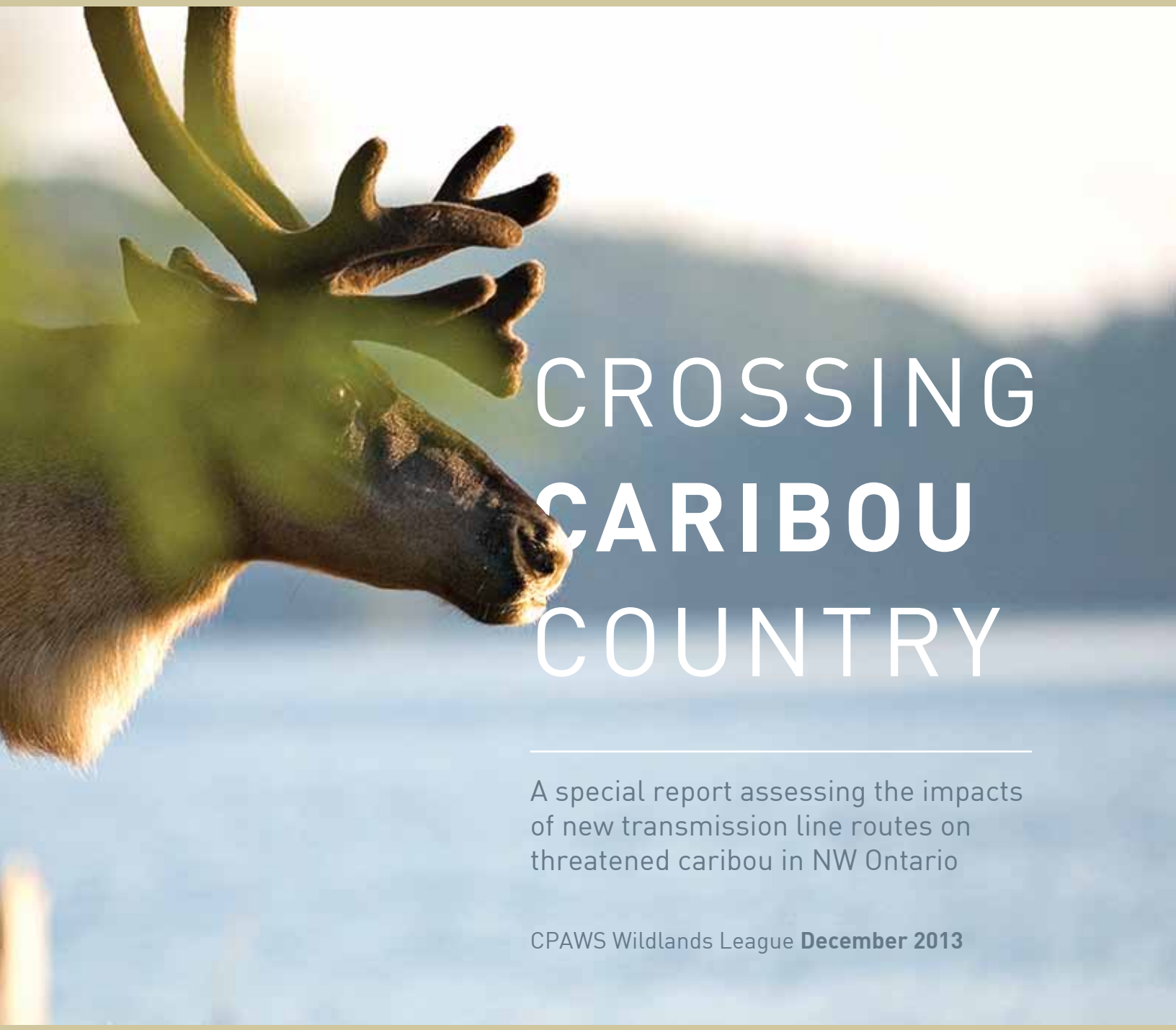

CROSSING **CARIBOU** COUNTRY

A special report assessing the impacts of new transmission line routes on threatened caribou in NW Ontario

CPAWS Wildlands League **December 2013**

ABOUT CPAWS WILDLANDS LEAGUE

CPAWS Wildlands League is a not-for-profit charity that has been working in the public interest to protect public lands and resources in Ontario since 1968, beginning with a campaign to protect Algonquin Park from development. We have extensive knowledge of land use in Ontario and history of working with government, communities, scientists, the public and resource industries on progressive conservation initiatives. We have specific experience with impacts of industrial development on boreal forests and wildlife that depend on them.

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Anna Baggio completed an undergraduate degree in Biology from McMaster University and a graduate degree from York University. Her passion for conservation was sparked at a national park in Georgian Bay where she studied spotted turtles and reptiles. For her Master's research, she worked with communities outside two small protected areas in Southern Costa Rica, examining land use and ecologically sustainable practices in agriculture. Anna has spent the last 12 years working with First Nations, governments, citizens, media, industry and communities to advance boreal forest protection. In June 2012, Anna played a lead role in delivering a groundbreaking 3 million ha action plan in NE Ontario under the Canadian Boreal Forest Agreement that protects caribou habitat and provides for local jobs. She has participated in the Ontario Minister of Natural Resources' Far North Advisory Council and currently sits on the Minister of Northern Development and Mine's Mining Act Advisory Committee. You can follow her on twitter @annabwild.

EXECUTIVE SUMMARY

CPAWS Wildlands League is a not-for-profit charity with a mission of protecting wilderness in Ontario. As part of our mandate, we examine and monitor new proposals for any new proposed linear disturbance (roads or transmission lines) in the Boreal Forest of Ontario because it is often the precursor to additional developments and opens up new areas for industrial activities which in turn have ramifications for at risk wildlife sensitive to disturbances such as forest dwelling woodland caribou. With this project, we examined proposals for a major new ~ 300km transmission line in Northwestern Ontario designed to supply power from Ignace/Dryden to Pickle Lake.

Based upon our findings from (a) our review of the literature investigating potential negative impacts to Boreal woodland caribou from situating a new transmission line, AND (b) from the quantitative assessment of range condition based on Environment Canada's cumulative disturbance risk analysis assessment framework, relative to the proposed transmission line routes, we offer the following eight brief conclusions:

- No additional permanent infrastructure should be introduced in the highly disturbed southern ranges (Churchill and Brightsand) and a focus on restoration is required;

- Any additional linear infrastructure is likely to result in some impacts to caribou, and probably at multiple scales. If transmission infrastructure must be installed, generally avoiding further bisection of intact habitat would be the primary tool for minimizing these impacts;

- There is significant evidence (based on our examination of three inter-related themes in the literature) that suggests routing infrastructure alongside an existing highway corridor is generally likely to be the least harmful to caribou, relative to "pioneer" line options;

- The quantitative assessment of range condition shows that, using the Environment Canada disturbance framework, Route 3(a) - the option beginning in Ignace and treading along the same corridor as Highway 599 (and excluding the Osnaburgh bypass), would not generate any additional anthropogenic disturbance in the Brightsand Range and only negligibly in the Far North and Churchill Ranges. This would be the least risky of the proposed routes to caribou overall. It would also represent the higher prospects of restoring the range to 65% undisturbed (if for example, construction is not too destructive and no further development is introduced);

- All other routing options would introduce additional anthropogenic disturbance in ranges that are already high risk contexts for caribou persistence.

- These subject caribou ranges have exceeded, or are close to exceeding, the established management threshold with little population condition data to inform decision making. We recommend that proponents invest in monitoring to support the collection of population condition data especially where gaps remain and to monitor any mitigation strategies over time;

- The tests of the *Endangered Species Act* should be built into the alternatives assessment framework by proponents and a cumulative effects assessment undertaken by the province as part of any Environmental Assessments for a new proposed transmission line; and

- We have identified two important research areas that we recommend be the subject of future study: (a) the permeability of the existing corridor Highway 599 to caribou movement, and the relative use of the bisected portions of the two delineated ranges; and (b) a re-examination of current range delineation in the Brightsand Range and neighbouring Churchill Range with respect to the potential role of Highway 599 as an existing or future anthropogenic "edge" that functionally affects these range extents.

INTRODUCTION

CPAWS Wildlands League is a not-for-profit charity with a mission of protecting wilderness in Ontario. As part of our mandate, we examine and monitor new proposals for any new proposed linear disturbance (roads or transmission lines) in the Boreal Forest of Ontario because it is often the precursor to additional developments and opens up new areas for industrial activities which in turn have ramifications for at risk wildlife sensitive to disturbances such as forest dwelling woodland caribou. With this project, we examined proposals for a major new ~ 300km transmission line in Northwestern Ontario designed to supply power from Ignace/Dryden to Pickle Lake. This is one of the five priorities described by Ontario in its Long Term Energy Plan in 2010. This priority was reconfirmed by Ontario in its Long Term Energy Plan just released in December 2013.

The report is separated into two parts. The first part examines the literature related to three inter-related themes of impacts on caribou (a threatened species in Ontario and Canada) including: (1) loss of habitat through cumulative disturbance from and avoidance of infrastructure; (2) predators/prey response to infrastructure; and (3) the role of infrastructure as barriers to movement. The second adds a new perspective to the public discourse on transmission line routes by assessing if the proposed routes would trigger any additional anthropogenic disturbance in the Brightsand and Churchill ranges that are already in a risky situation for caribou. Finally we make recommendations for proponents and Ontario to help in assessing proposed transmission lines in Northwestern Ontario with respect to threatened Boreal woodland caribou.

PHOTO / TED SIMONETT


SECTION ONE

A LITERATURE REVIEW

Available science, useful to considering the likely impacts of power-line infrastructure on woodland Caribou habitat, and their balance within a boreal mammal community

SPECIFIC RESEARCH QUESTION

From the perspective of avoiding negative impacts to woodland Caribou, would new transmission line infrastructure in NW Ontario be better situated alongside an existing highway or as a distinct corridor?

THREE INTER-RELATED THEMES

This review is organized into three integrated and overlapping themes corresponding with relevant impacts of infrastructure that are likely to influence caribou persistence in this landscape:

1. Loss of habitat through cumulative disturbance from, and avoidance of infrastructure by caribou
2. Predators / co-prey response to infrastructure
3. Infrastructure as impediments to Caribou movement, sources of direct mortality, and loss of habitat through alienation of historical range

1 LOSS OF HABITAT / AVOIDANCE OF INFRASTRUCTURE BY CARIBOU

For ranging mammals, the most important effects from linear disturbance include (a) direct loss of habitat as well as loss of habitat due to avoidance of infrastructure, and (b) barrier-effects due to an impedence of movement and direct mortality (Forman and Alexander 1998). While avoidance effects and barrier effects from infrastructure are very inter-related, this section focuses on the former.

The term "fragmentation" seems variously used to include these, and other, effects, though not consistently. For this review, we have attempted to be more explicit and break the concept into the two most caribou-relevant baskets of "avoidance" and "barrier" to help consider the dimensions of these effects. Despite this it is important to understand avoidance and barrier effects as ultimately integrated; while avoidance may increase the barrier influence of infrastructure, the barrier effect of roads and noise disturbance created might also result in, or exacerbate, avoidance of adjacent areas (Seiler & Eriksson 1997, Forman & Alexander 1998, Dyer et al. 2002).

CARIBOU SPATIALLY RESPOND TO ANTHROPOGENIC DISTURBANCE

For example, Courtois et al. (2007) found that space use by caribou is affected by forest disturbance (anthropogenic and natural both), and not by food scarcity. They suggest that caribou probably respond to disturbance by increasing size of home ranges (where there is the opportunity) and/or reducing fidelity to seasonal and annual home ranges.

AVOIDANCE LEADS TO LOSS OF HABITAT IN PROXIMITY TO ANTHROPOGENIC DISTURBANCE

For caribou, a lower abundance of animals in the vicinity of disturbed areas has often been documented, with diminished use noted within 1–5 km (Mahoney et al. 1991; Cameron et al. 1992; Smith et al. 2000; Dyer et al.

PHOTOS / TED SIMONETT

2001; Nellemann et al. 2001; Cronin et al. 1998). When considered at a population level, these incremental losses to avoidance may be expected to negatively contribute to habitat availability at a range scale, where there is insufficient space to adapt. Weclaw & Hudson (2004) suggest that the most detrimental factor on caribou population dynamics is the functional loss of habitat due to avoidance of good quality habitat in proximity to industrial infrastructures.

AVOIDANCE OCCURS AT DIFFERENT SPATIAL AND TEMPORAL (SEASONAL) SCALES

Resource selection for caribou is understood as being hierarchical, where the most limiting factors for the species should be avoided at the largest scale (McLoughlin et al. 2004; Dussault et al. 2005), continuing to dominate selection across progressively finer scales until the next most important limiting factor emerges (Rettie & Messier 2000). This selection is scalar by function and season (Leblond et al. 2011, Messier & Rettie 1998), and at different spatial scales, where the factors can independently or collectively limit caribou populations (Bergerud et al. 1990; Rettie & Messier 2000). By linking habitat selection to fitness as a function of scale, use-of-habitat assessments can be more effective (Mayor et al. 2009).

For example, in one multi-scale study of mountain caribou, Apps & McLellan (2006) found that, aside from vegetation conditions, remoteness from human presence, low road density, and little motorized access were important factors in the persistence of subpopulations at a metapopulation scale. At the subpopulation level, they identified icefields, non-forested alpine, hydro reservoirs, extensive road networks, and primary highway routes as key factors impeding population contiguity.

AVOIDANCE VARIES BY INTENSITY OF DISTURBANCE

Caribou avoid human developments, with evidence demonstrating that the level of avoidance is related to the intensity of human activity (Dyer et al. 2001). Leblond et al. (2013) investigated the strength of road avoidance behaviour of caribou versus the intensity of the disturbance. They monitored collared caribou during the gradual modification of a highway over a 7-year period and found that the proportion of individuals that excluded the highway from their home range increased as highway modifications progressed. A lower proportion of caribou locations were found in a 5000 m road-effect zone during and after highway modifications compared with before. Increased avoidance by reindeer and caribou has also been documented relative to roads, with pipelines (Dau and Cameron 1986, Cameron et al. 1992, Nellemann & Cameron 1998), oil wells (Dyer et al. 2001), as well as tourist resorts (Helle & Sarkela 1993; Nellemann et al. 2000, 2001).

CARIBOU GENERALLY AVOID ROADS AND OTHER LINEAR CORRIDORS

Leblond et al. (2011) found evidence of road effects on caribou habitat use at both local and landscape scales, and up to 1.25 km from roads. Dyer et al. (2001) reported caribou avoidance distances of 1,000 m from wells and 250 m from roads and seismic lines in Alberta. They also reported seasonal variation, with avoidance effects being highest during late winter and calving and lowest during summer, possibly as a result of lower traffic levels then.

AVOIDANCE OF ROADS INCREASES WITH TRAFFIC LEVELS

Reimers & Coleman (2003) attribute traffic as the ultimate factor influencing caribou movement across

transportation corridors. Polfus et al. (2011) found that mountain caribou avoided high-use roads by 2km and low-use roads by 1km.

AVOIDANCE MAY RESPOND TO INFRASTRUCTURE APPEARANCE OR VERTICAL RELIEF

Wolfe et al. (2000) found in their review that the physical appearance of roads (and railroads) may induce a caribou avoidance reaction due to road elevation or snow banks.

FEMALES MAY EXHIBIT MORE AVOIDANCE BEHAVIOUR

No studies reporting gender variability for caribou infrastructure avoidance behaviour were located. However, Schaefer & Mahoney (2007) found that females maintained an average of 9.2 km from active cutovers, while males occurred in proximity, with no incremental response to clearcutting. Similarly, female moose in Norway were found to avoid roads more than males (Eldegard et al. 2012).

CARIBOU AVOID POWERLINES, BUT POWERLINES WITH ROADS MORE

Nelleman et al. (2001) found that, while 2.5 km areas along powerlines on their own were avoided by reindeer, areas within 5 km from resorts or from roads and power lines in combination were avoided in all years. Where power lines were associated with roads and ski trails, density of reindeer was nearly 95% lower in areas 0–5 km from development, compared with areas beyond. Their study demonstrates a substantially greater avoidance effect of a paired situation, over a power line on its own. It is likely that this is related to the presence of human activity.

BEHAVIOURAL RESPONSES TO POWERLINE VEGETATION CONDITION

Nellemann et al. (2001) suggests that, compared to roads and railroads, power lines are not dangerous to pass under for terrestrial animals and their existence usually does not facilitate human use. However, caribou may negatively respond to the maintained low vegetation condition of a powerline, where it is open and may trigger the same avoidance responses often noted for clearcuts and recent burns (e.g. Courtois et al. 2008). For reindeer in Norway, Vistnes (1999) found that a 4 km zone surrounding a 66 kV power line was, on average, used 65% less than zones 8–12 km away, in spite of higher availability of forage near the power line. Ferguson & Elkie (2004) also noted that open conditions were generally avoided during travel seasons, though disturbed areas such as clearcuts and burns were not. Other ungulates (alternate prey) may also select for these disturbances, depending upon vegetation management, and so responding increases in predator density may be a factor in such behaviour along with a potential for enhanced predator mobility (see next reviewed theme).

PAIRING LINEAR INFRASTRUCTURE – "AVOIDANCE" VERSUS "BARRIER"

The cumulative impacts of the pairing of additional infrastructure along highways to caribou does not seem well studied, relative to the two overlapping effects of "avoidance" of use and the impedance of movement together. Instead, available studies seem to consider one or the other. For example, available evidence from Norway relating to reindeer (Skogland & Mølmen, 1980; Nellemann et al. 2000; Wolfe et al., 2000) describe the barrier effect of the highway (European road E6) and a parallel railroad, while another Norwegian example (Nellemann et al. 2001) considered the avoidance effects of a highway and transmission pairing.

AVOIDANCE GREATER DURING CALVING SEASON / GREATER LOSS OF CALVING SITES

Substantial evidence suggests that ungulate avoidance of human disturbances such as roads and other infrastructures is more pronounced during calving season (Nellemann & Cameron 1998, Vistnes & Nellemann 2001, Skarin et al. 2008, Singh et al. 2010). Female caribou fidelity to calving grounds suggests that calving areas may be more important than any other seasonal ranges (Skoog 1968). Possible consequences of loss of use or access to these areas not only include more competition for forage, and increased predation risk, but also lower productivity of the herd through decreased recruitment (Nellemann & Cameron 1998). Dau & Cameron (1986) analyzed the movement of maternal females in Alaska using aerial surveys before and after the construction of a road. They found that dramatically fewer caribou were proximate to the road system after construction. They suggest that an extensive, dense network of roads will result in widespread displacement of maternal caribou from calving grounds. They also found that even 10 years after exposure to roads, female calving in their research area remained consistently low. Strong avoidance of human developments during winter is important because it can exacerbate the already high energetic costs associated with movement in snow and female gestation coupled with poor winter nutrition (Parker et al. 2009).

CARIBOU AVOID INFRASTRUCTURE MORE DURING CONSTRUCTION

In a study of the patterns of range use before, during, and after the construction of a hydro development in Newfoundland, Mahoney & Shaefer (2002) found that caribou were less likely to be found within 3 km of the site once construction began, persisting at least 2 years after construction was completed. They compared the patterns of range use, site fidelity, and timing of migration and concluded that the development caused a disruption of migrational timing during construction and longer-term diminished use of the range surrounding the project site. Similarly, from a 7 year study of highway modifications in Quebec, Leblond et al. (2013) found that the proportion of individuals that excluded the highway from their home range increased as construction progressed. They found a lower proportion of caribou locations within a 5000 m road-effect zone during and after highway modifications compared with before. Nellmann & Cameron (1998) attributed the greatest incremental impacts to caribou from the initial construction of roads and related facilities in oilfields of Alaska.

CARIBOU AVOID HUMAN ACTIVITY MORE THAN INFRASTRUCTURE ITSELF

Caribou appear to be more sensitive to the human activities associated with construction, traffic, and noise, than to the infrastructure per se (Curatolo & Murphy 1986; Murphy & Curatolo 1987; Nellemann & Cameron, 1998; Smith et al., 2000; Dyer et al., 2001). This notion is also supported by research of mountain caribou by Polfus et al. (2011), who found that avoidance was responsive to seasonal human activity. In summer caribou avoided mines by 2km and cabins and camps by 1.5km, while in winter when human activity was low, avoidance of these features was minor. Negative behavioral reactions that vary from increased vigilance to panicked flight have also been observed for caribou following human-related harassment, low altitude aircraft and snowmobile traffic (Reimers & Colman, 2006; Seip et al., 2007). The presence of human activity is also suggested as a factor that likely influences calving site selection (Pinard et al. 2012).

CARIBOU HABITUATION POTENTIAL WEAK, EVEN WITH LOW HUMAN USE

Animals may habituate to disturbance within a few years (Bergerud et al. 1984; Mercer et al., 1985) as long as the degree of human activity is not too high or variable (Wolfe et al., 2000). But even with little human activity, habituation does not always occur, suggesting that other mechanisms are also involved (Cameron et al.1992; Nellemann and Cameron 1998). For example, Dau & Cameron (1986) argue that there is no evidence that maternal caribou can become habituated to tolerate road structures. They found that even a decade after exposure to roads, female calving in their research area remained consistently low. The mammal community shift documented by Bowman et al. (2010) and others, following significant anthropogenic disturbance addresses some of the mechanisms at play in a forest under logging pressure. With the resulting increases in alternate prey and predator densities in this study area, this study suggests that habituation is unlikely under the development pressures present.

PAIRING POWER-LINES TO EXISTING CORRIDORS MAY RESULT IN LESS AREA AVOIDED

For example, Luken et al. (1991) maintain that: "…in forests already fragmented by development activities, the presence of a single power-line corridor may render forest patches unsuitable for plant and animal species requiring large forest interior habitats. To avoid this, corridors can be sited in non-forested areas, along existing corridors, along the edges of existing forest patches, or in forest patches that at present lack viable interiors." Paralleling infrastructure has the potential to overlap some of the avoidance "shadow", resulting in less functional habitat loss, and less fragmentation than two separate corridors. This reduction of fragmentation, and overlapping of avoidance "shadows" is also likely to result in fewer key seasonal ranges such as calving areas being affected. The converse position, from a habitat loss perspective, is that it is likely to result in additional intensity of disturbance and a commensurately wider avoidance effect than a single linear feature on its own.

CUMULATIVE EFFECTS OVER A POPULATION RANGE

A critical, unresolved question of infrastructure effects on caribou is their cumulative effects, which, according to Nellemann & Cameron (1998), must address the potential for a non-linear relationship between animal response and either (or likely both) the area or degree of disturbance. Environment Canada (2011) outlines how a "total disturbance" tool (based on Sorensen et al. 2008) can be employed to inform population health, by examining the cumulative area disturbed within a population range, against a meta-analysis of caribou populations across Canada. It is through this lens that we relate relative disturbance contributions expected from the transmission line routes proposed, later in this report.

AVOIDANCE ALONG THE EDGE OF RANGE RECESSION COULD FORECAST EXTIRPATION OVER TIME

In the Ontario context of a northern stepwise access to virgin forests, Vors et al. (2007) found that, given a delayed population response, human disturbance was predictive of local extirpation, concluding that caribou were highly likely to become extirpated within at least 13km of cut-overs, for example (with cut-overs being the most predictive of the anthropogenic disturbances tested). They found the distance from utility corridors to be 38km.

SUMMARY
The avoidance effect of a highway corridor with the addition of a parallel powerline may be greater than the avoidance effect of the highway on its own. However, the addition of a separate powerline corridor as an additional linear disturbance is likely to result in far greater functional habitat loss overall, including inducing avoidance to additional high-value and/or seasonal habitat areas such as calving grounds. A new infrastructure corridor within interior forest is also more likely to trigger additional opportunistic human development, and produce changes to the relative composition of the mammal community, than if transmission was to pair with existing alignment of the highway. It may also enhance predator mobility and/or provide access into areas of refuge. In terms of avoidance effects, it seems that the pairing of such infrastructure could be expected to produce less overall avoidance, and associated habitat loss.

2 PREDATION RISK

Predation is recognized as the most proximate factor limiting woodland caribou populations (McLoughlin et al. 2005, Wittmer et al. 2005). There are several dynamic aspects of caribou predation that involve their niche, niche overlap, and balance within a baseline animal community that co-inhabits the forest with certain densities of other mammals including other ungulates such as moose and deer, and predators such as wolves. Though not studied in this region, other predators likely include black bears and wolverine, as they have been identified as predators (primarily of calves) elsewhere in Canada's boreal forest (e.g. Dussault et al. 2012, Pinard et al. 2012, Gustine et al. 2006), and also occur in Ontario's boreal forest.

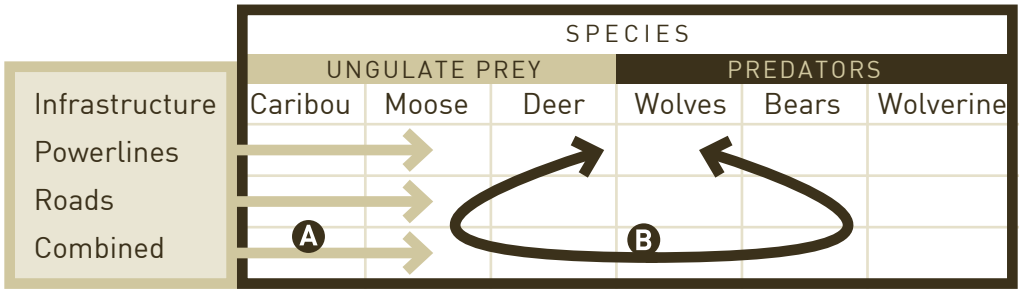
SPILL-OVER PREDATION

Anthropogenic disturbances have the potential to affect predator-prey dynamics (Messier 1994, Latham 2009, Bowman et al. 2010), where resulting increases in densities of other ungulates drives responsive increases in the density of common predators (Pinard et al. 2012) that overwhelm the anti-predator strategies employed by woodland caribou and diminish their population health (Rettie & Messier 2000, Brown et al. 2007, Vors et al. 2007), particularly during the calving season (Hins et al. 2009, Pinard et al. 2012). Habitat loss and loss of effective predator avoidance in the face of altered mammal communities have been suggested as the key mechanisms diminishing woodland caribou persistence in ranges experiencing anthropogenic disturbance.

MAMMAL COMMUNITY MATRIX

In trying to understand how infrastructure might affect caribou predation, considering the multi-species complexity of their adaptations to the boreal forest in this area seems meaningful. It is perhaps useful to consider a matrix of the potential mammal interactions with (a) the infrastructure, and (b) with each other following infrastructure changes:

Table 1: *illustration of matrix of species effects vs infrastructure. See text for details.*



OVERALL UNGULATE DENSITY DRIVES PREDATOR NUMBERS

Bowman et al. 2010 show that the systematic anthropogenic disturbance and vegetation from a spreading logging footprint increased availability of deciduous browse for moose and deer, induced a response in wolf density, and significantly altered the natural mammal community balance in a northwestern Ontario boreal forest. These findings support earlier suggestions that an increased density of alternative ungulate prey such as moose and/or white-tailed deer is widely expected to result in a numerical response of wolf, and possibly other predators (e.g. Messier 1994, Latham 2009, Bowman et al. 2010), leading to increased predation risk for caribou (Rettie & Messier 2000, Brown et al. 2007, Vors et al. 2007). This cumulative progression of the indirect impact of incremental development such as logging, and its associated road structure, to ungulate density change, follow-on predator response, and spill-over predation is collectively suspected to be playing an important role in overall caribou decline (e.g. Wittmer et al. 2005, 2007), since predation is recognized as the most proximate factor limiting caribou populations (McLoughlin et al. 2005, Wittmer et al. 2005).

CARIBOU

CARIBOU SPACING STRATEGY LESS EFFECTIVE WHEN UNGULATE DENSITY INCREASES

One of the most obvious anti-predator strategies adopted by female caribou at a home range and seasonal range scale, is to spatially segregate from conspecifics to reduce detection by predators (Stuart-Smith et al. 1997). Caribou are known to spatially segregate from each other to avoid predators by using habitats that are less suitable for both predators and their alternate prey, for example, islands (Bergerud et al. 1990), peatlands (McLoughlin et al. 2005), mature forests (Schaefer & Mahoney 2007), and high elevations (Gustine et al. 2006). This spacing strategy is less effective when overall ungulate, and resultant predator, densities increase (e.g. Bowman et al. 2010), as well as when dispersal options are limited by disturbance.

CARIBOU EXHIBIT PREDATOR DETECTION BEHAVIOUR

While understanding that predator avoidance begins at a broad scale through spacing strategies, the importance of this priority behaviour is also apparent at the stand scale, steep slope, low shrub, high tree density, and high vegetation and lichen ground cover have been identified as important properties of calving sites for woodland caribou (Carr et al. 2007). From their findings in a a Quebec multi-year study of 22 female caribou and the

year-year predation of their calves, Pinard et al. (2012) suggest that calving females specifically used areas from which they could visually detect approaching predators. Briand et al. (2009) also studied female woodland caribou behaviour in boreal Quebec at a fine scale, also confirming that a well-regenerated shrub layer was avoided. In keeping with Metsaranta et al. (2003), they suggested that caribou avoided sites containing abundant forage that was attractive to moose and, consequently, wolves.

Ungulates may exhibit predator avoidance behaviour whether the predators are actually present or not (Ferguson and Elkie, 2004), suggesting that predator avoidance is a priority behaviour.

MOOSE

MOOSE MAY, OR MAY NOT, AVOID POWER LINES

We would expect that the maintained vegetation condition of powerline right-of-ways would provide a substantial concentration of browse, and that moose would select for these corridors, as white-tailed deer do (Doucet & Thompson 2008). Specific study of powerline behaviour for moose, however, was not readily found. Only one reference was found, and it contradicted this expectation, though it did not provide any mechanistic support for the finding. Joyal et al. (1984) found that moose avoided power lines, with avoidance increasing with wider right of way widths. Whether this is due to predator avoidance, or forage quality is not clear. It is possible that human activity may have also played a role.

MOOSE MAY GENERALLY AVOID HIGHWAYS, EXCEPT TRADING-OFF RISKS FOR SOME BENEFITS

In a study of moose behaviour of highways in Quebec, Laurian et al. (2008) found that moose generally avoided at least 500m, except for sodium supplementation if sodium chloride is used for de-icing, and possibly to reduce predation risk for females. They also indicated that avoidance was not directly proportional to noise disturbance; moose systematically avoided the first 100 m adjacent to forest roads even in the absence of noise, while habitats adjacent to highway sides were sometimes used in proportion to their availability.

This general road avoidance agrees with Buson et al. (2000) and Ypst & Wright (2001), but contrasts with previous generalizations that environmental factors may attract moose to road corridors (Thompson & Stewart 1998), and studies such a Kittle et al. (2008), where consistent avoidance of human infrastructure was not found, perhaps as a predator avoidance tactic.

Eldegard et al. (2012) found that, in Norway, the probability that a site was used by moose increased with increasing abundance of high-quality browse and also with increasing distance to the nearest road, indicating that moose trade-off foraging against road avoidance. They also found that moose proximity to roads was influenced by levels of perceived human-derived risk; moose avoided smaller roads with low traffic volume less, relative to major roads with higher traffic volume, as well as avoiding roads more during the daytime. Males avoided roads less than females.

DEER

DEER RESPONSE TO A MANAGED FOREST AND ROADS

Bowman et al. (2010) noted an ingress of deer occupancy in the southern portion of their study area in NW Ontario, coincident with a higher density of roads, and deciduous vegetation. Kittle et al. (2008) found that deer selected for higher-use trails, possibly as a predation-avoidance strategy. Snow depth was also flagged as a limiting factor for deer, both at a northward ranging limitation, and at a habitat use scale.

Unlike caribou, Munro (2009) found that, in eastern Ontario, white-tailed deer presence was positively correlated to road density. He generally concluded that roads provide beneficial service to these animals, suggesting that de-icing salt (available to deer in the spring, coinciding with the time period of highest correlation between road density and deer presence) may be one of these benefits. Roadside browse availability, and predator avoidance were not discussed here, but are other possible benefits.

DEER BROWSE, EDGE EFFECTS, AND POWERLINE ROWS

Doucet & Thompson (2008) found that not only do white-tailed deer browse in Quebec transmission power line rights-of-way in winter, but that under certain conditions they are even able to control it. However, this study was undertaken in the Great Lake St Lawrence forest, and its relevance to a Boreal context (even at the northern edge of mixed-wood conversion) is not known. In a review of ROW studies relevant to Wisconsin, Willyard & Tikalsky (2008) reported that new edge habitat is a benefit to species that live in or use the habitat that exists in ROWs, such as deer, which profit from the browsing potential created by increased edge. Where infrastructure is paired, no new edge is created, while separate corridors would exhibit twice as much edge, in this case potentially beneficial to deer to their northern ranging limit, perhaps also facilitating expansion.

WOLVES

WOLVES HAVE A SPATIAL PREFERENCE FOR MOOSE

Basille et al. (2013) demonstrate that wolves primarily overlap spatio-temporally with Moose, versus Caribou. They also concluded that the risk that caribou faced was not only linked to any direct niche overlap with wolves, but also to the extent of their wolf-moose niche overlap during the same period. Bowman et al. (2010) also found wolves, moose, and deer together in their ordination analysis, and distinctly separate from caribou.

WOLVES USE LINEAR FEATURES, AND MORE WITH LOWER HUMAN ACTIVITY

In Alberta, wolves selected areas within 25 m of roads, trails, and a railway line (though terrain may play a focusing role in these mountainous study areas for the movement of humans and wildlife, as found by Roever et al. 2008, for Grizzly bears), and more strongly selected low-use roads and trails compared to high-use roads and trails (Whittington et al. 2005). Similarly, in Quebec, Lesmerises et al. (2012) found that wolf response to roads varied with human activity level as well as road type, but also found that wolves stayed closer to 2-lane highways than randomly expected.

WOLF TRAVEL SPEED IS HIGHER ALONG CORRIDORS THAN THROUGH FOREST

Wolves can travel 2.8 times faster in linear corridors than forest in the winter (James 1999), notably seismic lines in Alberta (James et al. 2004), which has also been found to increase kill rates on large ungulate prey species (Webb et al. 2008; McKenzie et al. 2009) and increase the spatial overlap of wolves and caribou (Neufeld 2006).

WOLF-CARIBOU PREDATION ENHANCED BY LOW-USE CORRIDORS

James & Stuart-Smith (2000) found that of 98 radio-collared caribou in Alberta, 35 were significantly further than random from corridors and only 3 were significantly closer. They also determined that wolf locations were closer than random to linear corridors. Though wolf predation sites were not significantly closer to corridors than were wolf locations or random points, caribou mortalities attributed to wolf predation were closer to linear corridors than were live locations from all caribou, indicating that caribou that are close to linear corridors are at a higher risk of depredation. Of contextual importance is that this study dominantly included a high density seismic/pipeline features (25,500km of the 26,850km of linear features) characterized by narrow right of way widths and relatively low human usage. With more human activity, less wolf selection has been identified elsewhere (Whittington et al. 2005). What wolf usage and behaviour might be relative to a powerline right-of-way appears unknown, though where not associated with human activity, it could be hypothesized that it might function in a predation-enhancing manner.

LOW-USE CORRIDORS MAY INCREASE WOLF ACCESS TO CARIBOU REFUGE

Similarly, Latham et al. (2011) found that, in Alberta, the use of seismic lines as movement corridors might also result in wolves hunting in caribou-preferred habitats (bogs and fens) more frequently than they did historically, particularly in the snow-free season when most caribou mortalities occur. Though they found no evidence that caribou mortalities occurred closer to industrial linear features than did live caribou, they concluded that wolf use of seismic lines increases predation risk for caribou close to these features.

BLACK BEARS

BLACK BEAR PREY ON CARIBOU (CALVES)

In a recent study in Quebec, Dussault et al. (2012) found that sixty-one per cent of calves died from bear predation within two months following their birth. In another, multi-year, study in Quebec of 22 female caribou and the year-year predation of their calves, Pimard et al. (2012) noted that, while wolf avoidance appeared to be effective in a highly managed landscape, caribou did not appear to have adjusted their predator avoidance strategy to the recent increase in black bear abundance, who have benefited from increased food abundance. In Newfoundland, Mahoney & Virgl (2003) found that, although predation couldn't be linked to the mortality of adult woodland caribou, black bears were responsible for 1/3 of calf fatalities. These are in agreement with earlier reports that northern black bears could compensate for a low-protein diet by preying on ungulate calves, such as moose, white-tailed deer, and caribou (Mathews & Porter 1988; Schwartz & Franzmann 1991; Linnell et al. 1995).

CARIBOU AVOID BLACK BEARS

Latham et al. (2011) suggests that woodland caribou in northeastern Alberta maintain spatial separation from not only wolves and alternative prey, but also from black bears, of which approximately 1/3 of those animals studied were suspected to have contributed to high caribou calf mortality. Similarly, in Newfoundland where wolves were not present, Mahoney and Virgl (2003) observed that caribou habitat selection significantly varied among seasons, but was consistent with the hypothesis that caribou avoid habitats where the likelihood of contact with a predator or alternative prey was high – in this case black bear.

BLACK BEARS MAY SELECT POWERLINES?

This review did not net any specific research regarding black bear use of transmission corridors, although in NE Alberta they have been known to select various industrial features (Boyce et al. 2011). Czetwertynski (2007) also identifies a high use of industrial linear features in Alberta and suggests that it is likely related to the high abundance of forage along these features and because hunting was prohibited in this particular area, allowing bears to exploit this resource unmolested. Together these findings might suggest a possible black bear selection of powerlines, though proximity to a highway may provide a disincentive.

BLACK BEAR HABITAT SELECTION IS VARIABLE – OPPORTUNISTIC OMNIVORES

Similarly, Boyce et al. (2011) found that habitat selection by individual black bears was highly variable and some bears selected habitats similar to those selected by caribou, i.e., bogs and fens. It is suggested that bears that specialize on foraging in peatlands might be responsible for some of the predation on caribou calves.

BLACK BEAR PREDATION OF CARIBOU IS SEASONAL

As black bears den during the winter months, their predation role logically occurs in the non-winter months.

FOREST CLEARING CREATES BEAR FORAGE

Early successional stands are favorable to black bear (Brodeur et al. 2008). Obbard & Kolenosky (1994) suggested that, in northeastern Ontario, the open areas created by timber harvesting are important late summer/fall foraging areas for black bears in the boreal forest at least up to 10 years after timber harvesting.

Timber harvest followed by no post-harvest treatment produces high amounts of forage for grizzly bears, especially on moist to wet sites (Zager et al. 1983, Bratkovich 1986, Hillis 1986, and others).

BEARS GENERALLY AVOID ROADS RELATIVE TO TRAFFIC LEVELS

In the southern Appalachian mountains, black bears were found to generally avoid areas within 800 m of gravel roads, and more than surfaced roads (Reynolds-Hogland & Mitchell 2007).

Similarly, in Shenandoah National Park, male black bears use areas near all roads, and females near light-duty and primary roads less than expected year-round; but greater than expected use of fire roads by females was attributed to use of native fruits growing in the road clearing (Garner & Vaughan 1987).

Dixon et al. (2007) report that habitat fragmentation and anthropogenic barriers to movement appear to have broadly limited the dispersal capabilities of the Florida black bear.

WOLVERINE

Bowman et al. (2010) noted a mammal community shift, where a higher density of roads and deciduous vegetation in the southern portion of their study area coincided with increases in deer, moose, and wolves, and a lower density of caribou and wolverines. As occupancy in the northern portions of the study area can be expected to approximate a natural condition, it can perhaps be inferred that wolverine do not respond numerically to increasing ungulate density in the manner described for wolves. Instead, wolverine seem to generally occupy the less disturbed areas in a distribution following that of the caribou. For the purposes of this review, we are satisfied that a focus on the other species will shed more light on the impacts of infrastructure on caribou, while acknowledging that wolverine predation on caribou is possible, with the highest likelihood probably in a natural boreal context.

SUMMARY

In general, the pairing of a powerline with existing infrastructure seems most likely to minimize the potential for shifting the mammal community structure, and facilitating predator access or mobility, relative to 'pioneer' corridor options. In this case, the pre-existing avoidance effect from an adjacent highway, where most of the mammals in this community are likely to already exhibit avoidance responses to some extent, has some potential to reduce some of the effects that a pioneer route may bring. In a pioneer application, the increased extent of forest edge, and low-human-use may have the potential to alter the mammal community balance and/or enhance predator mobility, all of which have been demonstrated to negatively affect caribou persistence.

3 INFRASTRUCTURE AS IMPEDIMENTS TO CARIBOU MOVEMENT, SOURCES OF DIRECT MORTALITY, AND LOSS OF HABITAT THROUGH ALIENATION OF HISTORICAL RANGE

For wide-ranging mammals, the most important effects from linear disturbance include (a) loss of habitat to avoidance of infrastructure, and (b) movement impedance, or barrier-effects (Forman and Alexander 1998). While avoidance effects and barrier effects from infrastructure are very inter-related, this section focuses on the latter: the permeability of the infrastructure to animal movement across the disturbance, including habitat loss in the

extreme, induced through low permeability linear features which reduce, or even cut-off, access to portions of an animals normal range.

ROADS IMPEDE CARIBOU, AND OTHER MAMMALS, MOVEMENT

Roads have been shown to impede movement of mammals such as caribou (James and Stuart-Smith 2000, Dyer et al. 2002), wolves (Whittington et al. 2005), and bears (Dixon et al. 2007).

LINEAR INFRASTRUCTURE IS VARIABLY PERMEABLE TO CARIBOU, BY TRAFFIC LEVEL AND SEASON

Dyer et al. (2002) demonstrate that, while seismic lines do not pose a barrier to caribou movement, roads with a moderate amount of traffic pose semi-permeable barriers. They also found that the greatest barrier effects occurred in late winter.

BARRIERS ARE LIKELY TO ALTER SPACE USE FOR CARIBOU AT A HOME RANGE SCALE

Where a corridor bisects a range, barrier effects commensurate with its functional permeability can be expected. Such effects can reasonably include spatial changes to home range extent, as well as reduced fidelity to seasonal ranges and annual home ranges (Courtois et al. 2007).

PRIMARY HIGHWAYS CAN IMPEDE UNGULATE POPULATION CONTIGUITY

Primary highways have been flagged as a contributing impediment to caribou population contiguity for both mountain caribou and wild reindeer (eg. Apps & McLellan 2006, Skogland & Mølmen, 1980; Nellemann et al., 2000; Wolfe et al., 2000), as well as moose in Quebec (Laurien et al. 2008).

PAIRED ROADS AND RAILWAYS A BARRIER TO POPULATION CONTIGUITY

A frequently referred-to (Skogland & Mølmen, 1980; Nellemann et al., 2000; Wolfe et al., 2000) barrier effect on wild reindeer in Norway is the highway (European road E6) and a parallel railroad crossing over the Dovre plateau, effectively splitting the alpine area in three wild reindeer areas.

PAIRED POWERLINES AND A WINTER CLOSED ROAD A BARRIER TO REINDEER FORAGING

Vistnes et al. (2004) studied reindeer distribution in relation to possible travel barriers (roads and power lines) in south-central Norway. Their lichen data suggested that wild reindeer used both sides of a closed road in winter, whereas 2 parallel power lines and a winter-closed road in combination reduced reindeer migration and resulted in very different grazing pressures on either side of the power lines, even 30 years after the power lines were constructed.

PIPELINES PAIRED WITH A ROAD DECREASES CARIBOU CROSSING FREQUENCY

Curatolo and Murphy (1986) found that migrating caribou can be deflected by paired infrastructure saying that, “It was only where a pipeline paralleled a road with traffic, that crossing frequencies were significantly less than expected (30% versus 66%). It is postulated that vehicles act in a synergistic fashion with a pipeline to produce a negative stimulus that results in decreased crossing frequency.”

LINEAR CORRIDORS CAN BECOME GENETIC BARRIERS

At a subpopulation level, Apps & McClellan (2006) identified primary highway routes are a key factor impeding population contiguity for mountain caribou, and highlighted that isolated caribou subpopulations are less likely to receive natural immigrants over the long term. Without such periodic augmentation, populations can be expected to become subject to genetic and stochastic threats (Foley, 1997). For example, Dixon et al (2007) suggest that fragmentation of once contiguous black bear habitat in Florida has resulted in genetically distinct populations. They report no isolation-by-distance relationship among Florida black bear populations, likely because of barriers to gene flow created by habitat fragmentation and other anthropogenic disturbances.

SUMMARY

Where a corridor bisects a range, barrier effects commensurate with its functional permeability can be expected. Such effects can reasonably include spatial changes to home range extent, as well as reduced fidelity to seasonal ranges and annual home ranges. In the extreme, barriers can functionally remove access to portions of a historically used range and can isolate a population genetically from genetic influx from the other side of the barrier.

APPLICATION TO THE CASE

Based upon our findings from the review above, we offer the following brief conclusions, in application to the potential pairing of a powerline corridor along the existing Hwy 599, in north-western Ontario, relative to options that would bisect undisturbed and semi-disturbed boreal forest.

RANGE DISTURBANCE

Current levels of impact (fire, anthropogenic) in these ranges is high – we recommend no further anthropogenic disturbance as a consequence. The effect of any additional anthropogenic disturbance - adding in addition footprint as well as linear density, will have range and population level implications.

DISTURBANCE MINIMIZATION

Any additional linear infrastructure is likely to result in some impacts to caribou, and probably at multiple scales. If transmission infrastructure must be installed, generally avoiding further bisection of intact habitat would be the primary tool for minimizing these impacts, likely resulting in:

(a) a relative reduction of industrial footprint, particularly when including zones of avoidance (see Weclaw & Hudson 2004),

(b) maximizing the potential for maintaining undeveloped refuge habitat (e.g. Northrup & Wittemyer 2013, Metsaranta 2008),

(c) minimizing any mammal community changes that an independent line might contribute to the range given a common (though variable) road avoidance of the related animals of this mammal community, through the pairing of powerline to a highway,

(d) minimizing increases in predator mobility through a 'scarecrow' effect of existing avoidance given human use of an existing adjacent highway, versus a "pioneer" routing (Leighton et al. 2010),

(e) no new linear barrier-effects introduced further impeding the movement of animals, and fragmenting their range, relative to a small likelihood of further impeding their movement across a highway corridor, which they are likely to already avoid to some distance (and could be assumed to already constitute a functional barrier to caribou),

(f) minimizing additional opportunistic human disturbance, where pioneer lines are opportunistically used to access forest resources and other activities that may contribute further to avoidance (as evidenced by other historical powerlines in this region, through satellite imagery), and

(g) minimizing additional loss of high-quality habitat, where pioneer lines are also more likely to trespass on undisturbed high-quality habitat such as calving areas, versus the pairing infrastructure approach where these effects have likely already been experienced.

For these reasons, we consider that routing this infrastructure alongside an existing highway corridor is generally likely to be the least harmful to caribou.

MOVEMENT BARRIER

One important potential exception to this conclusion would be any additional loss of permeability of movement across the corridor, IF the existing highway corridor is not already functioning as a barrier. This would including any resulting loss of access/use to the bisected portions of a range that may result from constructing a parallel transmission corridor along the highway (See Skogland & Mølmen, 1980; Nellemann et al., 2000; Wolfe et al., 2000 for examples of barrier effects of parallel infrastructure on reindeer populations). Though powerlines are likely to affect wildlife differently than a highway, the effects of their pairing are likely cumulative with regards to impedance of movement. So, for this particular application it is possible that, if transmission is added to the Pickle Lake road highway, any existing animal movement between the highway-bisected portions of the Churchill range might be further decreased. The existing permeability of the highway needs to be demonstrated.

It is reasonable to believe that a barrier effect has already occurred, and will likely increase in effect over time. Highway 599 has been in place for at least 30 years, and so some inter-generational habituation, including loss of fidelity to seasonal use areas could be expected depending on functional permeability of the road. The level of permeability is likely responsive to both traffic volume, and seasons (Dyer et al. 2002). The bulk of the highway 599 corridor experiences approximately 120-130 vehicles per day (Ministry of Transportation 2009), with significantly more traffic occurring around the community of Pickle Lake, and the road terminus (310-600 vehicles per day

average). While this is currently not high volume, the highway's anticipated role in servicing development in the Far North could be expected to drive this traffic frequency higher over time in all portions of the corridor, likely increasing any barrier effect regardless of parallel infrastructure.

SPECIFIC RECOMMENDATIONS

NEED TO UNDERSTAND PERMEABILITY OF HIGHWAY 599

As this infrastructure corridor is likely to already play a significant limiting role for caribou movement, it would be useful to study the permeability of the existing corridor, and the relative use of the bisected portions of the two delineated ranges. This information would inform the key questions of (1) whether or not the existing corridor is permeable to caribou (and to what extent), and therefore (2) whether or not the addition of a parallel power line would be exacerbating to the existing situation.

