

# Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada

## Woodland Caribou, Boreal Population



2011

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## PREFACE

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (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 within 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 (Tl'cho), four Wildlife Management Boards and Parks Canada Agency contributed information for this recovery strategy. In addition, a process was undertaken with Aboriginal knowledge holders within and adjacent to the distribution of boreal caribou, to ensure Traditional Knowledge informed the recovery strategy. Similarly, sessions were carried out with 169 Aboriginal communities and 232 stakeholder groups to gain input on key elements of the recovery strategy.

Landscape-level planning will be essential for the successful recovery of boreal caribou. Provinces and territories have the primary responsibility for management of lands and wildlife within boreal caribou range, and therefore have the jurisdictional mandate for recovery and conservation of the Boreal population of Woodland Caribou. In the Northwest Territories, Aboriginal Affairs and Northern Development Canada also have a key role. Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Environment Canada, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Boreal population of Woodland Caribou and Canadian society as a whole.

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures that will be taken by Environment Canada and other jurisdictions and/or organizations involved in the conservation of the species, for the survival and recovery of the Boreal population of Woodland Caribou to be achieved.

## ACKNOWLEDGEMENTS

Environment Canada would like to express its gratitude to the Aboriginal people who shared their knowledge about boreal caribou in support of recovering this species. Through sessions with Aboriginal traditional knowledge holders and Aboriginal communities, relevant knowledge with respect to boreal caribou life history, habitat use, population status, threats facing the species and conservation measures was received to support the development of this national recovery strategy. 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. Detailed local knowledge received will also be made available to support local and regional-level

action planning for boreal caribou, where consent for such use was 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 all the federal, provincial and territorial jurisdictions as well as Wildlife Management Boards and the Tlicho government, with management responsibility for this species, for generously sharing their information and expertise necessary to develop this recovery strategy. The Boreal Caribou Working Group, comprised of Environment Canada staff across Canada, contributed extensively to consultation and Aboriginal traditional knowledge gathering efforts carried out to inform the development of this recovery strategy, as well as to the compilation of materials and drafting of 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 2011 "Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada". Acknowledgement and thanks is given to all other parties that provided advice and input used to help inform the development of this recovery strategy including the Species at Risk Advisory Committee (SARAC), various Aboriginal organizations and individuals who advised on the consultation process and materials, and stakeholders who participated in consultation meetings.

## EXECUTIVE SUMMARY

This recovery strategy focuses on the Boreal population of Woodland Caribou (*Rangifer tarandus caribou*), hereafter 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 throughout seven provinces and two territories, extending from the northeast corner of Yukon Territory east to Labrador and south to Lake Superior.

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

Due to the specific life history characteristics they possess, boreal caribou are limited in their potential to recover from rapid, severe population declines. Boreal caribou are primarily threatened by a reduction in the availability and suitability of habitat necessary to carry out the life processes necessary for their survival and reproduction. Threats, primarily habitat alteration (i.e. habitat loss, degradation, and fragmentation) from both anthropogenic and natural stressors, and predation have resulted in local population declines throughout their distribution. Threats are closely interrelated and act cumulatively to have direct or indirect impacts on boreal caribou and their habitat. Recovery of boreal caribou is technically and biologically feasible across Canada.

The long-term recovery goal for boreal caribou is to achieve self-sustaining local populations throughout their distribution in Canada to the extent possible. Achieving this recovery goal is a very long process, particularly as boreal caribou exist in mature boreal forest ecosystems that are established over many decades that take many years to recover from disturbance.

To guide recovery efforts for the first 50 years, the population and distribution objective for boreal caribou throughout their distribution in Canada is to:

- *Maintain the current status of the 17 existing self-sustaining local populations;*
- *Achieve self-sustaining status for 12 local populations that are not self-sustaining, to ensure representivity of ecological conditions and maintain connectivity across Canada; and,*
- *Stabilize the remaining 28 local populations that are not self-sustaining.*

The critical habitat necessary to support the population and distribution objectives for the recovery and survival of boreal caribou has been identified. For each local population, the identification of critical habitat for boreal caribou is described by the i) location of habitat, ii) amount of habitat, and iii) type of habitat. Performance indicators have been identified and will be used to measure progress towards achieving this recovery goal.

The recovery of boreal caribou requires actions that vary by individual local population range. This recovery strategy provides broad strategies and general approaches to meet the recovery objectives, which will be used to inform the development of subsequent action plans and guide the implementation of recovery actions. The suite of potential recovery actions will be governed by local opportunities and constraints, and the level of urgency for a given recovery action will be determined by local population and habitat conditions.

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures that should be taken by Environment Canada, other federal departments, provinces and territories, jurisdictions, wildlife management boards, Aboriginal peoples, stakeholders, landowners 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 the Boreal population of Woodland Caribou (*Rangifer tarandus caribou*) (hereafter referred to as boreal caribou) is considered to be both technically and biologically feasible across the species' range based on the following four criteria outlined in the draft SARA Policies (Government of Canada, 2009):

**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 32,000<sup>1</sup> individuals, in at least 57 local populations across nine provinces and territories in Canada, capable of successful reproduction that are available to improve local population growth rates and abundance (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 undisturbed habitat within their ranges. For other local populations sufficient suitable habitat is currently unavailable to support local populations at a self-sustaining level but could be made available through efforts to restore lost, degraded and/or fragmented habitat.

**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 habitat loss, degradation, and fragmentation. These habitat alterations support conditions that favour higher alternate prey densities (e.g., moose, deer), resulting in increased predator populations (e.g., wolf) that in turn increase the risk of predation to boreal caribou. This threat can be avoided or mitigated through coordinated land use planning, and habitat restoration and management, in conjunction with predator/alternate prey management where local population conditions warrant such action.

**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 are available (e.g., protection and management of boreal forest habitat, habitat restoration, and predator/alternate prey management) 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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<sup>1</sup>Population estimate that is based on the total (24,459) for all local populations for which a population size is included in the Environment Canada 2011 Scientific Assessment of Critical Habitat for Boreal Caribou plus an estimate of 5800 animals in NWT and 1284 animals in ON that were reported in the 2008 Environment Canada Scientific Review. Use of the 2008 estimates for NWT and ON was necessary since range delineations for local populations in NWT and ON were revised in the 2011 report and corresponding size estimates for these new range delineations are not yet available.

## TABLE OF CONTENTS

<b>PREFACE</b> .....	<b>i</b>
<b>ACKNOWLEDGEMENTS</b> .....	<b>i</b>
<b>EXECUTIVE SUMMARY</b> .....	<b>iii</b>
<b>RECOVERY FEASIBILITY SUMMARY</b> .....	<b>v</b>
1. COSEWIC Species Assessment Information .....	1
2. Species Status Information .....	1
3. Species Information.....	2
3.1 Species Description.....	2
3.2 Population and Distribution .....	3
3.3 Needs of the Boreal Caribou.....	7
4. Threats .....	9
4.1 Threat Assessment .....	9
4.2 Description of Threats.....	10
5. Population and Distribution Objectives .....	14
6. Broad Strategies and General Approaches to Meet Objectives .....	18
6.1 Actions Already Completed or Currently Underway .....	18
6.2 Strategic Direction for Recovery .....	20
6.3 Narrative to Support the Recovery Planning Table .....	23
7. Critical Habitat .....	25
7.1 Describing Critical Habitat for Boreal Caribou .....	25
7.2 Identification of the Critical Habitat for Boreal Caribou.....	25
7.3 Schedule of Studies.....	30
7.4 Activities Likely to Result in the Destruction of Critical Habitat .....	30
8. Measuring Progress .....	32
9. Statement on Action Plans .....	33
9.1 Coordinated Approach .....	33
9.2 Range Specific Actions.....	34
10. References .....	35
APPENDIX A: Effects on the Environment and Other Species.....	42
APPENDIX B: Boreal Caribou Population Information .....	42
APPENDIX C: Aboriginal Traditional Knowledge Summary Reports on Boreal Caribou .....	42
APPENDIX D: Scientific Assessments of Critical Habitat for Boreal Caribou .....	42
APPENDIX E: Identifying Management Thresholds.....	52
APPENDIX F: Critical Habitat Factsheets .....	55



## 1. COSEWIC SPECIES ASSESSEMENT INFORMATION

**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-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

Boreal caribou are listed as Threatened federally under Canada's *Species at Risk Act* (SARA), based on an observed, estimated, inferred or suspected reduction in population size of > 30% over three generations (approximately 20 years). Boreal caribou have been provincially and territorially ranked throughout their distribution (see Table 1).

Boreal caribou are endemic to Canada, and are distributed throughout nine provinces and territories including British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Labrador, Northwest Territories, and Yukon Territory. Boreal caribou have not been ranked globally by NatureServe.

**Table 1. List and description of Canadian status and provincial designations for boreal caribou.**

Canadian Status	Provincial 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) LB - Threatened

