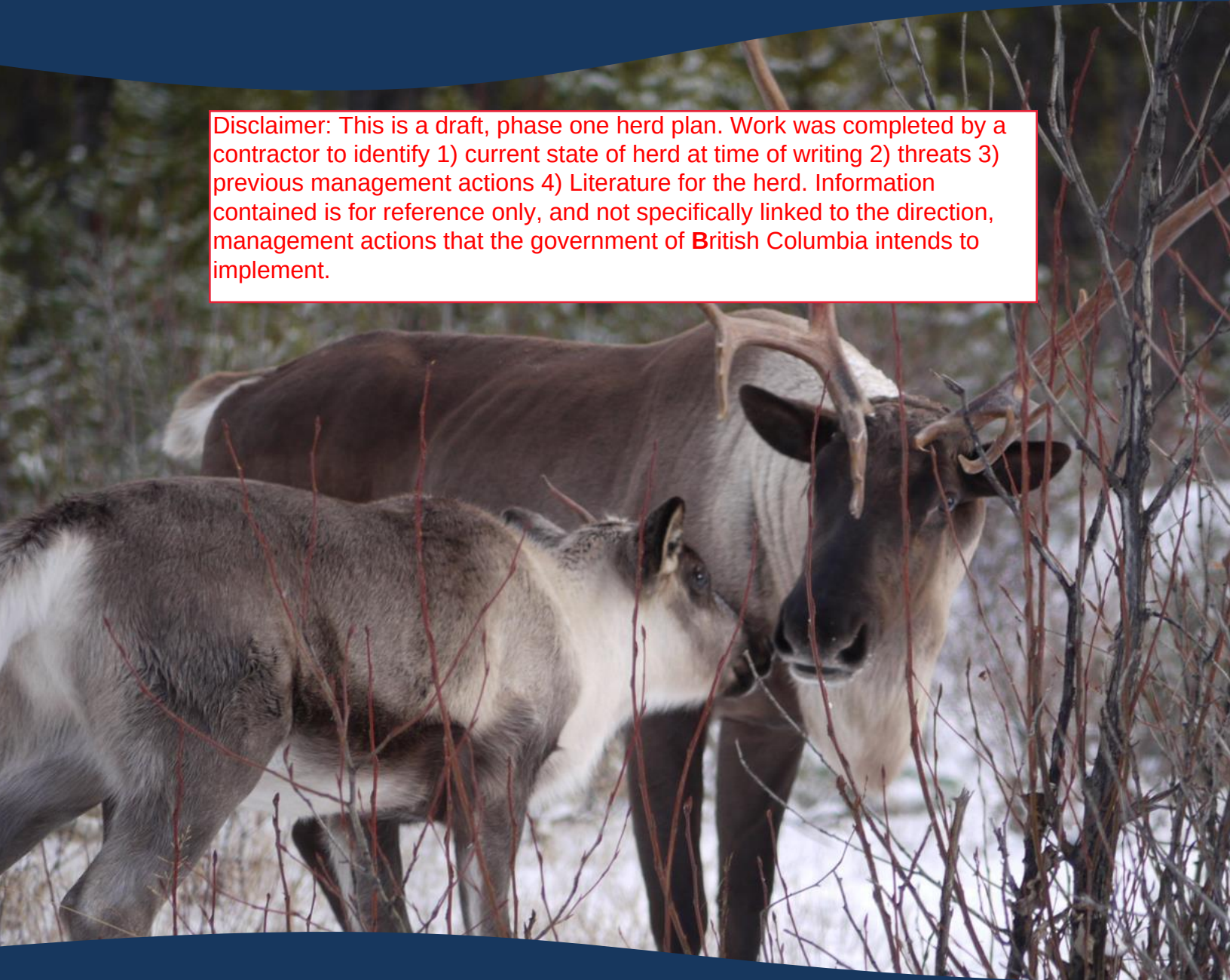


WOODLAND CARIBOU PLAN

Moberly Subpopulation

Pine River Local
Population Unit

Disclaimer: This is a draft, phase one herd plan. Work was completed by a contractor to identify 1) current state of herd at time of writing 2) threats 3) previous management actions 4) Literature for the herd. Information contained is for reference only, and not specifically linked to the direction, management actions that the government of British Columbia intends to implement.



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EXECUTIVE SUMMARY

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1 BACKGROUND

1.1 INTRODUCTION TO THE PROGRAM

The Moberly woodland caribou population designated as Southern Mountain Caribou (Designatable Unit (DU) 8 – Central Group) by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC; Environment Canada 2012a, 2014). As a group, the Central Mountain group of woodland caribou is recommended as Endangered (Environment Canada 2014). Previously, and until the DU structure for caribou populations is formally adopted, the Moberly caribou were considered Northern Caribou, and there are management plans devoted to their conservation (Youds et al. 2002, The Northern Caribou Technical Advisory Committee 2004, McNay et al. 2008, Youds et al. 2011, Austin 2012).

Woodland Caribou are further divided into Local Population Units by Environment Canada. Within the Central Mountain Caribou group there are Six Local Populations. The Moberly subpopulation is in the Pine River Local Population together with the Scott, Kennedy Siding and Burnt Pine (extirpated) subpopulations (Environment Canada 2014).

Range plans are required for all woodland caribou populations that are designated as threatened or endangered in Canada (Environment and Climate Change Canada 2016). Because the current designation for the Moberly subpopulation is “Endangered”, current monitoring indicates that they area very small but increasing and in need of comprehensive recovery planning.

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 Moberly Southern Mountain caribou subpopulation within in the Pine River Local Population Unit.

2 POPULATION DESCRIPTION

The Moberly caribou herd occurs on the east side of the Rocky Mountains, between Peace Arm and the Pine River valley that includes Highway 97. It is also known as the Klinse-Za herd (McNay et al. 2013). The caribou use windswept alpine slopes and adjacent subalpine forests on the eastern edge of the Rockies for winter habitat. Within the range of the Moberly herd, a total of 68,177 hectares of high-elevation habitat has been identified for winter use (Table 2; Seip and Jones 2012). Moberly caribou also use low-elevation habitat in winter. According to First Nations in the Moberly Lake area, this behaviour appears to be more common than previously reported. In summer, most of the Moberly caribou migrate west towards the central core of the Rocky Mountains, with some individuals crossing over to the west side. In summer, the caribou continue to occupy alpine and subalpine habitats (British Columbia Ministry of Environment 2014, p. 12).

