9 | 44.5    | 0.5        | 0.5   | 0.4                         | 58.9                             | 71.0          | 72.9                                   |
| Matrix 0-30 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 669 138       | 4.7                                  | 5.2            | 2.6            | 0          | 1.1         | 0.1      | 6.2      | 0   | 0.1  | 7.7          | 6.1  | 4.8      | 0         | 0        | 29.1 | 27.1    | 0.2        | 0.6   | 0.4                         | 29.3                             | 34.7          | 37.9                                   |
| High elevation | 906 888         | 4.3                                  | 4.6            | 1.6            | 0          | 0           | 0        | 0.5      | 0   | 0    | 0.7          | 0.4  | 0.5      | 0         | 0        | 3.7  | 10      | 0          | 0.8   | 0.5                         | 4.1                              | 5.0           | 8.9                                    |
| Low elevation  | 762 233         | 5.1                                  | 5.9            | 3.8            | 0          | 2.4         | 0.2      | 13.0     | 0   | 0.2  | 16.1         | 12.9 | 10.0     | 0         | 0        | 59.3 | 47.3    | 0.4        | 0.3   | 0.3                         | 59.3                             | 70.0          | 72.4                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a “settlement” polygon will overlap with a “road” polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of “Total anthropogenic disturbance” (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, “Total habitat disturbance” (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> “Road and trail” indicates the portions of the “Road” and “Trail” categories that were identified as both a road and a trail; “Total Road/Trail” is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

# Gataga

## Range use summary

During winter, caribou use high elevation alpine and subalpine habitat, and lower elevation spruce forests, then in spring use mainly lower elevation pine and spruce forests. During calving, summer, and rut, caribou are found primarily at high elevations.

| Season      | Overview of Habitat and Range Use <sup>1</sup>                                                                                                                                                                           | Source <sup>1</sup>                                  |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| Winter      | <ul style="list-style-type: none"> <li>Use both high elevation alpine and subalpine habitat, and lower elevation spruce forests</li> </ul>                                                                               | BC Ministry of Water, Land and Air Protection (2004) |
| Summer      | <ul style="list-style-type: none"> <li>From calving to rut (mid May to October), primarily use alpine and subalpine habitat, with highest use of alpine during summer and highest use of subalpine during rut</li> </ul> | BC Ministry of Water, Land and Air Protection (2004) |
| Migration   | <ul style="list-style-type: none"> <li>Primarily use lower elevation lodgepole pine and spruce forests during spring migration (April – mid May)</li> </ul>                                                              | BC Ministry of Water, Land and Air Protection (2004) |
| Total Range |                                                                                                                                                                                                                          |                                                      |

<sup>1</sup> Habitat use information is based on radio-collared caribou data collected between summer 2000 and summer 2003 in the Gataga and Frog caribou ranges combined

## Population size

The current population estimate of 265 caribou was based on a survey conducted in October 2000 in high elevation habitat in the Gataga caribou range. There is insufficient information available about the survey to determine whether it was a full count or a partial count, so this population estimate should be considered a minimum number present until a full survey can be conducted, and should not be used to assess trend when a full survey is conducted.

| Date | Population estimate | Number counted   | Method        | Reliability | Source                   |
|------|---------------------|------------------|---------------|-------------|--------------------------|
| 2000 | 265 <sup>1</sup>    | 265 <sup>1</sup> | Minimum count | Moderate    | BC MFLNRORD unpubl. data |

<sup>1</sup> There is insufficient information available to determine whether this was a full count or a partial count so this estimate should be considered a minimum number present until a full survey can be conducted, and should not be used to assess trend when a full survey is conducted. Since 2000, 39 caribou and 138 caribou were counted on portions of the Gataga range in 2001 and 2007 respectively

Since 2000, 39 caribou were counted during a caribou survey in a portion of the Gataga caribou range in February 2001 (BC MFLNRORD unpubl. data) and 138 caribou were counted during a Stone's sheep survey in a portion of the Gataga caribou range in March 2007 (Thiessen 2008, BC MFLNRORD unpubl. data).

Prior to 2000, 40 caribou were seen during a late winter survey in 1980 and 15 caribou were seen during a survey in February 1978 (see Population trend).

The estimate of 265 caribou is now over 20 years old and out of date, and it is unclear how much of the range was surveyed.

## Population trend

The calves/100 cows ratio during the October 2000 survey was above the 20 to 25 calves/100 cows level that is considered sufficient to support a stable population growth rate (Environment Yukon 2016). It is unknown whether fall surveys of rutting areas in the Gataga caribou range are biased against calves as detected in the nearby Spatsizi caribou range (Hatler 1987), however, the calves/100 cows ratio suggested a stable population in 2000 even if the survey was biased against calves.

## Gataga

| Year   | Month       | % calves <sup>1</sup> | Calves/ 100 adults <sup>1</sup> | Calves/100 cows <sup>1</sup> | Total <sup>2</sup> Counted | Total classified <sup>3</sup> |                    | Source <sup>4</sup>                   |
|--------|-------------|-----------------------|---------------------------------|------------------------------|----------------------------|-------------------------------|--------------------|---------------------------------------|
|        |             |                       |                                 |                              |                            | Calves+ Adults                | Calves+ Cows+Bulls |                                       |
| Winter |             |                       |                                 |                              |                            |                               |                    |                                       |
| 2007   | Mar         | 9                     | 10                              | –                            | (138) <sup>5</sup>         | 138                           |                    | BC MFLNRORD unpubl. data <sup>5</sup> |
| 2001   | Feb         | 21                    | 26                              | 31                           | 39 <sup>6</sup>            | 39                            | 39                 | BC MFLNRORD unpubl. data              |
| 1980   | Late winter | 15                    | 18                              | –                            | 40                         | 40                            |                    | Elliott (1980) <sup>7</sup>           |
| 1978   | Feb         | 13                    | 15                              |                              | 15                         | 15                            |                    | Bergerud (1978) (FW) <sup>8</sup>     |
| Fall   |             |                       |                                 |                              |                            |                               |                    |                                       |
| 2000   | Oct         | 17                    | 21                              | 27                           | 265                        | 265                           |                    | BC MFLNRORD unpubl. data              |

<sup>1</sup> Calf ratios were based on totals in each age/sex class (except as otherwise indicated) because data detailing composition of groups were not always available so we could not eliminate groups where some animals were unclassified

<sup>2</sup> Numbers in parentheses indicate surveys where caribou were not the primary focus

<sup>3</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

<sup>4</sup> All surveys were conducted by helicopter unless indicated as a fixed-wing (FW) or ground (GR) survey

<sup>5</sup> Number of caribou counted during the Stone's sheep survey was reported in Thiessen (2008), but numbers in the report were not broken down by caribou range and therefore the number counted in the Gataga caribou range was summarized from BC MFLNRORD unpublished data

<sup>6</sup> This total may differ from the total for this survey reported elsewhere because we only include the 39 caribou that were counted in the Gataga caribou range; another 54 caribou were counted in the Rabbit caribou range and 245 caribou were counted in the Frog caribou range during this survey

<sup>7</sup> No study area description was provided; the area was called Gataga-Kechika in the report so we assumed that it was in the Gataga caribou range

<sup>8</sup> Includes sightings in the Upper Gataga and South Gataga rivers. Bergerud (1978) also saw some tracks near the lakes where the South Gataga and Gataga rivers join.

Only the most recent late winter survey in 2007 has a reasonable sample size to estimate calf recruitment, which was below 15% calves recommended by Bergerud (1996) to achieve population stability.

The most recent estimate of calf recruitment is now almost 15 years old and is out of date for assessing current population trend.

Of the 55 radio-collared adult female caribou in the Frog and Gataga caribou ranges at the start of the project, 41 were still alive at the end of the three years, resulting in an annual mortality rate of 10% (BC MWLAP 2004). No information was presented on how the mortality rate was calculated or whether there were any collar failures during this time. No calf recruitment data were presented but if the calves/100 cows ratio from the October 2000 survey was representative of calf recruitment for all three years of the study, then calf recruitment was likely sufficient to balance adult mortality.

## Boundary Issues

There is insufficient information available to assess whether there are any boundary issues.

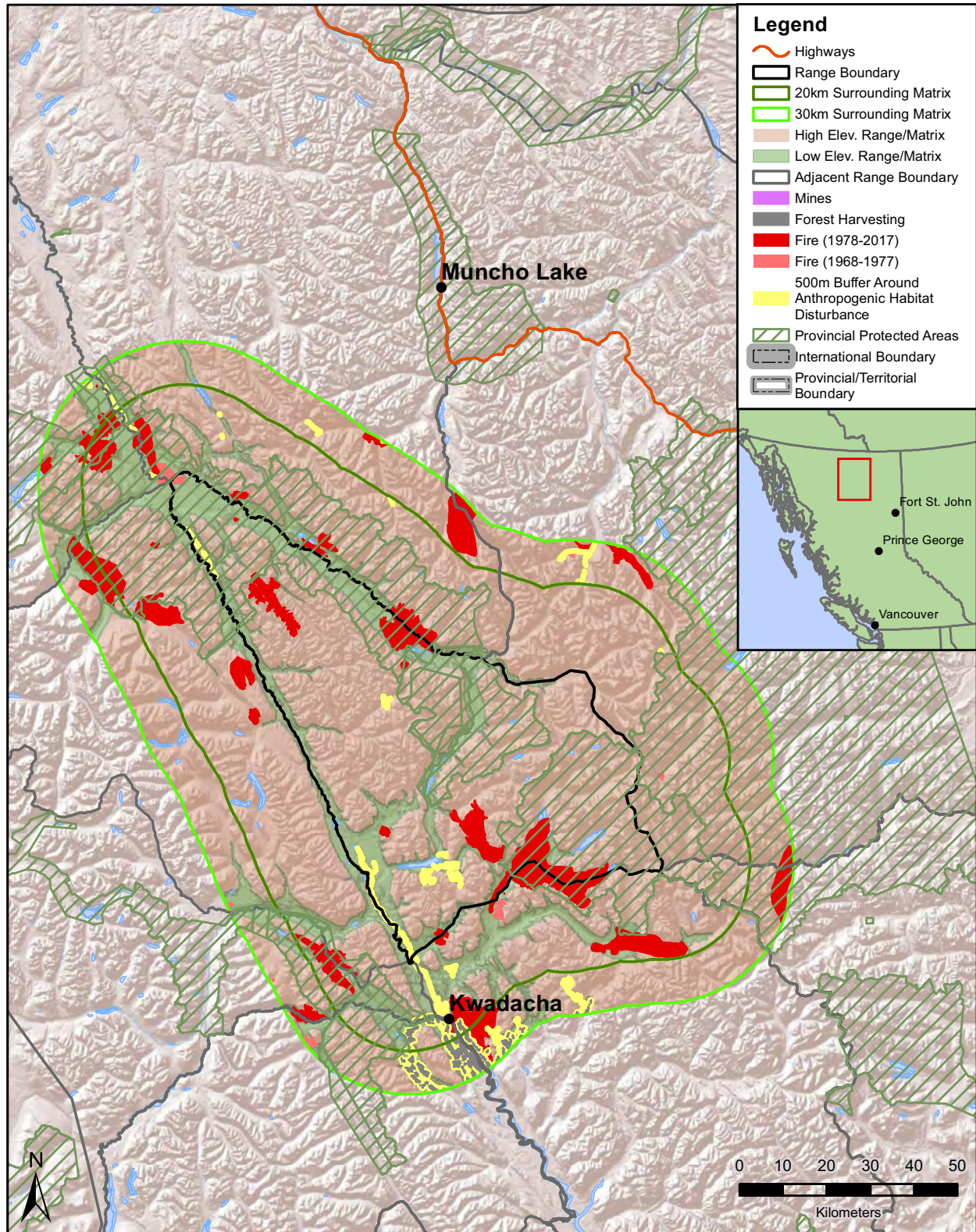
## Range condition

Within the current Gataga caribou range boundary, habitat disturbance covers 7%, 4% and 16% of the total, high elevation and low elevation portions of the range respectively. Primary disturbances are fire, forest insects, and roads/trails, all three of which are most prevalent in the lower elevation portion of the range. Roads/trails are the only recorded anthropogenic habitat disturbance within the range and are located primarily in the southwestern portion of the range. Habitat disturbance is slightly higher in the 30 km matrix surrounding the range, primarily due to more anthropogenic habitat disturbance in the form of roads/trails and cutblocks south of the range. Kwadacha is located south of the range within the 20 km and 30 km surrounding matrices.

Our analysis does not include fires from 2018 to 2021. During those four years, there were no substantial fires in the caribou range or surrounding matrix other than a small 7,000 ha fire in 2018 southwest of the Gataga caribou range in the 30 km surrounding matrix.



## Gataga



## Gataga

|                                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|----------------------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Total Range                      |                    |                               |                                |                                               |
| Range                            | 500 703            | 22.3                          | 77.7                           | -                                             |
| 0-20 km matrix surrounding range | 845 787            | 18.7                          | 81.3                           | 92.3 (NM)                                     |
| 0-30 km matrix surrounding range | 1 352 795          | 16.4                          | 83.6                           | 90.6 (NM)                                     |

<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub- Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA



## Gataga

|                | Range Area (ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|-----------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                 | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 500 703         | 5.1                                  | 5.3            | 1.4            | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 1.7  | 0       | 0          | 0     | 0                           | 1.7                              | 1.7           | 6.8                                    |
| High elevation | 389 212         | 3.6                                  | 3.6            | 0.7            | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 0.6  | 0       | 0          | 0     | 0                           | 0.6                              | 0.6           | 4.2                                    |
| Low elevation  | 111 491         | 10.7                                 | 11.2           | 4.1            | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 5.3  | 0       | 0          | 0     | 0                           | 5.3                              | 5.3           | 16.0                                   |
| Matrix 0-20 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 845 787         | 5.8                                  | 6.1            | 3.2            | 0          | 0           | 0        | 0.4      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 1.1  | 0       | 0          | 0     | 0                           | 1.1                              | 1.2           | 6.9                                    |
| High elevation | 687 709         | 4.0                                  | 4.1            | 1.3            | 0          | 0           | 0        | 0.1      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 0.1  | 0       | 0          | 0     | 0                           | 0.1                              | 0.1           | 4.2                                    |
| Low elevation  | 158 078         | 13.7                                 | 14.6           | 11.7           | 0          | 0           | 0.2      | 1.9      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 5.6  | 0       | 0.2        | 0     | 0                           | 5.6                              | 5.8           | 18.6                                   |
| Matrix 0-30 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 352 795       | 6.1                                  | 6.3            | 3.1            | 0          | 0           | 0        | 1.3      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 2.2  | 0       | 0          | 0     | 0                           | 2.2                              | 2.3           | 8.0                                    |
| High elevation | 1 130 671       | 4.3                                  | 4.4            | 1.5            | 0          | 0           | 0        | 0.2      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 0.6  | 0       | 0          | 0     | 0                           | 0.6                              | 0.7           | 4.9                                    |
| Low elevation  | 222 124         | 15.1                                 | 16.0           | 11.5           | 0          | 0           | 0.1      | 6.6      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 10.4 | 0       | 0.1        | 0     | 0                           | 10.4                             | 10.9          | 23.6                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a “settlement” polygon will overlap with a “road” polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of “Total anthropogenic disturbance” (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, “Total habitat disturbance” (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> “Road and trail” indicates the portions of the “Road” and “Trail” categories that were identified as both a road and a trail; “Total Road/Trail” is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

# Frog

## Range use summary

During winter, caribou use high elevation alpine and subalpine habitat, and lower elevation spruce forests, then in spring use mainly lower elevation pine and spruce forests. During calving, summer, and rut, caribou are found primarily at high elevations.

| Season      | Overview of Habitat and Range Use <sup>1</sup>                                                                                                                                                                         | Source <sup>1</sup>                                  |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| Winter      | <ul style="list-style-type: none"><li>Use both high elevation alpine and subalpine habitat, and lower elevation spruce forests</li></ul>                                                                               | BC Ministry of Water, Land and Air Protection (2004) |
| Summer      | <ul style="list-style-type: none"><li>From calving to rut (mid May to October), primarily use alpine and subalpine habitat, with highest use of alpine during summer and highest use of subalpine during rut</li></ul> | BC Ministry of Water, Land and Air Protection (2004) |
| Migration   | <ul style="list-style-type: none"><li>Primarily use lower elevation lodgepole pine and spruce forests during spring migration (April – mid May)</li></ul>                                                              | BC Ministry of Water, Land and Air Protection (2004) |
| Total Range |                                                                                                                                                                                                                        |                                                      |

<sup>1</sup> Habitat use information is based on radio-collared caribou data collected between summer 2000 and summer 2003 in the Frog and Gataga caribou ranges combined

## Population size

The current population estimate of 245 caribou was based on a survey conducted in February 2001 in high elevation habitat in the Frog, Gataga and Rabbit caribou ranges. A total of 338 caribou were counted in the three caribou ranges combined, 245 in the Frog caribou range, 39 in the Gataga caribou range and 54 in the Rabbit caribou range (BC MFLNRORD, unpubl. data). There is insufficient information available about the survey to determine whether it was a full count or a partial count, so this population estimate should be considered a minimum number present until a full survey can be conducted, and should not be used to assess trend when a full survey is conducted.

| Date | Population estimate | Number counted   | Method        | Reliability | Source                   |
|------|---------------------|------------------|---------------|-------------|--------------------------|
| 2001 | 245 <sup>1</sup>    | 245 <sup>1</sup> | Minimum count | Moderate    | BC MFLNRORD unpubl. data |

<sup>1</sup> There is insufficient information available to determine whether this was a full count or a partial count so this estimate should be considered a minimum number present until a full survey can be conducted, and should not be used to assess trend when a full survey is conducted.

