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

Scott
Subpopulation

Pine River
Local Population Unit

BRITISH COLUMBIA

Recommended Citation:

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EXECUTIVE SUMMARY

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1 BACKGROUND

1.1 INTRODUCTION TO THE PROGRAM

The Scott woodland caribou subpopulation is included in the Southern Mountain Caribou (Designatable Unit (DU) 8 – Central Group) population by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC; Environment Canada 2014). The Southern Mountain population of woodland caribou is listed as Endangered.

Woodland Caribou are further classified by Local Population Units by Environment Canada. Within the Central Group there are three Local Populations. The Scott subpopulation is in the Pine River Local Population Unit, along with Kennedy Siding, Moberly and Burnt Pine subpopulations. The Burnt Pine subpopulation is considered extirpated (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). The Scott subpopulation is red-listed in BC, and current monitoring indicates that they are in decline 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 Scott Central Mountain caribou subpopulation.

2 POPULATION DESCRIPTION

Caribou populations within this DU (8) are largely isolated from the Northern Mountain caribou (DU 7) to the north and west, Boreal caribou (DU 6) to the east and Southern Mountain caribou (DU 9) to the west and south (COSEWIC 2011).

Central mountain caribou occur on the east side of the Rocky Mountains, north of Kakwa Provincial Park in the south, to the southern shore of the east arm of Williston Lake (Reservoir) in the north.

The caribou use windswept alpine slopes and adjacent subalpine forests on the eastern edge of the Rocky Mountains for winter habitat. In summer, the caribou continue to occupy alpine and subalpine habitats (British Columbia Ministry of Environment 2014, p. 12).

2.1 DISTRIBUTION

Most caribou populations in the Central Mountains make seasonal elevational migrations similar to populations of the Northern Mountains. In recent years (or decades) some other Central Mountain populations are entirely or partially confined to mountainous areas during winter (D. Hervieux, in Williamson in prep.), likely in response to unfavourable, human-caused habitat changes on former low elevation winter ranges (D. Hervieux, unpublished data). In general, Central Mountain caribou disperse to calve at high elevations on the eastern slopes of the Rocky Mountains and winter in low-elevation coniferous forests on the boreal plains or foothills along the eastern slopes of the Rocky Mountains, where terrestrial lichens are accessible (Saher and Schmiegelow 2005). DU 8 caribou form small groups by late summer that range across montane habitats (Williamson in prep;

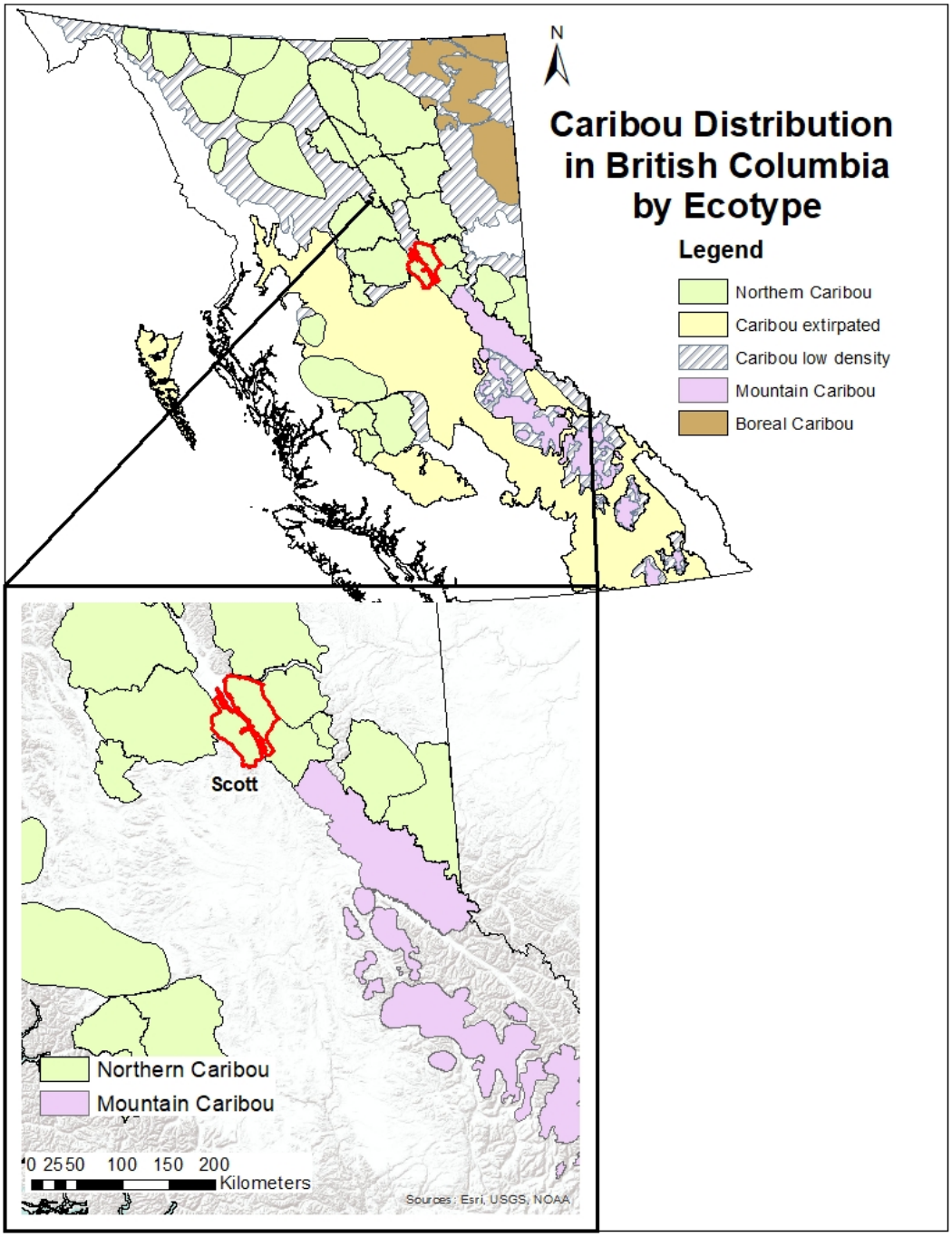
Edmonds 1988). Group sizes typically increase for the rut in mid-October and then return to smaller sizes as animals disperse to lower elevation forested winter ranges (Edmonds 1988, COSEWIC 2011).