2.1 DISTRIBUTION

The Moberly subpopulation is one in a tight cluster of caribou subpopulations distributed in east-central British Columbia within the distribution of southern mountain caribou (Figure 1). Their 3291 km² range lies in the southern Peace Region in the British Columbia Rocky Mountains and their range overlaps in the southwest with the Kennedy subpopulation. They are separated from the Graham subpopulation to the north by Williston Lake, by the Burnt Pine range (this subpopulation has been extirpated (Seip and Jones 2016b)) and parts of the

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Kennedy subpopulation by the Pine River valley and Highway 97. The Scott subpopulation is to the west of the Moberly subpopulation and they are separated by Callazon Creek valley.

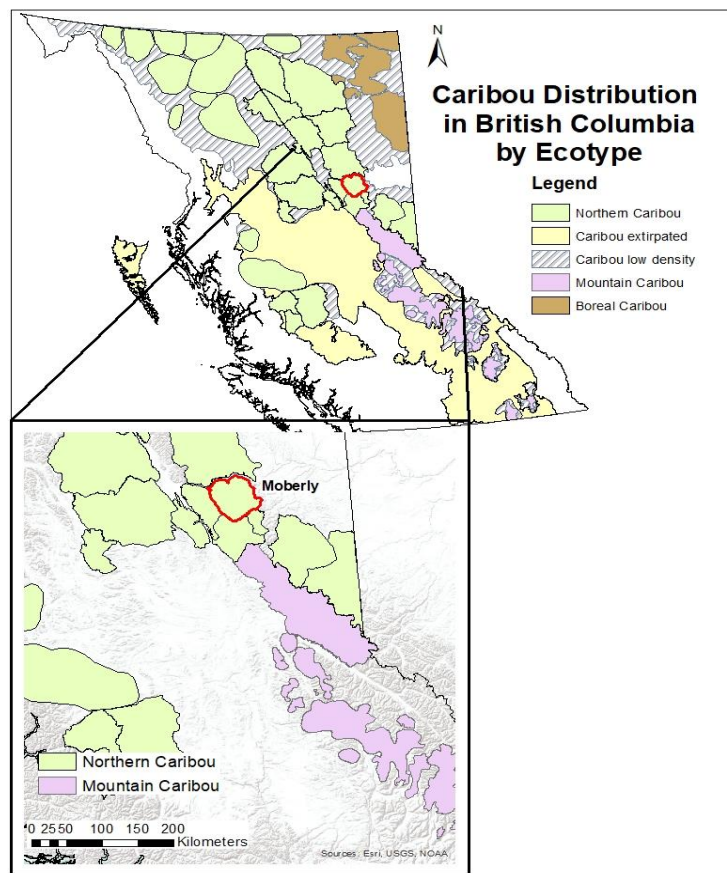


Figure 1: The geographical location of the Moberly subpopulation of woodland caribou. The 3291 km² range (inset: red outline) is situated within the Peace Region of eastern British Columbia.

2.2 HABITAT AND BEHAVIOUR

The Moberly herd primarily uses high-elevation habitat for both summer and winter range (Seip and Jones 2012). Caribou generally migrate from alpine and sub-alpine habitat in the central portion of the Rocky Mountains to the eastern edge of the Rocky Mountains in winter where they feed on terrestrial lichens on wind-blown slopes (Seip and Jones 2012). The herd may also periodically use low elevation winter habitat (British Columbia Ministry of Environment 2014).

The Moberly subpopulation generally occupies high-elevation mountainous areas during the winter. They select moderately sloped or ridgeline topography across the Boreal Altai Fescue Alpine ecological zone and the parkland subzone of the Englemann Spruce – Subalpine Fir ecological zone. Throughout the winter months, steep slopes and spruce-dominated habitats were avoided (Johnson et al. 2015).

2.3 POPULATION SIZE AND TREND

The Moberly caribou subpopulation has increased four years in a row since 2013 but remains critically low (Figure 2). Indeed, the increase from 2016–2017 was dampened by the death of individuals in avalanches (see

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below). The combination of maternity penning and wolf control has contributed to improve adult and calf survival and recruitment (Figure 3).

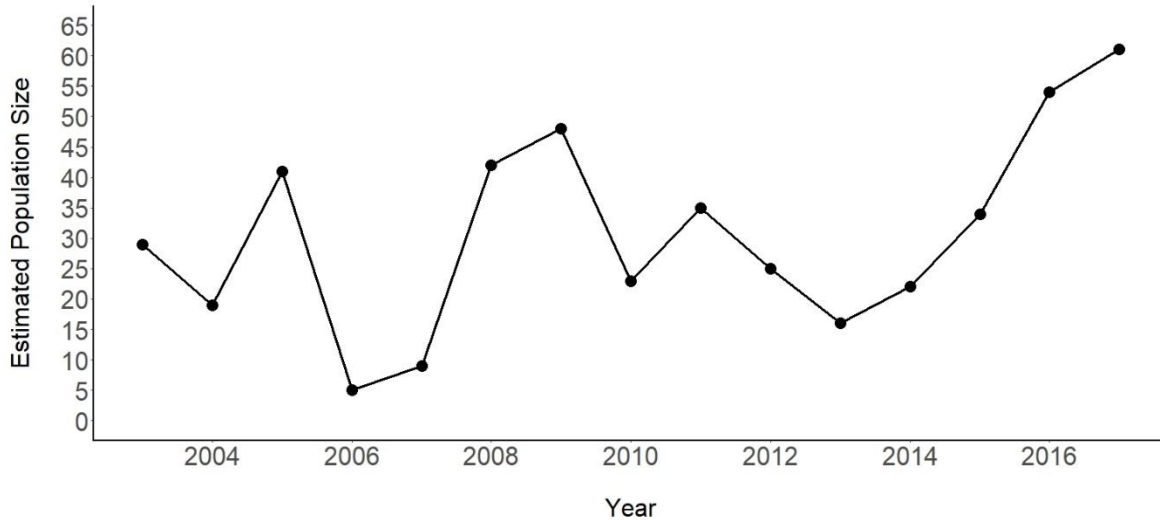


Figure 2: Estimates of population size by year for the Moberly subpopulation of northern mountain caribou. Data from Seip and Jones (2016a, 2016b, 2017).