Since 2001, 82 caribou were counted during a sheep and caribou survey in northern portion of the Frog caribou range in 2009 (Thiessen 2009) and 114 caribou were seen during a survey in March 2020 (A. Pelletier, pers. comm.). Between 80 and 96 caribou were counted in the area just south of the southern Frog caribou range boundary between 2009 and 2013 (see Population trend below), which is an area that Sittler et al. (2015) recommended adding to the Frog caribou range based on radio-collared caribou data. In 2009, a total of 162 caribou were counted during two surveys conducted one week apart in northernmost portion of the range (Thiessen 2009: 82 caribou) and just outside the southeastern portion of the range (MacDonald et al. 2009: 80 caribou)

Bergerud (1978) found lots of tracks on Rainbow Creek, Johiah Mountain, Ludwig Creek and Flat Top Mountain on March 2, 1978, but did not report seeing any caribou.

The current estimate of 245 caribou is now over 20 years old and out of date, and the area surveyed did not include the area south of the current Frog caribou range boundary that Sittler et al. (2015) recommended for inclusion in the Frog caribou range.

## Population trend

Neither of the two survey reports for fall surveys conducted in the area just south of the Frog caribou range in 2010 and 2012 presented data distinguishing bulls from cows, so we are unable to assess whether the calf/100 cow ratios were above or below the 20 to 25 calves/100 cows level that is considered sufficient to support a stable population growth rate (Environment Yukon 2016).

Calf recruitment based on caribou counted during the March 2020 Stone's sheep survey was higher than the 15% calves recommended by Bergerud (1996) to achieve population stability. In both winter surveys conducted in and adjacent to the Frog caribou range in 2009, calf recruitment estimates were below 15%, while calf recruitment in 2001 was over 15% calves. Sample size was low for the caribou counted during the March 2013 capture session and may not have been representative of calf recruitment. Percent calves during the two fall surveys was less than 15%. It is unknown whether fall surveys of rutting areas in the Frog caribou range are biased against calves as detected in the nearby Spatsizi caribou range (Hatler 1987). If so, the fall calf ratios may not be representative of calf recruitment. Sample sizes and the limited area covered may have also influenced calf ratios.

Of the 55 radio-collared adult female caribou in the Frog and Gataga caribou ranges at the start of the project, 41 were still alive at the end of the three years, resulting in an annual mortality rate of 10% (BC MWLAP 2004). No information was presented on how the mortality rate was calculated or whether there were any collar failures during this time. No calf recruitment data were presented but if calf recruitment from the February 2001 survey was representative of calf recruitment for all three years of the study, then calf recruitment would have been sufficient to balance adult mortality.

### Frog

| Year              | Month | % calves <sup>1</sup> | Calves/ 100 adults <sup>1</sup> | Calves/100 cows <sup>1</sup> | Total <sup>2</sup> Counted | Total classified <sup>3</sup> |                    | Source <sup>4</sup>                   |
|-------------------|-------|-----------------------|---------------------------------|------------------------------|----------------------------|-------------------------------|--------------------|---------------------------------------|
|                   |       |                       |                                 |                              |                            | Calves+ Adults                | Calves+ Cows+Bulls |                                       |
| Winter            |       |                       |                                 |                              |                            |                               |                    |                                       |
| 2020              | Mar   | 19                    | 23                              | 30                           | (114)                      | 108                           | 105                | A. Pelletier pers. comm.              |
| 2013 <sup>5</sup> | Mar   | 21                    | 27                              | 38                           | 33 <sup>6</sup>            | 28                            | 28                 | MacDonald and McNay (2013)            |
| 2009 <sup>5</sup> | Mar   | 9                     | 10                              | 18                           | 80                         | 80                            | 80                 | MacDonald et al. (2009)               |
| 2009              | Feb   | 7                     | 8                               | 10                           | 82 <sup>7</sup>            | 82                            | 82                 | BC MFLNRORD unpubl. data <sup>7</sup> |
| 2001              | Feb   | 16                    | 19                              | 23                           | 245 <sup>8</sup>           | 245                           | 245                | BC MFLNRORD unpubl. data              |
| Fall              |       |                       |                                 |                              |                            |                               |                    |                                       |
| 2012 <sup>5</sup> | Oct   | 14                    | 16                              |                              | 96                         | 96 <sup>9</sup>               |                    | Rudichuk et al. (2013)                |
| 2010 <sup>5</sup> | Oct   | 12                    | 14                              |                              | 92                         | 92                            |                    | McNay (2012)                          |

<sup>1</sup> Calf ratios were based on totals in each age/sex class (except as otherwise indicated) because data detailing composition of groups were not always available so we could not eliminate groups where some animals were unclassified

<sup>2</sup> Numbers in parentheses indicate surveys where caribou were not the primary focus

<sup>3</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

<sup>4</sup> All surveys were conducted by helicopter unless indicated as a fixed-wing (FW) or ground (GR) survey

<sup>5</sup> Surveys shown in italics were conducted primarily in an area south of the Frog caribou range and outside of any caribou ranges, in an area that Sittler et al. (2015) recommended including in the Frog caribou range based on radio-collared caribou data

<sup>6</sup> Includes 20 caribou counted in the Frog caribou range

<sup>7</sup> Number of caribou counted during a Stone's sheep and caribou survey (Thiessen 2009)

<sup>8</sup> The total number of caribou counted in the Frog caribou range in February 2001 that we present here differs from the total reported elsewhere. In our total, we only include the 245 caribou that were counted in the Frog caribou range (updated based on a closer examination of group locations); another 54 caribou were counted in the Rabbit caribou range and 39 caribou were counted in the Gataga caribou range.

<sup>9</sup> Includes 21 caribou counted in the Frog caribou range

## Boundary Issues

- Telemetry and other location data suggest that boundaries should be expanded into some areas that are not included in the Frog caribou range.
- The large gap between the Frog, Spatsizi, Horseranch, Rabbit, and Thutade caribou ranges is known to contain caribou.

Sittler et al. (2015) recommended extending the southern portion of the range to join up with the eastern portion of the Thutade range, based on data collected from caribou radio-collared in the area of low density just south of the Frog caribou range.

## Range condition

Within the current Frog caribou range boundary, habitat disturbance covers 4%, 3% and 12% of the total, high elevation and low elevation portions of the range respectively. Primary disturbances are fire and forest insects, the majority of which have occurred in the lower elevation portion of the range. Roads/trails are the only recorded anthropogenic habitat disturbance, making up less than 1% of the range, and which are located in low elevations along the eastern boundary of the range. Habitat disturbance is slightly higher in the 20 km and 30 km matrices surrounding the range, primarily due to more anthropogenic habitat disturbance in the form of roads/trails and cutblocks southeast of the range. Kwadacha is located southeast of the range, within the 20 km and 30 km surrounding matrices.

Our analysis does not include fires from 2018 to 2021. During those four years, there were no substantial fires in the caribou range or surrounding matrix other than a small 7,000 ha fire in 2018 just southwest of the Frog caribou range within the 20 km and 30 km surrounding matrices.

### Frog

|                                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|----------------------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Total Range                      |                    |                               |                                |                                               |
| Range                            | 504 069            | 11.3                          | 88.7                           | -                                             |
| 0-20 km matrix surrounding range | 885 050            | 22.9                          | 77.1                           | 41.0 (NM)                                     |
| 0-30 km matrix surrounding range | 1 392 243          | 21.5                          | 78.5                           | 63.1 (NM)                                     |

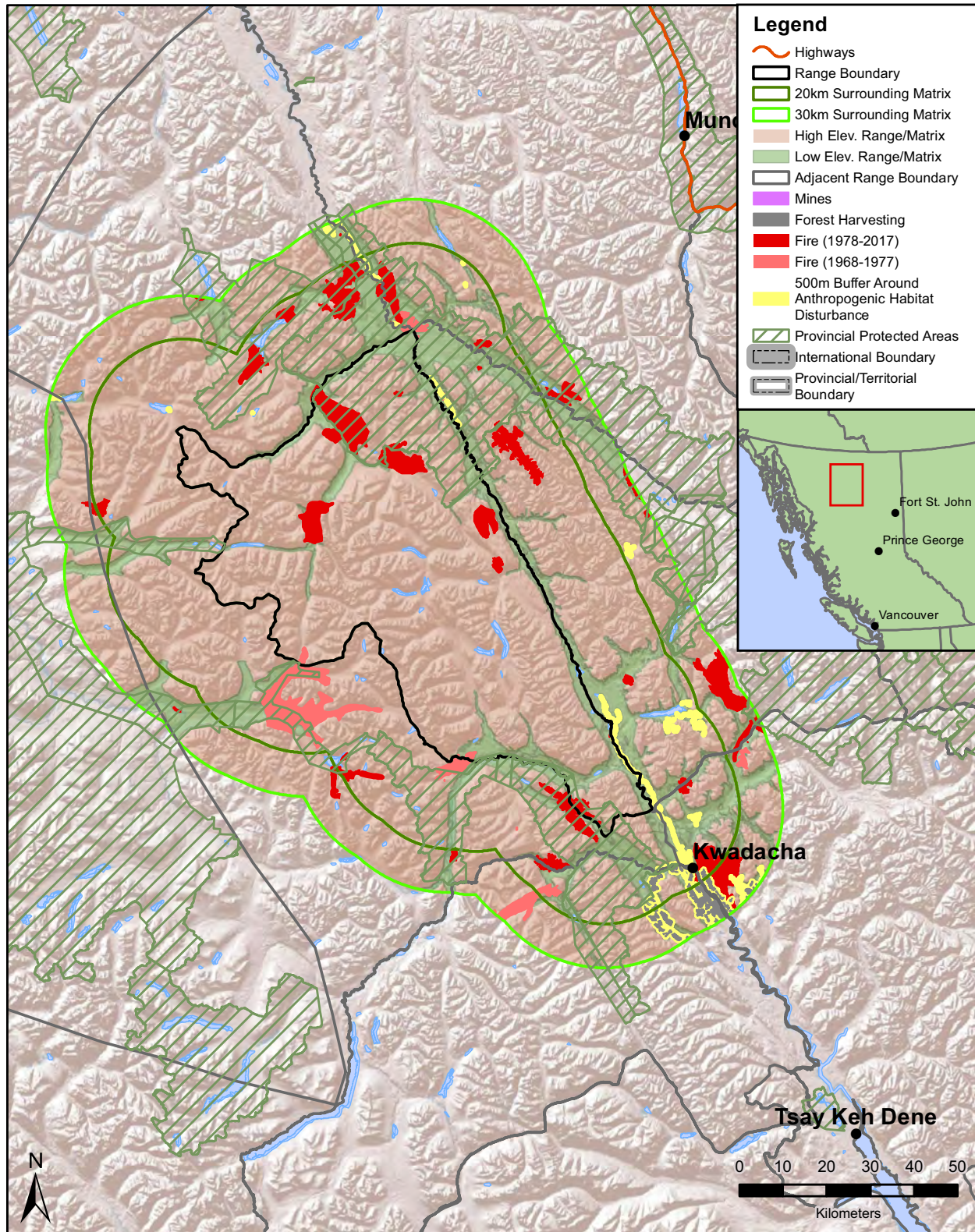
<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA



## Frog





## Frog

|                | Range Area (ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|-----------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                 | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 504 069         | 4.2                                  | 4.4            | 2.3            | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 0.1  | 0       | 0          | 0     | 0                           | 0.1                              | 0.1           | 4.3                                    |
| High elevation | 446 969         | 3.4                                  | 3.5            | 1.0            | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 0    | 0       | 0          | 0     | 0                           | 0                                | 0             | 3.4                                    |
| Low elevation  | 57 099          | 10.9                                 | 11.5           | 12.5           | 0          | 0           | 0        | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 1.1  | 0       | 0          | 0     | 0                           | 1.1                              | 1.1           | 12.0                                   |
| Matrix 0-20 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 885 050         | 3.5                                  | 5.8            | 2.5            | 0          | 0           | 0        | 0.4      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 1.9  | 0       | 0          | 0     | 0                           | 1.9                              | 2.0           | 5.3                                    |
| High elevation | 682 530         | 2.5                                  | 4.4            | 1.0            | 0          | 0           | 0        | 0.1      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 0.4  | 0       | 0          | 0     | 0                           | 0.4                              | 0.4           | 2.9                                    |
| Low elevation  | 202 520         | 7.0                                  | 10.5           | 7.4            | 0          | 0           | 0.2      | 1.5      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 7.0  | 0       | 0.1        | 0     | 0                           | 7.0                              | 7.2           | 13.7                                   |
| Matrix 0-30 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 392 243       | 3.7                                  | 5.4            | 2.6            | 0          | 0           | 0        | 1.1      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 2.2  | 0       | 0          | 0     | 0                           | 2.2                              | 2.4           | 5.6                                    |
| High elevation | 1 092 846       | 2.5                                  | 4.0            | 1.3            | 0          | 0           | 0        | 0.2      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 0.4  | 0       | 0          | 0     | 0                           | 0.4                              | 0.5           | 2.9                                    |
| Low elevation  | 299 392         | 8.0                                  | 10.5           | 7.2            | 0          | 0           | 0.1      | 4.3      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 9.0  | 0       | 0.1        | 0     | 0                           | 9.0                              | 9.3           | 15.5                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8 also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

# Finlay

## Range use summary

There is limited information available on range use of caribou within the Finlay caribou range. Caribou have been counted in alpine habitat during several winter surveys (Wood 1994, Zimmerman et al. 2002, Klaczek and Anderson 2020), however, less information is available about use of low elevations during winter or range use during summer.

| Season      | Overview of Habitat and Range Use                                                                                                                                  | Source                                                                |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Winter      | <ul style="list-style-type: none"> <li>High elevation windswept alpine slopes</li> </ul>                                                                           | Wood (1994)<br>Zimmerman et al. (2002)<br>Klaczek and Anderson (2020) |
| Summer      | <ul style="list-style-type: none"> <li>No information</li> </ul>                                                                                                   |                                                                       |
| Migration   | <ul style="list-style-type: none"> <li>Mostly seasonal elevation shifts for sedentary caribou</li> <li>Some caribou migrated to the Pink Mountain range</li> </ul> | Klaczek and Anderson (2020)                                           |
| Total Range |                                                                                                                                                                    |                                                                       |

Radio-collared caribou data suggests overlap between the Finlay and Pink Mountain caribou seasonal ranges (Zimmerman et al. 2002, Woods and McNay 2018, Klaczek and Anderson 2020). Based on 120 caribou collared in the Finlay and Pink Mountain caribou ranges from 1999 to 2005, 18 (11%) used both ranges (Woods and McNay 2018). Three caribou collared in the Finlay caribou range in March 2017 moved to the Pink Mountain area in June 2017 and remained in the Pink Mountain area the following winter (Klaczek 2018). A fourth radio-collared caribou also moved to the Pink Mountain area the following year (Klaczek and Anderson 2020).

