

WOODLAND CARIBOU PLAN

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

Woodland Caribou are further divided into Local Population Units by Environment Canada. Within the Central group there are three Local Populations. The Kennedy Siding subpopulation is in the Pine River Local Population Unit, along with the Scott and Moberly 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 Kennedy Siding 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 Kennedy Siding Central Mountain caribou subpopulation.

2 POPULATION DESCRIPTION

Caribou populations within this DU (8) are largely isolated from the Northern Mountain caribou (DU7) 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 in the north.

The caribou use windswept alpine slopes and adjacent subalpine forests on the eastern edge of the Rockies 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 undertake 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 (Hervieux et al. 2013, Williamson in preparation), probably in response to unfavourable anthropogenic 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 (Edmonds 1988, Williamson in preparation). Group sizes typically increase by the rut in mid-October and then

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return to smaller groups as animals disperse to lower elevation forested winter ranges (Edmonds 1988, COSEWIC 2011).

This site contains critical early winter habitat for mountain caribou in the vicinity of Kennedy (BCR) railway siding, situated approximately 25 km south-east of Mackenzie. The site is a flat alluvial fan bounded by Colbourne Creek to the south, Parsnip River to the west, Misinchinka River to the north and Misinchinka Mountain Range to the east. It is primarily covered by dry pine forest type with moderate to poor productivity. This area is within Natural Disturbance Type (NDT) 2, a zone with infrequent stand initiating events. Caribou typically use the Kennedy Siding site annually from late October to early January, depending on weather conditions. Caribou leave surrounding higher elevation fall ranges to avoid early winter accumulations of uncompacted snow. The caribou forage on terrestrial lichens, forbs and low shrubs under the pine forest. Relatively low snow accumulation allows the caribou to enter to forage and is not an impediment to caribou travel. Caribou leave this low elevation habitat as snow depth increases and move to high elevation sites which are either wind-swept or have compacted snow conditions (Arthur 2002).