The Scott caribou subpopulation was divided "in half" by the creation of the Williston Reservoir, and as a result, caribou no longer make what was a traditional migration across the Parsnip River. The result is that the herd now exists as two separate herds; the western and eastern groups (Figure 1; Sittler and McNay 2017; but see status of Scott West below).

The eastern herd of Scott caribou predominantly live on the east side of the Parsnip Arm of the Williston Reservoir, immediately adjacent to the Moberly range. Recently, some caribou from the Moberly range have been found to use portions of the Scott eastern winter range in some years (Seip and Jones 2015). During the winter, eastern Scott caribou live at high elevations, foraging for terrestrial lichens in alpine areas and for arboreal lichens in adjacent subalpine forests (British Columbia Ministry of Forests, Lands and Natural Resource Operations and British Columbia Ministry of Environment 2015).

The western Scott range area is approximately 1,934 km^2 and is located on the southwest shore of the Williston Reservoir, stretching from the southern tip of the Reservoir (Parsnip River) north to the Manson Peninsula (16 km to 102 km on the Finlay Forest Service Road). From the western shore of the Williston Reservoir, the herd area extends westward for approximately 25 km. Elevation in the area ranges from approximately 650 m to 1200 m, encompassing biogeoclimatic subzones ESSFmv3, SBSmk1, SBSmk2 and SBSwk2 (McNay et al. 2008, Sittler and McNay 2017).

Figure 1: The location of the Scott subpopulations (East and West) of woodland caribou. The 4149 km2 range (inset: red outline) is within the Omineca Region.



2.2 Habitat and Behaviour

The behaviour of the Scott caribou subpopulation has been profoundly affected by the Williston Reservoir. Historical accounts of their seasonal habitat use had them migrating from their summer habitat in high elevation areas around the Scott Creek headwaters, crossing the Parsnip River to montane winter range (British Columbia Ministry of Environment 2014, Sittler and McNay 2017, Government of British Columbia 2018). This migration pattern was stopped by the flooding associated with the construction of the WAC Bennet Dam (Sittler and McNay 2017) and until a study was conducted beginning in 2014, not much was known of the Scott subpopulation, post-Reservoir behaviour (Austin 2012).

Sittler and McNay (2017) concluded that the western Scott herd of the subpopulation has been extirpated, with few if any caribou remaining there. This makes their habitat and behaviour impossible to describe. The Scott East subpopulation movements have them overlapping with the Moberly subpopulation in the summer, but they migrate to separate low elevation range in winter.

The Scott herd is estimated to have 58% (2392 km^2) of undisturbed critical habitat; less than required (65%) for population recovery (McNay et al. 2014).

2.3 Population Size and Trend

Population estimates for the Scott caribou do not have a long history or a complete timeline. The segment of the Scott subpopulation with a range west of the Williston Reservoir has been extirpated (Sittler and McNay 2017). The segment that ranges East of the Williston Reservoir overlaps with the Moberly subpopulation and so its exact number is not entirely clear but counts in 2014 and 2015 show a declining trend (Figure 2). Modeling has predicted that the Scott subpopulation will be extirpated by or around 2021 (McNay et al. 2014).