NEED TO RE-EXAMINE CURRENT RANGE DELINEATION

As the currently delineated range boundary is generally not very far from this existing highway corridor, information gained on permeability would also inform the extent to which the bisected ranges may be effective management areas either before, or after, additional infrastructure is routed in this corridor. Relying upon the current range delineation in the face of a functional barrier, where portions of the range may be lost to the population, may have considerable relevance to the interpretation available tools such as total disturbance analysis for example (Sorensen et al. 2008, Environment Canada 2011), where the shadow of total disturbance could be significantly under-reported.

Given the adaptive basis of the current range boundaries employed in Ontario (Armstrong et al. 2010), it would be useful to test whether this effect might effectively challenge our understanding of the currently delineated boundary of the range, versus an alignment along the corridor. Has the existing highway already posed a functional barrier? Would increased traffic over time? Would the addition of parallel powerline infrastructure, and/or traffic over time?

In these circumstances, it might be reasonable to assume that this barrier effect along Highway 599 will become quite likely, and that the range extent may well functionally shift to snap to this corridor as an edge as the effect is realized, where loss of fidelity to seasonal areas and adjustment of home range could be expected (Courtois et al. 2007). At a population level, this barrier might also be expected to affect genetic flow east-west as has been observed for wild reindeer (Nellemann et al., 2000) and other mammals (e.g. Dixon et al. 2007). Relative to other alternatives (and acknowledging some limits to the confidence of current range delineation), this future might functionally leave both the Churchill and Brightsand ranges more isolated, but very similar in size and less bisected than other route options, given the proximity of the Highway 599 corridor to existing range delineation.

AN ASSESSMENT OF PROPOSED TRANSMISSION LINES IN NW ONTARIO WITH RESPECT TO THREATENED WOODLAND CARIBOU

INTRODUCTION

In this next section, we build on existing scientific knowledge about what is known about direct and cumulative impacts on caribou and transmission lines with a quantitative assessment of range condition as a function of the proposed transmission line routes. This assessment is partially based on Environment Canada's cumulative disturbance risk analysis assessment framework. We first set the stage by describing our previous experience with transmission lines in northern Ontario and by describing the current status of the three woodland caribou ranges. This is followed by our assessment of the proposed transmission line routes on cumulative disturbance in the ranges. We then round out the discussion with the *Endangered Species Act, 2007* and alternatives and end with our recommendations.

PHOTO / TED SIMONETT


SECTION TWO

BACKGROUND OF OUR INVOLVEMENT

CPAWS Wildlands League is a not-for-profit charity and our mission is to protect wilderness through the establishment of protected areas and through the promotion of natural resource use that is sustainable for nature, communities, and the economy. We have extensive knowledge of land use in Ontario and a history of working with government, communities, scientists, the public, and resource industries on progressive conservation initiatives. We have specific experience with the impacts of industrial development on Boreal Forests and the wildlife that depend upon them.

CPAWS Wildlands League pays close attention to any new proposed linear disturbance in the Boreal Forest of Ontario because it is often the precursor to additional developments and opens up new areas for industrial activities which in turn have ramifications for at risk wildlife sensitive to disturbances such as forest dwelling woodland caribou. As such, we participated and closely followed the proposed Northwest Transmission Expansion project [1] in 2009 and 2010. During that time we raised many substantive concerns with the proposed routing of the transmission line as it pertained to woodland caribou and the remote areas of Lake Nipigon. Forest Dwelling Woodland Caribou is a threatened species both in Ontario and in Canada. We, along with scientists and concerned Canadians, strongly urged Hydro One and Ontario to: minimize the creation of new linear disturbances on the landscape; and identify and propose alternative routes that tread over the same footprint or within the same corridor as existing permanent roads, railways and linear features to preserve the remoteness of Lake Nipigon and better protect the ecological integrity of Wabakimi Provincial Park.

In November 2010 we were pleased to see that the province announced in its Long-Term Energy Plan:

A new transmission line to Pickle Lake— one of this plan's five priority projects — will help to service the new mining load and help to enable future connections north of Pickle Lake. Subject to cost contributions from benefiting parties, Ontario will focus on supplying Pickle Lake from the Ignace/Dryden area immediately.

We applauded this decision to avoid intact forests [2] and called it a win-win for the economy and caribou. Ontario reconfirmed this priority in December 2013 with its Achieving Balance: Ontario's Long Term Energy Plan.

Today we continue to examine and monitor new proposals for transmission lines and roads in the Boreal Forest especially as they relate to threatened species such as woodland caribou. Ontario has committed to management of cumulative disturbance in the population range scale in its Caribou Conservation Plan [3] (CCP) and federally Environment Canada in its final version of the *Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal population, in Canada (2012)* [4] describe that, "the recovery goal for boreal caribou is to achieve self-sustaining local populations in all boreal caribou ranges throughout their current distribution in Canada, to the extent possible." A similar goal for the conservation goal of woodland caribou is described in Ontario's CCP.

At present, and the subject of EAs, there are two companies proposing competing transmission line projects to meet the objectives of the Long Term Energy Plan to supply Pickle Lake from Dryden/Ignace: Sagatay Transmission L.P. and Wataynikaneyap Power. With both the CCP and new direction outlined in the federal recovery strategy for Woodland Caribou in mind, we examined some of the landscape-level impacts of these two hydro lines on affected ranges in Ontario namely, Brightsand, Churchill and Far North. Specifically we evaluated the contribution to cumulative disturbance of each routing option for each caribou range as a means of assessing which option may pose less relative risk to woodland caribou populations using the tools we have available to us. Information on caribou population condition for each range (i.e., population size and trends) was not publicly available at the time of this writing. Hence, our assessment is limited to an evaluation of range condition per Environment Canada (2011). We did not conduct a cumulative effects assessment on each range. We strongly support this work being done by Ontario and will have recommendations on this later in the report.

THE TWO COMPANIES PROPOSING ROUTING OPTIONS

There are two companies proposing options to meet the priority described in the Long Term Energy Plan of supplying Pickle Lake from the Ignace/Dryden area:

Sagatay Transmission L.P. "was formed to plan and develop a new 230 kV high voltage electricity transmission line to Pickle Lake in northwestern Ontario. A preliminary preferred route has been identified from Ignace to Pickle Lake utilizing the Highway 599 corridor...The original partners in Sagatay were the Mishkeegogamang First Nation, the Ojibway Nation of Saugeen First Nation and Morgan Geare. In March 2013, Sagatay welcomed Algonquin Power & Utilities Corp. as a partner" (from the company description available at http://www.sagatay.com/index-1.html). A right of way approximately 40 metres (m) wide.is proposed to be cleared for the transmission line.

Wataynikaneyap Power is a transmission company "that has been formed between the Central Corridor Energy Group, representing 13 First Nations, and Goldcorp Canada Ltd. Wataynikaneyap Power is proposing to develop the New Transmission Line to Pickle Lake (the Project), which includes a new 300 km 230 kilovolt transmission line and associated Project components from the Dryden Area to Pickle Lake" (from a May 3, 2013 letter to Wildlands League from Golder on behalf of Wataynikaneyap Power). A right of way approximately 40 metres (m) wide is proposed to be cleared for the transmission line.

[1] See Appendix 1 for a materials associated with our work on the Northwest Transmission Project from 2009-2010.

[2] In general we do not support or oppose individual projects.

[3] See Appendix 2 for a copy of Ontario's Caribou Conservation Plan.

[4] See Appendix 3 for a copy of the final version of the Recovery Strategy.

3 DIFFERENT ROUTES

We looked at 3 routes, with 6 total routing options in this report:
Route 1 beginning in 3 options (a,b,c) between Dryden and Dinorwic to Sioux Lookout and then proceeding to Pickle Lake;
Route 2 that begins in the Dinorwic area and travels northward to Pickle Lake; and
Route 3 (a) that begin in Ignace and utilize the Highway 599 corridor to connect to Pickle Lake, with a possible bypass option (**Route 3(b)**).
We are confident that the spectrum of options is adequately covered in these six proposed routes.

CURRENT STATUS OF THE AFFECTED RANGES

The caribou population range is the most relevant scale at which to plan for the conservation of caribou. Moreover, Environment Canada (2012: 28-29) adds that:

undertaking landscape level and/or natural resource planning is appropriate for effective management of cumulative effects of habitat disturbance within boreal caribou ranges and for managing disturbance over time to ensure sufficient habitat is available for boreal caribou, both of which is difficult in the context of individual project approvals.

A maximum disturbance threshold of 35% has been set by Environment Canada that has in turn has a 60% probability of a caribou population being self-sustaining [5]. Although this is hard threshold does not consider the variability among different populations, it at least represents a reasonable starting point as to the relative risk faced by a given caribou population and its prospects for recovery. It cautions though that even with the maximum 35% disturbance as a target, there is still likely to be a 40% chance that local populations will not be self-sustaining and adds, "[l]ocal populations that have greater than 35% total disturbance (or less than 65% undisturbed habitat) will first be recovered to the 35% disturbance management threshold (i.e. to achieve 65% undisturbed habitat)" (Environment Canada 2012:66). Environment Canada is careful to characterize this as a continuum of risk and hence the term management threshold.

[5] Environment Canada (2012:x) defines a self sustaining population as: "A local population of boreal caribou that on average demonstrates stable or positive population growth over the short term (20 years), and is large enough to withstand stochastic events and persist over the long-term (50 years), without the need for ongoing active management intervention (e.g., predator management or transplants from other populations)".

[6] Data sets for Environment Canada: Fire disturbance from the National Fire database 2008; Anthropogenic Disturbance "Combined Access" 2006.

[7] Data sets for Wildlands League: Fire disturbance from Land Information Ontario 2009; Recent Forest Harvest (1997-2008); Forest Resource Inventory OGDE 2009; Linear Features MNR Road Segment LIO 2009.

[8] Wildlands League did not run total disturbance for the very large Far North Range in 2009 and 2010.

The current condition of each range potentially affected by the proposed transmission lines is below. It provides important context to assist in understanding additional impacts from any new anthropogenic disturbances and aids in the effective management of cumulative effects of habitat disturbance. It is also helpful because scientists have found that total disturbance (fire and anthropogenic disturbance combined) is the best predictor describing the relationship between calf recruitment and range condition (Environment Canada 2011). Population condition data for these ranges are not available at this time.

Table 2: *Total disturbance in each of the affected ranges currently in Ontario from Environment Canada (2012) and Wildands League (2009) and (2010). MNR's data has yet to be made publicly available.*

	Brightsand	Churchill	Far North
From Environment Canada [6], total disturbance (fire and anthropogenic)	42%	31%	14%
Environment Canada Risk Assessment (self sustaining SS; not self sustaining NSS)	NSS/SS	SS	SS
Wildlands League [7] Snapshot Report (based on draft ranges by MNR in 2009) using enhanced fire and anthropogenic disturbance data from Ontario	45%	46%	n/a [8]
Updated Wildlands League disturbance numbers (based on refined ranges from MNR in 2010).	40%	46%	n/a

Total disturbance in the Brightsand Range is above the 35% maximum disturbance threshold set by Environment Canada. Total disturbance in the Churchill Range is also approaching the maximum threshold. We believe that the 31% is likely an underestimate of disturbance in this range because when enhanced provincial data are used the ranges exceed the management threshold set by Environment Canada (see Wildlands League data above).

According to Environment Canada (2012), disturbance must be reduced over gradual increments every 5 years to 35%. It has instructed that range plans be completed for all ranges in Canada within the next 3-5 years where local populations must achieve or maintain a stable to increasing population as measured over five years. It also states that with respect to habitat condition for ranges less than 65% undisturbed habitat (2012:42): "identify in a range and/or action plan specific areas of existing undisturbed habitat, as well as those areas where future habitat is to be restored to an undisturbed condition over reasonable, gradual increments every five years." Both these ranges need recovery measures.

QUANTIFYING THE IMPACTS OF THE PROPOSED LINES AT THE LANDSCAPE SCALE

We commissioned Global Forest Watch to use the Environment Canada methodology for calculating disturbance and Environment Canada's baseline data from 2010 to determine the quantitative impact of six different routing options (including the preferred option by Sagatay and the preferred option by Wataynikaneyap Power) on the respective ranges. Global Forest Watch digitized each of the routes. Figure 1 shows the routes in Northwestern Ontario with highways and towns.

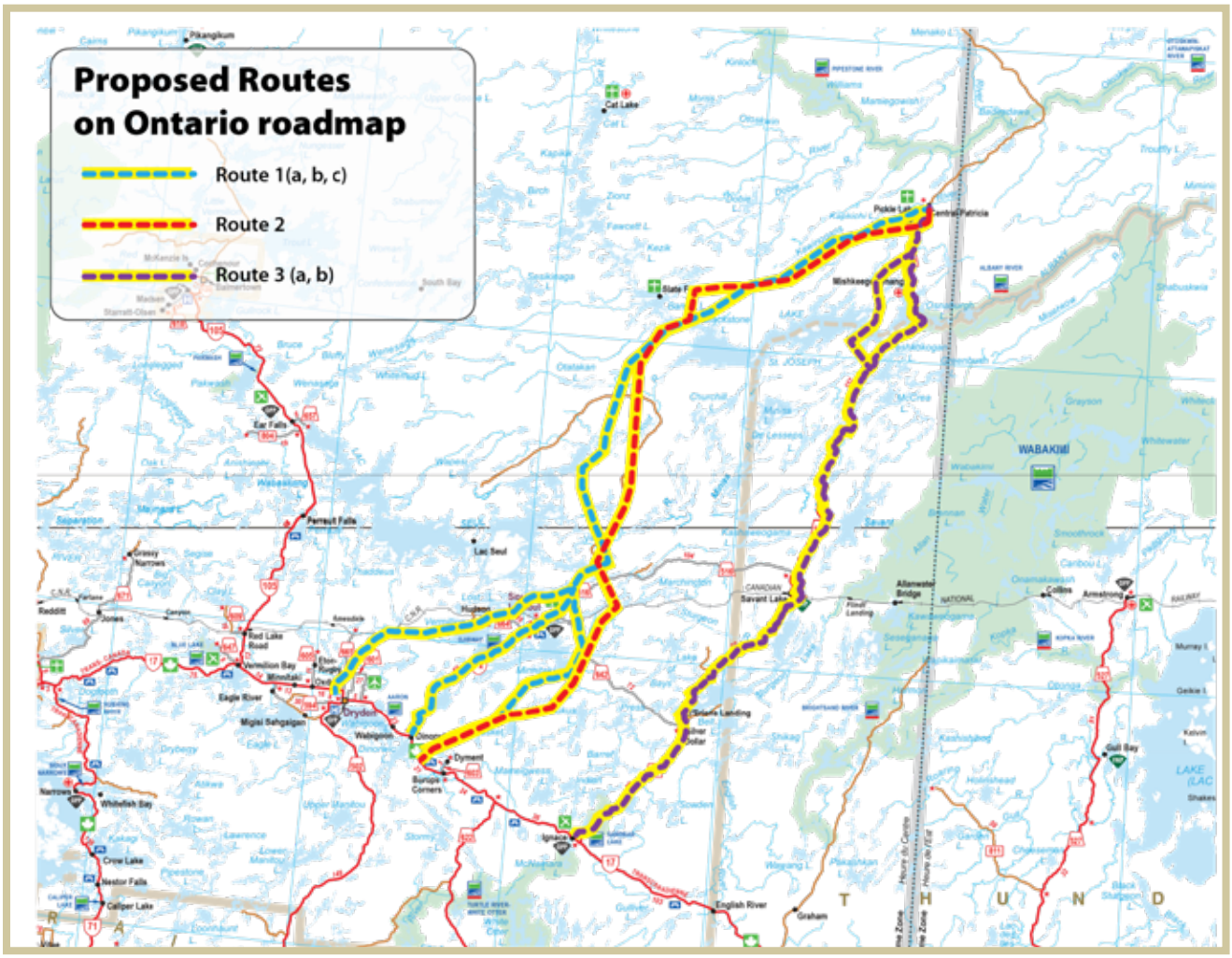


Figure 1: the proposed routes for transmission to supply Pickle Lake from Dryden/Ignace. Route 3 utilizes the Highway 599 corridor.

Figure 2 shows the ranges that would be affected by each of the transmission route proposals.

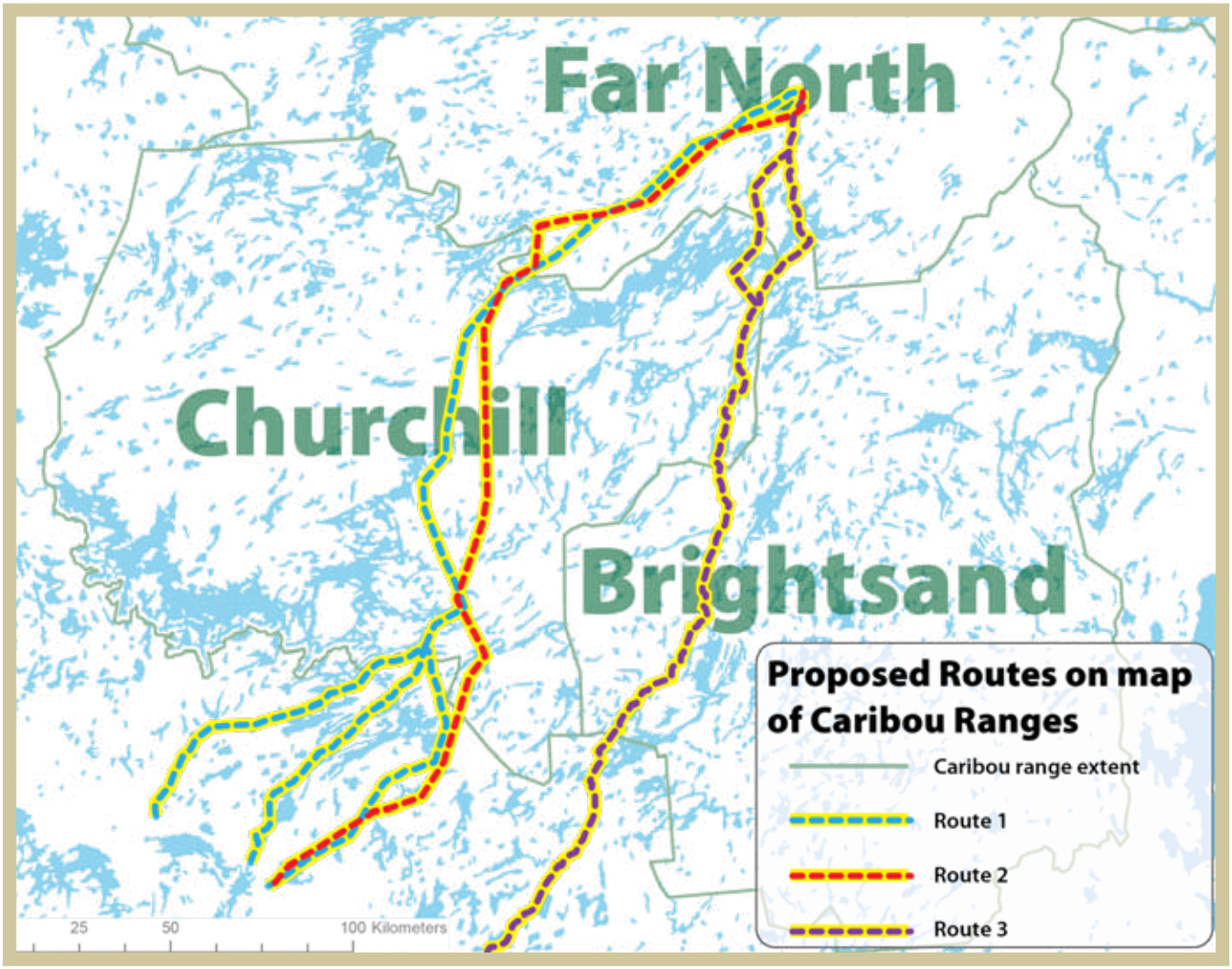


Figure 2 shows the proposed routes and the affected caribou ranges. The proposed routes would impact the Churchill and/or Brightsand and Far North ranges in Ontario.

RESULTS

In the Table 3, we describe the anthropogenic disturbance of the respective route options and the additional anthropogenic disturbance of each routing option on the range. Additional anthropogenic disturbance is important because two ranges are already in poor shape (they exceed or are approaching the maximum management disturbance threshold). Figure 3 below shows the results of the routing options from the perspective of their cumulative disturbance contributions to the three affected caribou ranges. The pink areas are disturbed areas (due to fire or anthropogenic, human-caused, changes).

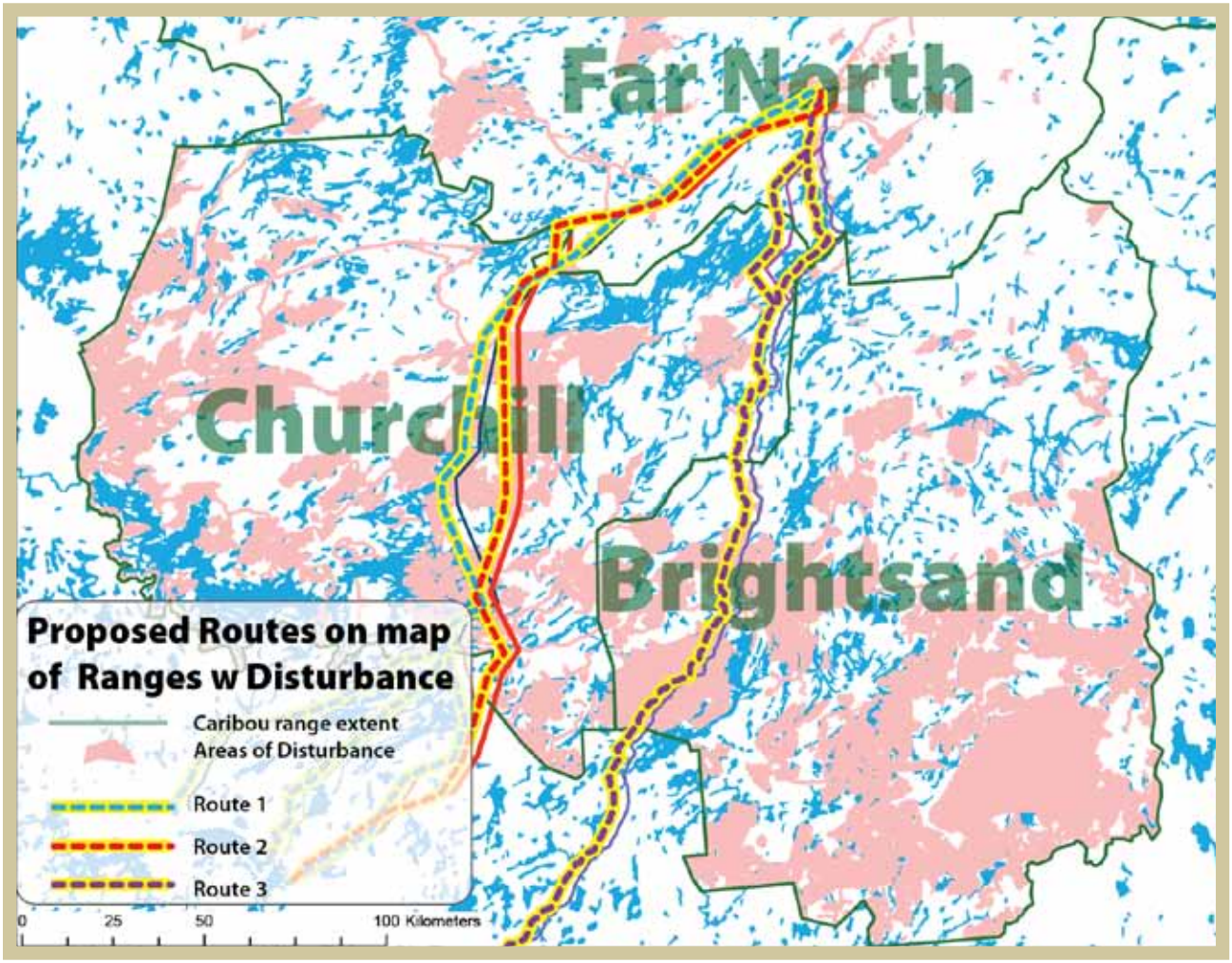


Figure 3 summarizes the results of the routing options from the perspective of their cumulative disturbance contributions to the three affected caribou ranges. The pink areas represent disturbance (fire and anthropogenic disturbance).

Table 3: *The anthropogenic disturbance of each respective route is presented plus the additional anthropogenic disturbance of each routing option on the range.*

Additional anthropogenic disturbance from proposed transmission line routes

Range	Area of the range (km^2)	Footprint of the project within the range (area km^2)	Additional disturbance from the project within the range (area km^2)
Route 1 (a,b,c)	begins in either (a) Dryden (b) Dinorwic, or (c) Jackfish, proceeds northward to Sioux Lookout and then parallels the existing E1C line (115kV transmission line that extends from Ear Falls to Pickle Lake) to Pickle Lake. There are three different routes proposed to get to the Sioux Lookout. This route crosses the Churchill and Far North Ranges only.		
Churchill	21,416	1(a) Dryden-Sioux, Sioux-Pickle **123.6**	63.3
		1(b) Dinorwic-Sioux, Sioux-Pickle **121.9**	63.4
		1(c) Jackfish-Sioux, Sioux-Pickle **122.7**	64.3
		1(a,b,c) All versions **94.4**	32
Route 2	begins in Dinorwic, proceeds northward to Pickle Lake, and then parallels the existing E1C line (115kV transmission line that extends from Ear Falls to Pickle Lake) to Pickle Lake. It crosses the Churchill and Far North Ranges only.		
Churchill	21,416	128	44
Far North	279,023	102	72
Route 3 (a,b)	begins in Ignace and utilizes the Highway 599 corridor to reach Pickle Lake, without (a) and with (b) the Osnaburgh bypass option.		
Brightsand	22,182	1(a) No By-Pass **103**	0
Churchill	21,416	1(b) By-Pass **103**	0
Far North	279,023	1(a) No By-Pass **56**	1
		1(b) By-Pass **82.6**	27.6
		1(a) No By-Pass **53**	1
		1(b) By-Pass **78.6**	22.6

Route 1 (a,b,c) – with three options to get to Sioux Lookout and then continues with the same proposed route from Sioux Lookout to Pickle, would trigger additional anthropogenic disturbance in several sections of the Churchill and Far North, creating new permanent linear disturbance in both of these ranges.

Route 2 - that begins in Dinorwic and continues northward to Pickle Lake, triggers additional anthropogenic disturbance in several sections of the Churchill and Far North Ranges using Environment Canada's disturbance framework. Moreover it creates a new permanent, large linear disturbance in both these ranges.

Route 3(a) – the Ignace-Pickle Lake route without Osnaburgh bypass, treads over the same footprint of an existing highway right-of way (Highway 599), with many related disturbances (logged areas for example) along it. It therefore does not trigger any additional anthropogenic disturbance in the Brightsand Range. In the Churchill and Far North Ranges it adds 1 km2 (or 100 ha) of additional disturbance to each range.

Route 3(b) – that originates in Ignace but bypasses the community of Mishkeegogamang on its way to Pickle Lake, would add additional anthropogenic disturbance in the Churchill and Far North Ranges.

ANALYSIS AND DISCUSSION

From the perspective of what is known about risk to caribou persistence in these areas, not introducing any additional permanent infrastructure in these highly disturbed southern ranges and focusing on restoration is required. We strongly recommend therefore that that a new permanent linear disturbance be avoided especially one of this scale (~300km).

Route 1&2 – While Route 2 (that originates in Dinorwic) aligns with some disturbance in terms of logged areas in the Churchill Range, it adds additional anthropogenic disturbance to the range and would unnecessarily create a new permanent north–south linear disturbance in currently occupied caribou habitat in the northern portion of this range and in the Far North Range. Fryxell (2013) describes the area north of Lake Joseph as 'heavily used by caribou' and some of 'the best available in the region'. This proposed option would further compromise the ability of the Churchill range further to be restored to 65% undisturbed habitat; would reduce connectivity within the range and reduce connectivity for this region of Ontario. The same criticism applies to all versions of Route 1 (a,b,c), proposed to bisect the central part of the Churchill and southern part of the Far North Ranges.

Given that these routes would bisect a range, as was noted in the literature review, barrier effects might reasonably be expected, including spatial changes to home range extent, as well as reduced fidelity to seasonal ranges and annual home ranges. In the extreme, barriers can functionally remove access to portions of a historically used range and can isolate a population genetically from genetic influx from the other side of the barrier.

Route 3 – The route that originates in Ignace and treads along the same footprint as Highway 599 without the Osnaburgh bypass, Route 3(a), avoids the creation of new permanent linear disturbances in this part of Ontario. We assume that local caribou populations have already significantly responded to the existing road network and

adjacent disturbed areas here. Caribou radio telemetry data [9] from this part of Ontario also seems to support this (e.g., see Fryxell (2013) draft report Assessment of potential environmental impacts of the proposed Sagatay Transmission Corridor to Pickle Lake with respect to woodland caribou). Fryxell (2013) states: "Given that extensive radio-telemetry data indicate that caribou rarely use the area within 15 km of the highway, the addition of transmission lines within the Highway 599 corridor is less likely to have deleterious impact on the Pickle Lake herd than increased disturbance north of Lake St. Joseph". Winter distribution data provided by MNR also seems to show caribou avoiding Highway 599 by up to 15 km [10].

Although this option does not add to overall disturbance, absent from consideration at this point is disturbance due to construction. While this may be temporary, it still adds some additional risk to a precarious situation for caribou.

While total disturbance (combined fire and anthropogenic disturbance) is the best predictor of the relationship between calf recruitment and range condition, the Scientific Update conducted by Environment Canada in 2011 noted that, "among the major categories of anthropogenic disturbance considered, linear disturbances were the most significant contributor to landscape change...and resultant caribou response (p. 267).

The scientists add, "the ubiquitous, negative influence of linear disturbances on caribou, relative to the more variable response to other disturbance types" may be explained by four factors (2011:268): the permanency of linear disturbances; uniformity relative to polygonal shaped disturbances; the "profound and disproportionate influence on landscape configuration and habitat fragmentation for sensitive species, relative to the area directly disturbed"; and, that the facilitation of increased predator movements and opening up new areas for ungulates while making habitat conditions less suitable for caribou. It speaks to the need for utmost caution when planning transmission lines in caribou country.

In this case in northwestern Ontario, we have ranges that have exceeded or close to exceeding the management threshold with little population condition data to inform decision making. We do, however, have sufficient knowledge to know that the southern ranges already present a relatively high risk situation for caribou.
Our assessment shows that Route 3(a) – the option beginning in Ignace and treading along the same corridor as Highway 599 and excluding the Osnaburgh bypass, would not trigger additional anthropogenic disturbance in the Brightsand Range and only negligibly in the Far North and Churchill Ranges. Based on the information available to us, it is our opinion that this route would be the least risky to caribou overall, of the routes proposed. It is also the route that has the higher prospects of restoring the range to 65% undisturbed (if for example, construction is not too destructive and no further development is introduced).

[9] This data is confidential and can only be shared with the written consent of Ministry of Natural Resources.
[10] Ibid.

There are limitations to relying only on cumulative disturbance metrics. MNR has not released information such as population condition, their range assessments, new boundaries for the Far North Range and the results of their 3-year radio collaring effort. Results from a University of Guelph-CNFER research project are also pending. All these would better inform decisions. But in the mean time, the framework offered by Environment Canada (2011) and serving as the foundation for the provincial (CCP) and national Environment Canada (2012) recovery efforts, is useful for advising on relative risk to local caribou in this area. This underscores why the assessment needs to be embedded within a large framework of risks to caribou using best available science and traditional knowledge.

Treading along a corridor of an existing permanent road has advantages. Caribou need large areas away from human disturbances so minimizing incursions into habitat is critical. Vors et al. (2007) suggests a minimum of a 13 km buffer of intact forests away from human caused disturbances and warns of a 2 decade time lag between disturbance by cutting and caribou extirpation. This is important context is this part of Ontario given that forest operations are ongoing in both the Churchill and Brightsand Ranges and there is a proposal by Gold Canyon Resources to build a new linear disturbance in the Churchill Range. Further radio telemetry data from Fryxell (2013) indicate that caribou are avoiding a 15 km buffer along the permanent Highway 599. This suggests that a route that within the corridor of an existing permanent road would be the least harmful option for caribou for this region of Ontario consolidating rather than dispersing disturbance (Environment Canada 2011).

As we saw in the previous section, a new infrastructure corridor within interior forest is also more likely to trigger additional opportunistic human development, and produce changes to the relative composition of the mammal community, than if transmission was to pair with existing alignment of the highway. It may also enhance predator mobility and/or provide access into areas of refuge. In terms of avoidance effects, it seems that the pairing of such infrastructure could be expected to produce less overall avoidance, and associated habitat loss. It may also enhance predator mobility and/or provide access into areas of refuge. In terms of avoidance effects, it seems that the pairing of such infrastructure could be expected to produce less overall avoidance, and associated habitat loss.

The risks associated with poorly planned access routes are high and not just to threatened species like woodland caribou. The Far North Science Advisory Panel warned in 2010 (p. 99): "Poorly planned access routes and transmission lines in particular have the potential to fragment habitat and create irreversible impacts on terrestrial and aquatic systems, including species abundance and distribution, carbon storage, and contamination of wild foods."

The Sagatay preferred route, Route 3a (Ignace to Pickle along Highway 599) was also identified by Fryxell (2013) through his draft ecological decision framework for evaluation of alternate transmission corridors. Dr. Fryxell evaluated the proposed corridors using 6 critical factors that should be considered in any "defensible decision framework" for the proposed Pickle Lake transmission corridor: (1) minimize overlap with the caribou herd range, (2) minimize loss of preferred habitat types (mature forest, bogs, and fens), (3) reduce deleterious changes

in caribou food availability across the range, (4) minimize road density and intensity of use, (5) avoid disruption of caribou migration routes, and (6) prevent changes in predation risk through elevated moose abundance, wolf abundance, or predation efficiency. Fryxell concluded that the Sagatay preferred option was preferable to any other of the Sagatay or Wataynikaneyap options.

We don't yet know the results from the MNR's own assessment of the proposed corridor routes (we assume they are doing one). MNR recently produced a Species at Risk Information Package to Support the Assessment of Impacts of the Proposed Central Corridor Energy Group/Goldcorp Transmission Corridor Routes on Species at Risk and provided it to Wataynikaneyap Power.

ESA COMPLIANCE AND THE ROLE OF ALTERNATIVES

A habitat regulation under the *Endangered Species Act* was promised in the CCP and was under development with respect to what activities will result in the destruction of caribou habitat in Ontario but recently we learned that Ontario is proceeding instead with General Habitat Protection for caribou. The MNR also recently enacted a number of exemptions for industries from the Act that means the standards for protection have been weakened. We believe this will ultimately lead to less meaningful protections for caribou and doesn't provide proponents with proper tools that can help them protect endangered species and meet their commitments under corporate social responsibility.

However, how proponents voluntarily meet or do not meet the 'alternatives' test of the *Endangered Species Act* could help the province determine which routing option to support to supply power from Ignace/Dryden to Pickle Lake. Authorizations will be needed under the *Endangered Species Act* in Ontario for activities that destroy or degrade caribou habitat and any other habitat of affected species at risk in the area. Proponents whose activities damage or destroy habitat can voluntarily seek an overall benefit permit under section 17(2)c or "if the Minister is of the opinion that the activity will result in significant social or economic benefit to Ontario" a 17(2)d permit. In either case, the requirements around alternatives are the same for both 17 (2)c and 17 (2)d. The alternatives clause states: "the Minister is of the opinion that reasonable alternatives have been considered, including alternatives that would not adversely affect the species, and the best alternative has been adopted".

From our assessment of the Corridor Routing Analysis provided by Wataynikaneyap after reading its Final Terms of Reference [11], it is clear that Wataynikaneyap's preferred route, Route 2 - Dinorwic to Pickle Lake paralleling the E1C line, would have difficulty meeting the alternatives test because it adds additional disturbance to ranges that are already in a risky condition and introduces a new permanent linear disturbance. Moreover, the Wataynikaneyap framework did not adequately consider range level impacts to woodland caribou and failed to ask a fundamental question of environmental assessment: how can environmental impacts be avoided in the first place? It admits it did not come up with the best alternative for the species. Further, as we noted in our comments to the Ministry

[11] The Final Terms of Reference for Sagatay have not yet been posted for public consultation.

of Environment, it only wishes to assess a reasonable range of alternatives 'if required' that are 'technically and economically feasible'.

Route 3(b) – the Ignace to Pickle Lake route including the Osnaburgh bypass, would also have difficulty meeting the alternatives test because it would add additional disturbance to ranges already in a risky situation. Route 3(a) – the Ignace to Pickle Lake option excluding the Osnaburgh bypass, would be in better position to meet the alternatives test because it not does add additional disturbance to ranges that are already in bad shape.
We advise all proponents and Ontario to incorporate the tests of the Act upfront into its alternatives assessment framework to inform decision making. As well, we recommend that proponents examining linear feature density in its Environmental Assessments. Linear feature density is an important predictor of caribou occurrence (e.g, Frair et al. 2008) even if the ecological mechanisms are not well understood. This would need to be nestled within a framework that considers configuration of disturbance in addition to density metric. A cumulative effects assessment would also need to be undertaken. These ranges are going to be under further stress due to new road proposals associated with new mining in the Ring of Fire and by exploration companies.

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SUMMARY

The Brightsand and Churchill Ranges are both highly disturbed ranges, already presenting a high risk to their respective caribou populations. In the absence of publicly available population condition data we have only range condition data to go on in addition to what is known about caribou in terms of scientific knowledge and impacts from transmission lines. Scientists have found that total disturbance (combined fire and anthropogenic disturbance) is a predictor of the relationship between calf recruitment and range condition. Southern ranges in Ontario need to see their overall disturbance reduced. All routes examined are likely to pose risks to caribou, however the various routes are likely to present a substantial range of additional risk. Route 1 – all of the routing options that we examined that go through Sioux Lookout on the way to Pickle Lake and Route 2 – the Dinorwic-Pickle Lake option, parallel to E1C (the Wataynikaneyap preferred option), would be major incursions of additional anthropogenic disturbance (300km permanent transmission line) in the Churchill and Far North Ranges. They would also bisect an area that is currently occupied habitat and that has been described as some of the best available habitat in the region. They would be likely to compromise the ability of the Churchill range to be restored to 65% undisturbed habitat, and would reduce connectivity within the range and reduce connectivity for this region of Ontario.

Route 3(a) – the Ignace-Pickle Lake option excluding Osnaburgh bypass (Sagatay's preferred option) would not create any additional anthropogenic disturbance in the Brightsand Range and very little (1km2) in each of the Churchill and Far North Ranges respectively. We assume and would anticipate that the populations of caribou have already significantly responded to the existing road network and adjacent disturbed areas here. Radio telemetry data from Fryxell (2013) indicate that caribou are avoiding a 15 km buffer along the permanent Highway 599. The Ignace-Pickle Lake option excluding Osnaburgh bypass would be the least risky for caribou and should be prioritized for consideration by Ontario.

The tests of the *Endangered Species Act* should be built into the alternatives assessment framework proposed by proponents and a cumulative effects assessment undertaken by the province as part of any Environmental Assessments. Finally we recommend that proponents invest in monitoring to support the collection of population condition data especially where gaps remain and to monitor any mitigation strategies over time.

CONCLUSION

Based upon our findings from (a) our review of the literature investigating potential negative impacts to woodland Caribou from situating a new transmission line, AND (b) from the quantitative assessment of range condition based on Environment Canada's cumulative disturbance risk analysis assessment framework, relative to the proposed transmission line routes, we offer the following brief conclusions:

- No additional permanent infrastructure should be introduced in the highly disturbed southern ranges (Churchill and Brightsand) and a focus on restoration is required;

- Any additional linear infrastructure is likely to result in some impacts to caribou, and probably at multiple scales. If transmission infrastructure must be installed, generally avoiding further bisection of intact habitat would be the primary tool for minimizing these impacts;

- There is significant evidence (based on our examination of three inter-related themes in the literature) that suggests routing infrastructure alongside an existing highway corridor is generally likely to be the least harmful to caribou, relative to "pioneer" line options;

- The quantitative assessment of range condition shows that, using the Environment Canada disturbance framework, Route 3(a) - the option beginning in Ignace and treading along the same corridor as Highway 599 (and excluding the Osnaburgh bypass), would not generate any additional anthropogenic disturbance in the Brightsand Range and only negligibly in the Far North and Churchill Ranges. This would be the least risky of the proposed routes to caribou overall. It would also represent the enhanced prospects of restoring the range to 65% undisturbed (if for example, construction is not too destructive and no further development is introduced);

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- All other routing options would introduce additional anthropogenic disturbance in ranges that are already high risk contexts for caribou persistence.

- These subject caribou ranges have exceeded, or are close to exceeding, the established management threshold with little population condition data to inform decision making. We recommend that proponents invest in monitoring to support the collection of population condition data especially where gaps remain and to monitor any mitigation strategies over time;

- The tests of the *Endangered Species Act* should be built into the alternatives assessment framework by proponents and a cumulative effects assessment undertaken by the province as part of any Environmental Assessments for a new proposed transmission line; and

- We have identified two important research areas that we recommend be the subject of future study: (a) the permeability of the existing corridor Highway 599 to caribou movement, and the relative use of the bisected portions of the two delineated ranges; and (b) a re-examination of current range delineation in the Brightsand Range and neighbouring Churchill Range with respect to the potential role of Highway 599 as an existing or future anthropogenic "edge" that functionally affects these range extents.

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APPENDICES

Appendix 1: CPAWS Wildlands League past work with transmission lines.
Appendix 2: Ontario's Caribou Conservation Plan
Appendix 3: Environment Canada 2012. Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada

APPENDIX 1

HYDRO ONE PLAN TO HASTEN THE DEMISE OF CARIBOU IN ONTARIO

BACKGROUNDER BY CPAWS WILDLANDS LEAGUE, FEBRUARY 23, 2010

THE NEW THREAT. Hydro One is planning on building a new 430km (230kv) transmission line from the Nipigon area to Pickle Lake (alongside Wabakimi Provincial Park in northwestern Ontario- see map). As a new permanent linear corridor, this is a known threat to caribou and healthy intact Boreal Forests. Hydro One says this corridor is designed to support new hydro generation and regional economic growth. It will also open up remote areas.

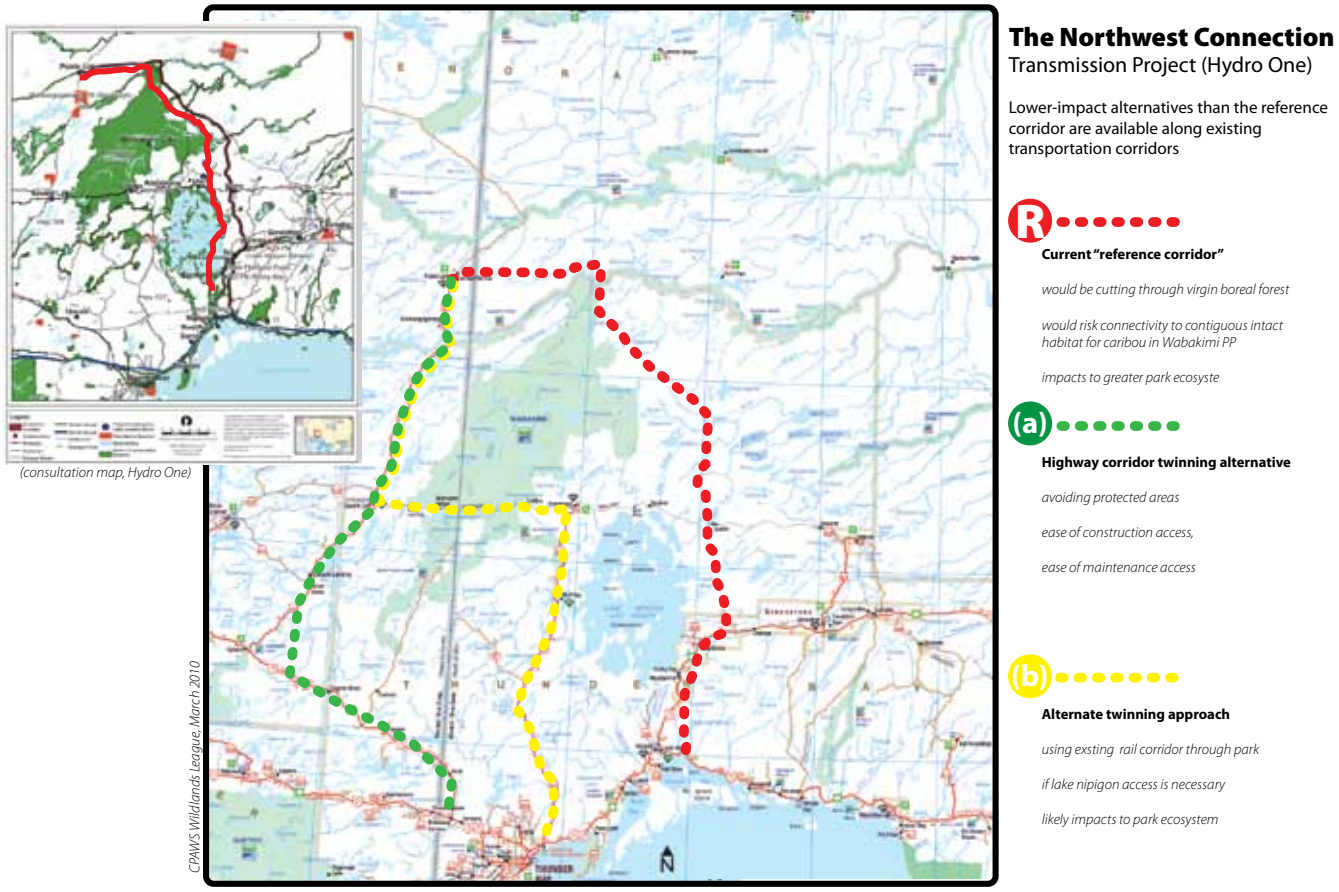
WHY WE ARE CONCERNED. As stated in the Lake Nipigon Signature Site Ecological Land Use and Resource Management Strategy, "the Lake Nipigon area is strategically important to long-term woodland caribou recovery due to its high quality and quantity of caribou habitat and its location near the southern limit of continuous caribou range." Routing a new permanent line on the east side of Lake Nipigon is at odds with recovering woodland caribou. It will erode the remoteness of the Lake Nipigon Signature Site and undermine the province's implementation of the *Endangered Species Act*.

To compound matters, the northern section of this proposed line will sever caribou habitat in Wabikimi Provincial Park from the intact habitat further north. It is widely acknowledged that Wabakimi is not nearly big enough to support healthy caribou populations and as one scientist lamented, this new permanent disturbance "will only help to hasten the demise of caribou in this part of Ontario".

Finally, the hydro corridor is being narrowly scoped in a piecemeal and ad hoc manner, in the absence of comprehensive, big-picture planning for the region and in the absence of a cumulative impacts analysis of all developments (existing and proposed).

SUMMARY OF WILDLANDS LEAGUE ADVICE TO HYDRO ONE WITH RESPECT TO THE PROPOSED NORTHWEST TRANSMISSION EXPANSION PROJECT

#1 Minimize the creation of new linear disturbances on the landscape.



#2 Identify and propose alternative routes that parallel existing permanent roads, railways and linear features to preserve the remoteness of Lake Nipigon and protect the ecological integrity of Wabakimi Provincial Park;

#3 Make the findings about the alternatives and associated costs and benefits publicly available so all Canadians can participate in determining the best route for this infrastructure especially since it's being touted as the basis for creating a 'new era of economic development across the region';

#4 Assess the cumulative impacts to caribou from this line and all development (existing and proposed) at the landscape scale;

and

#5 Devise and implement a plan with Ontario to increase permanent protection for caribou at the landscape scale in the four local ranges affected before any approvals are handed out, and in order to meet the requirements of the ESA.

WILDLANDS LEAGUE

For Immediate Release November 23, 2010

Caribou and Economy Win with New Hydro Line Route in NW ON

Group applauds decision to avoid intact boreal forests

TORONTO –CPAWS Wildlands League, a leading conservation group in the province, applauds a decision today by Minister Brad Duguid to re-route a permanent transmission line in north-western Ontario along existing roads and infrastructure. In particular, the group is pleased that healthy intact Boreal Forests and habitat for threatened caribou populations will be avoided.

"It's a win for Ontario's pocketbook and a win for critters, parks and waterways," says Janet Sumner, Executive Director. "It is comforting to know that when our decision-makers weigh their duty to endangered species and to advancing economic growth, that they can find a middle way, a path where the environment and the economy prosper," Sumner adds. "After all, the re-routed line will be cheaper to build than the original route proposed."

