

## 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

## Atlin

### Subpopulation

Northern Mountain Caribou



BRITISH  
COLUMBIA

**Recommended Citation:**

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## EXECUTIVE SUMMARY

DRAFT

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## 1 BACKGROUND

### 1.1 INTRODUCTION TO THE PROGRAM

The Atlin caribou 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) and appear on Schedule 1 of the Federal Species at Risk Act (SARA; [http://www.sararegistry.gc.ca/species/schedules\\_e.cfm?id=1](http://www.sararegistry.gc.ca/species/schedules_e.cfm?id=1)). They are blue-listed in British Columbia and are included in the Provincial Identified Wildlife Management Strategy (IWMS; British Columbia Ministry of Water, Land and Air Protection 2004, Skeena Region 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 Atlin subpopulation is blue-listed in BC, and current monitoring indicates that they are declining (Grant 2017, BC Conservation Data Centre 2018).

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 Atlin 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 Atlin subpopulation range area is fairly small, roughly 6857 square kilometres, bounded by Atlin Lake on the west, the Nakina River to the south, and Teslin Lake to the east (Figure 1; [http://www.env.gov.bc.ca/wld/speciesconservation/caribou\\_by\\_ecotype.html#\\_](http://www.env.gov.bc.ca/wld/speciesconservation/caribou_by_ecotype.html#_)).

The most recent population estimate for the Atlin subpopulation is 442 individuals, last censused in 2015. It was previously censused in 2007 with an estimated population of 800 (BC Ministry of Environment, 2010). The population trend is currently declining (Grant 2017).

Information on ecology and habitat use specific to Atlin caribou is limited. Available information indicates that seasonal movements of Atlin 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).

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

## Woodland Caribou Plan for the Atlin Subpopulation

- 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).
- Sub-boreal Spruce (SBS) zone is the montane zone dominating the landscape of the central interior of British Columbia. The SBS is found over a wide latitudinal range, from 51°30' to 59° N latitude. The zone generally occurs from the valley bottoms to 1100-1300 m elevation. Upland coniferous forests dominate the sub-boreal landscape. Hybrid white spruce (*Picea engelmannii* x *glauca*) and subalpine fir are the dominant climax tree species. Lodgepole pine, a seral species in the SBS, is common in mature forests in the drier parts of the zone and both lodgepole pine and trembling aspen pioneer the extensive seral stands. Paper birch is another pioneer tree, often on moist, rich sites. Douglas-fir is usually a long-lived seral species in the SBS, occurring abundantly on dry, warm, rich sites and as a consistent, although small, component of many mesic forests, especially in the southeastern part of the zone. Black spruce also occurs occasionally in climax upland forest.



