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

Spatsizi
Subpopulation

Northern Mountain Caribou

BRITISH COLUMBIA

Recommended Citation:

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EXECUTIVE SUMMARY

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1 BACKGROUND

1.1 INTRODUCTION TO THE PROGRAM

The Spatsizi subpopulation is the northern mountain ecotype of woodland caribou (*Rangifer tarandus caribou*), designatable unit seven (DU 7), and is within the Northern Mountain National Ecological Area (SMNEA). These herds are listed as *Threatened* by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2002, 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, Grant 2017)

Range plans are required for all woodland caribou populations that are designated as threatened or endangered in Canada (Environment and Climate Change Canada 2016). The Spatsizi 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 Spatsizi 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 employ the calving strategy of moving to high elevations on open sub-alpine ridges, spacing away from conspecifics and predators (COSEWIC 2011).

2.1 DISTRIBUTION

The Spatsizi subpopulation range area is 15,629 km^2 and the majority of the herd resides within the Spatsizi Wilderness Park in north western British Columbia (Figure 1). The terrain is primarily mountainous, but the rugged relief in many areas of the park gives way to wide open alpine plateaus and wide glacier-shaped valleys favored by caribou. The area boasts many rivers and lakes (Boonstra and Sinclair 1984).

The most recent population estimate for the Spatsizi subpopulation is 3000 individuals, last censused in 1996, and the population trend is currently unknown (Environment Canada 2012a, Grant 2017). There was a minimum total count survey conducted in 2010 for Spatsizi Park. They counted 671, of those 150 bulls, 434 cows, and 87 calves (Williams and Marshall 2010).

Information on ecology and habitat use specific to Spatsizi caribou is limited. Available information indicates that seasonal movements of Spatsizi caribou are dependent on snow conditions, though in general, they spend the summer in high elevation alpine and subalpine habitats and move to lower elevation coniferous forests during the winter (COSEWIC 2002). Winter forage consists primarily of terrestrial lichen (COSEWIC 2002).

Four biogeoclimatic (BEC) zones (Meidinger and Pojar 1991) occur in the range area. These BEC zones are generally described as follows:

- Boreal Altai Fescue Alpine (BAFA) is dominated mostly by rock, ice and snow with vegetation limited to shrubs, herbs, mosses, lichens and dwarf trees
- Spruce Willow Birch (SWB) occurs at mid-elevations below the BAFA. The SWB supports open forests of predominantly white spruce, subalpine fir and deciduous shrubs.
- Engelmann Spruce – Subalpine Fir (ESSF) is a forested mid-elevation zone occurring below the BAFA. Spruce and fir are the dominant species although lodgepole pine occurs on drier sites.

Boreal White and Black Spruce (BWBS) zone is found in the lower elevations. Frequent fires have resulted in extensive successional forests of lodgepole pine and trembling aspen. On gentle terrain, stands of white spruce and trembling aspen are interspersed with black spruce bogs (Brumovsky and McNay 2015).