Today Minister Duguid released Ontario's Long-Term Energy Plan. In it the plan states: "A new transmission line to Pickle Lake— one of this plan's five priority projects — will help to service the new mining load and help to enable future connections north of Pickle Lake. Subject to cost contributions from benefiting parties, Ontario will focus on supplying Pickle Lake from the Ignace/Dryden area immediately."

The northern section of Hydro One's original route would have severed caribou habitat in Wabikimi Provincial Park from the intact habitat further north. It is widely acknowledged that Wabakimi is not nearly big enough to support healthy caribou populations and as one scientist lamented, this new permanent disturbance would have only helped "to hasten the demise of caribou in this part of Ontario". With today's announcement, this is no longer a risk. An option that twins existing roads and infrastructure from Ignace/Dryden prevailed over charting through pristine Boreal Forests.

"We are over the moon," says Anna Baggio, Director Conservation Land Use Planning. "We thank Minister Duguid and Ontario for bringing 21st century leadership to 21st century challenges, like endangered species habitat and electrical transmission," Baggio adds. "This sets a strong precedent for Ontario that we hope can be applied to other resource sectors broadly."

CPAWS is a signatory to the Canadian Boreal Forest Agreement along with other environmental groups and major forest companies, which is aimed at joint leadership in the Boreal Forest. Finding thoughtful solutions for caribou and the economy is part of CPAWS' nationwide Boreal woodland caribou conservation campaign.

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For further information please visit www.wildlandsleague.org and contact:

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Ministry of Natural Resources

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Natural. Valued. Protected.

Ontario's Woodland Caribou Conservation Plan

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Minister's Message

I am proud to present *Ontario's Woodland Caribou Conservation Plan*, which lays out a comprehensive, science-based and responsive long-term strategy for recovering Ontario's Woodland Caribou. This plan builds on our province's strong track record of species protection and our commitment to sustainability as a priority in all our planning.

I would like to acknowledge the Ontario Woodland Caribou Recovery Team and the Woodland Caribou Science Review Panel for providing very helpful advice and support for the development of this plan. Many members of the public also participated in our public consultations. I thank everyone for their time and their considered input.

Through the implementation of this plan we will be initiating a number of recovery actions that will involve Aboriginal peoples, the scientific community, resource industries, other stakeholders, the general public and ministry staff.

A healthy caribou population is a good indicator of a healthy boreal forest. Ontario will continue to be a leader in caribou recovery and conservation in North America. I look forward to your continued involvement and support as we move forward.

Hon. Donna Cansfield
Minister of Natural Resources

Photo: Tim Timmermann

Caribou crossing a creek in Northern Ontario.

Photo: Lee Gerrish

Ontario's Woodland Caribou Conservation Vision:

Self-sustaining caribou populations in a healthy boreal forest.

Ontario's Woodland Caribou Conservation Goal

To maintain self-sustaining, genetically-connected local populations of Woodland Caribou (forest-dwelling boreal population) where they currently exist, improve security and connections among isolated mainland local populations, and facilitate the return of caribou to strategic areas near their current extent of occurrence.

Introduction

Woodland Caribou are native to Ontario's northern forests. They are an important indicator of the healthy boreal forest ecosystem on which they rely. As one of several jurisdictions responsible for managing the northern boreal forest, Ontario has an important role in Woodland Caribou stewardship.

The purpose of *Ontario's Woodland Caribou Conservation Plan* (*Caribou Conservation Plan* for this document) is to:

- provide broad policy direction regarding Woodland Caribou conservation and recovery;
- summarize the actions the Government of Ontario intends to take in response to recommendations in the Ontario Woodland Caribou Recovery Strategy and the government's priorities in taking those actions (Government Response Statement)[1]; and
- outline initiatives to support Woodland Caribou recovery.

Guiding Principles

The *Caribou Conservation Plan* is guided by these principles:

- Adaptive management which combines science and the use of new information to continuously improve management over time.
- Ecosystem-based management that considers all the natural factors that affect and sustain caribou.
- A healthy boreal forest that supports self-sustaining caribou populations.
- The precautionary principle, which means that incomplete information should not be used as a reason for delaying conservation action.
- A focus on the long-term sustainability of caribou ranges including the consideration of cumulative impacts.
- Consideration of caribou population health and habitat condition in resource development decisions.
- A science-based approach to caribou recovery that recognizes existing knowledge and its limitations.
- A commitment to incorporating Aboriginal Traditional Knowledge in decision-making where available.
- Consideration of social, economic and environmental concerns in the context of long-term caribou survival.

1. As per s. 11(8) of the *Endangered Species Act*, 2007, S.O. 2007, c.6

Scope and Scale of the Plan

Ontario's Woodland Caribou Conservation Plan provides policy direction for the management and recovery of Woodland Caribou (forest-dwelling boreal population), and will apply to the areas of continuous and discontinuous distribution shown in green in Figure 1. Woodland Caribou (forest-dwelling boreal population) are designated as **Threatened** in Ontario under the *Endangered Species Act*, 2007.

Aboriginal Peoples and Woodland Caribou

Ontario is committed to Aboriginal participation and involvement in caribou recovery. Aboriginal peoples will continue to play a unique role in Woodland Caribou conservation and recovery because of their close relationship with the land, and their knowledge of and interactions with caribou and other animals. Implementation of the *Caribou Conservation Plan* will be most effective in collaboration with Aboriginal peoples. Ultimately, the participation and involvement of Aboriginal peoples will enhance prospects for successful conservation and recovery of Woodland Caribou in Ontario.

For thousands of years, Woodland Caribou have been the dominant member of the deer family in much of northern Ontario. Caribou have long held cultural, spiritual, social and subsistence significance for many Aboriginal communities. Ontario is committed to providing opportunities for incorporating Aboriginal Traditional Knowledge (ATK) into caribou recovery and meeting any constitutional obligations that may exist with respect to Aboriginal and Treaty rights.

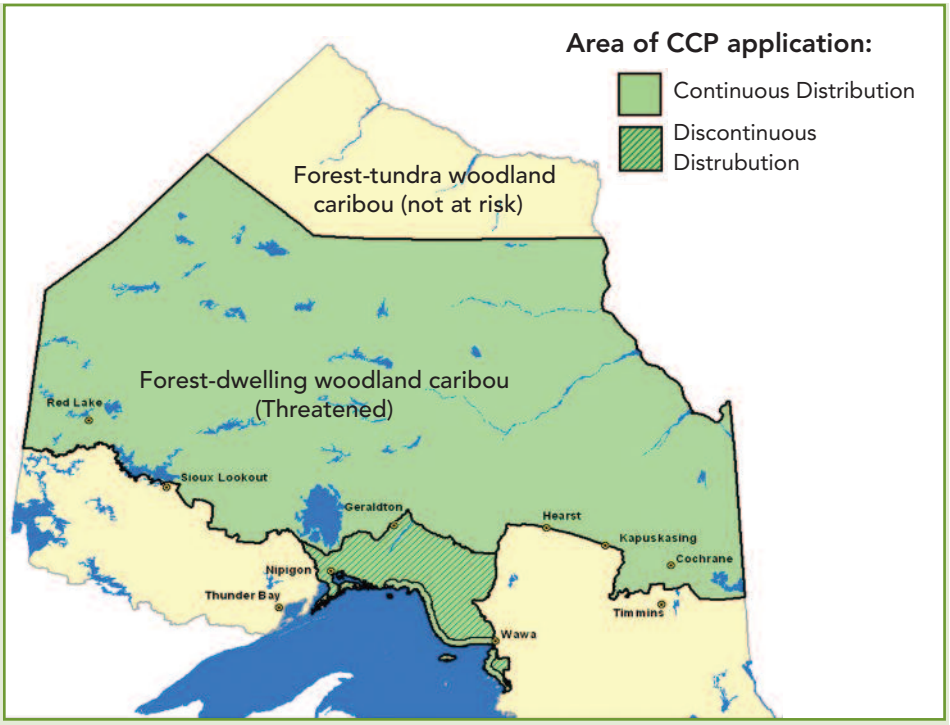


Figure 1. Area of application for the Caribou Conservation Plan shown in green. Note that there is some imprecision regarding the boundary between the forest-dwelling and forest-tundra ecotypes; the boundary as displayed is based upon the southern boundary of Wildlife Management Units 1A and 1B and closely approximates an ecological boundary.

Background

Woodland Caribou live in the boreal forest and taiga (subarctic evergreen forest) across northern Canada. They range across much of northern Ontario, with isolated populations as far south as Lake Superior. Caribou were once widespread across most of Ontario north of Lakes Huron and Superior. Expanding human settlement and development have resulted in significant habitat changes. These changes have had a long-term negative impact on caribou by fragmenting landscapes, changing forests, and creating ecological conditions that benefit other wildlife at the expense of caribou. As much as 40-50 per cent of the area of historic caribou distribution has been lost in Ontario since the late 1800s.

All caribou in Ontario are considered Woodland Caribou, but there are two different types based on the way they use their habitat. *Forest-dwelling Woodland Caribou* live year-round in the boreal forest, typically migrate less than 100 km annually and are designated as Threatened. The more northern *forest-tundra Woodland Caribou*, which are currently considered Not at Risk, travel in larger herds, winter in the boreal forest, and migrate longer distances to the open tundra of the Hudson Bay Lowlands for the spring and summer calving time. Forest-dwelling Woodland Caribou are the same as the Boreal Population of Woodland Caribou listed as Threatened under the federal *Species at Risk Act*. In this plan the terms *Woodland Caribou* and *caribou* both refer to the forest-dwelling type.

Caribou Ecology

Caribou habitat in the boreal forest is constantly changing. Much of the forest is naturally in an unsuitable condition for caribou at any one time, but caribou need and use the entire landscape over time as habitat changes. Caribou habitat is a shifting configuration of large patches of mature forest, occupied by evergreen trees such as Black Spruce and Jack Pine. Disturbances from fires, blowdown, and insects can quickly change the amount and distribution of habitat (Figure 2). There is also great ecological variation in caribou habitat across the province ranging from upland fire-dependent forests in the northwest to extensive lowland forests in the northeast where fire is much less frequent.

Caribou have very large individual annual home ranges of approximately 200-4,000 sq. km.

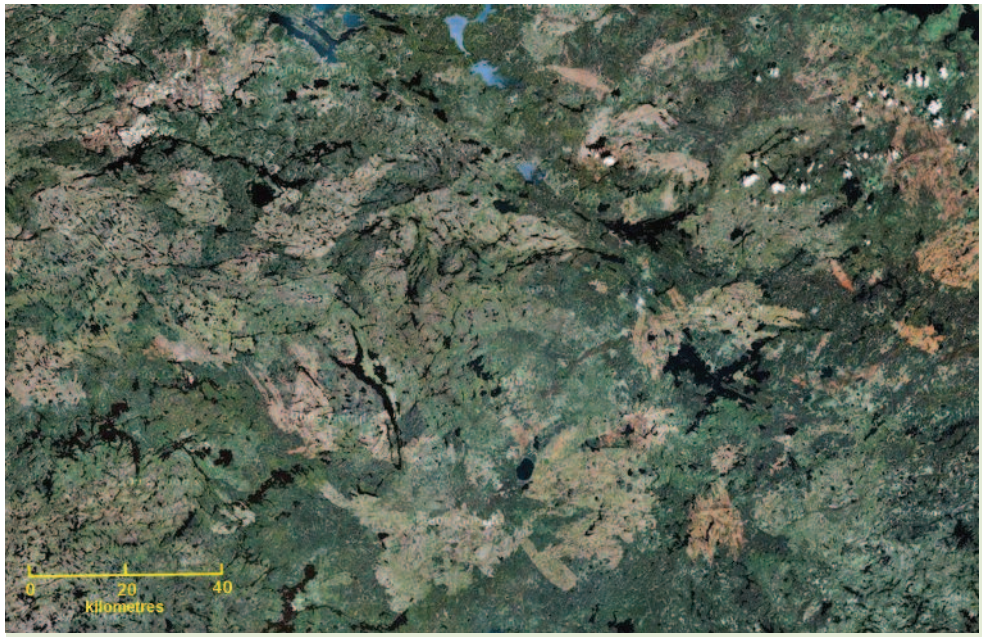


Figure 2. An example of the natural pattern of large forest habitat patches generated by the wild fire typical of upland boreal forests in northwestern Ontario. Forest fires burn and renew the boreal forest in very large patches of similar age, creating a dynamic configuration of caribou habitat that shifts over time. Caribou avoid the younger patches (lighter green), using the mature and older pure conifer forests (darker green). © 2009 Google – Map data © Tele Atlas

Caribou habitat needs must be considered from the broad landscape to very specific local sites where caribou find winter food (Figure 3). Caribou have very large individual annual home ranges of approximately 200-4,000 sq. km. This compares with Moose home ranges of less than 40 sq. km and even smaller White-tailed Deer home ranges.

Members of the deer family differ considerably in their ability to withstand and recover from various challenges and stresses. Woodland Caribou are considered the least resilient North American deer species and do not respond well to human disturbance. Caribou generally take the longest to recover from population stresses as they first breed at a later age, have only one young per year, and are very vulnerable to predators.

Forest-dwelling Woodland Caribou generally travel in small groups during the winter and are more solitary at other times of the year. To caribou, habitat is more than just trees and lichen. It also includes refuge habitat, for the avoidance of predators such as Gray Wolves and Black Bears. Biologists believe that caribou choose mature and older conifer-dominated forests to minimize contact with predators. To avoid predators, caribou disperse across the landscape in low numbers and select refuge (security) habitat which has large areas of mature and older coniferous forest or peatlands with low diversity. These areas have very little food for Moose and White-tailed Deer, and thus support lower numbers of predators. One of the main winter foods of caribou across Ontario is ground lichen, a food on which few other animals can survive.

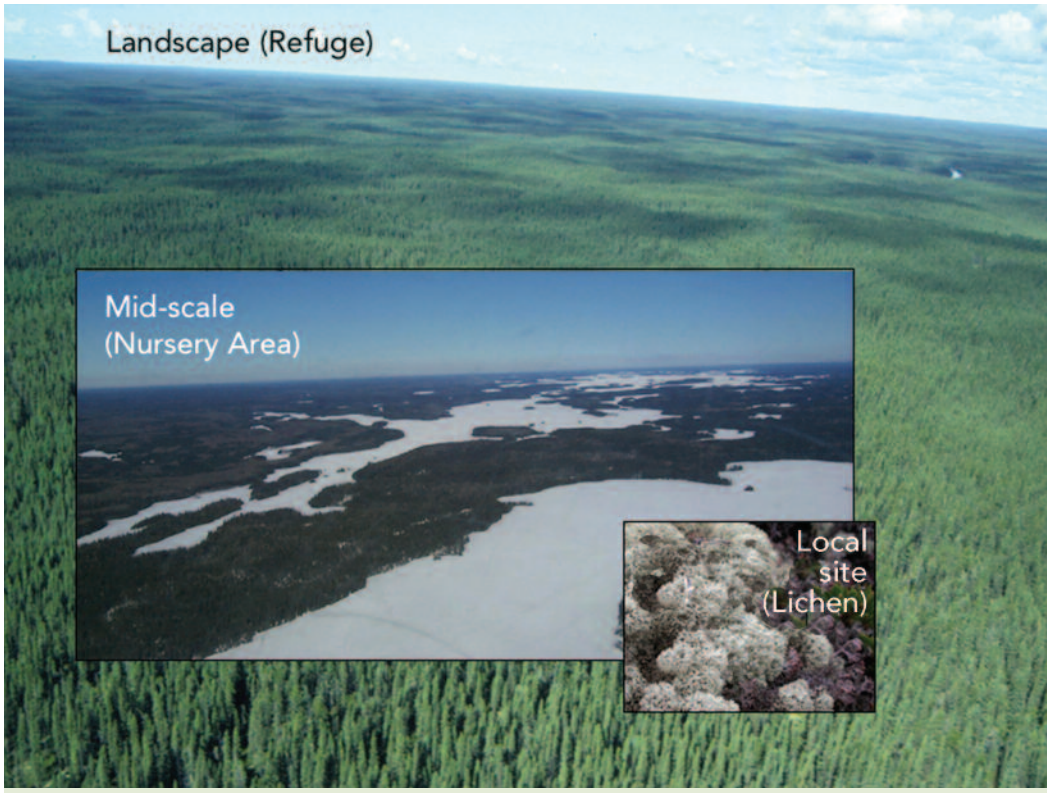


Figure 3. Illustration of the various scales of caribou habitat selection. Caribou distribution across the broader landscape is determined by predator avoidance (security/refuge habitat) while finer-scale habitat selection is determined by forage availability (e.g. lichens). High use areas such as nursery habitat are between these two scales. Photographs by Gerry Racey (landscape), Phil Elkie (nursery) and Glen Hooper (lichen).

Moose and White-tailed Deer thrive in younger forests after disturbance by fire or logging. When the numbers of Moose and White-tailed Deer increase, so do the abundance of associated predators and parasites. This can subsequently lead to the decline or disappearance of Woodland Caribou.

Effective Woodland Caribou conservation and recovery requires maintenance of a landscape suitable for caribou. The provincial distribution of Woodland Caribou can be divided into a number of smaller areas, or "local population ranges", which can be more efficient for management and better reflect local ecology, caribou movements and habitat use. In most cases local population ranges overlap, resulting in continuous provincial caribou distribution across most of the northern boreal forest.

Habitat Management

Effective caribou habitat management requires that all resource management activities consider implications to the provision of caribou habitat, with appropriate strategies to avoid or mitigate impacts. Management decisions must consider the dynamic nature of the caribou landscape, which varies naturally over time and across large areas (Figure 2). Because ecological conditions vary considerably across northern Ontario, different management approaches are needed in the northeast and northwest. Caribou habitat needs have been considered in many forest management plans in Ontario since the early 1990s. But there is still much to learn about how caribou respond to the habitat conditions resulting from forest harvesting.

The boreal forest is a fire-dependent ecosystem. While Woodland Caribou have adapted to this fire-driven landscape, they also require the availability of large areas of mature, coniferous forest. Whether forests are affected by forest fire, insects, blowdown, forestry or some other disturbance, it is essential that these disturbed forests once again become suitable for caribou. Effective silviculture in active forestry areas is essential to sustaining caribou and to providing future caribou habitat. Especially important is the successful regeneration of large patches of pure Jack Pine and Black Spruce forests that make up the natural configuration of caribou habitat. There are some uncertainties about the effectiveness of silviculture to replicate habitat conditions after natural wildfire.

Forest management practices are updated and refined as our understanding of the boreal forest improves. However, there are still a number of knowledge gaps and uncertainties. Forest management has made significant progress in emulating the pattern and composition of forests resulting from fire, although forestry cannot fully emulate all aspects of wildfire. Commercial forestry is relatively recent in the current caribou distribution area, and there are few areas where caribou reoccupancy of logged habitats can be fully documented, as this can take 40-60 years after disturbance. Ongoing research will improve the effectiveness of renewing habitat after logging so that it more closely reflects natural regeneration.

The implications of forest management are long-term, often decades or longer. Ontario must, therefore, incorporate a margin of error in current strategies to ensure that options for future decisions are not lost. For example, there has not yet been full demonstration that caribou will successfully re-inhabit areas impacted by modern logging, and there are uncertainties regarding the impact of environmental changes such as forest fires and climate change. Management actions today must always focus on the long-term benefit to caribou even if some uncertainty exists. Adjustments to forest management practices in northwestern Ontario since the early 1990s appear to have had some initial success at retaining caribou and caribou habitat near the southern edge of range. Whether this is forestalling range recession is unproven due to the level of population monitoring, but is suspected based on our observations. Although the evidence is not conclusive, short-term caribou well-being and management options for the future are probably greater due to the deferral of large tracts of mature forest at the southern edge of range.

Managing forest fire response can also help maintain and renew caribou habitat. A range of fire response options from full suppression to monitoring can be applied to support habitat preservation and renewal. Prescribed burning is an effective tool for renewing forest stands, particularly after logging and in degraded forests. There is substantial research on historical fire regimes, which has found that there is a great deal of variation in fire severity and long term impacts. Habitat changes can and do occur suddenly, especially due to large wildfires. The scale of such disturbance is likely to increase in coming decades with climate change. Management practices must accordingly be conservative and responsive, recognizing that large-scale forest fires may still affect the overall quality and availability of current and future caribou habitat. For individual ranges, the total area disturbed reflects the area burned by wildfire, as well as that affected by logging and other development.

Incorporating caribou conservation and recovery in land use planning requires consideration of caribou at the landscape scale, and an understanding of the point at which human disturbance has a significant impact on caribou ("thresholds of human disturbance").

Most Woodland Caribou in Ontario are distributed north of areas on which commercial forestry and large-scale agriculture occurs. This provides an opportunity to integrate caribou conservation with emerging Far North planning and policy direction. Protected areas also play an important role in the provision and retention of caribou habitat.

Caribou Conservation through Adaptive Management – Actions to Achieve Protection and Recovery

The goal of the *Caribou Conservation Plan* is to maintain self-sustaining, genetically-connected local populations of Woodland Caribou (forest-dwelling boreal population) where they currently exist, strengthen security and connections among isolated mainland local populations, and facilitate the return of caribou to strategic areas near their current extent of occurrence. To do this, Ontario intends to implement integrated recovery strategies and actions within an adaptive management framework.

Adaptive management is the best way to achieve sustainability and caribou conservation. It is a dual process – science and knowledge inform us of the best management practices, and the implementation of those practices becomes the object of scientific study. It is an ongoing cycle of research, implementation, new research and revised implementation. As we learn more, uncertainties are reduced, and the prospects for caribou conservation and sustainable resource use are improved. Management and science go hand-in-hand. The key strategies in the *Caribou Conservation Plan*, linked and integrated through the adaptive management cycle, are illustrated in Figure 4.

Outlined below are the actions that the Government of Ontario intends to take with respect to the protection and recovery of forest-dwelling Woodland Caribou. These actions are considered important toward achieving the recovery goal and objectives for the species.

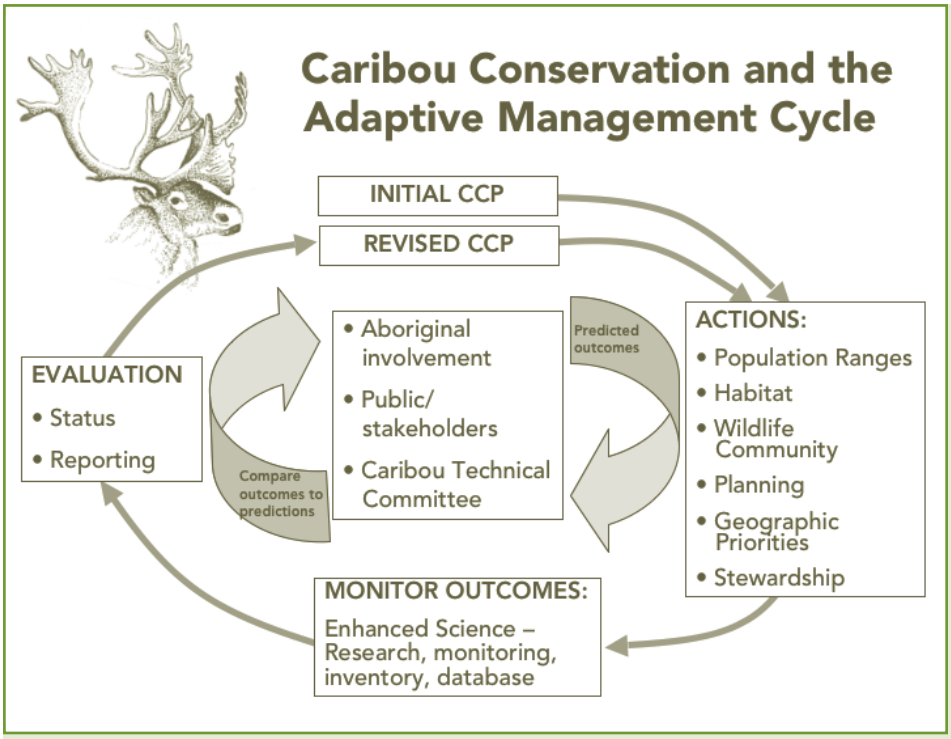


Figure 4. Application of the Adaptive Management Cycle to the Caribou Conservation Plan.

1.0 Enhance Caribou Science

1.1

Ontario is starting a collaborative provincial caribou research program to increase understanding of the response of caribou populations to human-caused disturbance, natural disturbance, and other influences such as predation, habitat quality and quantity. Research will also support implementation of range management (Section 2.0), provide benchmarks for range occupancy, population viability, population dynamics and habitat quality and quantity. It will also inform habitat suitability and population viability models.

1.2

The re-occupancy of previously logged areas by caribou will be studied as part of the broad caribou research program through several initiatives including:

- a broad assessment of caribou re-occupancy of formerly logged habitats, highlighting new science information, lessons learned and recommended adjustments to management;
- research on silvicultural efforts to renew future caribou habitat, including the use of herbicides and silviculture to renew ground lichen after logging; and
- case studies of known caribou reoccupancy of formerly logged areas.

1.3

Research on the establishment and use of thresholds of human disturbance and cumulative impact assessment will be a priority to support land-use planning decisions.

1.4

Ontario will expand current monitoring efforts by establishing a standard provincial caribou monitoring program to provide baseline data on populations, range occupancy, southern edge of continuous distribution, and population health data (e.g. birth and death rates) for Woodland Caribou across the province. This will include the development of standards and protocols for caribou monitoring surveys.

1.5

Ontario will initiate an ongoing population range monitoring program at the local population range level to support range management (Section 2.0). It is anticipated that 1-2 ranges will be monitored annually.

1.6

Ontario will create and maintain a provincial caribou database to store, manage and integrate caribou inventory and monitoring data from all past, current and future sources in support of caribou recovery (within the Natural Resource Values Information System – NRVIS).

1.7

Ontario will establish a Provincial Woodland Caribou Technical Committee to support the implementation of the *Caribou Conservation Plan*. It will provide provincial-level advice on the implementation of Ontario's Woodland Caribou recovery program to the provincial government. Potential members will have professional or technical expertise in areas such as caribou ecology, forest ecology, conservation biology, forest management and Aboriginal Traditional Knowledge.

2.0 Adopt a Range Management Approach

2.1

Ontario will adopt a range management approach to Woodland Caribou recovery. Caribou ranges will be the basis for evaluating habitat conditions and identifying caribou habitat, assessing population trends, and assessing and addressing cumulative impacts. Range management will be the primary approach that sets the spatial and ecological context for planning and management decisions within an adaptive management framework. Management actions will be refined and adapted as new information becomes available. Planning decisions will consider all factors influencing the well-being of caribou within the range including direct and indirect human impacts. MNR policy will be developed to guide implementation.

2.2

Ontario will identify local caribou population ranges, as units of analysis, within the provincial distribution of caribou. Preliminary ranges across the area of southern caribou distribution (within and immediately adjacent to areas licensed for forest management) have been identified for the *Caribou Conservation Plan* (Figure 5), based upon the following criteria (in priority order):

1. Animal survey data – movements, distribution, and evidence of shared geography;
2. Habitat functions and behavioural responses; and
3. Predominant risk factors.

Boundaries will be refined on a criteria-based approach as new scientific and management information and Aboriginal Traditional Knowledge become available, as part of the adaptive management process. Initial efforts will focus on development of a technical support document to further describe implementation of the range management approach, including refinement of the criteria for range delineation and the process for reviewing and modifying range boundaries as required. Local population ranges for more northern areas will be identified by 2012, in consideration of the Far North planning process as additional information becomes available.

2.3

As part of its commitment to range management, Ontario will establish range-specific population-based objectives (e.g. population health measures). Successful achievement of these objectives will require that all management decisions reflect and stay within known thresholds of range-level disturbance (human and natural).

2.4

Ontario will conduct and report on preliminary range assessments for the proposed preliminary ranges (see Figure 5) within the first six months of implementation of the *Caribou Conservation Plan*. Preliminary range assessments will provide the contextual direction for all resource management and land use management planning. These assessments will be based upon the methodology used in the federal Critical Habitat Science Review process tailored to Ontario's situation.[2]

2.5

Aboriginal Traditional Knowledge will be incorporated where available to support the delineation and refining of caribou ranges.

2.6

Ontario will work with other jurisdictions, in particular – Manitoba, Quebec, Parks Canada and Environment Canada to ensure the effective and co-ordinated management and conservation of local caribou populations and ranges that cross jurisdictional boundaries.

2.7

Ontario will develop a management strategy for discontinuous range management to enhance connectivity between the northern continuous range and the southern coastal Lake Superior populations. This connectivity will improve the prospects for persistence of the coastal population. Discontinuous range will not be managed broadly for caribou habitat to support self-sustaining populations. Instead it will be managed with a focus on specific landscapes that may support temporary caribou occupancy or movement between the continuous range and Lake Superior.

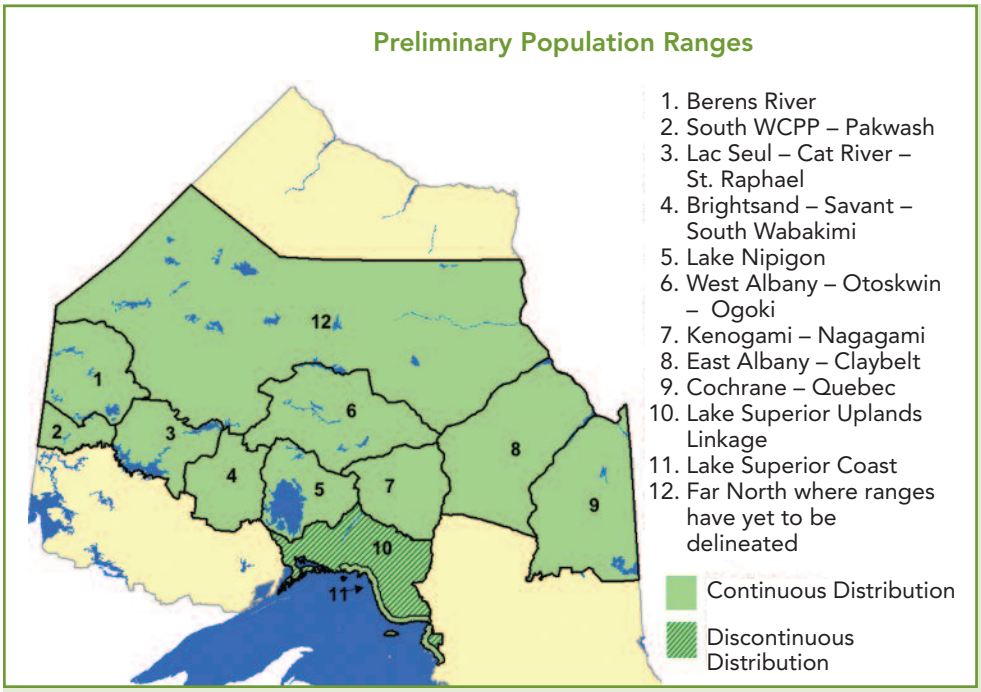


Figure 5. Preliminary delineation of local Woodland Caribou population ranges along the southern edge of the provincial extent of occurrence.

2. Environment Canada. 2009. Scientific review for the identification of critical habitat for woodland caribou (*Rangifer tarandus caribou*), boreal population, in Canada. August 2008. Ottawa: Environment Canada. 72 pp. plus 180 pp. appendices.

3.0 Improve Planning

3.1

Caribou populations and habitat will be important considerations in both the designation of conservation lands in the Far North Planning Area, as well as in the management of the rest of the northern landscape. The Ontario Government has committed to protecting at least 225,000 km^2 of the Far North Boreal region – this northernmost region represents 43 per cent of Ontario's land mass. Conservation of ecological features and functions, including caribou habitat and populations, will also be integrated into policy and planning tools developed for the Far North Land Use Strategy. Over time, Community Land Use Plans will be prepared in partnership with local First Nation communities to establish land use designations, including areas for protection, in the Far North.

3.2

Refinements will be made to existing land use and resource management planning processes to better incorporate caribou considerations:

3.2.1

The Crown Land Use Policy Atlas will be amended within areas of continuous current caribou distribution to reflect caribou presence and the need for additional consideration of caribou. Policies will include a commitment to consider caribou habitat values in all land use decisions. Land use policies for these areas will be updated as appropriate to incorporate new caribou policy.

3.2.2

Ontario will review Fish and Wildlife Enhanced Management Areas (EMAs) within the area of current caribou distribution to assess their effectiveness for caribou conservation and consider the potential establishment of additional caribou-related EMAs.

3.3

Parks, protected areas and conservation lands will be managed as important components of a broad landscape approach to caribou conservation through the following considerations:

- Caribou values will be considered within existing processes for the creation of new protected areas within areas licensed for forest management;
- Caribou habitat objectives and strategies will be integrated across the boundaries that separate dedicated protected areas from areas licensed for forest management or other development activities; and
- Caribou conservation and recovery will be incorporated into management planning for protected areas within the current distribution of caribou.

3.4

A Habitat Regulation under the *Endangered Species Act, 2007* is being planned to provide sufficient amount and arrangement of Woodland Caribou habitat to support self-sustaining local caribou populations. A landscape approach to habitat conservation would be used under the Habitat Regulation and broader policy and legislative tools to advance caribou conservation and recovery.

3.5

Ontario will provide for and renew caribou habitat during forest management planning by requiring the development of a "dynamic caribou habitat schedule" for each forest management plan. These schedules will be developed for and integrated across all forest management plans within continuous caribou distribution.

3.6

Decision-making will be integrated through processes that support the achievement of caribou habitat requirements. These will be achieved through forestry and other resource management planning processes, and will be consistent with the range management approach.

3.6.1

As part of the broader cumulative impact assessment approach to assessing the impacts of all resource management activities upon caribou (see 3.7), Ontario will implement an "insurance policy" to guide forest management decisions. This policy will link access to future forest tracts for harvesting to current habitat quality and availability, future habitat provision and population status at the population range level (Figure 6). The purpose of this approach is to ensure that there will always be a sufficient level of Woodland Caribou habitat, relative to natural variation, in areas where forest harvesting occurs.

Caribou Insurance Policy

The caribou habitat management approach is being strengthened to provide greater certainty for the provision of future caribou habitat in areas licensed for forest management within areas of continuous population distribution. Because caribou rely on mature and old forests, habitat management must be long-term. Deferrals (forest areas set aside from logging) will not be available for harvest until the following criteria are met:

1. **Habitat:**
   - There must be sufficient amount and arrangement of currently suitable habitat and future habitat
   - Based on silvicultural monitoring, logged areas must also be moving toward a suitable future habitat condition
2. **Caribou Population Health:**
   - The local Woodland Caribou population must be viable, based on an assessment, at the local population range level, of caribou presence, population size and trends.

These range-level assessments will be based on the best available information and conducted prior to forest management plan renewal (or changes to long-term management direction). If these criteria are not met, the deferrals will be prolonged until it can be demonstrated that there is sufficient habitat, successful habitat renewal, and a persistent caribou population. Ontario will develop guidelines to address implementation of the caribou insurance policy.

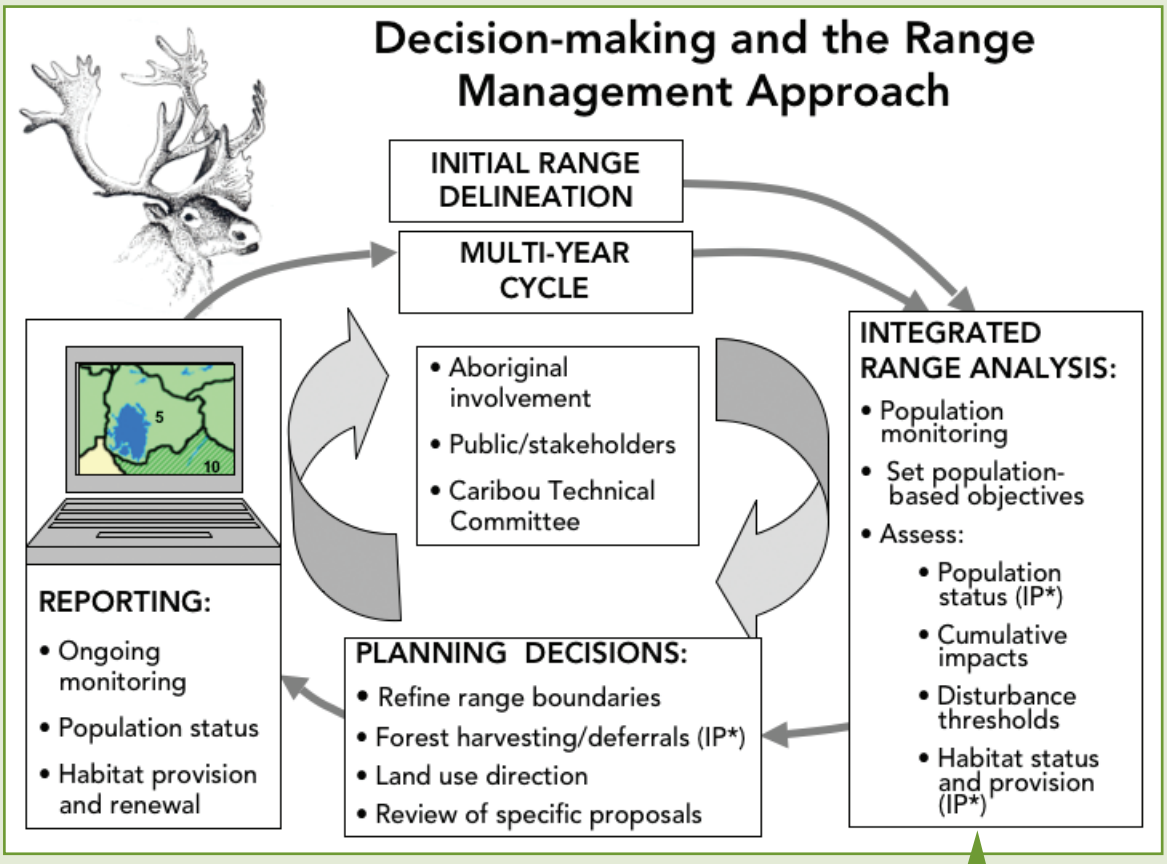
Deferrals:

- Normally constitute 70-80 per cent of the forest landbase – varies by forest management unit;
- Apply to areas licensed for forest management; and
- Current deferral areas typically are not available for harvest for 20 or more years.

Figure 6. Overview of the caribou insurance policy to support decision making in forest management.

3.6.2

The range management approach will be the key decision-making framework for caribou conservation in broader resource use and management planning decisions through the assessment of cumulative effects (Figure 7). Cumulative impact assessments will occur at both the population range level and an area of assessment centred on the proposed disturbance – Figure 7 illustrates how the cumulative effects approach is implemented through range management planning. This framework will integrate many of the key components of the *Caribou Conservation Plan* and provide the range assessments (population health status and contributing factors to any negative population trends) necessary to inform resource management decisions including the caribou "insurance policy" (3.6). The status of caribou habitat and populations at the population range level will guide decisions on resource management proposals, potential mitigation, and the need for recovery measures. If a range assessment suggests the need for additional long-term deferrals, they will be considered in the stressed range with potential opportunities to offset any associated wood supply impacts from adjacent healthier ranges that range assessments have shown can sustain additional harvest.



Integrated Range Analysis:
A Range Management Approach will evaluate range quality in terms of thresholds, probability of persistence and habitat composition and structure.
Evaluations will consider implications to caribou populations and future caribou habitat provision.

Green
- Range status meets or exceeds requirements for caribou population presence; and
- Development and forestry approvals follow established process with consideration of future implications to caribou populations.

Yellow
- Uncertain if range status sufficient to sustain caribou; and
- Development and forestry approvals may have special conditions to address future implications to caribou populations – e.g. best management practices, mitigative measures, etc.

Red
- Range status insufficient to sustain caribou;
- Development and forestry approvals must be geared towards improvements of conditions for caribou;
- Development may not be approved; and
- Land use direction may be reviewed.

*Figure 7. Demonstration of the decision-making approach to resource management applied through range management planning.**

* IP – indicates that the feature has a direct link to the insurance policy (3.6.1, Figure 6)

3.6.3

Policy will be developed to guide interpretation and implementation of strategies 3.6.1 and 3.6.2. Ontario will consider the following in developing supporting policy:

- A regular cycle will be established to conduct population monitoring and cumulative impact assessments for each population range; this will be on a different cycle from the development of Forest Management Plans;
- As population ranges may encompass several forest management units, the habitat and silvicultural criteria of the caribou insurance policy will be applied through the forest management planning process based on information for the specific forest management unit being reviewed;
- The caribou population health criteria in the caribou "insurance policy" will use the best "range level" information available at the time of FMP renewal or amendment; this assessment of population health will also consider factors other than forestry that may be affecting population health; and
- Policy to support implementation of strategy 3.6.1 will require ongoing dialogue between the ministry and forest industry on caribou habitat renewal status, identification of clear and fair science-based standards for performance, minimization of additional "red tape", reporting requirements and industry needs for investment certainty.

3.7

Ontario will develop caribou policy and planning tools to assess the implications of various resource development proposals, both individually and collectively, and assist in the evaluation of potential impacts to caribou population health and persistence.

3.7.1

Until strategic policy direction is available, major land use and development proposals within the area of caribou distribution will be assessed through a screening process. A screening tool will be developed to assess all significant development proposals within the provincial distribution of caribou, by evaluating the implications of the proposed development for caribou and identifying options for avoiding or limiting impacts on caribou.

3.7.2

Cumulative impact assessment will be central to evaluation of the status of caribou population ranges, understanding implications to caribou population health, refining the thresholds of landscape disturbance above which caribou may not survive and making informed decisions on appropriate types and levels of resource uses.

3.7.3

Ontario will develop policy to manage densities (thresholds) of roads and other linear features to support caribou persistence (e.g. maximum km of roads per 100 km^2).

3.7.4

Thresholds of human and natural disturbance will be considered in land-use planning decisions. Until research results on thresholds are established, the best available scientific information will be used.

3.8

A range assessment will be conducted and recovery actions subsequently developed for individual population ranges, using the best available science. This integrated analysis will consider trends in population health, cumulative impacts, current habitat availability, prospects for habitat renewal, disturbance and fragmentation. It will also consider current land use and resource management decisions and identify any additional required mitigation measures to provide for the long-term persistence of caribou. This could potentially include additional land use designations and decisions on areas available for harvest or development. Such decisions would include public consultation. This range assessment will ultimately provide the context for implementing the actions outlined in sections 3.5 and 3.6 and 3.7.

3.9

Ontario will work with resource sectors (e.g. forestry, mineral exploration and mining, renewable energy, tourism) and communities (e.g. with respect to major access roads) to increase awareness of the presence of caribou and related planning requirements, and the need to include appropriate caribou mitigation measures in resource development plans.

4.0 Enhance Caribou Habitat

4.1

In areas licensed for forest management within the continuous extent of caribou occurrence, Ontario will ensure that forest management practices fully consider both current and future Woodland Caribou habitat needs, reflecting natural forest conditions and dynamics.

4.1.1

Ontario will manage the quality, quantity and location of caribou habitat in the area of continuous extent of caribou occurrence. Forest management planning will use a variety of tools to provide for caribou habitat, including silviculture, scheduling of harvesting and deferrals, science-based modeling, precautionary planning in the face of natural uncertainty such as wildfire, and a requirement for caribou habitat provision objectives and a dynamic caribou habitat schedule. Direction on minimum and maximum limits for the amount and distribution of habitat will provide for an adequate supply of habitat to be available over time, based upon science-based models of the range of habitat conditions provided through natural disturbances (as being developed for the draft Forest Management Guide for Boreal Landscapes). Forest management plans will demonstrate how planning decisions provide for an uninterrupted supply of year-round caribou habitat within the limits of natural forest variability, recognizing the influence of both forest harvesting and wildfire.

4.1.2

Ontario will require the effective renewal of caribou habitat through a number of silvicultural initiatives, including:

- A caribou-based objective for silviculture to be included in all forest management plans within the geographic distribution of caribou;
- Use of the Silvicultural Effectiveness Monitoring and Independent Forest Audit programs to assess the effectiveness of forest renewal for caribou, provide recommendations for improvements, and monitor how successfully logged areas are tracking toward a suitable future habitat condition, before any long-term deferrals are made available for harvest; and
- New technical guidance for caribou habitat renewal in forest management guides.

4.1.3

Where caribou distribution is discontinuous (Figure 5), Ontario will look for opportunities through forest management planning and other land use planning to improve future connectivity between local caribou populations and isolated populations.

4.1.4

The Lake Superior coastal population will be managed for population security and persistence. The focus will be to protect and manage habitat and encourage connectivity to caribou populations to the north.

4.2

Ontario will develop caribou habitat policy so that all resource development and management activities within the geographic distribution of caribou with the potential to affect provision of caribou habitat consider the implications for Woodland Caribou and include appropriate conservation and mitigation measures.

4.2.1

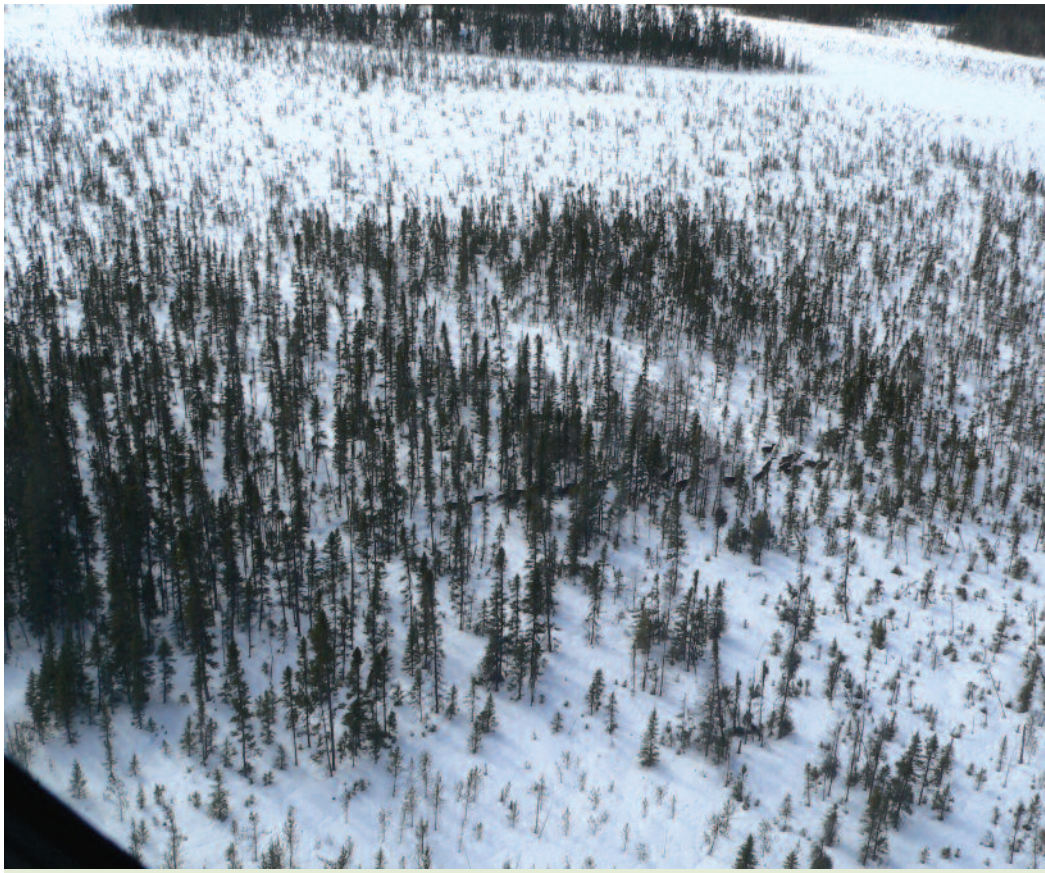
Ontario will develop policy for future primary resource access roads. This will include clear direction and standards for the decommissioning and removal of resource access roads in caribou range where necessary and feasible.

4.2.2

Caribou conservation values will be considered and incorporated where feasible into fire management strategies, planning priorities and processes to address:

- Important elements of habitat that require protection;
- The management of fire to provide future caribou habitat where feasible; and
- The role of prescribed burns in renewing future caribou habitat.

Photo: Melody Kiss



Aerial view of a group of caribou in Northern Ontario

5.0 Manage the Wildlife Community

5.1

White-tailed Deer hunting seasons are being expanded across northern Ontario to help slow deer range expansion within the area of provincial caribou distribution. Deer populations and associated parasites will be monitored to assess trends and their potential impact on caribou populations.