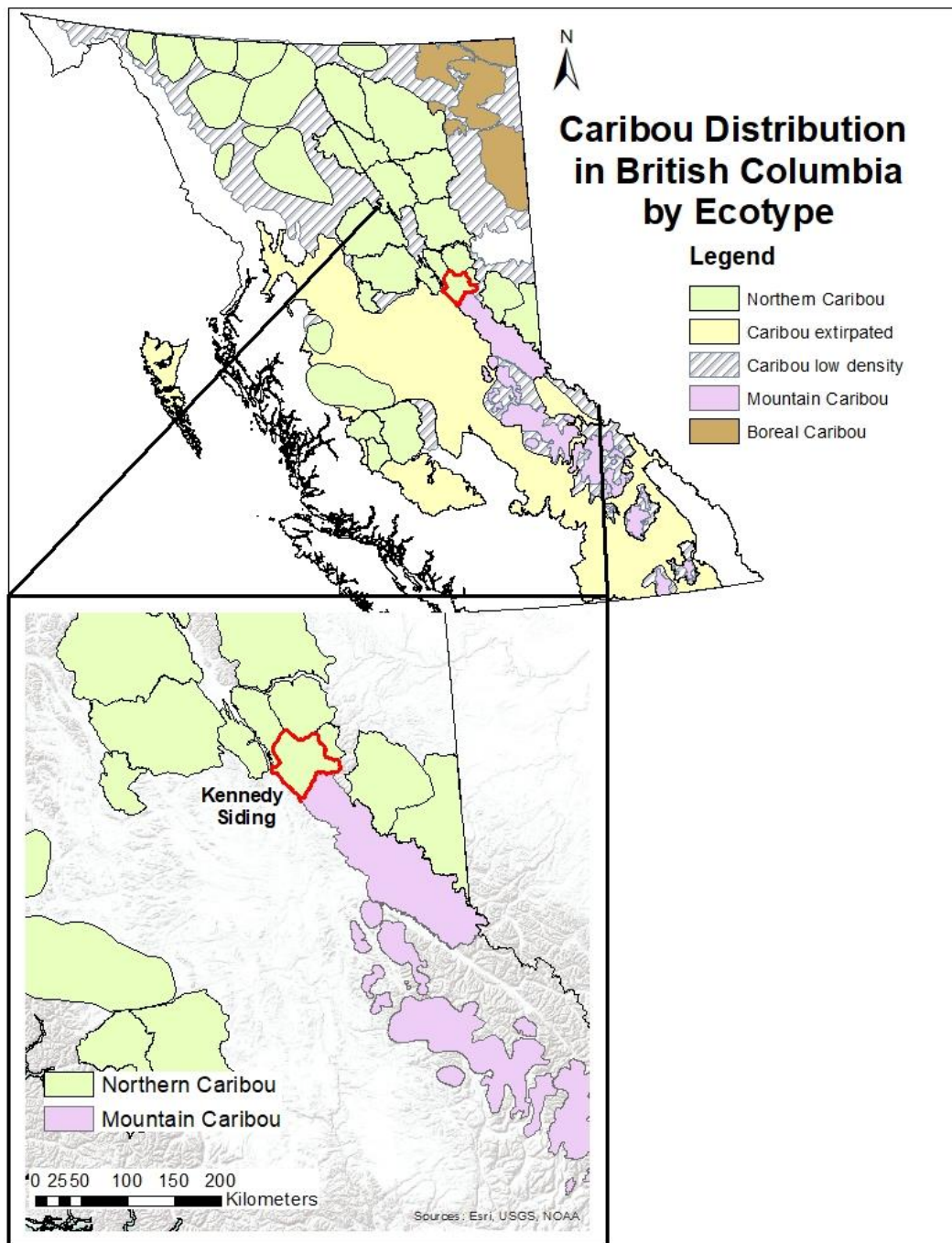


Figure 1: The location of the Kennedy Siding subpopulation of woodland caribou. The 2962 km² range (inset: red outline) is within the Omineca Region.

2.2 HABITAT AND BEHAVIOUR

Kennedy Siding caribou migrate from alpine habitats to low-elevation pine flats in early winter where they forage on terrestrial lichens in open and forested areas, and available arboreal lichens in mature-pine

stands (Seip and Jones 2016b). Caribou return to alpine and subalpine areas in the fall when deep snow makes cratering for terrestrial lichens at low-elevations impossible (Seip and Jones 2016b). During spring calving, Kennedy Siding caribou predominantly selected high-elevation (> 1800 m) fir dominated forests (Jones et al. 2007).

2.3 POPULATION SIZE AND TREND

Population estimates for the Kennedy Siding caribou subpopulation have been conducted periodically since the early 2000s (Figure 2). While the population has declined since the first counts in 2002, it has also fluctuated greatly and appears to have stabilized, and slightly increased from 2013 through 2017 (Figure 2).

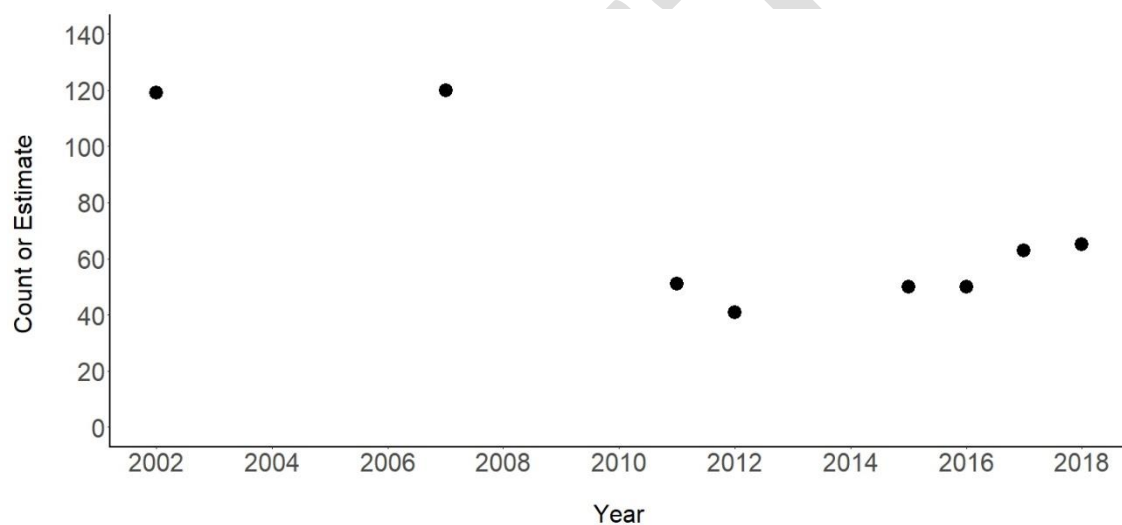


Figure 2: Caribou counts and estimates for the Kennedy Siding caribou subpopulation. Counts made by Government of British Columbia staff in all years. Estimates were from aerial survey corrected for sightability (2002, 2011, 2012). Counts were either total counts from remote cameras (2015, 2016, 2017) or a minimum count (2007). Data from Jones et al. (2004), Seip and Jones (2011), Austin (2012), Seip and Jones (2013, 2016b, 2017, 2018).

Caribou recruitment, measured as percent of calves in the population observed during a spring census (Bergerud and Elliot 1986), has been above the threshold range of 10 – 12% in most years since 2002 (Figure 3).