## Population size

The current population estimate is 96 caribou based the number of caribou counted during a census of the Finlay caribou range in March 2020 (see table below), which is similar to the 84 caribou estimated in the population in 2019 (Klaczek and Anderson 2020). The 2002 estimate of 26 caribou was based on the number of caribou counted during a stratified random block survey in February/March 2002. The highest number of caribou counted in the Finlay caribou range and the area south of the range was 193 caribou in March 1994 during a survey of alpine areas.

Bergerud (1978) did not see any caribou during his flight on March 3, 1978 in the Mt. Del area or Ospika River areas, but saw tracks on the muskeg near Mt. Del and at Tobin Lake, Bevel Mountain and along the lower 15 miles of the Ospika River. He estimated possibly 50 caribou in the Mt. Del area and possibly 100+ caribou in the Ospika River area based on tracks seen.

| Date | Population estimate | Number counted | Method                                               | Reliability | Source                      |
|------|---------------------|----------------|------------------------------------------------------|-------------|-----------------------------|
| 2020 | 96<br>(65-127)      | 96             | Minimum count <sup>1</sup>                           | High        | Klaczek and Anderson (2020) |
| 2019 | 84                  | 76             | Minimum count + sightability correction <sup>2</sup> | High        | Klaczek and Anderson (2020) |
| 2002 | 26                  | 26             | Stratified Random Block + Incidental sightings       | Unknown     | Zimmerman et al. (2002)     |
| 1994 | 193                 | 193            | Minimum count <sup>3</sup>                           | High        | Wood (1994)                 |

<sup>1</sup> Minimum count includes the Finlay range but not the area south of the range on the east side of Williston Lake (due to Covid); the 95% confidence interval for the population estimate was calculated by applying a bootstrap estimator

<sup>2</sup> Minimum count includes caribou within the Finlay caribou range; a sightability correction factor of 0.90 (based on a sightability correction from collared caribou during mark-resight surveys in the adjacent Chase and Wolverine ranges) was used to calculate the population estimate; an additional 10 caribou were observed with radio-collared caribou south of the Finlay range on the east side of Williston Lake;

<sup>3</sup> Minimum count includes caribou within the Finlay caribou range and in the area south of the range on the east side of Williston Lake

## Population trend

In 1994, the calf recruitment estimate was below 15% calves recommended by Bergerud (1996) to achieve population stability, while calf recruitment in 2002 was over 15% calves. In 2002, calf recruitment was above 15% calves but the number of caribou counted was low and may not have been representative of the total population. Calf recruitment estimates from the two most recent surveys (2019, 2020) suggest that the population currently may be stable or increasing.

Population trend inferred from the number of caribou counted during surveys suggests that the population has declined since 1994. Another factor to consider is that the 1994 survey may have been conducted during a winter with conditions that resulted in a large portion of the population using high elevation alpine areas. In the nearby Spatsizi caribou range, winter conditions resulted in most of the radio-collared caribou using windswept alpine slopes in only one of four years of the study (Hatler 1986). Also, a larger proportion of Pink Mountain caribou may have been wintering in the Finlay caribou range in 1994. However, the role that these two factors (winter conditions, Pink Mountain caribou distribution) may have played in differences in number of caribou counted during surveys in the Finlay caribou range does not mean that the population did not decline. A decline in the Finlay caribou population since 1994 would be consistent with the pattern of population declines observed in the nearby South Peace caribou herds (Seip and Jones 2014).

The sample size of caribou from the recent radio-collared caribou study (n=9) was too small to calculate adult survival or population growth rate (M. Klaczek, pers. comm.).

### Finlay

| Year   | Month   | % calves <sup>1</sup> | Calves/ 100 adults <sup>1</sup> | Calves/100 cows <sup>1</sup> | Total Counted   | Total classified <sup>2</sup> |                    | Source <sup>3</sup>         |
|--------|---------|-----------------------|---------------------------------|------------------------------|-----------------|-------------------------------|--------------------|-----------------------------|
|        |         |                       |                                 |                              |                 | Calves+ Adults                | Calves+ Cows+Bulls |                             |
| Winter |         |                       |                                 |                              |                 |                               |                    |                             |
| 2020   | Mar     | 19                    | 23                              | 38                           | 96 <sup>4</sup> | 96                            | 82                 | Klaczek and Anderson (2020) |
| 2019   | Mar     | 17                    |                                 | 32                           | 76 <sup>5</sup> | NA                            | NA                 | Klaczek and Anderson (2020) |
| 2018   | Feb/Apr |                       |                                 |                              | 27 <sup>6</sup> |                               |                    | Klaczek and Anderson (2020) |
| 2002   | Feb/Mar | 21                    | 27                              |                              | 26              | 19                            |                    | Zimmerman et al. (2002)     |
| 1994   | Mar     | 12                    | 14                              | 26 <sup>7</sup>              | 193             | 193                           | 107 <sup>7</sup>   | Wood (1994)                 |

<sup>1</sup> Calf ratios were based on totals in each age/sex class (except as otherwise indicated) because data detailing composition of groups were not always available so we could not eliminate groups where some animals were unclassified

<sup>2</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

<sup>3</sup> All surveys were conducted by helicopter unless indicated as a fixed-wing (FW) or ground (GR) survey

<sup>4</sup> Due to Covid, the area south of the Finlay range was not included in the survey

<sup>5</sup> Classification data were not included in report other than 14 calves and 8 unclassified adults; survey includes only the Finlay range; an additional 10 caribou (including 1 calf) were seen in the area south of the Finlay range during a telemetry tracking flight

<sup>6</sup> Classification data were not included in the report; includes 18 caribou in the Finlay range and 9 caribou in the area south of the Finlay range; two GPS collared caribou were not seen during the survey in the area south of the Finlay range so the minimum number alive in that area was 11 (Klaczek and Anderson 2020)

<sup>7</sup> The survey included 66 unclassified adults. Because some groups counted had a high number of unclassified adults, for the calves/100 cows ratio we only included the groups where all caribou were classified as bulls, cows or calves resulting in a sample of 107 caribou in just those groups combined

## Boundary Issues

- Telemetry data suggest overlap between Pink Mountain and Finlay caribou ranges.

Radio-collared caribou data suggests overlap between the Finlay and Pink Mountain caribou seasonal ranges (Zimmerman et al. 2002, Woods and McNay 2018, Klaczek and Anderson 2020). However, Woods and McNay (2018) analyzed radio-telemetry data from 1999 to 2005 from caribou collared in both the Finlay and Pink Mountain ranges, and although some caribou used both ranges, they concluded that the current boundaries were biologically relevant and that no boundary refinements were needed.

## Range condition

Within the current Finlay caribou range boundary, habitat disturbance covers 16%, 5% and 52% of the total, high elevation and low elevation portions of the range respectively. Primary disturbances are roads/trails, forest harvesting, forest pests and fire, the majority of which has occurred in the lower elevation portion of the range. Other habitat disturbance includes airstrips, reservoirs and settlements (Kwadacha is located along the northwestern boundary), which together make up <1% of the range. Anthropogenic habitat disturbance within the range is concentrated in the area along the western boundary. Habitat disturbance levels in the 20 km and 30 km matrices surrounding the range are similar to those in the range and are located primarily in low elevations in the area just east and southeast of the range boundary.

Habitat disturbance in the low elevation portion of the range exceeds the 35% disturbance threshold for critical habitat in the recovery strategy for southern mountain caribou (Environment Canada 2014).

Our analysis does not include fires from 2018 to 2021, however, there were no fires of appreciable size recorded in the Finlay caribou range during those four years, a 7,000 ha fire in the 30 km surrounding matrix in 2018, and a 7,800 ha fire in the 20 km and 30 km surrounding matrices in 2021.

### Finlay

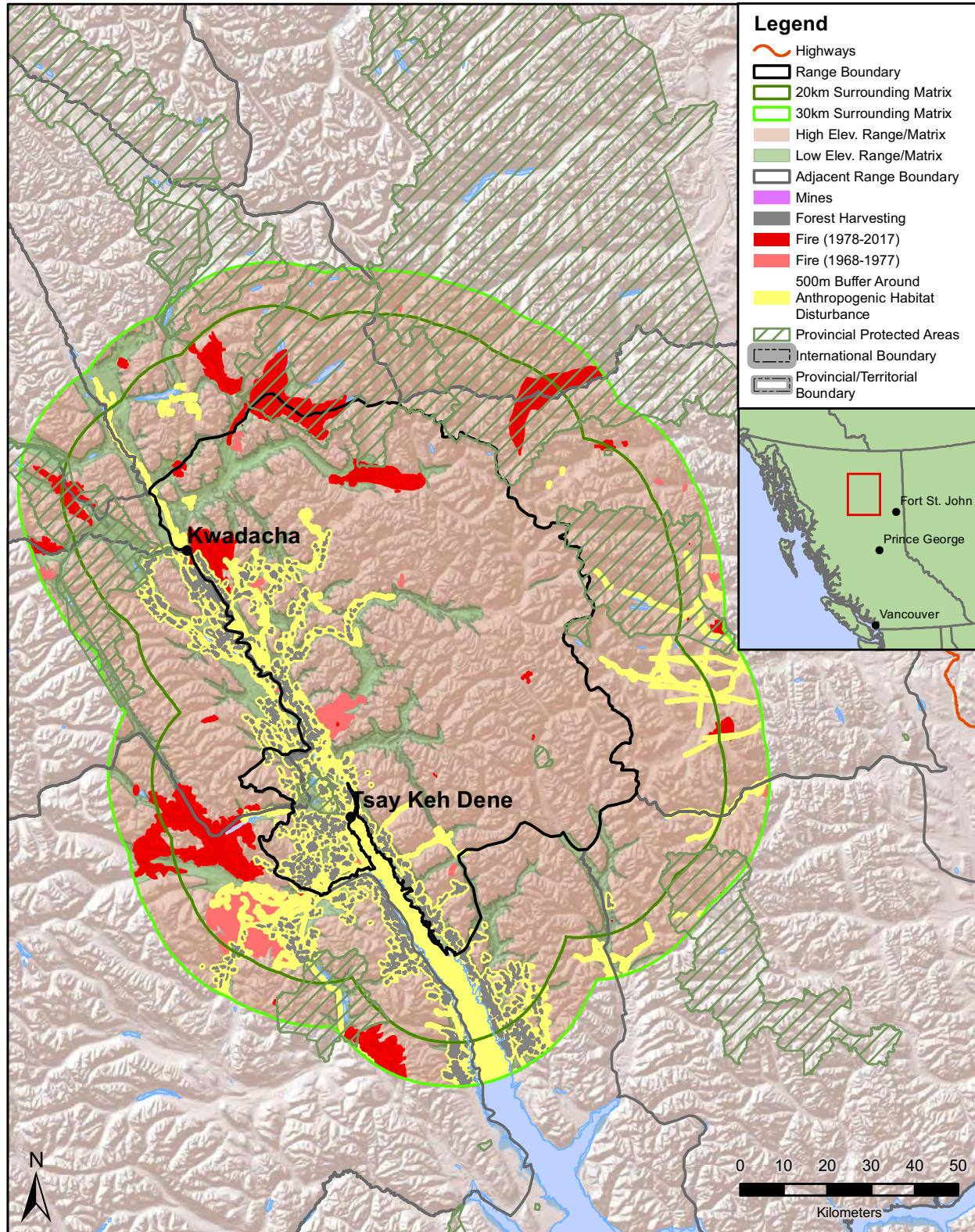
|                                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|----------------------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Total Range                      |                    |                               |                                |                                               |
| Range                            | 817 094            | 24.1                          | 75.9                           | -                                             |
| 0-20 km matrix surrounding range | 982 244            | 23.8                          | 76.2                           | 62.7 (NM)<br>22.1 (SM)                        |
| 0-30 km matrix surrounding range | 1 525 168          | 20.9                          | 79.1                           | 60.4 (NM)<br>25.6 (SM)                        |

<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA







## Finlay

|                | Range<br>Area (ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|--------------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                    | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 817 094            | 3.3                                  | 4.3            | 16.6           | 0          | 0           | 0.1      | 9.5      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 12.1 | 0       | 0.1        | 0     | 0                           | 12.1                             | 13.3          | 16.1                                   |
| High elevation | 619 983            | 2.1                                  | 2.6            | 8.7            | 0          | 0           | 0        | 2.1      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 2.1  | 0       | 0          | 0     | 0                           | 2.1                              | 2.7           | 4.8                                    |
| Low elevation  | 197 112            | 7.1                                  | 9.6            | 41.5           | 0.1        | 0           | 0.5      | 32.7     | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 43.2 | 0       | 0.4        | 0     | 0                           | 43.2                             | 46.7          | 51.9                                   |
| Matrix 0-20 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 982 244            | 5.7                                  | 8.1            | 13.8           | 2.8        | 0           | 0.1      | 8.1      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 11.4 | 0.6     | 0.2        | 0.1   | 0.1                         | 11.5                             | 15.5          | 20.8                                   |
| High elevation | 748 842            | 4.2                                  | 5.2            | 10.6           | 0          | 0           | 0        | 2.2      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 3.8  | 0.8     | 0.1        | 0.2   | 0.1                         | 3.9                              | 5.2           | 9.3                                    |
| Low elevation  | 233 401            | 10.5                                 | 17.3           | 24.1           | 11.7       | 0           | 0.6      | 27.0     | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 36.0 | 0       | 0.5        | 0     | 0                           | 36.0                             | 48.5          | 57.6                                   |
| Matrix 0-30 km |                    |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 525 168          | 5.4                                  | 7.2            | 13.1           | 2.3        | 0           | 0.1      | 6.3      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 9.7  | 0.8     | 0.1        | 0.3   | 0.2                         | 9.8                              | 13.3          | 18.4                                   |
| High elevation | 1 206 668          | 4.0                                  | 4.9            | 9.7            | 0          | 0           | 0        | 1.7      | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 3.6  | 1.0     | 0          | 0.3   | 0.3                         | 3.7                              | 5.1           | 9.0                                    |
| Low elevation  | 318 499            | 10.7                                 | 15.7           | 26.2           | 10.9       | 0           | 0.4      | 23.7     | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 32.7 | 0       | 0.5        | 0     | 0                           | 32.7                             | 44.4          | 53.7                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

# Thutade

## Range use summary

Caribou in the Thutade range are found primarily in high elevation habitat throughout the year at an average elevation of 1500 m or more. During winter, caribou use primarily windswept alpine slopes. On average, the highest elevations are used during summer and fall, although some caribou also use lower elevation forested areas during summer.

| Season      | Overview of Habitat and Range Use                                                                                    | Source                                                  |
|-------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| Winter      | <ul style="list-style-type: none"><li>Primarily high elevation windswept alpine</li></ul>                            | Sittler et al. (2015)<br>K. Sittler, pers. comm. (2019) |
| Summer      | <ul style="list-style-type: none"><li>Primarily high elevation</li><li>Some low elevation forested habitat</li></ul> | Sittler et al. (2015)<br>K. Sittler pers. comm. (2019)  |
| Migration   | <ul style="list-style-type: none"><li>Primarily low elevation</li></ul>                                              | Sittler et al. (2015)<br>K. Sittler pers. comm. (2019)  |
| Total Range |                                                                                                                      |                                                         |

## Population size

The highest number of caribou counted during surveys in the Thutade caribou range was 114 in fall 2019, but the survey did not include the whole range (M. Klaczek, pers. comm.). The highest number of caribou counted during previous surveys in the Thutade caribou range in an area comparable to the area that was surveyed in 2019 (which included six of the 11 survey units in the range), was 97 in October 2010 (McNay 2012).

| Date | Population estimate | Number counted   | Method        | Reliability | Source                   |
|------|---------------------|------------------|---------------|-------------|--------------------------|
| 2019 |                     | 114 <sup>1</sup> | Minimum count |             | M. Klaczek (pers. comm.) |

<sup>1</sup> The highest number counted during surveys in the Thutade caribou range was 114 in fall 2019; this survey only covered a portion of the range

## Population trend

The calves/100 cows ratio for the fall 2019 survey exceeded the 20 to 25 calves/100 cows level that is considered sufficient to support a stable population growth rate (Environment Yukon 2016). Although adult classification data were not available for the three fall surveys conducted from 2010 to 2013, the lowest possible values for the calf/100 cow ratios during those surveys would be the calves/100 adults ratios, which would assume that all adults were cows. Of the two of those three surveys with adequate sample sizes, one was within or above the 20 to 25 calves/100 cows level. It is unknown whether fall surveys of rutting areas in the Thutade caribou range are biased against calves as detected in the nearby Spatsizi caribou range (Hatler 1987), however, the calves/100 adults ratios suggest that the population may have been stable in 2010 and was at least stable in 2019, even if the surveys were biased against calves.