5.2

Ontario will document all known human-caused mortality of caribou, including road kills, poaching, rail kills, and subsistence harvest. This will help to increase knowledge about the extent and significance of all caribou mortality factors in relation to population viability.

5.3

Ontario will review the feasibility of caribou translocations (i.e. the trapping and transferring of animals within Ontario) as a caribou recovery tool for very specific situations, including an assessment of risks and the development of criteria and guidelines, if appropriate. This review will examine lessons learned from past experience in Ontario and elsewhere as well as disease transmission and regulatory considerations. Translocations have been shown to be successful at establishing caribou populations in very specific situations, such as predator-free islands.

5.4

Ontario will assess the relationship between Moose and caribou numbers in order to develop recommended objectives for maximum Moose numbers in Wildlife Management Units within continuous caribou distribution. This process will be implemented through the Moose management program by the establishment of Moose population objectives and harvest management strategies.

5.5

Within the geographic distribution of caribou, populations of predators will be managed primarily by managing habitat and the associated roads to reflect natural forest conditions. This will include the management of land and resource uses to maintain naturally-occurring low densities of prey (e.g. Moose, White-tailed Deer) and predators. Ontario will assess the feasibility and effectiveness of directly and indirectly influencing predator densities in very specific situations, and develop criteria and guidelines for managing the prey-predator balance as required.

6.0 Focus on Geographic Priority Areas

6.1

Ontario will initiate immediate recovery efforts to address the most at-risk local population ranges in the province across the southern edge of continuous caribou distribution (Figure 5) through a range of pilot recovery projects and actions. Pilot projects will include population range delineation and refinement, assessment of population health and landscape disturbance, research studies, inventorying areas requiring road decommissioning and silvicultural improvements, development of cumulative impact assessment tools, and a review of potential recovery actions such as improving landscape connectivity and the potential for caribou transfers. Criteria will be developed to prioritize recovery efforts and ensure that actions focus on the most urgent needs.

7.0 Improve Outreach and Stewardship

7.1

Ontario will provide effective ongoing communications, outreach and engagement in support of caribou conservation and recovery in Ontario.

7.2

Ontario will develop a series of publications on "*Best Management Practices in Caribou Country*" to increase awareness of caribou ecology and conservation practices, and to help mitigate some of the impacts of resource development. Topics will include:

- An explanation of how caribou habitat management is implemented within forest management plans (CCP Implementation);
- Managing cumulative effects among resource sectors in caribou country (an overview);
- Mining in caribou country;
- Renewable energy in caribou country;
- Roads and access planning in caribou country;
- Tourism and outdoor recreation in caribou country (e.g. shore lunches, campsites and boating, sustainable wildlife viewing);
- Caribou screening and decision support tools for resource users in caribou country; and
- Caribou habitat considerations in the area of discontinuous distribution.

7.3

Ontario intends to develop a "*State of the Woodland Caribou Resource Report*" by 2014 to support the review of progress towards recovery, including progress on:

- assessment of caribou populations and habitat conditions for all preliminary ranges;
- what has been learned regarding caribou reoccupancy of formerly logged habitats, including recommendations for improved management; and
- progress made towards recovery actions and commitments made in *Caribou Conservation Plan*.

7.4

Caribou recovery will be based on the best available scientific information. As caribou recovery proceeds, new information from research and monitoring and new recovery tools will become available. This information will be openly shared with the public, user groups and industry partners on an ongoing basis to foster and support caribou recovery through stewardship.

7.5

Individuals and groups involved in caribou stewardship activities will continue to be supported by government through capacity building and funding initiatives.

7.6

Ontario intends to reach out to Aboriginal communities, stakeholders and members of the public to seek additional information on caribou populations and habitat in support of caribou recovery.

7.7

Ontario will ensure ongoing communication with other ministries to better consider and incorporate caribou conservation needs in other resource development initiatives within the geographic distribution of caribou.

8.0 Integrate Aboriginal Traditional Knowledge

8.1

Ontario intends to continue to work in partnership with Aboriginal peoples to increase mutual knowledge and awareness of caribou, and to support caribou conservation through the implementation of the *Caribou Conservation Plan*. Aboriginal Traditional Knowledge will be incorporated in caribou management and research where available.

8.2

Ontario will work with Aboriginal peoples to identify and develop partnership opportunities for caribou research and recovery actions.

Source: John B. Ridley Research Library, Quetico Provincial Park

Pictograph of a caribou in Quetico Provincial Park

Moving Forward … Implementation

The *Caribou Conservation Plan* is a comprehensive multi-year plan that will apply across the provincial distribution of Woodland Caribou. Woodland Caribou recovery poses a significant conservation challenge – the boreal forest provides many important social and economic benefits, while at the same time, Woodland Caribou persistence is at risk from many of these same human uses and activities. Our decisions about boreal ecosystem management must balance the demand for northern resources, boreal forest health and the needs of Woodland Caribou.

Successful implementation of this plan requires a long-term commitment to an adaptive management approach. Adaptive management involves the ongoing scientific review and evaluation of progress on management actions, and the use of new science and management information to continually review and improve management. Ontario will apply an adaptive management approach to all elements of the *Caribou Conservation Plan* (Figure 4). Range management is the central element of the *Caribou Conservation Plan* that provides the geographical context for the adaptive management approach. It provides a context within which to develop a clear vision of a co-ordinated set of management actions that can achieve a desirable outcome for caribou. Management of local caribou populations and ranges and provincial populations will be refined as research and management activities provide new information, reflecting the adaptive management approach in action.

Climate change has long-term ecological implications for the boreal forest, including caribou persistence. A number of *Caribou Conservation Plan* recovery measures will help Ontario anticipate and respond to some potential future effects of climate change. These include:

- Implementation of integrated management strategies for all members of the deer family that occur in the same area (e.g. 5.1, 5.4). Ontario will respond to changes in cervid populations as caribou are affected by changes in climate;
- Managing the forest landscape within the range of natural variation to emulate natural habitat conditions into the future (4.1.1); and
- Proactive management of forest fires and forest fuels to help maintain older forest habitat and address anticipated more extreme and more frequent storm events (4.2.2).

Due to the comprehensive nature of the *Caribou Conservation Plan*, not all recovery actions will be funded and implemented simultaneously. Implementation will initially focus on the highest priority actions and areas for recovery, building upon these actions in subsequent years. Several initiatives will focus on preliminary local population ranges along the southern edge of continuous distribution (Figure 5) where the tools and techniques will be developed, refined, tested and demonstrated for broader application. A number of other aspects of the *Caribou Conservation Plan* (e.g. research, habitat management, population management, planning, and outreach and communication initiatives) will be implemented over time and on a broader scale. Ontario will develop an implementation plan to help guide priorities for various recovery actions.

This plan will include tools, policies and management approaches that will require further development prior to implementation.

Ontario will work closely with the forest industry to direct the immediate review of all forest management plans (current and in preparation) including the identification of a schedule for revisions and amendments. This will address the adjustments needed to ensure these plans meet commitments for silviculture, dynamic caribou habitat schedule, habitat and road management consistent with direction in the *Caribou Conservation Plan*, as well as the identification and development of key training messages for forest management planning teams. This will result in a Forest Management Plan adjustment schedule.

Ontario intends to continue to work in partnership with Aboriginal peoples, resource industries and other stakeholders to support implementation of the *Caribou Conservation Plan* over time. This will be a long-term commitment. Implementation of some actions may also require further consultation, such as the posting of specific regulation and policy proposals on the Environmental Registry.

Some of the key progress benchmarks for implementation of this plan are identified in Table 1. Specific times and sequencing may be adjusted as a more comprehensive implementation plan is completed, depending upon the availability of resources, staff and expertise.

Table 1. Preliminary Priorities for Implementing the *Caribou Conservation Plan* in the First Five Years

Timing	Key Benchmarks
6 months	■ Initial cumulative effects assessment for all preliminary population ranges. ■ The MNR will work closely with the forest industry to direct the immediate review of all forest management plans (current and in preparation) including the identification of a schedule for revisions and amendments. This will address the adjustments needed to ensure these plans meet commitments for silviculture, dynamic caribou habitat schedule, habitat and road management consistent with direction in the *Caribou Conservation Plan*, as well as the identification and development of key training messages for forest management planning teams. This will result in a Forest Management Plan adjustment schedule. ■ Documentation of preliminary population ranges and delineation criteria. ■ Finalize *Caribou Conservation Plan* implementation plan. ■ Development of preliminary screening tool to assess resource development proposals. ■ Establishment and implementation of Provincial Caribou Technical Committee.

1 year	■ Development and distribution of Best Management Practices related to: i) managing cumulative impacts among resource management sectors, and ii) caribou-management requirements within forest management plans.
	■ Draft range management policy.
	■ Incorporation and implementation of caribou habitat management direction in the Forest Management Guide for Boreal Landscapes.
	■ Development of initial dynamic caribou habitat schedules for all forest management units in continuous caribou distribution, and comparisons with existing management direction.
	■ Policy and technical guidance on disturbance thresholds analysis for Ontario.
	■ Provincial caribou monitoring plan, including protocols and standards.
	■ Technical document to provide rationale and support for range management implementation.
	■ Full operationalization of the provincial Woodland Caribou database.
	■ Interim policy interpretation and decision-making criteria associated with:
	  ■ implementation of caribou “insurance policy”;
	  ■ habitat renewal;
	  ■ road densities;
	  ■ road decommissioning; and
	  ■ caribou screening tool.

Timing	Key Benchmarks
3 years	■ Revised caribou habitat management direction for forest management planning. ■ Amendment of Crown Land Use Policy Atlas to reflect caribou presence and considerations. ■ Dynamic caribou habitat schedules developed, integrated and implemented across all of continuous caribou distribution. ■ Preliminary evaluation of coastal population linkage options to connect discontinuous and continuous range. ■ Identification of preliminary population ranges for all Far North ranges. ■ Plan in place for monitoring, assessment and reporting of human-caused mortality of caribou.

5 years	■ "*State of the Woodland Caribou Resource Report*" to support the review of progress towards recovery, including progress on:
	  ■ population assessment for all preliminary ranges;
	  ■ what has been learned regarding caribou reoccupancy of formerly logged habitats, including recommendations for improved management; and
	  ■ progress made towards recovery actions and commitments made in *Caribou Conservation Plan*.
	■ Preliminary population assessment complete for all preliminary ranges at southern extent of continuous caribou distribution (e.g. range occupancy, population viability).
	■ Formal review of preliminary population ranges (southern distribution).
	■ Policy direction on the amount and arrangement of caribou habitat reviewed and amended if necessary.

For More Information

The Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*) (Forest-dwelling, Boreal Population) in Ontario (2008). http://www.mnr.gov.on.ca/251755.pdf

The Report of the Ontario Woodland Caribou Science Review Panel: The Path Forward (2008). http://www.mnr.gov.on.ca/251753.pdf

The Caribou Discussion Paper Keeping Caribou in Ontario (2008). http://www.mnr.gov.on.ca/251715.pdf

Report on the Status of Woodland Caribou in Ontario (1999). Available through the MNR Species at Risk Manager, and Northwest and Northeast MNR offices - http://www.mnr.gov.on.ca/en/ContactUs/2ColumnSubPage/STEL02_179002.html

COSEWIC Assessment and Update Status Report on the Woodland Caribou Rangifer tarandus caribou in Canada (2002). http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr_woodland_caribou_e.pdf

Photo: Tim Timmermann

Female caribou nursing calf

Glossary of Terms

Adaptive Management – Monitoring the implementation of policy, practices and procedures through the use of scientific methods of investigation in order to assess policy effectiveness and adjust management approaches[3].

Cervid – a member of the deer family Cervidae; in Ontario native species consist of American Elk, Moose, White-tailed Deer and Woodland Caribou.

Connectivity – A qualitative term describing the degree to which mature and late successional ecosystems are linked to one another to form an interconnected network. The degree of interconnectedness and the characteristics of the linkages vary in natural landscapes based on topography and natural disturbance regime and influence the ability of caribou to move across the landscape for the purpose of breeding or habitat selection. Separation of these linkages results in forest fragmentation and reduced connectivity.[4]

Continuous Distribution – Area of Ontario occupied by Woodland Caribou, where individuals and local populations freely intermingle and mix, and where there are no geographic or human-caused barriers preventing the genetic interchange of populations.

Cumulative Effects – The additive influence of individual habitat disturbances that, when combined together, cause significant change to landscape-level ecological functions for caribou habitat, and/or to the probability of caribou living or persisting in a particular geographic area.

Deferral – Forest areas that form part of the managed landbase in licensed forest management units that are set aside from logging, typically for 20 years or more, as part of a dynamic caribou habitat schedule that plans and provides for an adequate amount of arrangement of habitat.

Decommissioning (Roads) – For roads or road networks where the management intent is to not maintain the road for public use, the physical work that will be undertaken to render the road impassable to vehicular traffic, enhance public safety and reduce potential environmental damage (e.g., removal of water crossings. The roadway will degenerate over time. Active preparation and planting or seeding of the roadbed may also be required for caribou conservation purposes.[5]

Discontinuous Distribution – Area of Ontario occupied by Woodland Caribou, where caribou exist in isolated populations, where individuals and local populations do not freely intermingle and mix, and where there are geographic or human-caused barriers preventing the genetic interchange of populations.

Distribution – see Extent of Occurrence.

Dynamic Caribou Habitat Plan Schedule – A long-term plan for the provision of sustainable year-round caribou habitat in very large interconnected habitat tracts, that is implemented through long-term strategies and operational plans for roads, forest harvesting and forest renewal within acceptable limits of habitat supply and population persistence.

Endangered Species – A species that lives in the wild in Ontario but is facing imminent extinction or extirpation.[6]

Extent of Occurrence – For Ontario, the defined area that encompasses the geographic distribution of all known populations of caribou, based on provincial and territorial distribution maps developed from observation and telemetry data, local knowledge and biophysical analyses.[7] This includes areas of both continuous and discontinuous distribution.

3. Adapted from Landscape Ecology and Adaptive Management. J.A. Baker. IN Ecology of a Managed Terrestrial Landscape: Patterns and Processes. A.H.Perera, D.L. Euler and I.D. Thompson Editors. UBC Press, Vancouver and Toronto
4. Adapted from B.C. Forest Practices Code Biodiversity Handbook 1995 - http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/biodiv/biotoc.htm.
5. Adapted from Ontario Ministry of Natural Resources *Forest Manual Planning Manual*, 2009
6. *Endangered Species Act,* 2007

Forest-dwelling Woodland Caribou – An ecological type of Woodland Caribou based upon habitat use and seasonal migratory behaviour. They live year-round in the boreal forest, typically migrate less than 100 km annually between winter and summer ranges (although there is significant variation), and have their calves singly in isolated locations. Designated as "Threatened" in Ontario.

Forest-tundra Woodland Caribou – An ecological type of Woodland Caribou based upon habitat use and seasonal migratory behaviour. They live in the far north of the province, travel in larger herds, spend the winters in the northern boreal forest and taiga and migrate long distances out to the tundra of the Hudson Bay Lowlands to have their calves, forming large groups of cows and calves. Designated as "Not at Risk" in Ontario.

Government Response Statement (GRS)/Response to a Recovery Strategy – A statement published by the Minister that summarizes the actions the Ontario government intends to take in response to the recommendations in a recovery strategy and their priorities. This needs to be done within nine months after a recovery strategy has been published.

Habitat – The suite of resources (food, shelter) and environmental conditions (abiotic variables such as temperature, and biotic variables such as competitors and predators) that determine the presence, survival, and reproduction of a population.[7]

Habitat Tracts – Patterns of landforms, vegetation composition, forest age class, and associated caribou use information which are mapped at scales meaningful to the way caribou use the landscape, and reflecting land forms, soils and disturbance regime patterns.

Home Range – The area traveled by an individual animal throughout its annual life cycle, as defined by seasonal movements and occupancy (e.g. summer home range, winter habitat, calving habitat).

Linear Feature – Any long, narrow area that has been cleared of vegetation or otherwise modified by people. Examples such as a road, trail, seismic line or right of way are modifications to the landscape that are typically placed to provide access of one form or another. Features can range in length and width, but all are considered a corridor of some sort.[4]

Local Population – A group of boreal caribou occupying a defined range, defined based upon some knowledge of movements, landscape ecology and physiography. This is the basic unit of conservation and management for Woodland Caribou recovery planning.[8]

Local Population Range – A broad geographical area used and/or required for a self-sustaining local population of Woodland Caribou that provides both present and future habitat needs.[8]

Migration – Seasonal movements of animals between winter and non-winter habitats.

Mitigation – A means of reducing the significance of adverse effects mitigation is "the elimination, reduction or control of the adverse environmental effects of the project, and includes restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means".[9]

Not at Risk – A species whose status has been assessed and determined to not be at risk.

7. Adapted from Scientific Review for the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada (2009) - http://www.sararegistry.gc.ca/document/default_e.cfm?documentID=1761
8. Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*) (Forest-dwelling, Boreal Population) in Ontario (2008) - http://www.mnr.gov.on.ca/251755.pdf
9. Cumulative Effects Assessment Practitioners' Guide Appendix A Glossary, Canadian Environmental Assessment Agency - http://www.ceaa.gc.ca/013/0001/0004/a_e.htm

Photo: Ted Armstrong

Caribou feeding near shoreline

Persistence – The survival of a population expressed as a given probability or likelihood over a specified time frame. The likelihood of not achieving specified persistence levels is a measure of extinction risk.[7]

Precautionary Principle – A philosophy or planning approach based on the premise that "where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat." [6]

Range Management – Recovery actions taken within a local population range to maintain and/or enhance the persistence of a local population of caribou.

Recovery – "The restoration of a species to self-sustaining population level, able to withstand random events and other environmental variables. Thus implies that human activities can be managed and/or habitat restored to allow a species to exist with no or little direct management."[10]

Recovery Strategy – a recovery strategy is a document prepared by species experts that outlines the long-term goals and short-term objectives for recovering a threatened, endangered or extirpated species, based on the best available scientific information. Recovery strategies must be prepared within one year of listing for endangered species and within two years of listing for threatened species. In Ontario, recovery strategies are considered advice to government.

Self-sustaining – A wildlife population that is able to sustain itself naturally in a healthy condition without external intervention or support.

Silviculture – The scientific, creative, and practical use of silvics at the site level to control vegetative species establishment, composition, growth, and stand structure.[11]

Stewardship – An ethic by which citizens care for our air, land and water as parts of a natural life-support system and collectively act to sustain and enhance it for generations to come.[12]

Threatened Species – A species that lives in the wild in Ontario, is not endangered, but is likely to become endangered if steps are not taken to address factors leading to its extinction or extirpation.[6]

10. Public Discussion Draft Action Plan Boreal Woodland Caribou Conservation in the Northwest Territories 2009-2014 - http://www.nwtwildlife.com/pdf/Caribou%20Action%20Plan_public%20discussion%20draft.pdf
11. Adapted from The Practice of Silviculture: Applied Forest Ecology. D.M. Smith, B.C. Larson, M.J. Kelty and P.M.S. Aston, 1997. John Wiley and Sons Inc., New York
12. Stewardship Strategy for Ontario – Collaboration of Organizations (2007) - http://www.stewardshipcentre.on.ca/index.php/about_sno_0e2ea

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For copies of the recovery strategy, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk Public Registry (www.sararegistry.gc.ca).

Cover photo: © John A. Nagy

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Note: The Woodland Caribou, Boreal population is referred to as "boreal caribou" in this document.

PREFACE

The federal, provincial, and territorial government signatories under the *Accord for the Protection of Species at Risk* agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (SARA), the federal competent ministers are responsible for the preparation of recovery strategies for listed extirpated, endangered, and threatened species and are required to report on progress every five years. The Minister of the Environment is the competent minister for this recovery strategy.

Environment Canada's Canadian Wildlife Service led the development of this recovery strategy. Seven provinces, two territories, one Aboriginal government, four wildlife management boards and the Parks Canada Agency contributed information for this recovery strategy. Additional effort was made by Environment Canada to engage Aboriginal communities that the minister considered directly affected by the recovery strategy. These efforts included two rounds of engagement, one before and the second one after the proposed recovery strategy was posted on the Species at Risk Public Registry, to gather information on boreal caribou and to provide communities with an opportunity to comment on the proposed recovery strategy. In the first round, 271 Aboriginal communities were contacted and 161 engaged, and in the second round, 265 Aboriginal communities were contacted and 87 engaged. In addition, 25 formal submissions were received from Aboriginal communities and organizations.

Following the posting of the proposed recovery strategy on August 26, 2011, the standard 60-day public comment period was extended by 120 days to February 22, 2012 as a result of Environment Canada's desire to consult Aboriginal communities prior to finalizing the recovery strategy. The high level of interest in boreal caribou resulted in the submission of 19,046 comments during and subsequent to the public comment period. The majority of these were received as copies of form letters initiated by environmental group's campaigns. A total of 192 more detailed and/or technical submissions were received from governments, wildlife management boards, Aboriginal communities and organizations, industry stakeholders, environmental organizations and academia.

Landscape level planning will be essential for the recovery of boreal caribou. Provinces and territories have the primary responsibility for management of lands, natural resources and wildlife within boreal caribou ranges, however this responsibility does vary in some parts of the country. In the Northwest Territories, for example, Aboriginal Affairs and Northern Development Canada has the primary role in land and natural resources management, as the manager of federal Crown lands. Success in the recovery of this species depends on the commitment, collaboration and cooperation of many different constituencies that will be involved in implementing the broad strategies and general approaches set out in this recovery strategy and will not be achieved by Environment Canada, or any other jurisdiction, alone. All Canadians are invited to come together to support and implement this strategy for the benefit of boreal caribou and Canadian society as a whole.

This recovery strategy will be followed by range plans and action plans that will provide information on measures that will be taken by provinces and territories, Environment Canada, other federal departments, wildlife management boards, Aboriginal communities, stakeholders,

and other organizations, to achieve the survival and recovery of boreal caribou. Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

ACKNOWLEDGEMENTS

Environment Canada would like to express its gratitude to the Aboriginal people who shared their knowledge about boreal caribou in support of the recovery of this species. Knowledge was shared by Aboriginal Traditional Knowledge holders and Aboriginal communities on boreal caribou life history, habitat use, population status, threats facing the species and conservation measures, and this information has been used in the development of this recovery strategy (see Appendices B and C). Aboriginal people consistently indicated that conservation of boreal caribou is essential, as this species is integral to the culture, identity and survival of their communities. The Aboriginal Traditional Knowledge that was shared may also be used to support the development of range plans and/or action plans for boreal caribou, where consent for such use is granted. Environment Canada appreciates that so many Aboriginal people were willing to share their knowledge and experiences to help in the recovery of this species.

Gratitude is also extended to federal, provincial and territorial jurisdictions, the Tłı̨chǫ government, and wildlife management boards with management responsibility for boreal caribou, for generously sharing information and providing expertise to develop this recovery strategy. The Boreal Caribou Working Group, comprised of Environment Canada staff from across Canada, contributed extensively by working with Canadians to gather information and support processes to collect Aboriginal Traditional Knowledge used to inform the development of this recovery strategy, and by compiling material and drafting the recovery strategy. Appreciation is extended to Environment Canada's Wildlife and Landscape Science Directorate, the boreal caribou Science Management Committee and boreal caribou science advisors, for their extensive efforts and contribution to the recovery strategy through the provision of the 2008 "Scientific Review for the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada", and the "Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada, 2011 Update". Acknowledgement and thanks are given to all other parties that provided advice and input used in the development of this recovery strategy, including the Species at Risk Advisory Committee (SARAC), various Aboriginal organizations, industry stakeholders, non-government organizations and academia.

EXECUTIVE SUMMARY

This recovery strategy is for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population herein referred to as "boreal caribou", assessed in May 2002 as threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Boreal caribou are distributed across Canada, occurring in seven provinces and two territories and extending from the northeast corner of Yukon east to Labrador and south to Lake Superior.

Boreal caribou are distributed broadly throughout the boreal forest. They require large areas comprised of continuous tracts of undisturbed habitat rich in mature to old-growth coniferous forest, lichens, muskegs, peat lands, and upland or hilly areas. Large areas with suitable quality habitat allow boreal caribou to disperse across the landscape when conditions are unfavorable (e.g. natural fire disturbance, anthropogenic disturbance) and to maintain low population densities to reduce their risk of predation.

The geographic area occupied by a group of boreal caribou that are subject to similar factors affecting their demography and used to satisfy their life history processes (e.g. calving, rutting, wintering) over a defined time frame is referred to as a range. There are 51 boreal caribou ranges in Canada. Information available to delineate boreal caribou ranges varies in certainty and therefore ranges are categorized into three types: conservation units, improved conservation units and local population units. In this recovery strategy, the group of boreal caribou occupying any of the three types of ranges is referred to as a "local population" of boreal caribou.

Due to the specific life history characteristics they possess, boreal caribou are limited in their potential to recover from rapid, severe population declines. Habitat alteration (i.e. habitat loss, degradation, and fragmentation) from both anthropogenic and natural sources, and increased predation as a result of habitat alteration have led to local population declines throughout their distribution. Some local populations of boreal caribou are at risk because of other factors, mainly over-harvest. Threats are closely interrelated and act cumulatively to have direct or indirect impacts on boreal caribou and their habitat. Recovery of all boreal caribou local populations across Canada is technically and biologically feasible.

The recovery goal for boreal caribou is to achieve self-sustaining local populations in all boreal caribou ranges throughout their current distribution in Canada, to the extent possible. Achieving the recovery goal would allow for local population levels sufficient to sustain traditional Aboriginal harvesting activities, consistent with existing Aboriginal and treaty rights of Aboriginal peoples of Canada. Ranges that are highly disturbed will take decades to recover from habitat alteration, as boreal caribou occur in mature boreal forest ecosystems that have evolved over centuries. Achieving this recovery goal for all local populations will take a number of decades.

To guide recovery efforts, the population and distribution objectives for boreal caribou across their distribution in Canada are, to the extent possible, to:

- Maintain the current status of the 14 existing self-sustaining local populations; and,
- Stabilize and achieve self-sustaining status for the 37 not self-sustaining local populations.

Performance indicators are identified as a means by which progress towards achieving the population and distribution objectives can be measured.

The critical habitat necessary to achieve the population and distribution objectives for the recovery and survival of boreal caribou is partially identified in this strategy. Critical habitat for boreal caribou is identified as: i) the area within the boundary of each boreal caribou range that provides an overall ecological condition that will allow for an ongoing recruitment and retirement cycle of habitat, which maintains a perpetual state of a minimum of 65% of the area as undisturbed habitat; and ii) biophysical attributes required by boreal caribou to carry out life processes.

Critical habitat for boreal caribou is identified for all boreal caribou ranges, except for northern Saskatchewan's Boreal Shield range (SK1), as additional information described in the schedule of studies is required.

This recovery strategy identifies 65% undisturbed habitat in a range as the disturbance management threshold, which provides a measurable probability (60%) for a local population to be self-sustaining. This threshold is considered a minimum threshold because at 65% undisturbed habitat there remains a significant risk (40%) that local populations will not be self-sustaining.

The recovery of boreal caribou requires actions that will vary according to both the habitat and population conditions within each boreal caribou range. This recovery strategy provides broad strategies and general approaches to achieve the population and distribution objectives, which will assist in the development of subsequent range plans and action plans. The suite of actions needed to maintain or recover the self-sustaining status of a boreal caribou local population will be determined and managed by the responsible jurisdictions in collaboration with Environment Canada, and consistent with this recovery strategy. The recovery actions most appropriate for a specific range will be governed by local opportunities and constraints, and the level of urgency for a given recovery action will be determined by both the population and habitat conditions within the range.

To guide the protection of critical habitat and the recovery of boreal caribou, range plans and/or action plans will be prepared following this recovery strategy. These plans will provide detailed information on recovery measures that will be implemented by provinces and territories, Environment Canada, other federal departments, wildlife management boards, Aboriginal communities, stakeholders, and other organizations involved in the conservation, survival and recovery of boreal caribou. Success in recovering boreal caribou will depend on the commitment, collaboration and cooperation among all interested parties.

RECOVERY FEASIBILITY SUMMARY

Recovery of boreal caribou is considered to be both technically and biologically feasible across the species' distribution in Canada based on the following four criteria outlined in the draft SARA Policies (Government of Canada, 2009).

Current evidence supports the conclusion that the recovery of all local populations is biologically and technically feasible. However, small local populations, and particularly those isolated from the core distribution of the national boreal caribou population, are at greater risk of not becoming self-sustaining. In these situations, a local population may have greater difficulty withstanding stochastic events, and may not experience enough immigration to maintain genetic diversity and therefore will be at greater risk of not persisting in the long-term. There may be other situations where recovery of a particular local population proves to be, over time and through unforeseen circumstances, not biologically or technically feasible and, as such, may affect the likelihood of achieving the population and distribution objectives.

1. Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance.
Yes. According to current best estimates, there are approximately 34,000 (see Section 3.2.2) boreal caribou across nine provinces and territories in Canada capable of successful reproduction and available to improve local population growth rates and abundance to achieve self-sustainability (Environment Canada, 2011b).

2. Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.
Yes. Some boreal caribou local populations have sufficient suitable habitat within their ranges. For other boreal caribou local populations where sufficient suitable habitat is currently unavailable to support local populations at a self-sustaining level, sufficient habitat could be made available through habitat management or restoration.

3. The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated.
Yes. The primary threat to most boreal caribou local populations is unnaturally high predation rates as a result of human-caused and natural habitat loss, degradation, and fragmentation. These habitat alterations support conditions that favour higher alternate prey densities (e.g. moose (*Alces alces)*, deer (*Odocoileus* spp.)), resulting in increased predator populations (e.g. wolf (*Canis lupus*), bear (*Ursus spp.*)) that in turn increase the risk of predation to boreal caribou. This threat can be mitigated through coordinated land and/or resource planning, and habitat restoration and management, in conjunction with predator and alternate prey management where local population conditions warrant such action. In some ranges, over-exploitation through hunting can also be an issue. This threat can be avoided or mitigated through regulations and stewardship.

4. Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.
Yes. Recovery techniques (e.g. protection and management of boreal forest habitat, habitat restoration, predator and alternate prey management, hunting regulations, stewardship initiatives)

are available to achieve the population and distribution objectives for boreal caribou, although there is uncertainty with regard to the effectiveness of some of these techniques, as they have not yet undergone a sufficiently long trial period.

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1 COSEWIC SPECIES ASSESSMENT INFORMATION[1]

Date of Assessment: May 2002

Common Name (population): Woodland Caribou (Boreal population)

Scientific Name: *Rangifer tarandus caribou*

COSEWIC Status: Threatened

Reason for Designation: A widespread population ranging across the boreal forests of northern Canada. Populations have decreased throughout most of the range. Threatened from habitat loss and increased predation, the latter possibly facilitated by human activities.

Canadian Occurrence: Northwest Territories (extending into Yukon), British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Newfoundland and Labrador.

COSEWIC Status History: The Boreal population was designated threatened in May 2000. Status re-examined and confirmed in May 2002.

2 SPECIES STATUS INFORMATION

This recovery strategy is for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, herein referred to as "boreal caribou". Boreal caribou are listed as threatened under Canada's *Species at Risk Act* (SARA), based on an observed, estimated, inferred or suspected reduction in population size of > 30% over three caribou generations (approximately 20 years). Boreal caribou have been provincially/territorially ranked in some jurisdictions (see Table 1). Boreal caribou have not been ranked globally by NatureServe.

Table 1. Canadian status and provincial/territorial designations for boreal caribou.

Canadian Status	Provincial/Territorial Designation
SARA – Schedule 1 (Threatened)	NT – Not Listed YT – Not Listed BC – Red Listed (Threatened – Endangered) AB – Threatened SK – Not Listed MB – Threatened ON – Threatened QC – Vulnerable (Special Concern – Threatened) NL – Threatened

[1] At the November 2011 Wildlife Species Assessment Meeting, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) voted to adopt 12 designatable units (DUs) for Caribou (*Rangifer tarandus*) in Canada. The report *Designatable Units for Caribou* (*Rangifer tarandus*) *in Canada* is available by contacting the COSEWIC Secretariat (cosewic/cosepac@ec.gc.ca). COSEWIC will begin the process of assessing all DUs in 2012.

3 SPECIES INFORMATION

There are four existing subspecies of caribou in Canada including the Peary Caribou (*Rangifer tarandus pearyi*), Barren-ground Caribou (*R. t. groenlandicus*), Grant's Caribou (*R. t. granti*), and Woodland Caribou (*R. t. caribou*) (Banfield, 1974). A fifth subspecies, the Dawson's Caribou (*R. t. dawsoni*), which occurred in Haida Gwaii (i.e. Queen Charlotte Islands, BC) is extinct. Each subspecies displays differences in morphology, behaviour, and areas of geographic occurrence. Based on the classification system used by COSEWIC in its 2002 assessment, there are six geographically distinct populations of the forest-dwelling Woodland Caribou: Northern Mountain population (special concern), Southern Mountain population (threatened), Boreal population (threatened), Forest-tundra population (not assessed), Atlantic-Gaspésie population (endangered), and the insular Newfoundland population (not at risk).

Boreal caribou are endemic to Canada, and are distributed across nine provinces and territories, including British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Newfoundland and Labrador, Northwest Territories, and Yukon (see Figure 1).

3.1 Species Description

Like all Woodland Caribou, boreal caribou are a medium-sized (1.0-1.2 m shoulder height and weighing 110-210 kg) member of the deer family (*Cervidae*) (Thomas and Gray, 2002). Adults have a dark brown coat with a creamy white neck, mane, shoulder stripe, underbelly, underside of the tail, and patch above each hoof (Banfield, 1974; Boreal Caribou ATK Reports, 2010-2011). A distinctive characteristic of all caribou is large crescent-shaped hooves that provide flotation in snow and soft ground (e.g. peat lands), and assist in digging through snow to forage on lichens and other ground vegetation (Thomas and Gray, 2002). Antlers of boreal caribou are flattened, compact, and relatively dense. As a unique feature among the deer family, both male and female boreal caribou have antlers during part of the year, although some females may have only one antler or no antlers at all (Thomas and Gray, 2002; Boreal Caribou ATK Reports, 2010-2011). In comparison to Barren-ground Caribou, boreal caribou antlers are thicker and broader, and their legs and heads are longer.

3.2 Population and Distribution

Boreal caribou are forest-dwelling, sedentary caribou that occur only in Canada and are distributed broadly across the boreal forest (Thomas and Gray, 2002; Festa-Bianchet, 2011). The Canadian distribution of boreal caribou stretches from the northeast corner of Yukon east to Labrador, and extends as far south as Lake Superior (see Figure 1) (Environment Canada, 2008; Environment Canada, 2011b). Across Canada, the southern limit of boreal caribou distribution has progressively receded northward since the early 1900s (see Figure 1), a trend that continues today (Thomas and Gray, 2002; Schaefer, 2003; Festa-Bianchet et al., 2011). Aboriginal Traditional Knowledge indicates that boreal caribou have moved northward as a result of habitat loss in the south (Boreal Caribou ATK Reports, 2010-2011).

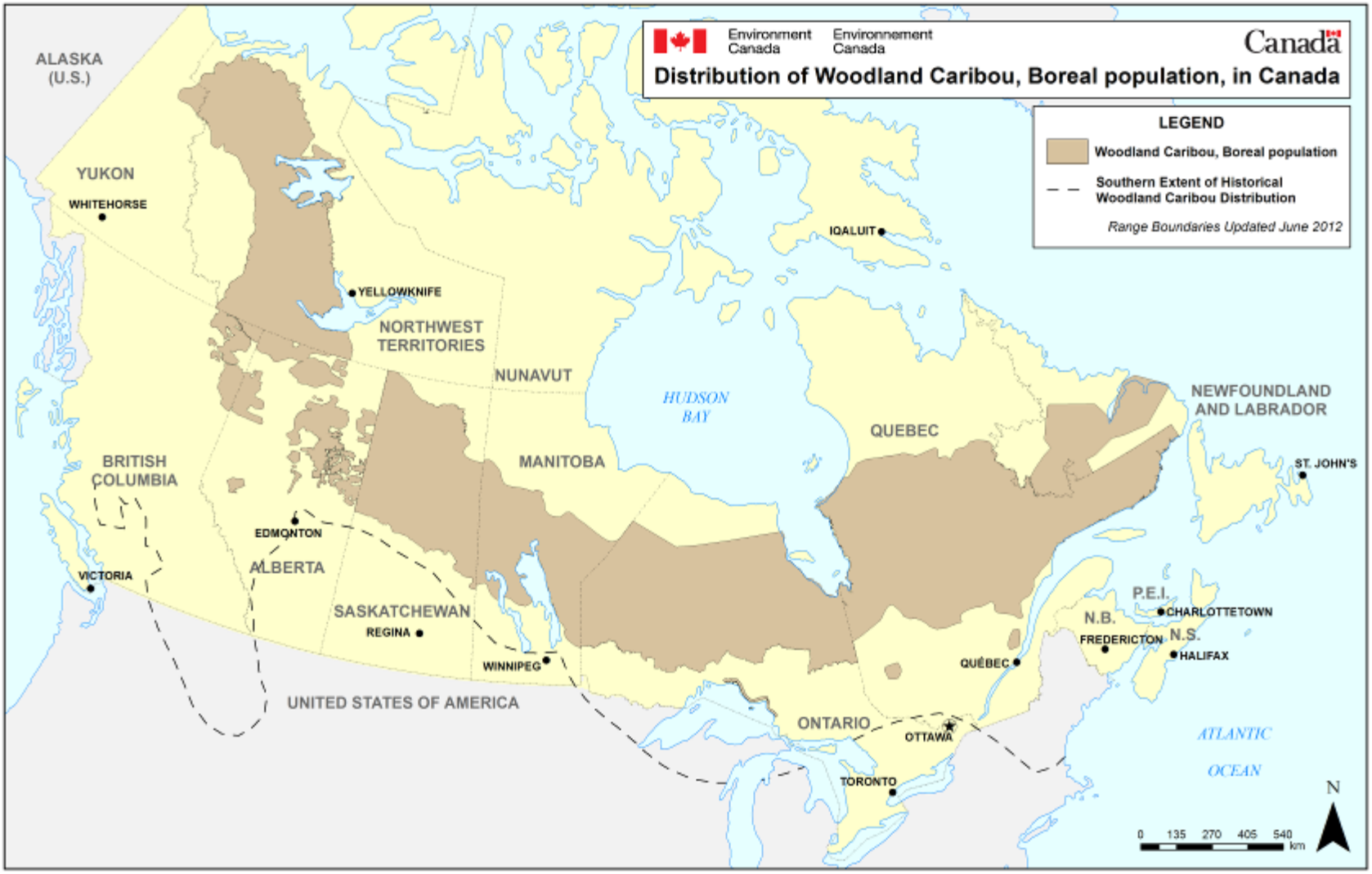

Figure 1. Distribution (i.e. extent of occurrence) of boreal caribou in Canada. The current distribution of boreal caribou is shown in brown. The estimated southern extent of historical Woodland Caribou distribution is indicated by the dashed line.

3.2.1 Boreal Caribou Ranges

The geographic area occupied by a group of boreal caribou that are subject to similar factors affecting their demography and used to satisfy their life history processes (e.g. calving, rutting, wintering) over a defined time frame is referred to as a range (Environment Canada, 2011b). Boreal caribou are distributed across 51 ranges (see Figure 2 and Table 2) based on the best available information provided by the provincial and territorial jurisdictions, including observational and telemetry data, and biophysical analyses (Environment Canada, 2011b).

In this recovery strategy, "local population" refers to a group of boreal caribou occupying any of the three types of boreal caribou ranges (conservation unit, improved conservation unit, local population unit).

Environment Canada (2011b) identified three types of boreal caribou ranges, categorized based on the degree of certainty in the delineated boundaries. Eight ranges have been identified as "conservation units" (low certainty), 20 ranges as "improved conservation units" (medium certainty), and 23 ranges as "local population units" (high certainty) (see Appendix F). It is anticipated there will be changes to conservation units and improved conservation units as more information becomes available. In this recovery strategy, "local population" refers to a group of boreal caribou occupying any of the three types of boreal caribou ranges (conservation unit, improved conservation unit, local population unit).

As a result of limited information on many of the ranges in Canada, only three transboundary ranges (a range that extends across a provincial or territorial boundary) have been defined: Northwest Territories range (NT1), Chinchaga range (AB1), and Lac Joseph range (NL1). As new and more refined information is continually being collected by jurisdictions, range delineation and population demographic information will be updated and may result in revisions to range boundaries and possibly more transboundary ranges.

Ranges can and do vary greatly in size; some cover very large areas (e.g. Northwest Territories range (NT1): 44,166,546 ha), whereas others are much smaller (e.g. Charlevoix range (QC2): 312,803 ha). Whether a range can support a self-sustaining local population is a function of both the amount and quality of habitat available for boreal caribou.

Of the 51 boreal caribou local populations, 14 are "self-sustaining", 26 are "not self-sustaining", 10 are "as likely as not self-sustaining", and one is "unknown", based on Environment Canada's (2011b) methodology and updated data from provincial and territorial jurisdictions (see Figure 3 and Appendix F). In the population and distribution objectives, "not self-sustaining" local populations refers to both the local populations assessed as "as likely as not self-sustaining" and those assessed as "not self-sustaining". The high fire in combination with very low anthropogenic disturbance estimates for northern Saskatchewan's Boreal Shield range (SK1) represent a unique situation that falls outside the range of variability observed in the data that informed the disturbance model used by Environment Canada (2011b) as a component of the integrated risk assessment framework. The probability of self-sustainability is reported as "unknown" due to the uniqueness of the disturbance regime and the uncertainty about the status of the population. Nevertheless, the high fire (55%) observed for northern Saskatchewan's Boreal Shield range (SK1) warrants caution with respect to additional anthropogenic disturbance. See detailed explanation in Appendix F.

The assessment of the likelihood of self-sustainability may change when ranges that cross jurisdictional boundaries are combined. Range boundaries and integrated risk assessments will be updated annually based on new or more refined evidence provided by the provincial and territorial jurisdictions.

In some cases, there are discrepancies between the range boundaries as presented in Figure 2, which were based on information provided by provincial and territorial jurisdictions, and the information that was provided by Aboriginal Traditional Knowledge holders. These will be addressed in range plans and/or action plans (see Sections 7.4 and 9) where provinces and territories, Aboriginal communities, and other people with knowledge of a particular boreal caribou range can work together to ensure range boundaries are based on the best available information.

Boreal caribou use of a range may change over time as a result of variation in ecological conditions (e.g. vegetation change as a result of natural disturbances, predator/prey dynamics) and patterns of human disturbance (e.g. industrial development) affecting the landscape. Variation in habitat conditions, resource availability, and the amount and arrangement of disturbance on the landscape, influences patterns of boreal caribou range use that result in either: a) a discrete range, where boreal caribou occupy a clearly defined area with little exchange with other ranges (e.g. Coastal range (ON6), Charlevoix range (QC2)); or b) a continuous range where boreal caribou are dispersed over a large area and may move more freely and over greater distances within the area characterized by common biophysical attributes (e.g. Northwest Territories range (NT1)).

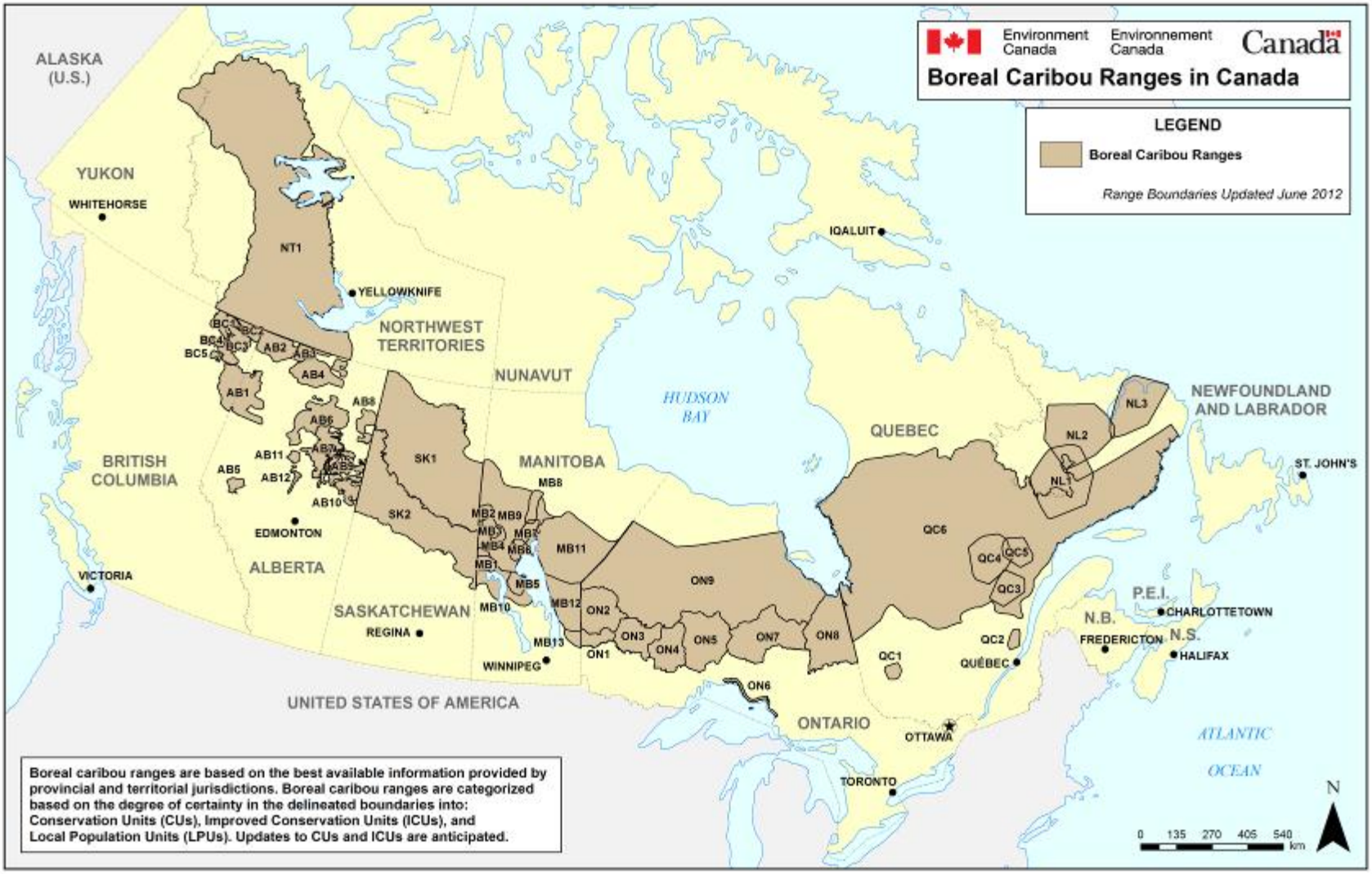

Figure 2. Geographic distribution of the 51 known ranges of boreal caribou in Canada.

Table 2. Range identification and range names for the 51 known ranges of boreal caribou in Canada.