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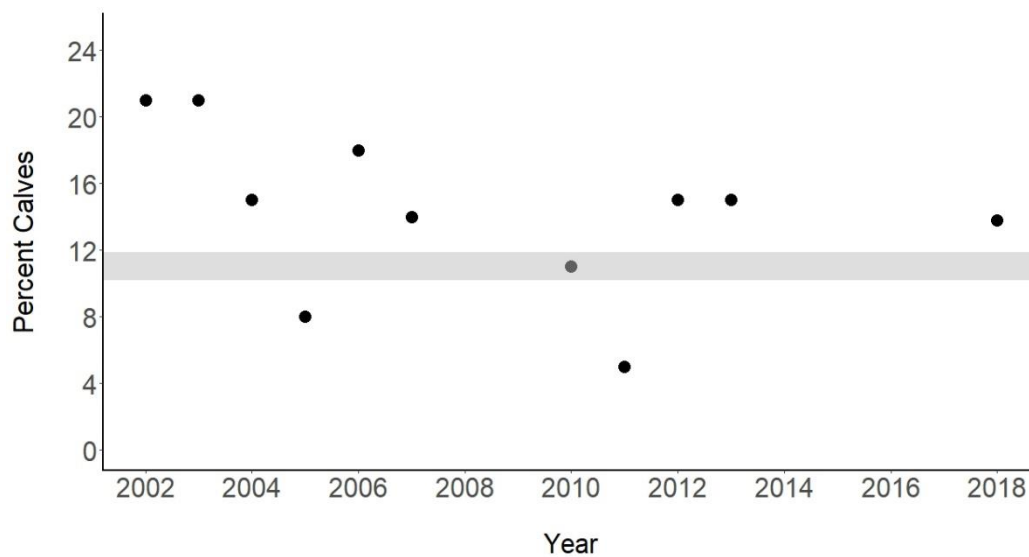


Figure 3: Caribou population recruitment measured in the Kennedy Siding caribou subpopulation range. Recruitment is defined here as the percent of the estimated population that is in the calf cohort. Recruitment lower than approximately 10 to 12% is considered below a threshold that will balance natural mortality (grey band; Bergerud and Elliot 1986). Data as in Figure 2. Figure 2: Caribou counts and estimates for the Kennedy Siding caribou subpopulation. Counts made by Government of British Columbia staff in all years. Estimates were from aerial survey corrected for sightability (2002, 2011, 2012). Counts were either total counts from remote cameras (2015, 2016, 2017) or a minimum count (2007). Data from Jones et al. (2004), Seip and Jones (2011), Austin (2012), Seip and Jones (2013, 2016b, 2017, 2018).

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 km² will result in woodland caribou declines. More recently, the federal recovery strategy identifies 3 wolves/1000 km² as a recovery target (Environment Canada 2014).

Wolves are the dominant predator of caribou in the Kennedy Siding caribou subpopulation, accounting for at least 41% of all mortalities between 2002 and 2015 (Seip and Jones 2016b). Average adult mortality rate is 16% (Seip and Jones 2016b). Radio collaring during the 2000s found high variability in adult annual mortality from 0 to 29% of caribou killed by wolves (mean = 16%) (Seip and Jones 2011, Table 9). It is important to note that during this time a wolf management program was being conducted (see below), contributing to differences over time. Between March 2015 and March 2017, there were 2 adult mortalities among radio-collared caribou (Seip and Jones 2016a, 2017).

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).

The subject of food limitation in the Kennedy Siding caribou subpopulation has been intensely and recently studied (Heard and Zimmerman 2017). The prevailing hypothesis that the few caribou that occupy a relatively large area are food limited relates to interactions with predators. It is not necessarily the abundance of food that limits the caribou, but its distribution. Habitat change in this area has forced woodland caribou to abandon critical habitats that no longer have accessible food and occupy other habitats where food is available, but that also have elevated predation risk (McLellan et al. 2012, D. Heard, personal communication). While this interaction has not yet been demonstrated, experiments to measure the impact of supplementing this subpopulation with food are underway.

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).

3.3.1.1 FORESTRY

Woodland caribou are an old-growth forest dependent species (Bergerud 2000). Hence, forest management affects their distribution and population dynamics. Although mountain caribou populations live seasonally in treeless, alpine ecosystems, all spend some of the year in forests. For this reason, forestry and natural disturbances will affect woodland caribou populations through habitat destruction and fragmentation (Smith et al. 2000). Forestry effects include very general habitat loss that reduces the amount of old-growth forest, to reduction in forest-based food resources to creating more, early seral forest habitat for apparent competitors (see below) such as deer and moose (Simpson and Woods 1987, Cichowski 1989, Seip 1990, Stevenson 1991, Cumming 1992). Factors, such as the type of forest regrowth (Cichowski 1989) and the size of cutblocks (Edmonds and Bloomfield 1984), play a role in the effect of forestry practices on woodland caribou populations. The ZOI of clearcuts for woodland caribou in Newfoundland was found to be 15 km beyond the actual cut block (Chubbs et al. 1993). Hence, even an array of small forest cutblocks can have a significant influence on caribou habitat availability.

