

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

Swan Lake Subpopulation

Northern Mountain Caribou



BRITISH
COLUMBIA

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EXECUTIVE SUMMARY

DRAFT

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1 BACKGROUND

1.1 INTRODUCTION TO THE PROGRAM

The Swan Lake 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 (NMNEA). These herds are listed as *Special Concern* 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; http://www.sararegistry.gc.ca/species/schedules_e.cfm?id=1). They are blue-listed in British Columbia (BC Conservation Data Centre 2018) 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 Swan Lake subpopulation is blue-listed in BC, and current monitoring is uncertain, but includes the possibility that they are declining.

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 Swan Lake 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).

2.1 DISTRIBUTION

The Swan Lake subpopulation range's western boundary runs along the east side of Teslin Lake south to the Jennings River area. It follows the Jennings river watershed east and heading north past the east side of Jennings Lake. From there it goes north to the west of Tootsee Lake and up into the Yukon Territory. Only a small portion of this herd's range is in the Yukon (Figure 1) and it appears to be separate from the nearby Wolf Lake herd (McNay 2011). This subpopulation was previously known as the Jennings caribou herd.

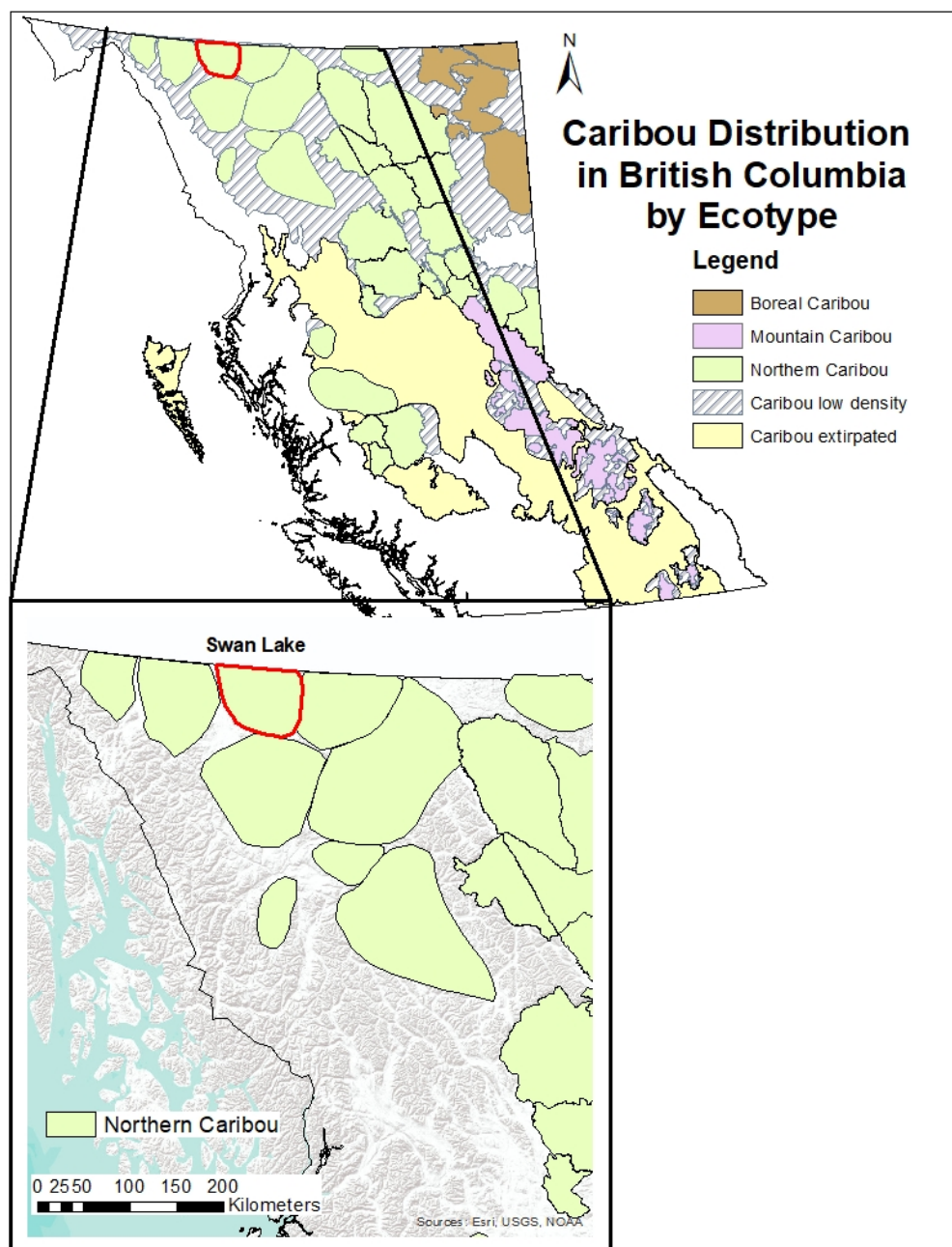
The most recent population estimate for the Swan Lake subpopulation is 400 individuals, last censused in 2005, with subsequent expert assessments at slightly higher population sizes (Figure 2) and the population trend is currently unknown (Environment Canada 2012a). Information on ecology and habitat use specific to Swan Lake caribou is limited. Available information indicates that seasonal movements of Swan Lake 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).