Range ID	Range Name
NT1	Northwest Territories
BC1	Maxhamish
BC2	Calendar
BC3	Snake-Sahtahneh
BC4	Parker
BC5	Prophet
AB1	Chinchaga (incl. BC portion)
AB2	Bistcho
AB3	Yates
AB4	Caribou Mountains
AB5	Little Smoky
AB6	Red Earth
AB7	West Side Athabasca River
AB8	Richardson
AB9	East Side Athabasca River
AB10	Cold Lake
AB11	Nipisi

Range ID	Range Name
AB12	Slave Lake
SK1	Boreal Shield
SK2	Boreal Plain
MB1	The Bog
MB2	Kississing
MB3	Naosap
MB4	Reed
MB5	North Interlake
MB6	William Lake
MB7	Wabowden
MB8	Wapisu
MB9	Manitoba North
MB10	Manitoba South
MB11	Manitoba East
MB12	Atikaki-Berens
MB13	Owl-Flinstone
ON1	Sydney

Range ID	Range Name
ON2	Berens
ON3	Churchill
ON4	Brightsand
ON5	Nipigon
ON6	Coastal
ON7	Pagwachuan
ON8	Kesagami
ON9	Far North
QC1	Val d'Or
QC2	Charlevoix
QC3	Pipmuacan
QC4	Manouane
QC5	Manicouagan
QC6	Quebec
NL1	Lac Joseph
NL2	Red Wine Mountain
NL3	Mealy Mountain

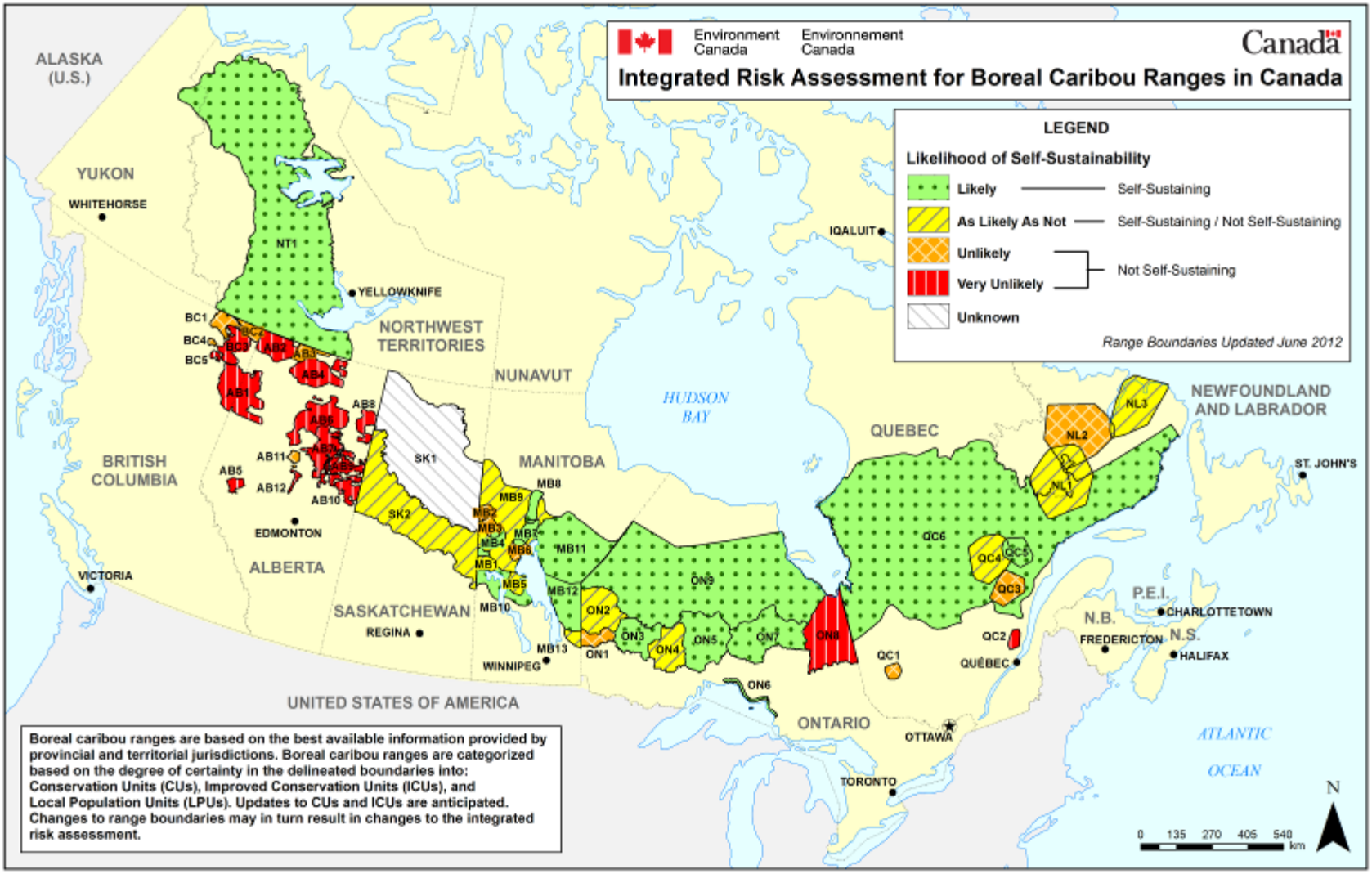

Figure 3. Integrated risk assessment for boreal caribou ranges in Canada, reflecting the capacity of each range to maintain a self-sustaining local population of boreal caribou.

3.2.2 Local Populations

Precise enumeration of the size of a boreal caribou local population is a challenge due to the large areas that boreal caribou occupy (often over thousands of square kilometres), the low densities at which they occur (making survey from aircraft challenging), and their relatively solitary habits (Environment Canada, 2008; Callaghan et al., 2010). Across Canada, densities average two to three animals per 100 km^2, but densities vary regionally and can be higher in areas with high quality habitat (Environment Canada, 2011b). The literature also reports that more than 300 boreal caribou are needed for self-sustaining local populations, thereby requiring ranges of at least 10,000 to 15,000 km^2 in size subject to type and quality of habitat (Environment Canada, 2011b).

Within ranges, boreal caribou are often found in small groups of fewer than 15 individuals. This will vary seasonally in accordance with life processes (e.g. calving, rutting, wintering) and based on local conditions within the range (Boreal Caribou ATK Reports, 2010-11). Boreal caribou typically form relatively mixed-sex groups; however, during calving periods females are generally solitary (Boreal Caribou ATK Reports, 2010-2011; Nagy et al., 2011).

Based on the best available information, the current overall number of boreal caribou in Canada is estimated to be approximately 34,000 individuals (Environment Canada, 2011b). This number is based on mean local population size estimates as provided by the provincial and territorial jurisdictions. Appendix F outlines the current population size and trend information for each of the 51 ranges, as provided by provincial and territorial jurisdictions (Environment Canada, 2011b).

3.3 Needs of the Boreal Caribou

3.3.1 Habitat and Biological Needs

Boreal caribou require large range areas comprised of continuous tracts of undisturbed habitat. In general, boreal caribou prefer habitat consisting of mature to old-growth coniferous forest (e.g. jack pine (*Pinus banksiana*), black spruce (*Picea mariana*)) with abundant lichens, or muskegs and peat lands intermixed with upland or hilly areas (Stuart-Smith et al., 1997; Rettie and Messier, 2000; Courtois, 2003; Brown et al., 2007; Boreal Caribou ATK Reports, 2010-2011). Large range areas reduce the risk of predation by allowing boreal caribou to maintain low population densities throughout the range and by allowing them to avoid areas of high predation risk, such as areas with high densities of alternate prey species (e.g. moose and deer) and predators (e.g. wolf and bear) (Rettie and Messier, 2001; Brown et al., 2003; Whittington et al., 2011) (see Section 4.2). Boreal caribou use a variety of habitats to avoid predators, including muskegs and bodies of water, as well as mature and old-growth forests (Boreal Caribou ATK Reports, 2010-2011).

Boreal caribou select habitat that provides food, particularly terrestrial and arboreal lichens, during late winter and early spring, and avoid early stage, successional forests and recently disturbed areas (Schaefer and Pruitt, 1991; Stuart-Smith et al., 1997; Rettie and Messier, 2000; Dunford et al., 2006; Boreal Caribou ATK Reports, 2010-2011), which have poor feeding options, impede movement, and attract other ungulates (Whitefeather Forest, 2006). In order to

access forage during winters with deep or crusted snow, boreal caribou require habitat that has arboreal lichens and shallower snow (such as mature coniferous stands with closed canopies and upland or hilly areas exposed to wind), where it is easier to dig for ground lichens (Vandal and Barrette, 1985; Thomas and Armbruster, 1996; Courbin et al., 2009; Boreal Caribou ATK Reports, 2010-2011; Moreau et al., 2012).

Boreal caribou have specific habitat requirements during calving and post-calving periods. To calve, pregnant cows travel to isolated, relatively predator-free areas where nutritious forage is available, such as islands in lakes, peat lands or muskegs, lakeshores and forests (Boreal Caribou ATK Reports, 2010-2011). Unavailable, inadequate or degraded habitat affects the reproductive success of females as well as the survival of calves, and can result in population decline (Thomas and Gray, 2002; McCarthy et al., 2011; Pinard et al., 2012).

Boreal caribou shift their use of habitat and their distribution within the range in response to various natural processes (e.g. forest fire, food availability, weather conditions) and human activities (e.g. development, logging, recreation) (Boreal Caribou ATK Reports, 2010-2011; Environment Canada, 2011b). For example, any mature and old-growth forest stands lost to fire or tree removal practices will result in the degradation of suitable habitat in the short-term. In response to such changing environmental conditions, boreal caribou will shift within their range. Over time, a disturbed area may recover and become suitable for use by boreal caribou.

3.3.2 Connectivity

Connectivity of habitat both within a range and between ranges is essential for boreal caribou persistence on the landscape. Within a range, habitat connectivity allows for seasonal movement among habitats with the different resources needed by boreal caribou to satisfy their life history requirements (see Appendix H for examples of biophysical attributes), and for boreal caribou to use different areas as they respond to disturbance or as disturbed habitat recovers (Saher and Schmiegelow, 2005).

Connectivity between boreal caribou ranges allows for immigration and emigration between local populations, which increases gene flow, thereby helping to maintain genetic diversity and the species' subsequent resilience to environmental stressors (e.g. disease, severe weather). Studies have demonstrated that isolation of local populations as a result of disturbance to the landscape (i.e. any form of anthropogenic or natural habitat alteration), can result in a significant reduction in genetic diversity (Courtois et al., 2003; Weckworth et al., 2012). Connectivity between ranges also maintains recovery or rescue effects between boreal caribou ranges. Finally, connectivity within and between boreal caribou ranges will allow for movement in response to changing environmental conditions (e.g. climate change) (Racey and Armstrong, 2000; Courtois et al., 2003; McLoughlin et al., 2004; Pither et al., 2006; Boreal Caribou ATK Reports, 2010-2011).

3.3.3 Limiting Factors

Boreal caribou possess certain life history characteristics that limit their potential to recover from rapid, severe population declines. As a primary anti-predator survival strategy, boreal caribou spatially separate themselves from predators and alternate prey, maintaining low population

densities across their range (Bergerud, 1988; Bergerud, 1996; Johnson et al., 2001; Environment Canada, 2008). Accordingly, continuous tracts of undisturbed habitat of suitable quality (i.e. with the required biophysical attributes) are needed to ensure self-sustaining local populations.

Boreal caribou have a low reproductive output relative to other ungulates and therefore are vulnerable to higher rates of mortality whether caused by predation or over-harvesting. Females typically do not produce young until three years of age and then have only one calf per year (Bergerud, 2000). In addition, while all age classes of boreal caribou are vulnerable to predation, calf mortality can be especially high, particularly within the first thirty days after birth (Bergerud and Elliot, 1986; Gustine et al., 2006). Calves disperse themselves over the landscape as an anti-predator tactic. In most cases predation is the main proximate factor limiting boreal caribou population growth, since the survival of calves to one year of age is usually low and is often insufficient to compensate for annual adult mortality in declining populations (Bergerud, 1974; Stuart-Smith et al., 1997; DeMars et al., 2011).

Small local populations with few adult females (and hence few births) and low calf survival have a low potential for population growth (Bergerud, 1980; Bergerud, 2000; McCarthy et al., 2011). In addition to being affected by reproductive and mortality rates related to their age distribution, small local populations can be disproportionately affected by stochastic events (e.g. environmental events such as winter icing or heavy snowfalls, fire, disease). Consequently, population growth is likely to be highly variable in small local populations, with an increased probability of extirpation (Caughley, 1994; Courtois et al., 2007).

4 THREATS

4.1 Threat Assessment

There are a variety of threats that directly and/or indirectly affect boreal caribou and their habitat across Canada. A summary of these threats and their national level of concern are provided below (see Table 3). The level of concern was determined using best available information, including Aboriginal Traditional Knowledge and comments received through engagement with Aboriginal communities. Threats and their level of concern differ between regions and local populations. For example, the level of concern for the effect of hunting on local populations is high in Labrador, while it remains medium nationally. Actions to mitigate threats will be addressed in subsequent range plans and/or action plans (see Sections 7.4 and 9).

Many of the threats to boreal caribou and their habitat are related and may interact, in which case they can have cumulative impacts that may not be evident when threats are examined individually (Weclaw and Hudson, 2004; Boreal Caribou ATK Reports, 2010-2011; Badiou et al., 2011). Additionally, the impacts of threats on the size and distribution of boreal caribou local populations have a lag effect, which can take years to manifest (Vors et al., 2007).

Table 3. Threat assessment table for boreal caribou.

Threat	Level of Concern[1]	Extent	Occurrence	Frequency	Severity[2]	Causal Certainty[3]
Habitat Alteration (Disturbance)						
Habitat alteration (loss, degradation or fragmentation) as a result of human land-use activities	High	Widespread across Canada	Current	Continuous	High	High
Habitat alteration (loss, degradation or fragmentation) as a result of forest fire	Medium	Widespread across Canada	Current	Recurrent	Moderate	High
Natural Processes						
Predation	High	Widespread across Canada	Current	Continuous	High	High
Parasites and disease	Low	Localized across Canada	Anticipated	Unknown	Unknown	Low

Threat	Level of Concern[1]	Extent	Occurrence	Frequency	Severity[2]	Causal Certainty[3]
Biological Resource Use						
Hunting	Medium	Localized across Canada	Current	Seasonal	Moderate	Medium
Climate and Natural Disasters						
Climate change and severe weather	Medium	Widespread across Canada	Current	Unknown	Unknown	Low-Med
Other Threats						
Noise and light disturbance	Low-Med	Localized across Canada	Current	Recurrent	Unknown	Low
Vehicle collisions	Low	Localized across Canada	Current	Recurrent	Low	Low
Pollution	Low	Localized across Canada	Unknown	Unknown	Unknown	Low

1 Level of concern: qualifies the level of concern for managing the threat for the recovery of the species, consistent with the population and distribution objectives. This criterion considers all other criteria in the table.

2 Severity: reflects the population-level effect (i.e. high means a very large population-level effect; low means a limited population-level effect).

3 Causal certainty: reflects the degree of evidence that is known for the threat (i.e. high: available evidence strongly links the threat to stresses on population viability; medium: there is a correlation between the threat and population viability according to best available information; low: the threat is assumed or plausible).

4.2 Description of Threats

The threats to boreal caribou and their habitat identified in Table 3 are described below.

4.2.1 Habitat Alteration (Disturbance)

Habitat alteration occurs when changes are made on the landscape that adversely impact the ecosystem, either temporarily or permanently, reducing the overall function of habitat within the range for boreal caribou. Habitat loss is a change to a landscape that results in areas with no immediate or long-term future value to boreal caribou (e.g. conversion to agriculture, development of industrial facilities) whereas habitat degradation refers to a reduced but not total loss of habitat value for boreal caribou (e.g. reduction in the availability or quality of habitat following timber harvesting or seismic line development). Habitat fragmentation is the dissection of habitat by human-made linear features (e.g. roads, seismic lines, pipelines, hydroelectric

corridors) and polygonal features (e.g. forestry cut blocks) that may affect how boreal caribou use habitat or may result in a negative impact on the overall condition of a local population.

Environment Canada mapped total disturbance levels on boreal caribou ranges across their distribution in Canada as a predictor of self-sustainability for boreal caribou local populations. The total disturbance footprint was measured as the combined effects of fire that has occurred in the past 40 years and buffered (500 m) anthropogenic disturbance defined as any human-caused disturbance to the landscape that could be visually identified from Landsat imagery at a scale of 1:50,000. Although the effect of anthropogenic disturbance varies for individual ranges (i.e. in some ranges extending up to 14 km), Environment Canada (2011b) demonstrated that the application of a 500 m buffer to mapped anthropogenic features best represents the combined effects of increased predation and avoidance on caribou population trends at the national scale (Environment Canada, 2011b).

Data and approaches used to measure disturbance in Environment Canada's meta-analysis (2011b) were consistently applied across all provinces and territories. Disturbance data has been used for the purposes of this recovery strategy. Provinces and territories may have updated information and tools (e.g. Lidar remote sensing, detailed field sampling, other inventory techniques) to measure disturbance that were not considered in the national-level integrated risk assessment. Strong evidence validated by Environment Canada may be used to update disturbance measures and the integrated risk assessment.

Environment Canada (2011b) developed a methodology for consideration of disturbance management thresholds, which is described in more detail in Appendix E. This recovery strategy identifies 65% undisturbed habitat in a range as the disturbance management threshold, which provides a measurable probability (60%) for a local population to be self-sustaining. This threshold is considered a minimum threshold because at 65% undisturbed habitat there remains a significant risk (40%) that a local population will not be self-sustaining.

In any given range, habitat disturbance reduces the suitability of adjacent habitat, increase rates of predation, increase access to the land for hunting opportunities, and can act as barriers to boreal caribou movement (Chubbs et al., 1993; Smith et al., 2000; Dyer et al., 2001; Lander, 2006; Boreal Caribou ATK Reports, 2010-2011; Environment Canada, 2011b). In some cases boreal caribou may use areas of inadequate or degraded habitat (e.g. remnant habitat following certain types of forest fires, buffer habitat surrounding certain types of development), particularly in highly disturbed ranges where opportunities for movement to suitable undisturbed habitat are limited or unavailable. In these situations boreal caribou are at a higher mortality risk. In addition, large-scale disturbances to the landscape (e.g. intense forest fire, widespread forest harvest) can cause boreal caribou to cease their use of portions of the range.

4.2.1.1 Habitat Alteration (Loss, Degradation or Fragmentation) as a Result of Human Land-use Activities

Aboriginal Traditional Knowledge and science identify disturbance primarily associated with the following human land-use activities as having a negative effect on boreal caribou local populations across Canada: forestry; oil and gas exploration and development; mining and mineral exploration and development; hydro-electric development; and tourism. These activities

affect boreal caribou through a combination of direct and functional habitat loss, decreased habitat quality (i.e. habitat degradation), and development of linear features such as roads and seismic lines (i.e. habitat fragmentation) (Thomas and Gray, 2002; Vors et al., 2007; Boreal Caribou ATK Reports, 2010-2011).

The effects of habitat alteration may reduce the viability of a boreal caribou local population through the reduction of habitat quality and quantity, possibly leading to a reduction in the size of the range, and potentially resulting in the extirpation of a local population.

4.2.1.2 Habitat Alteration (Loss, Degradation or Fragmentation) as a Result of Forest Fire

Forest fires are required for boreal forest regeneration and have historically played a significant role in the local population size and distribution of boreal caribou within their range and across their Canadian distribution (Thomas and Gray, 2002; Dzus et al., 2010). Natural processes such as forest fires can directly alter habitat, making it unsuitable for boreal caribou (e.g. loss of mature conifer stands, loss of lichens and other forage plants, barriers to movement) (Environment Canada, 2011b). Boreal caribou generally do not return to burned areas for several decades until the forest is old enough to support lichens and other food sources, although they may make limited use of burned areas to feed on new growth (Boreal Caribou ATK Reports, 2010-2011).

Historically, when a forest fire occurred, boreal caribou would shift their use of habitat from the burned areas to areas that are more suitable. However, with the increase of industrial exploration and development, in a number of ranges there are fewer available suitable areas into which boreal caribou can move. When combined with human-caused disturbance, forest fires can threaten boreal caribou recovery even though they are a natural component of the boreal forest ecosystem. In some areas, forest fires have been reported as occurring more frequently than in the past (Whitefeather Forest, 2006; Boreal Caribou ATK Reports, 2010-2011).

4.2.2 Natural Processes

4.2.2.1 Predation

Across most of the distribution of boreal caribou, human-induced habitat alterations have caused an imbalance in predator-prey relationships resulting in unnaturally high predation rates. This is the major factor affecting the viability of most boreal caribou local populations (Bergerud, 1988; Stuart-Smith et al., 1997; Rettie and Messier, 1998; Schaefer et al., 1999; James and Stuart-Smith, 2000; Wittmer et al., 2005; Chabot, 2011). Based on the weight of evidence coming from science and Aboriginal Traditional Knowledge, increased wolf and/or bear predation is the main proximate cause of boreal caribou decline across Canada (Bergerud, 1988; Edmonds, 1988; Seip, 1992; Boertje et al., 1996; Boreal Caribou ATK Reports, 2010-2011; Pinard et al., 2012). However, in some parts of Canada, cougar (*Puma concolor*), coyotes (*Canis latrans*), lynx (*Lynx canadensis*), and eagles (*Haliaeetus leucocephalus* and *Aquila chrysaetos*) have also been identified as predators of boreal caribou, particularly calves (Thomas and Gray, 2002; Boreal Caribou ATK Reports, 2010-2011; McCarthy et al., 2011).

Human-caused habitat alterations have been shown to facilitate movement of predators within the boreal forest and hence can increase the abundance, distribution and hunting efficiency of species that prey on boreal caribou (James and Stuart-Smith, 2000; Neufeld, 2006; Boreal Caribou ATK Reports, 2010-2011). Additionally, although boreal caribou may not be the target prey species, they are taken opportunistically when encountered. In boreal caribou ranges with habitat alterations that provide favorable conditions for prey species such as deer and moose, predators such as wolves can increase in number, which can significantly reduce or even eliminate boreal caribou local populations (Seip, 1991; Seip, 1992; Wittmer et al., 2005; Courtois and Ouellet, 2007; Courbin et al., 2008; Boreal Caribou ATK Reports, 2010-2011). In addition to deer and moose, elk (*Cervus canadensis*), bison (*Bison bison*), and beaver (*Castor canadensis*) are other species that predators of boreal caribou commonly hunt and that have increased in number within the distribution of boreal caribou (Boreal Caribou ATK Reports, 2010-2011).

4.2.2.2 Parasites and Diseases

Viral, parasitic, and bacterial diseases can affect individual boreal caribou and may have effects at the local population level in certain parts of the country, although it is not thought to be one of the major threats affecting boreal caribou at the national level.

Other natural processes such as forest insects and disease can leave large areas of forest defoliated, and eventually dead, and may have an effect on boreal caribou habitat. In particular the mountain pine beetle (*Dendroctonus ponderosae*), which covers large areas of northeastern British Columbia and northern Alberta and threatens to move into Saskatchewan, could indirectly affect boreal caribou (Richie, 2008; Environment Canada, 2011a).

4.2.3 Biological Resource Use

4.2.3.1 Hunting

Hunting has and continues to contribute to the decline of boreal caribou (Bergerud, 1967; Kelsall, 1968; Bergerud, 1974; Bergerud, 1978; Courtois et al., 2007; Boreal Caribou ATK Reports, 2010-2011). Both targeted hunting and incidental harvest (when boreal caribou intermingle seasonally with legally hunted migratory caribou ecotypes) of boreal caribou are of concern in several areas, and may be contributing to local population declines and/or preventing recovery (Environment Canada, 2011a).

Although the extent of hunting is poorly understood in most areas, analyses of historical population trends, data from radio-collared animals, and current demographic information suggest that hunting remains a significant component of adult female boreal caribou mortality and hence is a primary threat in some ranges (Dzus, 2001; Schmelzer et al., 2004; Courtois et al., 2007). Hunting of boreal caribou is facilitated by the construction of roads and other linear features and by the use of off-road vehicles that enable access to previously inaccessible areas (Boreal Caribou ATK Reports, 2010-2011). Moreover, Aboriginal Traditional Knowledge indicates that technological advances in hunting tools (e.g. high-powered rifles and scopes) and in methods used to locate and access hunting sites (e.g. GPS, satellite tracking, aircraft,

snowmobiles, trucks) have facilitated the chase of boreal caribou, resulting in a greater number of caribou being taken (Boreal Caribou ATK Reports, 2010-2011; Environment Canada, 2011a).

4.2.4 Climate and Natural Disasters

4.2.4.1 Climate Change and Severe Weather

Climate change has been identified by Aboriginal Traditional Knowledge holders and scientists as a threat to boreal caribou and their habitat. Both groups indicate that there are many uncertainties surrounding the impacts of climate change and how climate change may interact with other threats. The long-term effects of climate change and the implications on boreal caribou habitat are unknown.

Greater weather variability and severe weather events, which are expected to increase with climate change, are likely to increase the frequency and severity of wildfires and cause more freeze-thaw cycles, freezing rain, deep snow, hot summer temperatures, and changes in the forest composition and food supply (Thomas and Gray, 2002; Vors and Boyce, 2009; Boreal Caribou ATK Reports, 2010-2011). In some areas, a shift in the timing and length of seasons, with earlier spring thaws and later freeze-ups, has been observed by many Aboriginal Traditional Knowledge holders (Boreal Caribou ATK Reports, 2010-2011). Climate change will likely also lead to changes in habitat which, in the Northwest Territories, can increase permafrost melting.

Climate related changes in habitat favour deer and other prey species, which expand into boreal caribou range, increasing predator populations and predation of boreal caribou, and facilitating the spread of disease. Climate change may result in habitat change for boreal caribou, as it drives boreal forest composition to shift northwards, and results in other factors including the spread of forest insects that cause tree mortality (e.g. mountain pine beetle) (Johnston, 2009; Johnston, 2010).

4.2.5 Other Threats

Other threats that have a lower level of concern at the national scale (although they may be of greater concern for individual ranges) include:

Noise and Light Disturbance: Noise and light disturbance result in short-term behavioural and physiological responses of individual boreal caribou, including a startle response, elevated heart rate, and production of glucocorticoids. Sustained or repeated disturbance can result in avoidance of areas and the reduction in use of suitable habitat (Sapolsky, 1992; Creel et al., 2002).

Vehicle Collisions: In some areas, boreal caribou are vulnerable to mortality from vehicle or rail collisions (Brown and Hobson, 1998); however, on a national scale, vehicle collisions are not thought to pose a major threat to boreal caribou (Boreal Caribou ATK Reports, 2010-2011).

Pollution: The threat of pollution (e.g. from oil and gas, chemical spraying for forestry, pesticides, hydro, salt, dust and litter coming from the creation of roads) was identified as a concern through meetings held with Aboriginal communities (Environment Canada, 2011a) and by Aboriginal Traditional Knowledge holders (Boreal Caribou ATK Reports, 2010-2011). Very little is known about the severity of this threat to boreal caribou local populations.

5 POPULATION AND DISTRIBUTION OBJECTIVES

The national population of boreal caribou is currently made up of local populations distributed across 51 ranges in Canada (see Figure 2 and Table 2). Boreal caribou ranges are the fundamental units of conservation and management for boreal caribou recovery planning and actions (Thomas and Gray, 2002). The range is the appropriate unit of analysis for identifying critical habitat and other requirements for self-sustaining local populations of boreal caribou. The range represents the geographic area occupied by a group of individuals that are subject to similar factors affecting their demography and is used to satisfy their life history processes (e.g. calving, rutting, wintering) over a defined time frame.

5.1 Recovery of Boreal Caribou

5.1.1 Varying Ecological Conditions

Aboriginal Traditional Knowledge and comments received through engagement with Aboriginal communities identifies the need for continued presence of self-sustaining local populations in all boreal caribou ranges across Canada (Environment Canada, 2011a; Boreal Caribou ATK Reports, 2010-2011). This is reflected in the knowledge that all animals are connected to each other and that boreal caribou are essential to the balance of nature and for their role in the boreal ecosystem.

Boreal caribou encounter a wide variety of ecological conditions across their distribution. Taken together, all boreal caribou ranges contribute to ensuring that the full ecological gradient is represented and captures local adaptations to change. This allows for maintenance of the evolutionary potential of the species and accounts for the full spectrum of ecological interactions boreal caribou can have within the full array of ecological settings (Redford et al., 2011).

Science supports that conservation of a species such as boreal caribou is achieved by maintaining multiple local population units across a species' geographical range, in representative ecological settings, with replicate local populations in each setting that are self-sustaining, genetically robust, ecologically functional, and resilient to climate and other changes (Environment Canada, 2011b). Without connectivity, redundancy and representivity across several ecological scenarios there is an increased risk to the survival and recovery of boreal caribou.

Small local populations, particularly those isolated from the core distribution of the national population of boreal caribou, are at greater risk of not becoming self-sustaining or maintaining self-sustaining status. In these situations, a local population may have greater difficulty withstanding stochastic events, and may not experience enough immigration to maintain genetic diversity or adequate population size, and therefore will be at greater risk of not persisting in the long-term. Accordingly, different recovery actions (e.g. translocation, captive breeding) may be necessary to maintain and recover small local populations, and particularly those that are declining. There may be considerable uncertainty regarding the effectiveness of such recovery tools. It will be important to assess feasibility and conduct a risk assessment prior to undertaking any such activities.

There are several small local populations including Parker (BC4) and Prophet (BC5) in British Columbia, Nipisi (AB11) and Slave Lake (AB12) in Alberta, The Bog (MB1), Kississing (MB2), North Interlake (MB5), William Lake (MB6) and Owl-Flinstone (MB13) in Manitoba, and Red Wine Mountain (NL2) in Newfoundland and Labrador. Small isolated local populations include Little Smoky (AB5) in Alberta, Coastal (ON6) in Ontario, and Val D'Or (QC1) and Charlevoix (QC2) in Quebec (see Figure 2).

5.1.2 Connectivity Between and Within Boreal Caribou Ranges

Maintaining a long-term self-sustaining status for boreal caribou ranges depends on connectivity within and between ranges. Connectivity between ranges enables immigration and emigration between neighbouring boreal caribou local populations, which allows for the maintenance of local population size and genetic diversity. Maintaining genetic diversity is needed to maintain the resilience of a local population as described in Section 3.3.2.

Connectivity also allows wide ranging mammals like boreal caribou to adapt to changes in their natural environment (e.g. climate change, disturbance), recognizing that a contiguous population does not mean that each range must be physically connected to other ranges or that areas of habitat within a range must be physically connected to other areas. However, it does mean that the distance between ranges and between core habitat areas within a range should not be so large that no movement of boreal caribou could occur, though it may not be their preferred habitat type. Connectivity between ranges benefits gene flow and helps to maintain or increase population size. Connectivity within a range is important for seasonal movement and the use of habitat as boreal caribou respond to disturbance or as disturbed habitat recovers (Saher and Schmiegelow, 2005).

5.2 Objectives

5.2.1 Recovery Goal

The recovery goal for boreal caribou is to achieve self-sustaining local populations in all boreal caribou ranges throughout their current distribution in Canada, to the extent possible.

The recovery goal reflects the best available information, including scientific knowledge, Aboriginal Traditional Knowledge and comments received through engagement with Aboriginal communities. The goal is informed by the scientific principles of conservation and reflects the intent to recover all local populations. Achieving the recovery goal would allow for local population levels sufficient to sustain traditional Aboriginal harvesting activities, consistent with existing Aboriginal and treaty rights of Aboriginal peoples of Canada. Feedback received from Aboriginal communities indicated a strong support for this recovery goal.

Recovery for boreal caribou is the achievement of self-sustaining local populations, which are demographically and genetically viable connected local populations across the species' distribution. Current evidence supports the conclusion that the recovery of all local populations is biologically and technically feasible. As noted in Sections 3.3.3 and 5.1.1, small and isolated local populations are at greater risk of not becoming self-sustaining or maintaining self-sustaining status. There may be situations where recovery of a particular local population proves

to be, over time and through unforeseen circumstances, not biologically or technically feasible. Each boreal caribou local population contributes to the biodiversity, ecological functionality, and resilience of the species to environmental change, reducing the risk of species' extinction (Ray, 2011).

5.2.2 Population and Distribution Objectives

To guide recovery efforts, the population and distribution objectives (see Figure 4) are, to the extent possible, to:

- Maintain the current status of the 14 existing self-sustaining local populations (green dotted ranges); and
- Stabilize and achieve self-sustaining status for the 37 not self-sustaining local populations (blue hatched ranges).

"Not self-sustaining" local populations refers to the local populations assessed as "as likely as not self-sustaining", those assessed as "not self-sustaining", and that assessed as "unknown". Given the uncertainty about the status of the Boreal Shield (SK1) local population, the population and distribution objective is to manage for self-sustaining status. Implementation of the schedule of studies for SK1 included in this recovery strategy (see Section 7.2) will provide the data required to complete the integrated risk assessment for this range to determine its current status as self-sustaining or not self-sustaining.

5.3 Timelines to Recovery

Boreal caribou exist in mature boreal forest ecosystems that evolved over centuries, and in turn take decades to recover from disturbance. Reversing ecological processes detrimental to boreal caribou (e.g. habitat degradation and loss, the increase in predator and alternate prey populations), and instituting changes to management frameworks and ongoing land use arrangements, will often require time frames in excess of 50 to 100 years. Given these realities, while it is currently biologically and technically feasible to recover all local populations, under the best efforts of all parties, some local populations will not return to a self-sustaining status for a number of decades.

For several boreal caribou local populations, immediate actions to avoid extirpation are needed such that recovery can be achieved over time. Recovery will be monitored continuously and reported every five years (see Section 8).

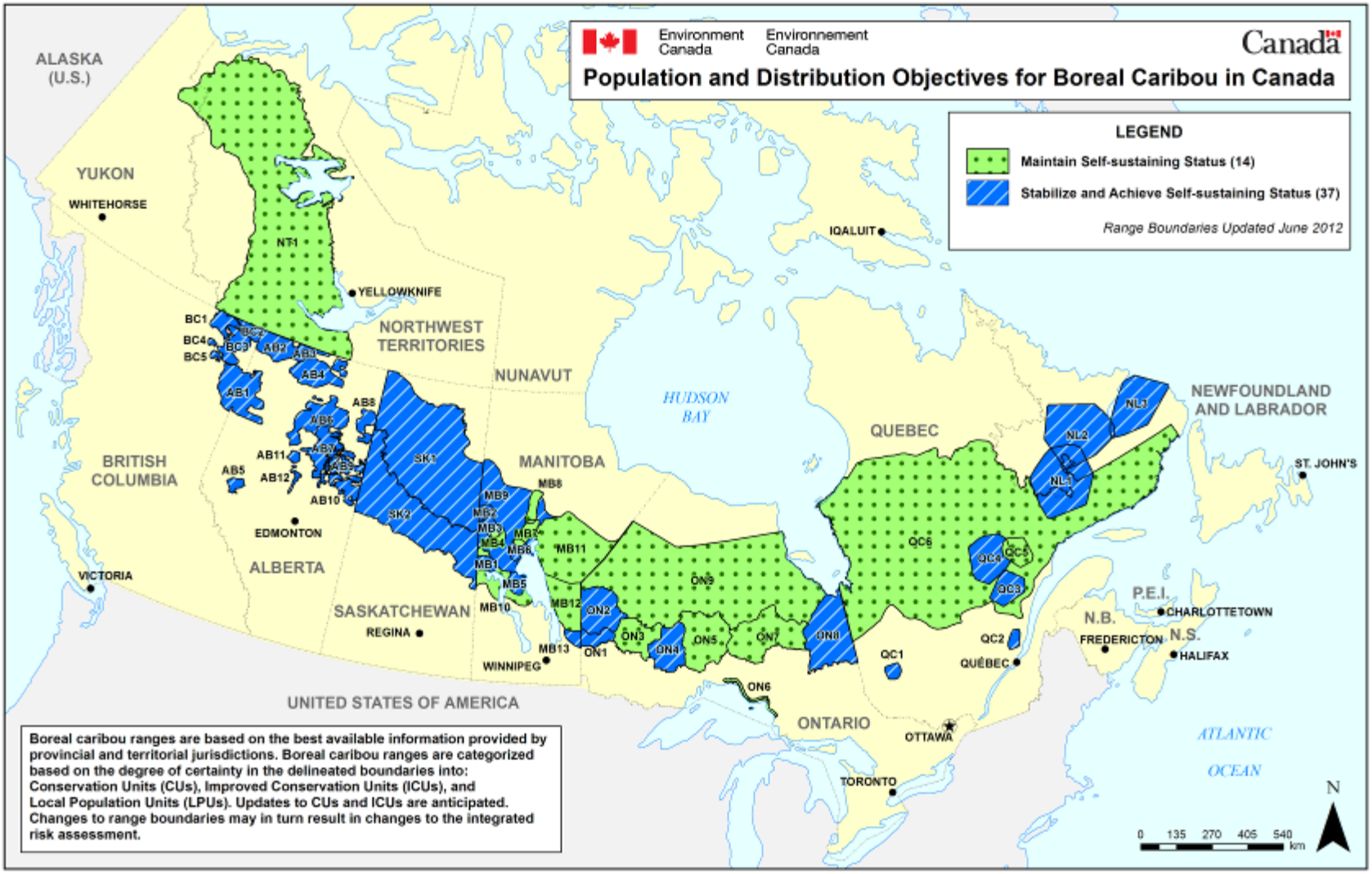

Figure 4. Population and distribution objectives for boreal caribou in Canada.

5.4 Prioritizing Recovery Actions and Managing Risk

All local populations are included in the goal for the recovery of boreal caribou based on their contributions to connectivity, representivity and redundancy. Each local population also faces different challenges to maintain or achieve self-sustaining status. Successful recovery of boreal caribou will require practical considerations and implementation of recovery actions tailored for each range. Prioritization of recovery actions is best addressed at the range and/or action planning stage where the allocation of effort and the rate of risk reduction for individual ranges can best be determined.

Range and/or action planning will consider a multitude of information and factors, such as regional ecological conditions, local population size and trend, boreal caribou movement between ranges, habitat condition between ranges, distribution of resources for restoration efforts, and others. In prioritizing recovery actions, consideration should be given to the current risk of extirpation of a local population, the length of time to achieve a self-sustaining status, ecological needs of connectivity, representivity and redundancy, as well as population and habitat conditions.

5.5 Achieving Recovery for Self-Sustaining Local Populations

Recovery is achieved for the 14 self-sustaining local populations by maintaining population and range conditions that support their self-sustaining status.

5.6 Achieving Recovery for Not Self-Sustaining Local Populations

Recovery is achieved for the 37 not self-sustaining local populations through a combination of coordinated habitat restoration and population management actions applied over time to return a local population to a self-sustaining status. For each not self-sustaining local population, the timeframe for achieving recovery will vary depending on whether the habitat condition and/or the population condition is/are a limiting factor.

For boreal caribou ranges where local populations are declining, stabilizing the local population by halting its decline will require immediate action. For all ranges wherein the local population size is small, achieving a stable population trend and recovering the population to a minimum of 100 animals[2] will be necessary to mitigate risk of quasi-extinction. Although certain local populations with fewer than 100 animals may be stable and persist over the short-term where adequate suitable habitat supply is available, the long-term persistence of those populations is less certain. In some instances, continued human intervention may be required to achieve the minimum population size target.

In addition to managing local population size, habitat management will also be necessary. This recovery strategy identifies 65% undisturbed habitat in a range as the disturbance management

[2] 100 animals provides a 0.7 probability of not reaching a quasi-extinction threshold of less than 10 reproductively active females under stable conditions (Environment Canada, 2011b).

threshold, which provides a measurable probability (60%) for a local population to be self-sustaining (see Appendix E).

For boreal caribou ranges with less than 65% undisturbed habitat:

- restoration of disturbed habitat to a minimum of 65% undisturbed habitat will be necessary.

For boreal caribou ranges with greater than or equal to 65% undisturbed habitat:

- maintenance of a minimum of 65% undisturbed habitat will be necessary.

There are 31 ranges where total disturbance exceeds 35% and which thereby do not meet the disturbance management threshold of 65% undisturbed habitat (see Section 7.1.1). Of these ranges, local population trends are declining (11 local populations), stable (eight local populations) or unknown (12 local populations).

In six ranges the habitat condition is good (i.e. undisturbed habitat exceeds 65%), and the local population trend is either declining (three local populations) or stable (three local populations). Note that for the three ranges that report stable population trend with good habitat condition, the quality of trend data and/or the small estimated population size resulted in those local populations being assessed as not self-sustaining.

6 BROAD STRATEGIES AND GENERAL APPROACHES TO MEET OBJECTIVES

6.1 Actions Already Completed or Currently Underway

Federal, provincial and territorial governments, wildlife management boards, Aboriginal people, non-government organizations, and affected industries across Canada have taken a range of actions to manage and protect boreal caribou and their habitat. Examples of actions already completed or currently underway vary across Canada, and include:

- identification and delineation of boreal caribou ranges and habitats within ranges;
- assessment of the population size and/or trend and/or distribution of local populations of boreal caribou across Canada;
- consideration of boreal caribou habitat requirements when planning and implementing forest harvesting and other industrial activities;
- development and implementation of operating guidelines for industrial development within boreal caribou ranges;
- land-use planning to identify areas within boreal caribou ranges where boreal caribou conservation is prioritized;
- closed, restricted, and/or managed hunting by Aboriginal and non-Aboriginal people, on a voluntary basis or through regulations;
- predator and alternate prey management in some ranges where local populations of boreal caribou are rapidly declining;
- development of cooperative stewardship agreements and activities to support the engagement of Aboriginal organizations and stakeholders in the monitoring, management, and conservation of boreal caribou;
- preparation of outreach materials on boreal caribou and dissemination to interest groups and the general public; and
- research on boreal caribou ranges, habitat, ecology and limiting factors.

Collectively, these actions, and the level of commitment associated with these actions, are an encouraging foundation upon which to build. Table 4 outlines the status of provincial and territorial recovery planning for boreal caribou.

Table 4. Status of boreal caribou recovery planning in provincial and territorial jurisdictions where boreal caribou occur.

Provincial/ Territorial Jurisdiction	Recovery Document	Recovery Objective
Northwest Territories	• Action Plan for Boreal Woodland Caribou Conservation in the Northwest Territories, 2010-2015 • Implementation Plan for the Action Plan for Boreal Woodland Caribou in the Northwest Territories: 2010-2015	• Conserve boreal caribou in all areas of the Northwest Territories to prevent from becoming a species at risk in the Northwest Territories • Maintain current contiguous distribution
British Columbia	• Implementation Plan for the Ongoing Management of Boreal caribou in British Columbia, 2011	• Decrease rate of decline • Reduce risk of extirpation for four populations within 50 years
Alberta	• A Woodland Caribou Policy for Alberta, June 2011 • Alberta Woodland Caribou Recovery Plan, 2004/5 – 2013/14	• Self-sustaining populations and maintain distribution • Ensure long-term habitat requirements within ranges
Saskatchewan	• Draft Recovery Strategy for Boreal Woodland Caribou in Saskatchewan, 2007	• Promote, sustain, and enhance populations • Maintain distribution of caribou and necessary ecosystems across range
Manitoba	• Manitoba's Conservation and Recovery Strategy for Boreal Woodland Caribou, 2005 • Draft Action Plans for Boreal Woodland Caribou Ranges in Manitoba – Owl-Flinstone and Atikaki-Berens Ranges	• Self-sustaining populations on all existing ranges • Maintain and/or increase habitat to support self-sustaining local populations • Manage habitat on all ranges
Ontario	• Ontario Recovery Strategy, Woodland Caribou, 2008 • Ontario Woodland Caribou Conservation Plan, 2009	• Maintain self-sustaining, genetically-connected local populations of Woodland Caribou (forest-dwelling boreal population) where they currently exist, improve security and connections among isolated mainland local populations, and facilitate the return of caribou to strategic areas near their current extent of occurrence
Quebec	• Quebec Recovery Strategy for Woodland Caribou, 2005-2012 • Updated Recovery Strategy (2012-2022) is completed and will be published shortly	• Maintain current distribution • Achieve and maintain uniform distribution (> 12,000 caribou) • Maintain and consolidate the isolated Val-d'Or and Charlevoix herds
Newfoundland and Labrador	• Recovery Strategy for Three Woodland Caribou Herds in Labrador, 2004 • Updated Recovery Strategy is currently being drafted	• Prevent extinction and improve status of all populations • Achieve self-sustaining populations across current and historical ranges

6.2 Strategic Direction for Recovery

The following table (see Table 5) and narrative describe, at a national level, the broad strategies and general approaches to be taken and the research and management activities needed to address the threats to boreal caribou and achieve the population and distribution objectives for each range. Many strategies and approaches are interrelated and details on their implementation and their level of priority will differ across the country and by local population and habitat conditions. Sequencing and timing of specific recovery actions and their level of priority will be outlined and addressed in subsequent range plans and/or action plans (see Sections 7.4 and 9).

Table 5. Recovery planning table for boreal caribou

Threat or Limitation	Priority[1]	Broad Strategy to Recovery	General Description of Research and Management Approaches
Landscape Level Planning			
Habitat alteration as a result of human land-use activities Habitat alteration as a result of natural processes	Urgent	Undertake landscape level planning that considers current and future boreal caribou habitat requirements	• Develop range plans (see Section 7.4) that outline range-specific population and habitat management activities with measurable targets to achieve recovery goal. • Undertake coordinated land and/or resource planning to ensure that development activities are planned (type, amount, and distribution) and implemented at appropriate spatial and temporal scales (e.g. consider sensitive periods/areas such as calving). • Plan to maintain habitat within and between boreal caribou ranges, to maintain connectivity where required. • Undertake coordinated planning among provincial and territorial jurisdictions that jointly manage ranges (i.e. transboundary ranges) to reach agreement on the overall strategic direction for local population recovery. • Develop range-appropriate cumulative effects assessment approaches. Very large ranges (Northwest Territories (NT1), Far North (ON9), and Quebec (QC6)) will require different approaches. • Communicate among governments, wildlife management boards, Aboriginal communities and organizations, non-governmental organizations, and other organizations responsible for land and/or resource management and/or conservation within the boreal forest to ensure coordination of planning and management and, where applicable, facilitate cross-jurisdictional cooperation and implementation.
Habitat Management			
Habitat alteration as a result of human land-use activities Habitat alteration as a result of natural processes	Urgent	Manage habitat to meet current and future habitat requirements of boreal caribou	• Protect key areas for boreal caribou through appropriate habitat management and protection mechanisms (e.g. legislated protected areas, no development zones, mixed use zones, and conservation agreements). • Undertake coordinated actions to reclaim boreal caribou habitat through restoration efforts (e.g. restore industrial landscape features such as roads, old seismic lines, pipelines, cut-lines, temporary roads, cleared areas; reconnect fragmented ranges).

Threat or Limitation	Priority[1]	Broad Strategy to Recovery	General Description of Research and Management Approaches
			• Measure and monitor disturbance on the landscape (see Section 4.2.1). Update range plans to reflect changes in habitat condition. • Where ranges are highly disturbed, identify areas that will be prioritized for boreal caribou recovery and targeted for early habitat reclamation. Incorporate management guidelines and actions into permitting conditions for activities identified as affecting boreal caribou or their habitat. • For ranges that are jointly managed (i.e. transboundary), undertake collaborative habitat management among responsible provincial and territorial jurisdictions to ensure equitable efforts are underway. • Encourage stewardship of boreal caribou habitat among industries, interest groups, and Aboriginal communities and organizations. • Assess the impact of natural disturbance (e.g. forest fire) on the long-term habitat management of boreal caribou ranges. Where necessary, incorporate short- and long-term boreal caribou habitat considerations, along with other considerations, into forest fire management. • Monitor habitat and use adaptive management to assess progress and adjust management activities as appropriate.
Mortality and Population Management			
Predation	High	Manage predators and alternate prey	• Where necessary, apply predator management as an interim management tool, in conjunction with other management approaches (e.g. habitat restoration and management), to achieve boreal caribou local population growth. Alternate prey management may also be applied in conjunction with predator management. • Where applicable, consider effective indirect predator management techniques as an alternative to direct predator management (e.g. limiting predator access, penning of boreal caribou). • Where mortality and/or population management are implemented, monitor boreal caribou local populations and consider monitoring the effects on other impacted species.
Hunting	Medium	Manage direct human-caused mortality of boreal caribou	• Determine the extent of current hunting, and the effects of hunting on boreal caribou local populations. • In consultation with Aboriginal people, develop and implement harvest strategies, where required to achieve boreal caribou recovery. • Assess and address impacts of hunting regulations for all boreal caribou ranges that overlap with other legally hunted Woodland Caribou ecotypes. • Reduce illegal hunting through stewardship, education and enforcement.

Threat or Limitation	Priority[1]	Broad Strategy to Recovery	General Description of Research and Management Approaches
Population Monitoring			
Knowledge gaps: Population dynamics (trends, size, structure, and distribution)	High	Conduct population studies to better understand population structure, trends and distribution	• Where necessary, refine understanding of the structure and functioning of boreal caribou local populations. • Monitor population size and/or trend, as well as changes in boreal caribou distribution over time and in relation to habitat condition and disturbance. • Coordinate data collection, data-sharing, and planning between or among neighbouring provincial and territorial jurisdictions to establish transboundary ranges where appropriate. • Revise boreal caribou range delineations based on updated population information from science and Aboriginal Traditional Knowledge.
Knowledge gaps: boreal caribou health and condition	Low - Medium	Monitor boreal caribou health and condition	• Gather information, monitor and manage the health and body condition of individual boreal caribou.
Knowledge gaps: boreal caribou sensory disturbance	Low - Medium	Monitor and manage sensory disturbance of boreal caribou	• Assess the extent, distribution, and possible consequences of sensory disturbance (e.g. aircraft traffic, snowmobiles, all-terrain vehicles, tourism, research, and equipment associated with oil and gas or forestry) on boreal caribou, and where required reduce its effects, particularly during sensitive periods (e.g. calving). • Minimize disturbance to boreal caribou during monitoring and research programs, and select monitoring and research techniques that are the least intrusive.