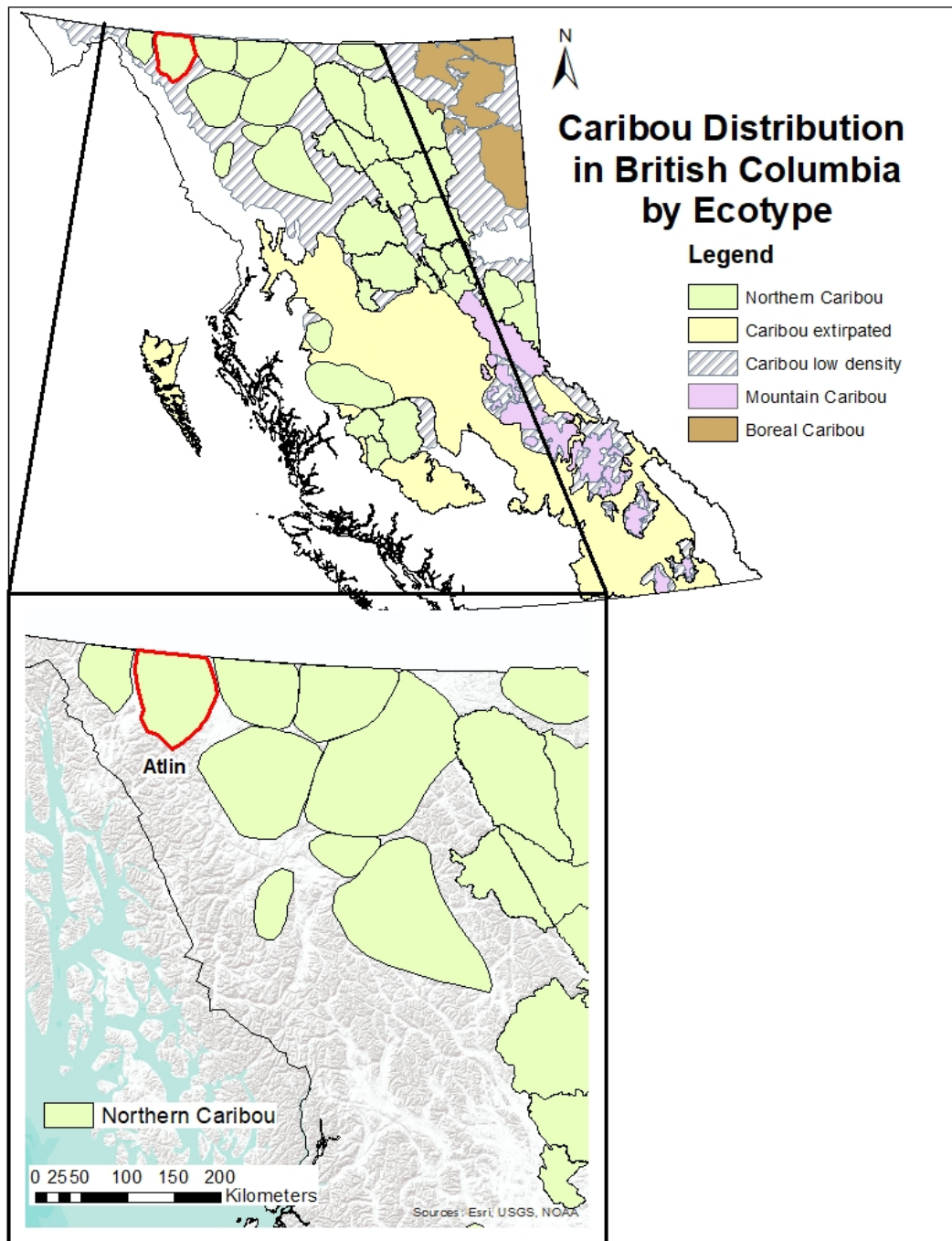


Figure 1: The location of the Atlin subpopulation of woodland caribou. The 6857 km<sup>2</sup> range (inset: red outline) is within the Skeena Region.

## 2.2 HABITAT AND BEHAVIOUR

In the spring, pregnant female Atlin caribou move and segregate in high-elevation, alpine habitats (Boral Altai Fescue Alpine; BAFA) to calve, whereas other caribou tend to be found at low elevations (Boreal White and

Black Spruce; BWBS) also lodgepole pine habitats where grass and willow have emerged from the snow (Polfus et al. 2010, McNay 2011). As summer proceeds, the entire subpopulation moves to the high elevation habitats, where they remain through the fall rut (Polfus et al. 2010). As snow accumulates in the mountains in the winter, caribou move to lowland forests, BWBS and Spruce Willow Birch (SWB) in search of terrestrial lichen under shallower snow (Polfus et al. 2010, McNay 2011).

### 2.3 POPULATION SIZE AND TREND

Although the Atlin caribou subpopulation has declined from its measured high of over 700 animals to approximately 400 animals (Figure 2), it may have stabilized at this lower abundance. This conclusion should be interpreted with caution as surveys have not been conducted with knowledge of the proportion of total herd counted (Williams and Dixon 2016).

