

Provincial Caribou Recovery Program Herd Planning Disclaimer



The following herd plans are a result of Phase One planning and are an incomplete product. Additionally, the documents are 'living' reports and will be updated regularly as Phase Two progresses.

Phase Two planning is currently underway for some herds however still at its early stages of development; many plans reflect this as they are in different stages along their scheduled project continuum.

One of the cornerstone guiding principles to the Caribou Recovery Program (the Program) is to use consistent, fact-based approaches for all woodland caribou herds in the province. The Program has refined and adopted a new format to herd planning that will effectively:

- ❖ Provide a consistent approach to managing all woodland caribou herds in BC
- ❖ Recognize the unique circumstances of each herd
- ❖ Build from current (legacy) caribou management plans
- ❖ Consider First Nations' and stakeholder interests and ideas
- ❖ Be included in larger regional plans

Completed herd plans will describe the status of each herd, and the threats faced by that particular herd. The plans will take note of previous actions, and actions that are planned to take place in the future. As we implement the herd plans, the Program will carefully monitor to which extent and magnitude the caribou respond, and modify its actions as accordingly. Herd plans will help us document our decisions and discuss issues with First Nations and with stakeholders.

Phase One consisted of:

- ✓ Status of herd or sub-population
- ✓ Identified threats
- ✓ Literature
- ✓ Previous work completed

Phase Two will consist of input from:

- Engagement with Indigenous communities
- Provincial Caribou Science Team
- Stakeholders
- Decision-support tools

WOODLAND CARIBOU PLAN

Rainbows Subpopulation

Chilcotin
Local Population Unit



BRITISH
COLUMBIA

Recommended Citation:

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EXECUTIVE SUMMARY

DRAFT

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1 BACKGROUND

1.1 INTRODUCTION TO THE PROGRAM

The Rainbows caribou subpopulation is the northern ecotype of woodland caribou (*Rangifer tarandus caribou*), designatable unit seven (DU 7), and is within the Southern Mountain National Ecological Area (SMNEA). These subpopulations are listed as *Threatened* by the Committee on the Status of Endangered Wildlife in Canada (Thomas and Gray 2002, Environment Canada 2014), and appear on Schedule 1 of the Federal Species at Risk Act (SARA). They are blue-listed in British Columbia and are included in the Provincial Identified Wildlife Management Strategy (British Columbia Ministry of Water, Land and Air Protection 2004).

Woodland Caribou are further divided into Local Population Units (LPU) by Environment Canada. The Rainbows subpopulation is in the Chilcotin LPU that it shares with the Charlotte Alplands and the Itcha-Ilgachuz subpopulations (Environment Canada 2014).

Range plans are required for all woodland caribou populations that are designated as *Threatened* or *Endangered* in Canada (Environment and Climate Change Canada 2016), including the Rainbows subpopulation. The Rainbows subpopulation is blue-listed in BC, and current monitoring indicates that they are in decline.

This document spans the divide between these disparate designations in British Columbia and Canada, compiling past research, knowledge and management actions into guidance for the management and recovery of the Rainbows northern mountain caribou subpopulation.

2 POPULATION DESCRIPTION

Relative to other western mountain caribou (DU 8 and 9), members of this DU are found in dry sub-boreal montane ecosystems and use pine-dominated habitats during winter. Most populations of northern mountain caribou are relatively small and sedentary, with individuals wintering in small groups. They generally use the calving strategy of moving to high elevations on open sub-alpine ridges, spacing away from conspecifics and predators (COSEWIC 2011). Their current range is 4409 km² in area (Freeman 2009).

2.1 DISTRIBUTION

The Rainbow caribou subpopulation are distributed in both high and low elevation habitats. Part of the subpopulation spend most of the year in the alpine and subalpine areas of the Rainbow Mountains. Others use low elevation forests from early winter to spring (The Northern Caribou Technical Advisory Committee 2004). The Rainbow caribou subpopulation is separated from the Itcha-Ilgachuz subpopulation by the Dean River that is at 1,100 m elevation (Apps et al. 2001a).

During summer, the Rainbow subpopulation is typically found in high elevation, dry, alpine landscapes with little vegetation productivity or overstory cover (Apps et al. 2001a). Preferred landscapes are also associated with higher elevations, more rugged terrain and northeastern aspects than random expectation. During winter, alpine-dwelling animals are associated with high elevation, dry landscapes with little forest cover and low productivity, while low elevation, wet landscapes with open or closed forest cover were avoided. Winter habitat selection by

forest-dwelling caribou was for broad landscapes of closed-canopy lodgepole pine overstory and higher site productivity at lower elevations (Apps et al. 2001a).

Although broad landscapes preferred by Rainbow animals had higher proportions of forests < 20 years old, this was not reflected at the finest scale. Broad landscapes with open, dry habitats were avoided by Rainbow caribou (Apps et al. 2001a).

2.2 HABITAT AND BEHAVIOUR

The Rainbows caribou subpopulation inhabits the Western Chilcotin Uplands “Ecosection”, west of Williams Lake, partially within the southern arm of Tweedsmuir Provincial Park. They use open, fescue alpine (BAFA), Engelmann spruce / subalpine fir, montane spruce and sub-boreal pine-spruce habitats (Freeman 2009). The alpine habitats where they both rut and calve are protected within Tweedsmuir Provincial Park (Freeman 2009).

Most of the Rainbow caribou subpopulation tend to occupy alpine habitats throughout the year, but habitat use can vary by season (Stevenson and Hatler 1985, Young and Roorda 1999). The fall rut occurs typically above treeline but occasionally in the subalpine and following the rut animals disperse to mature forests at low elevations as well as remaining in high elevation, alpine habitats (Young and Roorda 1999). In late winter animals that are not already in alpine habitats move to the alpine (above treeline) (Stevenson and Hatler 1985). In very deep snow years, low-lying areas around the Itcha Flats are used in late winter. In the spring, again, mature pine and mature spruce pine habitats are used, but late-spring calving occurs in the alpine (Young and Roorda 1999).

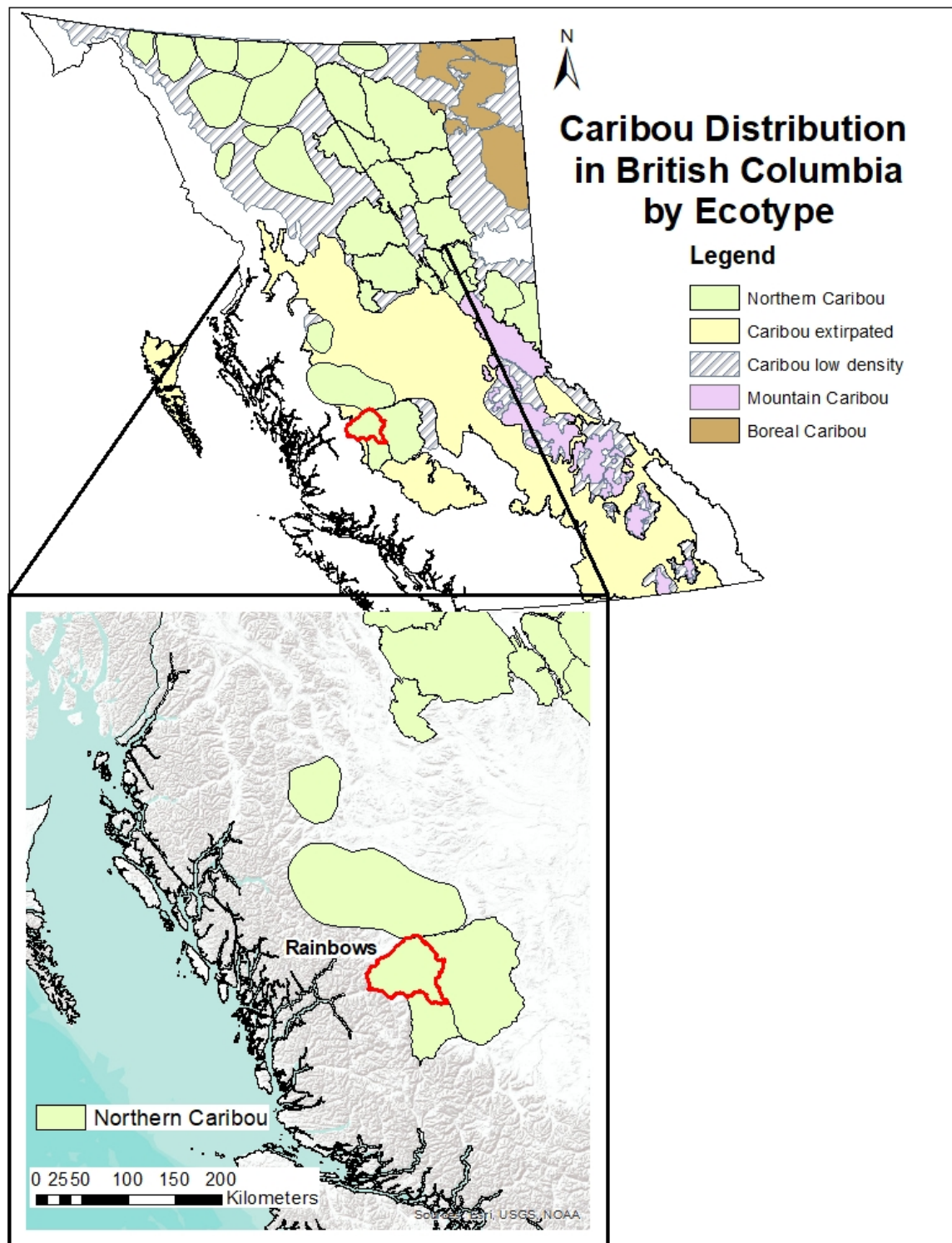


Figure 1: The location of the Rainbows woodland caribou subpopulation range. The 4409 km² range (inset: red outline) is within the Cariboo Natural Region.