[1] *Priority: reflects the level of priority of the broad strategy on a national level. This priority for each local population may differ.*

6.3 Narrative to Support the Recovery Planning Table

Recovery of boreal caribou will require the commitment, collaboration and cooperation among federal, provincial and territorial jurisdictions, wildlife management boards, Aboriginal people, local communities, landowners, industry and other interested parties. It will be important to monitor habitat conditions, size and/or trend, and the distribution of boreal caribou local populations so that the effectiveness of individual range management regimes can be evaluated, and adjusted as necessary. It should also be recognized that it takes time for the impact of human developments and natural disturbances on boreal caribou to become evident. Therefore, range plans and/or action plans must take into account the likelihood of a delayed boreal caribou population and distribution response to anthropogenic or natural habitat alterations.

6.3.1 Landscape Level Planning

As the range has been identified as the most relevant scale at which to plan for the conservation of boreal caribou, undertaking landscape level land and/or natural resource planning is appropriate for effective management of cumulative effects of habitat disturbance within boreal

caribou ranges and for managing disturbance over time to ensure sufficient habitat is available for boreal caribou, both of which are more difficult in the context of individual project approvals. Range-level planning for boreal caribou should consider current and future human developments and determine detailed management activities that are tailored to the conditions of the range and the local population in question. Range plans and/or action plans should take into account natural disturbances and cumulative effects of development within and between boreal caribou ranges.

It will be important to undertake coordinated land and/or resource planning to ensure that development activities are planned and approved, taking into consideration the cumulative impacts of all current and future developments within a range. Assessing cumulative effects will require a different approach for large continuous ranges than for smaller discrete ranges. The impact of disturbance that may be concentrated in part of a large continuous range may be masked given the size of the range. Dividing the large areas into smaller management units may allow land managers to better understand where the disturbance is occurring and plan accordingly, in order to avoid irreversible range retraction and permanent breaks in range connectivity.

In light of the impacts that actions taken in neighbouring ranges have on boreal caribou, it will be important that provinces and territories take a collaborative approach to land and/or resource planning, particularly in ranges that are jointly managed (i.e. transboundary), to ensure an agreed upon direction to boreal caribou recovery is attained.

6.3.2 Habitat Management

Boreal caribou ranges will need to be managed to ensure their current and future ability to support self-sustaining local populations. The effectiveness of various management activities may vary between and within ranges due to differences in population condition and specific local conditions.

Management of the amount, type and distribution of human developments will be necessary. Both anthropogenic and natural disturbances will need to be monitored and measured. Methods may vary in accordance with the information and tools available to the provinces and territories. Anthropogenic disturbance (i.e. industrial and other human activities) will need to be managed in a manner consistent with land and/or resource planning that has taken into account the current and future habitat requirements of boreal caribou. Disturbed areas may need to be improved or restored to support population and distribution objectives within each boreal caribou range. Maintaining connectivity within and between habitat patches and ranges will be particularly important for boreal caribou. In certain cases, it may be necessary to identify and designate protected areas with biophysical attributes for boreal caribou. For ranges that are jointly managed by provinces and territories (i.e. transboundary), collaborative habitat management approaches will be necessary to ensure that equitable recovery efforts are underway. Though ranges may cross provincial and territorial boundaries, each jurisdiction remains accountable for activities carried out in their own range.

6.3.3 Mortality and Population Management

6.3.3.1 Manage Predators and Alternate Prey

Human-induced habitat alterations have upset the natural balance between boreal caribou and their predators, resulting in unnaturally high predation rates in some boreal caribou ranges. As a result, in some ranges, a population management approach involving management of other wildlife species (i.e. predators and alternate prey) may be required to stop boreal caribou declines and stabilize the local population in order to prevent their extirpation in the short-term. Where the condition of the local population warrants such measures, predator and in some cases alternate prey management may be applied as interim management tools, recognizing that a punctuated approach to mortality management may be necessary over a period of time while habitat conditions in the range recover. Where mortality management is applied, concurrent application of other management tools will be needed to achieve boreal caribou recovery. In particular, habitat restoration and management will be necessary to recover the range conditions to provide an adequate habitat supply system to support boreal caribou local populations. Predator and alternate prey management should be considered simultaneously. Alternate prey management applied in the absence of concurrent predator management has the potential to be harmful to boreal caribou conservation.

6.3.3.2 Manage Direct Human-Caused Mortality of Boreal Caribou

The extent of hunting and its effect on boreal caribou local populations is largely unknown across most of the distribution of boreal caribou. Therefore, it is important to first determine the level of hunting within a range in order to understand the potential impact of hunting on the viability of a local population. Attention should also be given to areas where boreal caribou ranges overlap with legally hunted caribou ecotypes, and hunting regulations for the legally hunted caribou ecotypes should be modified as appropriate. In areas where hunting is shown to have a negative effect on local population viability, harvest strategies should be developed, in consultation with Aboriginal people, to achieve boreal caribou recovery.

6.3.4 Population Monitoring

6.3.4.1 Conduct Population Studies to Better Understand Boreal Caribou Population Structure, Trends and Distribution

There is considerable variation in the level of understanding of boreal caribou local population structure and trends across their distribution. While accurate population size and trend estimates are available for some local populations, for others, size and trend estimates are based primarily on professional judgement and limited data. For local populations where little is known, baseline population ecology studies such as boreal caribou collaring, aerial observations/counting, and on the ground monitoring activities are required to establish a baseline from which to plan and measure recovery progress. For all local populations, size and/or trend, and distribution should be monitored over time to test the efficacy of management actions and adapt those management actions as appropriate.

6.3.4.2 Monitor Boreal Caribou Health and Condition

Parasites and disease can affect individual boreal caribou and may have effects at the local population level in certain parts of the country. Pollution from oil and gas contaminated sites has also been shown to negatively affect the health of boreal caribou and may result in mortality if individuals consume toxins at waste sites. However, little is known about the severity of parasites, disease and pollution to individual boreal caribou or to boreal caribou local populations. Therefore, information on the health and body condition of boreal caribou should be monitored to better understand the relationship between these threats and the viability of local populations, and whether there is a need for additional recovery actions.

6.3.4.3 Monitor and Manage Sensory Disturbance of Boreal Caribou

The extent, distribution and effects of various sources of sensory disturbance (e.g. low-flying aircraft, snowmobiles, equipment associated with various industries) on individual boreal caribou and boreal caribou local populations should be assessed. Where required, management actions to reduce the effects of sensory disturbance on boreal caribou should be implemented and the effectiveness of the management actions should be monitored over time and adapted as necessary.

7 CRITICAL HABITAT

Under SARA, critical habitat is defined as "the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species". For boreal caribou, critical habitat identification describes the habitat that is necessary to maintain or recover self-sustaining local populations throughout their distribution. In some of the areas identified as critical habitat, the quality of habitat will need to be improved for recovery to be achieved.

Boreal caribou shift in their use of range over space and time, in accordance with changes in the location of biophysical attributes within the range as areas of disturbed and undisturbed habitat cycle on the landscape. For a local population to be self-sustaining over time, this habitat supply system (i.e. critical habitat) must function perpetually.

7.1 Identification of Critical Habitat for Boreal Caribou

Based on the foregoing, critical habitat for boreal caribou is identified for all boreal caribou ranges, except for northern Saskatchewan's Boreal Shield range (SK1), (see Figure 5) as:

- the area within the boundary of each boreal caribou range that provides an overall ecological condition that will allow for an ongoing recruitment and retirement cycle of habitat, which maintains a perpetual state of a minimum of 65% of the area as undisturbed habitat; and
- biophysical attributes required by boreal caribou to carry out life processes (see Appendix H).

Based on methodology developed by Environment Canada (2011b), a disturbance management threshold of 65% has been identified, which provides a measurable probability (60%) for a local population to be self-sustaining (see Appendix E). The precise location of the 65% undisturbed habitat within the range will vary over time. The habitat within a range should exist in an appropriate spatial configuration such that boreal caribou can move throughout the range and access required habitat when needed. The key to this identification is achieving and maintaining an overall, ongoing range condition that allows for the dynamic habitat supply system, with the biophysical attributes upon which boreal caribou depend, to operate. It is this dynamic habitat supply system within the range boundaries, containing the biophysical attributes, that is the habitat condition necessary for the recovery of boreal caribou.

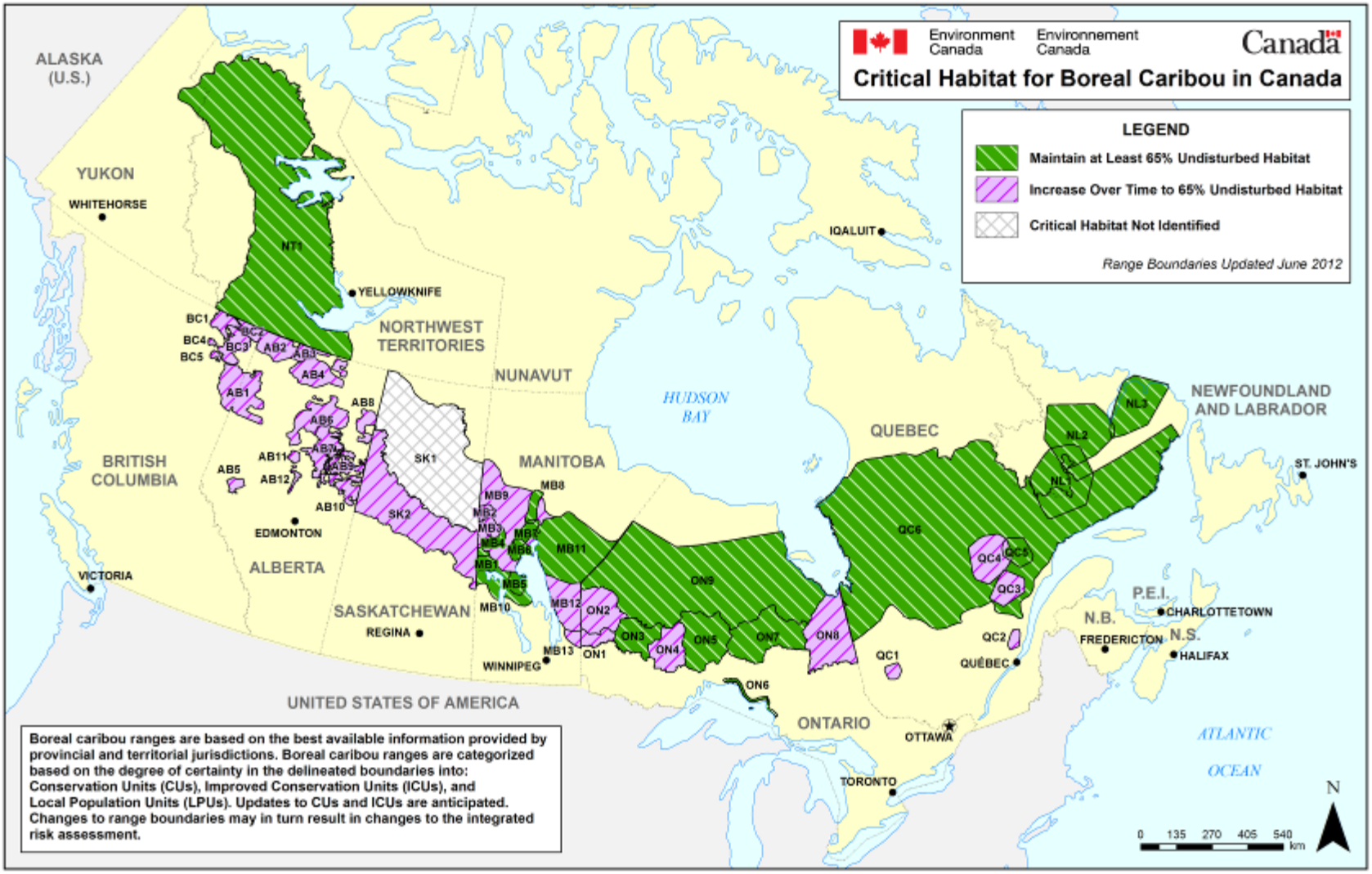

Figure 5. Critical habitat for boreal caribou in Canada.

Critical habitat is not identified in northern Saskatchewan's Boreal Shield range (SK1). The high fire, very low anthropogenic disturbance estimates for northern Saskatchewan represent a unique situation that falls outside the range of variability observed in the data that informed the disturbance model used by Environment Canada (2011b) (see Appendix F). Therefore, the disturbance model that informed the identification of critical habitat has not been applied for this range. More information is needed to confirm if the effect of total disturbance also applies in ranges where there is high fire and very low anthropogenic disturbance. A schedule of studies (see Section 7.2) is required to complete the critical habitat identification for the Boreal Shield range (SK1) in northern Saskatchewan.

7.1.1 Components of Critical Habitat

The identification of critical habitat for boreal caribou is comprised of three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat. Appendix J provides critical habitat component information for each boreal caribou range with the exception of Saskatchewan's Boreal Shield range (SKI) where critical habitat has not been identified.

Location

Location describes where critical habitat is found. For boreal caribou the relevant scale to identify critical habitat is the range, which delineates the area within which critical habitat is located. There are 51 ranges within the current distribution of the boreal caribou (see Figure 2 and Table 2).

Amount

Amount describes the quantity of critical habitat.

A strong relationship exists between habitat disturbance and whether a local population is stable, increasing or decreasing. As the quantity and/or severity of disturbance increases, there is increasing risk that a local population will be in decline (Environment Canada, 2011b), as further described in Appendix E.

This recovery strategy identifies a minimum of 65% undisturbed habitat in a range as the disturbance management threshold, which provides a measurable probability (60%) for a local population to be self-sustaining. This threshold is considered a minimum threshold because at 65% undisturbed habitat there remains a significant risk (40%) that local populations will not be self-sustaining.

Habitat disturbance within a range needs to be managed by the responsible jurisdiction at a level that will allow for a local population to be self-sustaining. As there is variation in habitat and population conditions between boreal caribou local populations across their distribution, for some ranges it may be necessary to manage the range above the 65% undisturbed habitat threshold, while for others it may be possible to manage the range below the 65% undisturbed habitat threshold. However, there must be strong evidence, validated by Environment Canada, from population data collected over an extended period of time to support the management decision to establish a lower range-specific threshold (i.e. the lag effects of disturbance on a local population have been considered and accounted for).

In the absence of strong evidence to support lowering the undisturbed habitat threshold below 65%, the amount of critical habitat for all ranges is at least 65% undisturbed habitat. For management purposes, the amount of critical habitat may need to be maintained or restored, depending on the level of disturbance in a range.

- In ranges with less than 65% undisturbed habitat, initially, critical habitat is the existing habitat that over time would contribute to the attainment of 65% undisturbed habitat.
- In ranges with 65% or more undisturbed habitat, critical habitat is at least 65% undisturbed habitat in a range.
- The habitat that is included in the 65% undisturbed habitat will change over time given the dynamic nature of the boreal forest.

Section 4.2.1 describes the methodology used to measure disturbance for each range.

Type

Type describes the biophysical attributes of critical habitat.

Biophysical attributes are the habitat characteristics required by boreal caribou to carry out life processes necessary for survival and recovery. Biophysical attributes within and adjacent to core habitat areas of boreal caribou use will be more important to a local population than those that are isolated and less accessible to boreal caribou (i.e. spatially separated by a disturbance). The biophysical attributes for boreal caribou will vary over space and time with the dynamic nature of the boreal forest. In addition, particular biophysical attributes will be of greater importance to boreal caribou at different points in time. Certain biophysical attributes are required more by a local population during different life processes, seasons or at various times over the years.

Information from Aboriginal Traditional Knowledge (Boreal Caribou ATK Reports, 2010-2011), habitat selection analyses, and scientific published reports (Environment Canada, 2011b) were used to summarize the biophysical attributes necessary for boreal caribou. Results are categorized by the habitat type (e.g. calving habitat, winter habitat) and are provided by ecozone in order to capture the ecological variation across the current distribution of boreal caribou (see Appendix H). In addition to variation across ecozones, the biophysical attributes necessary for boreal caribou will vary both between and within ranges. For certain ranges, more specific information was made available to describe biophysical attributes and this has been included in Appendix H.

7.2 Schedule of Studies

A schedule of studies is required under SARA where available information is inadequate to identify critical habitat. The schedule of studies outlines the essential studies required to identify the critical habitat necessary to meet the population and distribution objectives for boreal caribou set in this recovery strategy.

There is evidence suggesting that fire does cause stress on boreal caribou local populations when the proportion of the range disturbed by fire is high. Precaution around the additional effects of

anthropogenic disturbance in boreal caribou ranges that experience high levels of fire is necessary. Additional population trend data is required to understand the relationship between disturbance and boreal caribou survival in ranges with high fire and very low anthropogenic disturbance. This disturbance relationship occurs in northern Saskatchewan's Boreal Shield range (SK1).

The following schedule of studies is required to complete the identification of critical habitat in the Boreal Shield range in northern Saskatchewan (SK1).

Table 6. Schedule of studies required to complete the identification of critical habitat in the Boreal Shield range (SK1) in northern Saskatchewan.

Description of Activity	Rationale	Timeline
Collect population information (size, trend, etc.) for a minimum of 2 years in SK1 where population condition is unknown.	The effect of a high fire and very low anthropogenic disturbance habitat condition on the SK1 local population is unknown. These activities will provide the necessary information to identify critical habitat.	Population data collected and critical habitat identified for SK1 by end of 2016.
Update disturbance model in Environment Canada's Scientific Assessment (2011b) by including population information for SK1 to incorporate situations of high fire and very low anthropogenic disturbance.		
Identification of critical habitat in SK1.		

7.3 Activities Likely to Result in the Destruction of Critical Habitat

SARA requires that a recovery strategy identify examples of activities likely to destroy critical habitat. Destruction is determined on a case by case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by boreal caribou. Destruction may result from a single activity, multiple activities at one point in time, or from the cumulative effects of one or more activities over time (Government of Canada, 2009).

Activities that are likely to result in the destruction of critical habitat, include, but are not limited to, the following:

- Any activity resulting in the direct loss of boreal caribou critical habitat. Examples of such activities include: conversion of habitat to agriculture, forestry cut blocks, mines, and industrial and infrastructure development.
- Any activity resulting in the degradation of critical habitat leading to a reduced, but not total loss of both habitat quality and availability for boreal caribou. Examples of such activities include: pollution, drainage of an area, and flooding.

- Any activity resulting in the fragmentation of habitat by human-made linear features. Examples of such activities include: road development, seismic lines, pipelines, and hydroelectric corridors.

The likelihood that critical habitat will be destroyed is increased if any one of these activities, or combination thereof, were to occur in such a manner, place and time, that after appropriate mitigation techniques (see Appendix I) any one of the following were to occur:

- compromise the ability of a range to be maintained at 65% undisturbed habitat;
- compromise the ability of a range to be restored to 65% undisturbed habitat;
- reduce connectivity within a range;
- increase predator and/or alternate prey access to undisturbed areas; or
- remove or alter biophysical attributes necessary for boreal caribou.

A single project/activity may or may not result in the destruction of critical habitat; however, when considered in the context of all current and future development activities within and among ranges, the cumulative impacts may result in the destruction of critical habitat.

Mitigation of adverse effects from individual projects/activities will require a coordinated approach and management of cumulative effects within and among ranges. A cumulative effects assessment is essential to position the proposed project/activity in the context of all current and future development activities. The cumulative effects assessment will:

- assess the impact of all disturbances (anthropogenic and natural) at the range-scale;
- monitor habitat conditions, including the amount of current disturbed and undisturbed habitat (see Section 4.2.1), and amount of habitat being restored;
- account for planned disturbances; and
- assess the distribution of disturbance in large ranges for risk of range retraction in parts of the range.

For large continuous ranges, a different approach for assessing cumulative effects will be required than for smaller discrete ranges. Dividing the large areas into smaller management units will allow land managers to understand where the disturbance is occurring and avoid irreversible range retraction and a permanent break in range connectivity.

Determination of whether an activity is likely to result in the destruction of critical habitat will be facilitated by a range plan. For example, a range plan would identify activities that are likely to result in direct loss, degradation, and/or fragmentation of habitat, relevant to specific local circumstances. Any development that does not align with the range plan would be considered an activity likely to destroy critical habitat.

7.4 Range Plans

Given the dynamic nature of boreal caribou habitat requirements, the landscape scale at which those requirements operate, and the highly variable present-day land management and ecological conditions that exist among all boreal caribou ranges, range-specific approaches to protecting critical habitat, and in many cases improving the condition of critical habitat for this species, are needed.

In light of jurisdictional responsibilities for land and natural resource management, it is expected that they will develop range plans. In areas where the responsibility for land and natural resource management varies, range plans will be developed collaboratively between all responsible authorities. Range plans may be stand-alone documents, or part of other planning documents including action plans.

Range plans will outline how the given range will be managed to maintain or attain a minimum of 65% undisturbed habitat over time. Specifically each range plan should reflect disturbance patterns on the landscape, as measured and updated by the provinces and territories, and outline measures and steps that will be taken to manage the interaction between human disturbance and natural disturbance.

Difference between a range plan and an action plan

Action plans, which are required under SARA, provide the public and stakeholders with details on how the recovery strategy will be implemented. Action plans include a broad spectrum of subjects, such as: measures to address threats and to achieve population and distribution objectives; an evaluation of socio-economic costs and benefits to be derived from its implementation; and an approach for monitoring and reporting, etc. An action plan is not necessarily range-specific; it could cover multiple ranges or even specific recovery measures within a range. Range plans are documents that outline how a given range will be managed to ensure that critical habitat is protected from destruction.

Purpose of a range plan

The main purpose of a range plan is to outline how range-specific land and/or resource activities will be managed over space and time to ensure that critical habitat is protected from destruction. As such, each range plan should reflect disturbance patterns on the landscape, as measured and updated by the provinces and territories, and outline the measures and steps that will be taken to manage the interaction between human disturbance, natural disturbance, and the need to maintain or establish an ongoing, dynamic state of a minimum of 65% of the range as undisturbed habitat at any point in time to achieve or maintain a self-sustaining local population. While the general ecological principles and critical habitat dynamics described in the recovery strategy apply to all ranges, individual ranges also possess a unique mix of ecological and land use conditions (e.g. population condition, habitat condition and configuration, social and legal arrangements) that must be factored into decision making.

The range plans, consistent with this recovery strategy, will be one factor considered by the Minister of the Environment in forming an opinion on whether the laws of the province or

territory effectively protect critical habitat within each boreal caribou range. As such, range plans should contain the background information necessary for the Minister of the Environment to make an informed assessment of whether critical habitat protection is in place or is being realistically pursued throughout the range. Specifically, range plans should indicate what laws of the province or territory, legislative and/or regulatory provisions, licences or other instruments issued under an Act or regulation, or contractually binding agreements the jurisdiction intends to use to protect critical habitat. In the absence of range plans, the minister will use the best available information and consult with the jurisdiction to determine whether critical habitat is effectively protected. If the minister is of the opinion that there are no provisions in or measures under SARA or another Act of Parliament that protect the critical habitat (including a section 11 agreement) and the laws of the provinces and territories do not effectively protect their critical habitat, the Minister of the Environment is required to recommend that a protection order be made to the to the Governor in Council.

Range plans may form part of an action plan under SARA. However, in order to be adopted in whole or in part as an action plan by the Minister of the Environment, the range plan and the process used to develop it will need to meet the requirements of section 48 (cooperation) and section 49 (content) of SARA. In addition, range plans will be used to inform reporting that is required under SARA on implementation and progress toward meeting the population and distribution objectives of this recovery strategy. Finally, range plans may be used to inform decisions related to environmental assessments, issuance of permits (either under SARA or other applicable legislation), and other similar approval processes.

Process for developing a range plan

The development of each range plan will be led by the responsible provincial or territorial jurisdiction. In areas where the management responsibility for land and natural resource management varies, range plans will likely be multi-jurisdictional led between all responsible authorities. Range plans should be developed in a collaborative manner with directly affected stakeholders. Jurisdictions should also apply the appropriate level of cooperation with Aboriginal people as they would in any other resource management planning process that is undertaken within their province or territory. The exact process of collaboration that is used is the responsibility of each jurisdiction and may vary between jurisdictions.

Range plans may be updated by the jurisdictions over time to reflect changes in habitat and population conditions for any given range. In particular, range plans should be updated following any significant natural disturbance event (e.g. forest fires).

Timelines for the development of a range plan

Given the variation in management contexts, population and habitat information, and levels of risk across the geographic distribution of boreal caribou, range plans should be completed by the responsible jurisdiction(s) within 3-5 years of the posting of this recovery strategy.

What should be included in a range plan?

There is no single prescriptive approach to developing a range plan, and jurisdictions may select those approaches they consider most appropriate. Range plans should include such things as:

- Demonstration of how at least 65% undisturbed habitat in the range will be achieved and/or maintained over time;
- List of the laws of the province or territory (including any corresponding regulations, permits, licenses, etc.) and conservation measures (such as agreements, programs, compliance incentives, conservation leases, etc.) that will be used to prevent activities likely to destroy critical habitat;
    - Include land tenure assessment for all areas of critical habitat within each range
    - Where protection measures do not exist, the range plan should indicate the steps being taken to put them in place and the expected timeline for implementation
- Information on range-specific activities likely to destroy critical habitat within each range. This will involve identifying and assessing current projects/activities as well as any foreseeable future projects/activities, and should include a cumulative effects analysis;
- An approach for measuring disturbance to the landscape and monitoring critical habitat to ensure that protection mechanisms are in place and are working to prevent the destruction of boreal caribou critical habitat;
- An approach for monitoring population trends to ensure that local populations are responding positively to management techniques;
- An approach for monitoring natural disturbances, and habitat quality and quantity; and
- Identification of information needs and plans for addressing information gaps.

8 MEASURING PROGRESS

Under SARA, the competent minister must report on the implementation of a recovery strategy and the progress towards meeting its objectives every five years. Population and habitat conditions for boreal caribou will change over time given the changes to population demographics, the dynamic nature of the boreal ecosystem and the manner in which the species shifts in its use of the landscape over time. Accordingly, the five-year time frame for reporting on implementation allows for these changes to be included in an updated recovery strategy, and for subsequent range plans and action plans to be updated under an adaptive management framework.

Monitoring of boreal caribou local populations based on performance indicators will be essential to have the information necessary to evaluate the effectiveness of management actions and to make necessary adjustments through an adaptive management process over time.

8.1 Adaptive Management

The process of adaptive management planning and implementation acknowledges and supports the adjustment of management actions in light of new or more refined knowledge. Through adaptive management, knowledge gaps and uncertainties are identified, evaluated, and reported as information needs, addressed through monitoring and research, and then implemented through revised and improved management actions.

The challenge of achieving the recovery goal of self-sustaining local populations of boreal caribou will vary by boreal caribou range given the habitat and population conditions and management context associated with each range. In order to ensure adaptive management is applied to boreal caribou recovery, cooperation with federal, provincial and territorial jurisdictions, wildlife management boards, Aboriginal people, and others involved in the conservation, survival and recovery of boreal caribou is required.

8.2 Performance Indicators

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives.

The ultimate performance indicator of boreal caribou recovery is self-sustaining local populations throughout the entirety of their distribution in Canada. Performance indicators for this recovery strategy are that the population and distribution objective is met for each boreal caribou range, and that boreal caribou become less at risk. Recovery of all boreal caribou local populations is technically and biologically feasible; however given the challenges of recovery for boreal caribou, some local populations that are currently not self-sustaining will likely require a number of decades to return to a recovered state.

The performance indicators described below are provided as national guidelines to gauge the successful implementation of the recovery strategy. More detailed performance indicators that

reflect the specific local conditions (e.g. population condition, habitat condition, alternate prey/predator dynamics, mortality rates) of each boreal caribou range will need to be developed at the range plan and/or action plan stage.

General:

a) Complete range plans for each range within 3-5 years of the posting of this recovery strategy (see Section 7.4).

Population Condition (population trend and size):

a) Maintain current distribution of boreal caribou across Canada.

b) Achieve and/or maintain a stable to increasing population trend as measured over five years (i.e. $\lambda \geq$ stable) or other empirical data that indicates population trend is stable or increasing.

c) Achieve a minimum of 100 animals for boreal caribou ranges with population estimates of less than 100 animals, or show progress towards this goal every five years.

Habitat Condition (amount and type of undisturbed habitat):

a) For ranges with 65% or more undisturbed habitat, maintain the undisturbed habitat that includes the biophysical attributes needed for boreal caribou to carry out life processes at a minimum of 65% of the total range.

b) For ranges with less than 65% undisturbed habitat, identify in a range and/or action plan specific areas of existing undisturbed habitat, as well as those areas where future habitat is to be restored to an undisturbed condition over reasonable, gradual increments every five years.

c) Provide measurements of disturbance for each range that reflect the best available information, as provided by the provinces and territories, to update the recovery strategy accordingly every five years.

9 STATEMENT ON ACTION PLANS

As required by SARA, the Minister of the Environment will complete one or more action plans under this recovery strategy by December 31, 2015. These action plans will provide information on recovery measures that should be taken by Environment Canada and other federal government departments and agencies including Parks Canada Agency, Aboriginal Affairs and Northern Development Canada, Department of National Defence and the Canadian Forces among others, provincial and territorial jurisdictions, wildlife management boards, Aboriginal people, stakeholders and other organizations involved in the conservation, survival and recovery of boreal caribou. Action plans provide the public and stakeholders with details on how the recovery strategy will be implemented. Action plans include a broad spectrum of subjects, such as: measures to address threats and to achieve population and distribution objectives; an evaluation of socio-economic costs and benefits to be derived from its implementation; and an approach for monitoring and reporting. An action plan is not necessarily range-specific; instead it could cover multiple ranges.

Range plans are documents that outline how the habitat condition within a given range will be managed over time and space to ensure that critical habitat for boreal caribou is protected from destruction and therein, that each local population will either continue to be self-sustaining or become self-sustaining over time.

The Minister of the Environment may adopt or incorporate parts of a range plan, an existing provincial or territorial plan, or other relevant planning documents that meet the requirements of SARA as an action plan. Where the Minister of the Environment proposes to adopt an existing plan or a portion of it as a SARA action plan, it will be posted on the Species at Risk Public Registry for the prescribed 60-day comment period. Within 30 days after the expiry of the comment period, and considering the comments received, the minister will publish a final action plan.

9.1 Coordinated Approach

9.1.1 Provincial and Territorial Jurisdictional Leadership

Provinces and territories have the primary responsibility for management of lands and wildlife within boreal caribou distribution, however this responsibility does vary in some parts of the country. In the Northwest Territories, for example, Aboriginal Affairs and Northern Development Canada also has a significant role to play, as does the Parks Canada Agency where boreal caribou exist within national parks and historic sites.

Range plans and/or action plans will inform broader land-use planning and decision making, and will require substantial inter-agency communication and cooperation. Coordination will be particularly important for range and/or action plans that address boreal caribou recovery in transboundary ranges, and for ensuring connectivity within ranges and across the species current distribution is maintained.

9.1.2 Aboriginal Involvement

The Minister of the Environment must cooperate with affected Aboriginal organizations for recovery strategies and action plans. Across Canada, cooperation with Aboriginal people is key to the success in developing and implementing action plans.

In acknowledgement of the existing Aboriginal and treaty rights of Aboriginal peoples of Canada, and to the extent possible, details of harvesting plans for local populations, consistent with the principles of conservation, will be addressed in range and/or action plans subsequent to this recovery strategy. When applicable, harvesting plans will follow the required process under Land Claim Agreements or provincial/territorial laws. Aboriginal involvement will be required to determine population targets that ensure stable boreal caribou local populations are maintained and recovery of local populations that are not self-sustaining is achieved, while providing for traditional harvesting practices consistent with conservation and existing Aboriginal and treaty rights of Aboriginal peoples of Canada.

9.1.3 Stakeholder Engagement

Success in the recovery of this species depends on the commitment, collaboration, and cooperation of many different constituencies that will be involved in implementing the broad strategies and general approaches set out in this recovery strategy and will not be achieved by Environment Canada, or any other jurisdiction, alone. All stakeholders, including the industry sector, environmental organizations, and private landowners should be engaged where appropriate in developing and implementing action plans.

9.2 Range Specific Actions

The recovery of boreal caribou requires actions that will vary by individual boreal caribou range based on the population and habitat conditions. Each range will require a range-specific path forward for the recovery of boreal caribou. As described under Section 7.4, range plans and/or action plans are needed to guide protection and management of critical habitat, and overall recovery actions, in each boreal caribou range.

Range plans describe how critical habitat will be protected. These jurisdictionally-led range plans will be produced for each range within 3-5 years of the posting of this recovery strategy. In the absence of a range plan, the Minister of the Environment will use the best available information and consult with the jurisdiction to make a determination on the state of protection of critical habitat for boreal caribou.

9.2.1 Habitat and Population Management

The broad strategies and general approaches to meet the population and distribution objectives (see Section 6), as set out in this recovery strategy, will inform the development of subsequent range plans and action plans, where detailed local-level planning will occur to guide the implementation of recovery actions.

The broad strategies and general approaches are designed to guide range and action planning based on the state of each boreal caribou range. Many approaches and strategic directions are inter-related and should be implemented as described in the range plans and action plans. Generally, for self-sustaining local populations, minimal management actions may be necessary, and strategically planned development could take place without threatening boreal caribou and the status of the local population. Where local populations are not self-sustaining, specific management action is needed, in some cases for many decades, until sufficient habitat is restored and the population condition is improved. Mortality management, including predator and alternate prey management, may be needed to help prevent extirpation of a boreal caribou local population in the interim while habitat management efforts are underway to restore the ecological conditions of the range necessary to support a self-sustaining local population.

Jurisdictions are accountable for the long-term planning and management of boreal caribou ranges with the implementation of different habitat and population management tools available at their discretion, depending on the specific local conditions. The implementation of habitat management practices, such as fire suppression, and mortality management practices, such as predator control, are at the discretion of jurisdictions, and the application of these tools will vary in accordance with jurisdictional policies and procedures.

10 GLOSSARY

Note: The following terms are defined in accordance with their use in this document.

Aboriginal Traditional Knowledge (ATK): ATK includes, but is not limited to, the knowledge Aboriginal peoples have accumulated about wildlife species and their environment. Much of this knowledge has accumulated over many generations.

Anthropogenic: caused by human activity.

Biological feasibility: recovery is determined to be biologically feasible under the following circumstances: individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance; sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration; and primary threats to the species or its habitat can be avoided or mitigated.

Biophysical attributes: habitat characteristics required by boreal caribou to carry out life processes necessary for survival and recovery (see Appendix H).

Current distribution (extent of occurrence): the area that encompasses the geographic distribution of all known boreal caribou ranges, based on provincial and territorial distribution maps developed from observation and telemetry data, local knowledge (including in some cases Aboriginal Traditional Knowledge), and biophysical analyses.

Disturbance management threshold: at the scale of boreal caribou range, the habitat disturbance point below which conditions are such that the recovery goal will likely be met (i.e. acceptable level of risk), and above which the outcome is either highly uncertain or unacceptable.

Disturbed habitat: habitat showing: i) anthropogenic disturbance visible on Landsat at a scale of 1:50,000, including habitat within a 500 m buffer of the anthropogenic disturbance; and/or ii) fire disturbance in the last 40 years, as identified in data from each provincial and territorial jurisdiction (without buffer).

Existing habitat: the entire boreal caribou range area minus permanent alterations. See also *permanent alterations.*

Local population: a group of boreal caribou occupying a defined area distinguished spatially from areas occupied by other groups of boreal caribou. Local population dynamics are driven primarily by local factors affecting birth and death rates, rather than immigration or emigration among groups.

In this recovery strategy, "local population" refers to a group of boreal caribou occupying any of the three types of boreal caribou ranges (i.e. conservation unit, improved conservation unit, local population unit). See also *range*.

Not self-sustaining local population: in the population and distribution objectives "not self-sustaining local population" includes both the local populations assessed as "as likely as not self-sustaining" and those assessed as "not self-sustaining".

Permanent alterations: existing features found within a range, such as industrial and urban developments, permanent infrastructure, and graded or paved roads that do not currently possess or have the potential to possess the biophysical attributes of critical habitat for boreal caribou.

Quasi-extinction: a population with less than 10 reproductively active females.

Range: the geographic area occupied by a group of individuals that are subject to similar factors affecting their demography and used to satisfy their life history processes (e.g. calving, rutting, wintering) over a defined time frame. Environment Canada (2011b) identified three types of boreal caribou ranges categorized based on the degree of certainty in the delineated range boundaries (i.e. conservation unit, improved conservation unit, local population unit).

Range plan: a document that demonstrates how the habitat condition within a given range will be managed over time and space to ensure that critical habitat for boreal caribou is protected from destruction and therein, that each local population will either continue to be self-sustaining or become self-sustaining over time.

Self-sustaining local population: a local population of boreal caribou that on average demonstrates stable or positive population growth over the short-term (≤20 years), and is large enough to withstand stochastic events and persist over the long-term (≥50 years), without the need for ongoing active management intervention.

Technical feasibility: recovery is determined to be technically feasible when recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.

To the extent possible: current evidence supports the conclusion that the recovery of all local populations is technically and biologically feasible. There may be situations where recovery of a particular local population proves to be, over time and through unforeseen circumstances, not biologically or technically feasible and as such may affect the likelihood of achieving the population and distribution objectives for some local populations.

Undisturbed habitat: habitat not showing any: i) anthropogenic disturbance visible on Landsat at a scale of 1:50,000, including habitat within a 500 m buffer of the anthropogenic disturbance; and/or ii) fire disturbance in the last 40 years, as identified in data from each provincial and territorial jurisdiction(without buffer). Disturbance within the 500 m buffer would result in a reduction of the undisturbed habitat.

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APPENDIX A: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that certain strategies may also inadvertently lead to environmental effects beyond the intended benefits, or have negative impacts upon other species. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, but are also summarized below in this statement.

Boreal caribou are an umbrella species for the older-growth boreal forest at large. There are many species that share the same habitat requirements as boreal caribou and will benefit from the recovery actions outlined in this recovery strategy. This recovery strategy will benefit the environment and biodiversity as a whole by promoting the recovery of boreal caribou and by protecting and enhancing habitat.

The management measures outlined in this recovery strategy are those required to halt boreal caribou local population declines and to assist in stabilizing and recovering local populations. With respect to broader environmental impacts, certain management tools, most notably predator (e.g. wolves, bears) and alternate prey (e.g. moose, deer) management, may be required in areas with unnaturally high rates of predation on boreal caribou.

Short-term (i.e. 5-10 years) predator and alternate prey suppression has been used in wildlife management across North America over the past decades, with predator and alternate prey species generally demonstrating fairly rapid recovery once the measures have ceased.

The recovery strategy acknowledges that predator and alternate prey management may be required in some ranges to help stop boreal caribou declines and stabilize local populations that are at risk of extirpation. Where applied, predator and alternate prey management should be used as an interim management tool, in conjunction with other management tools (e.g. habitat restoration and management) to prevent extirpation and achieve population growth. Effective indirect predator management techniques (such as actions to limit the access of predators to boreal caribou) should be considered prior to undertaking direct predator and alternate prey management. When a predator or alternate prey management program is being planned, the conservation status of all affected species must be considered. Where implemented, the effects of mortality management activities on boreal caribou local populations should be monitored.

This recovery strategy will contribute to the achievement of the goals and targets of the *Federal Sustainable Development Strategy for Canada*. In particular, the strategy directly contributes to the Government of Canada's commitment to restore populations of wildlife to healthy levels, protect natural spaces and wildlife, and protect the natural heritage of our country.

APPENDIX B: ENGAGEMENT WITH ABORIGINAL PEOPLE IN THE DEVELOPMENT OF THE RECOVERY STRATEGY FOR BOREAL CARIBOU

Once a species is listed as extirpated, endangered or threatened under SARA, a recovery strategy must be developed. Recognizing the important traditional, cultural, and spiritual role of boreal caribou in the lives of Aboriginal people, Environment Canada sought considerable involvement from Aboriginal communities in the development of the recovery strategy for boreal caribou. Two rounds of engagement were undertaken, with a focus on seeking input and sharing information with Aboriginal communities. In addition, Environment Canada supported processes to gather Aboriginal Traditional Knowledge (see Appendix C). These two components were essential in the development of this document. Nationally, Environment Canada contacted over 260 Aboriginal communities located within and adjacent to the current distribution of boreal caribou during both rounds of engagement to invite them to participate in Environment Canada's process to develop the recovery strategy for boreal caribou.

Round 1 Meetings (2009-2011)

In the first round of engagement on the recovery strategy, Environment Canada contacted 271 Aboriginal communities and 161 of them participated. Engagement at this early stage in the development of the recovery strategy provided Aboriginal communities the opportunity to share comments, opinions, and information about boreal caribou. Environment Canada used this information to inform the development of the key elements of the recovery strategy, including: i) Population and distribution objectives for boreal caribou; ii) Threats to boreal caribou and their habitat; and iii) Identification of boreal caribou critical habitat.

The information that Environment Canada received from Aboriginal communities and from stakeholder meetings, meetings with the provinces and territories, scientific studies, and Aboriginal Traditional Knowledge studies were used to draft the proposed recovery strategy (Environment Canada, 2011a).

Round 2 Meetings (2011-2012)

In the second round of engagement, Environment Canada contacted 265[1] Aboriginal communities and 87 of those participated; in addition, Environment Canada received 25 formal submissions from Aboriginal communities and organizations. This round of engagement provided the opportunity for comments and dialogue on the proposed recovery strategy that was posted on the Species at Risk Public Registry on August 26, 2011. The required 60-day public comment period was extended by an additional 120 days until February 22, 2012 to allow time for Aboriginal communities to better participate in the engagement process and provide comments on the proposed recovery strategy prior to finalization.

[1] During the first round of engagement, 6 Aboriginal communities indicated they did not require any further follow-up throughout this process. This accounts for the discrepancy in the number of Aboriginal communities contacted during round 1 and 2.

Environment Canada considered all feedback received from Aboriginal communities, along with the over 19,000 comments received from government, industry, environmental organizations, and the public when finalizing this recovery strategy (Environment Canada, 2012). Changes made to the proposed recovery strategy were a direct result of the feedback received during the public comment period, including the input received from Aboriginal communities and organizations.

APPENDIX C: ABORIGINAL TRADITIONAL KNOWLEDGE SUMMARY REPORTS ON BOREAL CARIBOU

SARA specifies that "... the traditional knowledge of the Aboriginal peoples of Canada should be considered (...) in developing and implementing recovery measures." In the summer of 2009, Environment Canada made a commitment to ensure that Aboriginal Traditional Knowledge from across the range of boreal caribou would inform the development of the recovery strategy. This commitment came from the recognition that Aboriginal people possess significant and unique knowledge about boreal caribou biology, population trends, distribution, and threats facing the species, which could support recovery planning.

Environment Canada staff in each province/territory within the boreal caribou range began the process to have Aboriginal Traditional Knowledge inform the recovery strategy by contacting Aboriginal provincial and territorial organizations, Tribal Councils, and Aboriginal consultants/facilitators to determine their interest in helping to gather Aboriginal Traditional Knowledge. Additionally, each Aboriginal community within and adjacent to the range of boreal caribou was contacted and followed up with, inviting them to participate in the process of developing the recovery strategy. As a result of these efforts, one of three basic processes was followed in the participating communities:

1. Local or regional Aboriginal organizations interviewed knowledge holders;
2. Regional or local workshops coordinated by Aboriginal facilitators were held; or
3. Aboriginal Traditional Knowledge sharing was done in partnership with other initiatives (e.g. projects funded by Aboriginal Funds for Species at Risk).

All Aboriginal contractors/communities/organizations that participated prepared summary reports based on interviews with knowledge holders. Environment Canada's Boreal Caribou Working Group received all summary reports and reviewed these in detail to highlight information that could inform the recovery strategy. Knowledge provided that would be more applicable at the action planning stage was also identified and flagged by Environment Canada's Boreal Caribou Working Group. The purpose of this step was to identify where and how the Aboriginal Traditional Knowledge could support the recovery strategy and the subsequent range and/or action plans.

Each Aboriginal Traditional Knowledge summary report received contains unique and geographically specific information that is representative of the knowledge and experiences shared by knowledge holders (Boreal Caribou ATK Reports, 2010-2011). Aboriginal Traditional Knowledge with respect to boreal caribou life history, habitat use, population status, threats facing the species, and conservation measures was used to inform the recovery strategy. In addition, Aboriginal knowledge holders shared considerable detailed local knowledge about boreal caribou, which may be used to support range and/or action plans, if and where consent for such use is granted. In all cases, Environment Canada reconfirmed the intention of the use of Aboriginal Traditional Knowledge in this document with knowledge holders.

APPENDIX D: SCIENTIFIC ASSESSMENTS OF CRITICAL HABITAT FOR BOREAL CARIBOU

2008 Scientific Review

In 2007, Environment Canada launched a science-based review with the mandate to identify boreal caribou critical habitat to the extent possible, using the best available information, and/or prepare a schedule of studies to complete this task. The results were summarized in a report entitled *Scientific Review for the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada* (hereinafter referred to as the 2008 Scientific Review).

Identifying critical habitat for boreal caribou was framed as an exercise in decision analysis and adaptive management. Establishment of a systematic, transparent and repeatable process was central to the approach. The resultant Critical Habitat Framework was anchored by synthesis and analysis of available quantitative data and published scientific information on boreal caribou population and habitat ecology.

The 2008 Scientific Review established boreal caribou ranges as the appropriate scale at which to identify critical habitat, and applied a probabilistic approach to assessing the adequacy of the current range conditions to support a self-sustaining local population based on three lines of evidence: percent total disturbance, local population growth and local population size. Of the 57 local populations or units of analysis delineated at the time, 30 were assessed as 'Not Self-Sustaining' (integrated probability of less than 0.5), 17 as 'Self-Sustaining' (integrated probability of greater than 0.5), and 10 as "as likely as not self-sustaining" (integrated probability equal to 0.5).

Additional Scientific Activities

The 2008 Scientific Review established a foundation for the assessment of critical habitat; however, Environment Canada identified key areas for further exploration to improve the science foundation to inform the identification of critical habitat:

1. Implications to critical habitat identification of variation in approaches applied by provincial and territorial jurisdictions to delineate ranges.
2. Relative impacts of different disturbances and habitat types, and their configurations, on the ability of ranges to support self-sustaining local populations, and resultant critical habitat identification.
3. Identification of disturbance management thresholds for self-sustaining local populations.
4. Influence of future range conditions on disturbance management thresholds given the dynamic nature of disturbance in a given range.

The purpose of addressing these knowledge gaps was to further inform the identification of critical habitat for boreal caribou, using the best available information. To this end, Environment Canada undertook the work presented in the *Scientific Assessment to Inform the Identification of*

Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada, 2011 Update (herein referred to as the 2011 Scientific Assessment).

2011 Scientific Assessment: Concepts and Methodology

Similar to the 2008 Scientific Review, the 2011 Scientific Assessment was designed to provide a probabilistic evaluation of critical habitat relative to the set of conditions (demographic and environmental) for each range. The framework and components developed in the 2008 Scientific Review were expanded and enhanced through a suite of scientific activities including: enhanced disturbance mapping; habitat selection analysis; buffer analysis; meta-analysis of boreal caribou local population and habitat conditions; assessment of current conditions to support self-sustaining boreal caribou local populations using indicators of two ecological components of sustainability (stable or positive population growth and long-term persistence); representation of future conditions through application of a simple habitat dynamics model and; development of a methodology for establishing risk-based, range-specific disturbance management thresholds based on best available information.

Information to Support the Identification of Critical Habitat

The information to inform the identification of boreal caribou critical habitat provided in the 2011 Scientific Assessment for each range consists of the following four components:

1. The delineation and location of the range, and certainty in range delineation.
2. An integrated risk assessment based on multiple lines of evidence from three indicators, and application of hierarchical decision rules to evaluate the probability that current conditions on a range will support a self-sustaining local population. The result is expressed as a likelihood statement relative to achieving the population and distribution objectives.
3. Information to support the identification of disturbance management thresholds. Specifically, a consistent methodology for deriving such thresholds is provided, along with examples of their potential application, and discussion of their interpretation relative to the criteria and indicators evaluated.
4. A description of the biophysical attributes, defined as the habitat characteristics required by boreal caribou to carry out life processes necessary for survival and recovery. The results from the habitat selection analyses and other published reports were used to summarize biophysical attributes by ecozone.

The related goals of assessing the ability of ranges to support self-sustaining local populations, and establishment of disturbance management thresholds, must acknowledge uncertainties arising from the availability and reliability of information about current local population condition, as well as how local populations might respond to additional and often interacting stressors. The probabilistic approach applied in the 2011 Scientific Assessment explicitly incorporated the effects of uncertainties and data quality in the assessment process. This approach is consistent with the concept of adaptive management, which expresses probable outcomes as hypotheses. Monitoring and evaluation of realized outcomes informs adaptations of management strategies over time.