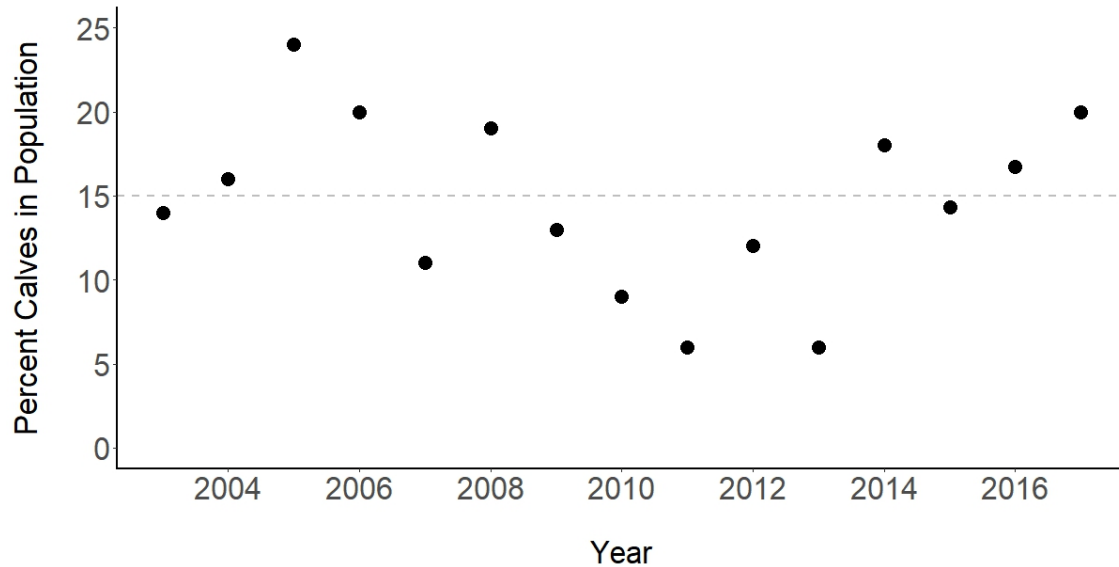


Figure 3: Calf recruitment in the Moberly caribou subpopulation. Dashed horizontal line is predicted threshold for population growth or stability (Bergerud and Elliot 1986, Bergerud 1988). Data from Seip and Jones (2016b, 2016a, 2017).

3 THREATS AND LIMITING FACTORS

Primary threats to caribou and their habitat have been noted by McNay et al. (2008), COSEWIC (2014) and a variety of independent studies focusing on individual threats (e.g. James et al. 2004, Wittmer et al. 2005b, Courtois et al. 2007, Seip et al. 2007, Wittmer et al. 2007). Threats are treated in isolation, but this does not discount the likelihood that they interact. Cumulate effects assessment (Sorensen et al. 2008, Johnson et al. 2015) is beyond the scope of this plan, but work on boreal caribou has demonstrated its value in developing comprehensive range planning for woodland caribou (Angelstam et al. 2004, Environment Canada 2012b).

Here we consider the following threats:

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 have indicated 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 hyperabundance (Hebblewhite et al. 2007), apparent competition mediated by expanding alternative prey distribution (Wittmer et al. 2007, DeCesare et al. 2010b, Latham et al. 2011b), and enhanced predator access to woodland caribou habitat (Hayhurst 1983, Latham et al. 2011a). More generally, Bergerud (2007) has calculated that wolf densities greater than 6.5 wolves/1000 km² will result in woodland caribou declines. More recently, the federal recovery strategy identifies 3 wolves/1000 km² as a target (Environment Canada 2014).

Research on predation was conducted in advance of the caribou recovery planning in British Columbia's Peace region (Austin 2012, Seip and Jones 2013). From 2002 to 2013, 43 female radio-collared caribou died; 12 of these were in the Moberly subpopulation. Almost two-thirds of deaths (63%) were confirmed predation event in the entire Peace region; most of these (33%) were by wolves (Austin 2012, Seip and Jones 2013). Ongoing monitoring since then has found that between 2015 and 2017 no collared caribou in the Moberly subpopulation were killed by predators (Seip and Jones 2016a, 2017).

3.2 FOOD LIMITATION

Woodland caribou are well known 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 small 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 the animals' nutritional needs (Newsome et al. 2000, Brown et al. 2007). Trade-offs between these two fundamental demands as they select habitats (avoiding predators, finding food) raises the potential for woodland caribou to be food or energy limited (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) Indeed, suitable winter habitat limits this subpopulation with the key habitat features being either wind-swept or densely covered areas where snow depths are sufficiently shallow to allow access to their lichen food (Apps and Dodd 2017).

Loss of winter food supply has been identified as a threat to the Moberly (Scott) subpopulation (McNay et al. 2008). Most of the Moberly subpopulation spends their winter on windswept alpine ridges while some animals make use of the Englemann Spruce – Subalpine Fir forests surrounding the alpine and subalpine parkland areas (Wood and Hengeveld 1998, Jones et al. 2004, Goddard and Scheck 2005). These animals feed on terrestrial lichens.

However, there is no comprehensive survey of caribou forage in the Moberly subpopulation range. Elsewhere in British Columbia (Environmental Stewardship Division 2002) it has been noted that fire suppression has resulted in more areas of old forest in protected areas than would otherwise be expected, resulting in greater lichen density.

A study of vegetation change in mountain pine beetle affected forests in west-central British Columbia suggests that terrestrial lichens may decline due to the increasing dominance of vascular plants in canopy gaps (Cichowski 2007). A related study in an adjacent area noted that terrestrial lichens recovered in 1 to 2 years from the effects of needle-fall from beetle killed trees (Willison and Cichowski 2006). While terrestrial lichens in this study had decline marginally as a result of kinnikinnick (*Arctostaphylos uva-ursi*) growth, they had not declined in direct response to pine needle fall (Willison and Cichowski 2006).