2.3 POPULATION SIZE AND TREND

The Rainbows caribou subpopulation is closely integrated with the Itcha-Ilgachuz and Charlotte Alplands subpopulations and to a limited extent, the Tweedsmuir subpopulation. The Rainbows subpopulation size was first reported in 1956 by R.W. Ritcey (cited in: Young and Freeman 2001) at 100 to 150 total animals. This is consistent with subsequent surveys. But beginning in 1996 surveys indicate a decline (Figure 2). The most recent reported population estimate is from a survey in 2016 that found 32 animals.

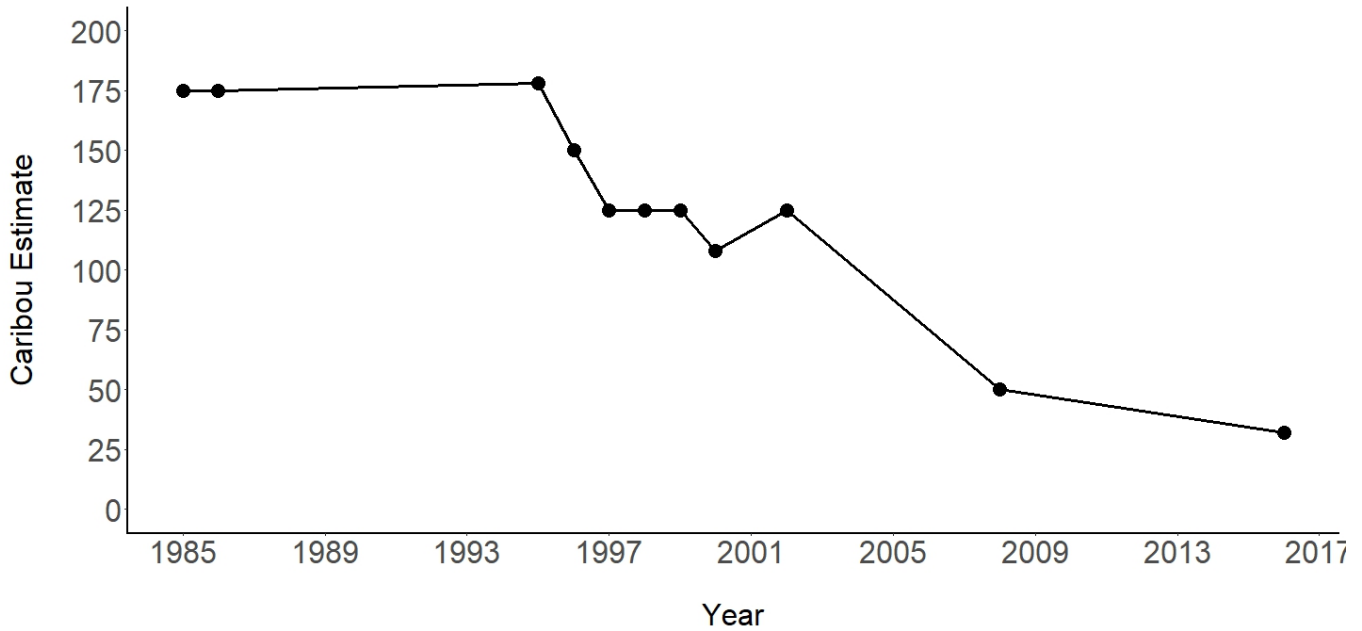


Figure 2: Caribou population estimates for the Rainbows subpopulation. Data from Young and Freeman (2001), Freeman (2009), Youds et al. (2011) and Dodd (2017).

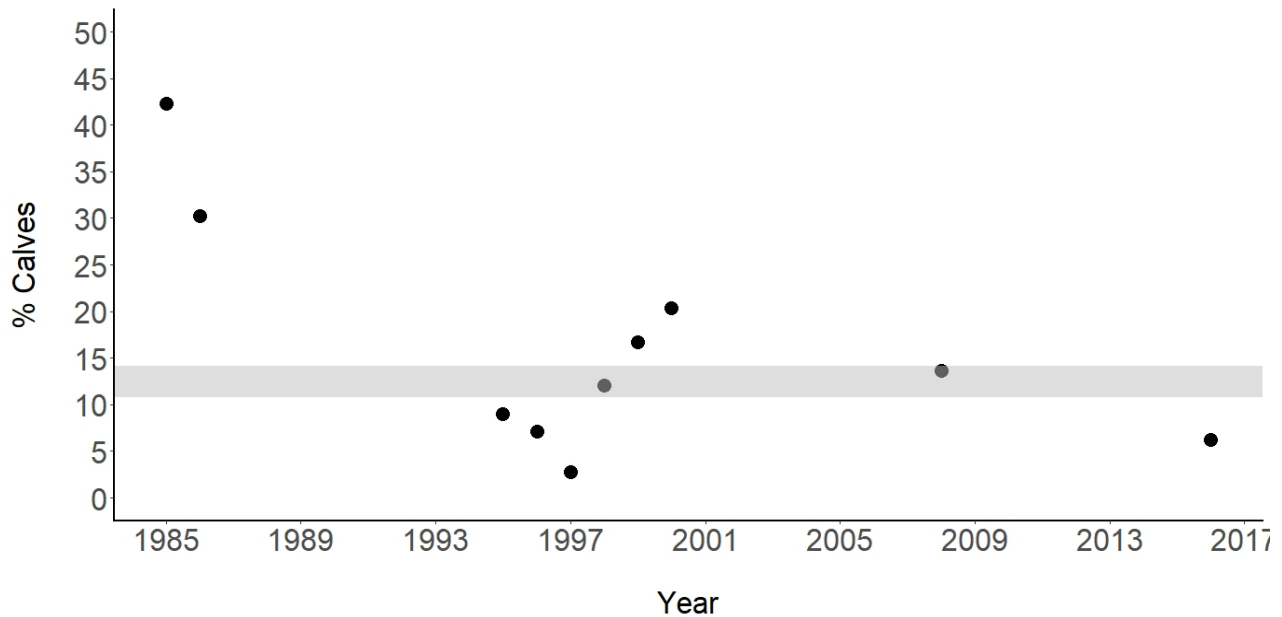


Figure 3: Caribou population recruitment measured in the Rainbows caribou subpopulation range. Recruitment is defined here as the percent of the counted population that is in the calf cohort. Recruitment lower than approximately 10 to 15% is considered below a threshold that will balance natural mortality (grey band; Bergerud and Elliot 1986). Data from Young and Freeman (2001), Freeman (2009), Youds et al. (2011) and Dodd (2017).

3 THREATS AND LIMITING FACTORS

Primary threats to caribou and their habitat have been noted by McNay et al. (2008), COSEWIC (2014) and a variety of independent studies (e.g. James et al. 2004, Wittmer et al. 2005b, Courtois et al. 2007, Seip et al. 2007, Wittmer et al. 2007). In this review, threats are treated in isolation, but this does not discount the likelihood that they interact. Cumulative effects assessment (Sorensen et al. 2008, Johnson et al. 2015) is beyond the scope of this plan, but elements such as predation, human activities, and climate change are known to affect one another. Work on boreal caribou has demonstrated the value in developing comprehensive range planning for woodland caribou that considers interacting threats (Angelstam et al. 2004, Environment Canada 2012b).