There are approximately 850 cutblocks in or bordering on the range of the Kennedy Siding caribou subpopulation covering 272 km² of the land base (9%). Much of this is concentrated in the south of the area they occupy, adjacent to Williston Lake and the Peace River, but there are cutblocks scattered throughout their range. Commercial logging began in the area in 1960 and continues to current day, however the undisturbed area in this range is above critical habitat threshold for recovery (73%; McNay et al. 2014).

3.3.1.2 MINING

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

There is mining in the range of Kennedy Siding caribou subpopulation, including the Kemess open-pit copper and gold mine and about 20 smaller gravel and sand pits. In total, they only cover 0.5 km² and are found adjacent to other disturbances such as roads. While they may play a role, it is minor in this region. The Sukunka Coal mine is about 25 km to the east of the Kennedy Siding range and the Murray River Coal mine is about 65 km to the southeast.

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).

The region of oil and gas resources in British Columbia intersects with the Kennedy Siding caribou subpopulation range at its extreme northeast corner. There are 32 km² (1%) of Oil and Gas Land Plats and Tenure Areas in the range including the Boulder / Charlie Lake and Boulder / Baldonnel areas. In these areas there are several well surface holes and numerous access roads.

There are tenures for over 2000 km of gas and oil pipeline rights-of-way within the Kennedy Siding caribou 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).

The Kennedy Siding caribou subpopulation range bounds on Williston Lake, the reservoir of the WAC Bennett Dam. This reservoir would impede any northwestward and northern movement of animals in this subpopulation. There are three tenure proposal areas for wind farms in the Kennedy Siding range; two close to the town of Mackenzie and one southeast of Mackenzie adjacent to Highway 97. All areas are in the investigative and monitoring phase of development.

3.3.1.5 OTHER

There are many developments along the edges and within the Kennedy Siding caribou subpopulation range, including a townsite (Mackenzie) and outlying residential (acreages) development, cutbocks, transmission corridors and highways. There are no major developments there, but many, smaller centres of activity.

3.3.2 RECREATION

Recreational use of caribou habitat refers largely to fall and winter activities, including snowmobiling, commercial heli-skiing, commercial cat-skiing, hiking 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 do not appear immediately.

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).

The town of Mackenzie is a popular destination for recreational snowmobilers. Morfee Mountain Road leads recreationalists to Mount Morfee which is popular for mountain snowmobiling. The Powder King Mountain Resort is accessible for snowmobile recreation along the Bijoux Trail / Bijoux Falls area and an abundant trail network near Mount West. And the Beaver Creek Trail skirts between the range of the Kennedy Siding and now extirpated Burnt Pine subpopulation ranges. Most use appears to be in the northern half of the caribou's range in this region.

3.3.2.2 HELI-SKI / CAT-SKI

Helicopter skiing and snowcat 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 heli-cat 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 heli- or cat-ski operations in the range of the Kennedy Siding caribou subpopulation.

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).

The Pine Pass area, Old Friend Creek, Pinegrove Mountain and the area around Powder King all within the Kennedy Siding caribou subpopulation is used by backcountry skiers. There is a downhill ski area at Powder King Mountain (Powder King Mountain Resort). As well there is a licence of occupation for a heli-hiking operation in the vicinity of Snow Lake, Peace River and Cariboo land districts operated by Canadian Mountain Holidays.

3.3.3 OTHER

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

3.3.3.1 AGRICULTURE

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

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

There is a small Agricultural Land Reserve area near Mackenzie and adjacent to the range of the Kennedy Siding caribou subpopulation. Otherwise, there is no agricultural activity in the area.

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, bisects the Kennedy Siding caribou subpopulation from the southwest to north east and runs briefly along its northern boundary with the Moberly caribou subpopulation. There have been no caribou reported killed on this stretch of the highway between 1988 and 2007 (Sielecki 2010).

3.3.3.3 LINEAR FEATURES

Linear features are narrow land disturbances that 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).

An electrical transmission corridor approximately parallels the route of Highway 97 from the southwest of the Kennedy Siding caribou subpopulation to the northeast.

3.3.3.4 HUNTING

The Kennedy Siding caribou subpopulation overlaps four Wildlife Management Units (WMUs) in the Omineca region; WMU 7-22, 7-23, 7-30, 7-31. The caribou hunt in these WMUs ended in 2002 and the last caribou killed by a hunter was in 2001. But other wildlife are hunted in 7-23 and 7-30 including mule deer, white-tailed deer, moose, elk and black bear. WMU 7-23 is a no shooting or hunting area from 6 November to 31 March each year (Arthur 2002).