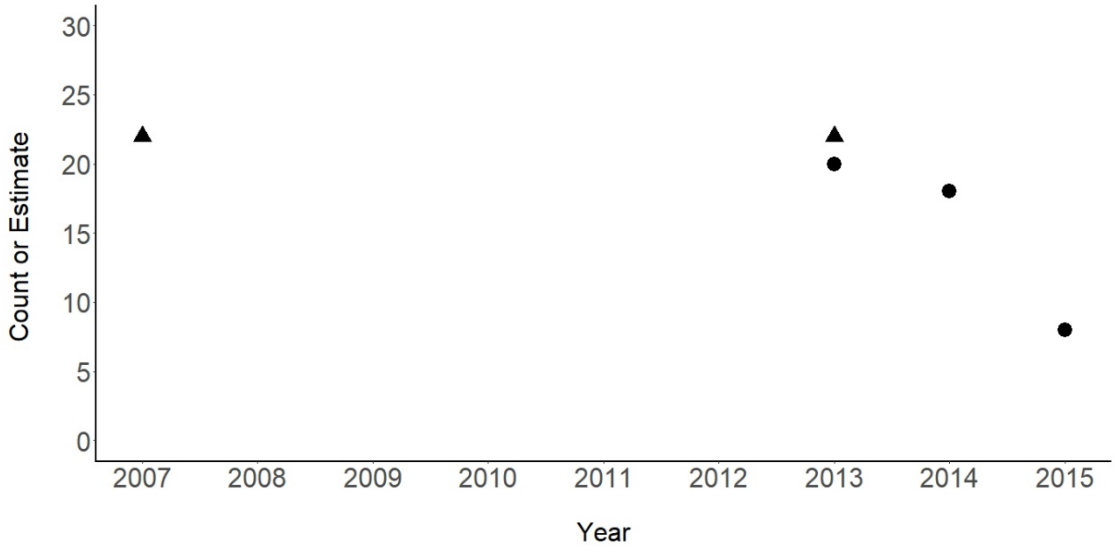


Figure 2: Caribou counts (dots) and estimates (triangles) for the Scott sub-population. Counts and estimates made by Government of British Columbia staff in all years and reported in Seip and Jones (2013) and Seip and Jones (2015).

Caribou recruitment, measured as percent of calves in the population observed during a spring census (Bergerud and Elliot 1986) has been rarely measured but is above threshold values required for recover (Figure 3).

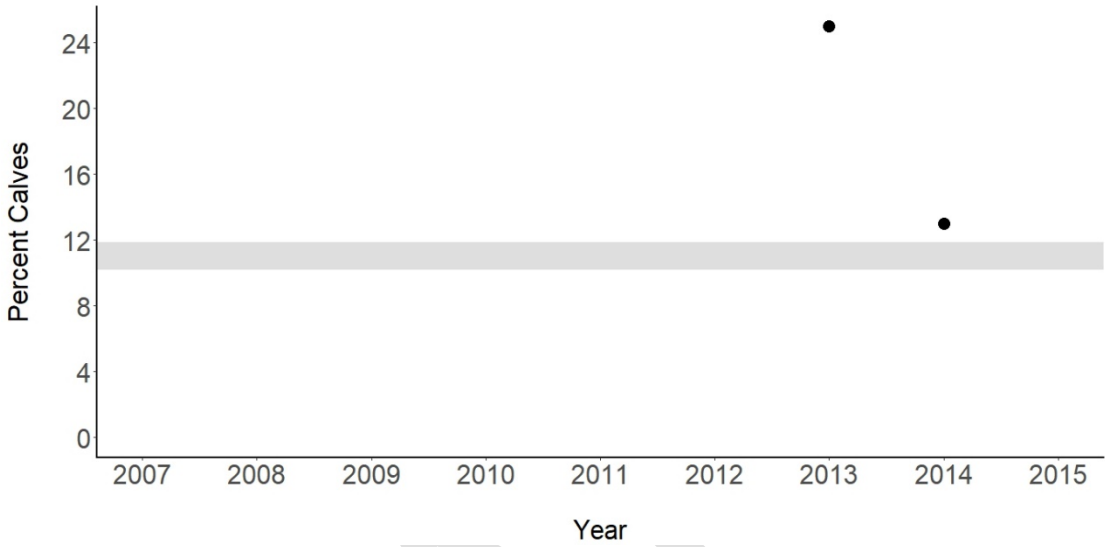


Figure 3: Caribou population recruitment measured in the Scott caribou subpopulation range. Recruitment is defined here as the percent of the estimated population that is in the calf cohort. Recruitment lower than approximately 10 to 12% is considered below a threshold that will balance natural mortality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

3 THREATS AND LIMITING FACTORS

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

Here, the following threats are considered:

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

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^2 will result in woodland caribou declines. More recently, the federal recovery strategy identifies 3 wolves/1000 km^2 as a target (Environment Canada 2014).