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 development and clean energy. Caribou are affected by industrial activities both due to the infrastructure that is associated with it 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 populations. Although some populations live seasonally in treeless, alpine ecosystems, all spend some of the year in forests. For this reason, forestry 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 (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).

At the stand level, harvesting reduces forage availability by removing slow-growing terrestrial lichens and their host-trees, and through changing the microclimate. Terrestrial lichens can dominate in regions where nutrients or water are in short supply, but not where they have to compete with vascular plants. Harvesting changes the conditions such that vascular plants and bryophytes out-compete lichens, decreasing forage availability (British Columbia Ministry of Environment 2014).

The Moberly caribou subpopulation overlaps on two Timber Supply Areas (TSAs); the Dawson TSA in the east that encompasses about 80% of the range and the McKenzie TSA in the west that covers about 20% of the range. The land used by the caribou remaining in the Moberly subpopulation are only found in the Dawson TSA; 2.3 million hectares in area. Of this area, about 1.6 million hectares The 2013 plan states that almost 1.9 m³ of timber can be removed annually from the area (Forest Analysis and Inventory Branch 2013, Nicholls 2014). The most recent harvest maps show 631 cutblocks in or overlapping with the Moberly subpopulation range for a total of approximately 16,000 Ha cut in over 650 blocks.

Industrial forestry activities in Peace region and Moberly caribou subpopulation range began in the 1970s. Forest harvesting had the largest total impact on caribou range between 2000 and 2009 (British Columbia Ministry of Environment 2014).

Vegetation resource inventory data up to 2014 and the forest tenure database for the Moberly range show that 18,809 hectares of low-elevation habitat was harvested (British Columbia Ministry of Environment 2014). A further 11,854 hectares has been converted to early-seral habitat through other processes (British Columbia Ministry of Environment 2014 Table 7).

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).

Within the range of the Moberly caribou subpopulation there are several mineral designations. Thirty-eight percent of the area is under Resource Reserve Areas (oil and gas tenures), 13% under coal reserves and 27% under placer reserve. There are no major active mines in the range, three gravel pits totaling approximately 9 Ha and two open pit mines in or adjacent to the range totaling about 11 Ha. Despite little exploration or operational activity and low risk, the potential for mining exists if activities are permitted (British Columbia Ministry of Environment 2014).

High elevation winter and summer ranges and matrix habitats have been mapped in the Moberly range. Currently, most of the Moberly range is protected under the Coal Act, Land Act, and Petroleum and Natural Gas Act (Environment and Climate Change Canada and British Columbia Ministry of Environment 2017). The exception to this is the Moberly High Elevation Winter Range that is currently only 40.2% protected under the Coal Act. However, once ratified, proposed Coal Land Reserves under the Regional Coal Agreement will protect 98.4% of high elevation winter range from coal mining development (Austin 2012).

3.3.1.3 OIL AND GAS

Oil and gas development threaten caribou populations through habitat destruction, human activity, access, habitat fragmentation that can lead to habitat abandonment and elevated predation (Dyer et al. 2001, Boutin et al. 2012, Hervieux et al. 2013). Given the spatial scope of developments and the range of activities that take place in caribou habitat to develop oil and gas resources (well sites, access roads, pipelines, seismic lines) 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 energy 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).

Thirty-eight percent of the area is under Resource Reserve Areas with a potential oil and gas tenures (British Columbia Ministry of Environment 2014). The eastern part of the Moberly caribou subpopulation range has conventional gas potential, but there is no current title and no interest in conventional exploration. Undeveloped conventional resources are expected to remain so pending the further exploitation of provincial unconventional shale gas reserves (Environment and Climate Change Canada and British Columbia Ministry of Environment 2017).

Seismic exploration associated with oil and gas development have a large impact because of their large footprint. Seismic activities can displace caribou from preferred habitat, destroy caribou habitat over the short- or long-term depending on the type of seismic activity, reduce the availability of forage, and increase the amount of early-seral habitat, which in turn increases ungulates and their predators (Stuart-Smith et al. 1997, Dzus 2001). Seismic lines may also provide access for predators and humans (Dickie et al. 2016).

Oil and gas development has occurred with the Peace region since the 1950s. Approximately 5400 hectares of low-elevation habitat in the Moberly and Burnt-Pine area has seen oil and gas activities, including 1147 Ha of well sites, 5 Ha of pipelines and 4281 Ha of seismic lines (British Columbia Ministry of Environment 2014 Table 4). (British Columbia Ministry of Environment 2014).

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 off migration routes. 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-park 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 is one active hydrometric station and 72 Run-of-the-River Hydroelectric generating stations in the Moberly caribou subpopulation range with an overall footprint of less than one Ha and approximately 70 km of access roads.

There are currently two wind developments within the Moberly range: the 34.5 megawatt (MW) PC47 and the 103.5 MW PC17 Project (BC Hydro 2013). There are also three projects in development in the region that have electricity purchase agreements with BC Hydro: the 185 MW Meikle Wind Project, the 15 MW Septimus Creek Wind Project and the 15 MW Moose Lake Wind Project (Environment and Climate Change Canada and British Columbia Ministry of Environment 2017). Wind energy tenures cover 26,376 Ha of Moberly caribou range and about 6% of its high elevation winter habitat (British Columbia Ministry of Environment 2014).

3.3.1.5 *OTHER*

There are currently no other major forms of industrial development within the Moberly caribou 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. Numerous studies have shown that woodland caribou to varying degrees avoid mechanized winter activities (Simpson 1987a, Simpson and Terry 2000, Mahoney et al. 2001, Kinley 2003, Wilson and Hamilton 2003, Seip et al. 2007). Despite numerous records of displacement, no study has been able to draw a link between winter recreational use and woodland caribou population decline.

3.3.2.1 *SNOWMOBILE*

Within the Central Group Local Population Unit area 31% of high-elevation caribou habitat and an additional 12% of range area is tenured by the Land Act for recreation. However, recreational activities are not considered a widespread concern. Popular snowmobiling areas are few as much of the windswept alpine habitat used by caribou is poor for snowmobiling (British Columbia Ministry of Environment 2014, Environment and Climate Change Canada and British Columbia Ministry of Environment 2017)

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 to monitor caribou and helicat ski operations in an attempt to minimize operational impacts.