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.

A caribou bull and a pregnant cow were killed by hunters in winter 2018 (Branco 2018). Although there are numerous charges for illegal hunting in the Omineca region from Ministry of Environment records spanning 2008 through 2018, it is not clear if any of these occur in the WMUs overlapping with the Kennedy Siding caribou subpopulation or if any of these were caribou related. With so few animals in this herd, relatively easy access to the land through resource roads and active hunting for other species in much of this area, poaching or (inadvertent kills) is a potential threat to this subpopulation.

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).

From 1922 through 2014, there have been 28 reported wildfires in the range of the Kennedy Siding caribou subpopulation for a total of 228 km² (7.7%) of the land area. Fire is a present but not significant natural disturbance in this subpopulation's range.

Mountain pine beetle (MPB) has affected forests largely on the edges of the Kennedy Siding caribou subpopulation range. Most areas have a long history of infestation and have succeeded from trace (1408 km²) and light (626 km²) through moderate (277 km²) to high (235 km²) and very high (188 km²) severity infestation. Much of their core range has not been affected by MPB.

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 Kennedy Siding 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, Lenart et al. 2002, 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, south of the Kennedy Siding range, will experience increased winter snow loads (Dawson et al. 2008, Griesbauer and Green 2010). This could affect food access and mobility for animals. Such a change could be positive for snow adapted, arboreal lichen eating caribou. This benefit could be negated by more frequent freeze-thaw cycles (Plummer et al. 2006) that will improve the ability to predators to move across frozen crusts as well as limit access to food for caribou (Gillett et al. 2004, Dawson et al. 2008). Predictions of forest type shifts due to climate change mediated by fires suggest that black spruce may be replaced by white spruce and lodgepole pine, affecting caribou habitat (Hebda 1997).

There has been no herd-specific research conducted linking climate change effects to the Kennedy Siding caribou subpopulation.

3.7 SMALL POPULATION SIZE EFFECTS

Small population effects include several threats to caribou that are unique to small (approximately less than 50 animals) and isolated subpopulations. These include reproductive and genetic isolation (McDevitt et al. 2009), predation (Sinclair et al. 1998, Abrams 2002), Allee effects where small groups are more vulnerable to predators (McLellan et al. 2010), risk of demographic bottlenecks where single-sex or male-dominated cohorts lead to

population decline and increased chance that localized natural events such as avalanches (McClung 2001), fires or floods that kill a disproportionate number or key members of a small herd (Hebblewhite et al. 2010b). Movement barriers that prevent inter-population dispersal exacerbate small population effects by preventing small or extirpated populations of rescue (Gilpin 1990). Small population effects can be a particular hazard for species with slow growth rates (Laikre et al. 1997).

With a population at or below 50 animals and having undergone two rapid declines in the past 20 years (2002 and 2008) the Kennedy Siding caribou subpopulation is very susceptible to small population effects, including a genetic bottleneck. Genetic analyses show that the Kennedy Siding caribou are closely related to other shallow-snow subpopulations (Hart Ranges, Quintette, Moberly; Serrouya et al. 2012) and both their 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 Parsnip and Kennedy Siding have a relatively high level of herd overlap compared to other caribou subpopulations and their genetic structure is very similar (McDevitt et al. 2009). Despite being isolated by Williston lake to the west and north, and bordering vacant caribou habitat to the east (the Burnt Pine herd has been extirpated), spatial isolation or distance does not appear to strongly affect population or individual level genetic diversity (McDevitt et al. 2009). This is aided by close relationships to the Hart Ranges and Parsnip herds.

4 MANAGEMENT HISTORY

4.1 HABITAT

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

An assessment of critical caribou habitat in the Kennedy Siding range found that the amount of undisturbed habitat there is above threshold for population recovery (73%; McNay et al. 2014).

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.

Pine le Moray Provincial Park sits within the Kennedy Siding caribou range and covers almost 30% of its range (Austin 2012). This park is open to hunting, snowmobiling, hiking and other recreational activities. Forestry is not

permitted (BC Parks 2018). In addition to this park, there are 263 km² of Old Growth Management Areas, 603.5 km² of Ungulate Winter Range (U-7-001, U-7-003, U-7-009, U-9-002) and 88 km² of Wildlife Habitat Area (Austin 2012). Fully 62% of the Kennedy Siding caribou subpopulation range is under some sort of protection.

Ungulate winter range orders do not prohibit forestry in the Kennedy Siding range but modify the harvest according to the Caribou Management Strategy to support caribou wintering habitat (Paquet 1997, Arthur 2002, Stevenson et al. 2003, British Columbia Ministry of Environment 2005, 2006).