In a study spanning 2014 – 15, four caribou in the Scott subpopulation were fitted with radio collars. None of these caribou died by predation (Seip and Jones 2016b). Between 2002 and 2015, four adult mortalities from the Scott subpopulation were recorded, three were by predation with two known to be by wolves, one an unknown predator and one mortality had an unknown cause (Seip and Jones 2016b).

There are no published estimates of wolf numbers or habitat use in the range of the Scott caribou subpopulation.

3.2 FOOD LIMITATION

Woodland caribou are herbivores and rare among large mammals as lichen eaters (Johnson et al. 2004). While lichen makes up the bulk of their winter diet (Johnson et al. 2000, Parker et al. 2005), it is a smaller proportion of their summer diet (Denryter et al. 2017). And although habitat selection is predominantly thought to be influenced by predator avoidance, selected habitats must also be able to satisfy an individual's nutritional needs (Newsome et al. 2000, 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).

Although there is no Scott subpopulation-specific information on food limitation, a model of habitat use by the adjacent Chase caribou subpopulation suggests that caribou select habitats according to food quality and availability (Doucette and McNay 2003). This interacts with predation risk if there is overlap between risky habitats and foraging opportunities (Doucette and McNay 2003). Given the amount of undisturbed, effective habitat they have remining in their range (1986 km^2), it is predicted that 258 caribou could be supported (McNay et al. 2014). This is a number far lower than existing estimates (Figure 2) and suggests that there is no direct food limitation for the Scott caribou subpopulation.

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 cutblocks for woodland caribou in Newfoundland was found to be 15 km beyond the actual cut area (Chubbs et al. 1993). Hence, even an array of small forest cutblocks can have a significant influence on caribou habitat availability.

Data from iMapBC (http://maps.gov.bc.ca/ess/sv/imapbc/) indicate that from 1963 through 2017, there were 894 km^2 of cutblocks in the range of the Scott caribou subpopulation (21% of the area). A 2014 analysis of caribou habitat in that area reported 469.5 km^2 of cutblocks ; approximately half of the GIS analysis (British Columbia Ministry of Environment 2014). McNay et al. (2014) reported that 58% of the Scott caribou subpopulation range has been disturbed; 7% below the 65% threshold predicted to be required for caribou recovery.

3.3.1.2 MINING

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

Mining is a significant industry in the range of the Scott caribou subpopulation. There are about 1266 km^2 of high elevation winter caribou habitat that are within a coal reserve, 1293 km^2 within a placer reserve and 1293 km^2 within the mineral reserve (British Columbia Ministry of Environment 2014). Much of these areas however, 1297 km^2, have been designated as Resource Review Areas (Johnson et al. 2015).

The Thompson Creek Metals Company has an active License to Cut covering 20 km^2 of the Mount Milligan gold and copper mine, just to the south of the western Scott range.

3.3.1.3 OIL AND GAS

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

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

There are no oil and gas tenure areas in the range of the Scott caribou subpopulation, however there is a gas distribution pipeline that bisects the western range and runs along the southern extent of the eastern range. Gas fields are not far away, with the Boulder and Brazion tenures approximately 25 km from the southeastern extent of the Scott 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 22 km^2 of wind energy tenures in the Scott caribou subpopulation range (Swanell; British Columbia Ministry of Environment 2014). The Conifex Biomass generator has been operational in Mackenzie, BC within the Scott caribou range since 2014.

The largest clean energy impact on the Scott caribou subpopulation has been the WAC Bennett hydroelectric dam that created the Williston Reservoir in 1968 (making Williston Lake the third largest lake in North America; https://www.bchydro.com/community/recreation_areas/visitor-centres/wac-bennett-visitor-centre.html). This reservoir divided the Scott subpopulation range into eastern and western sections and flooded seasonal movement corridors. Recently, caribou have been extirpated from the range west of the Williston Reservoir (Sittler and McNay 2017).

There are smaller-scale, water power tenures being explored on Mount Crysdale, Mount Selwyn, Middle Nation River, Upper Nation River, Lower Nation River and Finlay River.

3.3.1.5 OTHER

Beyond some small communication towers, private camps, roadside quarries there are no other significant developments active or being proposed in the Scott 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 be time-lagged.

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).

Snowmobiling is very popular on and around the Williston Reservoir and along the numerous logging roads within the Scott caribou subpopulation range. Bullhead Mountain, Mount McGetthing, Table Mountain, Morfee Mountain and the Dunlevy Valley are all popular, regional snowmobile areas (although not all directly within Scott caribou range). The Rocky Mountain Riders snowmobile club coordinates rides in the area and maintains two cabins for snowmobilers in the region.

There is a commercial summer and winter multipurpose tenure on Butler Ridge adjacent to the Scott caribou range.

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).

There are no HeliCat Canada registered helicopter or cat skiing operations in the range of the Scott caribou subpopulation range.

