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

Finlay
Subpopulation

Northern Mountain Population

BRITISH COLUMBIA

Recommended Citation:

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EXECUTIVE SUMMARY

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TABLE OF CONTENTS

DRAFT

DRAFT

1 BACKGROUND

1.1 INTRODUCTION TO THE PROGRAM

2 POPULATION DESCRIPTION

Finlay caribou are a subpopulation of northern mountain (NM) caribou, an ecotype of woodland caribou that is listed as *Special Concern* by the *Committee on the Status of Endangered Wildlife in Canada* (COSEWIC 2014). NM caribou currently occur in 45 subpopulations that are distributed across the northwestern section of British Columbia, the southwestern part of the Northwest Territories and the southern two-thirds of the Yukon Territory with one Yukon subpopulation being trans-boundary with Alaska (COSEWIC 2014). Within COSEWIC's (2011) Designatable Units classification system, which reflects evolutionary and ecological distinctions among caribou groups, NM caribou are considered part of Designatable Unit 7. In British Columbia, mountain-living caribou are classified into "northern" and "southern mountain" ecotypes, which reflect differences in feeding ecology during winter (Stevenson and Hatler 1985). The northern ecotype, which includes all NM caribou subpopulations, occurs in mountainous areas receiving relatively low annual snowfall and primarily forages on terrestrial lichens within mature conifer forests or wind-swept alpine slopes (Seip and McLellan 2008). The southern mountain ecotype, in contrast, inhabits the interior, deep-snow mountains and forages on arboreal lichens during winter as terrestrial foods are generally unavailable. Within British Columbia, NM caribou are currently *Blue-listed* with a conservation status of S2/S3 due to sustained declines in some subpopulations, uncertainty in the population trend of others, and high threats from predation and anthropogenic disturbance (BC Conservation Data Centre 2017).

2.1 DISTRIBUTION

The range of the Finlay subpopulation is located on the western slopes of the Northern Rocky Mountains in the north-central portion of the province (Fig. 1). The 8,175 km^2 range lies within the Northern Boreal Mountains ecoprovince and is typified by rugged alpine areas (Boreal Altai Fescue Alpine biogeoclimatic zone) and lower elevation forests (Spruce-Willow-Birch, Boreal White and Black Spruce, and Engelmann Spruce – Subalpine Fir zones; McNay 2011). The range is bounded to the north by the Kwadacha River valley, which separates it from the neighboring Gataga range, and to the west by the Northern Rocky Mountain Trench. To the east, the range is separated from the adjacent Pink Mountain caribou range by the height of the Northern Rocky Mountains. The range's southern boundary extends to the headwaters of the Ospika River and the southeastern corner abuts a portion of the Graham range. The northern and eastern periphery of the range is situated within the Muskwa-Kechika Management Area. The range encompasses Ed Bird-Estella Lakes Provincial Park and Ospika Cones Ecological Reserve as well as portions of the Kwadacha Wilderness Provincial Park and Recreation Area.

2.2 HABITAT AND BEHAVIOUR

NM caribou undergo seasonal range shifts in response to snowfall conditions affecting forage availability (Bergerud 1978, Heard and Vagt 1998). These shifts vary among subpopulations being affected by such factors as topography, predation risk, and snow characteristics (Seip and McLellan 2008). Considerable variation may also exist among individuals and among seasons. For example, in

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late winter, many caribou use wind-swept alpine ridges to access exposed terrestrial lichens, particularly during high snowfall years, whereas other individuals remain below treeline (Wood 1996). Caribou within the Finlay subpopulation appear to employ this mixed strategy with some individuals using lower-elevation conifer forests, particularly low-productivity lodgepole pine stands, and other using high-elevation alpine and subalpine areas during winter (McNay et al. 2009).

Differing spatial strategies are also found during calving with many females using high elevation sites above treeline while others calve in subalpine conifer forests prior to moving to higher elevation summer ranges (Wood 1996, Elliot 2004, Gustine and Parker 2008). Calving generally occurs from mid-May to mid-June (Radcliffe 2000, Gustine et al. 2006). Similar to the grouping behaviour of other woodland caribou, the average group size of NM caribou is highest during the rut (late September to early October) and smallest during calving (Bergerud et al. 1984, Bergerud and Page 1987).

2.3 Population Size and Trend

Over the past four decades, the Finlay subpopulation has had very few surveys to estimate population size (Table 1). In the late 1970s, Bergerud (1978) surveyed the Ospika River herd and estimated a herd size of 100+ caribou. Bergerud (1978) also surveyed an extensive area occupied by Lawyers Pass caribou and counted ~50 caribou in an area 30 km southeast of Fort Ware. While both of these areas likely fall within the Finlay range, it is unknown how the areal extent of Bergerud's (1978) survey compares to the areal extent of the current range.

In 1996, expert opinion suggested that the Finlay subpopulation numbered 200-400 caribou (Heard and Vagt 1998). Six years later, COSEWIC's (2002) status report on woodland caribou in Canada listed an estimate of 200 caribou within the Finlay range. These opinion-based estimates likely overestimated the actual population size as an aerial survey conducted in March 2002 recorded only 26 caribou within the Finlay range (Zimmerman et al. 2002). With no other surveys conducted over the next decade, the 2014 COSEWIC status report for NM caribou listed the size of the Finlay subpopulation as 19 caribou (COSEWIC 2014).

In the last two years, efforts to deploy radio-collars on caribou within the Finlay range have yielded more recent minimum counts. In March 2017, three collars were deployed on females located within the Finlay range but these animals subsequently moved into the adjacent Pink Mountain range just prior to calving (M. Klaczek. BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development, *personal communication*). In April 2018, six more collars were deployed: three within the Finlay range and three on caribou found in the 'trace occurrence' zone just north of the Ospika Arm of the Williston Reservoir. During fixed-wing reconnaissance flights for these latter collaring efforts, an estimated 10-15 caribou were counted within the Finlay range. Going forward, data from these collared animals should help refine range boundaries and assist in future surveys to estimate population size.

Estimates of juvenile recruitment and adult female survival, two demographic parameters with high influence on caribou population dynamics (DeCesare et al. 2012), are also rare for the Finlay subpopulation. Bergerud's (1978) early surveys within the Finlay range did not yield information on

herd composition. In the only formal aerial survey of the range, Zimmerman et al. (2002) recorded no bulls within the 26 caribou counted and estimated a ratio of 50 calves per 100 females. While this ratio may be indicative of a growing population at the time, this estimate should be viewed cautiously due to the small number of caribou encountered. The most recent estimates of adult survival were calculated by McNay and Giguere (2004) using radio-collar data from 25 females and 19 males captured within the Finlay range and monitored for various periods between 1990 and 2004. They estimated an annual survival rate of 77% [note that this survival rate is not gender-specific]. This survival rate was the lowest among neighboring herds (Chase = 91%, Wolverine = 93%, Scott=100%). Recent collaring efforts within the Finlay range should provide updated estimates adult female survival in the next few years.

In hunted populations of ungulates such as the Finlay subpopulation, harvest indices such as catch-per-unit-effort (CPUE) and hunter success rate can give an indication of population trend. The Finlay range is overlapped by WMUs 7-41, which covers the range's northern two-thirds, 7-37, which covers the southern third, and 7-40, which covers a small portion in the range's southwest corner. For WMU 7-41, CPUE and success rates have been generally low since 2000 and both indices seemed to have declined since the 1980s and 1990s (Fig. 2). In the last decade, only three bulls have been harvested from this WMU. Note that WMU 7-41 also extends into the Gataga range. Because of the low number of animals harvested and the relatively light hunting pressure, harvest indices provide limited inferences on population trend for the Finlay subpopulation.

In general, discerning population trend for the Finlay subpopulation is difficult due to limited demographic data, few and inconsistent estimates of population size, and unreliable harvest indices. Despite these deficiencies, COSEWIC (2014) has listed the population trend for this subpopulation as declining due to the sharp contrast in the opinion-based estimates in the late 1990s and the minimum counts recorded since that time.