### 3. SPECIES INFORMATION

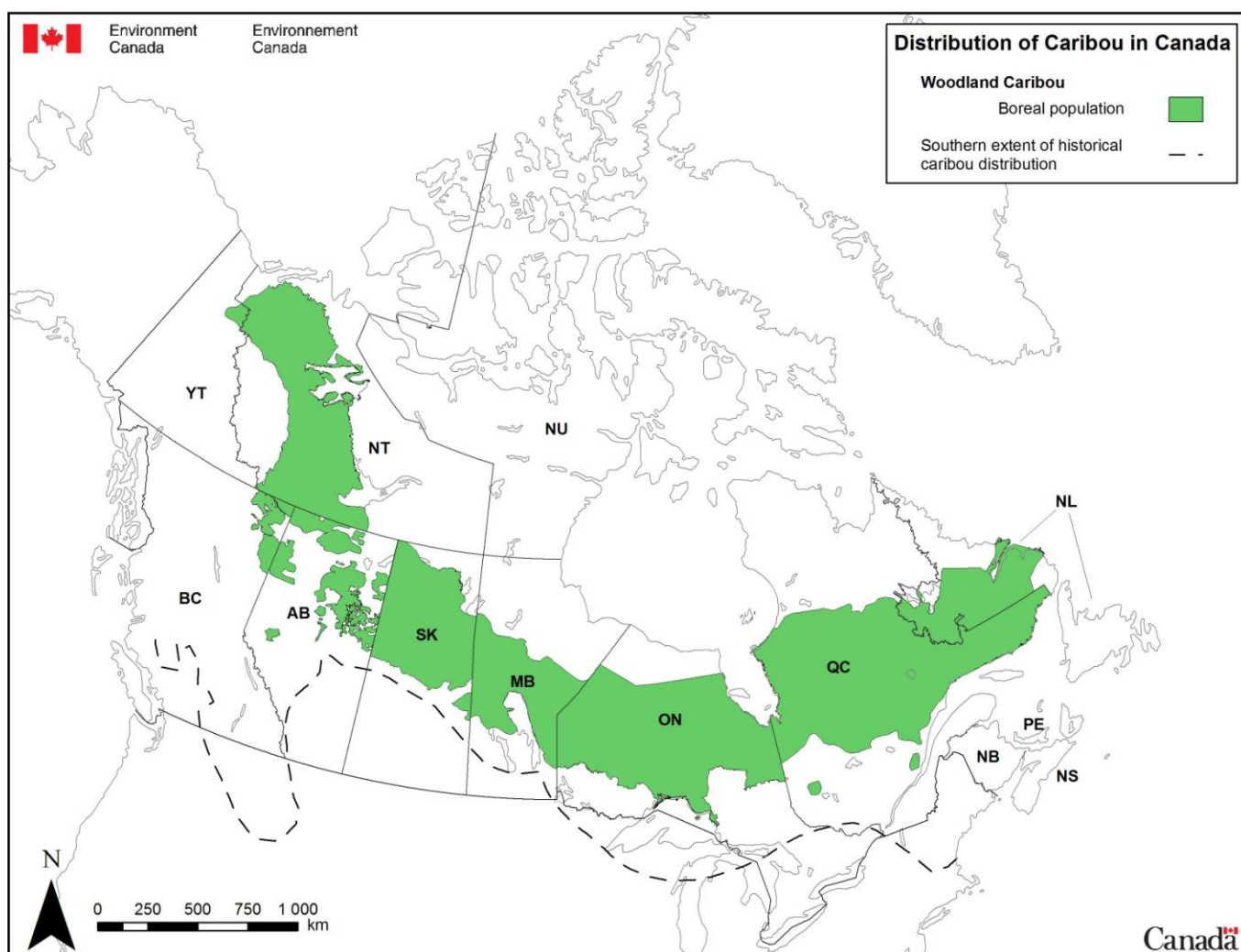
There are four existing subspecies of caribou in Canada including the Peary Caribou (*Rangifer tarandus pearyi*), Barren-ground Caribou (*R. t. groenlandicus*), Grant's Caribou (*R. t. granti*), and Woodland Caribou (Banfield, 1974). A fifth subspecies, the Dawson's Caribou (*R. t. dawsoni*), which occurred in Haida Gwaii (Queen Charlotte Islands) 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 five geographically distinct populations of the forest-dwelling Woodland Caribou (*Rangifer tarandus caribou*): Northern Mountain population (Special Concern), Southern Mountain population (Threatened), Boreal population (Threatened), Atlantic-Gaspésie population (Endangered), and the insular Newfoundland population (Not at Risk). This recovery strategy focuses on the Boreal population of Woodland Caribou.

#### 3.1 Species Description

Like all Woodland Caribou, boreal caribou are a medium-sized (1.0-1.2m shoulder height and weighing 110-210kg) 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., peatlands), 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 caribou bear 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 legs and faces 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 region (Thomas and Gray, 2002). They occur in nine provinces and territories including: British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Labrador, Northwest Territories, and Yukon Territory (Figure 1). The Canadian range stretches from the northeast corner of Yukon Territory, east to Labrador, and extends as far south as Lake Superior (Environment Canada, 2008; Environment Canada, 2011b). Across Canada, the southern limit of boreal caribou distribution has progressively receded northward since the early 1900s (Figure 1), a trend that continues today (Festa-Bianchet et al., 2011; Schaefer, 2003; Thomas and Gray, 2002). Aboriginal traditional knowledge similarly indicates that boreal caribou populations have moved northward as a result of the loss of habitat 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 green. The estimated southern extent of historical Woodland Caribou distribution is indicated by the dashed line.**

Boreal caribou are distributed across at least 57 local populations (Figure 2) (Environment Canada, 2011b).

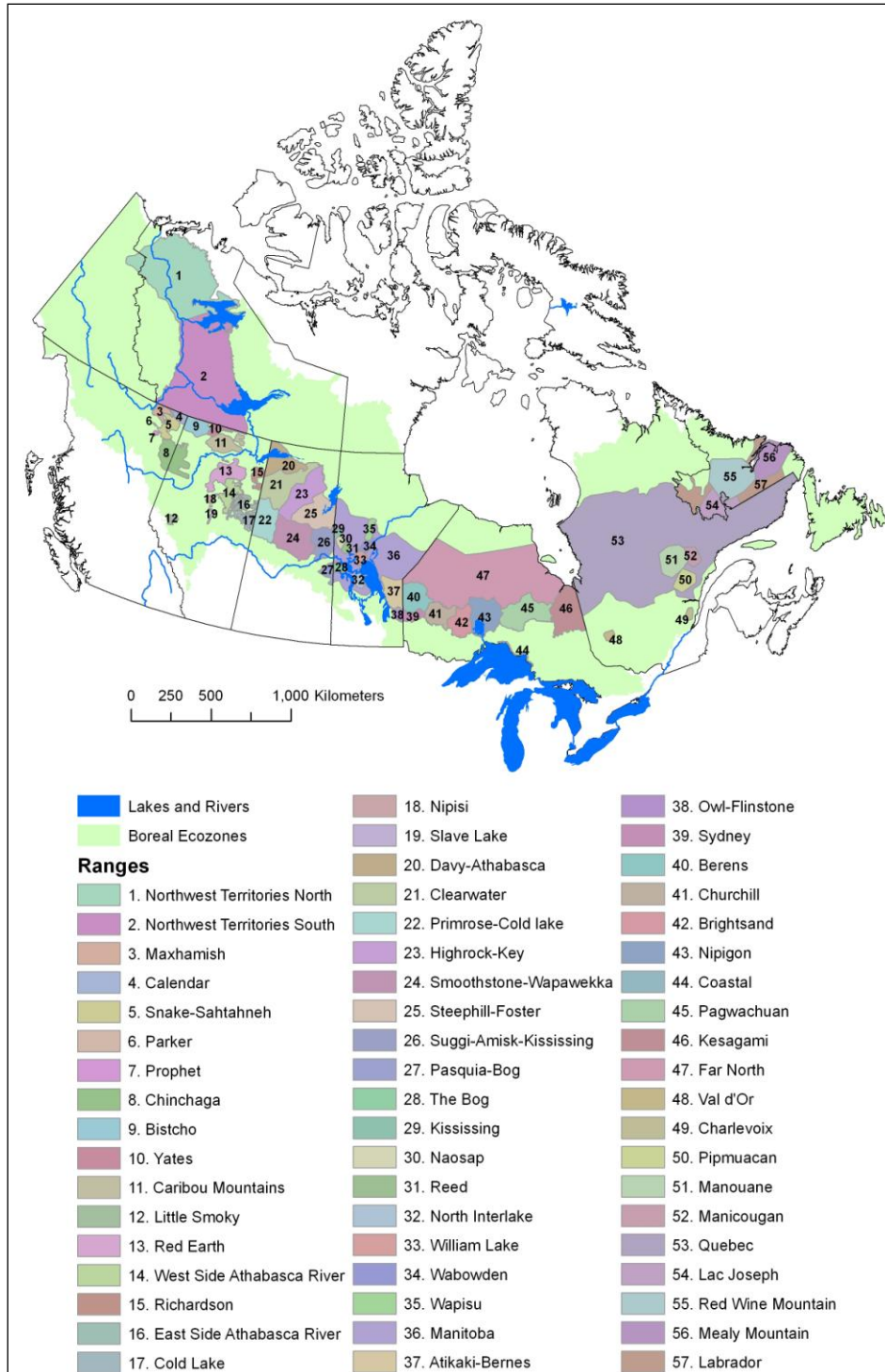
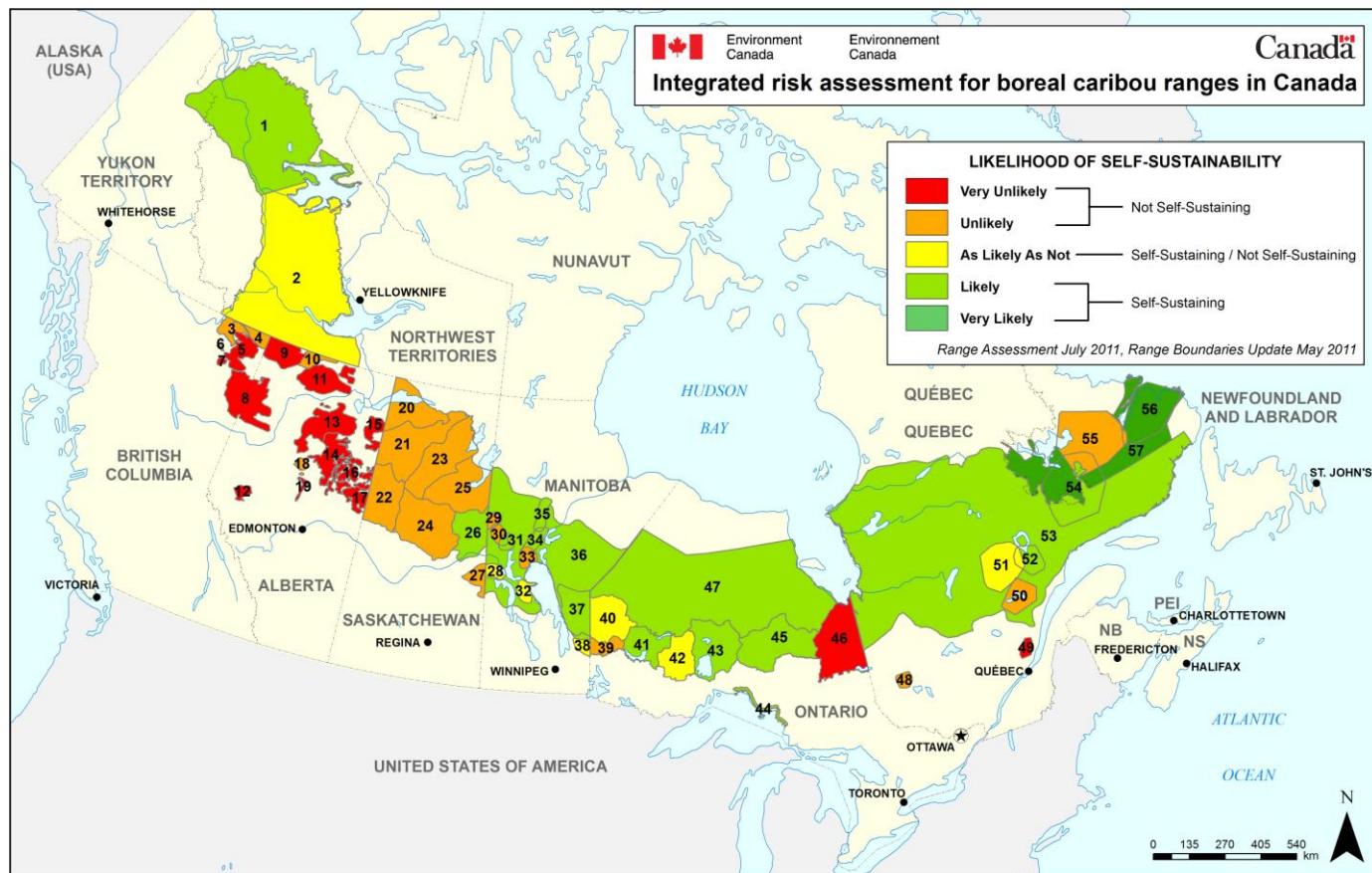


Figure 2. Geographic ranges of all 57 known local populations of boreal caribou in Canada.