3.3.2.3 OTHER

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

Backcountry skiing does not appear to be a common activity in the Scott caribou subpopulation range. The Pine Pass area (near the Powder King ski resort in the Kennedy Siding caribou subpopulation range), to the east of their range, is a popular, backcountry ski-touring destination.

3.3.3 OTHER

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

3.3.3.1 AGRICULTURE

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

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

There are four small (less than 12 km^2 in total) farming tenures in the Scott caribou subpopulation range, all on the outskirts of Mackenzie, BC.

3.3.3.2 MAJOR HIGHWAY CORRIDORS

Where they occur in caribou habitat, highways have strong, negative effects on caribou populations (Curatolo and Murphy 1986, Apps and McLellan 2006, McFarlane et al. 2009). Vehicle activity on highways poses a movement barrier for caribou as they are either reluctant to approach a roadway or get killed trying to cross (Dyer et al. 2002, Rytwinski and Fahrig 2012). Habitat and population fragmentation results as populations are unable to move between ranges. Highways and roadways can also give people access to caribou range that increases the potential for disturbance. Linear disturbances, such as roadways have a large ZOI (Wolfe et al. 2000, Oberg 2001, Polfus et al. 2011, Whittington et al. 2011).

Highway 97 (the John Hart Highway) runs south of the Scott caribou subpopulation range, and Highway 39 terminates at Mackenzie, BC near the southern tip of their range. Forestry Development roads are the only other traversing roadways in their range.

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 2018).

There are numerous linear disturbances crossing the range of the Scott caribou subpopulation. The Parsnip forest development road runs along the Williston Reservoir in the East Scott range. There is an 80 km long power

transmission line running along a forestry development road in the West Scott range. The caribou range for the East Scott group has numerous resource roads and linear features.

3.3.3.4 HUNTING

The Scott caribou subpopulation overlaps with Wildlife Management Units (WMU) 7-29, 7-30, 7-31 and a sliver of 7-28 along the western extent of their range. WMUs7-29 to 30 have fall mule deer, white-tailed deer, moose, elk, mountain goat seasons. There has been no caribou hunting in these WMUs since 2002, the last caribou shot in WMU 7-29 was in 1987 and from 1976 through 2002, 30 caribou were killed by resident and non-resident hunters. Hunting is not currently a threat to the Scott caribou subpopulation.

3.3.3.5 POACHING

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

There have been no reported incidents of caribou poaching in the Scott caribou subpopulation range since 2008.

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).

Although the area to the east of the Williston Reservoir has seen very little fire, several large fires to the east of what is now the Williston Reservoir, one in 1925 and another in 1942 burned 700 km^2 of area or about 80% of the total area burned over the entire Scott range since 1925. This is 17% of the total range area (Figure 4). Since 1968 (50 years from the time of writing), only 33 km^2 of area has burned in the Scott caribou subpopulation range (British Columbia Ministry of Environment 2014).

Mountain pine beetle infestations have affected the western side of the Williston Reservoir more than the eastern side of the Scott caribou subpopulation range. There are 1828 km^2 of severely infested forests and 170 km^2 of very severely infested forests. Mountain pine beetle observations began in 1979 and were last surveyed in 2016. They are predicted to have profound socio-economic effects on all caribou subpopulations in the British Columbia interior (Parkins 2008) as well as on caribou habitat (Cichowski 2007).

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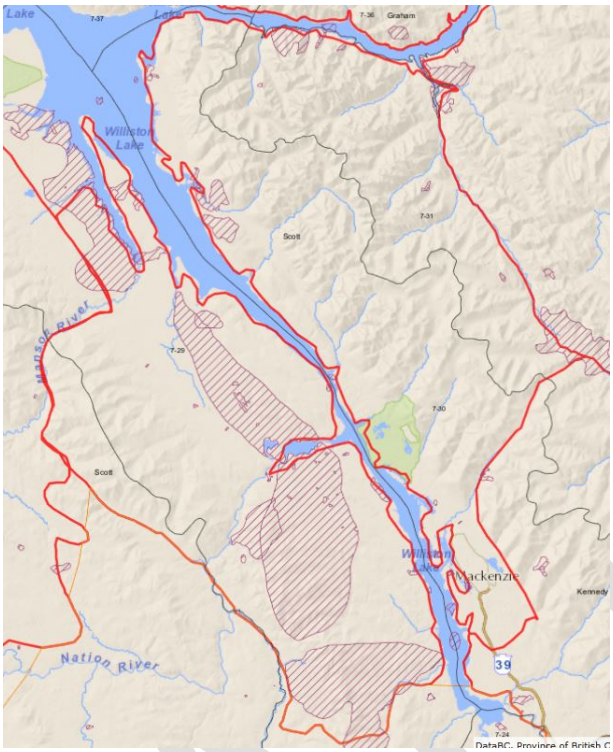

Figure 4: iMapBC snip showing burned areas in the Scott caribou subpopulation range. Burned perimeters are shown as red-hatched areas. The thick red lines are caribou subpopulation boundaries (labelled) and grey lines are Wildlife Management Unit boundaries (labelled).