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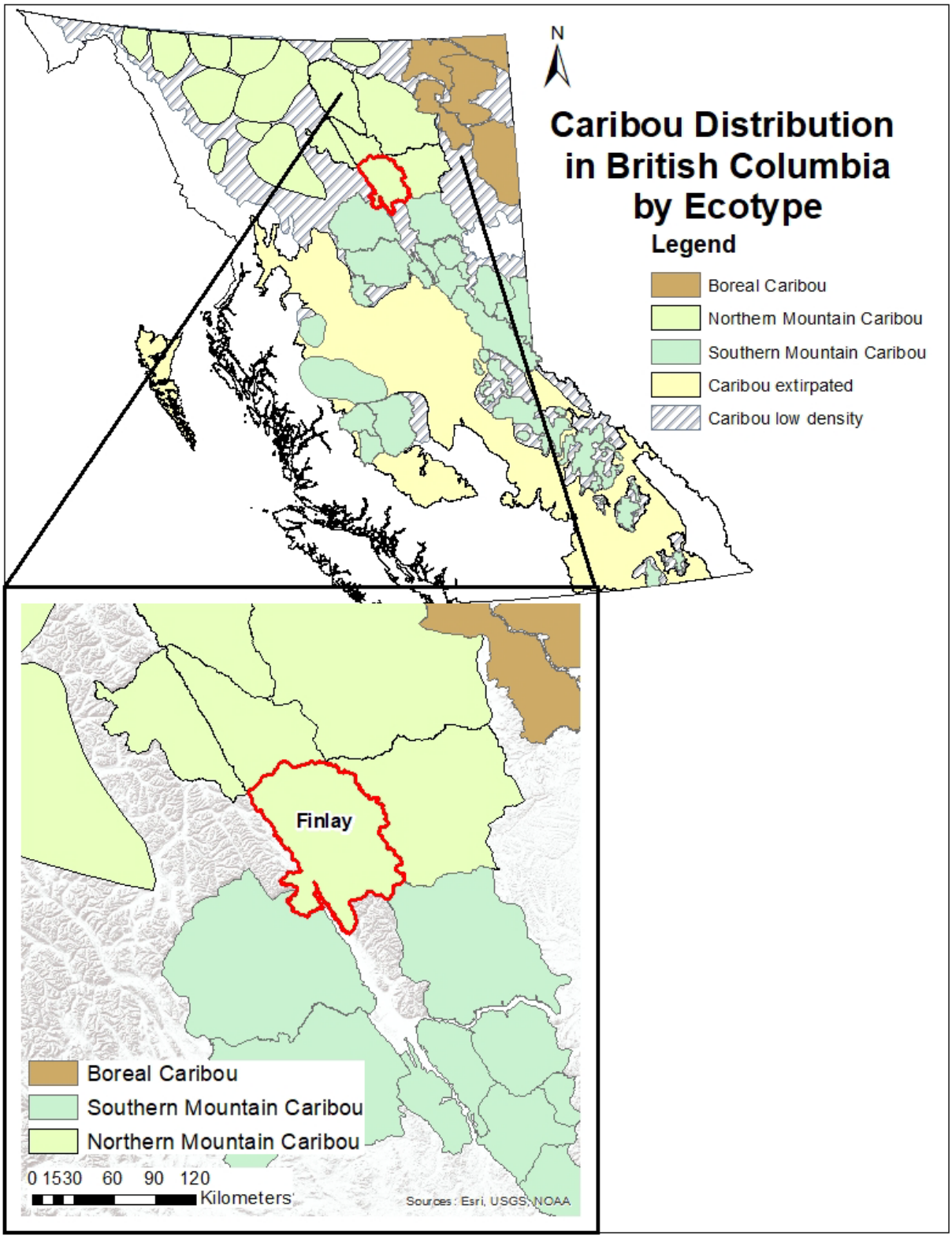

Figure 1: The geographical location of the Finlay subpopulation of northern mountain caribou. The 8,175 km^2 range (inset: red outline) is situated on the western slopes of the Northern Rocky Mountains of north-central British Columbia.

Table 1: Estimates of population size by year for the Gataga subpopulation of northern mountain caribou in north-central British Columbia.

Year	Estimate	Method	Survey Timing	Reference
1978	150+[1]	survey estimate	winter	Bergerud 1978
1996	200-400	expert opinion	NA	Heard and Vagt 1998
2002	200	unknown	NA	COSEWIC 2002
2002	26	minimum count	winter	Zimmerman et al. 2002
2014	19	minimum count	winter	COSEWIC 2014
2018	10-18[2]	minimum count	winter	M. Klaczek, *pers. comm.*

[1] Combined minimum counts from what was known as the Ospika River and a portion of the Lawyers Pass caribou herd seen 30 km southeast of Fort Ware. It is unknown how the extent of the combined survey areas compare to the current range.
[2] Minimum count during radio-collar deployment in March and April 2018.

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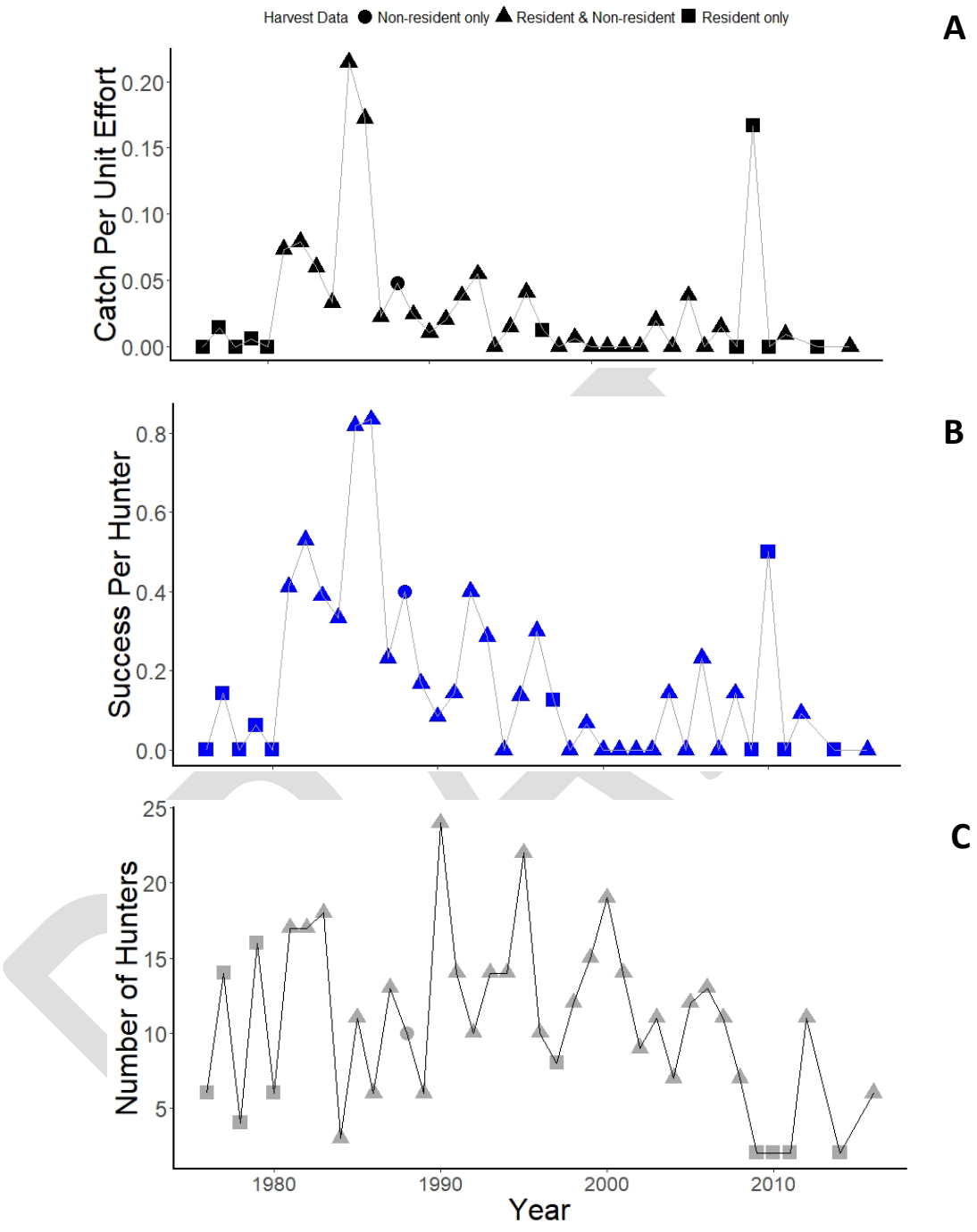

Figure 2: Harvest indices from 1976 to 2016 for Wildlife Management Unit (WMUs) 7-41, which overlaps the northern two-thirds of the range of the Finlay subpopulation of northern mountain caribou in north-central British Columbia. Catch per unit effort (A) is the total kills divided by the total number of hunter-days. Success per hunter (B) is the total kills divided the total number of hunters. The total number of hunters (C) represents both resident and non-resident hunters. Note that WMU 7-41 also overlaps the Gataga caribou range. Since 2005, WMU 7-41 has had a 10-week general hunting season for bulls with 5 points or larger.