Of the 57 boreal caribou local populations, 17 are self-sustaining, 33 are not self-sustaining, and for the remaining 7, the local population status is as likely as not self-sustaining (Environment Canada, 2011b) (Figure 3).



**Figure 3. Integrated risk assessment map demonstrating the current likelihood of self-sustainability for boreal caribou local populations in Canada.**

Precise enumeration of boreal caribou local population size is a challenge, particularly in certain areas, due to the large range areas that boreal caribou occupy (often over thousands of square kilometers), the low densities at which they occur (making survey from aircraft challenging), and their relatively solitary habits (Callaghan et al., 2010; Environment Canada., 2008). Aboriginal traditional knowledge shows that boreal caribou are generally found in small groups of fewer than 15 individuals (Boreal Caribou ATK Reports 2010-2011).

Typically, boreal caribou form relatively mixed-sex groups; however, during calving periods females are generally solitary (Boreal Caribou ATK Reports 2010-2011). Based on the best available information, the current overall number of boreal caribou in Canada is estimated to be

approximately 32,000<sup>2</sup> individuals (Environment Canada, 2011b). Appendix B outlines the current population size and trend information for each of the 57 local populations as provided by jurisdictions (Environment Canada, 2011b).

The geographic area a local population of boreal caribou occupies and moves within is referred to as a local population range or boreal caribou range. A local population range is a function of both the size of the area and the habitat condition. Boreal caribou local population ranges encompass an area that is large enough, with the necessary habitat conditions to support their life processes (e.g. calving, rutting, wintering etc.) and allow for a local population to be self-sustaining<sup>3</sup> (Environment Canada, 2011b). Boreal caribou local population ranges have been delineated based on the type and quantity of data available, and have been categorized along a data continuum from low to high quality (Environment Canada, 2011b).

A local population's use of range may change over time as a result of variation in ecological conditions (e.g., vegetation change as a result of fire, disturbance or range overutilization) and patterns of human disturbance (e.g., industrial development) affecting the landscape. Based on individual movements and geographical influences, range patterns of boreal caribou local populations are either: a) discrete, with a local population occupying a clearly defined range area (e.g., Lake Superior shoreline of Ontario, Charlevoix in Quebec); or b) continuous, with a local population dispersed over a large area characterized by common biophysical conditions (e.g., boreal taiga in the Northwest Territories. To be self-sustaining, a local population depends on an adequate habitat supply within the entirety of its range. As habitat condition changes in response to environmental conditions (e.g., large burns from wildfire) or human activity (e.g., tree removal), the habitat use within a range of a local population may vary.

Local populations have been identified as the appropriate ecological unit for conservation and management of boreal caribou (Thomas and Gray, 2002). The ranges of all known local populations of boreal caribou have been mapped (Figure 2), based on provincial and territorial observational and telemetry data, and biophysical analyses (Environment Canada, 2011b). In many cases there is limited information on which to base the local population delineation and therefore delineations are considered conservation units that are to be confirmed and refined over time (Environment Canada, 2011b).

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<sup>2</sup> Population estimate that is based on the total (24,459) for all local populations for which a population size is included in the Environment Canada 2011 Scientific Assessment of Critical Habitat for Boreal Caribou plus an estimate of 5800 animals in NWT and 1284 animals in ON that were reported in the 2008 Environment Canada Scientific Review. Use of the 2008 estimates for NWT and ON was necessary since range delineations for local populations in NWT and ON were revised in the 2011 report and corresponding size estimates for these new range delineations are not yet available.

<sup>3</sup> Self-sustaining for boreal caribou means a local population of boreal caribou that on average demonstrates stable or positive population growth (more births than deaths;  $\lambda \geq 1.0$ ) over 20 years, and is large enough to withstand random events (e.g., severe weather) and human-caused pressures, and persist over 50 years, without the need for management intervention (e.g., predator management or transplants from other populations).

### 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. Mature to old-growth coniferous forest (e.g. jack pine, black spruce) with abundant lichens, or muskegs and peatlands intermixed with upland/hilly areas (Darby and Pruitt Jr., 1984; Brown et al., 1986; Bradshaw et al., 1995; Stuart-Smith et al., 1997; Rettie and Messier, 2000; Courtois, 2003; Boreal Caribou ATK Reports 2010-2011, 2011). These 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 white-tailed deer) and predators (e.g., wolf and bear) (Rettie and Messier, 2001; Brown et al., 2003; also see Section 4.2). Aboriginal traditional knowledge identified that boreal caribou use a variety of habitats, such as muskegs and other bodies of water, old mature forests, and islands in order to avoid predators (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 W.O. Pruitt, 1991; Stuart-Smith et al., 1997; Rettie and Messier, 2000; Boreal Caribou ATK Reports 2010-2011) that 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/hilly areas exposed to wind), where it is easier to dig for ground lichens (Vandal and Barrette, 1985; Thomas and Armbruster, 1996; Boreal Caribou ATK Reports 2010-2011).

Boreal caribou have specific habitat requirements during calving and post-calving periods. To calve, pregnant cows travel to isolated, relatively predator-free areas with nutritious forage available, such as islands in lakes, peatlands 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).

Boreal caribou shift the use of their range in response to various natural processes (e.g., forest fire, food availability, weather conditions) and human activities (e.g., disturbance from 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 response to such changing environmental conditions, as habitat becomes unfavourable boreal caribou will shift within their range. Over time, the disturbed area will recover and may again become suitable for use by boreal caribou.

Connectivity between boreal caribou ranges enables immigration and emigration between local populations (Boreal Caribou ATK Reports 2010-2011; Racey and Armstrong, 2000), to maintain or increase genetic diversity (McLoughlin et al., 2004; Pither et al., 2006). Studies in Quebec

have demonstrated that isolation of local populations has resulted in a 20% reduction in genetic diversity (Courtois et al., 2003). Maintaining genetic diversity is important to the resilience of a local population to environmental stressors such as disease and provides the adaptive capacity of local populations to changes in environmental conditions such as climate change. Connectivity also provides potential movement corridors to facilitate response to changing conditions caused by climate change and is one of the main adaptive management approaches for wildlife species.

Boreal caribou encounter a wide variety of ecological conditions across their distribution. Local population ranges that represent the full ecological gradient are necessary to capture local adaptations that arise from adaptive variation. This allows for maintenance of the evolutionary potential of the species and accounts for the full range of ecological interactions a boreal caribou can have within the full range of ecological settings (Redford et al., 2011).

### **3.3.2 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; Johnson et al., 2001; Bergerud, 1996; Environment Canada., 2008). Accordingly, continuous tracts of undisturbed habitat of suitable quality (i.e. with the necessary biophysical attributes to support foraging, calving, etc) must be made available to ensure self-sustaining local populations.

Boreal caribou have a low reproductive output relative to other ungulates. 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). 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 (e.g., Bergerud, 1974; Stuart-Smith et al., 1997). In addition to predation, calves may succumb to poor nutritional condition, abandonment, inclement weather, or accidents.

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). In addition to being affected by reproductive and mortality rates related to their age distribution, small populations can be disproportionately affected by chance events (e.g., environmental events such as winter icing or heavy snowfalls, wildfire, disease). Consequently, population growth is likely to be highly variable in small populations, with an increased probability of extirpation (Caughley, 1994).



## 4. THREATS

### 4.1 Threat Assessment

There are a variety of threats that directly and/or indirectly affect local populations of boreal caribou and their habitat. A summary of these threats and their level of concern is provided in the table below (Table 2).

**Table 2. Threat Assessment Table for Woodland Caribou, Boreal Population**

Threat	Level of Concern <sup>1</sup>	Extent	Occurrence	Frequency	Severity <sup>2</sup>	Causal Certainty <sup>3</sup>
<b>Habitat Loss or Degradation</b>						
<b>Habitat Alteration (Loss, Degradation or Fragmentation) as a Result of Human Land-use Activities</b>	High	Widespread across Canadian range	Current	Continuous	High	High
<b>Habitat Alteration (Loss, Degradation or Fragmentation) as a Result of Natural Processes</b>	Medium	Widespread across Canadian range	Current	Recurrent	Moderate	High
<b>Natural Processes or Activities</b>						
<b>Predation</b>	High	Widespread across Canadian range	Current	Continuous	High	High
<b>Parasites &amp; Disease</b>	Low	Unknown	Anticipated	Unknown	Low	Low
<b>Biological Resource Use</b>						
<b>Hunting</b>	Medium	Localized across Canadian range.	Current	Seasonal	Moderate	Medium
<b>Climate and Natural Disasters</b>						
<b>Climate Change &amp; Severe Weather</b>	Medium	Widespread across Canadian range	Anticipated	Unknown	Unknown	Low-Med
<b>Disturbance or Harm</b>						
<b>Noises &amp; Light Disturbance</b>	Low-Med	Localized across Canadian range	Current	Recurrent	Unknown	Low

Threat	Level of Concern <sup>1</sup>	Extent	Occurrence	Frequency	Severity <sup>2</sup>	Causal Certainty <sup>3</sup>
<b>Accidental Mortality</b>						
<b>Vehicle Collisions</b>	Low	Localized across Canadian range	Current	Recurrent	Low	Low
<b>Pollution</b>						
<b>Pollution</b>	Low	Localized across Canadian range	Unknown	Unknown	Unknown	Low

<sup>1</sup> *Level of Concern: signifies that managing the threat is of (high, medium or low) concern for the recovery of the species, consistent with the population and distribution objectives. This criterion considers the assessment of all the information in the table.*

<sup>2</sup> *Severity: reflects the population-level effect (High: very large population-level effect, Moderate, Low, Unknown).*

<sup>3</sup> *Causal certainty: reflects the degree of evidence that is known for the threat (High: available evidence strongly links the threat to stresses on population viability; Medium: there is a correlation between the threat and population viability e.g. expert opinion; Low: the threat is assumed or plausible).*

Many of these threats are related and may interact, in which case they can have cumulative impacts on boreal caribou or their habitat that may not be evident when threats are examined individually (Weclaw and Hudson, 2004; Boreal Caribou ATK Reports 2010-2011, 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).

## 4.2 Description of Threats

The following threats are described in order of the most to the least significant in terms of the level of concern for their management.

### **Threat 1 - Habitat Alteration (Loss, Degradation or Fragmentation) as a Result of Human Land-use Activities**

Habitat alteration occurs when changes are made on the landscape that adversely impacts the ecosystem, either temporarily or permanently, reducing overall function. Habitat loss is the change to a landscape, resulting in areas with no current or immediate future value to boreal caribou (e.g., conversion to agriculture, development of industrial facilities) whereas habitat degradation implies a reduced but not total loss of habitat value for boreal caribou (e.g., reduction in the availability or quality of boreal caribou habitat following timber harvesting or seismic line development). Habitat fragmentation is the dissection of habitat by human-made linear features (e.g., roads, geophysical exploration lines, pipelines, hydroelectric corridors) that may negatively affect how boreal caribou use habitat.