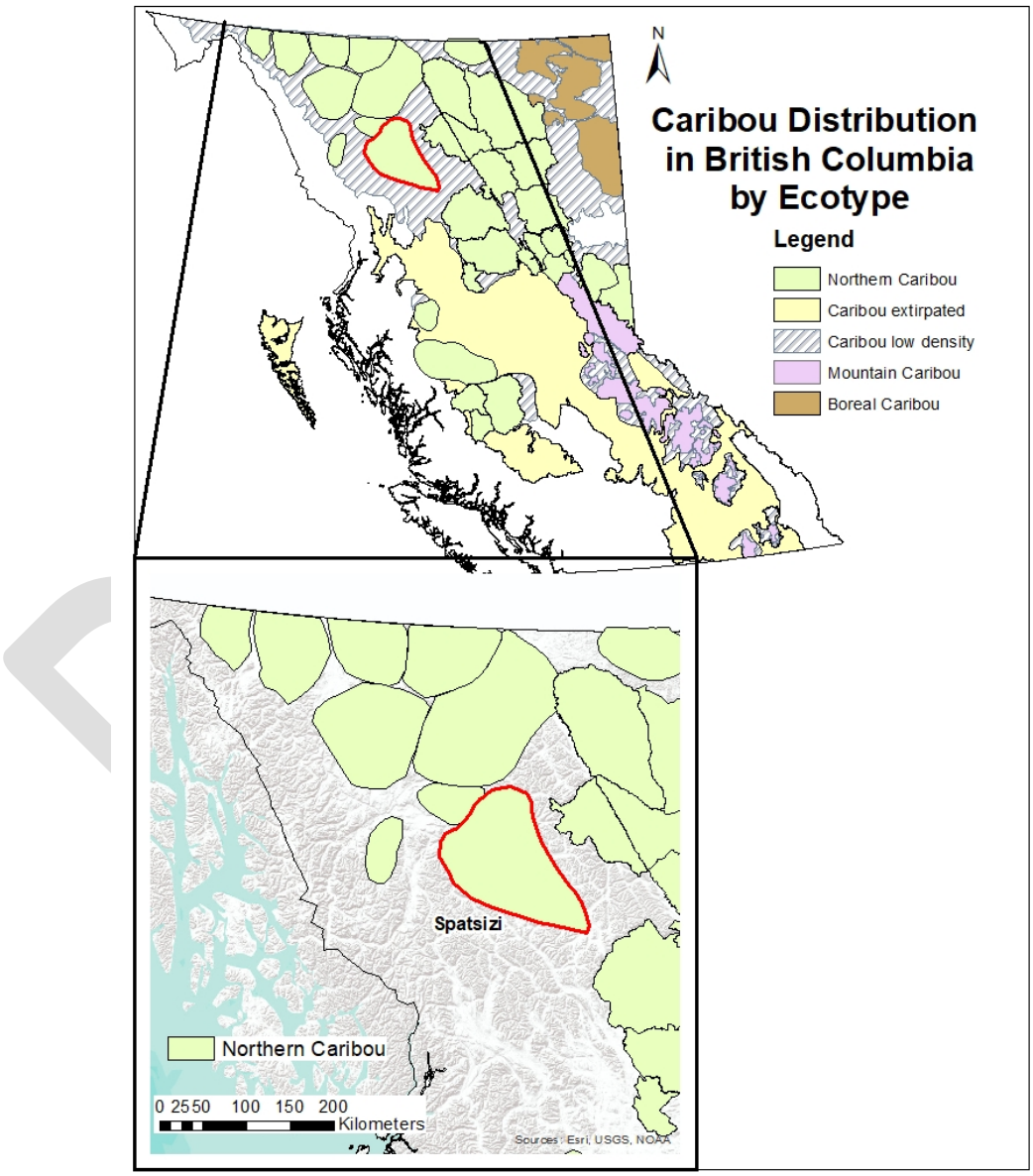

Figure 1: The location of the Spatsizi subpopulation of woodland caribou. The 15,629 km2 range (inset: red outline) is mostly within the Skeena Region, but its southern tip extends into the Omineca region.

2.2 Habitat and Behaviour

Habitat use by the Spatsizi caribou subpopulation is driven in part by the geographic distribution of landscapes (lowland forests, sub-alpine forests and alpine tundra) as well as selection for particular vegetation communities. In their range alpine and subalpine habitats are most abundant, followed by lowland spruce and pine forests. In winter, animals in this subpopulation select more strongly for geographic location, concentrating in the northern half of their range, along the Stikine River and spreading out in proportion to the availability of these habitats (Boonstra and Sinclair 1984, Hatler 1986). In the spring, they to migrate southward, concentrating in spruce and pine forests and brushy, birch habitats in the lowlands. The subpopulation is most dispersed in the spring, during calving (Hatler 1986). They gradually concentrate in alpine habitats through the summer and into the fall rut (Boonstra and Sinclair 1984). However, some animals in this subpopulation move very short distances between the winter and summer range (Hatler 1986).

2.3 Population Size and Trend

The population size and trend of the Spatsizi caribou subpopulation remains unclear despite seven surveys having been conducted since 1974 (Figure 2). The COSEWIC (2014) assessment and status report lists this herd as having over 2000 animals but its current trend is unknown. The most recent population count, that did not provide an estimate, but only reported number of animals seen within the Spatsizi Plateau Provincial Park, was 671 (Williams and Marshall 2010).