Here, the following threats are considered:

1. Predation
 2. Food limitation
 3. Human activities
 - a. Industrial
 - b. Recreational
 - c. Other
 4. Natural disturbance
 5. Parasites and diseases
 6. Climate change
 7. Hunting and poaching
- Small population size effects

3.1 PREDATION

GPS collar and radio telemetry studies indicate that the dominant, proximal cause of woodland caribou mortality is predation (Wittmer et al. 2013). Woodland caribou have evolved with their predators and have persisted despite millennia of predation (Bergerud 1988). While the predator species killing caribou vary regionally (wolf, black bear, grizzly bear, cougar), their impact on woodland caribou populations has increased as the result of three dominant processes: apparent competition mediated by alternative prey abundance (Hebblewhite et al. 2007), apparent competition mediated by expanding alternative prey distribution (Wittmer et al. 2007, DeCesare et al. 2010b, Latham et al. 2011a, Latham et al. 2011c), and enhanced predator access to woodland caribou habitat (Hayhurst 1983, Latham et al. 2011b). More generally, Bergerud (2007) has calculated that wolf densities greater than 6.5 wolves/1000 km² will result in woodland caribou declines. More recently, the federal recovery strategy identifies 3 wolves/1000 km² as a target (Environment Canada 2014).

Seip and Cichowski (1996) attributed a 15% adult female mortality rate for both the Itcha-Ilgachuz and Rainbows caribou subpopulations dominantly to summer predation. Where mortality source was determined, predation was largely attributed to wolves and bears (Seip and Cichowski 1996).

3.2 FOOD LIMITATION

Woodland caribou are herbivores and rare among large mammals as lichen eaters (Johnson et al. 2004). While lichen makes up the bulk of their winter diet (Johnson et al. 2000, Parker et al. 2005), it is a smaller proportion of their summer diet (Denryter et al. 2017). And although habitat selection is predominantly thought to be influenced by predator avoidance, selected habitats must also be able to satisfy an individual's nutritional needs (O'Brien et al. 2006, Brown et al. 2007). Trade-offs between these two fundamental demands (avoiding predators, finding food) raises the potential for woodland caribou to be food or energy limited as they seek predator refugia (Poole et al. 2000, Gustine et al. 2006). When it has been considered, estimates of caribou food abundance typically far exceeds population needs (Courtois et al. 2007).

In the Rainbows caribou subpopulation area, caribou feed primarily on terrestrial lichens but arboreal lichen use increases in late winter or throughout fall and winter when the snow is very deep (Himmer and Power 1999). Cichowski (1996) found that within the Rainbows caribou subpopulation range, lichen is abundant only in coniferous forests 50 years old or older. Lichens are also susceptible to mechanical damage from forestry operations. But because lichens compete poorly with vascular plants, they are most abundant on low productivity sites that typically do not have harvestable forests in this region (Cichowski 1989, Cichowski 1996). Preliminary results in a 2004 study suggested that mountain pine beetle killed forests in this region lost terrestrial lichens (Cichowski and Williston 2005). Although there are no data to suggest that food is limiting this group, a quantitative assessment of food available to caribou in the Rainbows subpopulation has not been undertaken.

3.3 HUMAN ACTIVITIES

Human activities have consequences for woodland caribou conservation throughout British Columbia. This section focusses on the consequences of human industrial, recreational and other (agriculture, highway, linear feature clearing) activities (Wolfe et al. 2000).

3.3.1 INDUSTRIAL

Industrial activities include forestry, mining, oil, gas and clean energy development. Caribou are affected by industrial activities both due to the presence of physical infrastructure as well as the resulting impacts on their habitat. A key concept to measure and understand industrial effects on caribou is the Zone of Influence (ZOI; Polfus et al. 2011). This is the area beyond the actual footprint of an industrial development or activity that affects caribou (Dyer et al. 2001). Zones of influence vary by activity and by the presence and absence of people.

3.3.1.1 FORESTRY

Woodland caribou are an old-growth forest dependent species (Bergerud 2000). Hence, forest management affects their distribution and population dynamics. Although mountain caribou populations live seasonally in treeless, alpine ecosystems, all spend some of the year in forests. For this reason, forestry and natural disturbances will affect woodland caribou populations through habitat destruction and fragmentation (Smith et al. 2000). Forestry effects include very general habitat loss that reduces the amount of old-growth forest, to reduction in forest-based food resources to creating more, early seral forest habitat for apparent competitors (see below) such as deer and moose (Simpson and Woods 1987, Cichowski 1989, Seip 1990, Stevenson 1991, Cumming 1992). Factors, such as the type of forest regrowth (Cichowski 1989) and the size of cutblocks (Edmonds and Bloomfield 1984), play a role in the effect of forestry practices on woodland caribou populations. The ZOI of clearcuts for woodland caribou in Newfoundland was found to be 15 km beyond the actual cut block (Chubbs et al. 1993). Hence, even an array of small forest cutblocks can have a significant influence on caribou habitat availability.

Logging has a greater potential impact on Rainbow subpopulation winter range than summer range as low elevation forests where snow slowly accumulates are both logged and are key winter habitats (Cichowski 1989). The Rainbows caribou subpopulation range is entirely within the Great Bear Rainforest North Timber Supply Area (TSA). Its current allowable annual cut is 830,500 m³ (established 1 January 2017). But most of this subpopulation's range is within Tweedsmuir Provincial Park where no forestry occurs. There are cutblocks and logging roads in the low-lying habitats on the eastern and southern portions of the subpopulation range, but most of the range has not been harvested. Most of the logging visible in this area has occurred since 1990. There are approximately 181 km² of forest cutblocks in the range of the Rainbows caribou subpopulation, or about 4% of its total range area.

A study of caribou habitat selection with respect to forest disturbance found that Rainbows caribou avoided logged areas at the large (landscape scale) but when logged stands were encountered, they were not avoided, and at times even selected (Apps and Dodd 2017). In addition, recently (within 5 to 20 years) logged landscapes were avoided, while they were not avoided at a finer, stand scale (Apps and Dodd 2017).

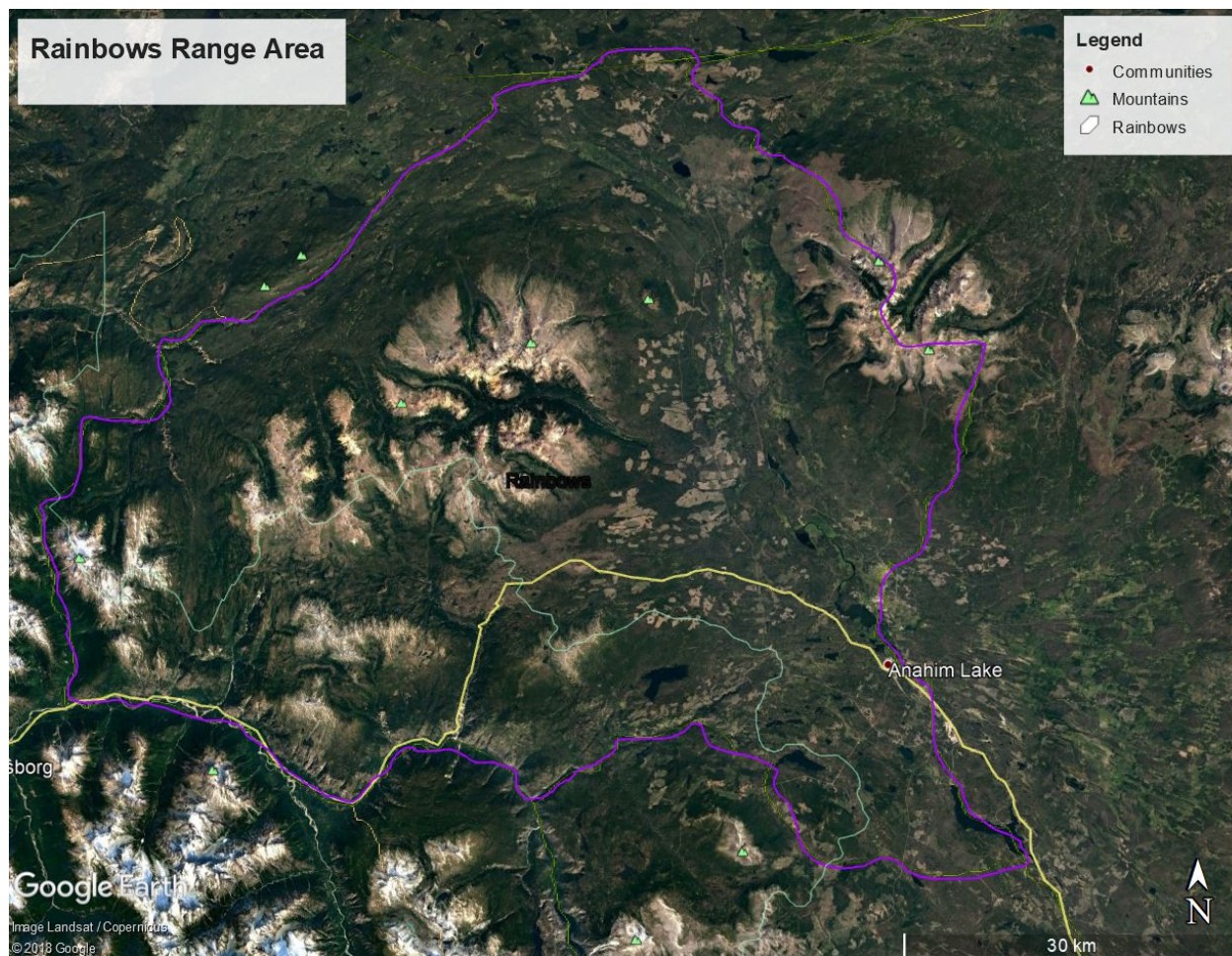


Figure 4: December 2016 Google Earth image of the Rainbows caribou subpopulation range. The purple boundary delineates the official year-round range of this subpopulation. Logged areas appear as pale patches in the right-centre of the image.