Aboriginal traditional knowledge and western 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 exploration and development; and hydro-electric development. 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; Boreal Caribou ATK Reports 2010-2011).

Boreal caribou are at greater risk of survival and tend to avoid associated industrial infrastructure such as roads, timber harvest cut-blocks, pipelines, oil and gas well sites, and geophysical exploration lines up to 500m (Environment Canada, 2011b). These developments reduce 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).

The effects of landscape 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 its range, and potentially resulting in its extirpation.

## **Threat 2 - Predation**

Across most of their distribution, 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 boreal caribou 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; Boreal Caribou ATK Reports 2010-2011). Aboriginal traditional knowledge and western science identify wolves (*Canis lupus*) and bears (*Ursus* spp.) as the primary predators of boreal caribou, both of which have increased in numbers across the country (Bergerud, 1988; Edmonds, 1988; Seip, 1992; Boertje et al., 1996; Boreal Caribou ATK Reports 2010-2011). 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).

Human-caused habitat alterations have been shown to facilitate travel by predators and hence can negatively affect boreal caribou by increasing the functional abundance, distribution and hunting efficiency of species that prey on caribou (James and Stuart-Smith, 2000; Neufeld, 2006; Boreal Caribou ATK Reports 2010-2011). Additionally, in boreal caribou ranges with habitat alterations that provide favourable conditions for prey species such as deer (*Odocoileus* spp) and moose (*Alces alces*), predators such as wolves can increase in number and have the potential to significantly reduce or even eliminate local boreal caribou populations as caribou are taken opportunistically (Seip, 1991; Seip, 1992; Courtois and Ouellet, 2007; Wittmer et al., 2005; Courbin et al., 2008; Boreal Caribou ATK Reports 2010-2011).

In addition to deer and moose, Aboriginal traditional knowledge identified elk (*Cervus canadensis*), bison (*Bison bison*), and beaver (*Castor canadensis*) as other prey species that predators of boreal caribou commonly hunt and that have increased within the distribution of boreal caribou (Boreal Caribou ATK Reports 2010-2011).

### **Threat 3 – Habitat Alteration (Loss, Degradation or Fragmentation) as a Result of Natural Processes**

Forest fires are required for boreal forest regeneration and have historically played a significant role in the size and distribution of boreal caribou local populations throughout their distribution (Thomas and Gray, 2002). 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). Aboriginal traditional knowledge indicates that 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 throughout their range, there are fewer available suitable areas into which boreal caribou can move. Forest fires are therefore considered a threat to 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).

### **Threat 4 – Hunting**

Hunting has contributed to the decline of boreal caribou (Kelsall, 1968; Bergerud, 1967; Bergerud, 1974; Bergerud, 1978; Boreal Caribou ATK Reports 2010-2011). Incidental harvest of boreal caribou (when they overlap seasonally with legally hunted migratory caribou ecotypes) and illegal hunting of boreal caribou are of concern in several areas, and may be contributing to population declines or preventing recovery in some cases (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 caribou mortality and hence is a primary threat in some local populations (Dzus, 2001; Schmelzer et al., 2004). 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, it was highlighted by Aboriginal traditional knowledge and in Aboriginal community meetings 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 and have resulted in a greater number of individuals being hunted (Boreal Caribou ATK Reports 2010-2011; Environment Canada, 2011a).

## **Threat 5 - Climate Change & Severe Weather**

Climate change has been identified by Aboriginal traditional knowledge holders and western scientists as a potential 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.

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; 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 knowledge holders (Boreal Caribou ATK Reports 2010-2011). Climate change will likely lead to changes in habitat that allow deer and other prey species to expand into boreal caribou range, increasing predation and facilitating the spread of disease. Climate change may result in habitat change for boreal caribou, due to a northward shift in boreal forest composition and allowing forest insects, which cause tree mortality (e.g., mountain pine beetle), to increase their distribution (Johnston, 2009; Johnston, 2010).

### **Other Threats**

Other threats that are a low level of concern include:

*Noise and Light Disturbance:* Noise and light disturbance results 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).

*Parasites and Disease:* Viral, parasitic, and bacterial diseases can affect individual boreal caribou and may have effects at the 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.

*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 recovery (Boreal Caribou ATK Reports 2010-2011).

*Pollution:* The threat of pollution (e.g., from oil and gas, chemical spraying for forestry, and hydro) was raised as a concern at several Aboriginal community meetings and by Aboriginal traditional knowledge holders. Very little is known about the severity of this threat to the recovery of boreal caribou.

## 5. POPULATION AND DISTRIBUTION OBJECTIVES

The national population of boreal caribou is made up of 57 local populations distributed across Canada (Figure 2). Local populations of boreal caribou and their range areas are the fundamental units of conservation and management for boreal caribou recovery planning and actions (Thomas and Gray, 2002).

Aboriginal traditional knowledge supports the continued presence of all boreal caribou populations across Canada, now and into the future, because all animals are connected to each other and caribou are important to the balance of nature and for their role in the ecosystem. Loss of boreal caribou will affect all other wildlife.

Best available western science states that conservation of a species is achieved by maintaining multiple population units across a species' natural range, in representative ecological settings, with replicate populations in each setting that are self-sustaining, genetically robust, ecologically functional, and resilient to climate and other changes (Environment Canada, 2011b).

Recovery extends beyond the individual local populations. Connectivity between local populations is an essential element of the achievement of a secure conservation status for boreal caribou. Connectivity of ranges will ensure that local populations benefit from and contribute to the conservation of neighbouring local populations by allowing for immigration and emigration and maintaining or increasing genetic diversity. Maintaining genetic diversity is important to the resilience of a local population as described in Section 3.3. Connectivity allows wide ranging, mammals to adapt to changes in their natural environment (e.g. climate change), recognizing that a contiguous population does not mean that each range must be physically connected to other ranges. It does mean that the distances between ranges should not be so large that no movement would occur and that the condition of the landscape between ranges should allow caribou to move through it with a reasonable likelihood of survival for the purposes of gene flow and rescue effects.

Caribou encounter a wide variety of ecological conditions across their distribution. Local population ranges that represent the full ecological gradient are necessary to capture local adaptations that arise from adaptive variation. This allows for maintenance of the evolutionary potential of the species and accounts for the full range of ecological interactions a boreal caribou can have within the full range of ecological settings (Redford et al., 2011).

There is a wide variance in the present condition and land use situation of each local population range, both ecologically and with respect to the decision-making processes, activities on the landscape, etc that will have to be modified in order to first stabilize the population, and then move toward full recovery. Extensive lead time is likely needed to both alter ecological processes detrimental to boreal caribou triggered decades ago, and institute changes to management frameworks and ongoing land use that in some cases may be subject to very long-term legal agreements, tenure, rights, etc. While the details of each particular case will be more precisely illuminated in the SARA Action Plan process, at this strategic level it is necessary to acknowledge that instant results are not achievable particularly in some ranges – but, will always be pursued to the extent possible in that situation.

The long-term recovery goal for boreal caribou is to achieve self-sustaining local populations throughout their distribution in Canada to the extent possible<sup>4</sup>.

Boreal caribou exist in mature boreal forest ecosystems that are established over many decades, and in turn take many years to recover from disturbance. The loss of habitat and the increase in predators and alternate prey populations in caribou ranges require time frames in excess of 50 to 100 years to reverse. As such, the population and distribution objectives stated in this strategy will be framed around the first 50 years of implementation that will assist in achieving the long-term recovery goal, whose ultimate attainment will likely take much longer.

To guide recovery efforts for the first 50 years of the recovery process, the following are the population and distribution objectives:

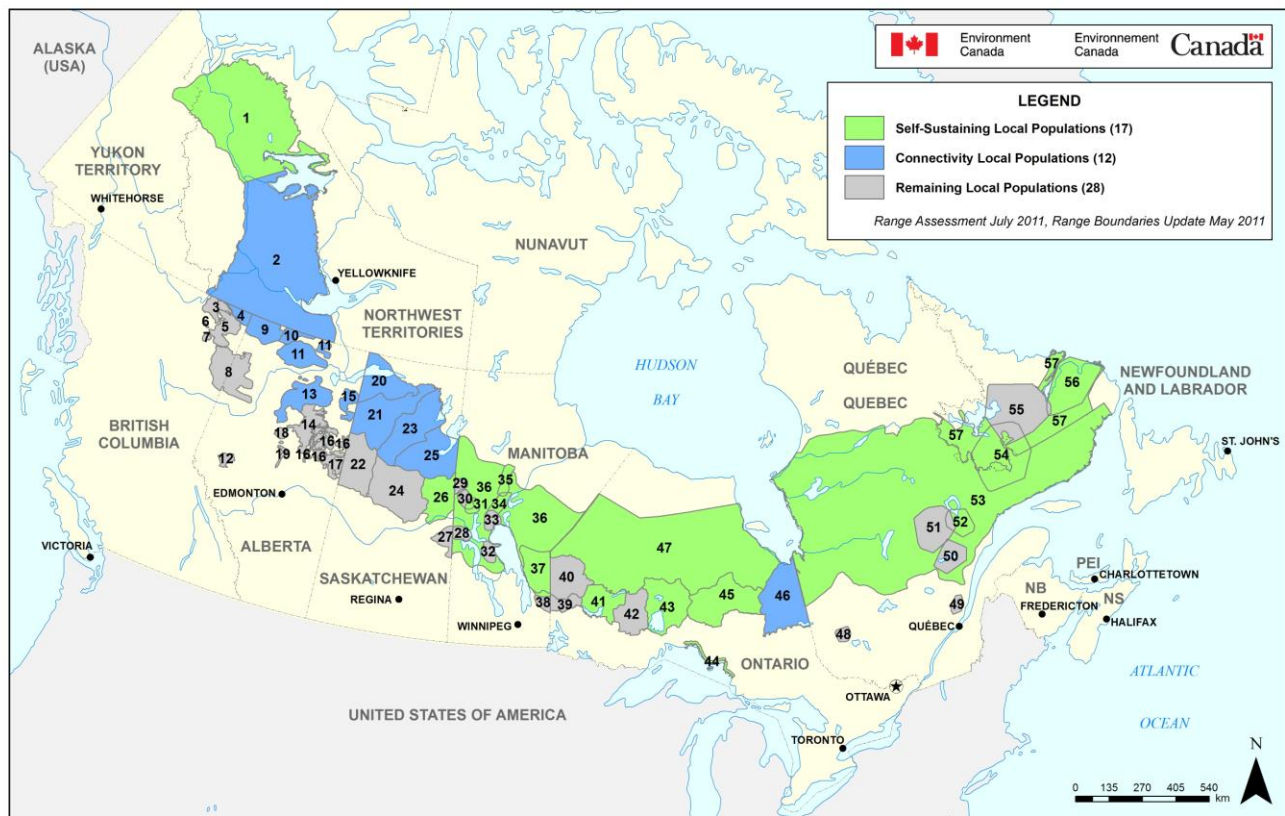
*Across the distribution<sup>5</sup> of boreal caribou as noted in Figure 4:*

- *Maintain the current status of the 17 existing self-sustaining local populations (green local populations in Figure 4);*
- *Achieve self-sustaining status for 12 local populations that are not self-sustaining, to ensure representivity of ecological conditions and maintain connectivity across Canada (blue local populations in Figure 4); and,*
- *Stabilize the remaining 28 local populations that are not self-sustaining (grey local populations in Figure 4).*

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<sup>4</sup> Current evidence supports the conclusion that the recovery of all local populations is technically and biologically feasible. However, 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 (see Definitions) and as such may affect the likelihood of achieving the population and distribution objectives for some individual local populations.