3 THREATS AND LIMITING FACTORS

Populations of NM caribou face a variety of threats and limiting factors that may compromise their stability now and in the future. Current declines in many woodland caribou populations have been ultimately attributed to direct and indirect effects of human activities and climate change (Vors and Boyce 2009, Festa-Bianchet et al. 2011, Environment Canada 2014). These effects have resulted in lowered rates of adult female survival and/or juvenile recruitment, two demographic rates that have high influence on caribou population dynamics (DeCesare et al. 2012). For most populations, effects of human activities and climate change have led to unsustainable rates of predation (McLoughlin et al. 2003, Wittmer et al. 2005*b*, Apps et al. 2013). Compared to other ungulates, caribou are particularly vulnerable to increasing predation because they have low reproductive rates (Bergerud 2000). To reduce predation risk, caribou generally occur at low densities and have evolved to live in low productivity habitats that spatially separates them from other ungulates and their generalist predators (Bergerud 1992). Effects from human activities and climate change likely compromise this spacing strategy by changing the abundance and spatial distribution of these other ungulates and predators, increasing the likelihood of caribou-predator encounters and consequently increasing predation rates (Festa-Bianchet et al. 2011).

The federal *Management Plan* for NM caribou (Environment Canada 2012*a*) and the recent status report by COSEWIC (2014) identified a number of threats potentially affecting NM caribou subpopulations and their habitat. These threats included: predation, industrial activities, roads and other linear features, recreational activities, natural disturbances (e.g. fire), hunting, climate change and parasites and diseases. This section discusses these threats – and others – and the order of discussion does not reflect their relative importance to a specific subpopulation. Note that while threats are discussed individually, they are not mutually exclusive as they may interact and their effects on caribou population dynamics are likely cumulative (Sorensen et al. 2008, Johnson et al. 2015). Overall, the NM caribou population was recently assigned a threat impact rating of High by COSWEIC (2014).

3.1 PREDATION

Woodland caribou populations are naturally limited by predation, which results in caribou occurring at relatively low but stable densities within their range (Fuller and Keith 1981, Bergerud 1996, Bergerud and Elliott 1998). Because caribou have low rates of reproduction, their populations are sensitive to changes in predation rates. Indeed, increasing predation is the primary proximate cause of population decline in most woodland caribou herds (McLoughlin et al. 2003, Wittmer et al. 2005*b*, Apps et al. 2013). Increasing predation in these populations has been ultimately linked to human-mediated landscape disturbance and climate change, both of which alter the abundances and distributions of predators and alternate prey (Seip 1992, Latham et al. 2011*b*, Apps et al. 2013, DeMars and Boutin 2018). Hypothesized mechanisms relating increased predation to landscape alteration and climate change are detailed under *Section 3.3 Human Activities* and *Section 3.6 Climate Change*.

In the Finlay range, field investigations of mortalities among radio-collared caribou monitored for various periods between 1990 and 2004 suggested that predation was the primary cause of adult caribou mortality (McNay and Giguere 2004). Inferences from other nearby NM caribou ranges such as the Pink Mountain and Muskwa ranges also suggest that predation is a major limiting factor influencing caribou population dynamics (Bergerud and Elliot 1986, Bergerud and Elliott 1998). In Pink Mountain, predation was found to be the dominant cause of mortality in calves < 60 days old (17 out of 19 mortalities over 2 calving seasons; Gustine et al. 2006). During wolf reductions in the 1980s, the Muskwa subpopulation was thought to have increased, primarily due to increased rates of juvenile recruitment. Adult female survival also likely increased as Bergerud (1996) suggested that in natural systems similar to those in the Muskwa range, predation is the primary source of adult mortality. This assertion is supported by a radio-collaring study (n = 46 females) conducted within the northern portion of the Muskwa range from 2000-2003 where four of five known mortalities were due to predation (by wolf or grizzly bear; Tripp et al. 2006). The Finlay range contains a similar suite of predators and has comparable geography to the Pink Mountain and Muskwa ranges; therefore, it is likely that predation effects on caribou population dynamics are similar among the three ranges.

3.2 FOOD LIMITATION

Spatiotemporal changes in the quality and quantity of food resources can influence the dynamics of caribou populations by directly affecting survival and reproductive rates (Parker et al. 2009). Woodland caribou are generally associated with old-growth habitats and food limitation may occur if such habitats are converted to early seral habitats (i.e. younger forest), which are avoided because of increased predation risk (Fortin et al. 2013, Serrouya et al. 2017*b*). Such avoidance behaviours may also result in caribou restricting their annual movements, leading to over-grazing of seasonal areas (Heard and Zimmerman 2017). Climate change may further affect food availability and quality; for example, an increase in rain-on-snow events may limit forage availability by increasing the probability of icing (Hansen et al. 2011).

For mountain-dwelling caribou in British Columbia, evidence to date suggests that food limitation is not a primary factor in recent populations declines (Wittmer et al. 2005*b*, McLellan et al. 2012). Such evidence, however, does not preclude any food limitation effect. For example, risk-sensitive foraging in highly altered landscapes may increase predation risk for caribou if such behaviour causes them to become more predictable in time and space or more clumped in their distribution (Fortin et al. 2013, DeMars et al. 2016). Food limitations may also result in smaller calves, which could have increased predation risk (Adams et al. 1995). Determining the magnitude of such food limitation effects, however, is difficult in a high predation environment because predation may occur before effects on body condition become evident (Cook and Cook 2015, Boutin and Merrill 2016).

To date, there have been no studies explicitly evaluating the nutritional condition of Finlay caribou. Studies, however, have been undertaken in the nearby Pink Mountain and Graham ranges. In the winters of 2001-2002 and 2002-2003, Parker and Gustine (2007) assessed nutritional status of Pink Mountain caribou by estimating rump fat on captured animals (n = 38; see also Gustine et al. 2007),

quantifying pregnancy rates and evaluating body mass of newborn calves. Their findings suggested that, at the time, these caribou were not nutritionally limited as all indices had values similar to other caribou populations considered to be robust. More recently, rump fat assessments were made on adult females captured during the winter of 2014-2015 in other NM caribou ranges (e.g. Graham; Cook and Cook 2015). Results of this study suggested that the nutritional condition of mountain-dwelling caribou was lower than caribou found further east on the boreal plains. The degree to which these lower nutritional scores affect caribou population dynamics, however, is not yet fully understood.

3.3 HUMAN ACTIVITIES

Human activities within and adjacent to caribou range are believed to be a primary driver of current declines in many populations of woodland caribou (Wittmer et al. 2007, Environment Canada 2008, Sorensen et al. 2008, Johnson et al. 2015) . Such activities can impact caribou populations through multiple mechanisms including direct habitat loss, displacement from preferred habitats (Seip et al. 2007) and indirectly increasing predation (Apps et al. 2013, DeMars and Boutin 2018). This section focuses on impacts associated with industrial activities, recreational activities and other activities such as agriculture and roads.

3.3.1 INDUSTRIAL

Industrial activities include forestry, mining, oil & gas development and clean energy.

3.3.1.1 FORESTRY

Woodland caribou are an old-growth forest dependent species (Bergerud 2000) and are therefore affected by forestry practices. Logging of old-growth forests can result in direct habitat loss and an increase in the extent of early seral (or young) forest, which can increase the abundance and alter the distribution of other ungulates (e.g. moose) and their predators, potentially leading to increased caribou predation (Serrouya et al. 2011, 2015). Cutblocks can further increase predation risk for caribou if behavioural avoidance of these areas causes caribou to become more clumped in their distribution (Schaefer and Mahoney 2007, Fortin et al. 2013).