3.5 Parasites and Diseases

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

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

There is no reported occurrence of brucellosis or tuberculosis in British Columbia in any species. Severe symptoms of Besnoitiosis have not been found in caribou in British Columbia (Miller et al. 2014a). However,

many of the other parasites can be found in woodland caribou in British Columbia with affects on individuals, but no reported population-effects on the Scott subpopulation. Chronic wasting disease, which has the potential for strong negative effects on this subpopulation, has not been detected in British Columbia in any species (Schwantje 2015).

3.6 Climate Change

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

Climate change models for British Columbia suggest that areas in the Cariboo 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).

The Scott caribou subpopulation lives in the Omineca Mountains where the largest impacts of climate change will be in snow pack changes, glacial retreat and vegetation shifts (Hamann and Wang 2006, Rose and Burton 2011). Predictions of quantitative changes to the Scott caribou subpopulation relative to climate changes have not been published, but there is growing evidence that the changing temporal and spatial environment will present an additional challenge to this herd (Steeger and Wilson 2006).

3.7 Small Population Size Effects

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

With a population below 50 animals since at least 2007 (and likely before that) and declining the Scott caribou subpopulation is very susceptible to small population effects, including a genetic bottleneck. Genetic analyses of

other caribou subpopulations in their region suggests close relatedness among shallow-snow subpopulations (Hart Ranges, Quintette, Kennedy Siding, Moberly; Serrouya et al. 2012). Although the Scott subpopulation was not part of this analysis, they are connected to the Moberly subpopulation. Amongst this group, the expected heterozygosity and allelic richness are moderately high (McDevitt et al. 2009).

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).

The Scott and Moberly have a relatively high level of herd overlap compared to other caribou subpopulations (Sittler and McNay 2017) and their genetic structure is likely similar (McDevitt et al. 2009). They are isolated to the west and north by the Williston Reservoir (assuming that the Scott west caribou are extirpated), have little contact with the Kennedy siding subpopulation due to its small size but likely mingle with the Moberly subpopulation to the east on the transition between winter and summer range (Seip and Jones 2016a, Sittler and McNay 2017).

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4 MANAGEMENT HISTORY

4.1 HABITAT

The Scott caribou subpopulation range is 59% in-tact caribou habitat; 2253 km^2 of very high quality, 478 km^2 of high quality, 1885 km^2 of moderate quality and 3086 km^2 of low quality habitat (Austin 2012). This is considered below the threshold required to promote recovery (Austin 2012).

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, 1996). For their part, forestry regulations prescribe practices to manage resource use and protect forests that are caribou habitat (Seip 1998).

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.

Heather-Dina Lakes Provincial Park falls entirely within the Scott caribou subpopulation range and protects 597 km^2 area, although much of this is not caribou habitat (lakes; British Columbia Ministry of Water, Land and Air Protection 2003). Hunting and backcountry skiing are permitted, but snowmobiling and off highway vehicles are not (British Columbia Ministry of Water, Land and Air Protection 2003) There are also 1428 km^2 of Old Growth Management Areas and 409 km^2 of Ungulate Winter Range (UWR) that also protect key caribou habitat in this range (Austin 2012). There are an additional 51 km^2 of Wildlife Habitat Area and 920 km^2 of UWR overlapping with the Moberly caribou subpopulation range within which the Scott subpopulation also ranges (British Columbia Ministry of Environment 2014).

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 2018). Restoration of mountain pine beetle affected stands has been trialed using a two step process where standing dead trees are knocked down and then burned to stimulate regrowth (Haughian et al. 2008, Sulyma 2009)Nevertheless, it is considered an essential step for caribou recovery in the absence of protection required for natural habitat regrowth that can take tens of decades.

There are many forestry cutblocks and forest service roads, particularly in the western segment of the Scott caribou subpopulation range. There are 311 km of retired forest service roads in their range, but it is not clear how much active restoration has occurred to these retired segments.

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 2500 km of forest service roads in the Scott caribou subpopulation range providing extensive recreational access. The Peace Northern Caribou Plan (Austin 2012) recommends that the benefits of additional recreational motor vehicle closures in the Scott herd areas be reviewed.

4.2.1 Snowmobile

Snowmobiling is a very popular activity in the range of the Scott caribou subpopulation. There is a motorized vehicle closure above 1400 m elevation in wildlife management unit 7-31 that overlaps with the eastern Williston Reservoir Scott subpopulation range (Austin 2012). There are no such restrictions in their range to the west of the Williston Reservoir.