3.3.1.2 MINING

Mine sites deter caribou both for the activities that occur there when they are active as well as for the habitat they destroy. Mines have a 2 km ZOI when they are active, but this shrinks to the physical footprint of the mine site when mines are dormant, inactive or abandoned (Polfus et al. 2011).

The Blackwater gold, silver, lead and zinc mine is just north of the Rainbows caribou subpopulation range, but there are no active mines within their range.

3.3.1.3 OIL AND GAS

Oil and gas development threatens caribou populations through habitat destruction, human activity, access, habitat fragmentation and elevated predation (Dyer et al. 2001, Boutin et al. 2012, Hervieux et al. 2013). Given the spatial scope of oil and gas developments (well sites, access roads, pipelines, seismic lines) and the range of activities that take place in caribou habitat cumulative effects of this combined with other activities (e.g. forestry, hydroelectric) also play a large role in threatening resident caribou herds (Nitschke 2008). A study of the

consequences to caribou of being disturbed by oil and gas exploration found that individuals in active plays can lose more than 15% of body mass over winter attributed to noise displacement (Bradshaw et al. 1998).

There are no oil and gas plays in the Rainbows caribou subpopulation range.

3.3.1.4 CLEAN ENERGY

Clean energy refers to hydroelectric dams and wind farms. Hydroelectric reservoirs in caribou range can destroy or fragment habitat and cut movement corridors. Research in southern British Columbia correlated hydroelectric development with declines in caribou populations (Simpson 1987b). Hydroelectric dams, during their construction and operation, have a ZOI that exceeds their footprint (Nellemann et al. 2003). Wind farm development can destroy caribou habitat, reduce forage availability, displace caribou and increase early-seral habitat that promotes growth of alternative prey populations (British Columbia Ministry of Environment 2014).

There are no hydroelectric dams in the Rainbows caribou subpopulation range. There are 6 dams on Pelican Creek, however these are operated by Ducks Unlimited for wetland restoration.

3.3.1.5 OTHER

There are no other, major industrial or urban developments in the Rainbows caribou subpopulation range.

3.3.2 RECREATION

Recreational use of caribou habitat refers largely to fall and winter activities, including snowmobiling, commercial heli-skiing, commercial cat-skiing and hunting. In some jurisdictions, winter tour skiing and mountaineering are also relevant recreational activities as is summer use with off highway vehicles (OHVs). Numerous studies have shown that woodland caribou avoid mechanized winter activities to varying degrees (Simpson 1987a, Simpson and Terry 2000, Mahoney et al. 2001, Kinley 2003, Wilson and Hamilton 2003, Seip et al. 2007). Despite records of displacement, no study has been able to draw a direct link between winter recreational use and woodland caribou population decline, largely because effects are chronic and be time-lagged.

3.3.2.1 SNOWMOBILE

Snowmobile use in caribou habitat can result in their displacement (Simpson 1987a, Apps et al. 2001b, Kinley 2003). Studies in British Columbia and elsewhere have shown that caribou are far less likely to occupy winter habitats that are being used for recreational snowmobiling than equivalent habitats without snowmobile use (Mahoney et al. 2001, Seip et al. 2007). Mechanisms of displacement include caribou avoiding or fleeing snowmobiles while they are in use, or avoidance of snowmobile packed trails that facilitate access to caribou winter habitat by human hunters and natural predators (Bergerud 1988, James and Stuart-Smith 2000, Oberg 2001, Polfus 2010, Whittington et al. 2011).

The Northern Caribou Strategy (Youds et al. 2002, Youds et al. 2011) recommended that recreational and commercial use of snowmobiles in the Rainbows caribou subpopulation range be regulated or prohibited from sensitive winter range to prevent potential caribou disturbance and displacement (Simpson and Terry 2000, Youds et al. 2002, Kinley 2003, Reimers et al. 2003, Seip et al. 2007).

Caribou in this subpopulation that winter in the Ilgachuz Mountains are unlikely to encounter snowmobiles because zoning restricts their use to approved routes and recreation areas away from wintering caribou

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(Environmental Stewardship Division 2002, Youds et al. 2011). In some years caribou in the Rainbows subpopulation migrate to Anahim Lake where they are most likely to encounter snowmobiles (Youds et al. 2011).

3.3.2.2 *HELI-SKI / CAT-SKI*

Helicopter skiing and cat skiing are backcountry recreational activities that enable off-piste skiers to access high mountain terrain using either a helicopter or a tracked snow-cat that shuttles them to the top of ski runs. This is a commercial activity with numerous operators in British Columbia represented under one umbrella organization, HeliCat Canada (HCC). In southern British Columbia, HCC partners with the British Columbia government and non-government organizations to monitor caribou and helicat ski operations and minimize operational impacts.

Bella Coola Helisports operates on the western edge of the range of the Rainbows caribou subpopulation. Although they are an accredited member of HeliCat Canada (Tomm 2017), they do not report wildlife observations as part of the Mountain Caribou Recovery Implementation Plan (MCRIP Progress Board 2007).

3.3.2.3 *OTHER*

Off Highway Vehicle (OHV) use is regulated, but occurs the Rainbows caribou subpopulation range. Wildlife regulations prevent their use for hunting. After hunting season OHV use is impractical due to snow. The 2002 NCS recommended little or no OHV access in the park that overlaps with the northeastern edge of the Rainbow's subpopulation range (Youds et al. 2002). The Itcha-Ilgachuz Park management plan allows 30 OHV permits each year to access Itcha Lake in August from the 3900 Road (Environmental Stewardship Division 2002). OHV use is confined to the 66 kilometer seismic trail from the park boundary to the Kettle Lake cabin (Youds et al. 2011). The current management plan for Tweedsmuir Park does not permit OHV use (British Columbia Ministry of Environment and Parks 1988, Youds et al. 2011).

Backcountry ski touring does occur in the Rainbows mountain range, with several mapped routes (e.g. 21 Mile Creek) but its impact has not been assessed and density of use appears to be low.

3.3.3 *OTHER*

Other human activities occur in caribou habitat and have the potential to harm caribou and / or affect caribou populations. Agriculture, transportation corridors, electrical transmission rights-of-way and hunting all have known effects on caribou populations (James and Stuart-Smith 2000, Wolfe et al. 2000).

3.3.3.1 *AGRICULTURE*

The effects of agriculture on caribou conservation are largely the result of conversion of low-elevation habitat to crops and pasture (habitat destruction) and the food subsidy they provide for alternative prey (deer, elk, moose). Habitat conversion is functionally similar to clearcut logging in that it removes overstory vegetation and can alter landscape properties like vegetation composition and local snow depth. Growing hay and grain crops within or adjacent to caribou range has the potential to directly increase the regional population size of deer, elk and moose that eat crops (Bowden 1985, Côté et al. 2004, Butler et al. 2008, Hatter et al. 2017) and indirectly their predators like bears and wolves. These, in turn, predate caribou, putting downward pressure on caribou populations (apparent competition).

There is some agriculture in the Rainbows caribou subpopulation range, but it is a very minor part of the rural economy and space use, and unlikely to affect caribou in this area.

3.3.3.2 MAJOR HIGHWAY CORRIDORS

Where they occur in caribou habitat, highways have strong, negative effects on caribou populations (Johnson and Todd 1977, Curatolo and Murphy 1986, Apps and McLellan 2006). Vehicle activity on highways poses a movement barrier for caribou as they are either reluctant to approach a roadway or get killed trying to cross (Dyer et al. 2002, Rytwinski and Fahrig 2012). Habitat and population fragmentation results as populations are unable to move between ranges. Highways and roadways can also give people access to caribou range that increases the potential for disturbance. Linear disturbances, such as roadways have a large ZOI (Wolfe et al. 2000, Oberg 2001, Polfus et al. 2011, Whittington et al. 2011).

Highway 20 goes through the southern portion of the Rainbows caribou subpopulation range for about 95 kilometers. Between 1998 and 2007 there were 747 recorded wildlife mortalities on Highway 20 (Sielecki 2010) but none of these were caribou (most are deer and moose).

3.3.3.3 LINEAR FEATURES

Linear features are narrow land disturbances that tend to traverse entire ranges. They include seismic cut lines, pipelines, forestry roads and overhead power transmission rights-of-way. Linear features are not necessarily cleared to a roadway standard, but enable both four-wheel-drive access and ease travel for predators and alternative prey (Hebblewhite et al. 2010a). One hypothesized effect is that linear features facilitate predator movement into and within prey habitat thereby increasing predator-prey overlap (DeMars and Boutin 2017, Newton et al. 2017).