The Finlay range is partially overlapped by the Mackenzie Timber Supply Area (TSA) and the region's economy is highly dependent on the forest sector (BC Land Use Coordination Office 2000). As such, the range has been impacted by forestry though the impact to date has been of relatively low intensity. An analysis using cutblock GIS data up to 2015 (cutblocks < 20 years old) shows that cutblocks comprise < 1% of the range's area. The majority of cutblocks are located along the range's western border and in small watersheds located between the Kwadacha and Akie Rivers.

3.3.1.2 MINING

Impacts from mining primarily relate to direct habitat loss. The effective amount of habitat loss, however, can extend well beyond its physical footprint due to behavioural avoidance of areas surrounding mine infrastructure (Polfus et al. 2011, Johnson et al. 2015). As noted previously, impacts that limit the spatial distribution of caribou can potentially lead to increased predation risk (Fortin et al.

2013, DeMars et al. 2016). Related infrastructure such as roads may further increase predation risk by increasing predator hunting efficiency and facilitating predator movement into caribou habitat (Latham et al. 2011*a*, DeMars and Boutin 2018).

The Finlay range overlaps the planning area of the Mackenzie Land and Resource Plan (BC Land Use Coordination Office 2000). This area is known to have significant mineral values compared to other regions in the province. Current GIS analyses show a continuous band of mineral claims (~ 80 –km long) located in the central portion of the Finlay range. These claims remain largely undeveloped but could be developed in the future. The largest claim holders are Ecstall Mining Corporation (Vancouver, BC) and Cirque Operating Corporation.

3.3.1.3 Oil and Gas

Landscape alteration from oil and gas exploration and extraction can affect caribou populations through direct habitat loss and by indirectly increasing predation. As with other industrial impacts, avoidance behaviours by caribou can increase the effective extent of habitat loss (Dyer et al. 2001, Vistnes and Nellemann 2008) and limit the spatial distribution of caribou, potentially increasing predation risk (Fortin et al. 2013, DeMars et al. 2016). Oil and gas impacts may further increase predation risk by facilitating the expansion of alternate prey (e.g. white-tailed deer) into caribou range (Dawe and Boutin 2016). Linear features associated with oil and gas development may also increase predation risk by enhancing predator hunting efficiency and facilitating predator movement into caribou range (Dickie et al. 2017, DeMars and Boutin 2018; see also *Section 3.3.3.3 Linear Features* below).

Using GIS data available from the BC Oil and Gas Commission up to 2016, there are currently no impacts from oil and gas development within the Finlay range.

3.3.1.4 Clean Energy

Infrastructure related to clean energy production (e.g. hydroelectric facilities, wind power) can impact caribou populations through mechanisms similar to other industrial developments. Caribou may avoid such infrastructure with the degree of avoidance dependent on the degree of human activity (Mahoney and Schaefer 2002, Colman et al. 2013). Such avoidance can alter seasonal migration patterns (Mahoney and Schaefer 2002), which can result in negative demographic impacts (Bolger et al. 2008). Power lines associated with energy development can also increase predation risk for caribou because these features create relatively permanent early seral habitat that is favorable to other ungulates (e.g. moose, white-tailed deer) and provide movement corridors for predators (Latham et al. 2011*a*, Dickie et al. 2017).

The southwestern border of the Finlay range is formed by the Williston Reservoir, which was created by the W.A.C. Bennet hydroelectric dam. Currently, there are no wind power or other clean energy developments within the boundaries of the Finlay range.

3.3.1.5 Other

There are currently no other major forms of industrial development within the Finlay caribou range.

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3.3.2 RECREATION

Recreational activities conducted within caribou range can impact caribou populations by displacing individuals into sub-optimal habitats (Seip et al. 2007), increasing stress levels (Freeman 2008) and / or facilitating predator movement into caribou habitat (Whittington et al. 2011). This section considers impacts related to snowmobiling and backcountry skiing as well as other activities such as hiking and mountain biking.

3.3.2.1 SNOWMOBILE

Among winter recreational activities, snowmobiling appears to have the highest impact on caribou, in part because the preferred areas for this activity overlap with the preferred winter habitat of caribou (Simpson and Terry 2000). Snowmobiling has been shown to displace caribou from preferred areas and the intensity of displacement – both in space and time – can depend on the intensity of snowmobile use (Simpson and Terry 2000, Seip et al. 2007). Snowmobiling may further induce physiological stress, potentially affecting individual fitness and population dynamics (Freeman 2008). Compacted trails from snowmobiles may also facilitate movement of predators into winter habitats of caribou, thereby increasing predation risk (Droghini and Boutin 2017).

Snowmobiling and other forms of motorized travel is highly managed within the Muskwa-Kechika Management Area, which is situated within the northern and eastern portions of the Finlay range. Snowmobiling is restricted to specific designated routes and none of these occur within the Finlay range (http://www.muskwa-kechika.com/management-area/access-management). Outside of the Muskwa-Kechika, there are no regulations on snowmobile use; however, because of the remoteness of the Finlay range and the lack of a developed trail network, snowmobile use within the range is likely minimal.

3.3.2.2 HELI-SKI / CAT-SKI

Heli- and cat-skiing can have similar mechanistic effects on caribou populations as snowmobiling though the degree of impacts is considered to be lower, primarily because skiing generally occurs on slopes steeper than those preferred by caribou (Simpson and Terry 2000). Also, best management practices such as skiing at least 500-m away from observed caribou may reduce caribou-skier encounters (Huebel 2012) although the lack of compliance with these practices remains an issue (L. DeGroot, *personal communication*).

There are no heli-skiing or cat-skiing companies operating within the Finlay range.

3.3.2.3 SUMMER RECREATION

Recreational activities in the snow-free seasons can also impact caribou populations. Trails associated with off-road vehicles, hiking, mountain biking and horseback riding may facilitate predator movements into summer habitats used by caribou, potentially increasing predation risk (Whittington et al. 2011). Human presence on hiking trails may also induce physiological stress, though this response may attenuate if humans are not perceived as a predation threat (Lesmerises et al. 2017).

The overall impact of summer recreational activities on the Finlay subpopulation of NM caribou is likely minimal. Hiking and horseback riding both occur within the Finlay range though their intensity is likely low due to the remoteness of this range (limited road access) and the small number of developed trails.

3.3.2.4 Other

In many ranges of mountain-dwelling caribou, backcountry skiing (i.e. ski touring) has become an increasingly popular activity. Simpson and Terry (2000) rated this activity's threat to caribou as low because of its non-motorized nature. Because of the range's remoteness, ski touring impacts within the Finlay are likely minimal.

3.3.3 Other

This section considers other forms of human activity potentially impacting caribou populations, including agriculture, major highways linear features and hunting.

3.3.3.1 Agriculture

Agriculture can impact caribou populations through a number of mechanisms. First, conversion of forested areas to agriculture can result in direct habitat loss and avoidance behaviours by caribou may increase the extent of loss beyond the physical footprint (Vistnes and Nellemann 2008). Second, agricultural areas are generally favourable to alternate prey (e.g. deer and elk), potentially increasing their populations and those of predators, which ultimately may increase predation rates of caribou. Third, agriculture could increase the likelihood of disease and parasite transmission among domesticated animals, alternate prey and caribou although such links have not been established within British Columbia caribou herds (Vors and Boyce 2009, Martin et al. 2011).

There are no significant impacts from agriculture within the Finlay caribou range.

3.3.3.2 Major Highway Corridors

Major highways can constitute a direct source of mortality (i.e. road kill) for caribou and may further alter or impede caribou movements (Leblond et al. 2013). Although road kill of caribou is generally rare, it can become an increasingly important mortality source for small populations (Kinley and Apps 2001). With respect to movement impacts, the relative permeability of highways to caribou movement is inversely related to traffic volumes (Leblond et al. 2013) and, as such, major highways with high traffic may lead to population fragmentation (Apps and McLellan 2006).

There are no major highways within or adjacent to the Finlay range. An all-weather gravel road is present on the range's western boundary. This road connects the community of Fort Ware to Tsay Keh Dene on the northern end of the Williston Reservoir.