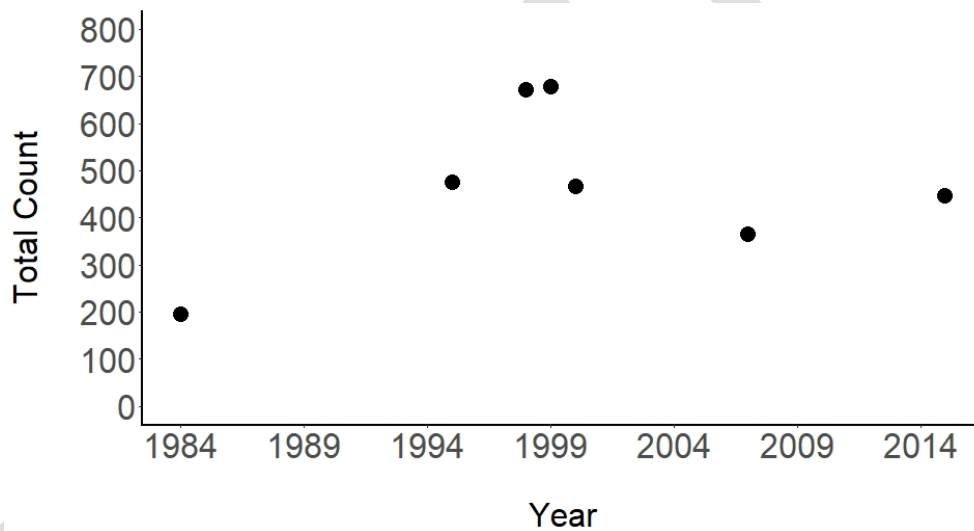


Figure 2: Caribou counts Atlin caribou subpopulation. Counts made by Government of British Columbia staff in all years (Marshall 1999, 2007, Williams and Dixon 2016).

Caribou recruitment, measured as percent of calves in the population observed during a spring census (Bergerud and Elliot 1986). Although percent of calves in the population has remained above threshold for the Atlin caribou subpopulation (Figure 3), issues with how the total population is censused suggests that recruitment may be too low to prevent a population decline. The Teslin Renewable Resources Council and BC Ministry of Environment suggest that the Atlin caribou subpopulation is declining likely due to low calf recruitment and low confidence in the 2007 population estimate (Taku River Tlingit First Nation and Province of British Columbia 2011, Environment Canada 2012a).

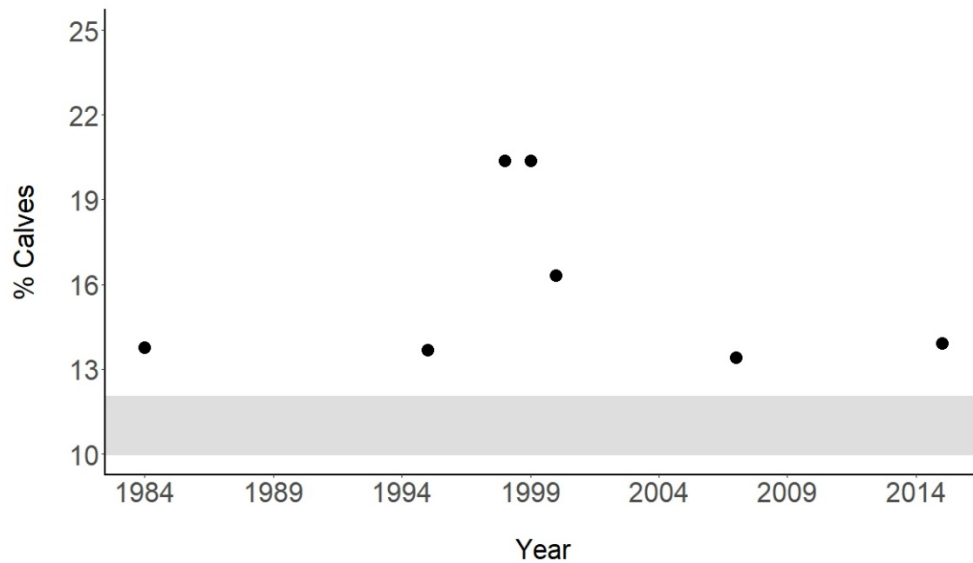


Figure 3: Caribou population recruitment measured in the Atlin caribou subpopulation range (Marshall 1999, 2007, Williams and Dixon 2016). Recruitment is defined here as the percent of the estimated population that is in the calf cohort. Recruitment lower than approximately 10 to 12% is considered below 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
8. 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 km<sup>2</sup> will result in woodland caribou declines. More recently, the federal recovery strategy identifies 3 wolves/1000 km<sup>2</sup> as a target (Environment Canada 2014).

Recent research has studied predation by wolves and bears on the Atlin caribou subpopulation (Merkle et al. 2017). Caribou are the dominant food of wolves in this area, despite being less abundant than moose, but caribou were not a large part of the bear (black and grizzly) diet. This research studied diet proportions from hair snags, so it was not able to determine predation rates *per se*.

A study of predator-prey relationships in the contiguous caribou populations in the Yukon showed that caribou populations respond positively to lower wolf numbers.