<sup>5</sup> For the purposes of this strategy, boreal caribou “distribution” is the area that encompasses the geographic distribution of all local populations across Canada based on provincial and territorial distribution maps (Figure 2) developed from observation and telemetry data, local knowledge including Aboriginal traditional knowledge and biophysical analyses, at the time of the publishing of this strategy (Boreal Caribou ATK Reports 2010-2011; Environment Canada, 2011b).



**Figure 4:** Population and distribution objectives as they apply to individual local populations.

### 5.1.1 Self-Sustaining Local Populations

Maintenance of the population and range conditions that support these local populations is required to ensure the recovery of boreal caribou. Seventeen (17) local populations of boreal caribou have been assessed as self-sustaining (Figure 4 – Green local populations).

### 5.1.2 Non Self-Sustaining Local Populations

Recovery of the forty (40)<sup>6</sup> non self-sustaining local populations requires a combination of coordinated habitat restoration and population management actions applied over time to return a local population to a normal state.

Initial recovery steps are to stabilize local populations by halting the decline in population size. Stability is achieved when a local population trend is stable or increasing. In addition the size of the local population should be large enough to mitigate risk of quasi-extinction.

<sup>6</sup> The seven (7) local populations with a status of “as likely as not self-sustaining” (Environment Canada, 2011b) are counted as “not self-sustaining” along with 33 not self-sustaining in this recovery strategy.



Twelve (12) local populations of boreal caribou are identified as “connectivity” populations in this recovery strategy (Figure 4 – Blue local populations). These local populations were prioritised to recover to self-sustaining levels, in order to maintain a connected self-sustaining population of boreal caribou that represent ecological conditions across the distribution of the species in the boreal forest.

Twenty-eight (28) local populations that are not self-sustaining will be stabilized (Figure 4 – Grey local populations). These 28 local populations were not identified as essential for connectivity and representative of ecological conditions across the distribution of the species. Local populations with estimates of greater than 100 animals will be stabilized at existing population size estimates (e.g. the population size for local population # 24 - Smoothstone-Wapawekka in Saskatchewan will not be permitted to drop below the reported size estimate of 700 animals). For local populations with fewer than 100 animals, a requirement of at least 100 animals with a stable to increasing population trend is needed to minimize the risk of quasi-extinction<sup>7</sup>.

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<sup>7</sup> 100 animals provides 0.7 probability of not reaching a quasi-extinction threshold of 10 animals under stable conditions (Environment Canada, 2011b).

## **6. BROAD STRATEGIES AND GENERAL APPROACHES TO MEET OBJECTIVES**

### **6.1 Actions Already Completed or Currently Underway**

Governments, Aboriginal peoples, interest groups, and affected industries across Canada have taken a range of actions to manage and protect boreal caribou and their habitat. For example, they have:

- identified and delineated boreal caribou ranges and habitats within ranges;
- assessed the population size and/or trend and/or distribution of all local populations of boreal caribou across Canada;
- taken into account boreal caribou habitat requirements when planning and implementing forest harvesting and other industrial activities;
- developed and implemented industrial development and operating guidelines for boreal caribou ranges;
- undertaken land-use planning to identify areas within boreal caribou ranges where caribou conservation is the highest land management priority and other activities are minimized;
- closed, restricted, and/or managed hunting by Aboriginal and non-Aboriginal people, on a voluntary basis or through regulations;
- conducted predator and alternate prey management in some ranges where local populations of boreal caribou are rapidly declining;
- developed cooperative stewardship agreements and activities to support the engagement of stakeholders in the monitoring, management, and conservation of boreal caribou;
- prepared educational information and communications materials on boreal caribou and disseminated them to interest groups and the general public; and,
- conducted research on boreal caribou populations, habitat, ecology and limiting factors.

Collectively, these actions, and the level of commitment associated with these actions, are an encouraging foundation to build upon. Table 3 outlines the status of Jurisdictional recovery planning.

**Table 3. List of provincial and territorial status for boreal caribou, and description of jurisdictional recovery planning underway.**

<b>Jurisdiction</b>	<b>Recovery Plan</b>	<b>Recovery Objective</b>
<b>Northwest Territories</b>	<ul style="list-style-type: none"> <li>• Action Plan – Boreal Woodland Caribou Conservation in NWT, 2010-2015</li> <li>• Boreal Woodland Caribou Implementation Plan, 2010</li> </ul>	<ul style="list-style-type: none"> <li>• Conserve boreal caribou in all areas of NWT to prevent from becoming a species at risk</li> <li>• Maintain current contiguous distribution</li> </ul>
<b>British Columbia</b>	<ul style="list-style-type: none"> <li>• Boreal Caribou Implementation Plan, 2010</li> </ul>	<ul style="list-style-type: none"> <li>• Decrease decline</li> <li>• Protect sufficient habitat to reduce the risk of extirpation and allow for population recovery in all 6 ranges within 50 years</li> </ul>
<b>Alberta</b>	<ul style="list-style-type: none"> <li>• A Woodland Caribou Policy for Alberta, June 2011</li> <li>• Alberta Woodland Caribou Recovery Plan, 2004/5 – 2013/14</li> </ul>	<ul style="list-style-type: none"> <li>• Self-sustaining populations and maintain distribution</li> <li>• Ensure long-term habitat requirements within ranges</li> </ul>
<b>Saskatchewan</b>	<ul style="list-style-type: none"> <li>• Draft Recovery Strategy for Boreal Woodland Caribou in Saskatchewan, 2007</li> </ul>	<ul style="list-style-type: none"> <li>• Promote, sustain, and enhance populations</li> <li>• Maintain distribution of caribou and necessary ecosystems across range</li> </ul>
<b>Manitoba</b>	<ul style="list-style-type: none"> <li>• Manitoba's Conservation and Recovery Strategy for Boreal Woodland Caribou, 2005</li> </ul>	<ul style="list-style-type: none"> <li>• Self-sustaining populations on all existing range</li> <li>• Maintain and/or increase habitat to support self-sustaining local populations</li> <li>• Manage habitat on all ranges</li> </ul>
<b>Ontario</b>	<ul style="list-style-type: none"> <li>• Ontario Recovery Strategy, Woodland Caribou, 2008</li> <li>• Ontario's Woodland Caribou Conservation Plan, 2009</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain and/or re-establish self-sustaining, genetically-connected populations where they currently exist</li> </ul>
<b>Quebec</b>	<ul style="list-style-type: none"> <li>• Quebec Recovery Strategy for Woodland Caribou, 2005-2012</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain current distribution</li> <li>• Achieve and maintain uniform distribution (<math>\geq 12,000</math> caribou)</li> <li>• Conserve adequate habitat needed to achieve recovery goals</li> </ul>
<b>Labrador</b>	<ul style="list-style-type: none"> <li>• Recovery Strategy for Three Woodland Caribou Herds in Labrador, 2004</li> </ul>	<ul style="list-style-type: none"> <li>• Prevent extinction and improve status of all populations</li> <li>• Achieve self-sustaining populations across current and historical ranges</li> </ul>

## 6.2 Strategic Direction for Recovery

Land-use decision making informed by landscape-level planning that takes into consideration boreal caribou conservation needs, coordinated by the jurisdictions, will be essential for the recovery of boreal caribou, and should reflect the broad strategies identified to meet the population and distribution objectives. The following table (Table 4) and narrative describe the broad strategies to be taken to address the threats to boreal caribou and a general description of the research and management activities. These broad strategies and general approaches will inform the development of subsequent action plans, where detailed local-level planning will occur to guide the implementation of recovery actions. The specific detail of required recovery actions will vary by jurisdiction and even by individual local population range, as the suite of potential recovery actions is governed by local opportunities and constraints, and the need and urgency for a given recovery action is determined by local population and habitat conditions.

Many approaches and strategic directions are interrelated and should be implemented as part of comprehensive action plans. It is anticipated that mortality management will be necessary to prevent the extirpation of non self-sustaining boreal caribou local populations until sufficient habitat is restored to support self-sustaining local population. Sequencing and timing of specific recovery actions will be clarified at the action planning stage.

**Table 4. Recovery Planning Table for Boreal Caribou**

Threat or Limitation	Priority	Broad Strategy to Recovery	General Description of Research and Management Approaches
<b>Landscape Level Planning</b>			
<p>Habitat alteration as a result of human land-use activities</p> <p>Habitat alteration as a result of natural processes</p>	Urgent	Undertake landscape-level planning that considers current and future boreal caribou habitat requirements	<ul style="list-style-type: none"> <li>• Establish measurable range-specific population and habitat objectives and management activities.</li> <li>• Undertake coordinated land use planning to ensure that development activities are planned (type, amount, distribution) and implemented at appropriate spatial and temporal scales (i.e. consider sensitive periods/areas such as calving) to achieve recovery objectives.</li> <li>• Assess the impact of natural disturbance (e.g., forest fire) in the long-term habitat management of boreal caribou ranges and incorporate short- and long-term boreal caribou habitat requirements into forest fire management.</li> <li>• Protect key areas for boreal caribou through appropriate habitat protection mechanisms (e.g., legislated protected areas, no development zones, mixed use zones, and conservation agreements etc.).</li> <li>• Use adaptive management to assess progress (through monitoring of local populations and their ranges) and adjust management activities as appropriate.</li> <li>• Communicate among governments, Aboriginal communities and organizations, non-governmental organizations, and other organizations responsible for land-use and resource management/conservation within the boreal forest to ensure coordination of planning and management on or near boreal caribou ranges.</li> </ul>
<b>Habitat Management</b>			
<p>Habitat alteration as a result of human land-use activities</p> <p>Habitat alteration as a result of natural processes</p>	Urgent	Manage habitat to meet current and future habitat requirements of boreal caribou	<ul style="list-style-type: none"> <li>• Manage habitat within and between boreal caribou ranges, to maintain connectivity where required.</li> <li>• 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).</li> <li>• Where applicable ensure cross-jurisdictional cooperation and implementation.</li> <li>• Incorporate management guidelines and actions into permit conditions for the key industrial and other human activities identified as affecting boreal caribou or their habitat.</li> <li>• Encourage stewardship of boreal caribou habitat among industries, interest groups, and Aboriginal communities and organizations.</li> </ul>