3.3.3.3 Linear Features

Industrial activities within forested systems are often accompanied by the creation of linear features such as roads, railways, power lines, pipe lines and seismic lines. Such features are thought to increase predation of caribou by increasing predator hunting efficiency (McKenzie et al. 2012, Dickie et al.

2017) and facilitating predator movement into caribou range (Whittington et al. 2011, DeMars and Boutin 2018). Linear features may further contribute to caribou-predator spatial overlap if such features facilitate the movement of alternate prey into caribou range (Dawe and Boutin 2016, Fisher et al. 2017). With natural resource exploration increasing in NM caribou ranges, the creation of new linear features is becoming an increasingly important management concern as such features may result in increased harvest by allowing easier human access to caribou habitat (Seip and McLellan 2008, Hegel and Russell 2013).

The Finlay range has been minimally impacted by linear features. The primary impacts have been forestry roads, which are situated along the range's western boundary and emanate from the Northern Rocky Mountain Trench.

3.3.3.4 HUNTING

Historical records indicate that NM caribou have long been hunted by First Nations in BC (Spalding 2000). Guided hunting has occurred within the Northern Rocky Mountains at least since the 1940s (Spalding 2000). Currently, licensed hunting for caribou is still allowed within WMUs 7-37, 7-40 and 7-41, which all overlap the Finlay range. Harvest is restricted to 5-point or larger bulls with a bag limit of one. Within British Columbia, all licensed harvest of caribou has been tracked since 1976 by compulsory inspection or hunter surveys. For a review of harvest statistics within the Finlay range, see *Section 2.3 Population Size and Trend* and Figure 2 above.

3.3.3.5 POACHING

The impact of illegal hunting (i.e. poaching) is unknown but is likely small (Environment Canada 2014).

3.4 NATURAL DISTURBANCE

Caribou populations are subject to impacts from a number of natural disturbances. Being dependent on old-growth forests, caribou are impacted by forest fires. Areas burned by fire may be avoided for up to 50 years (Dalerum et al. 2007) and the early seral habitat created post-fire may facilitate population increases in predators and alternate prey. Although caribou are likely adapted to the natural forest fire regime within and adjacent to their ranges, effects of forest fire may act cumulatively with human-mediated disturbances to negatively impact caribou demography (Sorensen et al. 2008). Caribou may also be affected by insect or disease outbreaks that affect forest stand condition. For example, mountain pine beetle outbreaks can highly impact old-growth pine stands, affecting lichen availability (Cichowski and Haeussler 2015, Apps and Dodd 2017) – a primary forage resource for caribou – and increasing the likelihood of fire (Lynch et al. 2006). For mountain-dwelling caribou, avalanches constitute another type of natural disturbance that can potentially impact demography, though under normal conditions their importance as a mortality should be small unless population sizes are small (Seip and Cichowski 1996, Hebblewhite et al. 2010).

Within the boreal forests of northeastern British Columbia, the median return interval for forest fires is ~ 100 years (Johnstone et al. 2010). Using forest fire data available to 2015, the extent of areas burned < 50 years ago constitutes ~ 4% of the Finlay range with the majority of these fires situated in lower

elevation conifer forests on the range's norther and western periphery. Within the last 50 years, the largest fire occurred in 1995 (9,489 ha burned) and was situated along the range's northwestern boundary.

The Finlay range has been affected by the mountain pine beetle, particularly within lower elevation forests situated in the range's western half (https://www.for.gov.bc.ca/hre/bcmpb/year13.htm). Projections into the year 2024 suggest that infestations are not expected to intensify in terms of spatial distribution within the Finlay range.

3.5 Parasites and Diseases

Caribou can be impacted by a range of native and introduced diseases and parasites (Bergerud et al. 2008, Schwantje et al. 2014). Disease and parasite outbreaks can limit caribou populations by affecting survival and reproductive rates (Klein 1991, Albon et al. 2002) and effects of disease and parasites may interact with other limiting factors such as predation and nutrition. Threats from disease and parasites are predicted to increase with climate change (see *Section 3.6* below), particularly if spatial overlap between caribou and other ungulate species increases (Bradley et al. 2005, Kutz et al. 2005, Dobson 2009). For example, increasing expansion of white-tailed deer into caribou range may increase the prevalence of meningeal worm in caribou, a parasite that is highly pathogenic to caribou and whose usual host is white-tailed deer (Anderson 1972).

Impacts from parasites and disease on the population dynamics of Finlay caribou are not well studied. In nearby ranges of boreal caribou, a three-year study documented a number of potential disease and pathogenic threats to these subpopulations, including the pathogenic bacterium *Erysipelothrix rhusiopathiae*, the protozoan parasite *Neospora caninum*, and high winter tick (*Dermacentor albipictus*) loads (Schwantje et al. 2014). Winter tick in particular was identified as an emerging threat to caribou in the region as moderate to severe infestations were observed in all ranges, although its prevalence in NM caribou has not been explicitly assessed. In the federal *Management Plan* for NM caribou, determining the role of disease and parasites in limiting caribou populations was identified as a priority for future research (Environment Canada 2012*a*).

3.6 Climate Change

Climate change can potentially exert numerous effects on caribou population dynamics. Warmer winters may impact forage availability by increasing icing events and / or causing poor snow conditions that limit the ability of SM caribou to access arboreal lichens (Kinley et al. 2007, Hansen et al. 2011). A warming climate may also change the abundances and distribution of alternate prey and their generalist predators, potentially increasing rates of caribou predation (Latham et al. 2011*b*, Dawe and Boutin 2016). Climate change may alter the spatial and temporal distribution of insects, diseases and parasites, potentially affecting individual fitness and population dynamics (Bradley et al. 2005). Changes to the natural disturbance regime (e.g. fire interval, fire intensity, avalanche frequency) may further impact caribou through mechanisms outlined in *Section 3.4*.

Impacts of climate change on the Finlay range have not been well studied. The negative impacts of the northward expansion white-tailed deer have been documented in ranges of boreal caribou (Latham et al. 2011*b*, Dawe and Boutin 2016) but whether white-tailed deer have impacted NM caribou ranges is unclear. Recent analyses using demographic data from boreal caribou subpopulations in northeast British Columbia have suggested that woodland caribou may be impacted from effects of climate change other than those related to alterations in predator-prey communities. Specifically, juvenile recruitment was negatively affected by increasing mean winter temperatures while adult female survival was positively associated with the timing of spring (i.e., later onset of spring growing conditions equated to increased survival; DeMars et al. 2017). Collectively, these relationships suggest that warmer winter temperatures and lowered snowfall may have a negative effect on caribou population dynamics. It is unknown whether the Finlay subpopulation has been specifically impacted by these predicted effects of climate change.

3.7 Small Population Size Effects

Caribou subpopulations that are small and isolated may be subject to negative demographic effects that can occur as a result of their small size (Caughley 1994). Such effects include inbreeding depression, genetic isolation from population fragmentation (Serrouya et al. 2012), demographic stochasticity (e.g. all offspring produced are of one sex), environmental stochasticity (e.g. the population is extirpated by a random natural disturbance such as an avalanche; Hebblewhite et al. 2010), and Allee effects (e.g. lowered demographic performance with decreasing population size; Courchamp et al. 1999). For group-living ungulates such as caribou, McLellan et al. (2010) documented a predation-mediated Allee effect where the predation rate may increase with declining population size because group size declines at a faster rate than the number of groups in the population and the number of groups dictates the rate of caribou-predator encounters.

Determining whether the Finlay subpopulation is – or will be – subject to small population size effects is difficult due to uncertainty in its current population size and range boundaries. The most recent estimates of population size indicate < 50 caribou within the Finlay subpopulation, which if accurate would indicate an increased likelihood of negative effects from small population size. Recent radio-collaring efforts, however, have shown that current range boundaries may not reflect the full extent of this caribou subpopulation. In 2017, three females captured and collared within the Finlay range travelled over to the Pink Mountain range just prior to calving (M. Klaczek, *personal communication*). These movements may indicate that Finlay caribou are a component of a much larger subpopulation.