### 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).

Particularly in the winter, Atlin caribou select lichen-rich habitats and there is some local depletion of lichen abundance due to caribou grazing (Polfus and Heinemeyer 2011). However, research into factors limiting northern caribou has suggested that food does not limit population growth (Hegel et al. 2010a), and changes to lichen abundance due to caribou foraging does not appear at large spatial scales (Polfus and Heinemeyer 2011).

### 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 Atlin caribou subpopulation range is within the Cassiar TSA in which about 19% of its 25,000 km<sup>2</sup> area is considered harvestable, and 2075 km<sup>2</sup> (8.3%) is available for harvest. There has been very little forestry in the Atlin caribou subpopulation range, with only 3.2 km<sup>2</sup> of cutblocks in their 6857 km<sup>2</sup> area.

#### 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 is a legacy of many small, abandoned mine sites from the gold-rush era in the Atlin region, including their access roads and trails, and their remains high mineral potential in the area (Polfus et al. 2010).

There is a large, inactive mine in the range of the Atlin caribou subpopulation, and it has been evaluated for mining development potential impacts (Environment Canada 2012a). The Taku River Tlingit First Nation (TRTFN), in partnership with BC Ministry of Environment and others have undertaken a three-year project to improve habitat modeling, complete a cumulative effects analysis, examine pregnancy rates and evaluate predator diets during the spring and early summer months (Polfus et al. 2010). Development of an open-pit, molybdenum mine in Ruby Creek (24 km northeast of the town of Atlin, within Atlin caribou subpopulation range), owned by Adanac Molybdenum Corporation, has been suspended since 2010 (Environment Canada 2012a), although the Corporation has applied to resume operation.

Phase two of the Tulsequah Chief Mine (gold, silver, copper, lead and zinc) is about 55 kilometers southwest of the Atlin caribou subpopulation range.

### 3.3.1.3 OIL AND GAS

Oil and gas development threatens caribou populations through habitat destruction, human activity, access, habitat fragmentation and elevated predation (Dyer et al. 2001, Boutin et al. 2012, Hervieux et al. 2013). Given the spatial scope of oil and gas developments (well sites, access roads, pipelines, seismic lines) and the range of activities that take place in caribou habitat cumulative effects of this combined with other activities (e.g. forestry, hydroelectric) also play a large role in threatening resident caribou herds (Nitschke 2008). A study of the consequences to caribou of being disturbed by oil and gas exploration found that individuals in active plays can lose more than 15% of body mass over winter attributed to noise displacement (Bradshaw et al. 1998).

There is no oil and gas development in the Atlin caribou subpopulation range.

### 3.3.1.4 CLEAN ENERGY

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

There are no clean energy projects in the Atlin caribou subpopulation range.

### 3.3.1.5 OTHER

There are no other major projects or developments planned for the Atlin 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, Kinley 2008, 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 take time to emerge.

### 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, 2008). 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).



Atlin Mountain and Atlin Lake, west of the town of Atlin and just outside of the Atlin caribou subpopulation range, are popular destinations for snowmobile recreation. The Atlin Road runs along the western boundary of the Atlin caribou range and provides access to snowmobile recreation into the range. Access roads to the Ruby Creek mine around Surprise Lake and many small, abandoned mine trails also give access for recreational snowmobiling to the interior habitat of the Atlin caribou subpopulation.

### 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).

Atlin Heli Sports operates in the area, but their ski terrain is to the west of the Atlin caribou subpopulation range (within the Carcross caribou subpopulation range). <https://www.hellobc.com/atlin/things-to-do.aspx>

### 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).

Backcountry skiing is not a popular or common activity in the Atlin caribou subpopulation range.

## 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).

## Woodland Caribou Plan for the Atlin Subpopulation

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 agricultural activity in the Atlin caribou subpopulation range.

### 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 Atlin Road (Yukon Hwy 7), connecting the town of Atlin to the Alaska Highway, runs along the western edge of the Atlin caribou subpopulation range. Although road-killed caribou are rare along this stretch of road, it is not unusual along the Alaska Highway, north of British Columbia and where the Carcross and Atlin caribou subpopulations intermingle. Highway mortality is considered a risk to population growth among northern mountain caribou (DU 7; 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).

There are no linear features in the Atlin caribou subpopulation range.