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

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- 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.

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).



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Figure 1: The location of the Swan Lake subpopulation of woodland caribou. The approximately 5516 km² range (inset: red outline) is within the Skeena Region. This subpopulation also ranges partially into the Yukon Territory.

2.2 HABITAT AND BEHAVIOUR

Caribou in the Swan Lake subpopulation spend most of the year in low-elevation, spruce-willow-birch (SWB) habitats that have abundant terrestrial lichen (McNay 2011). High elevation boreal alтай fescue alpine (BAFA) habitat are occupied during the fall rut and spring calving. Boreal white and black spruce (BWBS) habitat is occupied during the summer together with SWB areas (McNay 2011).

2.3 POPULATION SIZE AND TREND

There have been few population counts of the Swan Lake caribou subpopulation, and no systematic population estimates that account for sightability (Figure 2). Population size reported for the 1970's is given at 200 animals (Figure 2) but is a 'guess' based on local knowledge.

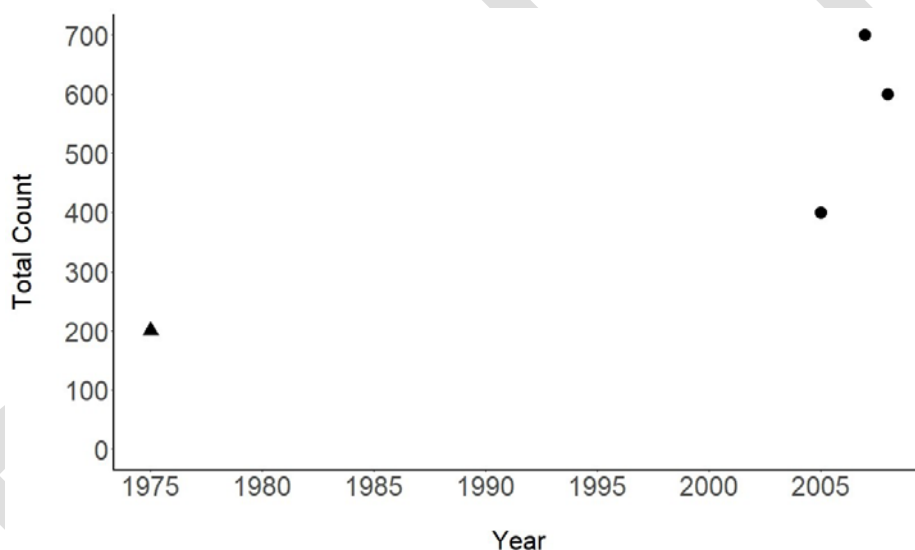


Figure 2: Caribou counts (filled dots) and estimate (triangle) for the Swan Lake sub-population. Counts were reported in Environment Canada (2012a), COSEWIC (2014) and Kinley (2009). The 1970's estimate was reported by (COSEWIC 2002) as a best guess by Government of British Columbia staff.

Caribou recruitment is unknown in the Swan Lake caribou subpopulation.

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. Recently, the federal recovery strategy identifies 3 wolves/1000 km² as a target wolf density in matrix habitat to support recovery (Environment Canada 2014).

There is no herd specific information on predation for the Swan Lake 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 food (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).

The Swan Lake caribou subpopulation prefer winter habitats that have abundant terrestrial lichens. This suggests two things. Herbivores that aggregate seasonally in food rich environments may do so because of food stress. However, these habitats are also the most abundant vegetation types in their range so their occupancy of this area

does not imply strong selection. As well, it informs governments that special management of this habitat type will be critical for subpopulation persistence and avoiding food limitation as a primary threat.

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.

There are no forestry cutblocks in the range of the Swan Lake caribou subpopulation.

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).

There are 62 mapped gravel pits along Highway 97 in the range of the Swan Lake caribou subpopulation. All are small with minimal additive impact on caribou.