The most recent late winter count in 2013 had a reasonable sample size to estimate calf recruitment, which was above the 15% calves recommended by Bergerud (1996) to achieve population stability. However, this estimate is now almost 9 years old and is out of date.

Sample sizes and/or lack of classification data precluded assessing population trend based on calf survival or recruitment rates for other surveys conducted in the Thutade caribou range.

Although population estimates are not available for the whole Thutade caribou range, the number of caribou counted during fall surveys of comparable portions of the Thutade range in 2010 and 2019 were similar (97 and 114 respectively) suggesting the the short-term trend may be stable (M. Klaczek, pers. comm.).

## Thutade

| Year   | Month | % calves <sup>1</sup> | Calves/ 100 adults <sup>1</sup> | Calves/100 cows <sup>1</sup> | Total <sup>2</sup> Counted | Total classified <sup>3</sup> |                    | Source <sup>4</sup>        |
|--------|-------|-----------------------|---------------------------------|------------------------------|----------------------------|-------------------------------|--------------------|----------------------------|
|        |       |                       |                                 |                              |                            | Calves+ Adults                | Calves+ Cows+Bulls |                            |
| Winter |       |                       |                                 |                              |                            |                               |                    |                            |
| 2013   | Mar   | 20                    | 24                              | 28                           | 47 <sup>5</sup>            | 46                            | 46                 | MacDonald and McNay (2013) |
| 1993   | Mar   | 4                     | 4                               | 6                            | (26) <sup>6</sup>          | 26                            | 26                 | Corbould (2001)            |
| Fall   |       |                       |                                 |                              |                            |                               |                    |                            |
| 2019   |       | 18                    |                                 | 33                           | 114                        | 114                           | NA                 | M. Klaczek, pers. comm.    |
| 2013   | Nov   | 17                    | 20                              | -                            | 6 <sup>5,7</sup>           | 6                             |                    | Sittler et al. (2014)      |
| 2012   | Oct   | 13                    | 15                              | -                            | 90 <sup>5,7</sup>          | 90                            |                    | Rudichuk et al. (2013)     |
| 2010   | Oct   | 23                    | 29                              | -                            | 97 <sup>5,7</sup>          | 97                            |                    | McNay (2012)               |
| 1991   | Sept  |                       |                                 |                              | 53                         |                               |                    | Ritchie in McNay (2012)    |
| 1990   | Oct   |                       |                                 |                              | 22                         |                               |                    | Ritchie in McNay (2012)    |

<sup>1</sup> Calf ratios based on totals in each age/sex class (except as otherwise indicated) because data detailing composition of groups were not always available so could not eliminate groups where some animals were unclassified

<sup>2</sup> Numbers in parentheses indicate surveys where caribou were not the primary focus

<sup>3</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

<sup>4</sup> All surveys conducted by helicopter unless indicated as a fixed-wing (FW) or ground (GR) survey

<sup>5</sup> Totals include only the caribou counted in survey units that became part of the Thutade caribou range

<sup>6</sup> Number of caribou counted during a Stone's sheep and mountain goat survey in the Russel Range

<sup>7</sup> no classification provided other than number of calves

Of the 18 adult female caribou radio-collared with satellite collars in March 2012 (6) and March 2013 (12), three were confirmed mortalities and another two mortalities were detected as of December 31, 2013, but were not investigated (Sittler et al. 2015). Sittler et al. (2015) did not include a calculation of an annual mortality rate.

## Boundary Issues

The Thutade caribou range was delineated based on recommendations from Sittler et al. (2015). Because the range boundaries were developed recently based on best available information, which included data from radio-collared caribou and surveys specifically designed to address range boundary questions, there are no identified issues with the current boundary.

## Range condition

Within the current Thutade caribou range boundary, habitat disturbance covers 11%, 6% and 50% of the total, high elevation and low elevation portions of the range respectively. Primary disturbances are roads/trails, forest harvesting, forest pests and fire, the majority of which has occurred in the lower elevation portion of the range. Other habitat disturbances within the range include powerline, railroad, agriculture, settlements and reservoirs. Roads/trails include the Omineca Resource Road and associated industrial roads, which traverse through the middle of the caribou range, the BC railgrade and associated resource roads along the southwestern range boundary, and the Finlay-Russel Resource Road along the eastern boundary. Forest harvesting is located in the area along the eastern boundary, and along the southwestern boundary. Kwadacha is located at the northeastern tip of the range. Although our data do not show any habitat disturbance due to mining activity, Kemess mine (an underground mine) is located in the northwestern portion of the range. Habitat disturbance is higher in the 20 km matrix surrounding the range, primarily due to more anthropogenic habitat disturbance in the form of roads/trails and cutblocks, and more fire.

Habitat disturbance in the low elevation portion of the range exceeds the 35% disturbance threshold for critical habitat in the recovery strategy for southern mountain caribou (Environment Canada 2014).

Our analysis does not include fires from 2018 to 2021. There was a 7,000 ha fire in 2018 in the northern portion of the Thutade caribou range and in the surrounding matrix, and a 7,800 ha fire in the surrounding matrix in 2021.

### Thutade

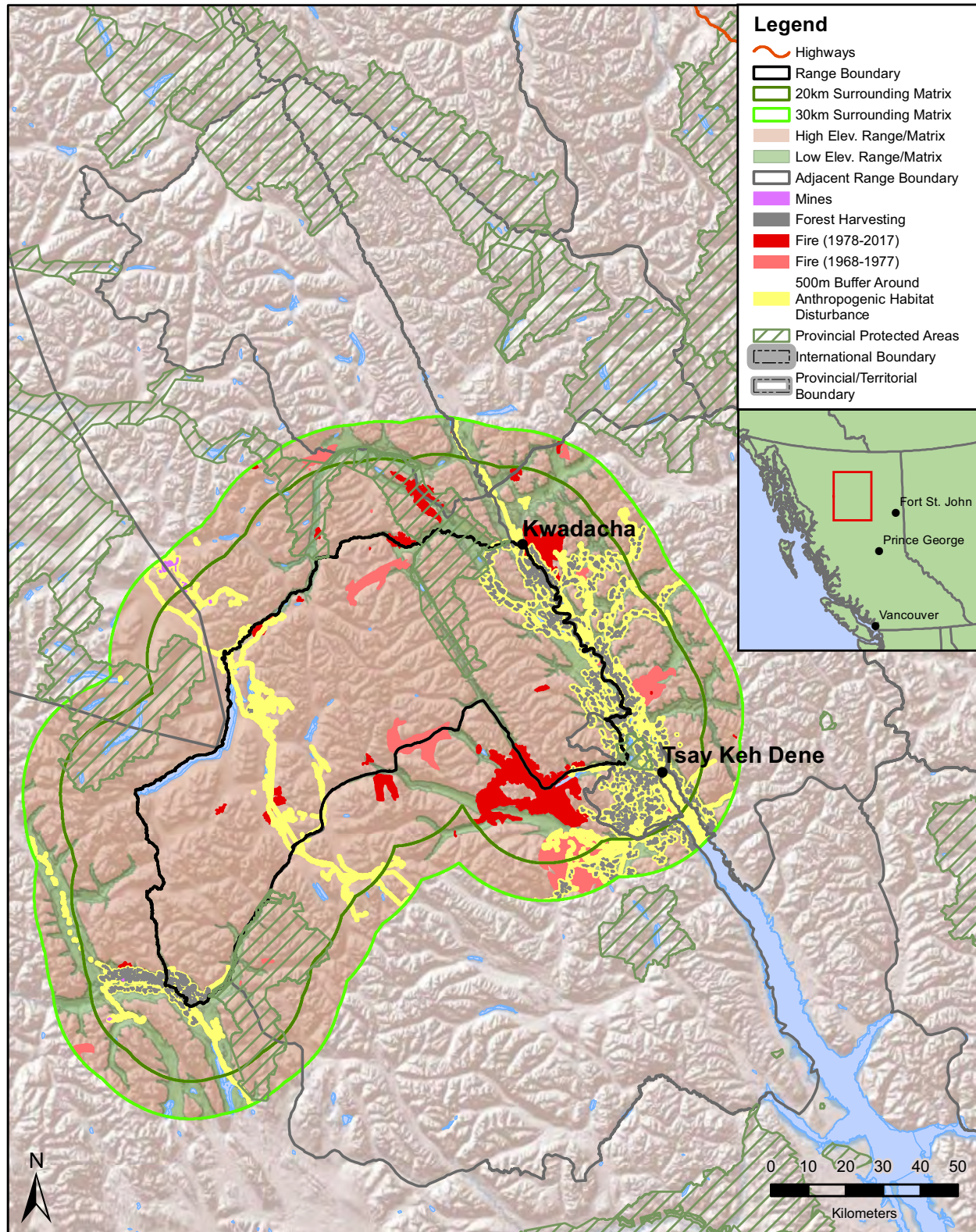
|                                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|----------------------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Total Range                      |                    |                               |                                |                                               |
| Range                            | 711 930            | 11.2                          | 88.8                           | –                                             |
| 0-20 km matrix surrounding range | 1 033 466          | 27.0                          | 73.0                           | 30.6 (NM)<br>27.9 (SM)                        |
| 0-30 km matrix surrounding range | 1 619 076          | 25.2                          | 74.8                           | 33.2 (NM)<br>26.7 (SM)                        |

<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA







## Thutade

|                | Range Area (ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|----------------|-----------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                |                 | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Range          |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 711 930         | 1.8                                  | 3.1            | 7.9            | 0          | 0.1         | 0.1      | 4.8      | 0   | 0    | 0            | 0    | 0        | 0.6       | 0.1      | 9.5  | 0       | 0.1        | 0     | 0                           | 9.5                              | 10.1          | 11.3                                   |
| High elevation | 632 082         | 1.1                                  | 2.4            | 4.8            | 0.1        | 0.2         | 0.1      | 1.2      | 0   | 0    | 0            | 0    | 0        | 0.6       | 0        | 5.1  | 0       | 0          | 0     | 0                           | 5.1                              | 5.4           | 6.3                                    |
| Low elevation  | 79 848          | 7.3                                  | 8.3            | 33.0           | 0          | 0           | 0.2      | 33.5     | 0   | 0    | 0            | 0    | 0        | 0         | 0.8      | 44.5 | 0       | 0.4        | 0     | 0                           | 44.5                             | 47.6          | 50.4                                   |
| Matrix 0-20 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 033 466       | 4.7                                  | 6.8            | 15.0           | 0.4        | 0           | 0.1      | 6.0      | 0   | 0    | 0            | 0    | 0        | 0.3       | 0.4      | 11.9 | 0       | 0.2        | 0     | 0                           | 11.9                             | 13.1          | 17.3                                   |
| High elevation | 754 663         | 3.0                                  | 4.3            | 9.0            | 0          | 0           | 0        | 1.3      | 0   | 0.1  | 0            | 0    | 0        | 0.3       | 0        | 3.6  | 0       | 0.1        | 0     | 0                           | 3.6                              | 4.0           | 6.9                                    |
| Low elevation  | 278 803         | 9.1                                  | 13.7           | 31.2           | 1.5        | 0           | 0.5      | 18.7     | 0   | 0    | 0            | 0    | 0        | 0         | 1.4      | 34.6 | 0       | 0.5        | 0     | 0                           | 34.6                             | 38.0          | 45.5                                   |
| Matrix 0-30 km |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total          | 1 619 076       | 3.0                                  | 5.4            | 11.7           | 0.5        | 0           | 0.1      | 5.1      | 0   | 0.2  | 0            | 0    | 0        | 0.2       | 0.3      | 10.3 | 0       | 0.2        | 0     | 0                           | 10.3                             | 11.6          | 14.3                                   |
| High elevation | 1 211 820       | 1.9                                  | 3.3            | 6.8            | 0          | 0           | 0        | 1.1      | 0   | 0.2  | 0            | 0    | 0        | 0.3       | 0        | 3.4  | 0       | 0.1        | 0     | 0                           | 3.4                              | 3.8           | 5.7                                    |
| Low elevation  | 407 251         | 6.3                                  | 11.6           | 26.4           | 2.2        | 0           | 0.4      | 17.0     | 0   | 0    | 0            | 0    | 0        | 0         | 1.2      | 31.0 | 0       | 0.4        | 0     | 0                           | 31.0                             | 34.9          | 40.1                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.

## Low density area

The low density area includes the area between the Spatsizi, Thutade, Frog, Rabbit and Horseranch and Tsenaglude caribou ranges.

### Range use summary

There is limited information on range use of caribou within the low density area. Caribou were counted in alpine habitat in the northern portion of the low density area in February/March 2009 (Thiessen 2009), and therefore are known to use high elevation habitat during winter. Caribou were seen in the Rainbow Lakes area in the northwestern portion of the low density area during summer but no habitat information was provided (Mundy 1963).

| Season      | Overview of Habitat and Range Use <sup>1</sup>                                                                              | Source          |
|-------------|-----------------------------------------------------------------------------------------------------------------------------|-----------------|
| Winter      | <ul style="list-style-type: none"> <li>high elevation alpine habitat in northern portion of the low density area</li> </ul> | Thiessen (2009) |
| Summer      |                                                                                                                             |                 |
| Migration   |                                                                                                                             |                 |
| Total Range |                                                                                                                             |                 |

### Population size and trend

There is no population estimate for caribou in the low density area. Prior to establishment of the Thutade caribou range, McNay (2012) estimated that a minimum of 301 caribou were observed in the low density area over the years during reconnaissance surveys, but did not suggest that this was an estimate.