The only linear features in the Rainbows caribou subpopulation range are roads – highways and logging road and forestry trunk roads (Figure 4).

3.3.3.4 HUNTING

The Rainbows caribou subpopulation is within the Cariboo Wildlife Management District and overlaps with wildlife management units (WMU) 5-6 and 5-10,11,12. Caribou hunting was permitted in 5-12 as recently as 2016, but not in the other WMUs since the 1980s. Between 1976 and 2013 there were 846 caribou killed by resident hunters. Guided caribou hunting has occurred since 1978 and from its onset until 2013, 207 caribou were killed.

There are general open seasons for deer (mule and white-tailed), mountain goat (5-6 & 5-11 only), black bear (5-10,11,12), wolf and cougar (not 5-10). Moose hunting occurs by limited entry draw in 5-11 and 5-12 (Government of British Columbia 2017). Tweedsmuir Provincial Park is open to bow hunting for deer in MUs 5-10 and 5-11 and a limited entry bull moose hunt (rifle) in 5-11.

3.3.3.5 POACHING

Caribou poaching is an unregulated, indiscriminate and largely unknown source of mortality across their range. Animals are taken in any season, of any age or sex and in any number. This kind of additive mortality can have a profound impact on caribou populations in British Columbia (Johnson 1985) and interacts with habitat management and human access (Stevenson 1990) resulting in population declines.

There have been no charges for caribou poaching recorded in the Environment Violations Database from 2006 to 2018. This does not mean that no poaching occurred during this period.

3.4 NATURAL DISTURBANCE

Fire as a natural disturbance can have large-scale and long-lasting impacts on woodland caribou (Environment Canada 2014). Fire kills individuals, destroys habitat and changes predator-prey dynamics by improving habitat for alternative prey and increasing wolf-caribou spatial overlap (Robinson et al. 2012). Fire suppression, on the other hand, has increased the possibility of very large and intense fires that could alter entire range areas (Environment Canada 2012a). Mountain pine beetle infestations are also natural disturbances with large-scale and long-term effects (Cichowski and Williston 2005).

From 1921 to 2017 there has been 629.5 km² of burned area (14.2% of the land area). Almost half (272 km²) of this fire area burned before 1938 (80 years from time of writing). Habitat and movement models of Rainbows caribou indicate that they avoid burned forests (Apps and Dodd 2017). Caribou avoided burned stands as winter habitat, but could persist in a landscape that had burned stands in it (Apps and Dodd 2017). However, during the summer and fall, they appeared to select recently (but not older) burned stands (Apps and Dodd 2017). Interestingly, forests burned with high severity were selected in the summer and fall, but avoided in winter (Apps and Dodd 2017).

All of the range area of the Rainbows subpopulation has been affected by mountain pine beetle (MPB) and about one quarter of the area (1000 km²) has been severely infested. A model of caribou habitat use in the Rainbows range with respect to MPB affected habitats using radio-collared animals suggested that they neither select nor avoid most MBP areas (Apps and Dodd 2017). They did appear to avoid forests that were MPB infested 11–13 years prior to the study (Apps and Dodd 2017).

3.5 PARASITES AND DISEASES

Caribou are generally susceptible to a range of native and introduced diseases and parasites found in other ungulate species. Brucellosis is a contagious disease of ruminants which can cause spontaneous abortions particularly among first time breeding females (Neiland et al. 1968). The bacteria causing brucellosis in caribou is primarily *Brucella suis* that also affects swine (Jones 2014). Caribou are highly susceptible to the meningeal worm (*Parelaphostrongylus tenuis*) that is fatal in some, but not all, deer species (Anderson 1972, Trainer 1973). Early reports of woodland caribou declines in eastern Canada attributed it to their overlap with white-tailed deer who are meant to be the primary host of *P. tenuis* (Cringan 1956). Besnoitiosis is a disease caused by infection with the protozoan parasite *Besnoitia besnoiti* and is known in wildlife and livestock around the world (Walden et al. 2014). It can cause spontaneous abortions in pregnant females and infertility in males, but it is primarily expressed as facial hair loss in infected animals. It has been found in free-ranging woodland caribou in northern Saskatchewan in 1976 (Wobeser 1976), captive caribou (Glover et al. 1990).

Caribou are also susceptible to tape worms (*Echinococcus granulosus*, *E. multilocularis*, *Taenia ovis krabbei*), bot flies (Oestrinae), warble flies (Hypodermatinae), liver flukes (*Fascioloides magna*), lumpy jaw (*Actinomyces bovis*), muscle worms (*Parelaphostrongylus andersoni*, *P. odocoilei*), and winter tick (*Dermacentor albipictus*) (Miller et al. 2014b).

There is no reported occurrence of brucellosis or tuberculosis in British Columbia in any species. Severe symptoms of Besnoitiosis have not been found in caribou in British Columbia (Miller et al. 2014a). However, many of the other parasites can be found in woodland caribou in British Columbia with affects on individuals, but no reported population-effects on the Rainbows subpopulation. Chronic wasting disease, which has the potential

for strong negative effects on this subpopulation, has not been detected in British Columbia in any species (Schwantje 2015).

3.6 CLIMATE CHANGE

For species such as woodland caribou that undergo seasonal migrations, have predators with seasonal cycles, respond to plant and insect phenology and are sensitive to snow depth and season length, climate change will have direct effects (Vors and Boyce 2009, Festa-Bianchet et al. 2011). With alpine tundra habitats predicted to shrink in a warming climate, the effects of climate change on caribou may be profound (Harding and McCullum 1997, Swift and Ran 2012). Natural resource industries, such as forestry and oil and gas are both vulnerable and have a role to play in climate change mitigation (Houghton et al. 2001). How they adapt may also have consequences for caribou (Racey 2005). Climate change adds much complexity to managing caribou for long-term recovery, including how it affects the distribution of alternative prey (Seip 2008, Dawe and Boutin 2016), predators (Hegel et al. 2010) and available food (Lenart et al. 2002, Parker et al. 2009).

Climate change models for British Columbia suggest that areas in the Rocky Mountains will experience differing patterns of winter snow that could affect food access and mobility for animals (Fyfe and Flato 1999). Such a change could be positive for snow adapted, arboreal lichen eating caribou. This benefit could be negated by more frequent freeze-thaw cycles (Plummer et al. 2006, MacNearney et al. 2016a) that will improve the ability to predators to move across frozen crusts as well as limit access to food for caribou (Gillett et al. 2004, Dawson et al. 2008). Predictions of forest type shifts due to climate change mediated by fires suggest that black spruce may be replaced by white spruce and lodgepole pine, affecting caribou habitat (Hebda 1997).

There have been no studies of predicted or actual effects of climate change on the Rainbows caribou subpopulation.

3.7 SMALL POPULATION SIZE EFFECTS

Small population effects include several threats to caribou that are unique to small (approximately less than 50 animals) and isolated subpopulations. These include reproductive and genetic isolation (McDevitt et al. 2009), predation (Sinclair et al. 1998, Abrams 2002), Allee effects where small groups are more vulnerable to predators (McLellan et al. 2010), risk of demographic bottlenecks where single-sex or male-dominated cohorts lead to population decline and increased chance that localized natural events such as avalanches (McClung 2001), fires or floods that kill a disproportionate number or key members of a small herd (Hebblewhite et al. 2010b). Movement barriers that prevent inter-population dispersal exacerbate small population effects by preventing small or extirpated populations of rescue (Gilpin 1990). Small population effects can be a particular hazard for species with slow growth rates (Laikre et al. 1997).

The Rainbows caribou subpopulation is very small and declining (Figure 2). With a highway traversing its range, its habitat fragmented by forestry, multi-species hunting in its range and abundant avalanche terrain, the potential for accidental deaths that could kill a large proportion of the population is high.

The genetic viability of caribou subpopulations is dependant upon their size and dispersal (inter-population migration) ability (Weckworth et al. 2012). Small populations are subject to genetic drift that is a simple function of their small and unique gene pool as well as reduced gene flow (Boulet et al. 2007). Populations that are small and declining, like the Rainbows caribou, are particularly susceptible to genetic isolation (Laikre et al. 1997,

Weckworth et al. 2012). That they are in close proximity to other and larger subpopulations (Tweedsmuir, Itcha-Ilgachuz, Charlotte Alplands) will help prevent short and mid-term genetic isolation.

4 MANAGEMENT HISTORY

4.1 HABITAT

The Rainbows caribou live in a mountainous, forested landscape half of which is roughly within areas protected from forestry and half unprotected lowland river valley. They select habitats most frequently within the protected areas (Apps and Dodd 2017). Importantly, these areas do not have secure connecting habitats which both isolates individuals within the subpopulation and places dispersing / migrating animals at high predation risk (Apps et al. 2001a).