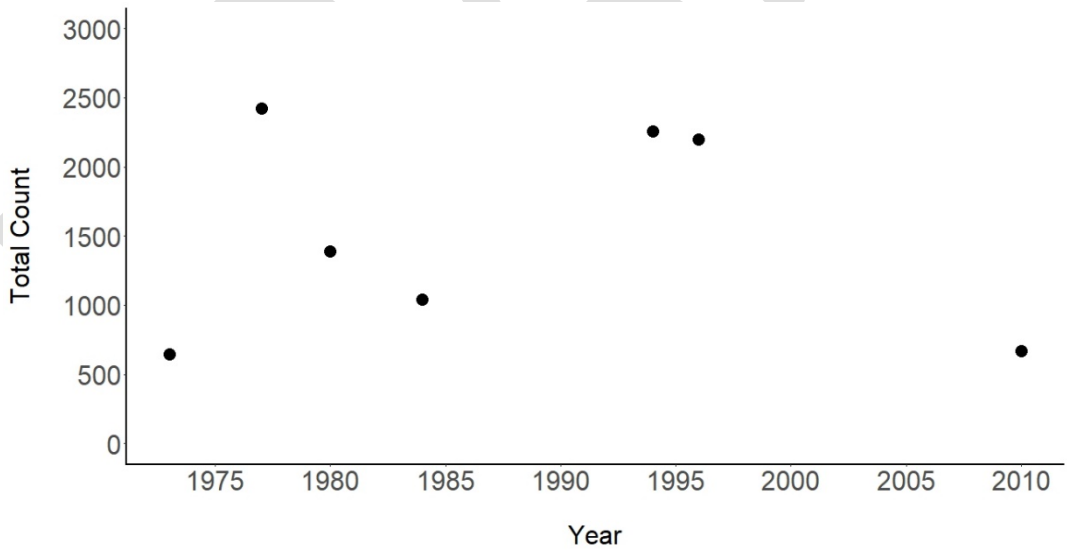

Figure 2: Caribou counts for the Spatsizi sub-population with data from Luckhurst (1973), Bergerud and Elliot (1986),COSEWIC (2014), Cichowski (1994), Sittler et al. (2015), Williams and Marshall (2010). Data come from surveys conducted at different times of year and using different survey methods.

Caribou recruitment, measured as percent of calves in the population observed during a spring census (Bergerud and Elliot 1986) has not been consistently measured for the Spatsizi caribou subpopulation. A number reported by Williams and Marshall (2010) suggests that percent calves in this subpopulation exceeds the population growth threshold (Figure 3).

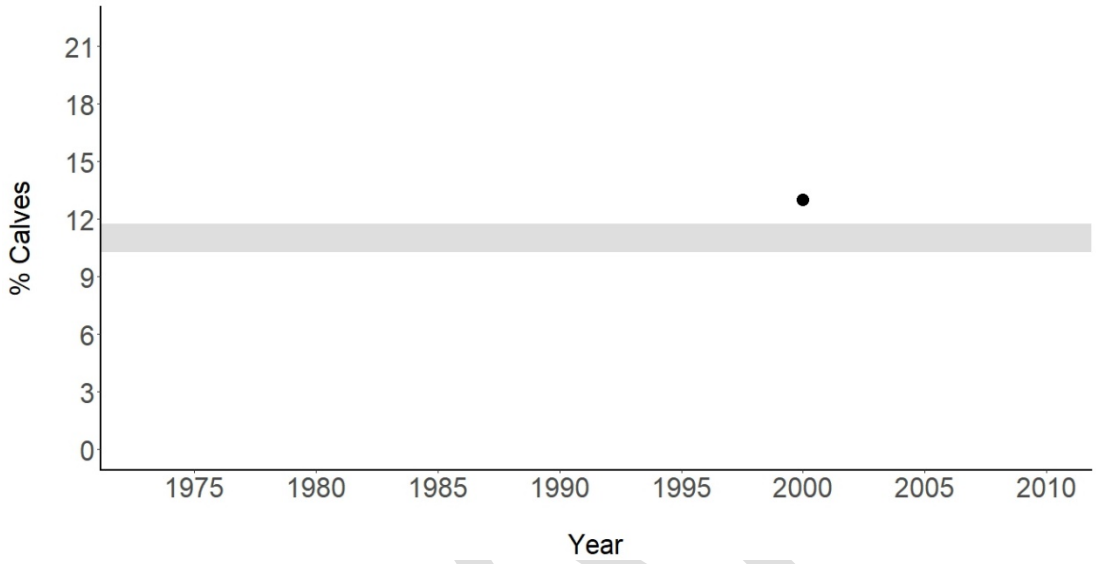

Figure 3: Caribou population recruitment measured in the Spatsizi caribou subpopulation range. Recruitment is defined here as the percent of the estimated population that is in the calf cohort. Recruitment lower than approximately 10 to 12% is considered below a threshold that will balance natural mortality (grey band; Bergerud and Elliot 1986).