### 3.3.3.4 HUNTING

A 5-point bull caribou hunt is open to a Limited Entry Hunt (LEH) from August 15 to October 15 annually (Fish and Wildlife Branch 2016). Only 19 tags are available to resident and non-resident (guided) hunters (Ministry of Forests, Lands and Natural Resource Operations 2017). In addition, there is a First Nations harvest that is assumed to be small, due to a voluntary hunting ban since 1993 (Polfus et al. 2011) as part of their contribution to the Southern Lakes Caribou Recovery Program. The number of hunting licenses has been reduced in recent years and an allowable annual harvest has been determined for the herd in cooperation with the Taku River Tlingit First Nation (Environment Canada 2012a).

Taku River Tlingit First Nation and BC jointly developed a harvest management plan for the Atlin caribou subpopulation that included data analysis and the development of a population model to project population trends given differing management scenarios (Polfus and Heinemeyer 2011, Environment Canada 2012a).



Between 1976 and 2015 in WMUs 6-25 and 6-26 (both of which include multiple caribou subpopulations) 896 caribou were killed by resident hunters and 1173 caribou were killed by non-resident hunters (total = 2069 or 53 caribou / year biased towards more kills in the earlier years).

### 3.3.3.5 POACHING

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

There are no records of poaching in the Skeena region from 2006 through 2017. Given that there is hunting for many ungulate species, including caribou, in the Atlin 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).

Wildfire is not common in the Atlin caribou subpopulation range. Since 1922, only 375 km<sup>2</sup> (5.4%) has burned, more than half of that before 1950. However, two of the largest single fires burned recently; in 2009 and 2015. There are no mountain pine beetle infested areas in the subpopulation range.

## 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 Atlin 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 British Columbia mountains 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).

A study of climate change interactions among Northern Mountain caribou, predation and food predicted that climate change can have real and negative effects on caribou populations mediated through elevated predation (Hegel et al. 2010a, Hegel et al. 2010b). There have been no herd-specific studies of climate change on the Atlin 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).

Because of their size and that they have not likely fallen below threshold densities, the risk to the Atlin caribou subpopulation due to small size and/or geographic isolation is low (Environment Canada 2012a).

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).

There may be fall overlap between the Level Kawdy and Atlin subpopulations (Environment Canada 2012a), and likely overlap with the Carcross subpopulation (Taku River Tlingit First Nation and British Columbia 2009). These subpopulation and spatial overlaps improve the genetic viability of the Atlin caribou subpopulation.

## 4 MANAGEMENT HISTORY

### 4.1 HABITAT

Although there is not a high-density of current human activity in the Atlin subpopulation range, there is a legacy of abandoned mine sites and research has shown that they select habitats to avoid the human footprint (Polfus et al. 2010). This work has shown that habitat selection varies across spatial and temporal scales; abandoned mines and cabins are only weakly avoided in winter, but strongly avoided in the summer, while active roads were avoided in positive correlation to their use (Polfus et al. 2010).

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 Taku River Tlingit First Nation and BC have planned land uses that consider caribou habitat requirements that includes strategic wildlife management planning with a focus on caribou population management (Environment Canada 2012a).

#### 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 one provincial park (Atlin/Teix'gi Aan Tlein Provincial Park) that partially overlaps with the Atlin caribou subpopulation range. In this park, Snowmobiling is permitted on Atlin Lake only, and hunting is allowed by permit. Ungulate Winter Range (UWR; u-6-041) has been proposed to constrain forest harvest and protect Thinhorn (Dall's) Sheep. It covers high elevation areas and roughly covers half of the Atlin subpopulation range area.

A survey of sensitive ecosystems in the Atlin region (including the range of the Atlin caribou subpopulation) identified the Pine-Lichen woodlands, a 4000 ha area nears Steamboat Mountain and Indian Lake (de Groot and

Pojar 2009). This area was recommended for protection due to its rarity and sensitivity, as well as its utility as caribou winter habitat (de Groot and Pojar 2009).

### 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.

Despite a long legacy of mine sites and abandoned roads in the area, there has been no significant habitat restoration in the Atlin 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).

There are almost 100 km of paved roads extending from the Atlin townsite, 400 km of unimproved gravel and dirt roads and a 740 km ATV trail system built on abandoned mining roads in the range (Polfus et al. 2011). The total road density within 10 km of Atlin is 0.53 km/ km<sup>2</sup>. The overall road density across range is 0.11 km/km<sup>2</sup> (Polfus et al. 2011).

Road use for mine exploration and development is a potential management issue in the Atlin caribou subpopulation range (Environment Canada 2012a).