There are no commercial leases or tenures for helicopter or cat skiing in the Moberly caribou 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, motorized assist off-piste skiing) and mountaineering bring their participants into alpine areas that overlap with woodland 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).

Commercial downhill ski resorts also operate in woodland caribou habitat and have impacts on individuals and habitats (Czetwertynski and Schmiegelow 2014). There are no downhill ski resorts or known development proposals in the Moberly caribou range.

Summer recreation can also affect the Moberly caribou subpopulation. Activities such as off-highway-vehicle (OHV) use and mountain biking allow deep access into caribou with only minimal road infrastructure required. ATV use for recreation (or hunting) is not prohibited in the Moberly caribou range, but there are no advertised trails for recreational OHV use. A review of popular mountain biking trails in the region show one near Hudson's Hope, on in Chetwynd and several in Pine Le Moray Provincial Park. All of these are adjacent to the current Moberly caribou range (MountainBikingBC 2017).

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 local snow depth. Growing hay and grain crops within or adjacent to caribou range has the potential to 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). Access to crops increases the population growth of these species that can increase the population of the predators that they share with caribou, putting downward pressure on caribou populations.

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

Neither farming nor ranching are prominent activities in the range of the Moberly caribou subpopulation.

3.3.3.2 MAJOR HIGHWAY CORRIDORS

Where they occur in caribou habitat, highways have a strong, negative effect on caribou populations (Curatolo and Murphy 1986, Apps and McLellan 2006, McFarlane et al. 2009). They have several effects. Vehicle activity on highways creates a movement barrier for caribou as they are either reluctant to approach or get killed crossing (Dyer et al. 2002, Rytwinski and Fahrig 2012). In the former case habitat and population fragmentation results. In the latter case, populations numbers decline directly. Highways and roadways can also provide access to people 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).

There are no major highways going through the Moberly range, however Highway 97 defines the southern boundary of the range and Highway 29 runs close to its eastern boundary. Caribou rarely cross these roads and highway mortality is rare. As well, and there are over one thousand kilometers of forestry and gravel roads within their range. This is approximately 0.36 km/km² of roads and trails in the area. Although not all of these roads are active, and traffic patterns are not reported, study indicates that road density alone affects individual caribou behaviour and population dynamics (Dyer et al. 2001) and this density is high relative to other areas (Dyer et al. 2002).

3.3.3.3 LINEAR FEATURES

Linear features are land disturbances that tend to be long, continuous and narrow, including things like seismic cut lines, pipelines and overhead power transmission rights-of-way. They are not cleared to a road standard, but enable both four-wheel-drive access and ease travel for predators and alternative prey (Hebblewhite et al. 2010a). One hypothesized effect is that linear features facilitate predator movement into and within prey habitat and increasing predator-prey overlap (DeMars and Boutin 2018).

The most prominent linear feature is a hydroelectric power transmission corridor from the WAC Bennett Dam that is just outside the herd range to the east. The corridor traverses the eastern half of the range and bounds the

southwestern range along highway 97. There are no pipeline (although the proposed route for the North Montney Nova Gas transmission line proposal is nearby (d'Entremont and Plate 2015)) or seismic lines in the area.

3.3.3.4 HUNTING

The Moberly caribou subpopulation has not been hunted since the 1970's (West Moberly First Nations 2014) despite a treaty right to do so (McNay et al. 2013).

Moose, white-tailed deer and elk hunting continue within the Moberly subpopulation range (Government of British Columbia 2017c). While reduction in alternative prey can be beneficial to woodland caribou, active hunting in their winter range may also contribute to accidental death by hunters who misidentify their prey. The specific impact to the Moberly subpopulation is unknown.

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 critical habitat and changes predator-prey dynamics by improving habitat for alternative prey and increasing wolf-caribou spatial overlap (Robinson et al. 2012). From 1925 to 2014 fires totalling 708 km² burned in and adjacent to (crossing the existing boundary) of the Moberly subpopulation range (22%). In northern and boreal habitats, it takes 80 years for a forest to recover from a fire to become caribou habitat again (Robinson et al. 2010). Fires since 1936 total 679 km² within the subpopulation range (20%). Influencing factors such as climate change and mountain pine beetle infestation may exacerbate the frequency, size and intensity of wildfires (Harding and McCullum 1997). Although there have been episodic large fire years (1945, 1960, 1985, 2014), there is no clear transition from a pre-beetle to a post-beetle era nor climate change.

Forests killed by mountain pine beetle alter wildfire risk and spread, reduce long-term lichen availability and create habitat scale movement barriers (Armleder and Waterhouse 2008), similar to burned areas once trees fall (10-15 years; Youds et al. 2011). In the range of the Moberly herd, peak mountain pine beetle attack was estimated to be in 2006. Since then 7776 km² of overlapping pine habitat has been assessed as having mountain pine beetle ranging from trace to very severe infestations. There is very little pine forest in the Moberly caribou subpopulation range that has not been affected by the mountain pine beetle.

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 Moberly 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 duration, may be directly affected by climate change (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). 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) and 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 (Dawe and Boutin 2016) and available food (Parker et al. 2009).

There is no herd-specific information on climate change effects on the Moberly caribou subpopulation.

3.7 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).

Although poaching can be a locally important source of caribou mortality, research using radio collared animals among northern caribou has not uncovered illegal harvest (Seip and Jones 2017). While this may be biased by focussing on animals in protected and remote areas, it suggests that poaching is not of strong conservation concern.

3.8 SMALL POPULATION SIZE EFFECTS

Small population effects include several threats to caribou populations that are unique to small (approximately less than 50 animals) and isolated subpopulations. These include reproductive and genetic isolation (McDevitt et al. 2009), predation 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, fires or floods can kill an entire herd (Hebblewhite et al. 2010b). Movement barriers that prevent inter-population dispersal exacerbate small population effects creating situations where small or extirpated populations have no chance of rescue.

The breeding population of the Moberly caribou subpopulation has been small for a long time (Figure 2), so that they are under a constant threat of small population effects. Indeed, three of 22 collared adult females died in

avalanches in 2016–17 (13.5% of the marked population) demonstrating the vulnerability of small populations to natural events in caribou habitat (Seip and Jones 2017). Nevertheless, likely due to predator control (see below), the Moberly caribou population increased by 13% from 2016 to 2017 (Seip and Jones 2017).