4 Management History

Many subpopulations of NM caribou have a limited history of active management, which in part may be due to the remoteness of their ranges and a lack of baseline information. In its initial assessment of NM caribou, COSEWIC (2002) suggested that most subpopulations were stable because their habitat was remote and relatively intact. Only two subpopulations were thought to be at risk with the primary threats being altered predator-prey dynamics and increased human access. Twelve years later, a

reassessment of NM caribou found two subpopulations to be increasing, seven were stable, nine were decreasing, and the statuses of the remaining 27 subpopulations were unknown due to data deficiencies (COSEWIC 2014). For subpopulations within British Columbia, one subpopulation was thought to be stable, seven were decreasing and the population trends for the remaining 15 were uncertain.

In 2012, the federal *Management Plan* for NM caribou was developed to prevent further population declines and avoid their potential listing as threatened or endangered. The *Plan* recommended a series of management actions to address the uncertainties surrounding the status of many subpopulations and to outline recovery measures for those in decline (Environment Canada 2012*a*). These actions were similar to those recommended for recovering Boreal and Southern Mountain caribou (Environment Canada 2012*b*, 2014), and broadly included the following key components:

i. Managing and protecting of sufficient habitat for caribou to carry out life history processes and reduce predation risk thereby ensuring long-term population persistence. Habitat protection generally has included access management.

ii. Managing the populations of other ungulate species.

iii. Managing of predator populations.

As a fourth key component, the *Management Plan* also recommended that NM caribou be managed for a sustainable harvest, which is unique to this population as Boreal and Southern Mountain caribou are no longer hunted.

This section reviews management actions undertaken for the Finlay subpopulation under five broad categories: habitat management, recreation and access management, predator management, alternate prey management, and population reinforcement. For a review of this subpopulation's harvest history and management, see Sections *2.3 Population Size and Trend* and 3.3.3.4 *Hunting*.

4.1 HABITAT

Protecting and restoring sufficient habitat for caribou to carry out essential life processes and reduce predation risk is fundamental to achieving self-sustaining populations (Environment Canada 2014, Ray et al. 2015). NM caribou require large tracts of undisturbed habitat and have evolved to inhabit alpine areas and old-growth forests, which separates them – both in terms of elevation and horizontal space – from other ungulates and their generalist predators (Bergerud et al. 1984, Bergerud and Page 1987, Seip 1992). In winter, NM caribou use mature forests and wind-swept alpine areas to access lichen (Johnson et al. 2004). Summer ranges are typified by alpine birch-sedge meadows (Oosenbrug and Theberge 1980, Denryter et al. 2017). Spatial requirements for NM caribou also extend beyond seasonal areas of high use (i.e. habitat cores) and can include "matrix" habitat, areas of relatively low use that may be used during migration (Environment Canada 2012*a*).

The 2012 federal *Management Plan* for NM caribou suggests that effective habitat management for each subpopulation requires delineating and protecting habitats with high influence on population dynamics (e.g. calving areas, rutting ranges, winter ranges, movement corridors). Because natural and

anthropogenic disturbances are known to negatively impact habitat quality (Wittmer et al. 2007, Sorensen et al. 2008), active restoration may be required for those subpopulations residing in highly disturbed landscapes.

4.1.1 PROTECTION

The northern and eastern portions of the Finlay caribou range (~ %40) are situated within the Muskwa-Kechika Management Area, which is managed to maintain wilderness values. Provincial Parks and Protected Areas encompass ~7% of the range's area and provide even stronger protections as no industrial development is permitted in these areas. Greater than 85% of the range's area is also designated as Ungulate Winter Range for either caribou, elk, moose, mountain goat and/or Stone's sheep.

4.1.2 ENHANCEMENT AND RESTORATION

There has been no management actions to enhance or restore caribou habitat within the Finlay range.

4.2 RECREATION AND ACCESS MANAGEMENT

The Finlay caribou range is generally remote and has much lower recreational activity than caribou ranges situated in mountainous areas of southern British Columbia. Part of the range is situated within the Muskwa-Kechika Management Area, which restricts motorized access to specific routes (http://www.muskwa-kechika.com/management-area/access-management).

4.2.1 SNOWMOBILE

Snowmobile use within the Finlay range is low compared to ranges of mountain-dwelling caribou located further south in the province (Simpson and Terry 2000, BC Ministry of Environment 2003). Within the Muskwa-Kechika Management Area, snowmobiling is restricted to designated routes, none of which occur in the Finlay range. Outside of this Management Area, there are no restrictions on snowmobile activity.

4.2.2 HELI-SKI / CAT-SKI

There are no heli- or cat-ski companies operating within the Finlay and thus it is not subjected to impacts from these activities.

4.2.3 SUMMER RECREATION

Due to its remoteness and limited road access, the Finlay range sees relatively light summer recreational use. Within the Muskwa-Kechika Management Area, motorized vehicles are restricted to a few specified access routes and none of these occur in the Finlay range. Other activities in the range include backpacking, horseback riding and guide outfitting, all of which occur at a low intensity and consequently there are no restrictions on these types of recreation.

4.2.4 OTHER

There are no other restrictions on recreational activities within the Finlay caribou range.

DRAFT

4.3 PREDATORS

Actions aimed at managing predators may include liberalizing hunting and trapping quotas (Cluff and Murray 1995), diversionary feeding (Lewis et al. 2017), managing alternate prey (Serrouya et al. 2017*c*), and lethal control (Bergerud and Elliott 1998, Hervieux et al. 2014). Note that actions such as lethal control are controversial (Boertje et al. 2010, Lute and Attari 2017) and are generally considered short-term strategies used to sustain small and rapidly declining populations until the effects of habitat restoration and protection are realized (Wittmer et al. 2010, Hervieux et al. 2014).

4.3.1 WOLF MANAGEMENT

Within British Columbia, active management of wolves began in the early 1900s with the introduction of a bounty program, which lasted until 1955 (BC Ministry of Forests, Lands and Natural Resource Operations 2014). Predator control programs were also initiated during the 1940s and the combined effect of these initiatives resulted in wolf populations declining to their lowest estimated numbers provincially in the late 1950s. The suppression of wolf numbers resulted in population peaks of caribou in northeastern British Columbia during the 1960s (Bergerud 1978, Spalding 2000) though the specific effects of wolf control on the Finlay subpopulation are unknown.

Since the cessation of province-wide wolf control, northeastern British Columbia has had a few periods of wolf removals. From 1978 – 1980, 71 wolves were removed from the Horseranch Mountains and an unknown number of wolves were removed from the Muskwa range by local guide outfitters (Bergerud and Elliott 1998). In the 1980s, wolf removal experiments were conducted in northeastern British Columbia to test the effects of wolf predation on recruitment rates – and consequently population growth rates – of four ungulate species (Bergerud and Elliott 1998). Within the Muskwa study area, wolves were removed in 1984 (60% reduction over a 6775 km^2 area), 1985 (77% reduction over 13,570 km^2) and in 1987 (62% reduction over 10,000 km^2). Within the Kechika study area, which included the Horseranch Mountains, wolves were removed in 1982 (85% reduction over 3833 km^2), 1983 (83% reduction over 7123 km^2), 1984 (76% reduction over 9961 km^2) and 1985 (65% reduction over 18,400 km^2). These removals resulted in high recruitment rates and probable population growth in caribou populations in the two study. Effects of the wolf removal program, however, were short-term as recruitment rates in the Muskwa study area had lowered from 30.4 calves per 100 females in the last year of wolf removal to 17.5 calves per 100 females three years later.

In the winter of 2015, wolf reductions were also initiated in the Klinse-za, Kennedy Siding and Quintette ranges (Seip and Jones 2015). Across these ranges, 57 wolves were removed in 2015, 201 in 2016 and 93 in 2017. Since the reductions began, all three subpopulations have had increases in adult survival, calf recruitment and population size while the Graham subpopulation, which served as a control, continued to decline (Seip and Jones 2017). Effects of this recent wolf control on the Finlay subpopulation, which range lies further north of the wolf control areas than Graham, are unknown.

Currently, there is an eleven month general hunting season for wolves with no bag limit in WMUs 7-37, 7-40, and 7-41, which all overlap the Finlay range.

4.3.2 Cougar Management

Being situated at the northern edge of cougar distribution within western North America, the Finlay range likely has a low density of cougars, though their population has not been explicitly enumerated. To date, cougar predation of Finlay caribou has not been documented and consequently cougars have not been subject to management actions in the context of caribou conservation. There are no general hunting seasons for cougars within WMUs 7-37, 7-40, and 7-41.