Threat or Limitation	Priority	Broad Strategy to Recovery	General Description of Research and Management Approaches
<b>Mortality Management</b>			
Predation	High	Manage predators and alternate prey	<ul style="list-style-type: none"> <li>• Predator control: conduct predator management within or adjacent to ranges where boreal caribou local populations are declining to reduce predator populations to levels that allow for the growth of boreal caribou local populations.</li> <li>• Alternate prey control: conduct prey management within or adjacent to ranges where boreal caribou local populations are declining, to reduce other prey populations (e.g. moose and deer) that attract predators and function as resource competitors, to allow for the growth of boreal caribou populations (e.g. minimize human-caused range extensions of alternate prey).</li> </ul>
Hunting	Medium	Manage direct human-caused mortality of boreal caribou	<ul style="list-style-type: none"> <li>• Determine the extent of current hunting, and the effects of hunting on boreal caribou local populations.</li> <li>• In consultation with Aboriginal peoples, develop and implement harvest strategies where required to achieve boreal caribou recovery.</li> <li>• Assess and address impacts of hunting regulations for all boreal caribou ranges that overlap with other legally hunted Woodland Caribou ecotypes.</li> <li>• Reduce illegal hunting through stewardship, education and enforcement.</li> </ul>
<b>Population Monitoring</b>			
Knowledge gaps: Local population dynamics (trends, size, structure, and distribution)	High	Conduct population studies to better understand local population structure, trends and distribution	<ul style="list-style-type: none"> <li>• Where necessary, refine understanding of the structure and functioning of local populations.</li> <li>• Monitor local population size and trends, as well as changes in boreal caribou distribution over time.</li> <li>• Revise boreal caribou range delineations based on updated population information.</li> </ul>
Knowledge gaps: Boreal caribou health and condition	Low - Medium	Monitor boreal caribou health and condition	<ul style="list-style-type: none"> <li>• Gather information on and monitor and manage the health and body condition of individual boreal caribou.</li> </ul>
Knowledge gaps: Boreal caribou Sensory Disturbance	Low - Medium	Monitor and manage sensory disturbance of boreal caribou	<ul style="list-style-type: none"> <li>• Assess the extent, distribution, and possible consequences of sensory disturbance (e.g., aircraft traffic, snowmobiles, all-terrain vehicles, and equipment associated with oil and gas or forestry and research), and where required reduce its effects (particularly during sensitive periods, i.e. calving) within boreal caribou ranges.</li> <li>• Minimize boreal caribou disturbance during monitoring and research programs and select monitoring and research techniques that are the least intrusive to boreal caribou.</li> </ul>

## **6.3 Narrative to Support the Recovery Planning Table**

### **6.3.1 Landscape Level Planning: Undertake coordinated and comprehensive landscape level planning for all boreal caribou ranges**

Undertaking landscape level land-use planning will ensure that the needs and management of boreal caribou are addressed at the outset of land-use planning as opposed to addressing the needs and management considerations on an ad hoc basis for individual project approvals. As the local population range has been identified as the most relevant scale at which to plan for the conservation of local populations, range-level land-use planning for boreal caribou is the appropriate scale at which to 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.

### **6.3.2 Manage habitat to meet current and future habitat requirements of boreal caribou**

Boreal caribou ranges should be managed to ensure their current and future ability to support self-sustaining boreal caribou local populations. This will be accomplished, in part, through management of the amount, type and distribution of human developments, taking into account natural disturbances within individual boreal caribou ranges and including management of cumulative effects, and prioritizing ranges where current habitat is insufficient or inadequate to maintain self-sustaining local populations in order to stabilize and/or recover non-self sustaining local populations. The effectiveness of various management activities within ranges should be measured against range-specific local population and habitat objectives. Boreal caribou range management will also involve coordinated restoration of boreal caribou habitat, with a priority on those ranges where current habitat is insufficient to maintain self-sustaining local populations.

Disturbance (i.e., industrial and other human activities) should be managed consistent with land-use planning that has taken into account the habitat requirements of boreal caribou. Adequate quality, amount, and spatial distribution of necessary habitat components must be provided within each local population range over both space and time. Maintaining connectivity within and between habitat patches and ranges is particularly important for boreal caribou. In certain cases, it will be necessary to identify and designate protected areas with important habitat for boreal caribou. In addition, other important areas will also need to be managed for local populations of boreal caribou.

Successful management of boreal caribou will require the commitment, collaboration and cooperation among management authorities, Aboriginal peoples, wildlife management boards, local communities, landowners, industry and other interested parties. It will be important to monitor habitat conditions and the trend, size and distribution of local populations of boreal caribou so that the effectiveness of range management regimes can be evaluated, and adjusted as necessary. It should also be recognized that it may take some time for the impact of human developments and natural disturbances on local populations of boreal caribou to be realized. Therefore, range management regimes must take into account the likelihood of a delayed boreal caribou population and distribution response to anthropogenic or natural habitat alterations.

### 6.3.3 Mortality Management

#### a) Manage predators and alternate prey

Human-induced habitat alterations have upset the natural balance between boreal caribou and their predators, particularly wolves, resulting in unnaturally high predation rates on boreal caribou. As a result, in some areas, specific management of other wildlife species (i.e., predators and/or alternate prey) will be required to stop boreal caribou population declines and to stabilize individual local populations in the short-term. However, while management of predators and/or alternate prey may be required for a period of time, local populations of boreal caribou will not be self-sustaining in the long-term unless habitat conditions on boreal caribou ranges are improved and/or maintained to meet boreal caribou requirements.

#### b) Manage direct human-caused mortality of boreal caribou

The extent of current legal and illegal hunting, and its effect on boreal caribou local populations, is largely unknown across most of the boreal caribou range. Therefore, it is important to first determine the level of hunting levels within a local population range in order to understand the potential impact of hunting on the viability of that local population. Particular attention will need to be given to areas where boreal caribou local population ranges overlap with legally hunted caribou ecotypes (e.g. Barren-ground Caribou, migratory Woodland Caribou ecotype), 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 peoples, to achieve boreal caribou recovery.

### 6.3.4 Population Monitoring

#### a) Conduct population studies to better understand local population structure, trends and distribution

There is considerable variation in the level of understanding of local population structure, trends, and distribution across the range of boreal caribou. 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 caribou collaring, aerial observations/counting, and on the ground monitoring activities will be required to establish a starting point from which to measure recovery progress. Population data will also be used to revise the delineation of boreal caribou ranges over time as better information becomes available. Finally, for all local populations, their size, trend and distribution should be monitored over time to test the efficacy of management actions and adapt those management actions as appropriate.

#### b) Monitor 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 also has the potential 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 these threats 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 to help identify areas that may require additional recovery actions.

**c) 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**

### **7.1 Describing Critical Habitat for Boreal Caribou**

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”.

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

#### **7.1.1 Location:**

Location describes where critical habitat is found. For boreal caribou the relevant scale to identify critical habitat is ranges of the local populations. As such, the range is the geographic unit that delineates the area within which critical habitat is located. There are 57 local population ranges within the current distribution of the boreal caribou (see Figure 2).

#### **7.1.2 Amount:**

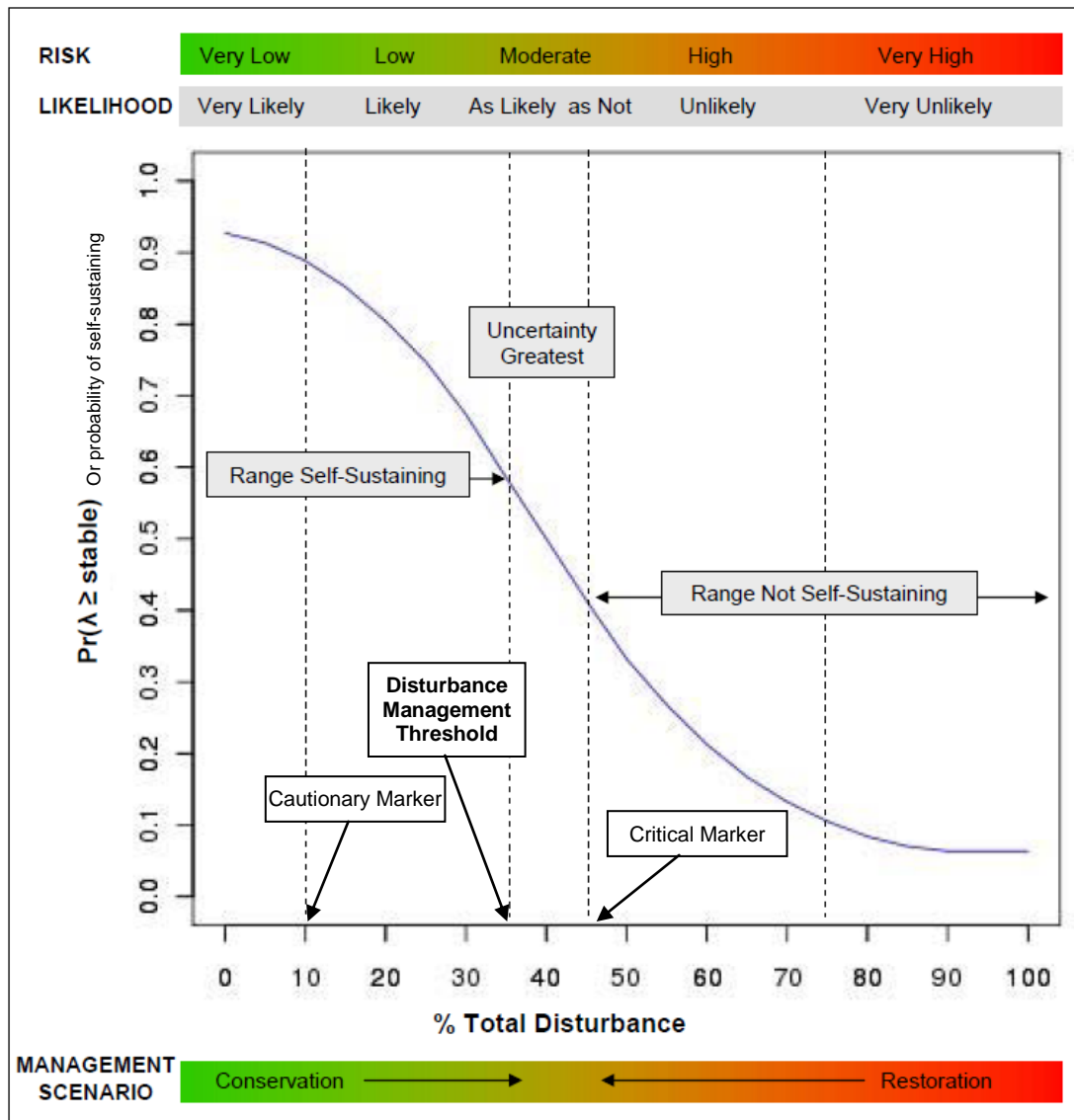
Amount describes the quantity of critical habitat.

A strong relationship exists between the survival of boreal caribou local populations and habitat disturbances where, as the quantity and/or severity of disturbance increases, boreal caribou survival decreases (Environment Canada, 2011b) as further described in Annex E. The Environment Canada’s 2011 Assessment of Critical Habitat for Boreal Caribou determined the relationship between the amount of undisturbed habitat in a range and the likelihood of a local population being self-sustaining as illustrated in Figure 5 (Environment Canada, 2011b). This recovery strategy identifies 65% undisturbed habitat in a range as the threshold which provides a measurable probability (60%) for a local population to be self-sustaining. It is important to note

that this is a minimum threshold because there is still a risk (40%) that local populations will not be self-sustaining.