The following table includes some observations of caribou in the low density area, excluding the newly delineated Thutade caribou range, and excluding observations in the area proposed as an extension to the Frog caribou range by Sittler et al. (2015). The caribou counted during surveys in the proposed extension to the Frog caribou range are included in the summary for the Frog caribou range.

#### Low density area

| Year   | Month    | % calves <sup>1</sup> | Calves/ 100 adults <sup>1</sup> | Calves/100 cows <sup>1</sup> | Total <sup>2</sup> Counted | Total classified <sup>3</sup> |                    | Source <sup>4</sup>            |
|--------|----------|-----------------------|---------------------------------|------------------------------|----------------------------|-------------------------------|--------------------|--------------------------------|
|        |          |                       |                                 |                              |                            | Calves+ Adults                | Calves+ Cows+Bulls |                                |
| Winter |          |                       |                                 |                              |                            |                               |                    |                                |
| 2013   | Mar      | 29                    | 40                              | 40                           | 7                          | 7                             | 7                  | MacDonald and McNay (2013)     |
| 2009   | Feb/Mar  | 4                     | 4                               | 7                            | (125) <sup>5</sup>         | 124                           | 124                | BC MFLNRORD unpubl. data       |
| Summer |          |                       |                                 |                              |                            |                               |                    |                                |
| 1991   | Sept     |                       |                                 |                              | 41 <sup>6</sup>            |                               |                    | Ritchie in McNay (2012)        |
| 1963   | July/Aug | 19                    | 24                              |                              | 47                         | 47                            |                    | Mundy (1963) (GR) <sup>7</sup> |

<sup>1</sup> Calf ratios were based on totals in each age/sex class (except as otherwise indicated) because data detailing composition of groups were not always available so we could not eliminate groups where some animals were unclassified

<sup>2</sup> Numbers in parentheses indicate surveys where caribou were not the primary focus

<sup>3</sup> Caribou classified at a minimum to calves and adults apply to % calves and calves/100 adults; caribou classified at a minimum to calves, cows and bulls apply to calves/100 cows

<sup>4</sup> All surveys were conducted by helicopter unless indicated as a fixed-wing (FW) or ground (GR) survey

<sup>5</sup> Number of caribou were counted during a Stone's sheep and caribou survey (Thiessen 2009) but the number of caribou in the low density portion of the survey area (in the northeastern portion of the low density area) was not specified in the report and therefore the number counted in the low density area was summarized from BC MFLNRORD unpublished data

<sup>6</sup> These caribou were counted in the low density area west of the current Thutade caribou range and south of the current Spatsizi caribou range. Sittler et al. (2015) recommended extending the Spatsizi caribou range boundary to include this area

<sup>7</sup> Caribou counted during a summer ground survey in the Rainbow Lakes area in the area between the Spatsizi and Horseranch caribou ranges

A total of 7 and 41 caribou were seen in March 2013 and September 1991, respectively, in areas that Sittler et al. (2015) recommended for inclusion in the Spatsizi caribou range. The highest number of caribou counted in the low density area was 125 caribou during a Stone's sheep and caribou survey in the northeastern portion of the low density area in February/March 2009 (Thiessen 2009, BC MFLNRORD unpubl. data). The 47 caribou counted in the Rainbow Lakes area (Mundy 1963) are also located in the northern portion of the low density area.

## Boundary Issues

In the southern portion of the low density area, Sittler et al. (2015) recommended boundary extensions to the Spatsizi and Frog caribou ranges in addition to the new Thutade caribou range.

Additional work needs to be conducted in the northern portion of the low density area to determine whether existing range boundaries need to be extended or new ranges created.

## Range condition

Within the current low density area, habitat disturbance covers 10%, 6% and 22% of the total, high elevation and low elevation portions of the range respectively. Primary disturbances are fires and roads/trails. Roads/trail are located primarily along the outer margins of the low density area in the southwest (Omineca Resource Road and associated industrial roads), northwest (Jade/Boulder road) and northeast.

Our analysis does not include fires from 2018 to 2021, however, there were no fires of appreciable size recorded in the low density area during those four years other than a 2,500 ha fire in the northern portion of the area in 2021.

### Low density area

|                  | Total Area<br>(ha) | % of Area                     |                                | % of matrix in<br>adjacent range <sup>3</sup> |
|------------------|--------------------|-------------------------------|--------------------------------|-----------------------------------------------|
|                  |                    | Low<br>elevation <sup>1</sup> | High<br>elevation <sup>2</sup> |                                               |
| Low density area |                    |                               |                                |                                               |
| Low density area | 1 206 836          | 80.8                          | 19.2                           | N/A                                           |

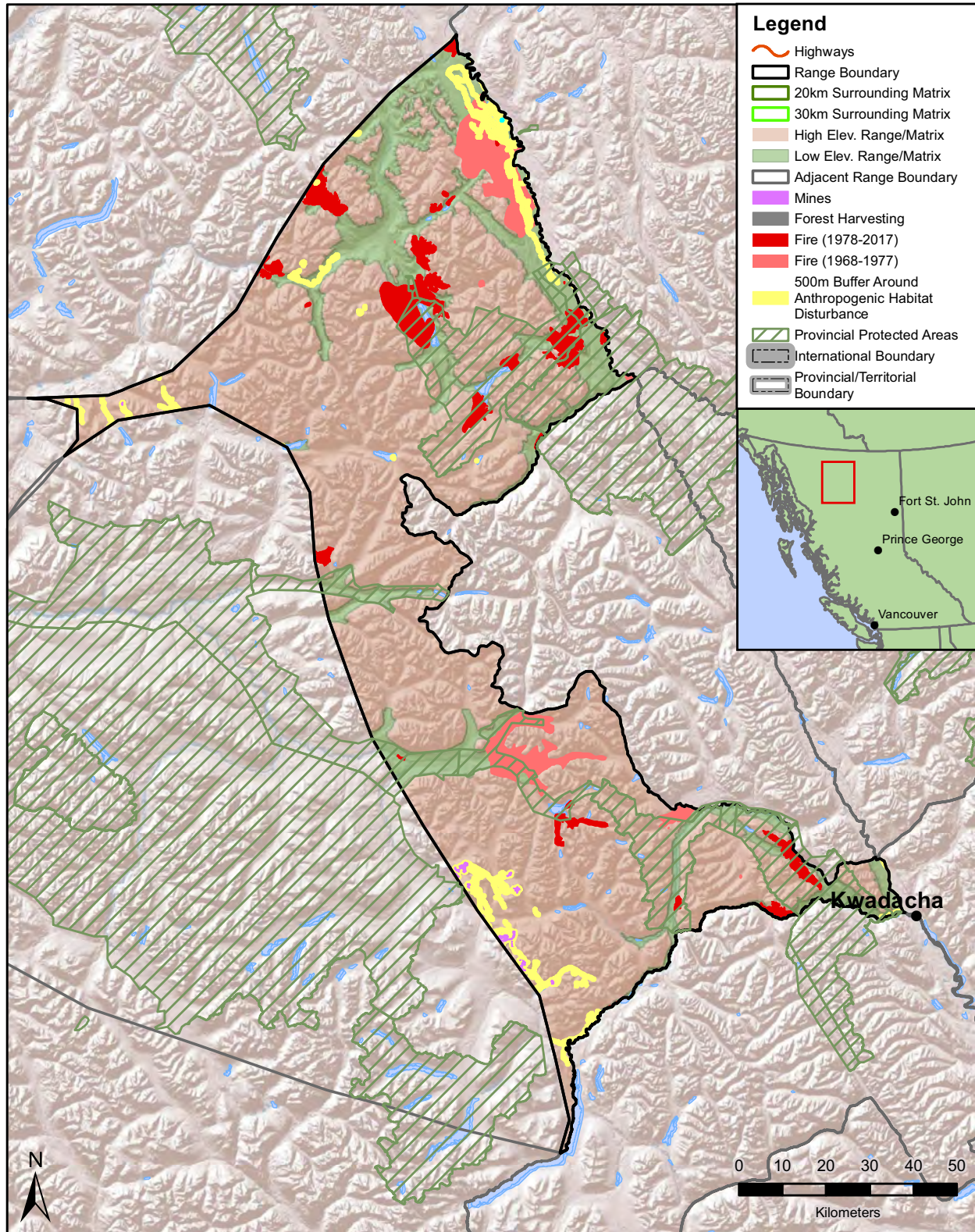
<sup>1</sup> Low elevation defined as that portion of the range that lies within the Boreal White and Black Spruce (BWBS) or Sub-Boreal Spruce (SBS) biogeoclimatic zones

<sup>2</sup> High elevation defined as that portion of the range that lies within the Spruce Willow Birch (SWB), Engelmann Spruce-Subalpine Fir (ESSF) or Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zones

<sup>3</sup> Indicates how much of the surrounding matrix lies within neighbouring caribou ranges; Boreal = ranges in Boreal National Ecological Area (NEA); NM = ranges in Northern Mountain NEA; SM = ranges in Southern Mountain NEA



## Low density area



## Low density area

|                  | Range Area (ha) | % habitat disturbance <sup>1,2</sup> |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
|------------------|-----------------|--------------------------------------|----------------|----------------|------------|-------------|----------|----------|-----|------|--------------|------|----------|-----------|----------|------|---------|------------|-------|-----------------------------|----------------------------------|---------------|----------------------------------------|
|                  |                 | Fire <40 years                       | Fire <50 years | Forest Insects | Reservoirs | Agriculture | Airstrip | Cutblock | Dam | Mine | Oil facility | Well | Pipeline | Powerline | Railroad | Road | Seismic | Settlement | Trail | Road and Trail <sup>3</sup> | Total Road or Trail <sup>3</sup> | Total Anthro. | Total Habitat Disturbance <sup>4</sup> |
| Low density area |                 |                                      |                |                |            |             |          |          |     |      |              |      |          |           |          |      |         |            |       |                             |                                  |               |                                        |
| Total            | 1 206 836       | 2.9                                  | 6.5            | 0.5            | 0          | 0           | 0        | 0        | 0   | 0.4  | 0            | 0    | 0        | 0         | 0        | 3.2  | 0       | 0          | 0.4   | 0.3                         | 3.2                              | 3.3           | 6.1                                    |
| High elevation   | 962 484         | 1.9                                  | 3.8            | 0.3            | 0          | 0           | 0        | 0        | 0   | 0.4  | 0            | 0    | 0        | 0         | 0        | 2.2  | 0       | 0          | 0     | 0                           | 2.2                              | 2.3           | 4.1                                    |
| Low elevation    | 229 127         | 7.3                                  | 18.0           | 1.2            | 0          | 0           | 0.1      | 0        | 0   | 0    | 0            | 0    | 0        | 0         | 0        | 7.8  | 0       | 0          | 1.9   | 1.7                         | 7.9                              | 7.9           | 15.1                                   |

<sup>1</sup> The anthropogenic habitat disturbance footprint includes a 500 m buffer consistent with the 500 m buffer used for anthropogenic habitat disturbance in EC (2014).

<sup>2</sup> As a result of overlapping types of habitat disturbance and overlapping buffers for anthropogenic habitat disturbance, some habitat disturbance polygons are identified as more than one type of habitat disturbance (e.g. a "settlement" polygon will overlap with a "road" polygon). As a result, one polygon could include the footprint of more than one type of habitat disturbance and therefore adding up the area of individual types of anthropogenic habitat disturbance will exceed the combined area of "Total anthropogenic disturbance" (see Tables 7 and 8), which merges all anthropogenic habitat disturbance and their buffers to eliminate overlaps. Similarly, "Total habitat disturbance" (see Tables 7 and 8) also merges the footprints of fires <40 years and anthropogenic habitat disturbance to eliminate double-counting overlapping habitat disturbances (e.g. a cutblock that was subsequently consumed in a fire).

<sup>3</sup> "Road and trail" indicates the portions of the "Road" and "Trail" categories that were identified as both a road and a trail; "Total Road/Trail" is the combined total of roads and trails and accounts for overlap between the two categories.

<sup>4</sup> Total habitat disturbance = combined area of total anthropogenic habitat disturbance (including a 500 m buffer) and fires <40 years.



# Appendix 3 References

## Preamble

Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? *Rangifer*, Special Issue No. 9: 95-116.

Cichowski, D. 1990. Population parameters of caribou in west-central B.C. In: Hebert, D. (ed.). *Proceedings of The Caribou Workshop*, November 24-26, 1988, Williams Lake, B.C. BC Ministry of Environment, Williams Lake, B.C.

COSEWIC. 2014. COSEWIC assessment and status report on the caribou *Rangifer tarandus*, Northern Mountain population, Central Mountain population and Southern Mountain population in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxii +113pp.

Duncan, S. 2009. Northern mountain caribou population dynamics Peace River Region. Unpublished report, University of Victoria, Victoria, B.C.

Environment Yukon. 2016. Science-based guidelines for management of Northern Mountain caribou in Yukon. Yukon Fish and Wildlife Branch Report MR-16-01. Whitehorse, Yukon, Canada.

Hatler, D. 1987. Perspectives on inventory of caribou in British Columbia. Spatsizi Association for Biological Research Report No. 4, BC Ministry of Environment and Parks Wildlife Report No. R-14. Spatsizi Association for Biological Research, Smithers, B.C. and BC Ministry of Environment and Parks, Victoria, B.C.

## Carcross

COSEWIC. 2014. COSEWIC assessment and status report on the caribou *Rangifer tarandus*, Northern Mountain population, Central Mountain population and Southern Mountain population in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxii +113pp.

Environment Yukon. 2016. Science-based guidelines for management of Northern Mountain caribou in Yukon. Yukon Fish and Wildlife Branch Report MR-16-01. Whitehorse, Yukon, Canada.

Florkiewicz, R. 2008. Southern Lakes Regional Wildlife Assessment: Appendix 1. Species Status Summary – Woodland Caribou. Prepared for Southern Lakes Wildlife Coordinating Committee, 47p.

Florkiewicz, R., R. Maraj, T. Hegel and M. Waterreus. 2007. The effects of human land use on the winter habitat of the recovering Carcross woodland caribou herd in suburban Yukon Territory, Canada. *Rangifer* Special Issue No. 17:181-197.

Francis, S., and J. Nishi. 2015. Range assessment as a cumulative effects management tool: Assessment of the Carcross caribou herd range in Yukon. Prepared for Environment Yukon. Yukon Fish and Wildlife Branch Report MRC-15-01, Whitehorse, Yukon, Canada.

Hatler, D. 1987. Perspectives on inventory of caribou in British Columbia. Spatsizi Association for Biological Research Report No. 4, BC Ministry of Environment and Parks Wildlife Report No. R-14. Spatsizi Association for Biological Research, Smithers, B.C. and BC Ministry of Environment and Parks, Victoria, B.C.

Jessup, L. and T. Drury. 2016. Carcross caribou - Fall composition survey 2015. Environment Yukon, Whitehorse, YK.

Schultze, G. 1990. 1990 Mountain goat and sheep inventory of the Tagish Highlands area in MU 6-27. BC Ministry of Environment, Smithers, B.C.

Williams, M., and K. Dixon. 2016. Ca38 - Carcross caribou herd fall composition survey, October 2-11, 2015. BC Ministry of Forests, Lands and Natural Resource Operations, Smithers, B.C.

## Atlin

Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? *Rangifer*, Special Issue No. 9: 95-116.

Bergerud, A.T. 1978. The status and management of caribou in British Columbia. Prepared for BC Fish and Wildlife Branch, Victoria, B.C.

Environment Yukon. 2016. Science-based guidelines for management of Northern Mountain caribou in Yukon. Yukon Fish and Wildlife Branch Report MR-16-01. Whitehorse, Yukon, Canada.