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 (Weckworth et al. 2012). Being so small for so long, the Moberly caribou are undergoing a strong genetic bottleneck (cf. McDevitt et al. 2009, Weckworth et al. 2012).

4 MANAGEMENT HISTORY

4.1 HABITAT

Within the Moberly caribou subpopulation range, there is 1374 km² of core high value summer range; about 42% of their entire range (Seip and Jones 2015). Very high suitable habitat aligns with alpine and parkland habitats where the risk of predation for caribou is low (Austin 2012).

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).

There are two provincial parks full within the range of the Moberly caribou subpopulation and one provincial park just outside the range on its southern boundary. Klin-se-za Provincial Park is a Class A park completely within in the Moberly subpopulation range. As well as being an important cultural landscape for the Sauteau and West Moberly Nations (Aird and Abel 2013), it protects approximately 2,100 hectares of high-elevation winter habitat. It was established in 2006 but does not yet have a management plan.

Bocock Peak Provincial Park is also a Class A park entirely within the range of the Moberly subpopulation. It is 1100 ha in area and largely protects high elevation habitats and limestone caves. It was established in 2000 and does not specifically protect wildlife as hunting and a wide range of non-motorized recreational activities are permitted within its boundaries (Government of British Columbia 2017a). It, too, lacks a management plan, but includes 670 hectares of high-elevation caribou winter habitat.

Pine le Moray Provincial Park is just outside the southern boundary of the Moberly caribou subpopulation.

In the Moberly subpopulation range, there are 31 parcels of protected Ungulate Winter Range. Fourteen of these parcels explicitly protect 430 km² of woodland caribou high-elevation and subalpine forest habitat (Jones et al. 2004, Goddard and Scheck 2005). There are also five Wildlife Habitat Areas (WHAs) that are no-harvest zones to protect caribou habitat. These protect 261 km² specifically for Moberly caribou.

4.1.1.1 NON-STAKING RESERVES

A reserve is established by a BC Regulation of the Chief Gold Commissioner under Section 22 of the Mineral Tenure Act and Section 21 of the Coal Act is the legal instrument to protect land from mineral, placer and coal exploitation (Government of British Columbia 2017b).

There are 274 km² protected under the Coal Act, 633 km² protected under the Land Act, 654 km² protected as Resource Review Areas, 485 km² protected as placer non-staking reserves, and 463 km² protected as mineral non-staking reserves (Environment and Climate Change Canada and British Columbia Ministry of Environment 2017).

4.1.1 OTHER

Old Growth Management Areas (OGMAs) are legal Crown land designations established under the Land Act that can be considered to contributing to the management of SPNC and their habitat. There are 240 spatially defined legally established OGMAs in the south Peace region of B.C., with 13,507 hectares overlapping with Moberly caribou range, 1593 ha of this in high elevation winter range (British Columbia Ministry of Environment 2014). In addition, significant areas in the Peace region are covered by a Motor Vehicle Access Closure (Austin 2012).

4.1.2 HABITAT RESTORATION AND ENHANCEMENT

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). 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 is no large-scale habitat restoration being conducted in the Moberly caribou subpopulation range.

4.1.3 ACCESS MANAGEMENT

Road access to woodland caribou habitat elevates conservation threats including conflicts with snowmobiles, 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 how they 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.

There are Motor Vehicle Prohibition Regulation closure areas for snowmobiles within the Central Group LPU boundaries (Environment and Climate Change Canada and British Columbia Ministry of Environment 2017), but very little of this is in the Moberly range.

4.2 PREDATORS

Unsustainable predation is acknowledged as a key, proximal mechanism of woodland caribou decline across Canada (Bergerud and Elliot 1986, Bergerud 1988). Woodland caribou populations have persisted despite ongoing predation from wolves, bears (black and grizzly) and cougars for millennia, but the profound impact of predators is a recent phenomenon. What has changed is habitats due to resource extraction, access to critical caribou ranges and the dynamics among caribou, their ungulate kin (moose, deer, elk) and predators.

Shrinking old-growth forest caribou habitat has forced caribou into increasingly smaller ranges, making their locations more predictable to predators, seasonal migratory routes track through predator rich areas, and bringing 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 wolf predation in particular (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).

Although habitat changes facilitate unsustainable predation, habitat return 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).

4.2.1 WOLF MANAGEMENT

Wolves are an important, year-round caribou predator. Caribou populations in northern British Columbia were shown to decline when wolf densities were 9–10/1000km² but increased at wolf densities from 1–4/1000km² (Bergerud and Elliot 1986). For this reason, target wolf densities that would enable caribou recovery are set to 6.5/1000km². 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.

The Moberly area wolf population is believed to have increased over the last few decades. In addition to a higher density of wolves there are reports of very large packs of 25 or more animals (Austin 2012). A 2009 survey found 13 wolf packs overlapping the six Peace northern caribou herds south of the Peace River (Austin 2012). Wolf hunting and trapping seasons have occurred throughout the Peace northern caribou herd areas during the wolf population increase, suggesting that this has been ineffective at wolf population regulation (Austin 2012).

Aerial wolf control has occurred throughout the Moberly caribou subpopulation range since winter 2015. Twenty-nine wolves were killed that first year, representing between 59 and 100% of wolves estimated to be in the population (Seip and Jones 2016a). Seventy-nine wolves were killed within or immediately adjacent to the wolf control area during January to March 2016 (Seip and Jones 2016a). Including those trapped, a total of 86 wolves were removed from the Moberly/Scott zone (Seip and Jones 2017). In the winter of 2017, there were 57 wolves removed from the Moberly/Scott zone (Seip and Jones 2017).

4.2.2 COUGAR MANAGEMENT

Cougars are not common in the Moberly caribou subpopulation range, but they are present (Spalding 1994). In British Columbia, particularly in the south (Wittmer et al. 2005a), cougars are a significant caribou predator. Cougar densities respond positively to deer density, and as deer densities climb, so will cougar densities. However, in northern British Columbia, there are only rare reports of cougar predation on caribou.

4.2.3 OTHER

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

There are 12 traplines that are either entirely or partially within or bounding on the Moberly caribou subpopulation range. Operators have the potential to remove caribou predators as part of their licences.