It is important to note that caribou are at greater risk of predation and will avoid anthropogenic footprints such as seismic lines, roads, cut blocks, etc, as well as the adjacent habitat for a distance up to 500m (Environment Canada, 2011b). Cumulatively, the total disturbed area that is avoided by boreal caribou includes the anthropogenic footprint plus a 500 m buffer plus areas where a fire has occurred in the past 40 years (no buffer applied). The remaining habitat within a range is considered undisturbed. Restoration of anthropogenic footprint will result in a larger area becoming undisturbed. This is of particular importance when considering linear disturbance such as seismic lines that may only be a few meters wide that, when restored, will result in a kilometer wide corridor that will be included within the 65% undisturbed habitat threshold.

The distribution of disturbance will also influence the amount of undisturbed habitat. Concentrated polygonal disturbances (eg. forest cut blocks) in one portion of a range result in more undisturbed habitat available to boreal caribou elsewhere within the range than compared to a network of linear disturbances (eg. seismic lines, pipelines etc.) scattered throughout a range.



**Figure 5.** Tiered management thresholds for managing risk associated with recovery planning for boreal caribou critical habitat.

### 7.1.3 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. Results from Aboriginal traditional knowledge gathering (Boreal Caribou ATK Reports 2010-2011), habitat selection analyses, and scientific published reports (Environment Canada, 2011b) were used to summarize key biophysical attributes necessary for boreal caribou. Results are categorized by the habitat selection type (e.g. calving, winter, avoidance, etc.) and are provided by ecozones in order to capture the ecological variation across the distribution of boreal caribou.

## 7.2 Identification of the Critical Habitat for Boreal Caribou

Based on the foregoing, the identification of critical habitat for boreal caribou is described as i) the location as the boundary of each local population's range within which critical habitat is found; ii) an amount of undisturbed habitat within each range that varies depending on the population and distribution objectives for that local population as described below and iii) the biophysical attributes applicable to each range. Critical habitat for all 57 boreal caribou local populations has been identified in Annex F.

### 7.2.1 Critical Habitat for Self-Sustaining Local Populations

For the 17 self-sustaining local populations, critical habitat is identified as:

**Location:** The range of the local population.

**Amount:** 65% undisturbed habitat within the range of the local population.

**Type:** Biophysical attributes of the range of the local population.

### 7.2.2 Critical Habitat for Non Self-Sustaining Local Populations Representing Ecological Conditions and Maintaining Connectivity

For the selected 12 non self-sustaining local populations that represent ecological conditions and maintain connectivity, critical habitat is identified as:

**Location:** The range of the local population.

**Amount:** The existing undisturbed habitat which must increase over time (i.e. over 50 years) to provide 65% of the total range area as undisturbed habitat. The description will be updated over time through an amendment to this recovery strategy.

**Type:** Biophysical attributes of the range of the local population.

### 7.2.3 Critical Habitat for Remaining Non Self-Sustaining Local Populations

For the 28 remaining, non self-sustaining local populations, critical habitat is identified as:

**Location:** The range of the local population.

**Amount:** Where the amount of undisturbed habitat<sup>8</sup>:

- 65% or more, the amount of critical habitat is 65% undisturbed habitat within the range of the Boreal population;
- more than 5% and less than 65%, the amount of critical habitat required initially is the undisturbed habitat. This may be decreased in an amendment to the recovery strategy should jurisdictions provide a plan that will support stabilised local populations through the use of mortality and habitat management tools; and
- 5% or less, the amount of critical habitat is all existing habitat<sup>9</sup>. Jurisdictions must continue to use mortality and habitat management tools to ensure these populations remain stable.

**Type:** Biophysical attributes of the range of the local population.

The relationship between the reduced amount of habitat needed in conjunction with mortality management is not well understood. It is expected that there is a threshold below which the level of disturbance will lead to boreal caribou local population declines due to lack of resources, such as forage, needed to support life stages. Such a threshold would be separate and distinct from the 65% undisturbed habitat threshold related to predator-prey dynamics. Lack of resources may be caused by avoidance of higher quality habitat areas adjacent to disturbance or direct loss of resources when habitat is converted through development or fire. As such, additional research and monitoring will be needed to address this uncertainty. This work will be prioritized in the schedule of studies.

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<sup>8</sup> “undisturbed habitat” is an area in a local population range that does not include fire disturbance within the last forty years, anthropogenic disturbance plus the 500m buffer around anthropogenic disturbance.

<sup>9</sup> “existing habitat” is the area in a local population range that excludes fire disturbance within the last 40 years and unbuffered anthropogenic footprints.

### 7.3 Schedule of Studies

Description of Activity	Rationale	Timeline
Determine the amount habitat required to stabilize a local population in a highly disturbed, non self-sustaining range where predation of boreal caribou is controlled through predator management	For the remaining 28 local populations where mortality management will be required to stabilize the local populations, there is a need to understand the mitigation effects of management on the amount of disturbance that can be tolerated within ranges while stabilizing local populations.	Preliminary results in 2 years based on modelling with substantial progressive improvement with implementation of a research program and monitoring over the next 5-10 years

### 7.4 Activities Likely to Result in the Destruction of 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 the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time (Government of Canada, 2009b). Destruction of boreal caribou critical habitat involves any activity that results in a temporary or permanent alteration of the habitat required to support the population and distribution objectives.

#### 7.4.1 Types of Destruction

Activities that are likely to result in the destruction of critical habitat are described as any habitat alteration that will result in changes to landscape within the range of a local population of boreal caribou that adversely impacts the ecosystem, either temporarily or permanently, reducing overall function. The amount of habitat alteration in a local population is also relative to the population and distribution objective to which the local population is associated and described under sections 7.4.2 for self-sustaining local populations, 7.4.3 for representative local populations and 7.4.5 for remaining non self-sustaining local populations. Destruction of critical habitat includes the activities that cause the following habitat alterations:

- Any activity resulting in the direct loss of habitat (e.g. conversion to agriculture, industrial and other infrastructure development) and changes the undisturbed habitat with the range of a local population and thereby reduces the availability of suitable habitat for boreal caribou.

- Any activity resulting in the degradation and/or conversion of habitat leading to a reduced, but not total, loss of habitat value (in terms of both quality and availability) for boreal caribou.
- Any activity resulting in the dissection of habitat by human-made linear features (e.g., roads, geophysical exploration lines, pipelines, hydroelectric corridors) that reduces the area of contiguous undisturbed habitat required by boreal caribou.

#### **7.4.2 Destruction of Critical Habitat for the 17 Self-Sustaining Local Populations**

Within the range identified for each of those local populations, any activity which results in habitat alterations that cause the undisturbed habitat to fall below 65 % of the range.

#### **7.4.3 Destruction of Critical Habitat for the 12 Non Self-Sustaining Local Populations Representing Ecological Conditions and Maintaining Connectivity**

Within the range identified for each of those local populations, any activity which results in habitat alterations that cause the undisturbed habitat to fall below the existing level of disturbance or prevents a gradual progress over time toward the 65% undisturbed habitat threshold within the total range area.

#### **7.4.4 Destruction of Critical Habitat for the 28 Remaining Non Self-Sustaining Local Populations**

Within the range identified for local populations where the amount of undisturbed habitat is 65% or more, any activity which results in habitat alterations that causes the undisturbed habitat to fall below 65% of the range.

Within the range identified for each local population with undisturbed habitat greater than 5% and less than 65%, any activity that would destroy undisturbed habitat. If a plan referred to in section 7.2.3 has been approved, any activity which results in habitat alteration of the critical habitat identified in the plan and published in an amended recovery strategy.

Within the range identified for each of local populations with undisturbed habitat at 5% or less, any activity which results in habitat alterations to existing habitat.

## 8. MEASURING PROGRESS

Monitoring of the local populations will be essential to have the information necessary to evaluate the effectiveness of management actions and make necessary adjustments over the 50 year time horizon.

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 of boreal caribou found throughout the entirety of their distribution in Canada. Performance indicators for this recovery strategy are that each of the population and distribution objectives are met and boreal caribou as a species become less at risk.

Specific performance indicators to gauge the successful implementation of the recovery strategy are described below.

### 8.1.1 Performance Indicators for the Recovery of the 17 Self-Sustaining Local Populations

- Undisturbed habitat area is maintained at no less than 65% of the total range area.

### 8.1.2 Performance Indicators for the Recovery of the 12 Non Self-Sustaining Local Populations Representing Ecological Conditions and Maintaining Connectivity

- Undisturbed habitat area does not drop below existing levels and is increased over next 50 years at reasonable, gradual increments every 5 years to no less than 65% of the total range area

### 8.1.3 Performance Indicators for the Recovery of the 28 Remaining Non Self-Sustaining Local Populations

- For local populations where the amount of undisturbed habitat is 65% or more, undisturbed habitat area is maintained at no less than 65% of the total range area.
- Local populations are stabilized within 5 years for those that initially had more than 100 animals.
- Local populations with initial estimates of less than 100 animals have an increasing population trend (i.e.,  $\lambda > 1$ ) within 5 years.



## **9. STATEMENT ON ACTION PLANS**

This recovery strategy will be followed by one or more action plans that 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, jurisdictions, Aboriginal peoples, stakeholders and organizations involved in the conservation, survival and recovery of boreal caribou.

### **9.1 Coordinated approach**

#### **9.1.1 Jurisdictional Leadership**

Provinces and territories have the primary responsibility for management of lands and wildlife within boreal caribou range, and therefore have the jurisdictional mandate for recovery and conservation of the boreal caribou. In the Northwest Territories, Aboriginal Affairs and Northern Development Canada also has a significant role to play, as does the Parks Canada Agency within National Parks where boreal caribou exist.

Development of one or more action plans for boreal caribou is required under the *Species at Risk Act*. Provincial, Territorial and Federal actions plans will be necessary for this widespread species. This suite of action plans will require substantial inter-agency communication and cooperation.

Provincial and territorial action plans will outline specific recovery actions at the boreal caribou range level and will inform broader land-use planning and decision making. Various provincial/territorial processes and documents, such as industrial operating guidelines and forest harvesting management plans, could potentially contribute to boreal caribou recovery action planning. Some of these processes and documents could provide interim guidance until boreal caribou action plans are completed.

#### **9.1.2 Aboriginal Involvement in Recovery**

It is important and necessary for Aboriginal peoples to have opportunities for effective involvement in boreal caribou recovery planning and actions. Across Canada, full participation by Aboriginal peoples is encouraged within provincial/territorial recovery planning and action teams.

#### **9.1.3 Stakeholder Engagement**

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this 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 vary by jurisdiction and by individual local population range. The suite of potential recovery actions is governed by local opportunities and constraints, and the need and urgency for a given recovery action is determined by local population and habitat conditions. Early attention is particularly important for the 12 non self-sustaining local populations representing ecological conditions and maintaining connectivity.