### 4.2.1 SNOWMOBILE

There is easy and increasing snowmobile access into alpine and sub-alpine winter range of the Atlin caribou subpopulation by mining roads (Environment Canada 2012a). There are no snowmobile access restrictions for trails or caribou areas in the range of the Atlin caribou subpopulation.

### 4.2.2 HELI-SKI / CAT-SKI

There are no heli-ski or cat-ski tenures in the Atlin caribou subpopulation range, although heli-ski companies operate in the area.

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 North Skeena Caribou 3-year Management Plan (Grant 2017).

### 4.3 PREDATORS

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

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

While habitat changes facilitate unsustainable predation, habitat regrowth and restoration 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 km<sup>2</sup> but increased at wolf densities from 1–4/1000 km<sup>2</sup> (Bergerud and Elliot 1986). For this reason, target wolf densities that would enable caribou recovery are set to 6.5/1000 km<sup>2</sup>. 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.

Although there are no targeted wolf management programs in the Atlin caribou subpopulation range, wolves are hunted and trapped in the area. Within WMUs 6-25 and 6-26 that overlap with this range, 691 wolves were reported hunted between 1976 and 2015 (about 18 per year). In this same area from 1983 to 2015, 237 wolves were trapped.

There is no current estimate of wolf population density in this area, but a 2009 wolf survey in the Coast Mountains, Yukon just north of the BC range, wolf density was 45.5 wolves per 1000 km<sup>2</sup> (Baer 2010). This is 22% lower from a 2004 survey, but still well above threshold for caribou recovery.

#### 4.3.2 COUGAR MANAGEMENT

Cougars are very rare or absent in the Atlin caribou subpopulation range, but they may be present (Spalding 1994). In British Columbia, particularly in the south (Wittmer et al. 2005a), cougars are a significant caribou predator. Cougar densities respond positively to deer density, and as deer densities climb, so will cougar densities. However, in northern British Columbia, there are only rare reports of cougar predation on caribou and, thus, no management of them.



### 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.

Although black bears and grizzly bears both predate caribou in the Atlin area, caribou are not a big part of bear diets (Merkle et al. 2017). Given the ban on 2017 grizzly bear hunting throughout BC and the low importance of bear predation on caribou population size, there is no active bear management outside of hunting and trapping in this region. Between 1976 and 2015, 1172 black and grizzly bears were hunted by resident and non-resident hunters.

## 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.

Research and monitoring of moose population trends in British Columbia suggest that they are stable in the Skeena region (Jones 1984). The population estimate in 2016 was approximately 35,000 animals with an annual hunting allocation of 4216 bulls (Kuzyk 2016).

A 2007 moose survey in the Atlin region found 1105 animals for a density of 0.152 moose/km<sup>2</sup> and was reported as a decline from previous (1995 and 2000) surveys (Heinemeyer 2007). This population was found to have 69 bulls/100 cows which is within the threshold established by the provincial government (Moose Management Technical Team 2015) and not different from previous surveys. The high bull / cow ratio suggests that the decline may be due to moose recruitment being below that needed to compensate for hunting and natural mortality

(Heinemeyer 2007). No moose management other than that to support the hunt is occurring (Moose Management Technical Team 2015).

### 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.

There are few deer in the Atlin caribou subpopulation range and there is no reported hunter kills and no management of them.

### 4.4.3 OTHER

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

There is a small elk presence in WMU 6-25 and in the 1970s through the 1980s they were hunted. But few were killed and there has been no hunt since 1989.

## 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.

There is no maternity penning operating or planned for the Atlin region.

### 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).

There are no captive breeding programs planned to reinforce the Atlin caribou subpopulation. Given its size, this herd has been considered as a candidate herd to contribute as a source population, but given the uncertainty in the subpopulation size and trend, it is a low priority (Kinley 2009).

### 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).

There are no translocation programs planned to reinforce the Atlin caribou subpopulation. Given its size, this herd has been considered as a candidate herd to contribute as a source population, but given the uncertainty in the subpopulation size and trend, it is a low priority (Kinley 2009).

### 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 Atlin 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 Northern Mountain Caribou population management plan (Environment Canada 2012a) suggested a five-point toolbox for caribou stewardship that included communicating research and monitoring needs to hunters, implement programs to formally recognize stewards and stewardship groups, educate and encourage habitat protections, find ways for stakeholders to track human activities in the area and, finally, to coordinate with hunters, researchers and the public to foster understanding and support (Environment Canada 2012a).