Key Findings

The information and analyses presented in the 2011 Scientific Assessment addresses limitations identified with implementation of the work presented in the 2008 Scientific Review. However, neither the approach nor the results of the 2011 assessment represent a fundamental shift from the 2008 Scientific Review's conclusion that range is the appropriate geographic delineation for critical habitat description. Further, the amount of total disturbance within a range remains the primary criteria for identifying critical habitat to meet a goal of self-sustaining local populations of boreal caribou.

Highlights of the application of the conceptual framework and associated analyses supporting the 2011 assessment include:

1. Nearly 70% of the variation in boreal caribou recruitment across 24 study areas spanning the full range of boreal caribou distribution and range condition in Canada was explained by a single composite measure of total disturbance (fire + buffered anthropogenic), most of which could be attributed to the negative effects of anthropogenic disturbance.

2. Of the 57 identified boreal caribou ranges in Canada at the time, 17 (30%) were assessed in the 'self-sustaining' category, 7 (12%) in the "as likely as not self-sustaining category", and 33 (58%) in the 'not self-sustaining' category.

3. Range-specific disturbance management thresholds can be derived from a generalized disturbance-population growth function in conjunction with range-specific information. A methodology was developed to extend the critical habitat description for consideration of disturbance management thresholds when acceptable risks are defined by managers.

In addition to these highlights, several important observations related to the availability of information emerged, and recommendations related to these are advanced:

1. Most boreal caribou ranges in Canada have not been fully described owing to a lack of standardized animal location data and poor understanding of movement within and between ranges. While a total of 57 ranges were still recognized at the time by provincial and territorial jurisdictions in Canada, changes to the delineation of boreal caribou ranges have been made since the 2008 Scientific Review, by various jurisdictions, based on different criteria. The issue of appropriate delineation of transboundary ranges remains unresolved.

2. Demographic data are lacking for many boreal caribou ranges in Canada. Monitoring and assessment programs to provide data on local population size, local population trend, recruitment and adult mortality are required to improve understanding of factors affecting boreal caribou survival and recovery, to increase certainty in assessment results, and to monitor response of local populations to recovery actions and to assess progress towards meeting the population and distribution objectives for boreal caribou across Canada.

In conclusion, significant advances were made to the conceptual and methodological design in the 2011 Scientific Assessment to address some key uncertainties or limitations identified in the 2008 Scientific Review. These advances improved the robustness of the results with respect to providing a scientific basis to inform the identification of critical habitat for boreal caribou across Canada.

APPENDIX E: IDENTIFYING DISTURBANCE MANAGEMENT THRESHOLDS

This Appendix is derived from Environment Canada's Scientific Assessment (2011b), and has been adapted for the purposes of this recovery strategy. A methodology was developed for consideration of disturbance management thresholds (Environment Canada, 2011b) and is herein described. Establishing disturbance management thresholds requires a recovery goal and an acceptable level of risk from a management perspective.

The recovery goal for boreal caribou is to achieve self-sustaining local populations in all boreal caribou ranges throughout their current distribution in Canada, to the extent possible. Environment Canada (2011b) expressed this recovery goal as the likelihood of observing a mean lambda (population growth) over a 20-year period of a stable or increasing population and the likelihood of the population size remaining above a quasi-extinction threshold of 10 reproductively active females over a 50 year period. The likelihood of the population remaining stable or increasing over 20 years was based on two indicators: population trend and disturbance level within a boreal caribou range. In order to assess the influence of disturbance level on the population trend, a study was completed to develop a relationship that expresses the probability of a population being stable or increasing at varying levels of total range disturbance (see Figure E-1). This relationship was derived by combining information on the negative effects of disturbance on boreal caribou recruitment with a national mean annual adult survival rate for mature females. This relationship was used to inform the range condition required to meet the recovery goal which is a core element of the identification of critical habitat in this recovery strategy.

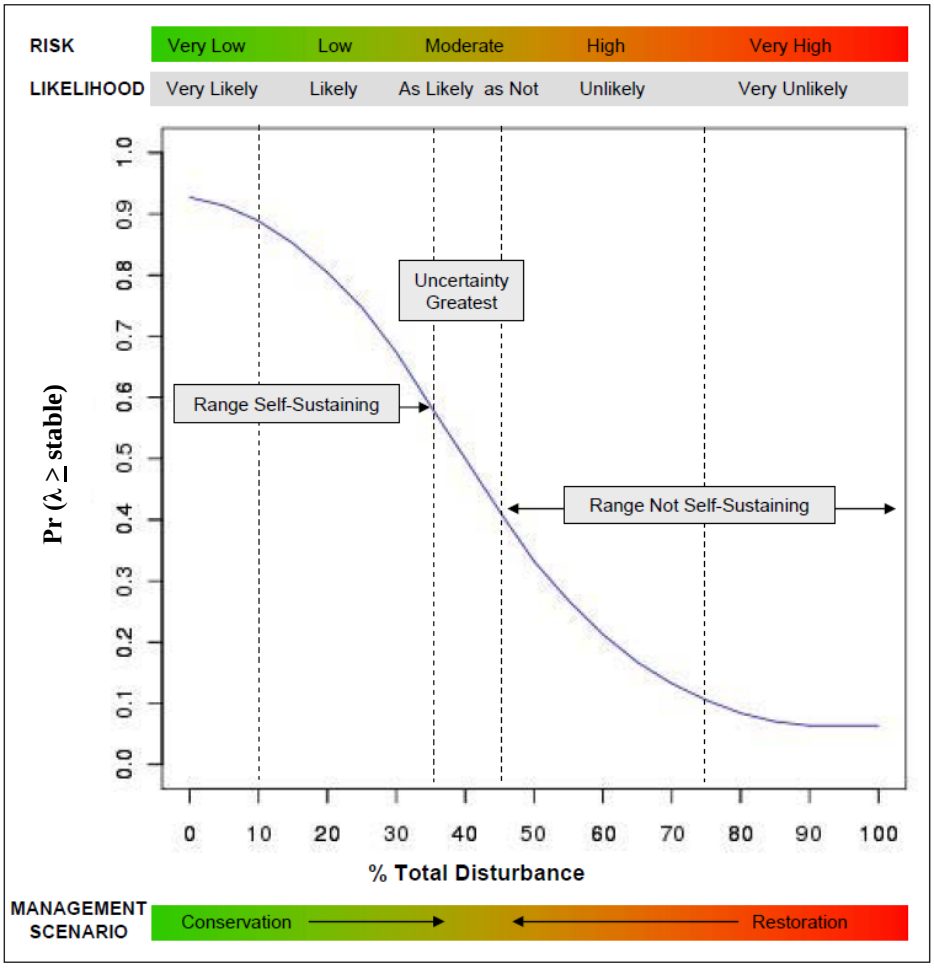

Figure E-1. Disturbance management thresholds: The probability of observing stable or positive growth (λ ≥ stable) of boreal caribou local populations over a 20-year period at varying levels of total range disturbance (fires ≤ 40 years + anthropogenic disturbances buffered by 500 m). Certainty of outcome, ecological risk, and management scenarios are illustrated along a continuum of conditions.

The disturbance values associated with the likelihood of achieving a self-sustaining local population can be used to express the relative risk of not achieving a self-sustaining local population (see Table E-1). At this point, a given management objective or target must be specified in order to determine what is an acceptable level of risk from a management perspective.

Table E-1. Intervals of total range disturbance associated with varying levels of certainty in outcome and assigned risk relative to achieving stable or positive population growth.

Probability of Sustained Stable or Positive Growth[1]	Likelihood of Desired Outcome	Disturbance Interval	Level of Risk
≥ 90%	Very Likely	≤ 10%	Very Low
< 90 to ≥ 60%	Likely	> 10 to 35%	Low
< 60 to ≥ 40%	As Likely as Not	> 35 to 45%	Moderate
< 40 to ≥ %10	Unlikely	> 45 to 75%	High
< 10%	Very Unlikely	>75%	Very High

[1] *Intervals adapted from the International Panel on Climate Change 2005; time frame for assessing mean growth rate is 20 years.*

A disturbance management threshold marks the point below which (i.e. at lower levels of disturbance) range conditions are likely to meet the recovery goal with an acceptable level of risk, and above which the outcome is either highly uncertain or unacceptable. In this recovery strategy a 0.6 or 60% probability of self-sustainability (i.e. population growth is stable/increasing) is applied resulting in a maximum disturbance management threshold of 35% total disturbance (or 65% undisturbed habitat as referenced throughout the recovery strategy) (see Figure E-1). A probability of 1.0 or 100 % is ideal, however, unrealistic since 0% total disturbance is virtually impossible even without anthropogenic disturbances. The maximum disturbance management threshold of 35% at 0.6 or 60% probability of self-sustainability is a reasonable starting point providing a likely certainty of recovery, given the available information on boreal caribou at this time. It is important to emphasize that this is a maximum disturbance management threshold because there is still a risk (0.4 or 40%) that local populations will not be self-sustaining. Local populations that have greater than 35% total disturbance (or less than 65% undisturbed habitat) will first be recovered to the 35% disturbance management threshold (i.e. to achieve 65% undisturbed habitat). The disturbance management threshold may be altered in the future as more information becomes available on the associated level of risk for boreal caribou local populations to meet the recovery goal outlined in this strategy.

APPENDIX F: SUMMARY OF BOREAL CARIBOU LOCAL POPULATION CONDITION AND HABITAT CONDITION

Table F-1 provides a summary of boreal caribou local population condition and habitat condition for each of the 51 boreal caribou ranges. Boreal caribou distribution (see Figure 2) and population and habitat condition information is based on the best available information including observational and telemetry data, and biophysical analyses, provided by provincial and territorial jurisdictions (Environment Canada, 2011b). As a result of limited information on many of the ranges in Canada, only three transboundary ranges (a range that extends across a provincial or territorial boundary) have been defined: Northwest Territories range (NT1), Chinchaga range (AB1), and Lac Joseph range (NL1). As more refined information is being continually collected by jurisdictions, range delineation and population demographic information will be updated and may result in revisions to range boundaries and possibly more transboundary ranges. The assessment of self-sustainability may change when ranges that cross jurisdictional boundaries are combined. Range boundaries and integrated risk assessments will be updated annually based on new or more refined evidence provided by the provincial and territorial jurisdictions. In some cases, local population size estimates and trend data are based primarily on professional judgment and limited data, and not on rigorously collected field data.

The Range Type lists the different classification of local populations based on updated range boundaries for boreal caribou provided by jurisdictions, which were subsequently classified into three types reflecting the level of certainty in range boundaries: Conservation Units (CU - low certainty), Improved Conservation Units (ICU- medium certainty), and Local Population (LP - high certainty).

Risk assessment is the status of self-sustainability of the local populations where SS=self-sustaining; NSS = not self-sustaining; NSS/SS = as likely as not self-sustaining.

Further explanation on disturbance is provided in Section 4.2.1.

Table F-1. Boreal caribou local population condition and habitat condition information.

Range Identification	Range Name	Range Type	Population Size Estimate	Population Trend	Disturbed Habitat (%)			Risk Assessment
					Fire[1]	Anthropogenic[2]	Total[3]	
Northwest Territories								
NT1	Northwest Territories	ICU	6500	not available[4]	24	8	31	SS
British Columbia								
BC1	Maxhamish	LP	300	not available	0.5	57	58	NSS
BC2	Calendar	LP	290	not available	8	58	61	NSS
BC3	Snake-Sahtahneh	LP	360	declining	6	86	87	NSS
BC4	Parker	LP	40-60	not available	1	57	58	NSS
BC5	Prophet	LP	50-100	not available	1	77	77	NSS
Alberta								

Range Identification	Range Name	Range Type	Population Size Estimate	Population Trend	Disturbed Habitat (%)			Risk Assessment
					Fire[1]	Anthropogenic[2]	Total[3]	
AB1	Chinchaga (incl. BC portion)	LP	250	declining	8	74	76	NSS
AB2	Bistcho	LP	195	declining	20	61	71	NSS
AB3	Yates	LP	350	stable	43	21	61	NSS
AB4	Caribou Mountains	LP	315-394	declining	44	23	57	NSS
AB5	Little Smoky	LP	78	declining	0.2	95	95	NSS
AB6	Red Earth	LP	172-206	declining	30	44	62	NSS
AB7	West Side Athabasca River	LP	204-272	declining	4	68	69	NSS
AB8	Richardson	LP	150	not available	67	22	82	NSS
AB9	East Side Athabasca River	LP	90-150	declining	26	77	81	NSS
AB10	Cold Lake	LP	150	declining	32	72	85	NSS
AB11	Nipisi	LP	55	not available	6	66	68	NSS
AB12	Slave Lake	LP	65	not available	37	63	80	NSS
Saskatchewan								
SK1	Boreal Shield	CU	not available	not available	55	3	57	Unknown[5]
SK2	Boreal Plain	CU	not available	not available	26	20	42	NSS/SS
Manitoba[6]								
MB1	The Bog	ICU	50-75	stable	4	12	16	NSS/SS
MB2	Kississing	ICU	50-75	stable	39	13	51	NSS
MB3	Naosap	ICU	100-200	stable	28	26	50	NSS
MB4	Reed	ICU	100-150	stable	7	20	26	SS
MB5	North Interlake	ICU	50-75	stable	4	14	17	NSS/SS
MB6	William Lake	ICU	25-40	stable	24	10	31	NSS
MB7	Wabowden	ICU	200-225	stable	10	19	28	SS
MB8	Wapisu	ICU	110-125	stable	10	14	24	SS
MB9	Manitoba North	CU	not available	not available	23	16	37	NSS/SS
MB10	Manitoba South	CU	not available	not available	4	13	17	SS
MB11	Manitoba East	CU	not available	not available	26	3	29	SS
MB12	Atikaki-Berens	ICU	300-500	stable	31	6	35	SS

Range Identification	Range Name	Range Type	Population Size Estimate	Population Trend	Disturbed Habitat (%)			Risk Assessment
					Fire[1]	Anthropogenic[2]	Total[3]	
MB13	Owl-Flinstone	LP	78	stable	25	18	39	NSS/SS
Ontario[7]								
ON1	Sydney	ICU	not available	stable	28	33	58	NSS
ON2	Berens	ICU	not available	not available	34	7	39	NSS/SS
ON3	Churchill	ICU	not available	not available	6	28	31	SS
ON4	Brightsand	ICU	not available	not available	18	28	42	NSS/SS
ON5	Nipigon	ICU	300	stable	7	25	31	SS
ON6	Coastal	CU	492	not available	0	16	16	SS
ON7	Pagwachuan	ICU	not available	not available	0.9	26	27	SS
ON8	Kesagami	ICU	492	declining	3	36	38	NSS
ON9[8]	Far North	CU	not available	not available	14	1	15	SS
Quebec								
QC1	Val d'Or	LP	30	declining	0.1	60	60	NSS
QC2	Charlevoix	LP	75	stable	4	77	80	NSS
QC3	Pipmuacan	ICU	134	stable	11	51	59	NSS
QC4	Manouane	ICU	358	stable	18	23	39	NSS/SS
QC5	Manicouagan	ICU	181	increasing	3	32	33	SS
QC6[8]	Quebec	CU	9000	stable	20	12	30	SS
Newfoundland and Labrador								
NL1[9]	Lac Joseph	LP	1282	declining	7	1	8	NSS/SS
NL2	Red Wine Mountain	LP	97	declining	5	3	8	NSS
NL3[9]	Mealy Mountain	LP	1604	declining	0.4	1	2	NSS/SS

[1] Fire disturbance is any area where a fire has occurred in the past 40 years (without buffer).

[2] For anthropogenic disturbance, a 500 meter buffer is applied to all linear and polygonal disturbances.

[3] For total disturbance, both anthropogenic and fire disturbances that overlap are not counted twice in the total.

[4] Some trend data exists for local study areas within Northwest Territories, but it is insufficient to establish a range-level trend.

[5] The high fire in combination with very low anthropogenic disturbance estimates for northern Saskatchewan's Boreal Shield range (SK1) represent a unique situation that falls outside the range of variability observed in the data that informed the disturbance model used by Environment Canada (2011b) as a component of the integrated risk assessment framework. The probability of self-sustaining is reported as "unknown" due to the uniqueness of the disturbance regime and the uncertainty about the status of the population. Nevertheless, the high fire (55%) observed for northern Saskatchewan's Boreal Shield range (SK1) warrants caution with respect to additional anthropogenic disturbance. This is further explained below under the heading: "Detailed Explanation for Integrated Risk Assessment for Boreal Shield (SK1)".

[6] The Government of Manitoba is in the process of updating their range boundaries. This will result in an update to current range delineations, as well as a revision of their self-sustainability status following integrated risk assessment of any new range boundaries.

[7] *A total of 5000 boreal caribou were reported for Ontario in 2008 (Ontario Woodland Caribou Recovery Team, 2008).*

[8] *The range is likely made up of several populations for which the self-sustainability status may vary. New data is currently being collected by the provincial jurisdiction for this range. This may result in an update to the range delineation and/or the identification of new ranges, as well as a revision of their self-sustainability status following integrated risk assessment of new ranges or new range boundaries.*

[9] *The Government of Newfoundland and Labrador has provided data that indicates a recent decline for Mealy Mountain and Lac Joseph. The data provided does not meet the criteria of lambda reported for 3 years or more in the last 10 years as defined in the assessment process but does provide evidence for caution. Therefore, even though the habitat condition for these two ranges indicates "very likely" to be self-sustaining, they have been assigned a status of "as likely as not" based on this reported decline. These populations should be carefully monitored and a re-assessment completed.*

Detailed Explanation for Integrated Risk Assessment for Boreal Shield (SK1)

The integrated assessment applied in the 2011 Science Assessment was based on three lines of evidence: i) population trend, ii) population size and iii) habitat condition (as defined by amount of total disturbance). If data was not available for one of the lines of evidence the assessment was still based on lines of evidence with available data. A measure of disturbance was available for all boreal caribou ranges.

There is no trend data or population data for SK1. There were population estimates provided by Saskatchewan for four previously defined management units across the boreal shield based on estimated area of habitat and average density of caribou, however, no formal surveys have been carried out in SK1. Disturbance was measured using same methods applied to all ranges and as described in Environment Canada (2011b).

The probability of a self-sustaining status for the habitat condition was dependent on a relationship between total disturbance and recruitment developed through a meta-analysis of study areas across Canada. The range of conditions for anthropogenic and fire disturbance in the meta-analysis is representative of the range of disturbance values for caribou ranges assessed across Canada with the exception of SK1. SK1 disturbance is comprised of 3% buffered anthropogenic and 55% fire resulting in total non-over lapping disturbance of 57%. For SK1, the proportion of total disturbance that is anthropogenic is outside of the data range (5% for SK1 as compared to 12% to 100% for meta- analysis study areas). The highest percent fire in the meta-analysis data set is represented in two of the 24 study areas with 41 and 42 % fire with 8% and 23% anthropogenic disturbance respectively.

As such, the uncertainty associated with application of the model to SK1 is greater than for the remaining 50 Ranges. Therefore the meta-analysis model was not applied to SK1 to provide an integrated assessment or to inform the identification of critical habitat.

In the absence of the application of the disturbance model to provide an integrated assessment, the probability of self-sustaining for SK1 has been reported as “unknown”, but caution with respect to additional anthropogenic disturbance is warranted based on the following:

- At this time there are no trend data for SK1 to indicate if caribou numbers are stable, increasing or declining and there are no reliable population estimates.

- The meta-analysis (and past analysis in the published literature) has demonstrated that it is the cumulative effects of anthropogenic disturbance with fire that contribute to the relationship between disturbance and caribou recruitment. Although several models were tested in Environment Canada (2011b) that separated anthropogenic and fire disturbance, the top model (using Akaike's Information Criterion - AIC) was the total disturbance (one variable) model. It is conceivable that additional data from high fire - low anthropogenic study areas could result in a two variable model performing better and allowing greater differentiation of the relative contributions of fire and anthropogenic effects.
- Although caribou adapt to fire by shifting use to unburned areas until burned areas recover, this adaptation strategy is dependent on alternate undisturbed areas being available for caribou use. Examination of the trend in cumulative area burned does demonstrate an increase in rate of burn since the 1970's as compared to previous period (1945-70). Review of literature that has examined evidence for changes in fire regimes in the boreal due to climate change indicates that the area burned by forest fires in Canada has increased over the past four decades, at the same time as summer season temperatures have warmed (Van Wagner, 1988; Skinner et al., 1999, 2002; Podur et al., 2002; Stocks et al., 2003; Gillet et al., 2004).
- Given that SK1 has a high level of fire disturbance (55%) that contributes to the high level of total disturbance (57%), caution is warranted in terms of additional anthropogenic disturbance until trend data is available for SK1. Population trend data showing a stable or increasing trend based on lambda measured for 3 years within a 10 year period would result in an assignment of self-sustaining for SK1. Data collected in the interim could, nevertheless, still be used to inform the potential risk of not meeting the recovery goal of self-sustainability.
- Continuous improvement of the meta-analysis will be pursued to increase an understanding of factors such as relative contributions of fire and anthropogenic effects on patterns of disturbance, impacts on quality of remaining habitat, etc. Collection of recruitment data from a sample of "high fire - very low anthropogenic" study areas, collected over a minimum of 2 years from radio collared adult females, would expand the range and amount of data for the meta-analysis to include conditions representative of SK1 and may provide greater understanding of the relative contributions of fire and anthropogenic disturbances. The updated model (with the additional data) could then be applied to SK1 to provide the habitat condition indicator as a component of the integrated assessment and to inform critical habitat identification.

APPENDIX G: DETAILS ON THE IDENTIFICATION OF CRITICAL HABITAT FOR BOREAL CARIBOU

Table G-1 provides a summary of boreal caribou habitat condition for each of the 51 boreal caribou ranges. Boreal caribou distribution (see Figure 2) and habitat condition information is based on the best available information including observational and telemetry data, and biophysical analyses, provided by provincial and territorial jurisdictions (Environment Canada, 2011b). As a result of limited information on many of the ranges in Canada, only three transboundary ranges (a range that extends across a provincial or territorial boundary) have been defined: Northwest Territories range (NT1), Chinchaga range (AB1), and Lac Joseph range (NL1). As more refined information is being continually collected by jurisdictions, range delineation and population demographic information will be updated and may result in revisions to range boundaries and possibly more transboundary ranges. The assessment of self-sustainability may change when ranges that cross jurisdictional boundaries are combined. Range boundaries and integrated risk assessments will be updated annually based on new or more refined evidence provided by the provincial and territorial jurisdictions.

As described in Section 7.1.1, the identification of critical habitat for boreal caribou is comprised of three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

Table G-1. Boreal caribou critical habitat information.

Range Identification	Location	Amount					Type
	Range Name	Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Biophysical Attributes (see corresponding ecozone table in Appendix H)
			Fire[1]	Anthropogenic[2]	Total[3]		
Northwest Territories							
NT1	Northwest Territories	44,166,546	24	8	31	69	Taiga Plain Boreal Plain Southern Arctic Taiga Cordillera
British Columbia							
BC1	Maxhamish	710,105	0.5	57	58	42	Taiga Plain
BC2	Calendar	496,393	8	58	61	39	Taiga Plain
BC3	Snake-Sahtahneh	1,198,752	6	86	87	13	Taiga Plain
BC4	Parker	75,222	1	57	58	42	Taiga Plain
BC5	Prophet	119,396	1	77	77	23	Taiga Plain
Alberta							
AB1	Chinchaga (incl. BC portion)	3,162,612	8	74	76	24	Taiga Plain, Boreal Plain
AB2	Bistcho	1,436,555	20	61	71	29	Taiga Plain
AB3	Yates	523,094	43	21	61	39	Taiga Plain

Range Identification	Location	Amount					Type
	Range Name	Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Biophysical Attributes (see corresponding ecozone table in Appendix H)
			Fire[1]	Anthropogenic[2]	Total[3]		
AB4	Caribou Mountains	2,069,000	44	23	57	43	Taiga Plain Boreal Plain
AB5	Little Smoky	308,606	0.2	95	95	5	Montane Cordillera Boreal Plain
AB6	Red Earth	2,473,729	30	44	62	38	Boreal Plain
AB7	West Side Athabasca River	1,572,652	4	68	69	31	Boreal Plain
AB8	Richardson	707,350	67	22	82	18	Boreal Shield(West) Boreal Plain
AB9	East Side Athabasca River	1,315,980	26	77	81	19	Boreal Plain
AB10	Cold Lake	672,422	32	72	85	15	Boreal Plain
AB11	Nipisi	210,771	6	66	68	32	Boreal Plain
AB12	Slave Lake	151,904	37	63	80	20	Boreal Plain
Saskatchewan							
SK1	Boreal Shield	18,034,870	55	3	57	43	Taiga Shield Boreal Shield(West)
SK2	Boreal Plain	10,592,463,	26	20	42	58	Boreal Plain
Manitoba							
MB1	The Bog	446,383	4	12	16	84	Boreal Plain
MB2	Kississing	317,029	39	13	51	49	Boreal Shield(West)
MB3	Naosap	456,977	28	26	50	50	Boreal Shield(West) Boreal Plain
MB4	Reed	357, 425	7	20	26	74	Boreal Shield(West) Boreal Plain
MB5	North Interlake	489,680	4	14	17	83	Boreal Plain
MB6	William Lake	488,219	24	10	31	69	Boreal Plain
MB7	Wabowden	628,938	10	19	28	72	Boreal Shield(West) Boreal Plain
MB8	Wapisu	565,044	10	14	24	76	Boreal Shield(West)

Range Identification	Location	Amount					Type
	Range Name	Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Biophysical Attributes (see corresponding ecozone table in Appendix H)
			Fire[1]	Anthropogenic[2]	Total[3]		
MB9	Manitoba North	6,205,520	23	16	37	63	Boreal Shield (West)
							Boreal Plain
MB10	Manitoba South	1,867,255	4	13	17	83	Boreal Plain
MB11	Manitoba East	6,612,782	26	3	29	71	Boreal Shield (West and West Central)
MB12	Atikaki-Berens	2,387,665	31	6	35	65	Boreal Shield (West Central)
MB13	Owl-Flinstone	363,570	25	18	39	61	Boreal Shield (West Central)
Ontario							
ON1	Sydney	753,001	28	33	58	42	Boreal Shield (West Central)
ON2	Berens	2,794,835	34	7	39	61	Boreal Shield (West Central)
ON3	Churchill	2,150,490	6	28	31	69	Boreal Shield (West Central)
ON4	Brightsand	2,220,921	18	28	42	58	Boreal Shield (West Central)
ON5	Nipigon	3,885,026	7	25	31	69	Boreal Shield (West and West Central)
ON6	Coastal	376,598	0	16	16	84	Boreal Shield (Central)
ON7	Pagwachuan	4,542,918	0.9	26	27	73	Hudson Plain
							Boreal Shield (Central)
ON8	Kesagami	4,766,463	3	36	38	62	Hudson Plain
							Boreal Shield (Central)
ON9	Far North	28,265,143	14	1	15	85	Hudson Plain
							Boreal Shield (West, Southeast, Central)
Quebec							
QC1	Val d'Or	346,861	0.1	60	60	40	Boreal Shield (Southeast)
QC2	Charlevoix	312,803	4	77	80	20	Boreal Shield (Southeast)

Range Identification	Location	Amount					Type
	Range Name	Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Biophysical Attributes (see corresponding ecozone table in Appendix H)
			Fire[1]	Anthropogenic[2]	Total[3]		
QC3	Pipmuacan	1,376,899	11	51	59	41	Boreal Shield (East)
QC4	Manouane	2,716,449	18	23	39	61	Boreal Shield (East)
QC5	Manicouagan	1,134,129	3	32	33	67	Boreal Shield (East)
QC6	Quebec	62,156,186	20	12	30	70	Boreal Shield (Central, East)
Newfoundland and Labrador							
NL1	Lac Joseph	5,802,491	7	1	8	92	Taiga Shield Boreal Shield (East)
NL2	Red Wine Mountain	5,838,594	5	3	8	92	Taiga Shield Boreal Shield (East)
NL3	Mealy Mountain	3,948,463	0.4	1	2	98	Taiga Shield Boreal Shield (East)

[1] *Fire disturbance is any area where a fire has occurred in the past 40 years (without buffer).*

[2] *For anthropogenic disturbance, a 500 meter buffer is applied to all linear and polygonal disturbances.*

[3] *For total disturbance, both anthropogenic and fire disturbances that overlap are not counted twice in the total.*

APPENDIX H: BIOPHYSICAL ATTRIBUTES FOR BOREAL CARIBOU CRITICAL HABITAT

Biophysical Attributes

Aboriginal Traditional Knowledge (Boreal Caribou ATK Reports, 2010-2011), habitat selection analyses, and scientific published reports (Environment Canada, 2011b) were used to summarize biophysical attributes required by boreal caribou to carry out life processes necessary for survival and recovery. Results are provided by ecozone and ecoregion in order to capture the ecological variation across the distribution of boreal caribou.

Boreal Caribou Ranges by Ecozone and Ecoregion

Boreal caribou are distributed in the boreal forest across eight ecozones in Canada including: Taiga Plain, Montane Cordillera, Taiga Shield, Boreal Plain, Boreal Shield, Hudson Plain, Southern Arctic, and Taiga Cordillera. The largest ecozone, Boreal Shield, is further divided into five ecoregions: Boreal Shield West, Boreal Shield West Central, Boreal Shield Central, Boreal Shield East, and Boreal Shield South East (see Figure H-1).

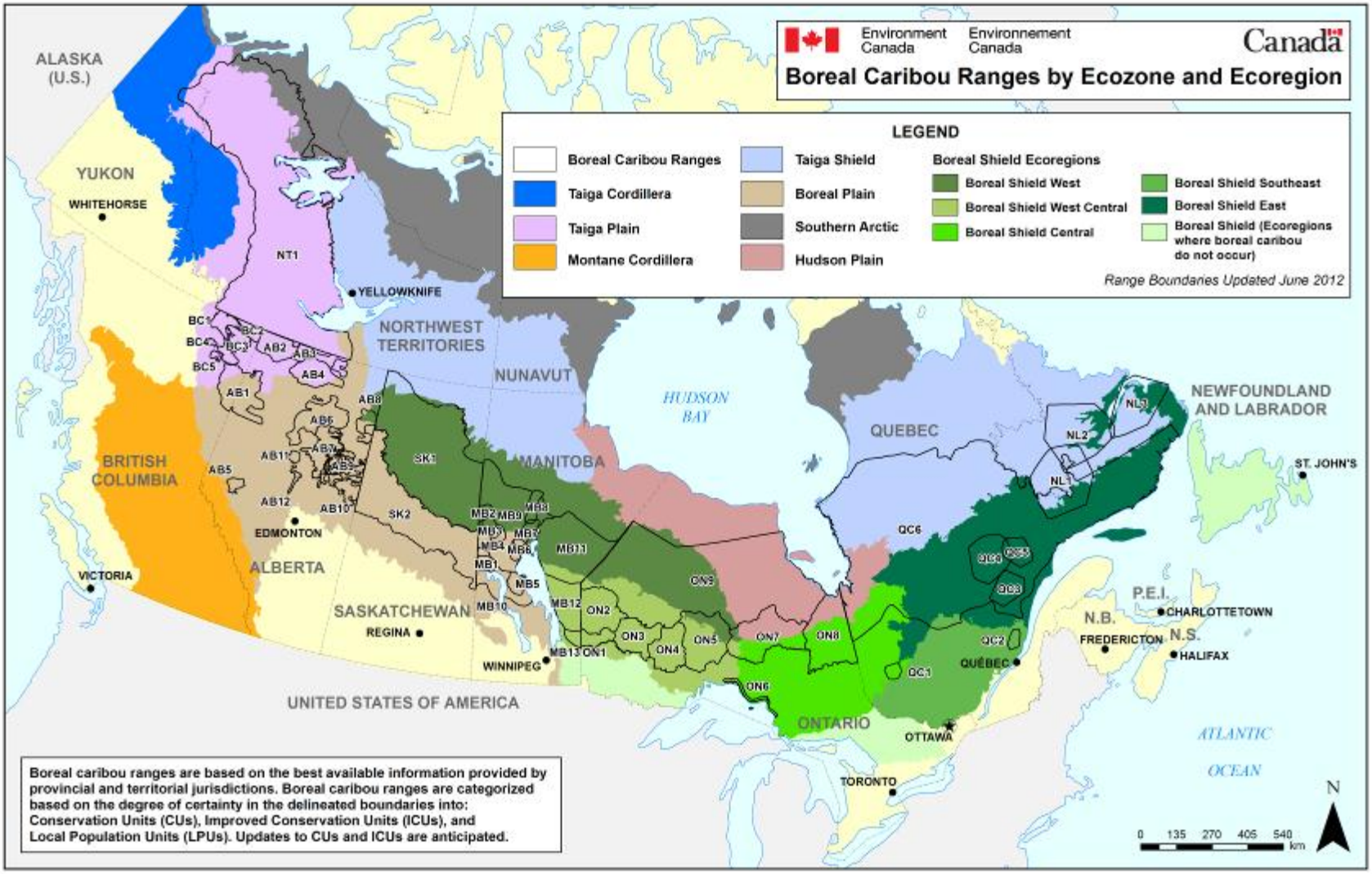

Figure H-1. Boreal caribou distribution across ecozones and ecoregions in Canada.

Biophysical Attribute Descriptions

The biophysical attributes for boreal caribou critical habitat are categorized by the types of habitat used by boreal caribou in accordance with seasonal and life-stage activity which include broad scale, calving, post-calving, rutting, wintering, and travel. This information is provided in the following tables by ecozone and ecoregion.

Biophysical attributes will vary both between and within boreal caribou ranges. As the biophysical attributes presented in this recovery strategy were developed at a national scale by ecozone and ecoregion, and not by local population, it is anticipated that each provincial and territorial jurisdiction may have or will develop over time, a more refined description of the biophysical attributes required for each range. Biophysical attributes specific to boreal caribou ranges in Labrador have been provided by the jurisdiction and are included in Table H-6 below.

Table H-1. Biophysical attributes for boreal caribou critical habitat in the Taiga Plain ecozone.

Type of habitat	Description
Broad scale	Mature forests (jack pine, spruce, and tamarack) of 100 years or older, and open coniferous habitat. Large areas of spruce peat land and muskeg with preference for bogs over fens and upland and lowland black spruce forests with abundant lichens, and sedge and moss availability. Flatter areas with smaller trees and willows, hills and higher ground.
Calving	Open coniferous forests, tussock tundra, low shrub, riparian, recent burned areas, south and west aspects and hills and higher locations. Muskegs, marshes, staying close to water sources. Caribou observed on small islands of mature black spruce or mixed forests within peat lands, in old burns at the edge of wetlands, in alder thickets with abundant standing water and on lake shores.
Post-calving	Muskegs or areas with access to muskegs, open meadows on higher ground, close to water (lakes and rivers) and mixed bush areas. Open coniferous forests with abundant lichens, low shrub, riparian, tussock tundra, sparsely vegetative habitat, recent burns and west aspects. Old burns and neighbouring remnant unburned forests selected in late spring and early summer.
Rutting	Open coniferous and mixed wood forests, low shrub, riparian, tussock tundra, recent burns and west aspect. Still use muskegs that harbor ground lichen and sedges, mixed bush areas, areas of higher ground. Regenerating burns and sparsely vegetated habitat.
Winter	Open coniferous forests (black spruce and pine) that provide adequate cover with abundant lichens, riparian areas. Caribou observed in muskeg areas in early winter. Spruce-lichen forests, fire regenerated, sparsely vegetated habitat, herbaceous and tall shrub habitat and sphagnum moss with scattered spruce. As snow depth increases, they remain more often in areas of dense pine or thickly wooded black spruce, with hanging lichen and remains access to open, mixed vegetation for ground forage.
Travel	Females show high fidelity to calving sites among years (i.e. within 14.5 km). Many caribou shift the pattern of use based on seasonal preferences, in large multi-habitat areas. Rates of movement increase during the rut and are greatest in winter.

Table H-2. Biophysical attributes for boreal caribou critical habitat in the Montane Cordillera ecozone.

Type of habitat	Description
Broad scale	Upland lodge pole pine, mixed conifer lodgepole pine/black spruce and treed muskeg areas with abundant lichens. Open, pine dominated stands of 80 years or more.
Calving	Areas closer to cut-blocks with a high proportion of larch are selected during calving. Lower mountain peaks.
Post-calving	Homogeneous areas of conifer dominated stands.
Rutting	No information on rutting habitat currently available.
Winter	Caribou use areas with a high proportion of larch and pine forests during winter.

Table H-3. Biophysical attributes for boreal caribou critical habitat in the Taiga Shield ecozone (see Table H-6 for biophysical attributes more specific to Labrador ranges).

Type of habitat	Description
Broad scale	Upland tundra dominated by ericaceous shrubs (*Ericaceae* spp.), lichen, grasses and sedges. Lowland tundra composed of peat land complexes (muskeg and string bogs), wetlands (swamps, marshes), lakes, rivers and riparian valleys. Dense mature jack pine and black spruce stands with balsam fir and tamarack present and open conifer forests with abundant lichens.
Calving	String bogs, treed bogs, small open wetlands (< 1 km^2), large muskeg, marshes along water bodies. Barren grounds. Calving on peninsulas and islands increases with amount of open water.
Post-calving	Forested wetlands. Hilly areas, coastal sites, along shorelines of water bodies (rivers, lakes, creeks), marshes with lichen availability.
Rutting	Open wetlands, swamps. Mature forests, mountainous terrain with forests of black spruce, tamarack and pine trees with abundant lichen.
Winter	Forested areas are used in years of low snow accumulation; otherwise winter habitat selection reflects general avoidance of deep snow, including use of tundra habitat at higher elevations in mountainous regions and bogs along lakes or oceans. Forested wetlands. Tundra uplands and sand flats in proximity to water. Barren grounds. Bog edges, glacial erratics and bedrock erratics with lichen and lakes. Some use of mature white spruce and fir stands as alternative to habitat with arboreal lichens. Mix of mature forest stands, mountainous terrain with forests of black spruce, tamarack and jack pine with abundant lichen.
Travel	Connectivity between selected habitat types important given reported patterns of movement among caribou. Some animals have been reported to travel up to distances of approximately 200 km, although the majority of animals appear to move shorter distances. Females show fidelity to post-calving sites returning to within 6.7 km of a given location in consecutive years.

Table H-4. Biophysical attributes for boreal caribou critical habitat in the Boreal Plain ecozone.

Type of habitat	Description
Broad scale	Late seral-stage (> 50 years old) conifer forest (jack pine, black spruce, tamarack), treed peat lands, muskegs or bogs, use dry islands in the middle of muskegs, with abundant lichens. Hilly or higher ground and small lakes. Restricted primarily to peat land complexes. Higher elevations (~1135 m). Selected old (>40 years) burns.
Calving	Bogs and mature forests selected for calving as well as islands and small lakes. Peat lands and stands dominated by black spruce and lowland black spruce stands within muskeg are used for calving.
Post-calving	Forest stands older than 50 yrs. Upland black spruce/jack pine forests, lowland black spruce, young jack pine and open and treed peat lands and muskeg are also selected during summer. Use lichen and low muskeg vegetation. In some areas, sites with abundant arboreal lichen are selected during summer.
Rutting	Mature forests. Upland black spruce/jack pine forests, lowland black spruce, young jack pine and open and treed peat lands and muskeg during summer.
Winter	Treed peat lands, treed bog and treed fen and open fen complexes with > 50% peat land coverage with high abundance of lichens. Use of small lakes, rock outcrops on lakes for lichen access. Mature forest > 50 years old. Upland black spruce/jack pine forests, lowland black spruce, young jack pine and open and treed peat lands.

Table H-4a. Biophysical attributes for boreal caribou critical habitat in the Boreal Shield West ecoregion.

Type of habitat	Description
Broad scale	Conifer/tamarack-dominated peat land complexes, muskegs or bogs, use dry islands in the middle of muskegs and upland moderate to dense mature conifer forests (jack pine, black spruce, tamarack) with abundant lichens. Hilly or higher ground, lots of smaller lakes in area.
Calving	Peat lands, stands dominated by black spruce, mature forest stands and treed muskeg all used for calving. Caribou will use islands, small lakes, lakeshores during calving.
Post-calving	Wooded lakeshores, islands, sparsely treed rock, upland conifer-spruce and treed muskeg are used in summer. Sites with a high abundance of arboreal lichen are important for foraging in some areas. Dense conifer and mixed forest are also used.
Rutting	Dense and sparse conifer and mixed forests. Open riparian habitats are also used during the rut.
Winter	Mature upland spruce, pine stands and treed muskeg. Jack pine dominated forests. Caribou select sparse and dense conifer, mixed forests and treed bogs. In some areas caribou will select habitat with greater visibility and further away from forest edges.
Travel	Some males move > 100 km during the rutting season. Traditional travel routes between summer and winter ranges occur in large peat land complexes. Caribou migrate in a north to south pattern.

Table H-4b. Biophysical attributes of boreal caribou habitat in the Boreal Shield West Central ecoregion.

Type of habitat	Description
Broad scale	Mature conifer uplands and conifer/tamarack dominated lowlands. Conifer/tamarack-dominated peat lands, muskegs with abundant arboreal lichens, upland mature conifer forests stands with abundant terrestrial lichen and rocky areas with sparse trees. Elevations of 300 m. Intermediate values of Normalized Difference Vegetation Index[1]. Selection for old (>40 years) burns.
Calving	Forested wetlands/treed bog, old burns, sparse conifer and dense spruce. Need lichen availability. Peat lands, raised hillrocks with large muskeg areas, forested islands and shorelines of large lakes selected during calving. Jack pine or jack pine/black spruce forests also used for calving.
Post-calving	Peat land with forested islands, islands, and shorelines selected during summer. Mature, dense forest stands.
Rutting	Semi-open and open bogs and mature conifer uplands selected during rutting. Terrestrial lichens and arboreal lichens, sedges and bog ericoids (*Andromeda glaucophylla, Chamaedaphne calyculata, Kalmia polifolia,* and *Ledum groenlandicum*) are important sources of forage.
Winter	Mature coniferous stands. Areas with a high proportion of lakes (> 5-100 ha) with convoluted shorelines. Caribou forage in areas with high lichen abundance and fewer shrubs in jack pine and black spruce stands with low tree densities, low basal areas and short heights. Caribou select open bogs, intermediate to mature jack pine rock ridges, jack pine habitats with lichens and lakes, but move to jack pine ridges in mature conifer stands with lichen when winter conditions prevent foraging in bogs. Arboreal lichens, terrestrial lichens, sedges and ericaceous species are an important source of forage.
Travel	Travel mainly in conifer forests, avoiding open habitats (e.g. lakes, disturbed areas, etc.) when migrating from summer to winter habitat. Use frozen lakes for travel during winter/spring, in some instances to reach islands for calving. Spring migration is not restricted to specific travel routes. Some move at a range of 100 km during the rutting season. Caribou moved 8-60 km away after logging operations were begun.

Table H-4c. Biophysical attributes for boreal caribou critical habitat in the Boreal Shield Central ecoregion.

Type of habitat	Description
Broad scale	Late seral-stage black spruce-dominated lowlands and jack pine dominated uplands. Open black spruce lowlands. Low-density late seral-stage jack pine or black spruce forests and black spruce/tamarack-dominated peat lands with abundant terrestrial and moderate arboreal lichens. Caribou also use areas with dry to moist sandy to loamy soils and shallow soils over bedrock. Elevations of 300 m. Intermediate values of Normalized Difference Vegetation Index[1]. Selection for old (>40 years) burns.
Calving	Open canopies of mature black spruce and mesic peat land with ericaceous species for calving are selected for calving in the Claybelt region. Females with calves selected areas with more abundant ericaceous shrubs and terrestrial lichens during the summer compared to females without calves.
Winter	Large areas of contiguous forests dominated by black spruce. Open conifer forests or forests with lower tree densities where terrestrial and arboreal lichen are abundant and there is significant less snow (e.g. shorelines) are also selected.

Table H-4d. Biophysical attributes for boreal caribou critical habitat in the Boreal Shield East ecoregion (see Table H-6 for biophysical attributes more specific to Labrador ranges).

Type of habitat	Description
Broad scale	Conifer-feather moss forests on poorly-drained sites and mature conifer uplands with abundant terrestrial lichen. Black spruce, jack pine and balsam fir stands present with abundant lichen. Water bodies and wetlands (swamps, marshy areas with tamarack). Mountains or rolling hills. Elevations of 300 m. Intermediate values of Normalized Difference Vegetation Index[1]. Selection for old (>40 years) burns.
Calving	Open wetlands, peninsulas and islands. Sedges, ericaceous species, bryophytes, alder and larch selected in spring. Balsam fir, dense black spruce stands, spruce-fir forests older than 40 years, and dry bare land with high lichen densities. Mature conifer stands, as well as wetlands (marshes, peat moss areas). Higher altitudes used for calving in this area rather than lake or water bodies.
Post-calving	Open and forested wetlands (marshes, swamps), and continued use of peninsulas and islands. Hilly areas, coastal sites, shorelines (rivers, lakes, creeks). Aquatic plants, dwarf birch (*Betula glandulosa*), deciduous shrubs, ericaceous species and moss.
Rutting	Open wetlands selected, swamps. Terrestrial and arboreal lichens, forbs, sedges, mosses and coniferous and deciduous shrubs. Balsam fir stands, dense spruce stands, mature and regenerating conifer stands, other forest stands (tamarack, pine) with abundant lichens, wetlands (swamps) and dry bare lands.
Winter	Forested wetlands. Some use of upland-tundra for loafing. Mountainous terrain. Dry bare land, wetlands, mature conifer forests with lichen, balsam fir stands, dense spruce stands, and mixed spruce-fir forests older than 40 years selected in southern areas. Observed along frozen bodies of water. Use of mature forests protected from harvesting increases probability of encounters with wolves that select the same habitats in winter. Shallow snow depths selected in late winter.
Travel	Caribou move greater distances during the rutting season.

Table H-4e. Biophysical attributes for boreal caribou critical habitat in the Boreal Shield Southeast ecoregion.

Type of habitat	Description
Broad scale	Late seral-stage black spruce-dominated lowlands and jack pine-dominated uplands, Balsam fir stands, marshlands and abundant lichen.
Calving	Open, medium-closed conifer forests. Elevations of 300 m. Intermediate values of Normalized Difference Vegetation Index[1]. Selection for old (>40 years) burns.
Rutting	Dense and open mature conifer forests of spruce, tamarack, jack pine and young conifer forests between 30 – 50 years old.
Winter	Open stands of balsam fir, balsam fir-black spruce, black spruce, black-spruce-tamarack and jack pine stands older than 70 yrs. Dry bare lands, 30-50 year old stands of balsam fir or fir-black spruce, as well as 50 year old jack pine stands, and arboreal and terrestrial lichens.

Table H-5. Biophysical attributes for boreal caribou critical habitat in the Hudson Plain ecozone.

Type of habitat	Description
Broad scale	Habitats selected generally to reduce predation risk. Shrub rich treed muskeg and mature conifer forests abundant in lichens. Shorelines of deep lakes and rivers (birch trees). Poorly drained areas dominated by sedges, mosses and lichens, as well as open black spruce and tamarack forests. Elevations of 150m. Intermediate levels of ruggedness[1] and Normalized Difference Vegetation Index[2].
Calving	Mature conifer stand with and without lichens and muskegs. Preference for higher altitudes compared to habitat use during other periods.
Post-calving	Fens, bogs and lakes.
Rutting	Wetlands and conifer stands with lichen. Mature and regenerating conifer stands are also used, albeit to a lesser degree. Caribou use hills in the lowlands, treed islands in muskegs with several different tree species.
Winter	Dense and mature conifer forests with lichens and wetlands. Peat lands dominated by open bogs and terrestrial lichens. Large patches of intermediate and mature black spruce, shrub-rich treed muskeg and mixed conifer stands all used in late winter.
Travel	Movements greatest in fall/winter when caribou transition from calving to winter habitat. Long range movements are greater in areas with high moose densities, presumably to reduce predation risk.

[1] *Vector ruggedness is a metric used to capture variability in slope and aspect.*

[2] *Normalized Difference Vegetation Index (NDVI) is an index that provides a standardized method of comparing vegetation greenness between satellite images.*

NOTE: A small portion of boreal caribou critical habitat in the northern portion of the Northwest Territories range falls within the Southern Arctic ecozone and the Taiga Cordillera ecozone. Currently, there is no information available on boreal caribou habitat use or biophysical attributes in either of these ecozones. Biophysical attributes in the Taiga Plain ecozone are used to describe the type of habitat needed for the identification of critical habitat for boreal caribou in the Southern Arctic and Taiga Cordillera ecozones.

Biophysical attributes specific to Labrador ranges, containing detailed information as made available by the jurisdiction.