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). Generally, Bergerud (2007) has calculated that wolf densities greater than 6.5 wolves/1000 km^2 will result in woodland caribou declines. More recently, the federal recovery strategy identifies 3 wolves/1000 km^2 as a target (Environment Canada 2014).

Surveys conducted in the 1980's indicated that there are as many as 9.6 wolves/1000 km^2 in the Spatsizi caribou subpopulation range, but in some years much less (Bergerud and Elliot 1986). The low years of wolf population density corresponded to high fall population caribou calf densities, with > 85% calf mortality when wolf densities were high and 70% when wolf densities were low (Bergerud and Elliot 1986). This study demonstrated the link between calf survival and wolf density and identifies predation as a primary threat to the Spatsizi caribou subpopulation.

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).

Boonstra and Sinclair (1984) studied the caribou distribution in the Spatsizi Plateau Wilderness Area and found that they selected habitats where terrestrial lichen was available during the winter, typical of northern caribou (Environment Canada 2012a). At other times of year, they selected wooded habitats with arboreal lichen and evergreen shrubs were their principal food source. Their habitat selection patterns indicate that at some times of the year they select habitats with abundant food suggesting that it could be limiting (Boonstra and Sinclair 1984). While food limitation is not commonly implicated as a strong population factor for northern mountain caribou (Seip and Cichowski 1996), and limited resource extraction in this area does not appear to limit habitat, it remains possible that food limits some population segments at some times of the year (Sleep and Loehle 2010).

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.

The northern 4/5 of the Spatsizi caribou subpopulation range lies within the Cassiar timber supply area (TSA) and the southern fifth overlaps with the MacKenzie TSA. However, there is no forestry activity within their range nor are there any forestry cutblocks in the area. Most of the range overlaps with protected areas that prohibit timber removal.

3.3.1.2 MINING

Mine sites deter caribou both for the activities that occur there when they are active as well a 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 Red Chris mine, along western boundary of the Spatsizi caribou subpopulation range is an open pit silver, copper and gold mine that has operated since 2012. It covers 231.42 km^2 of caribou habitat (https://www.imperialmetals.com/our-operations/red-chris-mine/overview).

There are several major mine proposals immediately adjacent to the Spatsizi caribou subpopulation range. To the southeast is the Kemess Underground gold and copper mine and directly south is the Groundhog underground coal mine (Atrum Coal Ltd.). Neither have yet been developed but are in the permitting phases of establishment (https://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/permitting/major-mine-permitting-office). Mining and quarrying are considered low impact threats to the Spatsizi subpopulation by (COSEWIC 2014).

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 range of the Spatsizi caribou subpopulation.

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 major clean energy projects in the range of the Spatsizi caribou subpopulation.

3.3.1.5 Other

There are no other major projects or developments planned for the Spatsizi 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 wildlife generally and woodland caribou in particular avoid mechanized winter activities to varying degrees (Simpson 1987a, Simpson and Terry 2000, Mahoney et al. 2001, Kinley 2003, Wilson and Hamilton 2003, Borkowski et al. 2006, Seip et al. 2007, Harris et al. 2014). 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 can be delayed.

3.3.2.1 Snowmobile

Snowmobile use in caribou habitat can result in their displacement (Simpson 1987a, Webster 1997, Apps et al. 2001, Brade 2003, 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, Powell 2004, Polfus 2010, Whittington et al. 2011). A study of stress using hormone profiles in free-ranging caribou demonstrated that elevated fecal glucocorticoids in animals as far as 10 km from snowmobile activity, suggesting that caribou perceive snowmobiles in their habitat as a stressor (Freeman 2008).

Most of the Spatsizi caribou subpopulation range is protected by parks and ecological reserves (Spatsizi Plateau Wilderness Provincial Park, Gladys Lake Ecological Reserve and the Stikine River Park, Tatlatui Provincial Park, Pitman River Protected Area). The Park Act prohibits snowmobiling in the provincial parks and ecological reserves except when specifically authorized. Snowmobile use is permitted in the Gladys Lake ER by the Tahltan First Nation and for trapline holders (Skeena Region Environmental Stewardship Division 2003).