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

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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 exploration or development in the Swan Lake caribou subpopulation area.

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 Swan Lake caribou subpopulation range.

3.3.1.5 OTHER

There are no other major projects or developments planned for the Swan Lake 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 delayed in time.

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, Freeman 2008). 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).

The Northern Mountain Caribou management plan (Environment Canada 2012a) states that the Swan Lake caribou subpopulation is exposed to recreational snowmobiling. There is some snowmobile access to the area (Peepre 2009), and uncontrolled access roads particularly originating on the Alaska Highway (BC Hwy 97). Snowmobiling on Teslin Lake, that runs along the western edge of the Swan Lake caribou range, is popular and provides inland access.

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 largely 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.

There are no heli-ski or cat-ski tenures in the Swan Lake caribou subpopulation range. Last Frontier Heliskiing operates in the vicinity of the Swan Lake caribou subpopulation. They are accredited HCC members but do not report wildlife sightings. Atlin Heli Sports and Yukon Alpine Heliski also operate in northern British Columbia, but their runs are to the west of the Swan Lake caribou subpopulation 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).

Ski touring does not appear to be a popular activity in this area with the closest mapped routes occurring in White Pass well to the northwest of the Swan Lake caribou subpopulation range. The Jennings river is renown for summer canoeing, but its remote location ensures light use (Peepre 2009).

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 no significant agriculture in the Swan Lake caribou subpopulation range.

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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).

The Alaska Highway (Hwy 97 in British Columbia) traverses the northern edge of the BC range of the Swan Lake caribou subpopulation range for approximately 63 km. Management plans indicate that vehicle collisions along the Alaska Highway may affect wintering caribou (Environment Canada 2012a).

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).

Except for the Alaska Highway, there are no linear corridors (electrical transmission corridors, pipelines, seismic lines) in the range area of the Swan Lake caribou subpopulation area.

3.3.3.4 HUNTING

The Swan Lake caribou subpopulation lies entirely within Wildlife Management Unit (WMU) 6-25 in the Skeena region. Caribou hunting by permit is allowed, as does hunting for moose, sheep, goats, wolves and bears. Between 1976 and 2015, 1435 caribou were killed in this WMU, not all from the Swan Lake subpopulation (average ~ 37 / year). This WMU also includes the Atlin and Level Kawdy caribou subpopulations. Without an accurate and up-to-date caribou census in the area, it is difficult to know the hunting impact.

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) to result in population declines.

There are no records of charges issued for hunting caribou out of season in the Skeena region from 2006 through 2018.

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 are no MPB infested forests in the range of the Swan Lake caribou subpopulation.

There have been approximately 495 km² of burned forests in the Swan Lake caribou range area (9%). Most of this area (300 km²) burned in 2004 and all but about 13 km² has burned since 1958 (60 years from the time of writing). Thus, although the amount of burned forest in the Swan Lake caribou range is small, it is relatively young and thus can affect caribou habitat selection (Robinson et al. 2010, Robinson et al. 2012).

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 Swan Lake 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 Interior Mountains may experience increased, or at least uncertain, winter snow loads (Dawson et al. 2008, Griesbauer and Green 2010, Bennett et al. 2012) that could affect food access and mobility for animals. Although shifts in tree species distributions have been predicted for the Cassiar Mountains (Hamann and Wang 2006). Climate 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, Kittel et al. 2011). 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 has been no herd specific research on climate change effects on the Swan Lake 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).

Although there is low confidence in the current or historical Swan Lake caribou subpopulation size, it is unlikely that it has declined sufficiently to undergo a genetic bottleneck (Figure 2). More research and monitoring, including genetic sampling, is required to confirm this assertion.

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, Weckworth et al. 2012).

The Swan Lake caribou subpopulation intermingles with the Atlin and Little Rancheria subpopulations in British Columbia, the Wolf Lake herd in the Yukon, and, to some extent the Level Kawdy subpopulation to the south. With opportunities for genetic exchange with other northern caribou subpopulations, phenomena such as drift and isolation that affect small populations are less likely (Weckworth et al. 2012). This is contingent on habitat connectivity among these groups being sustained.

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 allowable annual cut. 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 absence of large-scale forestry or mining in the Swan Lake caribou subpopulation range means that there has also been no habitat management.

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.

There is no explicit caribou protection in Swan Lake subpopulation range. There are no provincial or national parks, and no special protection wildlife habitat areas. Slightly less than half of the range however is protected for Dall's (Thinhorn) Sheep (*Ovis dalli*) all at high elevation by ungulate winter range (UWR; u-6-041) designation. The protection constrains forestry (of which there is none in the area) and thus also protects caribou habitat.