Table H-6. Biophysical attributes of boreal caribou critical habitat in the Taiga Shield ecozone and Boreal Shield East ecoregion, specific to Labrador ranges.

Type of habitat	Description
Broad scale	Subarctic and boreal forests. Tundra and low shrubs at high elevations. Numerous lakes, peatlands (string, plateau and basin bogs, ribbed and ladder fens) and peatland complexes of several wetland types adjacent and contiguous to each other, broad river valleys. Lichen woodlands, new and regenerating burns. Intermediate values of Normalized Difference Vegetation Index[1]. <u>Lac Joseph (NL1)</u> Mid and low subarctic forests characterized by open coniferous forests, eskers and upland plateaus. Black spruce dominant; jackpine and trembling aspen occur sporadically. Poorly-drained sites characterized by extensive ribbed fen-string bog complexes bordered by black-spruce sphagnum stands. Well drained sites and river uplands often containing open lichen woodlands. Lakes comprising approximately 15%of range, including Lac Joseph, Lake Ashuanipi and Atikonak Lakes. <u>Red Wine Mountain (NL2)</u> High boreal forest and alpine areas in addition to low subarctic forest. Boreal forest portions contain productive, close-canopied boreal forests, with deep river valleys. Black spruce predominant, while some balsam fir, white birch, and trembling aspen also occur. Dominant topographical feature are the Red Wine Mountains (600m- 900m asl), and an extensive upland boreal plateau consisting of a mosaic of extensive string bogs and open conifer forest (400 m asl). Alpine areas with tundra vegetation; larch and black spruce on lower valley slopes. <u>Mealy Mountain (NL3)</u> Extensive tree-less coastal barrens and offshore islands with tundra-like vegetation, and extensive string bogs and open pools of water, with hummocks dominated by scrub spruce and Labrador tea on the Eagle River Plateau. Mid-boreal forest characterized by closed-canopied black spruce and balsam fir forests. Eskers which occasionally support ribbons of lichen woodland. Dominant topographical feature is the Mealy Mountain range (1000m asl), containing alpine areas with tundra vegetation.
Calving	Muskegs, lakes and islands, peninsulas of large lakes, or combinations of these features. Mature, dense conifer stands (>90 years) with a sphagnum, forb or shrub understory, particularly when in proximity to wetlands or lakes.
Post-calving and summer	Immediately post calving: wetlands and areas with open water, and adjacent areas of mature, dense coniferous forest. Summer (July through September) and early fall: broader array of vegetation communities in the vicinity of their calving areas, including mature coniferous forests with a shrub or moss/forb understory, treed bogs and some open-canopied woodlands with an extensive shrub understory. Open and forested wetlands (muskeg, treed bogs) and continued use of peninsulas and islands, shorelines (rivers, lakes, creeks). Riparian plants, dwarf birch (*Betula glandulosa*), willow, ericaceous shrubs, forbs grasses and sedges for forage.
Rutting	Wetlands and areas with open water, and adjacent areas of mature, dense coniferous forest. Mature coniferous forests with a shrub or moss/forb understory, treed bogs and some open-canopied woodlands with an extensive shrub understory. Open and forested wetlands (muskeg, treed bogs) and continued use of peninsulas and islands, shorelines

Type of habitat	Description
	(rivers, lakes, creeks). Riparian plants, dwarf birch (*Betula glandulosa*), willow, ericaceous shrubs, forbs and sedges for forage.
Winter	Early winter (November through January): lichen woodlands and lichen-shrub woodlands. Occasional use of wetlands. Late winter: lichen woodlands, ice-covered water bodies (for rest and as a refuge), and regenerating burns (with shrub and Cladina mitis understory) in some cases. Extensive use of coastal barrens in Mealy Mountain range. Some use of Alpine areas in Red Wine Mountain and Mealy Mountain range.
Travel	During spring and fall migration, select open habitats that are easy to travel through. In particular, during spring migration select for (frozen) wetlands and burns, and during fall migration added open lichen woodlands to the latter cover classes. Most females travel up to 20 km from winter areas to calving sites, but can move by as much as 120 km.

[1] *Normalized Difference Vegetation Index (NDVI) is an index that provides a standardized method of comparing vegetation greenness between satellite images.*

APPENDIX I: MITIGATION TECHNIQUES TO AVOID DESTRUCTION OF CRITICAL HABITAT

Mitigation of the adverse effects that may result from a proposed project on boreal caribou could include different techniques. These techniques include avoiding destruction of undisturbed habitat or biophysical attributes necessary for the species to carry out life processes, reducing noise or pollution, or minimizing disturbance by adapting its shape or adjusting the timing of the disturbance. Table I-1 provides examples of considerations and possible mitigation techniques when planning development within a boreal caribou range.

Table I-1. Examples of considerations when planning development within a boreal caribou range and possible mitigation techniques.

Considerations when planning development	Examples of possible mitigation techniques
Threshold of disturbance in the short- and long-term	Minimize the footprint of development, consider locations where habitat is already disturbed; restore habitat to provide continual availability of undisturbed habitat over time.
Ecological factors	Avoid destruction of biophysical attributes (see Appendix H).
Spatial configuration	Minimize disturbance by adapting its shape (small polygon vs. linear).
Sensory disturbances	Mitigation of noise, light, smells, vibrations to prevent harassment of boreal caribou.
Pollution	Mitigate pollution through scrubbers or other techniques. Some types of pollution may be especially of concern (e.g. air pollution that increases acidity may affect lichens on which boreal caribou depend for food).
Timing of disturbance	Certain types of disturbance could occur only in seasons when boreal caribou are not using the area or do not respond negatively to the activity.
Induced effects	New access roads in previously undisturbed areas may induce further disturbance by opening territory to more development, recreational users, etc. This could be prevented by an access management plan that could include limiting access, decommissioning roads, etc.
Corridors that support predator movement	Impact may be reduced by using techniques that prevent use of corridor by predators (no compaction of snow, immediate replanting of trees, etc.).
Increases in predator and/or alternate prey populations	Mortality management techniques may be considered where the killing of predators would be a final, necessary option implemented temporarily, along with habitat restoration.

APPENDIX J: CRITICAL HABITAT FACTSHEETS

Illustration © Judie Shore

CRITICAL HABITAT FACTSHEETS: NORTHWEST TERRITORIES

Critical Habitat Identification: Northwest Territories Range (NT1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-1. Key map of the general location of the range.

Figure J-2. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
44,166,546	24	8	31	69	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain
	Boreal Plain
	Southern Arctic
	Taiga Cordillera

[1] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: BRITISH COLUMBIA

Critical Habitat Identification: Maxhamish Range (BC1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-3. Key map of the general location of the range.

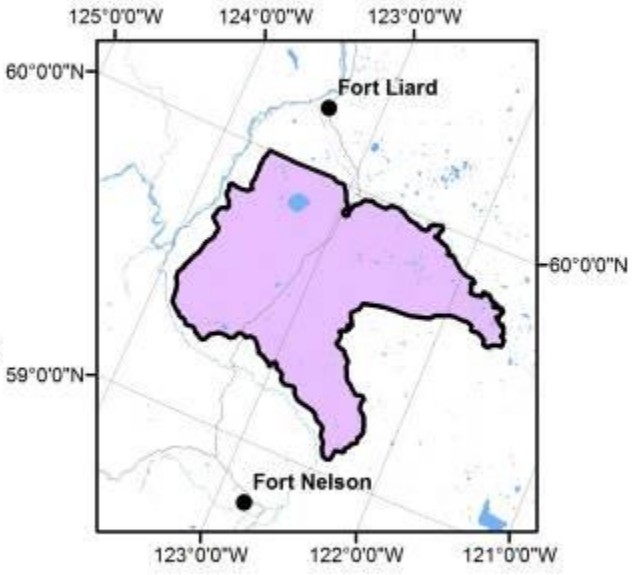

Figure J-4. The geographic boundary within which critical habitat is located.

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
710,105	0.5	57	58	42	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Calendar Range (BC2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

---

i) Location: Where critical habitat is found.

Figure J-5. Key map of the general location of the range.

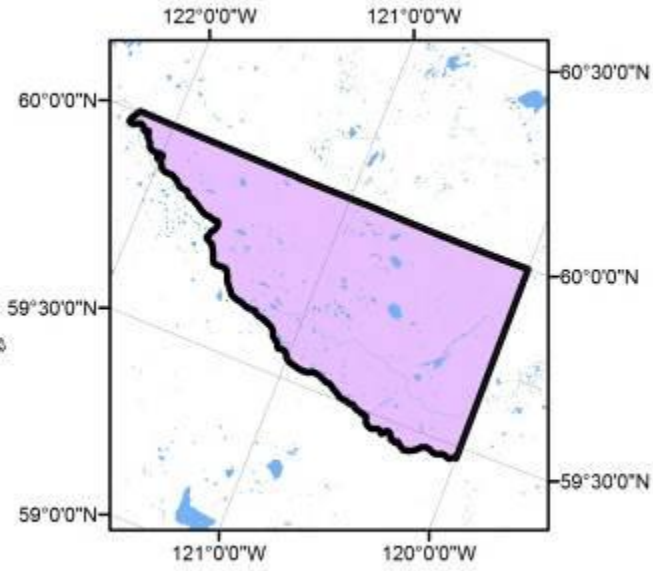

Figure J-6. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
496,393	8	58	61	39	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Snake-Sahtahneh Range (BC3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-7. Key map of the general location of the range.

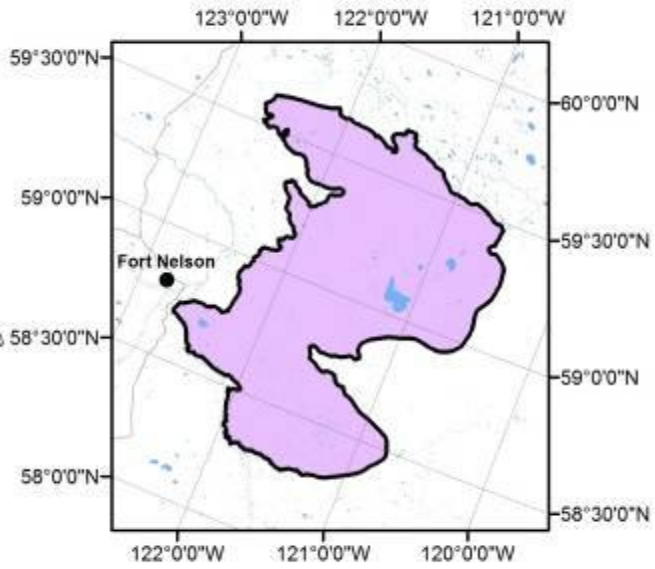

Figure J-8. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,198,752	6	86	87	13	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Parker Range (BC4)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

---

i) Location: Where critical habitat is found.

Figure J-9. Key map of the general location of the range.

Figure J-10. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
75,222	1	57	58	42	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Prophet Range (BC5)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-11. Key map of the general location of the range.

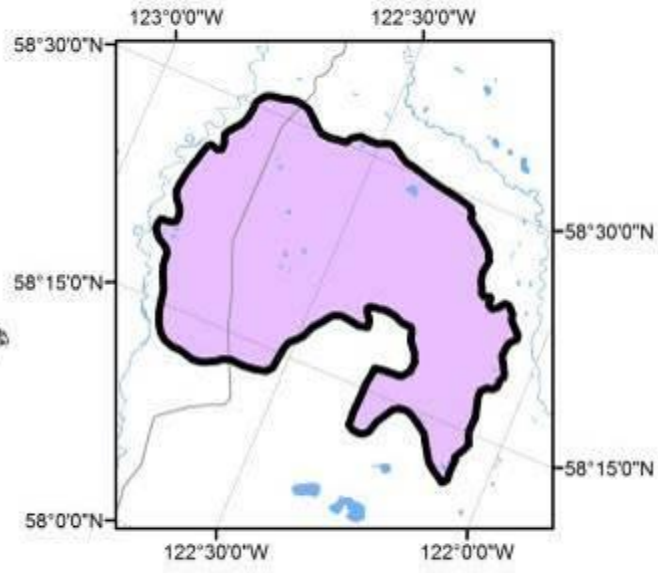

Figure J-12. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
119,396	1	77	77	23	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: ALBERTA

Critical Habitat Identification: Chinchaga Range (incl. BC portion) (AB1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-13. Key map of the general location of the range.

Figure J-14. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
3,162,612	8	74	76	24	Existing habitat that would contribute to at least 65% undisturbed over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain
	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Bistcho Range (AB2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

---

i) Location: Where critical habitat is found.

Figure J-15. Key map of the general location of the range.

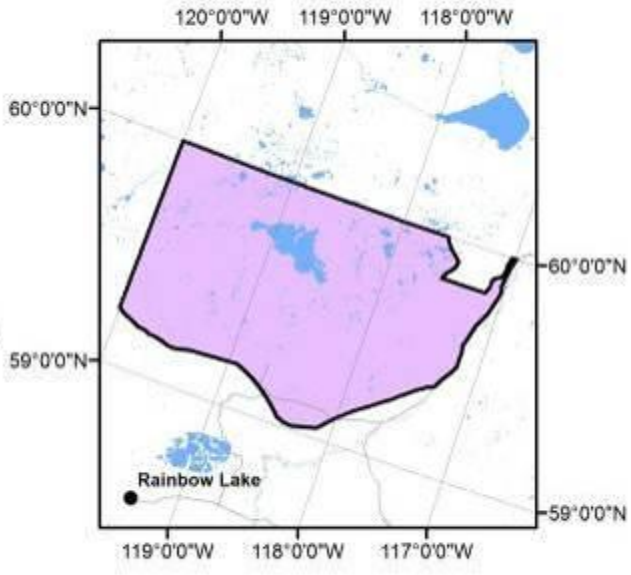

Figure J-16. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,436,555	20	61	71	29	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Yates Range (AB3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

---

i) Location: Where critical habitat is found.

Figure J-17. Key map of the general location of the range.

Figure J-18. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
523,094	43	21	61	39	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Caribou Mountains Range (AB4)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

---

i) Location: Where critical habitat is found.

Figure J-19. Key map of the general location of the range.

Figure J-20. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,069,000	44	23	57	43	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain
	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Little Smoky Range (AB5)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

---

i) Location: Where critical habitat is found.

Figure J-21. Key map of the general location of the range.

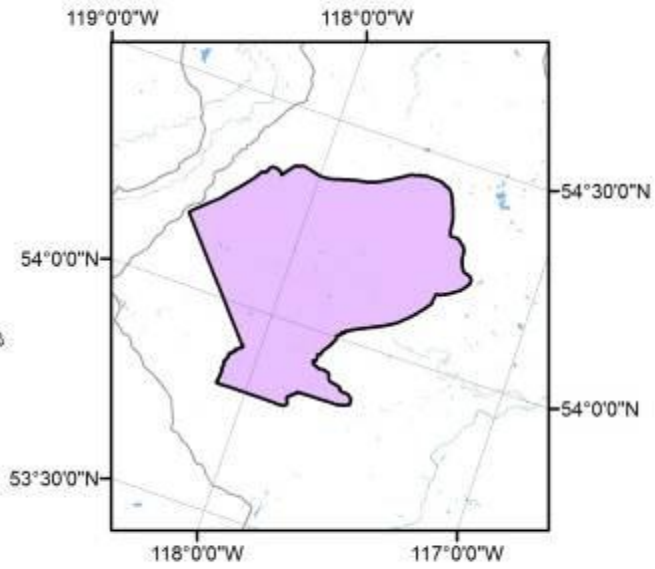

Figure J-22. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
308,606	0.2	95	95	5	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Montane Cordillera
	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Red Earth Range (AB6)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

---

i) Location: Where critical habitat is found.

Figure J-23. Key map of the general location of the range.

Figure J-24. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,473,729	30	44	62	38	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: West Side Athabasca River Range (AB7)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

---

i) Location: Where critical habitat is found.

Figure J-25. Key map of the general location of the range.

Figure J-26. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,572,652	4	68	69	31	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Richardson Range (AB8)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-27. Key map of the general location of the range.

Figure J-28. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
707,350	67	22	82	18	Existing habitat that would contribute to at least 65% undisturbed over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
	Boreal Plain
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: East Side Athabasca River Range (AB9)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-29. Key map of the general location of the range.

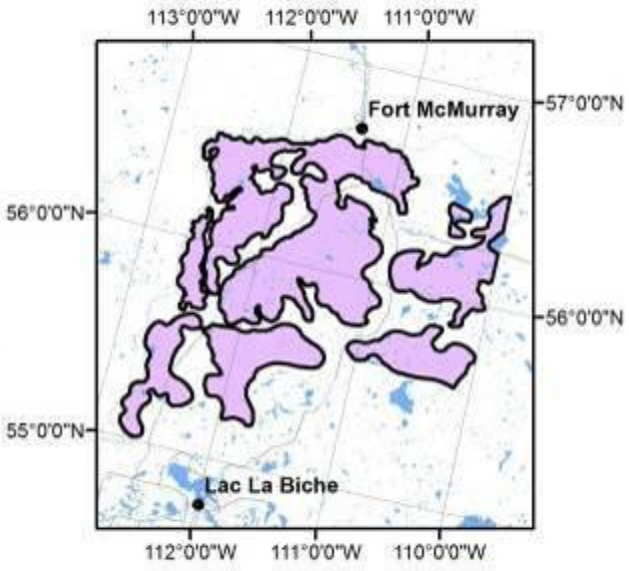

Figure J-30. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,315,980	26	77	81	19	Existing habitat that would contribute to at least 65% undisturbed over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Cold Lake Range (AB10)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

---

i) Location: Where critical habitat is found.

Figure J-31. Key map of the general location of the range.

Figure J-32. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
672,422	32	72	85	15	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Nipisi Range (AB11)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

---

i) Location: Where critical habitat is found.

Figure J-33. Key map of the general location of the range.

Figure J-34. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
210,771	6	66	68	32	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Slave Lake Range (AB12)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

---

i) Location: Where critical habitat is found.

Figure J-35. Key map of the general location of the range.

Figure J-36. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
151,904	37	63	80	20	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: SASKATCHEWAN

Critical Habitat Identification: Boreal Shield Range (SK1)

A schedule of studies is required under SARA where available information is inadequate to identify critical habitat. The schedule of studies outlines the essential studies required to identify the critical habitat necessary to meet the population and distribution objectives for boreal caribou set in this recovery strategy.

There is evidence suggesting that fire does cause stress on boreal caribou populations when the proportion of the range disturbed by fire is high and precaution around the additional effects of anthropogenic disturbance in boreal caribou ranges with high fire is necessary. However, additional population trend data is required to understand the relationship between disturbance and boreal caribou survival in ranges with high fire and very low anthropogenic disturbance. This disturbance relationship occurs in northern Saskatchewan's Boreal Shield range (SK1).

The following schedule of studies is required to complete the identification of critical habitat in the Boreal Shield Range in northern Saskatchewan.

Table J-1: Schedule of studies required to complete the identification of critical habitat in the Boreal Shield range (SK1) in northern Saskatchewan

Description of Activity	Rationale	Timeline
Collect population information (size, trend, etc.) for a minimum of 2 years in SK1 where population condition is unknown.	The effect of a high fire and very low anthropogenic disturbance habitat condition on the SK1 local population is unknown. These activities will provide the necessary information to identify critical habitat.	Population data collected and critical habitat identified for SK1 by end of 2016.
Update disturbance model in Environment Canada's Scientific Assessment (2011b) by including population information for SK1 to incorporate situations of high fire and very low anthropogenic disturbance.		
Identification of critical habitat in SK1.		

Critical Habitat Identification: Boreal Plain Range (SK2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

---

i) Location: Where critical habitat is found.

Figure J-37. Key map of the general location of the range.

Figure J-38. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
10,592,463	26	20	42	58	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: MANITOBA

Critical Habitat Identification: The Bog Range (MB1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

---

i) Location: Where critical habitat is found.

Figure J-39. Key map of the general location of the range.

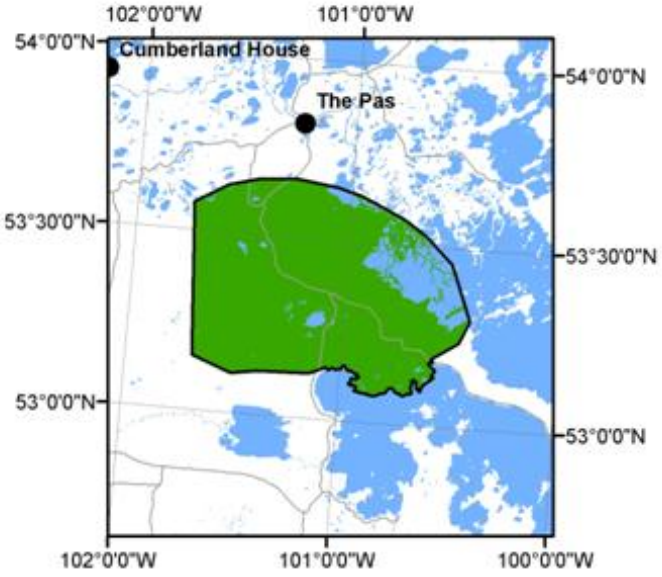

Figure J-40. The geographic boundary within which critical habitat is located.

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
446,383	4	12	16	84	At least 65% undisturbed habitat

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Kississing Range (MB2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-41. Key map of the general location of the range.

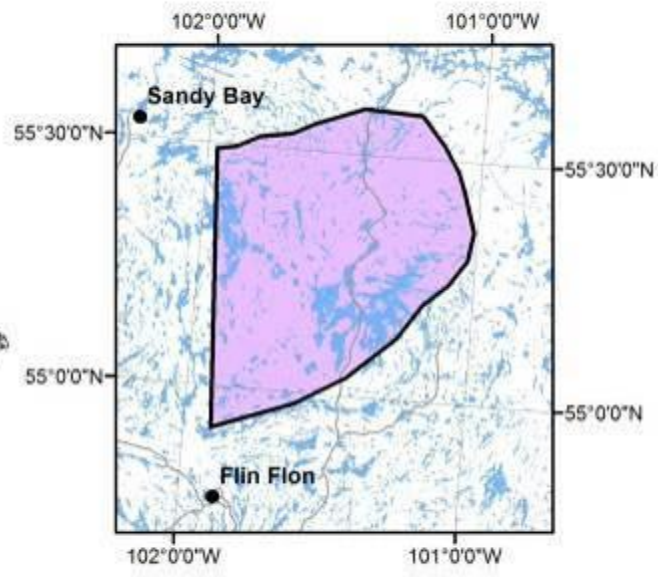

Figure J-42. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
317,029	39	13	51	49	Existing habitat that would contribute to at least 65% undisturbed over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: Naosap Range (MB3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-43. Key map of the general location of the range.

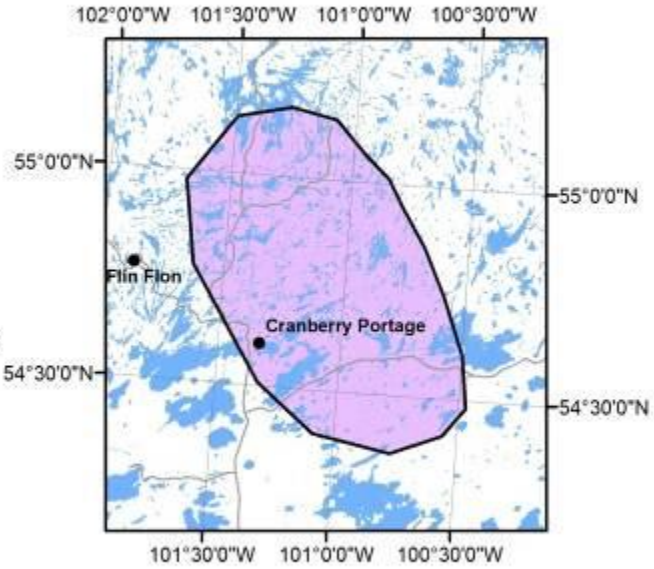

Figure J-44. The geographic boundary within which critical habitat is located

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
456,977	28	26	50	50	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
	Boreal Plain
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: Reed Range (MB4)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-45. Key map of the general location of the range.

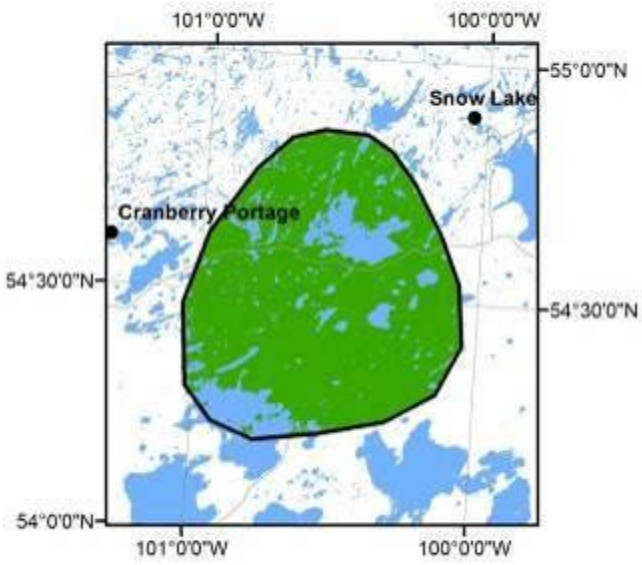

Figure J-46. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
357, 425	7	20	26	74	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
	Boreal Plain
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: North Interlake Range (MB5)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

---

i) Location: Where critical habitat is found.

Figure J-47. Key map of the general location of the range.

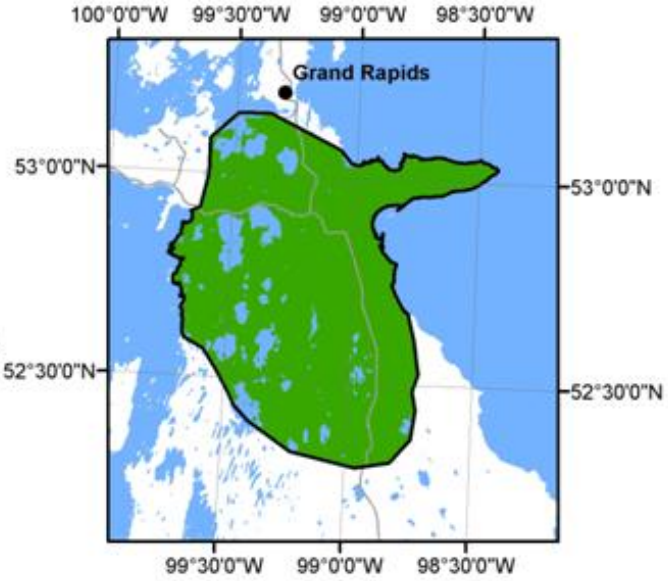

Figure J-48. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Critical Habitat Undisturbed
	Fire	Anthropogenic	Total		
489,680	4	14	17	83	At least 65% undisturbed habitat

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: William Lake Range (MB6)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-49. Key map of the general location of the range.

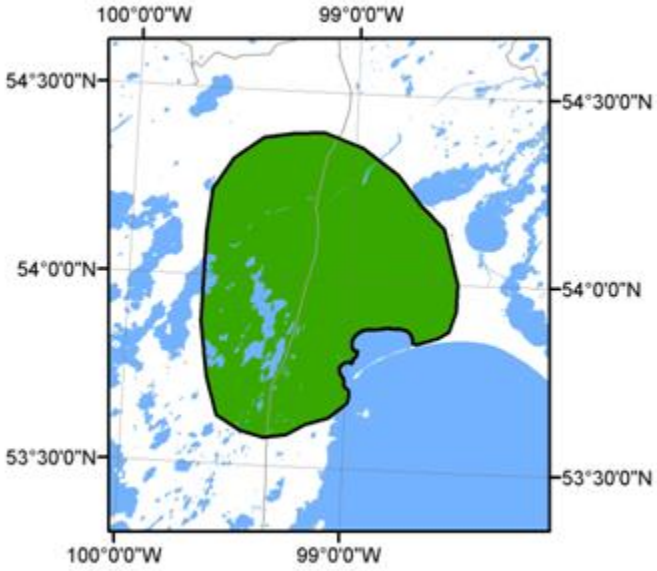

Figure J-50. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
488,219	24	10	31	69	At least 65% undisturbed habitat

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Wabowden Range (MB7)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-51. Key map of the general location of the range.

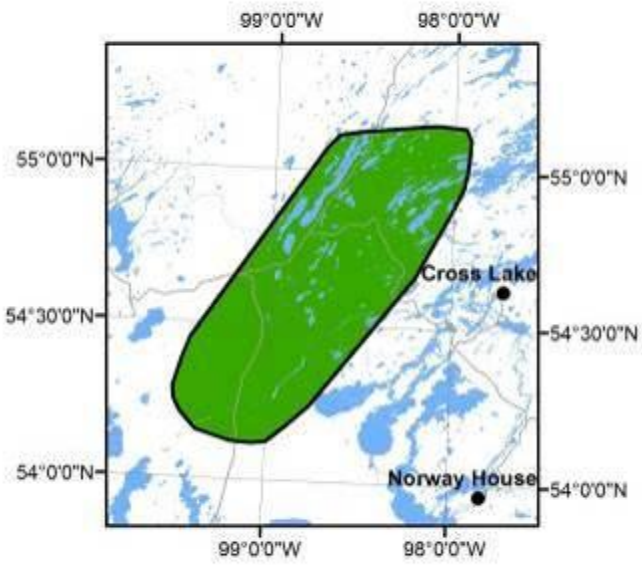

Figure J-52. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
628,938	10	19	28	72	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozones(s)[1]:	Boreal Shield
	Boreal Plain
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: Wapisu Range (MB8)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-53. Key map of the general location of the range.

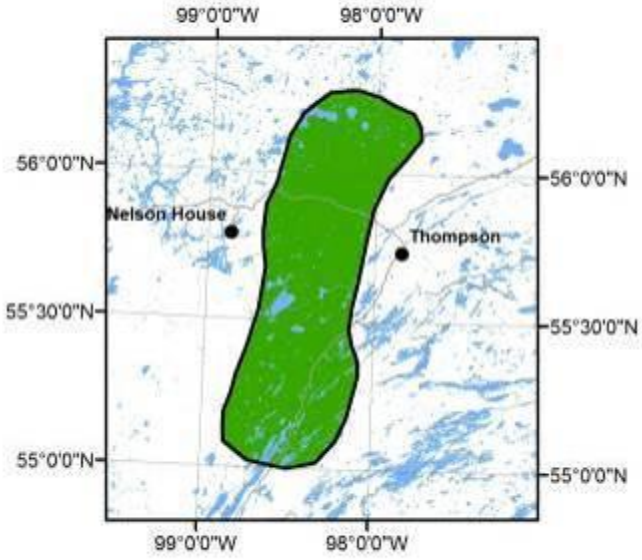

Figure J-54. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
565,044	10	14	24	76	At least 65% undisturbed habitat

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: Manitoba North Range (MB9)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-55. Key map of the general location of the range.

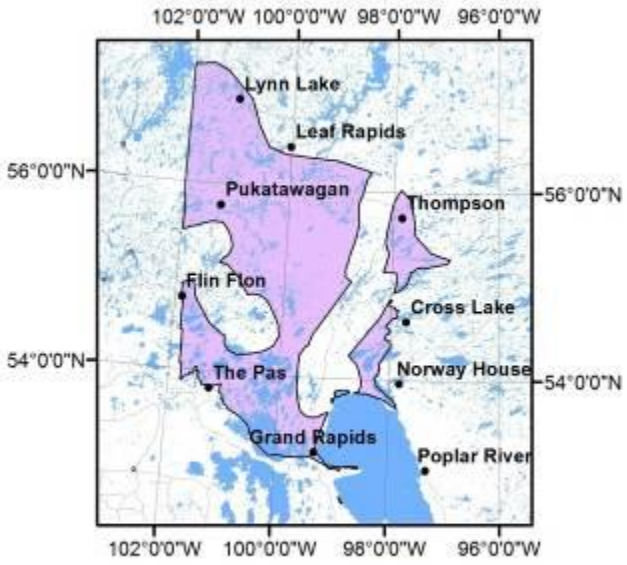

Figure J-56. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
6,205,520	23	16	37	63	Existing habitat that would contribute to at least 65% undisturbed over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
	Boreal Plain
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: Manitoba South Range (MB10)[1]

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-57. Key map of the general location of the range.

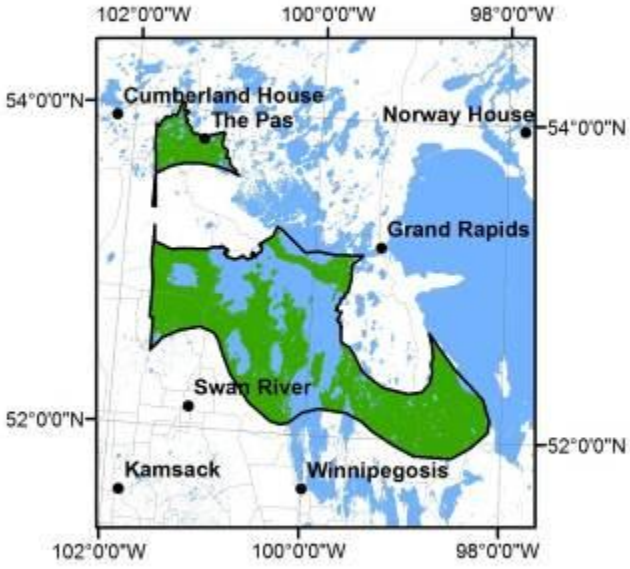

Figure J-58. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,867,255	4	13	17	83	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[2]:	Boreal Plain

[1] *The Government of Manitoba is in the process of updating their range boundaries. This will result in an update to current range delineations, as well as a revision of their self-sustainability status following integrated risk assessment of any new range boundaries.*

[2] *See Appendix H*

Critical Habitat Identification: Manitoba East Range (MB11)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-59. Key map of the general location of the range.

Figure J-60. The geographic boundary within which critical habitat is located.

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
6,612,782	26	3	29	71	At least 65% undisturbed habitat

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West)
	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Atikaki-Berens Range (MB12)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

---

i) Location: Where critical habitat is found.

Figure J-61. Key map of the general location of the range.

Figure J-62. The geographic boundary within which critical habitat is located.

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,387,665	31	6	35	65	At least 65% undisturbed habitat

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Owl-Flinstone Range (MB13)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-63. Key map of the general location of the range.

Figure J-64. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
363,570	25	18	39	61	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: ONTARIO

Critical Habitat Identification: Sydney Range (ON1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-65. Key map of the general location of the range.

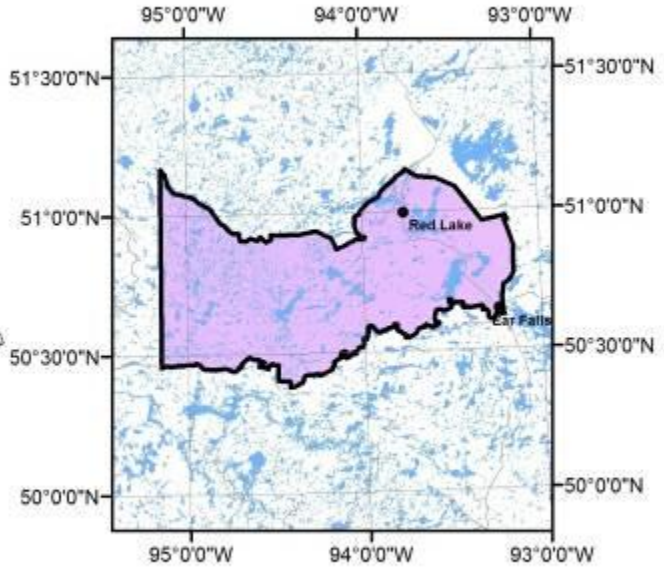

Figure J-66. The geographic boundary within which critical habitat is located.

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
753,001	28	33	58	42	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Berens Range (ON2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-67. Key map of the general location of the range.

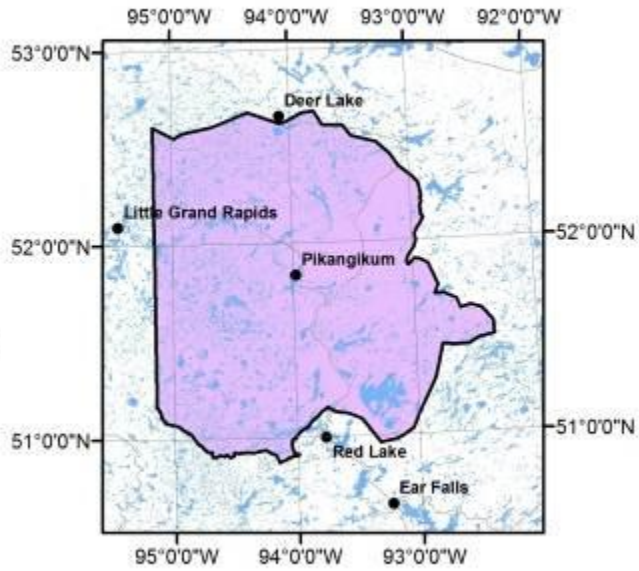

Figure J-68. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,794,835	34	7	39	61	Existing habitat that would contribute to at least 65% undisturbed over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Churchill Range (ON3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

---

i) Location: Where critical habitat is found.

Figure J-69. Key map of the general location of the range.

Figure J-70. The geographic boundary within which critical habitat is located.

---

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,150,490	6	28	31	69	At least 65% undisturbed habitat

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Brightsand Range (ON4)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-71. Key map of the general location of the range.

Figure J-72. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,220,921	18	28	42	58	Existing habitat that would contribute to at least 65% undisturbed over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Nipigon Range (ON5)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-73. Key map of the general location of the range.

Figure J-74. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
3,885,026	7	25	31	69	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West)
	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Coastal Range (ON6)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-75. Key map of the general location of the range.

Figure J-76. The geographic boundary within which critical habitat is located.

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
376,598	0	16	16	84	At least 65% undisturbed habitat

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (Central)

[1] *See Appendix H*

Critical Habitat Identification: Pagwachuan Range (ON7)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-77. Key map of the general location of the range.

Figure J-78. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
4,542,918	0.9	26	27	73	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Hudson Plain
	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (Central)

[1] *See Appendix H*

Critical Habitat Identification: Kesagami Range (ON8)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-79. Key map of the general location of the range.

Figure J-80. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
4,766,463	3	36	38	62	Existing habitat that would contribute to at least 65% undisturbed over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Hudson Plain
	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (Central)

[1] *See Appendix H*

Critical Habitat Identification: Far North Range (ON9)[1]

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-81. Key map of the general location of the range.

Figure J-82. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
28,265,143	14	1	15	85	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[2]:	Hudson Plain
	Boreal Shield
Ecoregion(s)[2]:	Boreal Shield (West)
	Boreal Shield (Southeast)
	Boreal Shield (Central)

[1] *The range is likely made up of several populations for which the self-sustainability status may vary. New data is currently being collected by the provincial jurisdiction for this range. This may result in an update to the range delineation and/or the identification of new ranges, as well as a revision of their self-sustainability status following integrated risk assessment of new ranges or new range boundaries.*

[2] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: QUEBEC

Critical Habitat Identification: Val d'Or Range (QC1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-83. Key map of the general location of the range.

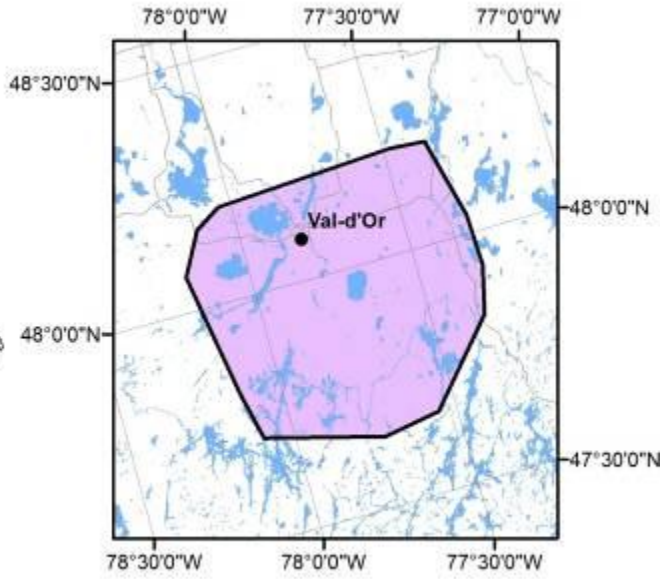

Figure J-84. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
346,861	0.1	60	60	40	Existing habitat that would contribute to at least 65% undisturbed over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (Southeast)

[1] *See Appendix H*

Critical Habitat Identification: Charlevoix Range (QC2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-85. Key map of the general location of the range.

Figure J-86. The geographic boundary within which critical habitat is located.

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
312,803	4	77	80	20	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (Southeast)

[1] *See Appendix H*

Critical Habitat Identification: Pipmuacan Range (QC3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-87. Key map of the general location of the range.

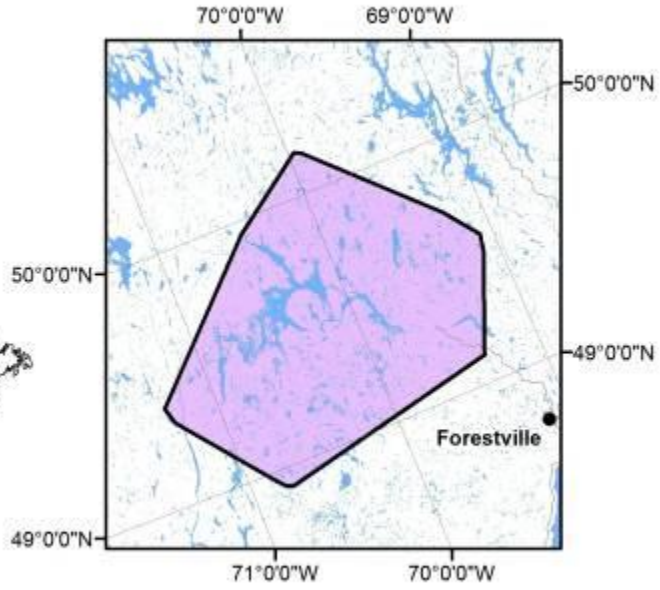

Figure J-88. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,376,899	11	51	59	41	Existing habitat that would contribute to at least 65% undisturbed over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*

Critical Habitat Identification: Manouane Range (QC4)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-89. Key map of the general location of the range.

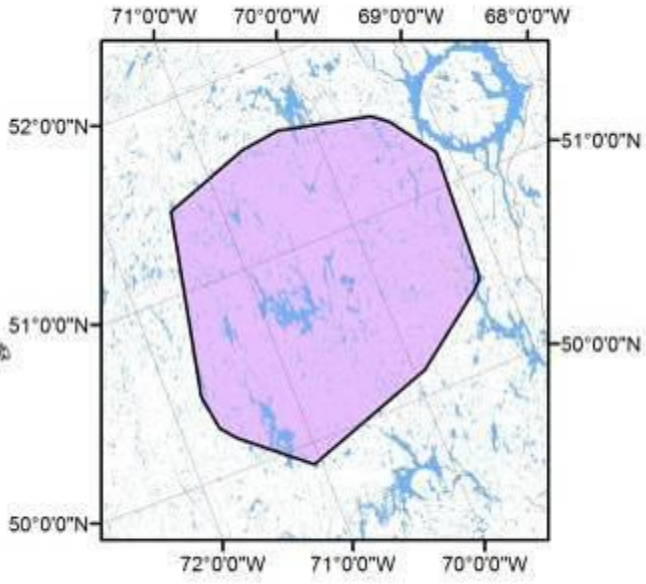

Figure J-90. The geographic boundary within which critical habitat is located.

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,716,449	18	23	39	61	Existing habitat that would contribute to at least 65% undisturbed over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*

Critical Habitat Identification: Manicouagan Range (QC5)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-91. Key map of the general location of the range.

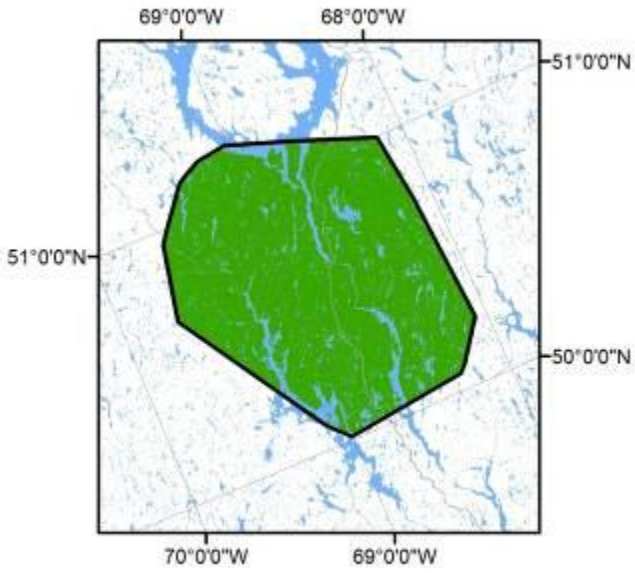

Figure J-92. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,134,129	3	32	33	67	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*

Critical Habitat Identification: Quebec Range (QC6)[1]

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-93. Key map of the general location of the range.

Figure J-94. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
62,156,186	20	12	30	70	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[2]:	Boreal Shield
Ecoregion(s)[2]:	Boreal Shield (Central)
	Boreal Shield (East)

[1] *The range is likely made up of several populations for which the self-sustainability status may vary. New data is currently being collected by the provincial jurisdiction for this range. This may result in an update to the range delineation and/or the identification of new ranges, as well as a revision of their self-sustainability status following integrated risk assessment of new ranges or new range boundaries.*

[2] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: NEWFOUNDLAND AND LABRADOR

Critical Habitat Identification: Lac Joseph Range (NL1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-95. Key map of the general location of the range.

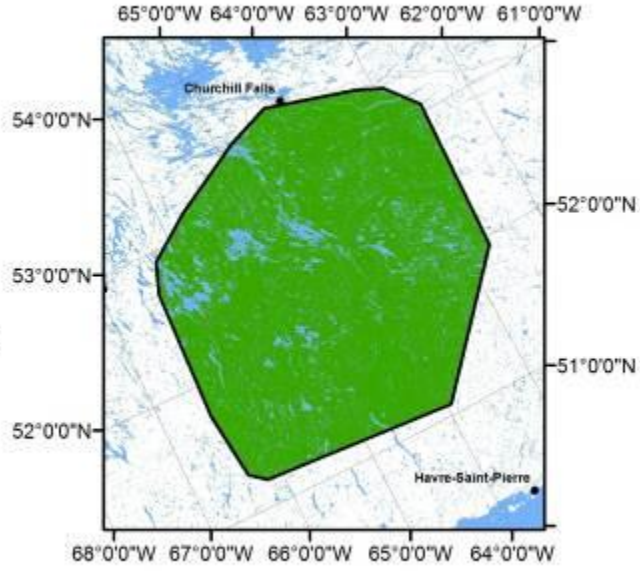

Figure J-96. The geographic boundary within which critical habitat is located.

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
5,802,491	7	1	8	92	At least 65% undisturbed habitat

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iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Shield
	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*

Critical Habitat Identification: Red Wine Mountain Range (NL2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-97. Key map of the general location of the range.

Figure J-98. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
5,838,594	5	3	8	92	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Shield
	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*

Critical Habitat Identification: Mealy Mountain Range (NL3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-99. Key map of the general location of the range.

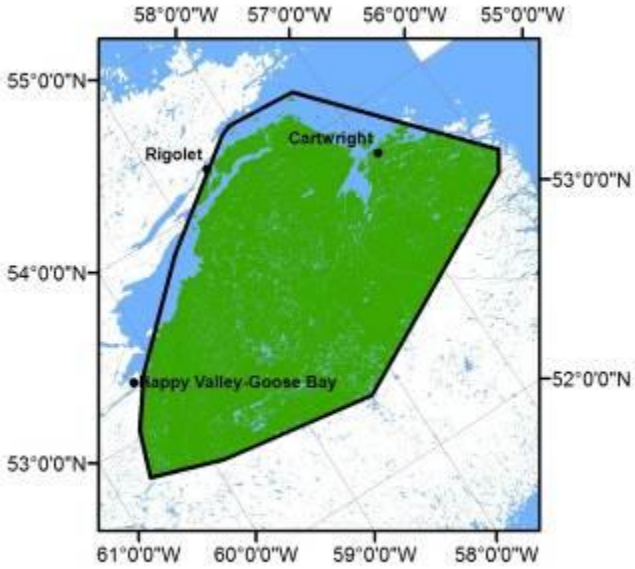

Figure J-100. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
3,948,463	0.4	1	2	98	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Shield
	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*

WILDLANDS LEAGUE

A chapter of the Canadian Parks and Wilderness Society

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