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). 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 active habitat restoration in the Kennedy Siding caribou subpopulation range. Abandoned mine sites, electrical transmission rights-of-way, pipelines, cutblocks and MPB affected forest stands are all candidate sites for restoration. But outside of small-scale re-contouring of sand and gravel pits, there is no restoration occurring.

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 approximately 1145 km of forest roads and 26 km of oil and gas roads in the range of the Kennedy Siding caribou subpopulation (0.4 km / km²). While this is a moderate road density (Kinley and Apps 2001, Courtois et al. 2007, Leblond et al. 2011), it does facilitate access into core caribou range.

4.2.1 SNOWMOBILE

There is a formal snowmobile closure area in the southeastern portion of the Kennedy Siding caribou subpopulation range. The legal closure of the Northern Hart Ranges is a year-round closure enabled by the Wildlife Act and covers about 150 km² of the total range area (5%). Snowmobiles are not permitted for use in hunting in MUs 7-23 and 7-30.

4.2.2 HELI-SKI / CAT-SKI

There are no heli-ski or cat-ski operations in the range area of the Kennedy Siding caribou subpopulation. There is a tenure for heli-hiking in the southeastern part of their range covering about 310 km² (10%) of their range area.

See section 3.3.2.2 for general threat information.

4.2.3 OTHER

The Powder King ski resort operates with three lifts and 37 runs on Powder King Mountain within the Kennedy Siding caribou subpopulation range. It operates from mid-November until mid-April annually. It provides backcountry ski access to the alpine terrain north of the resort.

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 occur too slowly to recover woodland caribou in the short-term. As a result, direct predator management is a caribou recovery tool to ensure that populations persist long enough to benefit from habitat restoration efforts (Wilson 2009, Brook et al. 2014, Hervieux et al. 2014).

4.3.1 WOLF MANAGEMENT

Wolves are an important, year-round caribou predator. Caribou populations in northern British Columbia were shown to decline when wolf densities were 9–10/1000 km² but increased at wolf densities from 1–4/1000 km² (Bergerud and Elliot 1986). For this reason, a target wolf density that would enable caribou recovery has been identified as 3/1000 km² (Type 2 Matrix; Environment Canada 2014). In the absence of effective habitat or alternative prey management to achieve these densities, direct wolf management must be undertaken to achieve caribou conservation goals.

Lethal wolf management began in the Kennedy Siding caribou subpopulation range in 2014 with a goal to reduce wolves by 80% (Boutin and Merrill 2016). Only 2 of an estimated 32–53 wolves in the area were killed in Scott/Kennedy that year (Boutin and Merrill 2016, Seip and Jones 2016b). In the winter of 2015–16 however, 24–50 wolves were killed in the Kennedy Siding area, 6 to 11 killed in 2016–17 (Seip and Jones 2017; note that wolf kill numbers reported differ among years due to management boundary changes in 2017, 2018). Estimates for the greater wolf control area that included the Quintette, Klinse-za, Bearhole-Redwillow, South Narraway, Graham and Kennedy Siding herds suggest that wolf management efforts removed all wolves from the area.

4.3.2 COUGAR MANAGEMENT

Although cougars are present in the Kennedy Siding caribou subpopulation range and likely growing, there is no published evidence that they are significant caribou predator in this area. There is a fall through winter cougar hunt in WMU 7-23, but between 1985 and 2013 only two cougars were reported killed by hunters. There is no other cougar population management for the benefit of caribou recovery in place.

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.

Between 2002 and 2015, one caribou mortality was attributed to a bear predator. There is an ongoing black bear hunt in WMUs 7-23 and 7-30 and between 1976 and 2013, about 2100 bears were killed by resident and non-resident hunters. During this same time, 374 grizzly bears were hunted, but the grizzly bear hunt was suspended in 2017 across British Columbia (McLellan et al. 2017). Given that bears appear to be a minor caribou predator in this area, and that there is an ongoing hunt for black bears, there is no additional bear management being undertaken specifically to benefit 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 Kennedy Siding caribou subpopulation overlaps with 3 Game Management Zones; 70c, 70d and 7Pa. The moose density in this area is 954, 568 and 574 /1000 km² respectively and declining with rates of change below 1 in all areas (Kuzyk et al. unpublished). These densities are high for caribou recovery (Serrouya et al. 2017).

Specific moose management to benefit caribou recovery in this region is not being conducted and is unlikely given that moose populations are already declining here.

In 2005/08, the British Columbia Ministry of Environment initiated a study to reduce the moose density in the range of the Parsnip caribou herd (the northern extension of the Hart Ranges subpopulation that occupies habitat immediately south of the Kennedy Siding range area) (Gillingham et al. 2008). Hunting quotas in the Parsnip River area were liberalized and predator densities were compared to a region (Wolverine) where no moose reduction had occurred (Steenweg et al. 2009). Although this program has continued through 2018, it has not been able to reduce moose densities sufficiently to result a numerical reduction in the wolf population (Steenweg 2011, D. Heard personal communication 2018, Klaczek and Heard 2016, Serrouya et al. 2017).