4.2.2 HELI-SKI / CAT-SKI

Yellowhead Helicopters, Pacific Western Helicopters all operate out of Mackenzie and fly areas that include the Scott caribou subpopulation range. While they do recreational skiing in other areas, they do not advertise heli-skiing from Mackenzie. There are no Heli-Cat Canada member organizations operating in the Scott range.

See section 3.3.2.2 for general threat information.

4.2.3 OTHER

The town of Mackenzie lies within the recognized boundary of the Scott caribou subpopulation range and is the base of many recreational activities that extend into caribou range including hunting, snowmobiling, ski-touring and OHV riding.

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 9–10/1000km^2 but increased at wolf densities from 1–4/1000km^2 (Bergerud and Elliot 1986). For this reason, target wolf densities that would enable caribou recovery are set to 6.5/1000km^2. In the absence of effective habitat or alternative prey management to achieve these densities, direct wolf management must be undertaken to achieve caribou conservation goals.

Following a recommendation from the Peace Northern Caribou Plan (Austin 2012) a wolf control program was begun in the Scott/Moberly caribou subpopulation range beginning in the winter of 2015 (Sittler et al. 2015, Seip and Jones 2016b, Sittler et al. 2016, Sittler and McNay 2017). Simultaneously there was a caribou population increase due to higher adult survival and high calf recruitment (Seip and Jones 2016a). From 1976 to 2013, 565

wolves were killed by resident and non-resident hunters in the wildlife management units overlapping with the Scott caribou subpopulation (mean = 15 per year).

4.3.2 Cougar Management

There has been a legal cougar hunt in the wildlife management units overlapping the Scott caribou subpopulation since 1985. Since that time only 2 cougars have been legally killed by hunters. Outside of this hunt, there is no strategy of cougar management to protect caribou in the Scott subpopulation area.

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.

Black and grizzly bears are present, but not particularly abundant in the range of the Scott caribou subpopulation, although there is no systematic management of their populations outside of an annual hunt. The grizzly bear hunt was suspended in the Moberly area, overlapping the eastern Scott subpopulation range, in 2012 (Ministry of Forests, Lands and Natural Resource Operations 2012) and suspended across the province in 2017 (McLellan et al. 2017). But between 1976 and 2013, 145 grizzly bears were killed by hunters. The population of grizzly bears in the area has been estimated to be low (maximum 20 bears / 1000 km^2) in this region.

Black bears continue to be hunted in this region, and their populations are typically higher than that of grizzly bears. Hunters killed 2648 black bears between 1976 and 2013 (more than 75 per year on average) in the wildlife management units overlapping with the Scott caribou subpopulation. Beyond managing this hunt, there is no systematic management of black bears in this region to promote caribou recovery.

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.

The Peace Northern Caribou Plan recommends that alternate prey (moose, deer, elk) be reduced through hunting in the Scott subpopulation area (Austin 2012). More than 12,000 moose were hunted in the wildlife management units overlapping the Scott caribou subpopulation range between 1973 and 2013. The licenced harvest of moose has been declining in British Columbia since 1996 (Kuzyk et al. unpublished). Given that moose populations are already declining, it seems unlikely that a specific management program will be initiated.

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.

Both mule and white-tailed deer (mostly mule deer) are hunted in the wildlife management units overlapping the Scott caribou subpopulation, but there is no other management being used to lower these populations to benefit caribou recovery.

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 are elk in the range of the Scott caribou subpopulation and between 1976 and 2013, 283 were legally killed by hunters in the wildlife management units overlapping their range. But no other elk management measures are being used to benefit caribou populations.

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.

Maternity penning was recommended for the Moberly (Klinse-Za) subpopulation in their action plan (McNay et al. 2013). The spatial overlap between the Moberly and Scott subpopulations means that such recovery actions affect both groups, and it is likely that some Scott animals have been included (Seip and Jones 2016a, McNay et al. 2017). Penning began for the Moberly/Scott caribou subpopulations 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).

4.5.2 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 facilities that can reinforce the Scott caribou subpopulation. With their low numbers however, they would be a candidate recipient herd should the opportunity arise, particularly with the predator management and habitat protection that is in place.

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 have been no translocations to or from the Scott caribou subpopulation range. Their low size makes them an inappropriate donor population, but the predator control program and moderately high habitat values in the eastern portion of their range make them an appropriate recipient herd.

4.5.4 OTHER

The proximate cause of caribou population declines is predation. While predator management is a direct way to manage this threat, an alternative solution is predator exclusion fencing (Hayek et al. 2016). In part, this approach is linked to direct predator management as any predators within an exclusion fence would be lethally removed, and it is linked to maternity penning as this is a form of small-scale, temporary predatory exclusion fencing. However, there are recent, and very large scale (thousands of hectares), proposals to erect predator exclusion fencing as a mitigation for caribou populations where habitat restoration is an unrealistic goal but the caribou population is critically low (Boutin and Merrill 2016, Cornwall 2016, Hebblewhite 2017, Proulx and Brook 2017).