4.3 PRIMARY PREY

Moose, elk, white-tailed deer and mule deer are ungulate species along with woodland caribou that are in the diet of large, mammalian predators such as wolves, bears and cougars. In a process known as apparent competition (Holt 1977) where an increase in one prey population will lead to a decrease in a second prey population because the first prey increase boosts the shared predator numbers that kill the second prey at a higher rate. Across their range, woodland caribou populations have been suffering from apparent competition due to expanding ranges of “primary prey” into their habitat (DeCesare et al. 2010b, Wittmer et al. 2013). For this reason, managing primary prey, either directly through hunting quotas, or indirectly through habitat management.

4.3.1 MOOSE MANAGEMENT

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

There have been few systematic moose surveys in this management unit (7-31) of the Peace Region (Moose Management Technical Team 2015). Hunting surveys suggest an over-harvest in the 1990s, but a rebound in the moose populations after 1996 that appeared to be sustained through to 2006 (Rowe 2008). A moose survey just north of the Moberly range (Farrell) found a 0.65/km² moose density that is considered normal for this area (Webster 2011, Moose Management Technical Team 2015). A 2015 moose survey to the east of the Moberly range, in management unit 7-42, found 0.24 moose/km², a significant, 70% decline from the 2001 survey (Thiessen and Baccante 2012, Lirette 2015).

4.3.2 DEER MANAGEMENT

Managing deer populations in support of caribou conservation is a challenge. Where mule deer and white-tail deer ranges overlap, mule deer tend to decline, perhaps also due to apparent competition (Robinson et al. 2002). Neither are strictly regulated by either predators or food, but white-tailed deer populations respond as strongly to food availability than 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 and loss of native winter habitat (Pierce et al. 2012, 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), increased hunter take and likely a government cull.

Mule and white-tailed deer densities in the Peace region tend to concentrate where agriculture is prevalent (Woods 2017). East of the Moberly range, where farms and ranches are common, mule deer populations have been declining since 2005 (Woods 2017, Table 3.1) whereas white-tailed deer populations, although small, have been stable or increasing (Woods 2017, Table 3.2). There are no survey data for the Moberly range, but by

extension from neighbouring regions, mule deer populations are likely declining, which white-tailed deer populations are likely small given the small agricultural presence.

4.3.3 OTHER

Elk, like moose and deer, are wolf prey and could potentially facilitate apparent competition with caribou (see above). Although elk are more common to the east of the Moberly caribou range where agriculture is more prevalent, they are found in management unit 7-31 that encompasses the Moberly subpopulation. 161 elk were found during a 1989 survey (BC Ministry of Environment, unpublished). A 2016 survey just east of Moberly range found 354 elk near Gwillim Lake Park (Robitaille and Privé 2016). No elk management takes place in the Moberly caribou range, but there is an open hunting season for 6-point bulls from 1 Sep to 31 Oct (Government of British Columbia 2017c).

4.4 POPULATION REINFORCEMENT

The International Union of Conserving Nations has established guidelines for reintroductions and other 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).

The management tools described in this section are based on the assumption that caribou populations are being reinforced and not reintroduced.

4.4.1 MATERNITY PENNING

Maternity penning (sometimes called maternal penning) is a technique to increase calf recruitment by capturing and penning pregnant females protected from predators. The females are held through parturition and for up to six weeks after birth. By this time calves are large and strong enough to better avoid predators, improving their survival 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 known as an *in situ* method as the pen is constructed within their home range and animals are never moved outside of their home range.

Maternity penning projects began for the Moberly caribou subpopulation in 2015. Initial results indicate that maternity penning is effective to increase calf survival when combined with predator control close to the pen (Environment and Climate Change Canada and British Columbia Ministry of Environment 2017). It has resulted in a small decrease in calf mortality, and perhaps because of the wolf control near the pen, has dropped adult female mortality from 23.2% to zero (Seip and Jones 2016a).

4.4.2 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. 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 approach 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. A number of factors, such as source animals, animal husbandry, avoiding genetic bottlenecks, gene mixing with destination herds, status of destination herds, disease transmission, fate of male calves and many more must be considered in such an effort (Dolman et al. 2015, Hayek et al. 2016).

There are no captive breeding facilities that can reinforce the Moberly caribou sub-population. With their low numbers however, they would be a candidate herd should the opportunity arise, particularly with the predator management and habitat protection that is in place.

4.4.3 TRANSLOCATION

Translocation is the reinforcement of small populations by moving animals directly from a sustainable population (Hayek et al. 2016). The goal is to rapidly increase the numbers of animals of all age and sex groups 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 have been no translocations to or from the Moberly caribou subpopulation range.

4.4.4 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 Moberly caribou subpopulation (Antoniuk et al. 2016).

4.5 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 regulations where none were before (Hayek et al. 2016). Gaining the social licence to undertake management actions like predator management, translocations, 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 running reinforcement activities such as maternity pens.

In the range of the Moberly caribou subpopulation, stewardship and outreach is currently focussed on the maternity penning reinforcement effort. This initiative is a partnership among the West Moberly First Nations, Saulteau First Nations, Wildlife Infometrics and West Fraser Integrated Forestry and the BC Government (Coady 2016). The British Columbia Fish and Wildlife Compensation Program is active in community outreach promoting caribou recovery efforts and offer grants to stakeholders wanting to undertake conservation actions (www.fwcp.ca). The Habitat Conservation Trust Foundation, a non-profit funded by hunters and outfitters, also supports caribou recovery and research in the Moberly range (www.hctf.ca).

4.6 RESEARCH

Every caribou subpopulation in British Columbia requires some degree of management action; habitat protection or restoration, population reinforcement, alternative prey management, 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 these factors are well understood in a broad sense, ongoing research is necessary to fine tune caribou responses to ecological stimuli and human disturbance.

In the range of the Moberly caribou subpopulation, key questions include target caribou densities in areas where animal numbers have dropped below threshold numbers, determining population response to intensive management approaches (predator management, population reinforcement) (Hayek et al. 2016), effective buffer widths for critical habitat protection (Robinson et al. 2010) and alternative prey numerical responses to disturbances of different size and type.