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.

The white-tailed deer population in the range of the Kennedy Siding caribou subpopulation is fairly large and growing (British Columbia Ministry of Forests, Lands and Natural Resource Operations 2015). Between 1987 and 2013 about 1000 white-tailed deer were killed by resident and non-resident hunters. There is no specific program to manage white-tailed deer beyond hunting licence regulation in this area.

Mule deer in this area are likely declining and hunting regulations in all WMUs that overlap with the Kennedy Siding caribou subpopulation are quite restrictive with a short, antlered season only. Between 1987 and 2013, only 515 mule deer were reported killed by hunters in this region. UWR areas established to protect caribou range here also protect mule deer habitat.

4.4.3 OTHER

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

Elk are present but not abundant in the range of the Kennedy Siding caribou subpopulation. There is a hunting season for them (7-23 and 7-30) and between 1977 and 2013 about 100 elk were reported killed by hunters. There is no elk population management in this area specifically targeted towards caribou recovery.

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.

While maternity penning is being conducted in a nearby herd (Klinse-za), there is no penning program active for the Kennedy Siding caribou subpopulation (Heard and Zimmerman 2017, McNay et al. 2018).

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).

With protected habitat, very low wolf densities, a small but stable caribou population, low adult mortality and high calf-recruitment, they would be a candidate population to receive female additions from a captive breeding population (Seip and Jones 2017). They are not a good candidate to contribute females to captive breeding (Hayek et al. 2016). However, there is no captive breeding program currently active.

4.5.3 TRANSLOCATION

Translocation is the reinforcement of small populations by moving animals directly from a sustainable population (Ray et al. 2015, Hayek et al. 2016). The goal is to rapidly increase the numbers of animals of all ages and sexes in the target population (Miller et al. 2007, DeCesare et al. 2010c). Animals are captured in their home range, transported to the target range and either soft released in a temporary pen that offers an opportunity for individuals to adjust to their new surroundings, or hard released directly into the destination habitat.

Compared with other reinforcement methods, translocation is a relatively cost-effective approach to add animals to small populations. It has been tried successfully and unsuccessfully with caribou populations in Canada and British Columbia (Compton et al. 1995, Stronen et al. 2007, Hayek et al. 2016).

The Kennedy Siding caribou subpopulation has not been a contributor or recipient of animal translocation (Hayek et al. 2016).

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).

There is no large predator exclusion area anywhere in mountain caribou range. Beginning in September 2016, a feeding station was built for the Kennedy Siding caribou subpopulation and in one year 6090 kg of supplemental food was provided over one winter (Heard and Zimmerman 2017). This reinforcement effort is an attempt to improve the nutritional status of the extant individuals and stimulate population growth (Hayek et al. 2016).

4.6 STEWARDSHIP/OUTREACH

Local communities and stewards are an essential part of caribou recovery. Management actions to recover very small populations are at times expensive, controversial and require the imposition of new and restrictive regulations (Hayek et al. 2016). Gaining the social licence to conduct management actions like predator management, translocation, captive breeding and access restrictions requires outreach. Effective outreach programs to local communities and regional populations must accompany planning for management actions (Antoniuk et al. 2015). This includes information to municipal and regional administrations, business stakeholders, recreational groups, conservation organizations, farming organizations, hunting clubs among others (see below). Outreach must be timely, targeted and inclusive to be effective (Wilkinson 2010).

Stewardship is the active participation by citizens or citizen groups in conservation and recovery programs. For caribou this can take a number of forms ranging from ambassador programs where citizen volunteers promote caribou conservation at community events, habitat protection through conservation offsets (Robichaud and Knopff 2015) to fund-raising and operating reinforcement activities such as maternity pens.

The Kennedy Siding caribou subpopulation is among a cluster of woodland caribou herds including Klinse-za, Wolverine, Hart Ranges, Quintette, Bearhole-Redwillow, South Narraway and Graham. It is also adjacent to the town of Mackenzie where there is an active community of outdoor recreationalists, hunters and conservationists. It also bounds on Williston Lake, a reservoir created by the WAC Bennett Dam, has a ski-hill in its range and has a regionally important highway (97) running through it. The Kennedy Siding herd has been well studied and there are ongoing management actions such as predator management and supplemental feeding that provide opportunities for stewardship with this herd. These include involving volunteer groups in management actions, community outreach, interpretative displays and events at popular venues.

4.7 RESEARCH

Every caribou subpopulation in British Columbia requires some degree of management action; habitat protection or restoration, population reinforcement, alternative prey management or predator control. Yet few caribou subpopulations in British Columbia have sufficient, herd-specific information to enable confident management decisions. To fill these gaps, scientific research and traditional ecological knowledge must be gathered to fill critical gaps.