The Atlin caribou range crosses the British Columbia - Yukon boundary. 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 outreach and stewardship opportunities.

There are significant opportunities for stewardship for the Atlin 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 Highway creating opportunities for broad outreach as well as local stewardship for personal interpretation (e.g. caribou ambassadors <http://ecologynorth.ca/caribou-ambassador-2/>). As one of the few woodland caribou herds that is relatively large and stable (COSEWIC 2014) albeit with uncertainty, this subpopulation may be a candidate to provide source animals for reinforcement activities. 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 have 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 recent research on habitat selection relative to human disturbance, female pregnancy rates and cumulative human effects (Polfus et al. 2010) and how local, Indigenous knowledge informs caribou ecology and conservation (Polfus et al. 2014). Further research to more fully understand predator-prey relationships in the region, food availability as well as caribou responses to habitat change is needed (Polfus and Heinemeyer 2011).

### 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 Atlin (and Carcross) subpopulation was monitored as part of the Southern Lakes Caribou Recovery Program conducted by the Yukon government (Environment Canada 2012a). In addition, there have been four intensive recovery and maintenance programs directed towards increasing and stabilizing northern caribou in the Yukon. Monitoring of the Atlin subpopulation suggested that they were unstable and declining (Environment Canada 2012a). Ongoing monitoring and reporting of Atlin caribou to establish subpopulation size and trend to enable management.

## 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 Atlin caribou and their habitat may benefit or inhibit the protection of other species and their habitats (British Columbia Ministry of Environment 2013). The potential need for predator management will directly affect wolves, whose populations would be intentionally reduced, and other ungulate species like moose, whose densities may also have to be lowered to facilitate caribou conservation.

## 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).

In the range of the Atlin caribou subpopulation, there are limited commercial activities. 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 these operators.

Recreational snowmobiling is also a somewhat common activity, overlapping 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 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 Atlin 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:** Taku River Tlingit First Nation, Teslin Tlingit Council, Carcross Tagish First Nation

**Local:** Atlin, Teslin, Watson Lake, Dease Lake, Jakes Corner, Tagish

**Regional:** Whitehorse, Smithers

**Organizations:** **Recreation:** Atlin Helicopters, Tundra Helicopters, Osprey Air, Discovery Helicopters, British Columbia Snowmobile Federation, Klondike Heliskiing, Klondike Snowmobile Association, Land Conservancy of British Columbia, Outdoor Recreation Council of British Columbia, Quad Riders Association of British Columbia, Monkeyflower Adventures

**Protection:** Teslin Renewable Resources Council, Yukon Fish and Wildlife Management Board

**Commercial:** **Hunting and Trapping:** **Accommodation and Guiding:** Indian River Ranch, Moon Lake Outfitters, Taku Safari, Minto View Cabins, Indian Creek Cabins, Glacier View Cabins (Sidka Tours)

**Forestry** (*Active licences to cut*): Robert Smallwood, Ministry of Transportation and Infrastructure, Adanac Molybdenum Corporation, John Zogas, Atlin District Airport Association, Sector Resources Canada Ltd., Lake Atlin Resort Ltd., Taku Land Corporation, R & L Godkin Contractors Ltd., Chieftain Metals Inc.

**Forestry** (*Woodlots*): none

**Agriculture**: none

## 8 RECOMMENDED ACTIONS

### 8.1 SHORT TERM (WITHIN 6–12 MONTHS)

- Compile and publish results from caribou survey data collected from 1998 through 2015.

### 8.2 MEDIUM TERM (WITHIN 12–24 MONTHS)

- Conduct a spring subpopulation population survey, considering non-invasive mark-recapture (scat DNA) methods.
- Track harvest data to provide information on age and composition of herd (Environment Canada 2012a).

### 8.3 LONG TERM (WITHIN 24–48 MONTHS)

- Evaluate policy and feasibility of the Atlin caribou subpopulation as a source population for reinforcement of other subpopulations.
- Use population modelling to establish sustainable harvest rates and thresholds (Environment Canada 2012a).
- Measure mortality sources for Atlin caribou (predator, hunting, motor vehicle collision, natural events).
- Plan the protection of key caribou habitats (pine-lichen flats) (de Groot and Pojar 2009).
- Support and develop stewardship programs.

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