To date, this conservation method has not been attempted anywhere, including in the range of the Scott 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.

There are abundant stewardship opportunities for the Scott caribou subpopulation. There are several first nations communities (West Moberly and Saulteau First Nations) actively engaged in their recovery and with a long cultural, management and conservation history with local caribou populations, offer considerable wealth in stewardship actions and messages (Coady 2016, McNay et al. 2017). There are active winter recreational groups using caribou habitat, particularly in the range west of the Williston Reservoir who are concerned and affected by caribou management actions. As well, government management occurring in their range, particularly maternity penning, create ideal opportunities for stewards and stewardship groups to become involved.

The WAC Bennett dam not only offers a venue for stewards (e.g., caribou ambassadors) to make contact with a visiting public, it is also part of the story. The expansion of Williston Lake as the dam reservoir has profoundly affected the biology of this subpopulation. It highlights messages around migration, seasonal habitat use and connectivity.

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.

In association with the maternity penning operation in the eastern range of the Scott caribou subpopulation, ongoing research to establish population recovery relative to predation, adult mortality and recruitment is needed. As well, to recover caribou in the western range of the Scott caribou subpopulation, a more thorough understanding of habitat restoration techniques to potentially accelerate the return of caribou critical habitat is required.

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.

Ongoing monitoring of the caribou and wolf populations associated with the maternity penning operation within the Moberly subpopulation (overlapping with the Scott subpopulation) is needed. Annual population surveys to determine population size and calf recruitment is recommended.

Movement and distribution monitoring to determine if animals are using the range to the west of the Williston Reservoir should be periodically conducted. Periodic assessment of habitat recovery and linear disturbance restoration using remote sensing tools is also recommended.

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 the Scott caribou and their habitat may benefit or inhibit the protection of other species and their habitats (British Columbia Ministry of Environment 2013). Predator management directly reduces locally eliminates wolf populations. Other ungulate species like moose may have their numbers lowered to facilitate caribou conservation. Habitat protections focussed on caribou also protect species such as mule deer, bighorn sheep and old-growth species such as the northern goshawk.

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).

All of the high-elevation habitat (> 1400 m) in the eastern range of the Scott caribou subpopulation is protected from motorized vehicle (snowmobile, OHV) use. This affects snowmobile and OHV user groups. As well, the presence of wildlife habitat areas, ungulate winter range and old growth management areas in their range limits access to timber resources to protect caribou habitat. This may affect the regional resource economy.

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 Scott 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**: West Moberly First Nation, Saulteau First Nations, Tse'Khene Nation (McLeod Lake Indian Band), Takla Lake First Nation, Tsay Keh Dene

Local: Mackenzie, Hudson’s Hope, Moberly Lake, Lemoray, Germansen Landing

Regional: Prince George, Dawson Creek, Fort St. John, Chetwynd

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 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, Yellowstone to Yukon Initiative

Commercial: **Hunting and Trapping**: **Accommodation and Guiding**: 15 traplines (TR0728-T1, T5, T7, TR0729-1, T2, T3, T4, T5, TR0730-T2, T3, T4, T5, TR0731-T2, T3, TR0737-T1), Finlay River Outfitters (based in Mackenzie but hunt further north), Mackenzie Mountain Outfitters (1978) Ltd., Circle M Outfitters, Claw Mountain Outfitters, Inzana Outfitters, Omineca Guide & Outfitters, Opatcho Lake Outfitters, Pitka Mountain Outfitters, Tsay Keh Dene Outfitters, United Guide & Outfitters, Wayne Mueller Guide and Outfitter, Two Rivers Guide Outfitters, Larry Erickson's Alpine Outfitters

Forestry *(Active licences to cut)*: A.M. Anderson Ventures, Richard Ismay, Canadian Forest Products, D & D Boon Construction Services, Mackenzie Fish & Game Association, McLeod Lake Mackenzie Community Forest Limited Partnership,

Forestry *(Woodlots)*: Mackenzie District Manager, David Wilson, Denise McGowan, Pine Plateau Holdings

Agriculture: four tenures near Mackenzie.

8 Recommended Actions

8.1 Short Term (Within 6–12 Months)

- Follow-up on Moberly (Klinse-Za) / Scott herd maternity penning conservation effort with caribou population, caribou recruitment and wolf population monitoring
- Begin exploration of caribou habitat and access restoration on the western range of the Scott subpopulation.

8.2 Medium Term (Within 12–24 Months)

- Undergo program to recover caribou habitat in the western range of the Scott caribou subpopulation with an objective of increasing habitat density to and above recovery threshold
- Continue predator management.
- Maintain population and recruitment surveys

8.3 Long Term (Within 24–48 Months)

- Maintain predator management to meet caribou recovery goals
- Maintain habitat restoration program to achieve threshold habitat density for caribou recovery.

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