Forest dwelling caribou in the Rainbows subpopulation occupy different habitats in the summer and fall than in the winter and spring (Apps and Dodd 2017). This pattern is classic of northern caribou. Although they are broadly associated with montane spruce and sub-boreal pine-spruce habitats, they shift elevations by season. Low elevations were occupied in late winter and spring, moving to higher elevations in summer and fall.

4.1.1 PROTECTION

Provincial park legislation does not automatically protect caribou habitat from forestry, mining and petroleum resource activities. When land is acquired for a provincial park, with it comes the mineral and coal leases as well as timber and related licences (with compensation) (Government of British Columbia 1996a). Hunting is also prohibited (Government of British Columbia 1996b). Petroleum and natural gas tenures are permitted by the British Columbia Park Act (Section 33 Government of British Columbia 1996a) but are not relevant in this subpopulation range.

The Rainbows caribou subpopulation range overlaps with two provincial parks (Tweedsmuir and Itcha-Ilgachuz), designated ungulate winter range (UWR) and a wildlife habitat area (WHA). The WHA (5-087) is a modified timber harvest area established to protect caribou habitat in the low elevation portion of the Rainbows caribou subpopulation (British Columbia Ministry of Forests, Lands and Natural Resource Operations 2004). There are 17 Ungulate Winter Range (UWR) parcels in or adjacent to the range of the Rainbows caribou subpopulation. All of these are on the far western edge of the range and have been established to protect either mountain goats or mule deer. They cover approximately 65 km² of habitat and prohibit tree harvest within their boundaries. As well, the Burnt Bridge Creek Conservancy lies within the Rainbows subpopulation range, adjacent to Tweedsmuir Provincial Park on the southwest. It is a 16.91 km² area established in 2008 to protect historical and cultural values.

Logging is not permitted in either Tweedsmuir and Itcha-Ilgachuz Provincial Parks but limited hunting (not caribou) is allowed in both parks. There is a ski hill in Tweedsmuir Provincial Park within the Rainbows caribou range with gladed runs and ski lifts that operate one day a week during the winter and track-set cross country ski trails. Snowmobiling is permitted on designated areas and trails within Tweedsmuir Provincial Park throughout the Rainbows caribou range, and in Itcha-Ilgachuz provincial park where it overlaps with the Rainbows caribou range.

4.1.2 ENHANCEMENT AND RESTORATION

Large-scale habitat restoration and enhancement for caribou protection and recovery generally refers to oil and gas activities (well sites, seismic lines) rather than forestry. Habitat restoration is very expensive and rarely undertaken at a scale that is beneficial to caribou (Schneider et al. 2010, Dickie et al. 2017). Small-scale habitat restoration actions, like decommissioning roads, replanting seismic lines or installing movement and visual barriers along pipelines can be effective (MacNearney et al. 2016b, Pigeon et al. 2016, DeMars and Boutin 2017). Nevertheless, it is considered an essential step for caribou recovery in the absence of protection required for natural habitat regrowth that can take tens of decades (Bentham and Coupal 2015, van Rensen et al. 2015).

Beyond tree planting on forest cut blocks, no large-scale restoration of disturbed habitat has occurred within the Rainbows caribou subpopulation area.

4.2 RECREATION AND ACCESS MANAGEMENT

Road access to woodland caribou habitat elevates conservation threats including conflicts with motor vehicles, hunting pressure, habitat fragmentation and, in some cases, predation (James et al. 2004, Apps and McLellan 2006, Seip et al. 2007, Apps and Dodd 2017). A key element of caribou life history is to seek separation from competitors (moose, deer, elk) and their predators (Bergerud and Elliot 1986, Wittmer et al. 2007). Constructed access roads into woodland caribou habitat connects them to their threats and contributes to population declines (Dussault et al. 2012).

There are 862 km of forestry roads (active and retired) in the Rainbows caribou subpopulation range. Because of the provincial parks in their range, forestry roads are unevenly distributed, but nevertheless make for 0.2 km road / km² range area largely in summer habitat. This is low (Dyer et al. 2002, Smith 2004, Apps and McLellan 2006, Beauchesne et al. 2014, COSEWIC 2014, Bennett 2017). At this density, roads should not threaten caribou recovery, however, their management as part of a plan to regulate seasonal access will be a part of caribou persistence and recovery.

4.2.1 SNOWMOBILE

Snowmobiling is a very popular activity in the range of the Rainbows caribou subpopulation both by residents and non-resident recreationalists. Snowmobile access is managed in WHAs (see above) by preventing new access roads and limiting human disturbance. Snowmobiling is restricted but not prohibited in the provincial parks with areas and trails set aside for snowmobile use in both Tweedsmuir and Itcha-Ilgatcha parks. There is little information on how much use these areas get from snowmobiling.

4.2.2 HELI-SKI / CAT-SKI

There is one heli-ski company operating along the western edge of the Rainbows caribou subpopulation range (Bella Coola Helisports). This company operates numerous runs and two lodges in the area. See section 3.3.2.2 for general threat information.

4.2.3 OTHER

Recreational access to the Rainbows mountain range, based out of Anahim Lakem is promoted as and has become a winter destination for backcountry ski-touring, snowshoeing and cross-country skiing. There are ski clubs in the region that map routes, groomed trails and winter facilities for residents and tourists. Snow conditions in this region are best in late winter and spring (Travel British Columbia 2011).

4.3 PREDATORS

Unsustainable predation is acknowledged as a key, proximal mechanism of woodland caribou declines across Canada (Bergerud and Elliot 1986, Bergerud 1988, Environment Canada 2012b, 2014). Woodland caribou metapopulations have persisted despite ongoing predation from wolves, bears (black and grizzly) and cougars for millennia, but the existential impact of predators on caribou is a recent phenomenon. Human changes to habitats, fragmentation, movement barriers, dynamics of alternative prey and predator access to caribou habitat have led to conditions where caribou subpopulations are permanently extirpated.

Shrinking old-growth forest caribou habitat has forced caribou into increasingly smaller ranges, making their home range potentially more predictable to predators. Seasonal migratory routes track through predator rich areas and bring them into closer proximity to alternative prey species that can sustain higher predator populations (Seip 1992, Apps et al. 2013). Road and seismic line clearing and winter trail packing makes travel for predators into caribou critical habitats more efficient, elevating predation (Dickie et al. 2016). And, finally, a shift in forest structure towards younger age classes has favoured moose, deer and elk at densities that can support greater predator densities. Not only does this shift bring woodland caribou into closer proximity to predators, but it also promotes greater predator abundance (Hebblewhite et al. 2007).

While habitat changes facilitate unsustainable predation, habitat regrowth and restoration occur too slowly to recover woodland caribou in the short-term. As a result, direct predator management is a caribou recovery tool to ensure that populations persist long enough to benefit from habitat restoration efforts (Wilson 2009, Brook et al. 2014, Hervieux et al. 2014).

Predation is a dominant source of caribou mortality in the Rainbows subpopulation (Seip and Cichowski 1996).

4.3.1 WOLF MANAGEMENT

Wolves are an important, year-round caribou predator. Caribou populations in northern British Columbia were shown to decline when wolf densities were 9–10/1000 km² but increased at wolf densities from 1–4/1000 km² (Bergerud and Elliot 1986). For this reason, target wolf densities that would enable caribou recovery are set to 6.5/1000 km². In the absence of effective habitat or alternative prey management to achieve these densities, direct wolf management must be undertaken to achieve caribou conservation goals.

Wolf populations are neither monitored or managed in the range area of the Rainbows caribou subpopulation (Youds et al. 2011). Hunting and trapping continues with 262 wolves killed by resident and non-resident hunters in the management units overlapping with the Rainbows caribou subpopulation range between 1997 and 2013. No reliable, long-term trapping data are available for this area.

4.3.2 COUGAR MANAGEMENT

Cougars are not common in the Rainbows caribou subpopulation range, but they are present (Spalding 1994). In British Columbia, particularly in the south (Wittmer et al. 2005a), cougars are a significant caribou predator. Cougar densities respond positively to deer density, and as deer densities climb, so will cougar densities. However, in west-central and northern British Columbia, there are only rare reports of cougar predation on caribou. A cougar hunting season is in force in the wildlife management units that overlap with the Rainbows subpopulation range but from 1978 through 2013 only 21 cougars were killed by resident and non-resident hunters. The objective of this hunt is not explicitly to manage this predator to benefit caribou, and there is no estimate of the number of cougars in this area. This harvest does not likely affect caribou population dynamics.

4.3.3 OTHER

Grizzly bears, black bears and wolverines are also woodland caribou predators (Seip 1992). However, their protection status, seasonality and / or low predation rate and dependence on caribou as food does not warrant management to benefit caribou populations. In rare cases associated with intensive caribou management programs (captive breeding, maternity penning) bear or wolverine removal may be conducted.