Hatler, D. 1987. Perspectives on inventory of caribou in British Columbia. Spatsizi Association for Biological Research Report No. 4, BC Ministry of Environment and Parks Wildlife Report No. R-14. Spatsizi Association for Biological Research, Smithers, B.C. and BC Ministry of Environment and Parks, Victoria, B.C.

Hatler, D. 1977a. Caribou survey - Atlin local - February 10, 1977. Data extracted from Ungulate Inventory Database.

Hatler, D. 1977b. Caribou survey - Atlin area, November 24, 1977. Data extracted from Ungulate Inventory Database.

Hatler, D. 1974. Caribou survey - Atlin area, November 21, 1974. Data extracted from Ungulate Inventory Database.

Hazelwood, G. 1975. Goat survey Atlin Park, August 22, 1975. Data extracted from Ungulate Inventory Database.

Hodson, K. 1980a. Caribou survey, March 23-24, 1980. Data extracted from Ungulate Inventory Database.

Hodson, K. 1980b. Stone's sheep survey - East of Atlin Lake, June 21, 1980. Data extracted from Ungulate Inventory Database.

Hodson, K. 1979a. Caribou survey Atlin area, Atlin Lake, Snowdon Range, Silver Salmon River, March 13-16, 1979. Data extracted from Ungulate Inventory Database.

Hodson, K. 1979b. Caribou survey, October 27, 1979. Data extracted from Ungulate Inventory Database.

Jones, G. 1982. Atlin Park and Recreation Area mountain goat survey, July 4-7, 1982. BC Ministry of Lands, Parks and Housing, Victoria, B.C.

Marshall, R. 2008. Note to file: Atlin caribou survey April 12-13, 2008. Unpubl. rep. BC Ministry of Environment, Smithers, B.C.

Marshall, R. 2007a. East Atlin stratified random block caribou survey, February 14-16, 2007. BC Ministry of Environment Smithers, B.C.

Marshall, R. 2007b. Atlin caribou rut survey, October 22-23, 2007. Unpubl. note to file, BC Ministry of Environment, Smithers, B.C.

Marshall, R. 2006. Atlin caribou reconnaissance, March 25, 2006. Unpubl. rep., BC Ministry of Environment, Smithers, B.C.

Marshall, R. 2003. Atlin caribou herd March 2003 classified count. Unpubl. rep., BC Ministry of Environment, Smithers, B.C.

Marshall, R. 2001. Atlin caribou October 2001. Unpubl. flight summary, BC Ministry of Environment, Smithers, B.C.

Marshall, R. 2000a. Atlin caribou March 2000. Unpubl. flight summary, BC Ministry of Environment, Smithers, B.C.

Marshall, R. 2000b. Atlin caribou June 2000. Unpubl. flight summary, BC Ministry of Environment, Smithers, B.C.

Marshall, R. 2000c. Atlin caribou November 2000. Unpubl. flight summary, BC Ministry of Environment, Smithers, B.C.

Marshall, R. 1999a. Atlin caribou herd population assessment 1998/99. Unpubl. rep., BC Ministry of Environment, Smithers, B.C.

Marshall, R. 1999b. Atlin caribou rut survey 1999. Unpubl. flight summary, BC Ministry of Environment, Smithers, B.C.

Marshall, R. 1998. Atlin caribou March 1998. Unpubl. flight summary, BC Ministry of Environment, Smithers, B.C.

Marshall, R. 1997a. Atlin caribou March 1997. Unpubl. flight summary, BC Ministry of Environment, Smithers, B.C.

Marshall, R. 1997b. Atlin caribou June 1997. Unpubl. flight summary, BC Ministry of Environment, Smithers, B.C.

- Marshall, R. 1997c. Atlin caribou October 1997. Unpubl. summary of YTG radio-telemetry flight. BC Ministry of Environment, Smithers, B.C.
- Marshall, R. 1997d. Atlin caribou November 1997. Unpubl. flight summary, BC Ministry of Environment, Smithers, B.C.
- Marshall, R. 1996. Atlin caribou March 1996. Unpubl. flight summary, BC Ministry of Environment, Smithers, B.C.
- Marshall, R. 1995a. Atlin caribou March 1995. Unpubl. flight summary, BC Ministry of Environment, Smithers, B.C.
- Marshall, R. 1995b. Atlin caribou October 1995 - YTG flight survey. Unpubl. flight summary, BC Ministry of Environment, Smithers, B.C.
- Marshall, R. 1984. Caribou survey of Atlin, September 16, 1984. Unpubl. rep., BC Ministry of Environment, Smithers, B.C.
- Polfus, J., M. Hebblewhite and K. Henemeyer. 2011. Identifying indirect habitat loss and avoidance of human infrastructure by northern mountain woodland caribou. *Biological Conservation* 144:2637-2646.
- Stephen, J. 1977. Caribou survey Atlin district, December 4, 1977. Data extracted from Ungulate Inventory Database.
- Thiessen, C. 2018. Atlin Watsix (Caribou) survey. BC MFLNRORD, Smithers, BC. 1 page infographic.
- Williams, M., and K. Dixon. 2016. Ca 37 - 2015 Atlin caribou herd fall composition survey, October 8-11, 2015. BC Ministry of Forests, Lands and natural Resource Operations, Smithers, B.C.

## **Swan Lake**

- Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? *Rangifer*, Special Issue No. 9: 95-116.
- Bergerud, A.T. 1978. The status and management of caribou in British Columbia. Prepared for BC Fish and Wildlife Branch, Victoria, B.C.
- Environment Yukon. 2016. Science-based guidelines for management of Northern Mountain caribou in Yukon. Yukon Fish and Wildlife Branch Report MR-16-01. Whitehorse, Yukon, Canada.
- Hatler, D. 1987. Perspectives on inventory of caribou in British Columbia. Spatsizi Association for Biological Research Report No. 4, BC Ministry of Environment and Parks Wildlife Report No. R-14. Spatsizi Association for Biological Research, Smithers, B.C. and BC Ministry of Environment and Parks, Victoria, B.C.
- Williams, M. 2009. Population ecology of the Swan Lake caribou herd. Prepared for Habitat Conservation Trust Foundation. BC Ministry of Environment, Smithers, B.C.

## **Little Rancheria**

- Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? *Rangifer*, Special Issue No. 9: 95-116.
- Bergerud, A.T. 1978. The status and management of caribou in British Columbia. Prepared for BC Fish and Wildlife Branch, Victoria, B.C.
- Environment Yukon. 2016. Science-based guidelines for management of Northern Mountain caribou in Yukon. Yukon Fish and Wildlife Branch Report MR-16-01. Whitehorse, Yukon, Canada.
- Florkiewicz, R., N. Flynn, N. MacLean, S. Francis, J. Adamczewski and V. Loewen. 2003. Little Rancheria caribou in the Yukon: evaluation of winter habitat quality and habitat use. Department of Environment, Government of Yukon, Whitehorse, Yukon.
- Hatler, D. 1987. Perspectives on inventory of caribou in British Columbia. Spatsizi Association for Biological Research Report No. 4, BC Ministry of Environment and Parks Wildlife Report No. R-14. Spatsizi Association for Biological Research, Smithers, B.C. and BC Ministry of Environment and Parks, Victoria, B.C.
- Jex, B. 2013. Summary of Level-Kawdy caribou GPS collar fix data from Ca-36 project. BC Ministry of Forests, Lands and Natural Resource Operations. Smithers, B.C. 4p.

MacLean, N. In prep. Identification and analysis of landscape and stand winter habitat management requirements for the Little Rancheria and Horseranch woodland caribou herds. Prepared for BC Ministry of Water, Land and Air Protection, Smithers, B.C.

Marshall, R. 1999. Stratified random block survey of the Little Rancheria and Horseranch caribou herds February/March 1999. Unpublished report, BC Ministry of Environment, Smithers, B.C.

Marshall, R., M. Williams and N. MacLean. Unpubl. data - Cassiar caribou and moose telemetry 1996-2001. BC Ministry of Environment, Smithers, B.C.

Farnell, R., and J. McDonald. 1990. The distribution, movements, demography and habitat use of the Little Rancheria caribou herd - Final Report. Yukon Department of Renewable Resources, Whitehorse, Yukon.

## **Horseranch**

Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? Rangifer, Special Issue No. 9: 95-116.

Bergerud, A.T. 1978. The status and management of caribou in British Columbia. Prepared for BC Fish and Wildlife Branch, Victoria, B.C.

Bergerud, A.T., and J.P. Elliott. 1998. Wolf predation in a multiple-ungulate system in northern British Columbia. Can. J. Zool. 76:1551-1569.

Bergerud, A.T., and J.P. Elliott. 1986. Dynamics of caribou and wolves in northern British Columbia. Can. J. Zool. 64:1515-1529.

Elliott, J.P. 1986. Kechika enhancement project of northeastern B.C. wolf/ungulate management - 1985-86 Annual Report. Wildlife Working Report No. WR-20, BC Ministry of Environment and Parks, Fort St. John, B.C.

Elliott, J.P. 1985. Kechika enhancement project of northeastern B.C. wolf/ungulate management - 1984-85 Annual Report. Wildlife Working Report No. WR-13, BC Ministry of Environment, Fort St. John, B.C.

Environment Yukon. 2016. Science-based guidelines for management of Northern Mountain caribou in Yukon. Yukon Fish and Wildlife Branch Report MR-16-01. Whitehorse, Yukon, Canada.

Hatler, D. 1987. Perspectives on inventory of caribou in British Columbia. Spatsizi Association for Biological Research Report No. 4, BC Ministry of Environment and Parks Wildlife Report No. R-14. Spatsizi Association for Biological Research, Smithers, B.C. and BC Ministry of Environment and Parks, Victoria, B.C.

MacLean, N. In prep. Identification and analysis of landscape and stand winter habitat management requirements for the Little Rancheria and Horseranch woodland caribou herds. Prepared for BC Ministry of Water, Land and Air Protection, Smithers, B.C.

Marshall, R. 2004. Horseranch and Little Rancheria 2004. Unpubl. flight summary, BC Ministry of Environment, Smithers, B.C.

Marshall, R. 1999. Stratified random block survey of the Little Rancheria and Horseranch caribou herds February/March 1999. Unpublished report, BC Ministry of Environment, Smithers, B.C.

Marshall, R. 1996. Horseranch Stratified Random Block Survey (survey conducted by John Elliot). Unpubl. summary, BC Ministry of Environment, Smithers, B.C.

Marshall, R., M. Williams and N. MacLean. Unpubl. data - Cassiar caribou and moose telemetry 1996-2001. BC Ministry of Environment, Smithers, B.C.

Mundy, K. 1963. Report to the Fish and Game Branch on the Northern Survey, 1963. Unpubl. rep. BC Fish and Game Branch, Victoria.

Thiessen, C. 2009. 2009 Stone's sheep/caribou inventory - MU 7-52 (revised). BC Ministry of Environment, Fort St. John, B.C.

## **Level Kawdy**

Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? Rangifer, Special Issue No. 9: 95-116.

Bergerud, A.T. 1978. The status and management of caribou in British Columbia. Prepared for BC Fish and Wildlife Branch, Victoria, B.C.



Environment Yukon. 2016. Science-based guidelines for management of Northern Mountain caribou in Yukon. Yukon Fish and Wildlife Branch Report MR-16-01. Whitehorse, Yukon, Canada.

Hatler, D. 1987. Perspectives on inventory of caribou in British Columbia. Spatsizi Association for Biological Research Report No. 4, BC Ministry of Environment and Parks Wildlife Report No. R-14. Spatsizi Association for Biological Research, Smithers, B.C. and BC Ministry of Environment and Parks, Victoria, B.C.

Bergerud, A.T., and J.P. Elliott. 1986. Dynamics of caribou and wolves in northern British Columbia. Can. J. Zool. 64:1515-1529.

Jex, B. 2013. Summary of Level-Kawdy caribou GPS collar fix data from Ca-36 project. BC Ministry of Forests, Lands and Natural Resource Operations. Smithers, B.C. 4p.

Jex, B. 2012. Level Mountain-Kawdy Plateau telemetry-based caribou survey - Summary Report. BC Ministry of Forests, Lands and Natural Resource Operations, Smithers, B.C.

Jex, B. 2011. Level Mountain - Kawdy Plateau transect-based caribou composition survey - Summary Report. BC Ministry of Forests, Lands and Natural Resource Operations, Smithers, B.C. 7p.

Kerkhoff, K. 2013. Level-Kawdy caribou composition survey: March 2013. BC Ministry of Forests, Lands and Natural Resource Operations. Smithers, B.C. 8p.

Marshall, R. 2002. Level Mountain/Kawdy Inventory - 2002 (Caribou). BC Ministry of Environment, Smithers, B.C. 1 p.

Marshall, R. 1999. Level Kawdy mountain caribou surveys - October 1998 and 1999. BC Ministry of Environment, Smithers, B.C.

Mundy, K. 1963. Report to the Fish and Game Branch on the Northern Survey, 1963. Unpubl. rep. BC Fish and Game Branch, Victoria.

van Drimmelen, B. 1983. Inventory of the Kawdy-Jennings-Level Mountain caribou population. BC Ministry of Environment, Smithers, B.C. 21p. (summarized by Marshall)

## **Edziza**

Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? Rangifer, Special Issue No. 9: 95-116.

Cichowski, D. 1996. Mountain goat and Stone's sheep survey - March 27-28, 1996 - Mount Edziza Provincial Park and Recreation Area. BC Parks, Smithers, B.C. 4p.

Environment Canada. 2014. Recovery Strategy for the Woodland Caribou, Southern Mountain population (*Rangifer tarandus caribou*) in Canada. *Species at Risk Act Recovery Strategy Series*. Environment Canada, Ottawa. viii + 103pp.

Environment Yukon. 2016. Science-based guidelines for management of Northern Mountain caribou in Yukon. Yukon Fish and Wildlife Branch Report MR-16-01. Whitehorse, Yukon, Canada.

Grant, L. 2018. Edziza Hodzih (caribou) rut count: October 2017. BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development, Smithers, B.C. 10p.

Harper, F. 1972. Wildlife values in the southern watershed of the Stikine River in northwestern British Columbia. Unpubl. rep. BC Ministry of Environment, Victoria, B.C.

Hatler, D. 1987. Perspectives on inventory of caribou in British Columbia. Spatsizi Association for Biological Research Report No. 4, BC Ministry of Environment and Parks Wildlife Report No. R-14. Spatsizi Association for Biological Research, Smithers, B.C. and BC Ministry of Environment and Parks, Victoria, B.C.

Hatler, D.F. 1986. Studies of radio-collared caribou in the Spatsizi Wilderness Park area, British Columbia 1980-1984. Report 3, Spatsizi Association for Biological Research, Smithers, B.C. 202 pages.

Hatler, D. 1983. Mt. Edziza Provincial Park - Flight Form - 1 February 1983. Unpubl. rep. to BC Ministry of Lands, Parks and Housing, Victoria, B.C.

Hatler, D. 1982. Mt. Edziza Provincial Park and vicinity - Flight Form - 16 March 1982. Unpubl. rep. to BC Ministry of Lands, Parks and Housing, Victoria, B.C.

Hatler, D. 1980. Flight Form - Mt. Edziza caribou - 3 March 1980. Unpubl. rep. to BC Ministry of Lands, Parks and Housing, Victoria, B.C.