Alternative sources of information such as traditional and local knowledge, stewardship activities and outreach can support effective management decision making while ecological monitoring and research is being conducted. Indeed, they should occur together. Traditional and local knowledge has made compelling contributions to caribou conservation and recovery across Canada (Russell et al. 2000, Festa-Bianchet et al. 2011, Muir and Booth 2012, Polfus et al. 2014).

4.7 MONITORING

Ecological, population and industrial footprint monitoring is an essential activity towards the conservation and recovery of woodland caribou. This provides the information that enables 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.

Key elements of the caribou program in the Moberly subpopulation range include: management effectiveness (predator management, maternity penning) (British Columbia Ministry of Environment 2013, Environment and Climate Change Canada and British Columbia Ministry of Environment 2017).

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. 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 predation. None of these management actions can or will imperil other wildlife species but will necessitate changes to their population density an/or distribution.

Actions taken to protect and manage Moberly caribou and their habitat may benefit or inhibit the protection of other species and their habitats (British Columbia Ministry of Environment 2013). As the Moberly caribou subpopulation recovers, the effects on other wildlife populations should be monitored. Baseline data for moose, elk and deer as well as wolf and bear are available through regular census’.

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. However, changes to operations, seasonal restrictions and area closures will be required, locally affecting some recreational and commercial activities.

Perhaps the most profound impact on values of caribou recovery in the Moberly range is the inability of the West Moberly First Nation to exercise their Treaty right to hunt caribou due to the cumulative industrial impacts causing population decline (2011). Caribou population recovery sufficient to allow a hunt to resume would have a positive impact on the values of First Nations.

In the range of the Moberly caribou subpopulation, there are limited commercial activities. Forestry was at its peak in the 1990’s, mining operations are either very localized or exploratory and there is no oil and gas activity. Moose hunting is popular in this area. Access and declining moose populations are concerns for hunters as well as issues for caribou conservation. These overlapping values will require consultation, partnering and mindful management. Recreational snowmobiling is also a popular activity, overlapping to a large extent with hunting. Again, careful management of recreational snowmobiling that considers elements of caribou recovery will be required to enable coexistence.

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. Neighbours include local governments, industry tenure holders, and recreation groups. Neighbours could potentially become future partners.

Woodland Caribou Plan for the Moberly Subpopulation

Below is a list of communities in and adjacent to Moberly 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:** West Moberly Nation, Saulteau Nation, (Treaty 8)

Local: Moberly Lake, Hudson's Hope, Mackenzie

Regional: District of Chetwynd, Peace River Regional District, Prince George, Chetwynd, Dawson Creek, BC Rural Network

Organizations: **Recreation:** Tourism Dawson Creek, Horse Council of British Columbia, Back Country Horsemen of British Columbia, British Columbia Snowmobile Federation (Rocky Mountain Riders, Pine Valley Trail Blazers, Tumbler Ridge Riders Snowmobile Club, Prince George Snowmobile Club), Land Conservancy of British Columbia, Prince George Rod and Gun Club, Dawson Creek Sportsman's Club, Mackenzie Fish & Game, Outdoor Recreation Council of British Columbia, Quad Riders Association of British Columbia, Northern British Columbia Caving Club, British Columbia Speleological Federation

Protection: Western Canada Wilderness Committee, BC Spaces for Nature

Commercial: **Hunting and Trapping:** Moberly River Outfitters, Kylo Brothers Outfitters, Tracks BC / High Prairie Outfitters, Pine River Outfitters, Uchodi River Outfitters, Bullhead Mountain Outfitting, British Columbia Trappers Association, Guide Outfitters Association of British Columbia, BC Wildlife Federation

Accommodation and Guiding: Moberly Lake Marina & Resort, Dunneza Lodge

Forestry (Active licences to cut): Canadian Forest Products, Dokie Expansion Holdings, West Fraser Mills, Westcoast Energy, Dokie Wind Energy, Tembec Industries, Fred MacDonald, McCabe Holdings, Pine Valley Coal, 0541237 BC, Willow Creek Coal, Conuma Coal Resources, BC Hydro and Power Authority, Harewood Timber Development, James Dawkin, Canadian Kailua Dehua Mines,

Forestry (Woodlots): Jacobus Haagsman, Banyon Consulting, John Steward, Longwood Production

Agriculture: BC Cattlemen's Association, BC South Peace River Stockmen's Association, Peace River Forage Association

8 RECOMMENDED ACTIONS

8.1 SHORT TERM (WITHIN 6–12 MONTHS)

- Manage the predator-prey relationship with a goal of controlling wolf populations to a density of less than 1.5 wolves/1000km² verified by periodic wolf population counts.

- Continue to support maternity penning by the Klinse-Ze First nation to reinforce the Moberly caribou subpopulation. The success of this program will be monitored by measuring spring calf recruitment through aerial census and through survival of collared calves.

8.2 MEDIUM TERM (WITHIN 12–24 MONTHS)

- Reduce moose densities in a manner consistent with the provincial moose management framework (Moose Management Technical Team 2015)
- Seral distribution within Matrix Habitat at applicable Natural Disturbance Unit. This will be measured using remote sensing tools or physical mapping of annual change in aerial extent of natural disturbances.
- Manage recreation to avoid human disturbance of caribou through prohibiting motorized recreational incursions into core caribou habitat. This will be accompanied by a stewardship and outreach effort. This will be measured by both counting vehicle tracks in core caribou habitat as well as with legislative tools that track prohibitions and regulations.

8.3 LONG TERM (WITHIN 24–48 MONTHS)

- Maintain a stable to increasing population for the Moberly/Scott herd over the next 7 years. The objective is to consistently increasing population trend to achieve a minimum of 100 animals. This will be monitored by measuring population size and growth rate.
- Ensure a supply of habitat that supports a sustainable caribou population by leaving core habitat undisturbed or allowing it to recover. This will be measured using remote sensing tools of aerial extent of undisturbed or recovering vegetation classes.
- Expand habitat protection such that all high elevation habitat is protection as provided by the Recovery Strategy (Environment Canada 2014). This will be measured using legislative tools that track protected areas management through the Forest and Range Protection Act in British Columbia.
- Coordinate management actions with other initiatives including federal and provincial jurisdictions.

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