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. Concentrations of glucocorticoid stress hormones are higher in caribou that live where commercial heli-skiing operates than in areas without heli-skiing (Freeman 2008).

The Bell 2 Lodge, operated by Last Frontier Heliskiing is located just southwest of the Spatsizi caribou subpopulation range along Highway 37. Although their ski terrain is close to Spatsizi habitat, it is not within their range.

3.3.2.3 OTHER

Backcountry tour skiing and mountaineering are recreational activities that occur in caribou habitat and can have an impact on woodland caribou conservation. Backcountry skiing (a term embracing of backcountry ski touring, unsupported, off-piste skiing and snowmobile assisted off-piste skiing) and mountaineering bring their participants into alpine areas that overlap with mountain caribou populations at sensitive times of the year (rut, winter). Unexpected encounters between individuals and people who are not in a vehicle can be very stressful for caribou and they can show a very strong flight response (McKay 2007).

Although backcountry tour skiing occurs in the Spatsizi Wilderness Provincial Park, access is limited making it an uncommon activity. There is a mapped backcountry ski traverse (Stikine – Iskut) to the west of the Spatsizi caribou subpopulation range. It is likely that backcountry skiing is rare enough here to not pose a threat to caribou.

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, oil and gas exploration and pipelines 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).

Spread of disease and parasites from and to cattle is also a threat to woodland caribou from agricultural operations (Neiland et al. 1968, Trainer 1973, Wobeser 1976, Sifton 2001), and is discussed in section 3.5 (Parasites and Disease).

There is very little agricultural activity in or near the range of the Spatsizi caribou subpopulation.

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 37, the Stewart-Cassiar or Dease Lake Highway, runs just beyond the western edge of the Spatsizi caribou subpopulation range. From 1988 to 2007, 19 caribou were killed on highways in BC Highway District 10 (Bulkley-Stikine). This is a vast area, and certainly not all of these animals were killed along Highway 37. Nevertheless, 560 animals were killed on this highway during this period, by far the most of any highway in the region. Moose are the most common animal struck on this district's highways and there is little suggestion that highway mortality is a significant threat to the Spatsizi caribou subpopulation.

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 (Oberg 2001, 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).

In 2013–14, BC Hydro constructed a transmission line to the Red Chris mine, which lies along the southwestern boundary of the Spatsizi caribou subpopulation range. The new power supply is likely to increase the feasibility of potential projects in and adjacent to caribou ranges in northwestern BC (BC Hydro 2013, COSEWIC 2014).

3.3.3.4 Hunting

The Spatsizi caribou subpopulation range overlaps with two wildlife management regions (Skeena and Omineca) and six wildlife management units (WMUs; 6-18, 19, 20, 7-39, 40, 62). Hunting, including for caribou, is permitted within the protected areas that overlap the Spatsizi caribou subpopulation (Skeena Region Environmental Stewardship Division 2003). This policy has been criticized because what enables it is not matched by the research and monitoring required to manage it (Scudder and Sinclair 1976, Pearse 1983). WMUs 6-19 and 6-20, which make up the vast majority of the Spatsizi caribou subpopulation range, have had 1627 recorded caribou kills from 1976 to 2015 (approximately 42 animals per year on average). Depending upon what its current size is, this could threaten the Spatsizi caribou subpopulation.

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.

Given that there is hunting for many ungulate species in the Spatsizi caribou subpopulation range it is likely that poaching, or at least accidental caribou kills, occur there. However limited motorized access to the area should make this an unusual event and unlikely to affect population trends.

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).

There have only been 22 fires recorded in the Spatsizi caribou subpopulation range since 1958 totaling 553.5 km^2 (3.5% of the total area). This is a relatively small area. The very mountainous terrain in this area leads to few opportunities for ignitions and limited fire spread, perhaps accounting for this small area burned. This could nevertheless affect caribou as it will be concentrated in connecting, lowland habitats.

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 tenius*) 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 Spatsizi 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). 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) and available food (Parker et al. 2009).

Climate change models for British Columbia suggest that areas in the BC interior will experience increased winter snow loads (Dawson et al. 2008, Griesbauer and Green 2010) that could affect food access and mobility for animals. 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) 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 is no herd-specific research on climate change effects on the Spatsizi caribou subpopulation.