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 known enhancement or restoration activities taking place in the Swan Lake caribou subpopulation range.

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).

Because there is no forestry in the range area of the Swan Lake caribou subpopulation, there are also no special access, or forestry roads in this area.

4.2.1 SNOWMOBILE

There are no snowmobile access restrictions in the Swan Lake caribou subpopulation range. See section 3.3.2.1 for general threat information.

4.2.2 HELI-SKI / CAT-SKI

The Mountain Caribou Recovery Implementation Plan, established to manage woodland caribou in southern British Columbia, has developed a partnership with HeliCat Canada (HCC) to establish a wildlife reporting mechanism and operational practices for commercial helicopter and cat skiing in caribou habitat. While this does not automatically extend to northern mountain caribou, the practices adopted in southern British Columbia are reasonable protection measures for all wildlife, including caribou.

There are, as yet, no helicopter or cat ski operations in the Swan Lake caribou subpopulation range, and so management is unnecessary. See section 3.3.2.2 for general threat information.

4.2.3 OTHER

There are no specific management actions to regulate or limit other recreational activities such as backcountry skiing or summer OHV use. Within the Yukon range of northern caribou subpopulations, use of off-road vehicles, trail designations and seasonal restrictions on trail use have been recommended (Francis and Nishi 2015).

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). Finally, a shift in forest structure towards younger age classes has favoured moose, deer and elk at densities that can support greater predator densities (Peters et al. 2013). 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 occurs 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 9–10/1000 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. The federal recovery strategy has established that critical habitat for southern mountain caribou includes matrix habitat that has fewer than 3 wolves/km² (Environment Canada 2014). 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.

Focussed wolf management on the British Columbia range of the Swan Lake caribou subpopulation has not occurred (Environment Canada 2012a). Between 1976 and 2015, 486 wolves were killed by resident and non-resident hunters and 205 wolves killed by trappers in WMU 6-25 (between 1983 and 2012). There has been no systematic census of the wolf population in this area to know if they are above or below threshold density.

Intensive wolf management has occurred in the Yukon 200 km north of the Swan Lake caribou subpopulation northern boundary. In the Finlayson Lake area wolves were reduced during the 1980s and 90s, but rebounded to pre-control densities shortly after control ended (Hayes and Harestad 2000).

4.3.2 COUGAR MANAGEMENT

Cougars are very rare and possibly absent in the Swan Lake caribou subpopulation range (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 do not require management.

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 Swan Lake caribou subpopulation, although there is no specific density estimate. It falls within the Cassiar Grizzly Bear Population Unit that has, in total, an estimated 612 grizzly bears and an estimated density of 10–20 grizzly bears /1000 km² (Ministry of Forests, Lands and Natural Resource Operations 2012). Extrapolating this estimate suggests there are 55 to 110 grizzly bears in the Swan Lake caribou subpopulation range.

Grizzly bears have been managed in this area only by means of an annual hunt. Resident and guided, non-resident hunters killed 211 grizzlies from 1976 to 2015 in WMU 6-25; an average of about 5 animals per year. 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 Swan Lake are unknown.

Black bears are less frequent caribou predators, and they are present in the Swan Lake caribou subpopulation range. Their population size is also not precisely known. Resident and non-resident hunters have killed 243 black bears from 1976 to 2015; approximately 6 per year.

4.4 PRIMARY PREY

Caribou, 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 increase 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 ability to achieve this separation. 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.

In a 1988 survey of moose just south of the Swan Lake caribou subpopulation range, Marshall (1988) estimated 0.45 moose/km² across a 5000 km² survey area. About a decade later, a survey covering the Liard Plains / Blue River region, just east of Swan Lake estimated 0.35 moose / km² (Marshall 1997) and a survey of the Teslin area that included the Swan Lake area in 2000 found an average moose density of approximately 0.4 moose/km² (Marshall 2000). A decade after that, a survey in Atlin estimated 0.182 moose / km², albeit over a much smaller area (Heinemeyer 2007). Serrouya et al. (2017) reported that a moose density decline from 1.58 to 0.44 / km² led to increasing caribou adult survival. Although there is no explicit moose management in this area, surveys seem to suggest that moose densities are declining. This needs to be confirmed with a follow-up on the 2007 survey.

There is no targeted moose management in the Swan Lake caribou subpopulation area beyond that achieved through hunting regulations and bag limits. Approximately 125 moose are hunted from WMU 6-25 annually.

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 (mule and white-tailed) are rare or absent from the Swan Lake caribou subpopulation range and are not managed.