4.3.3 Other

Within the context of caribou conservation, there have been no other management actions directed at other predators (e.g. bears or wolverine) within the Finlay range.

4.4 Alternate Prey

Declines in many populations of woodland caribou have been attributed to apparent competition, an indirect interaction between two or more prey species and a shared predator (Holt 1977, DeCesare et al. 2010, Hebblewhite 2017). In this process, increased abundances of other ungulate species – stemming from an increase in favourable habitat following landscape alteration – has led to higher populations of predators, resulting in unsustainable predation of caribou. Because of these linkages, recommended strategies for recovering caribou populations includes reducing the abundances of primary prey (Wittmer et al. 2013, Serrouya et al. 2015, Boutin and Merrill 2016).

4.4.1 Moose Management

The Finlay range has received periodic surveys to estimate moose abundance and/or density, though these surveys were not specifically focused on the Finlay range *per se* and the areas surveyed generally exceeded the current boundaries of the Finlay range. In 1998, a survey of what was known as the Akie study area, which encompassed the Finlay range, recorded 286 moose (Pacific Slope Consulting 1999). Two years later, Demarchi (2000) recorded in 313 moose in slightly larger study area. Zimmerman et al. (2002) re-surveyed the western portion of the Akie study area and recorded 77 moose. In 2007, Walker et al. (2007) estimated a moose density of 0.59 moose / km^2 in the Northern Williston Watershed, which included portions of the Finlay range. This density is higher than proposed thresholds conducive to caribou persistence (e.g. < 0.2 – 0.3 moose / km^2; Bergerud 1996); however, this survey was focused on moose habitat and did not include the entirety of caribou range.

To date, there has been no active management of moose in the context of caribou conservation within the Finlay range. Currently, licensed general hunting for moose within WMUs 7-37, 7-40 and 7-41 is restricted to spike-fork bulls with a bag limit of one. The impact of First Nations hunting on moose populations is unknown.

4.4.2 Deer Management

White-tailed deer and mule deer are present within the Finlay caribou range. Mule deer are more abundant (Kline 2013) although the northern distribution and abundance of white-tailed are likely increasing (Latham et al. 2011*b*, Dawe and Boutin 2016). There are general hunting seasons for both

mule deer and white-tailed deer bucks within WMUs 7-37, 7-40, and 7-41. The bag limit for each species is one. To date, there have been no management actions targeted toward deer in the context of caribou conservation in the Finlay caribou range.

4.4.3 OTHER

Elk (*Cervus elaphus*), mountain goat (*Oreamnos americanus*) and Stone's sheep (*Ovis dalli stonei*) are also present within the Finlay caribou range. For elk, there is a 12-week general hunting season for bulls with six points or larger in WMUs 7-37 and 7-41 and an four-week general season for six-point bulls in WMU 7-40. For Stone's sheep, there is a general hunting season for full curl rams in WMUs 7-37, 7-40, and 7-41. There is also a general hunting season for mountain goat in all three WMUs. The bag limit for each species is one. None of these species have been subject to management actions in the context of caribou conservation.

4.5 POPULATION REINFORCEMENT

To bolster small populations, management actions may include population reinforcement. Such measures include maternal penning, captive breeding, and translocation. Population reinforcement techniques are generally considered to be highly invasive, logistically difficult and expensive (Hayek et al. 2016).

4.5.1 MATERNAL PENNING

Maternal penning is a captive-rearing technique where wild female caribou are captured in late-winter and confined to a predator-proof pen within their range to give birth (Hayek et al. 2016). Females and calves are retained in the pen for at least four weeks post-parturition. The main objective of maternal penning is to increase calf survival during the neonate period when predation rates are generally highest (Adams et al. 1995, Pinard et al. 2012). To effectively improve caribou population dynamics, the success of maternal penning depends on the proportion of the female population penned, the survival of penned females and calves post-release, and the survival of wild females and calves.

Maternal penning has not been used within the Finlay caribou range.

4.5.2 CAPTIVE BREEDING

Captive breeding is defined by Hayek et al. (2016) as "keeping and selectively breeding caribou in captivity, usually at an ex-situ facility, over a relatively long period of time with the purpose of releasing individuals back into the wild". To date, captive breeding of caribou has not been implemented as a management tool for conserving wild caribou populations.

There have been no captive breeding efforts undertaken for the Finlay subpopulation.

4.5.3 TRANSLOCATION

Translocation refers to the movement of individuals from one population (or subpopulation) to another (Hayek et al. 2016). Numerous translocation efforts for caribou have taken place across South America and are reviewed in Bergerud and Mercer (1989) and Hayek et al. (2016).

There have been no translocations of other caribou into the Finlay subpopulation.

4.5.4 OTHER

There have been no other forms of population reinforcement implemented for the Finlay subpopulation.

4.6 STEWARDSHIP/OUTREACH

[NO IDEA WHAT TO PUT HERE....]

4.7 RESEARCH

Most subpopulations of NM caribou are relatively little studied, perhaps because they are a lower management priority due to being less threatened than populations of boreal and southern mountain caribou (Environment Canada 2012*a*). Within British Columbia, the first research efforts aimed at evaluating NM caribou ecology and behaviour began in the late 1970s with Bergerud's (1978) surveys of various subpopulations to estimate size, juvenile recruitment and population trend. Since then, numerous studies have been conducted within NM caribou ranges, with research focusing on predator-prey dynamics (Bergerud and Elliot 1986, Bergerud and Elliott 1998, Gustine et al. 2006), estimating vital rates (Parker and Gustine 2007, McNay et al. 2014), spatial behaviours (Bergerud et al. 1984, Bergerud and Page 1987), habitat selection (Gustine and Parker 2008, Polfus et al. 2014), responses to disturbance impacts (Polfus et al. 2011), pregnancy rates (McNay et al. 2014), diet (Denryter et al. 2017) and nutritional condition (Parker and Gustine 2007). While these studies have collectively informed the broad management strategies outlined in the federal *Management Plan* for NM caribou, further herd-specific research will likely be necessary to develop effective strategies for individual subpopulations (Environment Canada 2012*a*).

For the Finlay subpopulation, one of the first investigations into herd structure and composition was conducted by Halter (1990), though his survey was focused on moose and was not restricted the current boundaries of the Finlay range. This survey found that most caribou were found in high elevation (>1375-m) alpine areas in late winter. The most intensive research involving Finlay caribou occurred during the mid-late 1990s and early 2000s when caribou in the MacKenzie Timber Supply Area were monitored in a project funded by Slocan Forest Products and Finlay Forest Industries (Pacific Slope Consulting 1999, Zimmerman et al. 2001). The project encompassed the current boundaries of the Finlay range and also extended into the Pink Mountain, Chase, Wolverine and Scott ranges (Pacific Slope Consulting 1999, McNay and Giguere 2004). Within the Finlay range, the project deployed radio-collars on 44 individuals. Data from these animals provided inferences on habitat selection (Zimmerman et al. 2001), survival rates and mortality causes (McNay and Giguere 2004) The project also provided the last formal census of the Finlay subpopulation (Zimmerman et al. 2002; M. Klaczek, MFLNRORD biologist, *personal communication*).

Recently, a new radio-collaring program has been initiated within the Finlay range (M. Klaczek, MFLNRORD biologist, *personal communication*). In late winter 2017, GPS radio-collars were deployed on three adult females, though these animals subsequently moved over to the Pink Mountain

range. In February and March 2018, six additional GPS radio-collars were deployed: three within the current delineation of the Finlay range and three just south of the range near the Ospika Arm of Lake Williston in area designated as "trace occurrence". Data from these animals should provide further insights into seasonal movements, habitat selection and demography of Finlay caribou and help refine range boundaries.

4.8 MONITORING

In the last 40 years, the Finlay subpopulation has been infrequently surveyed and has been primarily monitored by harvest statistics or an assessment of incidental observations recorded during surveys focused on other ungulate species (Environment Canada 2012*a*; see *Section 2.1 Population Size and Trend)*. The most extensive monitoring occurred in the mid-late 1990s and early 2000s as part of a larger project investigating caribou ecology in the Mackenzie Timber Supply Area (Pacific Slope Consulting 1999, Zimmerman et al. 2001, 2002). Data from this project provided an initial assessment of adult female survival (McNay and Giguere 2004) and the last formal census of the Finlay subpopulation (Zimmerman et al. 2002). Because monitoring has been infrequent, no empirical estimates of population trend are available for the Finlay subpopulation.