- Hatler, D. 1979a. Flight Form - Edziza Park area - 14 January 1979. Unpubl. rep. BC Ministry of Environment, Smithers, B.C.
- Hatler, D. 1979b. Flight Form - Edziza Park and vicinity - 1 February 1979. Unpubl. rep. BC Ministry of Environment, Smithers, B.C.
- Hatler, D. 1979c. Flight Form - Dease Lake to Edziza Provincial Park - 29 May 1979. Unpubl. rep. BC Ministry of Environment, Smithers, B.C.
- Hatler, D. 1978a. Flight Form - Dease Lake - Grand Canyon - Edziza Park - Iskut - 5 March 1978. Unpubl. rep. BC Ministry of Environment, Smithers, B.C.
- Hatler, D. 1978b. Ground observations in Edziza Provincial Park, 31 July - 5 August, 1978. Unpubl. rep. BC Ministry of Environment, Smithers, B.C.
- Hatler, D. 1978c. Flight Form - Edziza Park Area - 31 July 1978. Unpubl. rep. BC Ministry of Environment, Smithers, B.C.
- Hatler, D. 1978d. Flight Form - Edziza Park NW end - 6 October 1978. Unpubl. rep. BC Ministry of Environment, Smithers, B.C.
- Hatler, D. 1977a. Flight Form - Smithers - Iskut - Atlin and Return, 29-31 March 1977. Unpubl. rep. BC Ministry of Environment, Smithers, B.C.
- Hatler, D. 1977b. Wildlife observations, Edziza Park area - 27 July - August 4, 1977. Unpubl. rep. BC Ministry of Environment, Smithers, B.C.
- Hatler, D. 1977c. Flight Form - Klastline Plateau, Edziza Park, Level Mtn., Grand Canyon of Stikine - 10 October 1977. Unpubl. rep. BC Ministry of Environment, Smithers, B.C.
- Hatler, D. 1976. Flight Form - Smithers - Edziza - Spatsizi Park - Return, 30 March - 2 April 1976. Unpubl. rep. BC Ministry of Environment, Smithers, B.C.
- Hatler, D. and G. Hazelwood. 1985. Mountain goat surveys in the Talatui, Spatsizi and Mt. Edziza Provincial Park areas, British Columbia July 1985. Unpubl. rep. BC Ministry of Lands, Parks and Housing, Victoria, B.C. 97p.
- Hazelwood, G. 1979. Mt. Edziza Wildlife Survey - October 13, 1979. Unpubl. rep. BC Ministry of Lands, Parks and Housing, Victoria, B.C.
- Hazelwood, G. 1975. Mount Edziza Park - Wildlife Survey. Unpubl. rep. BC Ministry of Lands, Parks and Housing, Victoria, B.C.
- Hodson, K. 1978. Flight Form - Smithers - Edziza - Telegraph Cr. - Dease Lake - February 24, 1978. Unpubl. rep. BC Ministry of Environment, Smithers, B.C.
- Hodson, K. 1977. Wildlife observations while on hike from Mowdade Lake to Buckley Lake - August 31 - September 5, 1977. Unpubl. rep. BC Ministry of Environment, Smithers, B.C.
- Jones, G. 1988. Mt. Edziza Park and Recreation Area mountain sheep survey. BC Parks, Victoria, B.C.
- Jones, G. 1984. Mt. Edziza Park mountain sheep survey March 23, 24, 1984. Unpubl. rep. BC Ministry of Lands, Parks and Housing, Victoria, B.C.
- Jones, G. 1983. Mt. Edziza Park Wildlife Survey - Caribou - March 15, 1983. Unpubl. rep. BC Ministry of Lands, Parks and Housing, Victoria, B.C.
- Jones, G. 1982. Mt. Edziza Park Wildlife Survey - March 2, 1982. Unpubl. rep. BC Ministry of Lands, Parks and Housing, Victoria, B.C.
- Luckhurst, A. 1973. Winter Survey Report - B.C. Land Inventory (Wildlife Division) Winter 1972-73. Unpubl. rep. BC Ministry of Environment, Victoria, B.C.
- Marshall, R. 2006. Mt. Edziza Park 2006. BC Ministry of Environment, Smithers, B.C. 1p.
- Osmond-Jones, T. 1984a. Flight Report - 13th February 1984 - Mt. Edziza reconnaissance to establish location and numbers of caribou. Unpubl. rep. BC Ministry of Lands, Parks and Housing, Smithers, B.C.
- Osmond-Jones, T. 1984b. Flight Report - 14th February 1984 - Mt. Edziza sheep classified count. Unpubl. rep. BC Ministry of Lands, Parks and Housing, Smithers, B.C.

- Osmond-Jones, T. 1984c. Flight Report - 26 February 1984 - Mt. Edziza reconnaissance to establish location and numbers of caribou. Unpubl. rep. BC Ministry of Lands, Parks and Housing, Smithers, B.C.
- Osmond-Jones, T. 1984d. Flight Report - 14th March 1984 - Mt. Edziza reconnaissance to establish location and numbers of caribou. Unpubl. rep. BC Ministry of Lands, Parks and Housing, Smithers, B.C.
- Osmond-Jones, T. 1983. Wildlife survey - Caribou - Mt. Edziza Park 28th Oct 1983. Unpubl. rep. BC Ministry of Lands, Parks and Housing, Smithers, B.C.
- Sather, M. 1983. Mt. Edziza Park caribou survey: September 27 to October 12, 1983. Unpubl. rep. BC Ministry of Lands, Parks and Housing, Victoria, B.C.
- Stewart, A. 1981. Wildlife Survey in Mount Edziza Park - August 21, 1981. Unpubl. memo. BC Ministry of Environment, Victoria, B.C.
- van Drimmelen, B. 1982. Mount Edziza Park - Survey Form - January 30, 1982. Unpubl. rep. BC Ministry of Environment, Smithers, B.C.

## **Tsenaglode**

- Bergerud, A.T., and J.P. Elliott. 1998. Wolf predation in a multiple-ungulate system in northern British Columbia. *Can. J. Zool.* 76:1551-1569.
- Environment Yukon. 2016. Science-based guidelines for management of Northern Mountain caribou in Yukon. Yukon Fish and Wildlife Branch Report MR-16-01. Whitehorse, Yukon, Canada.
- Hatler, D. 1987. Perspectives on inventory of caribou in British Columbia. Spatsizi Association for Biological Research Report No. 4, BC Ministry of Environment and Parks Wildlife Report No. R-14. Spatsizi Association for Biological Research, Smithers, B.C. and BC Ministry of Environment and Parks, Victoria, B.C.
- Hatler, D.F. 1986. Studies of radio-collared caribou in the Spatsizi Wilderness Park area, British Columbia 1980-1984. Report 3, Spatsizi Association for Biological Research, Smithers, B.C. 202 pages.
- Mundy, K. 1963. Report to the Fish and Game Branch on the Northern Survey, 1963. Unpubl. rep. BC Fish and Game Branch, Victoria.
- Thiessen, C., and L. Grant. 2020. Tsenaglode hodjih (caribou) composition survey 2017. BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development, Smithers, B.C.

## **Spatsizi**

- Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? *Rangifer*, Special Issue No. 9: 95-116.
- Bergerud, A.T. 1978. The status and management of caribou in British Columbia. Prepared for BC Fish and Wildlife Branch, Victoria, B.C.
- Bergerud, A.T., and J.P. Elliott. 1998. Wolf predation in a multiple-ungulate system in northern British Columbia. *Can. J. Zool.* 76:1551-1569.
- Cichowski, D. 1994. Stone's sheep and caribou survey - March 24-26, 1994 - Spatsizi Plateau Wilderness Park, Stikine River Recreation Area, Gladys Lake Ecological Reserve. BC Parks, Smithers, B.C.
- Cichowski, D. 1993. Stone's sheep survey - March 11-14, 1993: Spatsizi Plateau Wilderness Park, Stikine River Recreation Area, Gladys Lake Ecological Reserve. BC Parks, Smithers, B.C.
- Eastman, D. 1979. Northern Inventory - caribou - October, 22, 1979. BC Ministry of Environment, Victoria, B.C.
- Environment Yukon. 2016. Science-based guidelines for management of Northern Mountain caribou in Yukon. Yukon Fish and Wildlife Branch Report MR-16-01. Whitehorse, Yukon, Canada.
- Grant, L. and C. Thiessen. 2018. Spatsizi hodjih (caribou) composition survey: October 2017. BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development, Smithers, B.C. 11p.
- Guiguet, C. 1959. Field Notes - C. Guiguet - Spatsizi Area July - August 1959. B.C. Provincial Museum, Victoria, B.C.
- Hartman, F. 1962a. Game survey flight report. Unpubl. rep. BC Fish and Game Branch.

- Hartman, F. 1962b. Report to the Fish and Game Branch on an aerial survey of big game of the Stikine Drainage (Kinaskan Lake to Hyland Post). Unpubl. rep. BC Fish and Game Branch.
- Harper, F. 1972. Wildlife values in the southern watershed of the Stikine River in northwestern British Columbia. Unpubl. rep. BC Ministry of Environment, Victoria, B.C.
- Hatler, D. 1987. Perspectives on inventory of caribou in British Columbia. Spatsizi Association for Biological Research Report No. 4, BC Ministry of Environment and Parks Wildlife Report No. R-14. Spatsizi Association for Biological Research, Smithers, B.C. and BC Ministry of Environment and Parks, Victoria, B.C.
- Hatler, D.F. 1986a. Studies of radio-collared caribou in the Spatsizi Wilderness Park area, British Columbia 1980-1984. Report 3, Spatsizi Association for Biological Research, Smithers, B.C. 202 pages.
- Hatler, D. 1986b. Caribou population composition surveys, Spatsizi Wilderness Park and vicinity - 10-12 October 1986. Prepared for BC Ministry of Lands, Parks and Housing, Victoria, B.C.
- Hatler, D. 1982. Unpubl. rep. on radio-tracking flight, 7 November 1982. Spatsizi Association for Biological Research, Smithers B.C. 15p.
- Hatler, D. 1981a. Spatsizi Association for Biological Research: 1980-81 Progress Report No. 4. Spatsizi Association for Biological Research, Smithers, B.C.
- Hatler, D. 1981b. Spatsizi Association for Biological Research: 1980-81 Progress Report No. 12. Spatsizi Association for Biological Research, Smithers, B.C.
- Hatler, D. 1979a. Flight form - Dease Lake - Spatsizi - Takla Lake - 15 January 1979. Unpubl. rep., BC Ministry of Environment, Smithers, B.C.
- Hatler, D. 1979b. Flight form - Tatlatui Park and Spatsizi Park - Jan 31 - Feb 2, 1979. Unpubl. rep., BC Ministry of Environment, Smithers, B.C.
- Hatler, D. 1978. Flight form - Tomias Mountain - 7 October 1978. Unpubl. rep., BC Ministry of Environment, Smithers, B.C.
- Hatler, D. 1977. Flight Form - Spatsizi - Tatlatui - Lawyers Pass areas - 7-9 October 1977. Unpubl. rep., BC Ministry of Environment, Smithers, B.C.
- Hatler, D. 1976a. Flight Form - Buckinghorse Lake - Kluayetz Crk; Didene Crk. - BCR Camp; Fire Flats - Buckinghorse Crk. 13 July 1976. Unpubl. rep. BC Ministry of Environment, Smithers, B.C.
- Hatler, D. 1976b. Flight form - Spatsizi - 28-30 September 1976. Unpubl. rep. BC Ministry of Environment, Smithers, B.C.
- Hatler, D. and G. Hazelwood. 1985. Mountain goat surveys in the Talatui, Spatsizi and Mt. Edziza Provincial Park areas, British Columbia July 1985. Unpubl. rep. BC Ministry of Lands, Parks and Housing, Victoria, B.C. 97p.
- Hatler, D. and G. Hazelwood. 1984. Mountain goat surveys in Spatsizi Wilderness Park, British Columbia, July 1984. Unpubl. rep. BC Ministry of Lands, Parks and Housing, Victoria, B.C. 81p.
- Hazelwood, G. 1979. Spatsizi caribou survey - October 9-12, 1979. BC Ministry of Lands, Parks and Housing, Victoria, B.C.
- Jones, G. 1988. Winter wildlife survey January 25 - February 3, 1988: Spatsizi Plateau Wilderness Park, Stikine River Recreation Area, Gladys Lake Ecological Reserve. BC Parks, Victoria, B.C.
- Jones, G. 1985. Spatsizi Park caribou survey - October 7-8, 1985. BC Ministry of Lands, Parks and Housing, Victoria, B.C.
- Jones, G. 1984. Spatsizi Park caribou survey - Oct 6-9, 1984. BC Ministry of Lands, Parks and Housing, Victoria, B.C.
- Jones, G. 1983. Spatsizi Park wildlife survey - February 15-21 and March 15-18, 1983. BC Ministry of Lands, Parks and Housing, Victoria, B.C.
- Jones, G. 1982a. Spatsizi Park wildlife survey February 28 - March 4, 1982. BC Ministry of Lands, Parks and Housing, Victoria, B.C.
- Jones, G. 1982b. Spatsizi Park caribou survey September 26 to October 6, 1982. BC Ministry of Lands, Parks and Housing, Victoria, B.C.

- Jones, G. 1981. Spatsizi Park caribou survey - October 9-11, 1981. BC Ministry of Lands, Parks and Housing, Victoria, B.C.
- Jones, G. 1980. 1980 Spatsizi caribou survey. BC Ministry of Lands, Parks and Housing, Victoria, B.C.
- Luckhurst, A. 1973. Winter Survey Report - B.C. Land Inventory (Wildlife Division) Winter 1972-73. Unpubl. rep. BC Ministry of Environment, Victoria, B.C.
- Marshall, R. and M. Williams. 2010. Spatsizi caribou herd survey - November 2010. BC Ministry of Forests, Lands and Natural Resource Operations, Smithers, B.C.
- Marshall, R. 2005. Spatsizi wildlife survey - thimhorn sheep, mountain goat and caribou March 2003. BC Ministry of Environment, Smithers, B.C.
- Mundy, K. 1963. Report to the Fish and Game Branch on the Northern Survey, 1963. Unpubl. rep. BC Fish and Game Branch, Victoria.
- Sather, M. 1983. Spatsizi Park caribou survey - September 28 to October 9, 1983. BC Ministry of Lands, Parks and Housing, Victoria, B.C.
- Sittler, K.S., R.S. McNay and L. Giguere. 2015. Herd boundary refinement for the Chase, Spatsizi and Frog caribou herds in north-central British Columbia: Final Report 2012-2015 - HCTF Project #7-394. Wildlife Infometrics Inc. Report No. 499. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.

## **Liard Plateau**

- Bergerud, A.T. 1978. The status and management of caribou in British Columbia. Prepared for BC Fish and Wildlife Branch, Victoria, B.C.
- Environment Yukon. 2016. Science-based guidelines for management of Northern Mountain caribou in Yukon. Yukon Fish and Wildlife Branch Report MR-16-01. Whitehorse, Yukon, Canada.
- Hatler, D. 1987. Perspectives on inventory of caribou in British Columbia. Spatsizi Association for Biological Research Report No. 4, BC Ministry of Environment and Parks Wildlife Report No. R-14. Spatsizi Association for Biological Research, Smithers, B.C. and BC Ministry of Environment and Parks, Victoria, B.C.
- McNay, R.S., L. Giguere and V. Brumovsky. 2014. Identification of designated areas for the ongoing management of Liard Plateau woodland caribou (*Rangifer tarandus caribou*) in British Columbia. Wildlife Infometrics Inc. Report No. 439. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.
- Powell, T. 2006. Range use and fall composition of the Liard Plateau caribou herd in Yukon and northern British Columbia. Yukon Department of Environment, Watson Lake, Yukon.
- Thiessen, C. 2010. Liard Plateau caribou survey: February 2010. Peace Region Technical Report. BC Ministry of Environment, Fort St. John, B.C.