3.7 Small Population Size Effects

Small population effects include several threats to caribou that are unique to small (approximately less that 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 Spatsizi caribou subpopulation is relatively large, and although its status is officially unknown, it is unlikely that it has declined to a density that would result in a genetic bottleneck.

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 are particularly susceptible to genetic isolation (Laikre et al. 1997, Serrouya et al. 2012, Weckworth et al. 2012).

Serrouya et al. (2012) found that physical movement and dispersal barriers were a greater indicator of genetic partitioning of caribou populations in western Canada than snow depth, seasonal migratory patterns or feeding

habits. The Spatsizi caribou subpopulation is relatively unusual in British Columbia in living in predominantly functional habitats and in close proximity to other subpopulations with which genetic exchange is possible. Changes in resource use, linear disturbance density or road construction will add movement barriers and genetic isolation, but their current density is unlikely to threaten this caribou subpopulation.

4 MANAGEMENT HISTORY

4.1 HABITAT

Habitat management in this area is overseen by the provincial government and implemented by the forestry industry through application of their AAC (see above). Active restoration takes place in the form of cutblock replanting that accelerates seedling establishment (Cichowski 1989, Cichowski 1996). For their part, forestry regulations prescribe practices to manage resource use and protect forests that are caribou habitat (Seip 1998).

The Red Chris mine along the Spatsizi caribou subpopulation's western boundary will have to be restored once it is inactive. It covers a 231.42 km^2 area.

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 Spatsizi caribou subpopulation enjoys almost complete habitat protection within its range. The combination of provincial park, ecological reserve, active and proposed ungulate winter range and wildlife habitat areas cover 80 to 90% of this subpopulation's range. The prohibitions offered by these protected areas do not extend to hunting but do prevent or restrict forestry, mining and oil-and-gas development.

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. 2016, 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.

There are no enhancement or restoration activities in the range of the Spatsizi caribou subpopulation.

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 very few access roads for recreational use in the Spatsizi caribou subpopulation range. There are only 610 km of resource roads in the range amounting to 0.04 km / km^2 which is very low (Pigeon et al. 2016, Bennett 2017). There are no access controls on the roads that are found outside of the protected areas. Within the protected areas, management plans dictate season and mode of access (Skeena Region Environmental Stewardship Division 2003).

4.2.1 SNOWMOBILE

Snowmobile use in the protected areas that overlap most of the Spatsizi caribou subpopulation range is tightly managed (Skeena Region Environmental Stewardship Division 2003). Access is permitted for first nations, hunters and authorized guide-outfitters.

4.2.2 HELI-SKI / CAT-SKI

There are no heli-ski or cat-ski operations in the Spatsizi caribou subpopulation range. See section 3.3.2.2 for general threat information.

4.2.3 OTHER

Specific management actions to regulate or limit other recreational activities such as backcountry skiing or summer OHV use exist within the Management Plan for Stikine Country Protected Areas (Skeena Region Environmental Stewardship Division 2003).

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 (Dzus 2001). 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).

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 9–10/1000km^2 but increased at wolf densities from 1–4/1000km^2 (Bergerud and Elliot 1986). For this reason, target wolf densities that would enable caribou recovery are set to 6.5/1000km^2. 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 control was conducted in the area of the Spatsizi caribou subpopulation since the 1920's with definite reduction in the wolf population (Spalding 2000). Current park management policy prohibits predator control (Pearse 1983), and there is no wolf control currently being conducted by the BC Government.

4.3.2 COUGAR MANAGEMENT

Cougars are absent or very rare in the Spatsizi caribou subpopulation range, but they may be present (Goodchild et al. 1980, 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 northern British Columbia, there are only rare reports of cougar predation on caribou, and there is no need for cougar management to support the Spatsizi caribou subpopulation.

4.3.3 OTHER

Grizzly bears, black bears and wolverines are also woodland caribou predators (Seip 1992, Wittmer et al. 2005a). 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.

Grizzly bears are abundant in the range of the Spatsizi caribou subpopulation, with an estimated 90 to 100 animals in Spatsizi Plateau Wilderness Provincial Park. Long term grizzly bear monitoring has placed its population across the Spatsizi Grizzly Bear Population Unit at 540 in 2004 and 2008, 666 in 2012 (Hamilton et al. 2004, Hamilton 2008, Ministry of Forests, Lands and Natural Resource Operations 2012).