In late-winter 2017, a new monitoring program was initiated within the Finlay range with the deployment of three GPS radio-collars on adult females (M. Klaczek, MFLNRORD biologist, *personal communication*). In the winter of 2018, an additional six radio-collars were deployed on females within (n = 3) and adjacent (n = 3) to the Finlay range. These collared animals should assist with future surveys to estimate population size and composition with such demographic data allowing for more direct monitoring of population trend.

5 IMPLICATIONS TO OTHER WILDLIFE

Management actions focused on conserving caribou will necessarily have impacts on other wildlife species. Caribou generally require landscapes where densities of other ungulates and predators are low; thus, management actions undertaken for caribou may result in population sizes of moose, deer, and wolf that are much lower than those currently experienced (Serrouya et al. 2015, 2017*c*). Reducing the populations of these species may occur from either direct management actions (e.g. lethal control) or through environmental changes (e.g. habitat restoration for caribou) that lowers the extent of suitable habitat.

Conserving caribou will likely benefit a myriad of other species co-occurring within old-growth forests. In this context, caribou may be considered an "umbrella" species (Bichet et al. 2016). Such species generally have large spatial requirements and are sensitive to environmental changes, both attributes associated with caribou. Meeting the habitat requirements of caribou will therefore result in the habitat needs of many other species also being met.

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6 IMPLICATIONS TO OTHER VALUES

Enacting measures to conserve caribou will likely have impacts on social, political and economic values. Most woodland caribou populations occur in working landscapes managed for natural resource extraction. Conserving caribou in these landscapes will require limits on these activities, which will invoke socioeconomic costs (Schneider et al. 2011). Limiting recreational activities such as snowmobiling and skiing within caribou range will likely create further socioeconomic costs. To effectively mitigate these impacts while conserving caribou in multi-use landscapes, conservation planning will need to incorporate both economic costs and the biological needs of caribou in a spatially-explicit modelling framework (Schneider et al. 2011, 2012).

In many caribou ranges, reducing the current densities of other ungulate species will be fundamental to conserving caribou (Serrouya et al. 2015). Lowered populations of big-game species such as moose and white-tailed deer will result in reduced hunting opportunities. While incorporating hunters in the initial lowering of these populations can be advantageous and seen as a "win-win" (Serrouya et al. 2015), the long-term suppression of these populations will likely require support from the regional hunting community.

Caribou have evolved a life history strategy that is dependent on large landscapes of intact wilderness (Bergerud 2000). For many, such landscapes have inherent and intangible value. Intact wilderness also has economic benefits, including climate regulation, sedimentation control and nutrient cycling (Balmford et al. 2002).

Caribou conservation can also elicit ethical issues. For many small and rapidly declining populations, management actions may include direct control of predators and other ungulates (Hervieux et al. 2014). Such actions can elicit considerable controversy and, consequently, require substantial scientific support and justification for their implementation (Boertje et al. 2010).

7 PARTNERS / NEIGHBOURS

[LEAVING THIS FOR THE RELEVANT GOV FOLKS....]

Partners are bodies, currently existing or with strong future potential, that can assist in some aspect of management, such as expertise, financial contribution, in-kind support or moral support.

Neighbours are bodies within in the caribou subpopulation area that are currently not participating in caribou management that could be affected by caribou management, such as local governments, industry tenure holders, and recreation groups. These neighbours could potentially become future partners.

8 RECOMMENDED ACTIONS

In 2012, the federal *Management Plan* for NM caribou was released to outline objectives and strategies for recovering and managing subpopulations of NM caribou (Environment Canada 2012*a*). The primary

goal of the *Management Plan* was to facilitate cooperative management of NM caribou to prevent the population from becoming threatened or endangered. Inherent to the latter part of this goal is that subpopulations are maintained within their natural range of variability. To achieve this goal, the *Management Plan* outlined a number of objectives, including:

i. Evaluating and monitoring population size and trend
ii. Managing harvest for sustainable use
iii. Identifying and protecting demographically important habitats
iv. Understanding and managing predator-prey dynamics
v. Assessing health risks (e.g. parasites and disease) to caribou
vi. Evaluating disturbance impacts in a cumulative affects framework
vii. Foster multi-stakeholder stewardship and develop knowledge sharing programs

The relative importance and order of implementation of the above objectives will vary by subpopulation and will depend on such factors as current population size, population trend (stable, increasing or decreasing) and known threats. To assess progress toward management objectives, the *Management Plan* recommended that population size and trend, habitat conservation and the reduction of threats be used as performance measures.

Below, recommended management actions are outlined for the Finlay subpopulation. Following the framework of the federal Management Plan, actions are grouped under three headings: Population Management, Habitat Management, and Communication and Involvement.

Recommended Actions for the Finlay Subpopulation

1. *Population Management*

    - *Develop a consistent monitoring program to track population size and trend*

      Over the last 30 years, the Finlay subpopulation has been primarily monitored by harvest statistics. Such statistics assume that hunter success rates are directly proportional to animal abundance, an assumption that may not always hold (Peacock and Garshelis 2006). Going forward, population size should be estimated at regular intervals (e.g. every 3 years) using a consistent survey design (see Wittmer et al. 2005*a* and Serrouya et al. 2014, 2017*a* for examples and discussion). In the absence of consistent estimates of population size, trend can be monitored indirectly using Hatter and Bergerud's (1991) "R/M" equation, which estimates the population growth rate (λ) by relating annual adult female survival (S) to juvenile recruitment (R) ($\lambda = S / (1 - R)$; DeCesare et al. 2012*b*, Serrouya et al. 2017*a*). This indirect approach requires a sample of radio-collared females to estimate S and late-winter composition surveys to estimate R. An advantage to the indirect approach is that by maintaining a sample of radio-collared animals, information on mortality causes can also be collected, which can provide insights into mechanisms influencing population declines. If an indirect approach is used, periodic surveys should still be done to validate trend estimates (Serrouya et al. 2017*a*).

    - *Manage harvest for sustainable use*

Current hunting regulations allow for a general season on 5-point or larger bulls within the Finlay range with no quota on the number of animals harvested. Hayes et al. (2003) suggested that harvest rate should not exceed 2% of the population. Although precise estimates of population size for the Finlay range are lacking, expert opinion suggests a population size of < 50 animals. Over the last decade, only three bulls have been harvested within WMU 7-41, which overlaps two-thirds of the range. While this relatively low harvest is within the threshold proposed by Hayes et al. (2003), further analyses should be conducted to ensure that current harvest rates are sustainable.

- *Identify potential limiting factors affecting caribou population growth rate*

  Understanding limiting factors is important for effective management of wildlife populations. The radio-collaring studies conducted between 1990 – 2004 yielded initial insights on potential limiting factors within the Finlay subpopulation (e.g., predation was identified as the primary cause of adult female mortality; McNay and Giguere 2004). How these factors – and others – have influenced the current suspected decline in the Finlay subpopulation is unknown.

2. *Habitat Management*

   - *Identify then ensure protection of core habitat areas*

     The Finlay range is partially situated within the Muskwa-Kechika Management Area, which mandates that wildlife values be balanced with responsible resource development. To achieve this mandate, core habitat areas for caribou within the Finlay range should be identified to inform the development of effective management strategies that incorporate resource development with caribou conservation.

   - *Maintain a spatial inventory of natural and anthropogenic disturbances within caribou range*

     Substantial evidence from boreal and southern mountain caribou populations demonstrates a negative relationship between caribou population growth rates and the amount of disturbance within caribou range (Environment Canada 2008, 2014). Analyses from these populations suggest that the spatial extent of buffered (500-m) disturbances should not exceed 35% of caribou range.

3. *Communication and Involvement*

   - *Facilitate shared stewardship with all relevant stakeholders, including guide outfitters and First Nations*

     The Finlay range has a long history of use by First Nations and incorporating traditional knowledge and perspectives should be integral to any management plan. The Finlay range is also an important area for guided hunting and local outfitters should be consulted and included in management planning.

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8.1 Short Term (Within 6-12 Months)

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8.2 Medium Term (Within 12-24 Months)

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8.3 Long Term (Within 24-48 Months)

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