## **Rabbit**

- Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? Rangifer, Special Issue No. 9: 95-116.
- Bergerud, A.T. 1978. The status and management of caribou in British Columbia. Prepared for BC Fish and Wildlife Branch, Victoria, B.C.
- BC Caribou Recovery Program. 2021. Population estimates for caribou herds of British Columbia - October 2021. Province of BC. [https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/wildlife-wildlife-habitat/caribou/bc\\_caribou\\_herds\\_population\\_estimates.pdf](https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/wildlife-wildlife-habitat/caribou/bc_caribou_herds_population_estimates.pdf) (accessed December 2021).
- Hatler, D. 1987. Perspectives on inventory of caribou in British Columbia. Spatsizi Association for Biological Research Report No. 4, BC Ministry of Environment and Parks Wildlife Report No. R-14. Spatsizi Association for Biological Research, Smithers, B.C. and BC Ministry of Environment and Parks, Victoria, B.C.
- Hatler, D.F. 1986. Studies of radio-collared caribou in the Spatsizi Wilderness Park area, British Columbia 1980-1984. Report 3, Spatsizi Association for Biological Research, Smithers, B.C. 202 pages.
- Thiessen, C. 2008. March 2007 Stone's Sheep Inventory Region 7B. BC Ministry of Environment, Fort St. John, B.C.



## Muskwa

Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? *Rangifer*, Special Issue No. 9: 95-116.

Bergerud, A.T. 1978. The status and management of caribou in British Columbia. Prepared for BC Fish and Wildlife Branch, Victoria, B.C.

Bergerud, A.T., and J.P. Elliott. 1998. Wolf predation in a multiple-ungulate system in northern British Columbia. *Can. J. Zool.* 76:1551-1569.

BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development. In prep. No title (Analysis of Pink Mountain and Muskwa telemetry data 2016-2017). BC MFLNRORD, Fort St. John, B.C.

COSEWIC. 2014. COSEWIC assessment and status report on the caribou *Rangifer tarandus*, Northern Mountain population, Central Mountain population and Southern Mountain population in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxii +113pp.

Elliott, J. 1987. Muskwa wolf management project of northeastern B.C. 1986-87 Annual Report. BC Ministry of Environment, Fort St. John, B.C. Wildlife Working Report No. WR-27.

Elliott, J. 1986. Muskwa wolf management project of northeastern B.C. 1985-86 Annual Report. BC Ministry of Environment, Fort St. John, B.C. Wildlife Working Report No. WR-21.

Elliott, J. 1985. Muskwa wolf management project of northeastern B.C. 1984-85 Annual Report. BC Ministry of Environment, Fort St. John, B.C. Wildlife Working Report No. WR-14.

Elliott, J. 1984. Muskwa wolf management project of northeastern B.C. 1983-84 Annual Report. BC Ministry of Environment, Fort St. John, B.C. Wildlife Working Report No. WR-8.

Elliott, J. 1980. Surveys of caribou, moose and wolf in northern British Columbia winters of 1978-79 and 1979-80. BC Fish and Wildlife Branch, Fort St. John, B.C.

Environment Canada. 2014. Recovery Strategy for the Woodland Caribou, Southern Mountain population (*Rangifer tarandus caribou*) in Canada. *Species at Risk Act Recovery Strategy Series*. Environment Canada, Ottawa. viii + 103pp.

Environment Yukon. 2016. Science-based guidelines for management of Northern Mountain caribou in Yukon. Yukon Fish and Wildlife Branch Report MR-16-01. Whitehorse, Yukon, Canada.

Hatler, D. 1987. Perspectives on inventory of caribou in British Columbia. Spatsizi Association for Biological Research Report No. 4, BC Ministry of Environment and Parks Wildlife Report No. R-14. Spatsizi Association for Biological Research, Smithers, B.C. and BC Ministry of Environment and Parks, Victoria, B.C.

Krebs, C.J. 1989. *Ecological Methodology*. Harper and Row, New York, New York.

Thiessen, C. 2008. March 2007 Stone's Sheep Inventory Region 7B. BC Ministry of Environment, Fort St. John, B.C.

Tripp, T., G. Radcliffe and T. Willmott. 2006. Caribou populations and ecology, northern Muskwa-Kechika: Final Project Report and Data Analysis: 2000-2004. (Project# M-K-2005-2006-21). Prepared for Muskwa-Kechika Trust Fund, Fort St. John, B.C.

Watters, M. and C. DeMars. 2016. There and back again: one caribou's (*Rangifer tarandus*) migratory behaviour hints at genetic exchange between Designatable Units. *Can. Field Nat.* 130:304-307.

## Pink Mountain

Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? *Rangifer*, Special Issue No. 9: 95-116.

Bergerud, A.T. 1978. The status and management of caribou in British Columbia. Prepared for BC Fish and Wildlife Branch, Victoria, B.C.

BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development. In prep. No title (Analysis of Pink Mountain and Muskwa telemetry data 2016-2017). BC MFLNRORD, Fort St. John, B.C.

BC Ministry of Forests, Lands and Natural Resource Operations. 2014. Management plan for the grey wolf (*Canis lupus*) in British Columbia. B.C. Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC. 48p.

- Elliott, J. 1980. Surveys of caribou, moose and wolf in northern British Columbia winters of 1978-79 and 1979-80. BC Fish and Wildlife Branch, Fort St. John, B.C.
- Environment Canada. 2014. Recovery Strategy for the Woodland Caribou, Southern Mountain population (*Rangifer tarandus caribou*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. viii + 103pp.
- Environment Yukon. 2016. Science-based guidelines for management of Northern Mountain caribou in Yukon. Yukon Fish and Wildlife Branch Report MR-16-01. Whitehorse, Yukon, Canada.
- Goddard, A. 2009. Pink Mountain northern ecotype caribou winter range inventory. Peace Region Technical Report. B.C. Ministry of Environment, Fort St. John, B.C.
- Gustine, D., and K. Parker. 2008. Variation in the seasonal selection of resources by woodland caribou in northern British Columbia. *Can. J. Zool.* 86: 812-825.
- Hansen, I-G. 2017. Pink Mountain caribou recruitment survey, March 20-21, 2017 - Briefing Document. BC Ministry of Forests, Lands, and Natural Resource Operations, Fort St. John, B.C.
- Hatler, D.F. 1986. Studies of radio-collared caribou in the Spatsizi Wilderness Park area, British Columbia 1980-1984. Report 3, Spatsizi Association for Biological Research, Smithers, B.C. 202 pages.
- Hoffos, R. 1987. Wolf management in British Columbia: the public controversy. Wildlife Bulletin No. B-52. Wildlife Branch, BC Ministry of Environment and Parks. Victoria, B.C.
- Klaczek, M. 2018. 2018 distribution and abundance of the Finlay caribou (*Rangifer tarandus*) herd - year 1 (2017/18) report on activities. Peace Region Fish and wildlife Compensation Program. Project Report PEA-F18-W-2323. 7p.
- Klaczek, M. and M. Anderson. 2020. 2020 distribution and abundance of the Finlay caribou (*Rangifer tarandus*) herd - Year 3 (2019/20) final report on activities. Peace Region Fish and Wildlife Compensation Program. Project Report PEA-F20-W-2958. 25p.
- Parker, K., and D. Gustine. 2007. Winter habitat selection and calving strategies of woodland caribou in the Besa-Prophet. Prepared for Muskwa-Kechika Advisory Board, Fort St. John, B.C. 52p.
- Thiessen, C. 2008. March 2007 Stone's Sheep Inventory Region 7B. BC Ministry of Environment, Fort St. John, B.C.
- Woods, A.D. and R.S. McNay. 2018. Refinement of caribou herd boundaries - Finlay Herd. Report No. 606. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.
- Zimmerman, K., R.S. McNay, L. Giguere, S. Walshe, G. Keddie, L. Wilson, K. Schmidt, P. Hengeveld and A. Doucette. 2002. Aerial-based census results for caribou and moose in the Mackenzie Timber Supply Area March 2002. Wildlife Infometrics Inc. Report No. 044. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.

## **Gataga**

- Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? *Rangifer*, Special Issue No. 9: 95-116.
- BC Ministry of Water, Land and Air Protection. 2004 Frog Gataga Caribou. Unpublished report, BC Ministry of Water, Land and Air Protection, Fort St John, B.C.
- Environment Yukon. 2016. Science-based guidelines for management of Northern Mountain caribou in Yukon. Yukon Fish and Wildlife Branch Report MR-16-01. Whitehorse, Yukon, Canada.
- Hatler, D. 1987. Perspectives on inventory of caribou in British Columbia. Spatsizi Association for Biological Research Report No. 4, BC Ministry of Environment and Parks Wildlife Report No. R-14. Spatsizi Association for Biological Research, Smithers, B.C. and BC Ministry of Environment and Parks, Victoria, B.C.
- Thiessen, C. 2008. March 2007 Stone's Sheep Inventory Region 7B. BC Ministry of Environment, Fort St. John, B.C.

## **Frog**

- Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? *Rangifer*, Special Issue No. 9: 95-116.

Bergerud, A.T. 1978. The status and management of caribou in British Columbia. Prepared for BC Fish and Wildlife Branch, Victoria, B.C.

BC Ministry of Water, Land and Air Protection. 2004 Frog Gataga Caribou. Unpublished report, BC Ministry of Water, Land and Air Protection, Fort St John, B.C.

Environment Yukon. 2016. Science-based guidelines for management of Northern Mountain caribou in Yukon. Yukon Fish and Wildlife Branch Report MR-16-01. Whitehorse, Yukon, Canada.

Hatler, D. 1987. Perspectives on inventory of caribou in British Columbia. Spatsizi Association for Biological Research Report No. 4, BC Ministry of Environment and Parks Wildlife Report No. R-14. Spatsizi Association for Biological Research, Smithers, B.C. and BC Ministry of Environment and Parks, Victoria, B.C.

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-Kechika Management Area. Wildlife Infometrics Inc. Report No. 318. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.

McNay, R.S. 2011 (Revised 2012). 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.

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.

Sittler, K.S., R.S. McNay and L. Giguere. 2015. Herd boundary refinement for the Chase, Spatsizi and Frog caribou herds in north-central British Columbia: Final Report 2012-2015 - HCTF Project #7-394. Wildlife Infometrics Inc. Report No. 499. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.

Thiessen, C. 2009. 2009 Stone's sheep/caribou inventory - MU 7-52 (revised). BC Ministry of Environment, Fort St. John, B.C.

## Finlay

Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? Rangifer, Special Issue No. 9: 95-116.

Bergerud, A.T. 1978. The status and management of caribou in British Columbia. Prepared for BC Fish and Wildlife Branch, Victoria, B.C.

Environment Canada. 2014. Recovery Strategy for the Woodland Caribou, Southern Mountain population (*Rangifer tarandus caribou*) in Canada. *Species at Risk Act Recovery Strategy Series*. Environment Canada, Ottawa. viii + 103pp.

Klaczek, M. 2018. 2018 distribution and abundance of the Finlay caribou (*Rangifer tarandus*) herd - Year 1 (2017/18) report on activities. Peace Region Fish and Wildlife Compensation Program Project Report PEA-F-18-W-2323. BC Ministry of Forests, Lands and Natural Resource Operations Fish and Wildlife Section, Prince George, B.C.

Klaczek, M., and M. Anderson. 2020. 2020 Distribution and abundance of the Finlay caribou (*Rangifer tarandus*) herd - Year 3 (2019/20) final report on activities. Peace Region Fish and Wildlife Compensation Program. Project Report PEA-F-20-W-2958. 25p.

Seip, D. and E. Jones. 2014. Population status of caribou herds in the Central Mountain Designatable Unit within British Columbia, 2014. BC Ministry of Environment, Prince George, B.C.

Wood, M. 1994. Muskwa Range (east of Finlay River) winter ungulate inventory, March 1994. Peace/Williston Fish and Wildlife Compensation Program Report No. 32. 6p.

Woods, A.D. and R.S. McNay. 2018. Refinement of caribou herd boundaries - Finlay Herd. Report No. 606. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.

Zimmerman, K., R.S. McNay, L. Giguere, S. Walshe, G. Keddie, L. Wilson, K. Schmidt, P. Hengeveld and A. Doucette. 2002. Aerial-based census results for caribou and moose in the Mackenzie Timber Supply Area March 2002. Wildlife Infometrics Inc. Report No. 44. 31p plus appendices.

## **Thutade**

Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? Rangifer, Special Issue No. 9: 95-116.

Corbould, F. 2001. Abundance and distribution of Stone's sheep and mountain goats on the Russel Range, March 1993. Peace/Williston Fish and Wildlife Compensation Program, Report No. 243.

Environment Yukon. 2016. Science-based guidelines for management of Northern Mountain caribou in Yukon. Yukon Fish and Wildlife Branch Report MR-16-01. Whitehorse, Yukon, Canada.

Hatler, D. 1987. Perspectives on inventory of caribou in British Columbia. Spatsizi Association for Biological Research Report No. 4, BC Ministry of Environment and Parks Wildlife Report No. R-14. Spatsizi Association for Biological Research, Smithers, B.C. and BC Ministry of Environment and Parks, Victoria, B.C.

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.

McNay, R.S. 2011 (Revised 2012). 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.

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.

Sittler, K.S., R.S. McNay and L. Giguere. 2014. Herd boundary refinement for the Chase, Spatsizi and Frog caribou herds in north-central British Columbia: Year End Report 2013 - HCTF Project #7-394. Wildlife Infometrics Inc. Report No. 457. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.

Sittler, K.S., R.S. McNay and L. Giguere. 2015. Herd boundary refinement for the Chase, Spatsizi and Frog caribou herds in north-central British Columbia: Final Report 2012-2015 - HCTF Project #7-394. Wildlife Infometrics Inc. Report No. 499. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.

## **Low Density Area**

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.

McNay, R.S. 2011 (Revised 2012). 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.

Mundy, K. 1963. Report to the Fish and Game Branch on the Northern Survey, 1963. Unpubl. rep. BC Fish and Game Branch, Victoria.

Sittler, K.S., R.S. McNay and L. Giguere. 2015. Herd boundary refinement for the Chase, Spatsizi and Frog caribou herds in north-central British Columbia: Final Report 2012-2015 - HCTF Project #7-394. Wildlife Infometrics Inc. Report No. 499. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.

Thiessen, C. 2009. 2009 Stone's sheep/caribou inventory - MU 7-52 (revised). BC Ministry of Environment, Fort St. John, B.C.

## Appendix 4. Data limitations

In addition to issues with range boundaries, the spatial data layers for roads and trails resulted in duplication of data in some cases, and did not allow us to distinguish between roads and trails, which has bearing on use (e.g., motor vehicles vs. hiking and horses). Also, population size and trend information was limited, making it difficult to assess population status as it related to habitat disturbance.

For roads and trails, although some linear features were duplicated in the spatial layers we used, the application of the 500 m buffer around linear features eliminated double-counting of those features, since they were all incorporated into one amalgamated buffer. As a result, we could only represent the extent of linear features as an area-based metric, and we were not able to report extent of linear features as a distance. However, because the habitat disturbance thresholds that we were using also included linear features as an area-based metric, representing linear features this way did not compromise our analysis.

Another limitation for roads and trails was that we were unable to distinguish between roads and trails using the spatial datasets. Although some data distinguished between the two, it was not consistent across all data. As a result, we had to combine roads and trails into one category since it was beyond the scope of this project to investigate each linear feature to identify whether it was a road or a trail.

Although roads/trails are the dominant anthropogenic habitat disturbance on caribou ranges in northern BC, there are additional ATV/UTV trail networks that are not represented in the BC government's datasets, and therefore additional effort will be needed to identify and map them (B. Jex, pers. comm. 2019).

Ideally, we would have sufficient data to compare levels of habitat disturbance on individual ranges to population status. However, due to the limited information on population size and status, we were constrained in what inferences we could make from the data.



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**Wildlife Conservation Society Canada**  
344 Bloor Street West, Suite 204  
Toronto, Ontario. M5S 3A7  
Telephone: (416) 850-9038



**WCSCanada.org**