Grizzly bears have been managed in this area by means of an annual hunt. Resident and guided, non-resident hunters killed 425 grizzlies from 1976 to 2015 in the Skeena WMUs overlapping with the Spatsizi caribou subpopulation; an average of almost 11 animals per year. The Gladys Lake Ecological Reserve prohibits grizzly bear hunting (Ministry of Forests, Lands and Natural Resource Operations 2012). However, in 2017, the BC government ended grizzly bear hunting throughout the province (Bellringer 2017, McLellan et al. 2017). All else being equal, this will presumably lead to an increase in the grizzly bear population in the area, there is no plan to manage them with respect to caribou protection. Rates of grizzly bear predation on caribou in the Spatsizi are unknown.

Black bears are less frequent caribou predators, and they are present in the Spatsizi caribou subpopulation range. But their population size is not precisely known. It was estimated at 100 animals in 1982 (cited in Benn et al. 1986). Resident and non-resident hunters have killed 269 black bears from 1976 to 2015; approximately 7 per year. Ballard (1994) predicted that black bear predation on caribou in the Spatsizi area would be secondary to wolf predation on caribou.

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, but the decline of the second prey species is 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.

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, Serrouya et al. 2017). 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.

There were few comprehensive moose surveys prior to 1980 in the Spatsizi area (Spalding 1980 cited in Pearse 1983). In 1983 there was an estimate of 1000–1300 moose in the Spatsizi Plateau Provincial Park (Pearse 1983). In 1980, Hatler (1993) surveyed three habitat types (low, medium and high quality) and found an estimate of 1912 (range = 1520–2305) moose. This puts moose density between 0.37 and1.31/km^2, below maximum carrying capacity of 2 (Moose Management Technical Team 2015), but above what Serrouya et al. (2017) found to permit caribou recovery in the Revelstoke area of British Columbia. A 2016 estimate of moose populations across British Columbia found them to be stable in Region 6 (Skeena; Kuzyk 2016). Beyond hunting regulation, there is no moose management in this area designed to benefit caribou populations.

4.4.2 DEER MANAGEMENT

Managing deer populations in support of caribou conservation is a challenge. Both mule and white-tailed 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 occur at low densities (white tailed deer are absent and black tailed deer are rare) in the range of the Spatsizi caribou subpopulation. Hunting records between 1976 and 2015 revealed only five mule deer killed during 1987. There is no deer management in this area.

4.4.3 OTHER

Elk, like moose and deer, are wolf prey and could potentially facilitate apparent competition with caribou (DeCesare et al. 2010b).

Elk are very rare in the Spatsizi caribou subpopulation range, are not hunted and not managed in this area.

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 added to. 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.

With the relatively large and stable Spatsizi caribou population is not necessary to consider maternity penning to support the herd at this time.

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 a *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 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 such an effort (Dolman et al. 2015, Hayek et al. 2016).

Captive breeding to reinforce the Spatsizi caribou subpopulation is not being planned, particularly given its size and status. Given that this subpopulation is relatively large it may be considered as a source population for captive breeding programs to reinforce other herds.

4.5.3 TRANSLOCATION

Translocation is the reinforcement of small populations by moving animals 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 and British Columbia (Compton et al. 1995, Stronen et al. 2007, Hayek et al. 2016).

The current size and status of the Spatsizi caribou subpopulation makes is a stronger candidate as a donor for caribou translocation than as a recipient. Williams and Marshall (2010) conducted a survey of Spatsizi Provincial Park caribou, in part, to determine whether it would meet the criteria for a donor population for translocation. In this case, the Level Kawdy subpopulation was deemed to be the better donor herd.

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, and it is 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 Spatsizi 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.

Stewardship for the Spatsizi caribou subpopulation should be integrated with that from its neighbouring, northern caribou subpopulations. Its remote location, limited access and no large, nearby communities would make it difficult to engage the public with a standalone stewardship and outreach program. The objective should be to improve public awareness of woodland caribou in northern British Columbia (Racey and Armstrong 1996).

Links among provincial parks, ecological areas, and other regional protected areas create opportunities for outreach for the Spatsizi caribou. Messages around the importance of habitat protection, impacts of recreation and predator effects can be effectively illustrated to visitors of these sites. The benefits to caribou and people of habitat stewardship plus opportunities for citizens to participate in surveys (e.g. scat and hair collection) and for outreach based on tracking, observing and photographing caribou exist in this relatively remote part of British Columbia.