There has been decades of research into caribou biology and conservation. This body of work has informed scientists and policy makers of the key factors that contribute to caribou population dynamics, important threats and potential solutions. Key findings have been the proximate role of predation and apparent competition in caribou population fluctuations and the ultimate role of habitat destruction in caribou population declines. While their interactions are broadly understood, ongoing research to fine tune caribou responses to ecological stimuli and human disturbance including habitat fragmentation and primary prey density can improve our management.

There are several key information pieces needed to better understand caribou population dynamics in the Kennedy Siding population range. The first is an understanding of the interaction of nutrition and predation; are caribou in good enough nutritional condition to avoid predators and do nutritional constraints put caribou in predation risk. As well a more precise understanding of sources of calf mortality is needed to determine what is killing caribou when they are less than 6 months old (D. Heard personal communication, 2018).

4.8 MONITORING

Ecological, population and industrial footprint monitoring is an essential activity for the conservation and recovery of woodland caribou. This work provides the information to enable the detection of conservation threats, the effectiveness of management activities and the status of target populations. Although it cannot replace conservation action, it is an essential piece of the caribou recovery program.

The ongoing caribou feeding and wolf control programs at Kennedy Siding will require ongoing effectiveness monitoring. This includes caribou and wolf population estimates, age-specific mortality measures and caribou body condition monitoring. As well, the boundary of the Kennedy Siding subpopulation with respect to its neighbouring herds remains uncertain necessitating more precise measures of animal movements and distribution in this region (McNay and Hamilton 2010).

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 Kennedy Siding 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 affects wolves, whose populations have intentionally reduced or locally eliminated. Other ungulate species like moose may have their numbers lowered to facilitate caribou conservation.

6 IMPLICATIONS TO OTHER VALUES

The recovery and protection of woodland caribou populations will affect a range of human values and activities across caribou range (Scarfe 2006). These include recreational / commercial activities such as camping, snowmobiling and backcountry skiing, commercial resource extraction activities such as forestry, mining and oil and gas development as well as non-commercial resource uses such as hunting. Research shows that none of these activities will have to be halted to protect woodland caribou (Kruse et al. 1998, Hebblewhite et al. 2006, Hebblewhite 2017). However, changes to operations, seasonal restrictions and area closures will be required, locally affecting some recreational and commercial activities (Government of Alberta 2016).

In the range of the Kennedy Siding caribou subpopulation, there are limited commercial activities. Currently commercial logging operations in the area are compelled to avoid UWR that has been established over much of the high elevation terrain to protect caribou and prevents logging in this area.

Recreational snowmobiling is popular in this area, and winter recreationalists have had access to some areas in the south of their range restricted to protect caribou habitat (Grant 2017). There are no Heli- and Cat-ski tenures here, but Heli-hiking does occur and there is a ski hill in caribou habitat that provides access to caribou winter habitat for backcountry skiers. Further restrictions on caribou habitat access could impact these activities.

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 Kennedy Siding 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 Nation, Saulteau Nation, Tse'Khene Nation (McLeod Lake Indian Band), Treaty 8 Nations

Local: Moberly Lake, Hudson's Hope, Mackenzie, McLeod Lake

Regional: Prince George, District of Chetwynd, Peace River Regional District, Chetwynd, Fort Fraser, 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

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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:** 13 traplines (TR0722-T1, T2, T6, T7, TR0723-4, T6, T7, T8, TR0729T2, TR0730-T1, T2, TR0731-T1, T2), 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

Accommodation and Guiding: CMH Helisports, Powder King Mountain Resort, Mackenzie Snowmobile Tours

Forestry (Active licences to cut): Richard Ismay, Powder King Mountain Resort Inc., BC Hydro and Power Authority, Glencore Coal Canada Resources Ltd.,

Forestry (Woodlots): James Whissell, Denise McGowan, Pine Plateau Holdings Inc., Michael Hoffart, Bruce Lake Forestry Ltd., The Mackenzie Forestry Education, Longwood Production Ltd., John Steward.

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)

- Maintain the Supplemental Feeding Program and associated monitoring.
- Maintain predator management program.
- Initiate a study to determine sources of mortality for young-of-the-year caribou.

8.2 MEDIUM TERM (WITHIN 12–24 MONTHS)

- Initiate, together with neighbouring herds, an outreach and stewardship program to highlight state and actions regarding the Kennedy Siding caribou subpopulation.
- Promote a captive breeding program that will in the long-term be able to repopulate this herd.

8.3 LONG TERM (WITHIN 24–48 MONTHS)

- Report on the Supplemental Feeding Program results
- Population and recruitment count and analysis.

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