There are 15 grizzly bears / km² in the Rainbows caribou subpopulation range (Youds et al. 2011). There are 29 traplines that are either entirely or partially within or bounding on the Rainbows range. Operators have the potential to remove caribou predators as part of their licences. Caribou predation by bears has not been documented in this area.

4.4 PRIMARY PREY

Moose, elk, white-tailed deer and mule deer (including black-tailed deer) share large, mammalian predators such as wolves, bears and cougars. In what is known as apparent competition (Holt 1977), an increase in one prey population will lead to a decrease in a second prey population. It appears as if these two, prey species are competing with each other for food, but the decline of the second prey species can be due to the boost that their shared predator population experiences because of the high density of the first prey species. Woodland caribou have avoided apparent competition by occupying habitats distant from other deer species. However, changes to their habitats, movement barriers and facilitated predator access have limited their access to continued isolation. Across their range, woodland caribou populations have been subject to apparent competition (DeCesare et al. 2010b, Wittmer et al. 2013). For this reason, managing primary prey, either directly through hunting quotas, or indirectly through habitat management, has become a caribou management action.

Ungulates in this area segregate by habitat (Davis 2009). Mule deer tend to occupy Douglas fir stands (Armleder et al. 1994), moose select spruce forests (Baker 1990) and caribou are found in lodgepole pine stands (Youds et al. 2002). Apparent competition may not be an important process at current ungulate densities.

4.4.1 MOOSE MANAGEMENT

Throughout British Columbia, moose are a common and sustaining prey of wolves (Messier 1994). But their expanding range (Bergerud and Elliot 1986), a wolf numerical response to moose densities (Messier and Joly 2000) and apparent competition with woodland caribou mean that even moderate moose densities in or adjacent to caribou range poses a threat to caribou persistence (Seip and Cichowski 1996, Lessard et al. 2005). Moose densities respond positively to early seral forest habitat and negatively to human hunting, and moose numbers have been falling around the province in response to harvest pressure (Moose Management Technical Team 2015). Lessard et al. (2005) found that a 10% increase in the moose harvest could stabilize caribou populations.

Moose populations in the area of the Rainbows caribou subpopulation range are below threshold densities of 0.4 moose / km² (McNay et al. 2013). A 2013 report established moose populations in MU 5-10 and 5-12 to be stable and slightly below the threshold. In MU 5-6, moose densities were found to also be below threshold but declining.

A 2012 winter moose survey in Hunting Zone 5-12 that includes the northeastern quarter of the Rainbows caribou range also recorded a declining population, down from 0.58 moose/km² in 2002 to 0.23 moose/km² in 2012 (O'Bryan 2012). In British Columbia, a low moose density is considered for populations below 0.2 moose/km² (Moose Management Technical Team 2015).

4.4.2 DEER MANAGEMENT

Managing deer populations in support of caribou conservation is a challenge. Both white-tailed and mule deer can support predator populations that have negative effects on caribou (Latham et al. 2011c). Both can transmit diseases that could be catastrophic were they to spread to caribou populations (see above; Habib et al. 2011). Where mule deer and white-tail deer ranges overlap, mule deer tend to decline, perhaps also due to apparent competition (Robinson et al. 2002). In British Columbia, there is active management to increase mule deer populations through habitat protection (British Columbia Ministry of Environment 2017) and manage white-tailed deer populations through hunting regulations (British Columbia Ministry of Forests, Lands and Natural Resource Operations 2015). Neither are strictly regulated by either predators or food. White-tailed deer populations respond strongly to food availability as well as hunting or predation (Fryxell et al. 1991, Messier 1991, Dumont et al. 2000). Mule deer are similar, but tend to be more vulnerable to predation, food availability, severe weather and loss of native winter habitat (Pierce et al. 2012, Forrester and Wittmer 2013, Bergman et al. 2015). Indeed, regulating deer density using hunter tags must counter some difficult trends (declining number of hunters, increase prey refugia from hunters and increased use of residential areas by deer) to be successful (Brown et al. 2000). Managing deer populations to a lower density will require managing artificial food sources (hay, grain), and access to high quality habitats as well as increased hunting pressure.

Deer populations in the Rainbows caribou subpopulation range are variable by wildlife management unit. In general mule deer populations are greater than white-tailed deer populations. Hunting records suggest that there are only white-tailed deer populations in WMUs 5-06 and 5-12 on the eastern half of the range. Of these WMUs, only 5-12 has a detectable white-tailed deer population with no real trend over time. Mule deer are found throughout the range and typically more abundant in the east than the west. In WMU 5-06, the mule deer population appeared to crash between 1994 and 2000 while it has remained roughly stable elsewhere. Beyond adjusting harvest regulations to increase offtake, no direct deer management is being conducted, nor is it clear that it is needed.

4.4.3 OTHER

Elk, like moose and deer are wolf prey and could potentially facilitate apparent competition with caribou (DeCesare et al. 2010b). However, elk are not observed in aerial surveys of the Rainbows caribou subpopulation range.

4.5 POPULATION REINFORCEMENT

The International Union of Conserving Nations (IUCN) has established guidelines for reintroductions and related conservation translocations (IUCN Species Survival Commission 2012), of which population reinforcement is one tool. In this document, reinforcement is defined as an intentional movement and release of an organism into an existing population of conspecifics within its indigenous range. It differs from reintroduction in that the species has not been extirpated from that range (DeCesare et al. 2010a), but existing populations are being supplemented. The management tools described in this section are based on the assumption that caribou populations are being reinforced and not reintroduced.

4.5.1 MATERNITY PENNING

Maternity penning (sometimes called maternal penning) is a technique to increase calf recruitment by capturing and temporarily penning pregnant females to protect them from predators. These females are held through parturition and for up to six weeks after calves are born. By this time calves are large and strong enough to better avoid predators, improving their survival probability and population recruitment. Thus, if young-of-the-

year predation is a contributing factor to unsustainable population decline, maternity penning can be an effective mitigation (Hayek et al. 2016). Maternity penning is an *in situ* method where the pen is constructed within their home range and animals are never moved outside of their home range.

There is no maternity penning operating or planned for the Rainbows caribou subpopulation range.

4.5.2 CAPTIVE BREEDING

Captive breeding is a conservation method that captures both male and female animals and moves them permanently to a facility where they are bred under controlled conditions (IUCN Species Survival Commission 2012). The objective is to create a surplus of female calves in the breeding facility that can then be translocated to ranges to reinforce small populations. To be effective, recipient populations should have low adult female survival that this action can reverse. This is an *ex situ* approach that takes animals away from their home range and returns animals to ranges that may not be where they originate (Harding and McCullum 1997). A number of factors, such as availability of source animals, animal husbandry, genetic bottlenecks, gene mixing with destination herds, status of destination herds, disease transmission, fate of male calves among others must be considered in captive breeding (Dolman et al. 2015, Hayek et al. 2016).

Captive breeding to reinforce the Rainbows caribou subpopulation is not being planned.

4.5.3 TRANSLOCATION

Translocation is the reinforcement of small populations by moving animals to a small population directly from a sustainable population (Ray et al. 2015, Hayek et al. 2016). The goal is to rapidly increase the numbers of animals of all ages and sexes in the target population (Miller et al. 2007, Decesare et al. 2010c). Animals are captured in their home range, transported to the target range and either soft released in a temporary pen that offers an opportunity for individuals to adjust to their new surroundings, or hard released directly into the destination habitat.

Compared with other reinforcement methods, translocation is a relatively cost-effective approach to add animals to small populations. It has been tried successfully and unsuccessfully with caribou populations in Canada (Compton et al. 1995, Stronen et al. 2007, Hayek et al. 2016). A translocation of caribou in the neighbouring Charlotte Alplands subpopulation was conducted between 1984 and 1991 (Young et al. 2001). Animals were taken from the Itcha Ilgachuz subpopulation to the east of the Rainbows subpopulation. Short term reviews of the outcomes of the five translocations that were conducted deemed the effort a success based on the observation that the caribou remained in the Charlotte Alplands area and the whole subpopulation was increasing at that time (Young et al. 2001).

Because of its already small size the Rainbows caribou subpopulation is not a candidate as a source population for translocation. As well, because the population is declining and factors such as primary prey and predators are not being managed, they are not a strong target candidate population for translocation (Hayek et al. 2016).

4.5.4 OTHER

The proximate cause of caribou population declines is predation. While predator management is a direct way to manage this threat, an alternative solution is predator exclusion fencing (Hayek et al. 2016). In part, this approach is linked to direct predator management as any predators within an exclusion fence would be lethally removed. It is also linked to maternity penning as this is a form of small-scale, temporary predatory exclusion fencing. However, there are recent, and very large scale (thousands of hectares), proposals to erect predator

exclusion fencing as a mitigation for caribou populations where habitat restoration is an unrealistic goal, but the caribou population is critically low (Boutin and Merrill 2016, Cornwall 2016, Hebblewhite 2017, Proulx and Brook 2017).