The history and conservation of northern caribou is a compelling and informative outreach story that can contribute to stewardship and recovery. This group is critical for the persistence of woodland caribou in British Columbia, both in their current status as more abundant than other groups in the province, and for their potential as source populations for reinforcement efforts. Stewardship and outreach contribute to both their protection and acceptance of their use as a conservation tool that benefits other subpopulations.

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 our management.

Much of the research conducted on the Spatsizi caribou subpopulation was conducted in the wake of the creation of Spatsizi Plateau (wilderness) Provincial Park and surrounding protected areas in an attempt to guide policy (Pearse 1983, Boonstra and Sinclair 1984, Jones 1984, Benn et al. 1986). Since then, little has been done.

Research needs include a study of mortality sources for caribou, grizzly bear population response to hunting prohibition, relationship between moose and caribou density and distribution, habitat effects of climate change and wolf population dynamics.

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.

A sustainable pattern of caribou, alternative prey and predator population monitoring in the range of the Spatsizi caribou subpopulation is needed. Management decisions to effectively protect this herd need information to be effective and credible. The use of DNA mark/recapture technology simplifies and expedites population monitoring (Poole et al. 2001, Hettinga et al. 2012).

5 IMPLICATIONS TO OTHER WILDLIFE

Changing population trends of woodland caribou will require manipulating the environment in ways that favour caribou ecology and life history at the expense of other wildlife. More old growth forest will benefit caribou but not moose or 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. None of these management actions can or will imperil other wildlife species but will precipitate changes to their population density and/or distribution.

Despite no significant changes to the habitat in the Spatsizi caribou subpopulation range, this population may have declined from a high in the late 1970s and mid 1990s. What we know about the causes of caribou decline implicate by elimination, increased predation, likely by wolves and likely mediated by the presence of moose in this ecosystem. This suggests that moose, and wolf populations may have to be managed to lower densities to allow caribou to recover.

There are many formal protections for wildlife habitat in this region with provincial park, ecological reserve, wildlife habitat area and UWR no harvest protections. Hunting is still permitted in most places.

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 and backcountry skiing, commercial resource extraction activities such as forestry, mining and oil and gas development as well as non-commercial resource uses such as 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).

Hunting is still permitted in most protected areas that overlap with the Spatsizi caribou subpopulation. Hence, the tools are in place to precisely regulate hunting harvest with the appropriate wildlife population status and trend monitoring tools. How these tools are used to protect caribou in this area may affect values such as hunting, trapping, recreational access and tourism.

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 Spatsizi subpopulation range, organizations that have a clear interest in how this area is managed and businesses that have a commercial interest in the area (McNay 2012). This may not be a complete list, particularly of distant organization with an inherent interest.

Communities: **First Nations**: Tse Keh Nay (Tsay Keh Dene, Takla Lake First Nations, Kwadacha) Iskut First Nation, Tahltan Central Council, Kwadacha Nation.

Local: Dease Lake

Regional: Fort Nelson, Smithers

Organizations: **Recreation**: British Columbia Snowmobile Federation, Klondike Snowmobile Association, Land Conservancy of British Columbia, Outdoor Recreation Council of British Columbia

Protection: Kaska Tribal Council, Kaska Dena Council

Commercial: **Hunting and Trapping**: **Accommodation and Guiding**: Lonesome Mountain Outfitters, Collingwood Bros. Guides & Outfitters

Forestry *(Active licences to cut)*: Imperial Metals Corporation (Red Chris Mine), Red Chris Development Company Ltd.

Forestry *(Woodlots)*: none

Agriculture: none

8 RECOMMENDED ACTIONS

8.1 SHORT TERM (WITHIN 6–12 MONTHS)

Complete report detailing population size, trend and status of the Spatsizi caribou subpopulation.

8.2 MEDIUM TERM (WITHIN 12–24 MONTHS)

Plan and begin study of caribou predation in the Spatsizi caribou subpopulation focusing on wolves and grizzly bears, particularly in the wake of the grizzly bear hunting ban.

8.3 LONG TERM (WITHIN 24–48 MONTHS)

Plan habitat assessment using remote sensing and GIS tools.

Plan long-term monitoring of caribou, moose and deer population using DNA mark-recapture methods.

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