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 present in the Swan Lake caribou subpopulation range, and there was an elk hunt during the 1980's. But they are rare and not managed.

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.

Until more information on calf recruitment in the Swan Lake caribou subpopulation is gathered, it is unclear whether it is a candidate herd for maternity penning. As well, this reinforcement approach tends to favour very small populations more than large or even moderate sized caribou populations like found at Swan Lake.

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 Swan Lake caribou subpopulation is not being planned.

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 of the Swan Lake caribou subpopulation makes it a stronger candidate as a donor for caribou translocation than as a recipient, but there are no plans for this subpopulation to participate in translocation.

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 Level Kawdy 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.

The Swan Lake caribou subpopulation range crosses the British Columbia - Yukon boundary. Although the Wolf Lake herd range in Yukon is separate (Farnell et al. 1996), there are few movement barriers and these groups likely intermingle. Their shared ecology and management makes the Swan Lake and Wolf Lake caribou subpopulations both a stewardship challenge and opportunity. Interjurisdictional differences in human population distribution, wildlife management methods, stakeholder relations and management approaches create challenges for creating consistent outreach and building successful partners and stewards for this herd. That this herd crosses the frontier between British Columbia and Yukon, inhabits lands close to Whitehorse, the largest urban area in the region, creates significant opportunities by linking the handful of cross-boundary herds in communications and stewardship actions.

There are significant opportunities for stewardship for the Swan Lake caribou subpopulation. There is a thousands year long relationship between the people that inhabit this region that includes subsistence hunting for caribou (King and Carlick 1997). Thousands of tourist vehicles pass through this region along the Alaska and Stewart-Cassiar Highways creating opportunities for broad outreach as well as local stewardship for personal interpretation (e.g. caribou ambassadors <http://ecologynorth.ca/caribou-ambassador-2/>). Effective outreach and stewardship is a necessary step in this process so that local people understand the process and their contribution to broader conservation.

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.

There has been very little research on the Swan Lake caribou subpopulation. Key information pieces on habitat use, sources of mortality and effects of developments and disturbance would contribute to its effective management.

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 Swan Lake caribou subpopulation has been the subject of recent, three-year study to determine herd size, survival, and distribution relative to nearby herds (Environment Canada 2012a). The results of this study have yet to be released. Monitoring needs include herd size and trend, and ongoing estimates of the moose population, resource use and human effects on the landscape.

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.

Actions taken to protect and manage Swan Lake caribou and their habitat may benefit or inhibit the protection of other species and their habitats (British Columbia Ministry of Environment 2013). If predator management is called for, it will directly affect wolves, whose populations would be intentionally reduced. Other ungulate species like moose, whose densities may also have to be lowered to facilitate caribou conservation, may also be affected to protect this caribou subpopulation.

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).

There are few commercial activities in the range of the Swan Lake caribou subpopulation. Currently, commercial logging operations in the area are compelled to avoid UWR that has been established over much of the high elevation terrain to protect Dall's sheep. Expansion of UWR to new areas, if proposed, would further impede potential operators.

Recreational snowmobiling is also a reasonably popular activity, overlapping to some extent with moose hunting. Again, careful management of recreational snowmobiling that considers elements of caribou recovery will be required to enable coexistence (Grant 2017).

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

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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 the Swan Lake 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:** Teslin Tlingit Council, Kaska Dena, Tahltan, Dease River Band Council

Local: Morley River, Teslin, Dease Lake, Lower Post, Upper Liard, Jade City

Regional: Atlin, Watson Lake, Whitehorse

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

Protection: Teslin Renewable Resources Council, Kaska Tribal Council, Kaska Dena Council, Yukon Fish and Wildlife Management Board, Southern Lakes Wildlife Coordinating Committee

Commercial: **Hunting and Trapping: Accommodation and Guiding:**

Forestry (*Active licences to cut*): Douglas Martens,

Forestry (*Woodlots*): none

Agriculture: none

8 RECOMMENDED ACTIONS

8.1 SHORT TERM (WITHIN 6–12 MONTHS)

- Complete the report from data collected during 2005 to 2008 to update the subpopulation status.
- Update the moose population estimate for the Swan Lake caribou subpopulation range.
- Plan a follow-up survey to estimate current population size and recruitment (consider DNA mark-recapture).

8.2 MEDIUM TERM (WITHIN 12–24 MONTHS)

- Plan a satellite collar study to determine extent of movement and habitat use of the Swan Lake caribou subpopulation.

8.3 LONG TERM (WITHIN 24–48 MONTHS)

- Develop wildlife habitat areas to protect key caribou range for the Swan Lake caribou subpopulation.

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