To date, this conservation method has not been attempted anywhere, including in the range of the Rainbows caribou subpopulation (Antoniuk et al. 2016).

4.6 STEWARDSHIP/OUTREACH

Local communities and stewards are an essential part of caribou recovery. Management actions to recover very small populations are at times expensive, controversial and require the imposition of new and restrictive regulations (Hayek et al. 2016). Gaining the social licence to conduct management actions like predator management, translocation, captive breeding and access restrictions requires outreach. Effective outreach programs to local communities and regional populations must accompany planning for management actions (Antoniuk et al. 2015). This includes information to municipal and regional administrations, business stakeholders, recreational groups, conservation organizations, farming organizations, hunting clubs among others (see below). Outreach must be timely, targeted and inclusive to be effective (Wilkinson 2010).

Stewardship is the active participation by citizens or citizen groups in conservation and recovery programs. For caribou this can take a number of forms ranging from ambassador programs where citizen volunteers promote caribou conservation at community events, habitat protection through conservation offsets (Robichaud and Knopff 2015) to fund-raising and operating reinforcement activities such as maternity pens.

With the large number of caribou herds in the range area of the Rainbows caribou subpopulation, opportunities for stewardship and outreach with First Nations communities, hunting clubs, outdoor recreation groups and naturalist groups is high. Messages around this small and declining population in comparison to other populations that are larger or increasing under more direct management intervention (predator management, reinforcement) could focus attention on caribou recovery.

4.7 RESEARCH

Every caribou subpopulation in British Columbia requires some degree of management action; habitat protection or restoration, population reinforcement, alternative prey management or predator control. Yet few caribou subpopulations in British Columbia have sufficient, herd-specific information to enable confident management decisions. To fill these gaps, scientific research and traditional ecological knowledge must be gathered to fill critical gaps.

There has been decades of research into caribou biology and conservation. This body of work has informed scientists and policy makers of the key factors that contribute to caribou population dynamics, important threats and potential solutions. Key findings have been the proximate role of predation and apparent competition in caribou population fluctuations and the ultimate role of habitat destruction in caribou population declines. While their interactions are broadly understood, ongoing research to fine-tune caribou responses to ecological stimuli and human disturbance including habitat fragmentation and primary prey density can improve management.

There has been relatively little research conducted on the Rainbows caribou subpopulation. There has been work on habitat selection with respect to mountain pine beetle infested areas (Cichowski and Williston 2005) as well as studies of this subpopulation's general movements, seasonal cycles and habitat selection patterns (Cichowski 1989). Studies linking Rainbows caribou specific population dynamics to habitat disturbance, predation and human use have not been conducted.

4.8 MONITORING

Ecological, population and industrial footprint monitoring is an essential activity for the conservation and recovery of woodland caribou. This work provides the information to enable the detection of conservation threats, the effectiveness of management activities and the status of target populations. Although it cannot replace conservation action, it is an essential piece of the caribou recovery program.

The Rainbows caribou subpopulation is small and declining. Systematic monitoring of this subpopulation has been undertaken since the mid 1980s to measure its population size, composition and trend (Figure 2, 3). Ongoing monitoring of this subpopulation's size and distribution is needed to support efforts for its reinforcement (Hayek et al. 2016). Monitoring of alternative prey (moose and deer) as well as predators, particularly wolves, would also assist in predicting and managing threats. Ongoing measures of habitat change, whether recovery following disturbance or shifts from mature to early seral stages is also a critical element to inform management. —

5 IMPLICATIONS TO OTHER WILDLIFE

Managing declining caribou population trends will require manipulating the environment in ways that favour caribou ecology and life history potentially at the expense of other wildlife. More old growth forest will benefit caribou but not moose nor deer. Reducing adult female and calf mortality may require lethal wolf control. Maternity penning makes calves, common spring prey for black and grizzly bears, less vulnerable to these predators that generally benefit from this food source. None of these management actions can, or will imperil other wildlife species, but will precipitate changes to their population density and/or distribution.

Actions taken to protect and manage the Rainbows caribou subpopulation and their habitat may benefit or inhibit the protection of other species and their habitats (British Columbia Ministry of Environment 2013). Predator management directly affects wolves, who's populations have been intentionally reduced, and other ungulate species like moose, who's densities may also have to be held low to facilitate caribou conservation (Serrouya et al. 2017).

6 IMPLICATIONS TO OTHER VALUES

The recovery and protection of woodland caribou populations will affect a range of human values and activities across caribou range (Scarfe 2006). These include recreational / commercial activities such as camping, snowmobiling, heli-cat skiing and backcountry skiing, commercial resource extraction activities such as forestry, mining and oil and gas development as well as recreational / extractive resource uses such as resident and non-resident hunting. Research shows that none of these activities will have to be halted to protect woodland caribou (Kruse et al. 1998, Hebblewhite et al. 2006, Hebblewhite 2017). However, changes to operations, seasonal restrictions and area closures will be required, locally affecting some recreational and commercial activities (Government of Alberta 2016).

Recreational snowmobile use has been restricted, but not prohibited, within the protected areas (provincial parks) overlapping the Rainbows caribou subpopulation range using legal area and trail closures. As well Wildlife Habitat Area and Provincial Park protections restricts or prevents forestry over much of the subpopulation range. A legal caribou hunt ended in WMU 5-12 in 2017. The last caribou killed by a resident hunter was as late as 2013 (although it could have been since 2013), The caribou hunt in the rest of the subpopulation range ended in the 1980s. Helicopter and cat skiing must abide by restrictive best management practices when operating in caribou winter habitat.

7 PARTNERS / NEIGHBOURS

Partners are existing or potential groups that can contribute to woodland caribou management with expertise, funding, in-kind or moral support. Neighbours are groups within in the caribou subpopulation area that are currently not participating in caribou management but that could be affected by caribou management. They include local governments, industry tenure holders, and recreation groups. Neighbours could potentially become future partners.

Below is a list of communities in and adjacent to Rainbows subpopulation range; organizations that have a clear interest in how this area is managed and businesses that have a commercial interest in the area. This may not be a complete list, particularly of distant organization with an inherent interest.

Communities: **First Nations (Indigenous):** Ulkatcho First Nation, Nuxalk Nation (Bella Coola Band), Heiltsuk Nation

Local: Anahim Lake, Hagensborg, Bella Coola, Nimpo Lake, Charlotte Lake, Stuie

Regional: Williams Lake, Quesnel, Prince George, Smithers

Organizations: **Recreation:** West Chilcotin Tourism Association, Tweedsmuir Ski Club, Horse Council of British Columbia, Back Country Horsemen of British Columbia, British Columbia Snowmobile Federation (Prince George Snowmobile Club, Quesnel Snowmobile Club, Williams Lake Powder Kings), Land Conservancy of British Columbia, Prince George Rod and Gun Club, Quesnel Rod and Gun Club, Alpine Club of Canada, Outdoor Recreation Council of British Columbia, Quad Riders Association of British Columbia

Protection: Western Canada Wilderness Committee, BC Spaces for Nature

Commercial: **Hunting and Trapping:** Lehman Creek Outfitters, Blackwater River Outfitting, British Columbia Trappers Association, Guide Outfitters Association of British Columbia, BC Wildlife Federation

Accommodation and Guiding: Escott Bay Resort, Rainbow Mountain Outfitting, Six Mile Ranch (Itcha Ilgachuz Mt. Outfitters), Bella Coola Helisports

Forestry (*Active licences to cut*): BC Ministry of Transportation and Infrastructure, Cariboo Regional District, Chilcotin Aggregates Ltd., Nimpo Lake Community Association, David Jorgenson, Kenneth Karan,

Forestry (*Woodlots*): none

Agriculture: BC Cattlemen's Association, Cariboo Cattlemen's Association, North Cariboo Agricultural Marketing Association

8 RECOMMENDED ACTIONS

8.1 SHORT TERM (WITHIN 6–12 MONTHS)

- Initiate predator management program with a goal of maintaining wolf populations at a density of less than 6.5 wolves/1000 km² verified by periodic wolf population counts.
- Initiate a regional outreach program to foster support for management that will promote ongoing growth of the Rainbows caribou program.

8.2 MEDIUM TERM (WITHIN 12–24 MONTHS)

- Continue caribou population monitoring through annual or bi-annual aerial census or through non-invasive techniques such as scat mark-recapture (Ball et al. 2007).
- Initiate access management in the forested regions of the Rainbows caribou subpopulation including logging road rehabilitation.

8.3 LONG TERM (WITHIN 24–48 MONTHS)

- Maintain and enforce current population and habitat (UWR, Wildlife Habitat Areas and Provincial Park) protection.
- Ensure a supply of habitat that supports a sustainable caribou population by allowing it to recover. This will be measured using remote sensing tools of aerial extent of undisturbed or recovering vegetation classes.

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