### 9.2.1 *Specific Management Actions*

Broad Strategies and General Approaches to Meet Objectives (Section 6) as set out in the recovery strategy will inform the development of subsequent 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 recovery action planning based on the state of the local population range. Generally, for self-sustaining local populations, minimal management actions may be necessary, and strategically planned development could take place without threatening the status of these local populations. Where local populations are not self-sustaining, specific management action is needed, in some cases for many decades (50 years or more) until sufficient habitat is restored.

Many approaches and strategic directions are inter-related and should be implemented as part of comprehensive action plans. It is expected that mortality management including predator and/or alternate prey control would need to occur while habitat restoration is underway to prevent local extirpation of a boreal caribou local until the ecological conditions of the range has been restored. Immediate and long term actions will vary based on the habitat and population condition of each range. Sequencing and timing of specific recovery actions will be clarified at the action planning stage.

One or more action plans will be published in 2013, with priority given to publication of action plans for the 12 representative local populations.

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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 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 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 population declines and to assist in stabilizing and recovering local populations. With respect to broader environmental impacts, certain management tools, most notably predator (wolves, principally) and alternate prey (moose, deer) control, will be required in areas with unnaturally high rates of predation on boreal caribou, in some cases for very long periods of time. The extent of the impacts of extensive predator/alternative prey control at the species/ecosystem level are difficult to quantify, as they will depend on the duration and intensity with which this control method is implemented within a local population range. Short-term (i.e. 5-10 years) predator/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. However, long-duration (i.e. up to 40-50 years) predator/alternate prey suppression, particularly that involving an apex predator such as wolves are in the boreal forest, over large ranges such as dealt with in this strategy, has not been employed anywhere in North America, and the effects of this management action on long-term boreal ecosystem structure and function are highly unpredictable. Where mortality management is enforced, monitoring of boreal caribou and the species being controlled (e.g. wolves, bears, moose, deer) must be undertaken.

## APPENDIX B: BOREAL CARIBOU POPULATION INFORMATION

The following information is extracted directly from Environment Canada’s 2011 Scientific Assessment of Critical Habitat for Boreal Caribou (Environment Canada, 2011b).

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 population ranges based on updated range boundaries for boreal caribou provided by jurisdiction which were subsequently classified into three types reflecting the level of certainty in range boundaries: Conservation Units (low certainty), Improved Conservation Units (medium certainty), and Local Population (high certainty).

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

Range	Range Type	Population size (minimum)	Population size (maximum)	Population trend	Risk Assessment
<b>Northwest Territories</b>					
Northwest Territories - North	LP	n/a	n/a	n/a	SS
Northwest Territories - South	LP	n/a	n/a	n/a	NSS/SS
<b>British Columbia</b>					
Maxhamish	LP	306	306	n/a	NSS
Calendar	LP	291	291	n/a	NSS
Snake-Sahtahneh	LP	365	365	declining	NSS
Parker	LP	25	25	n/a	NSS
Prophet	LP	54	54	n/a	NSS
<b>Alberta</b>					
Chinchaga (incl. BC portion)	LP	250	250	declining	NSS
Bistcho	LP	195	195	declining	NSS
Yates	LP	350	350	stable	NSS
Caribou Mountains	LP	315	394	declining	NSS
Little Smoky	LP	78	78	declining	NSS
Red Earth	LP	172	206	declining	NSS
West Side Athabasca River (WSAR)	LP	204	272	declining	NSS
Richardson	LP	150	150	n/a	NSS
East Side Athabasca River (ESAR)	LP	90	150	declining	NSS
Cold Lake	LP	150	150	declining	NSS
Nipisi	LP	55	55	n/a	NSS
Slave Lake	LP	65	65	n/a	NSS

Range	Range Type	Population size (minimum)	Population size (maximum)	Population trend	Risk Assessment
<b>Saskatchewan</b>					
Davy-Athabasca	CU	310	310	n/a	NSS
Clearwater	CU	425	425	n/a	NSS
Primrose-Cold Lake	CU	350	350	n/a	NSS
Highrock-Key	CU	1060	1060	n/a	NSS
Smoothstone-Wapawekka	CU	700	700	declining	NSS
Steephill-Foster	CU	1075	1075	n/a	NSS
Suggi-Amisk-Kississing	CU	430	430	n/a	SS
Pasquia-Bog	CU	30	30	declining	NSS
<b>Manitoba</b>					
The Bog	ICU	50	75	stable	NSS/SS
Kississing	ICU	50	75	stable	NSS
Naosap	ICU	100	200	stable	NSS
Reed	ICU	100	150	stable	SS
North Interlake	ICU	50	75	stable	NSS/SS
William Lake	ICU	25	40	stable	NSS
Wabowden	ICU	200	225	stable	SS
Wapisu	ICU	100	125	stable	SS
Manitoba	CU	775	1585	stable	SS
Atikaki-Berens	ICU	300	500	stable	SS
Owl-Flinstone	LP	78	78	stable	NSS/SS
<b>Ontario</b>					
Sydney	ICU	n/a	n/a	stable	NSS
Berens River - Atikaki	ICU	n/a	n/a	n/a	NSS/SS
Churchill	ICU	n/a	n/a	n/a	SS
Brightsand	ICU	n/a	n/a	n/a	NSS/SS
Nipigon	LP	300	300	stable	SS
Coastal	LP	492	492	n/a	SS
Pagwachuan	ICU	n/a	n/a	n/a	SS
Kesagami	ICU	492	492	declining	NSS
Far North	CU	n/a	n/a	n/a	SS
<b>Quebec</b>					
Val d'Or	LP	30	30	declining	NSS
Charlevoix	LP	75	75	stable	NSS
Pipmuacan	ICU	134	134	stable	NSS
Manouane	ICU	358	358	stable	NSS/SS
Manicouagan	ICU	181	181	increasing	SS
Quebec	CU	9000	9000	stable	SS
<b>Labrador (Newfoundland)</b>					
Lac Joseph	LP	1101	1101	n/a	SS
Red Wine Mountain	LP	97	97	declining	NSS
Mealy Mountain	LP	2106	2106	stable	SS

<b>Range</b>	<b>Range Type</b>	<b>Population size (minimum)</b>	<b>Population size (maximum)</b>	<b>Population trend</b>	<b>Risk Assessment</b>
Labrador	CU	n/a	n/a	n/a	SS

<b>Population Trend</b>	<b>Number of Populations</b>
Declining	14
Stable	19
Increasing	1
Unknown	23
<b>Total</b>	<b>57</b>

<b>Risk Assessment</b>	<b>Total Number of Local Populations</b>
NSS	33
NSS/SS	7
SS	17

	<b>Local Populations with Size Estimates</b>	<b>Estimated Population Size (average)</b>
<b>2011 Size Estimates Available</b>	<b>48</b>	<b>24,459</b>
<b>Local Populations with No Data</b>	<b>9</b>	<b>7,084 *</b>
<b>TOTAL</b>	<b>57</b>	<b>31,543</b>

\*The 2011 Scientific Assessment did not include population estimates for Boreal Caribou local populations in the NWT and ON. For NWT and ON Boreal Caribou, population information was taken from the 2008 Scientific Review. An estimate of 5800 animals in NWT and 1284 animals in ON (Total 7,084) that were reported in the 2008 Environment Canada Scientific Review.

## **APPENDIX C: ABORIGINAL TRADITIONAL KNOWLEDGE SUMMARY REPORTS ON BOREAL CARIBOU**

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 national recovery strategy. This commitment came from the recognition that Aboriginal peoples possess significant, unique knowledge about caribou biology, distribution and threats facing the species and population trends, 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 national 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. Each Aboriginal community within and adjacent to the range of boreal caribou was sent a letter inviting them to participate in the process of developing the national recovery strategy.

As a result of these efforts, one of three basic processes was followed in the 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 (i.e. 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 recovery strategy drafting team received all summary reports and reviewed these in detail to highlight information that could inform the national recovery strategy. Knowledge provided that would be more applicable at the action planning stage was also identified and flagged by the recovery strategy drafting team. The purpose of this step was to identify where and how the Aboriginal traditional knowledge could support the national recovery strategy and the subsequent regional/local action plans.

Each summary report received contains unique and geographically specific information that is representative of the knowledge and experiences shared by knowledge holders. 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 drafting of the national recovery strategy. In addition, Aboriginal knowledge holders shared considerable detailed local knowledge about boreal caribou which may be used to support regional-level action plans. In all cases, Environment Canada verified and validated the accuracy of the knowledge holders' information and reconfirmed the intention for its use.

The development of the national boreal caribou recovery strategy is an opportunity to work together and benefit from the best available information from Aboriginal traditional knowledge and scientific knowledge to support the recovery of boreal caribou in Canada. Bringing together

the two knowledge systems to help recover species at risk in Canada will take time and is a learning experience for all involved. Environment Canada appreciates the time, effort and knowledge contributed by knowledge holders, interviewers, organizers, interpreters and all others who have contributed to this work. This great wealth of knowledge shared by knowledge holders across Canada has been gained from generations of time spent living with and beside the caribou. Environment Canada values the sharing of this knowledge and has used the information to inform the national recovery strategy.

The compilation of Aboriginal traditional knowledge summary reports gathered for the purposes of boreal caribou recovery will be available on the Species at Risk Public Registry, <http://www.sararegistry.gc.ca>, September 2011.

## **APPENDIX D: SCIENTIFIC ASSESSMENTS OF CRITICAL HABITAT FOR BOREAL CARIBOU**

### **2008 Scientific Review**

In 2007, Environment Canada (EC) 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 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 population based on three lines of evidence: percent total disturbance, population growth and population size. Of the 57 local population ranges or unit of analysis, 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 either ‘Self-Sustaining’ or ‘Non-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, EC 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 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 populations, and resultant critical habitat identification;
- 3) identification of disturbance-based management thresholds (hereinafter referred to disturbance thresholds) for self-sustaining local populations;
- 4) influence of future range conditions on disturbance 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, EC undertook the work presented in 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) within 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 population and habitat conditions; assessment of current conditions to support self-sustaining caribou 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 Inform 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:

- i. The delineation and location of the range, and certainty in range delineation.
- ii. 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 population. The result is expressed as a likelihood statement relative to achieving the recovery objective.
- iii. Information to support the identification of disturbance-based 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.
- iv. A description of the bio-physical attributes, defined as the habitat characteristics required by caribou to carry out life processes necessary for survival and reproduction. The results from the habitat selection analyses (this report) and published reports were used to summarize key bio-physical attributes by ecozone.

The related goals of assessing the ability of ranges to support self-sustaining populations, and establishment of management thresholds for disturbance, must acknowledge uncertainties arising from the availability and reliability of information about current population condition, as well as how 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 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 caribou.

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

- **Nearly 70% of the variation in caribou recruitment across twenty-four 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.**
- **Of the 57 identified boreal caribou ranges in Canada, 17 (30%) were assessed in the ‘self-sustaining’ (SS) category, 7 (12%) in the ‘not self-sustaining/self-sustaining’ (NSS/SS) category, and 33 (58%) in the ‘not self-sustaining’ (NSS) category.**
- **Range-specific disturbance-based 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-based 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.

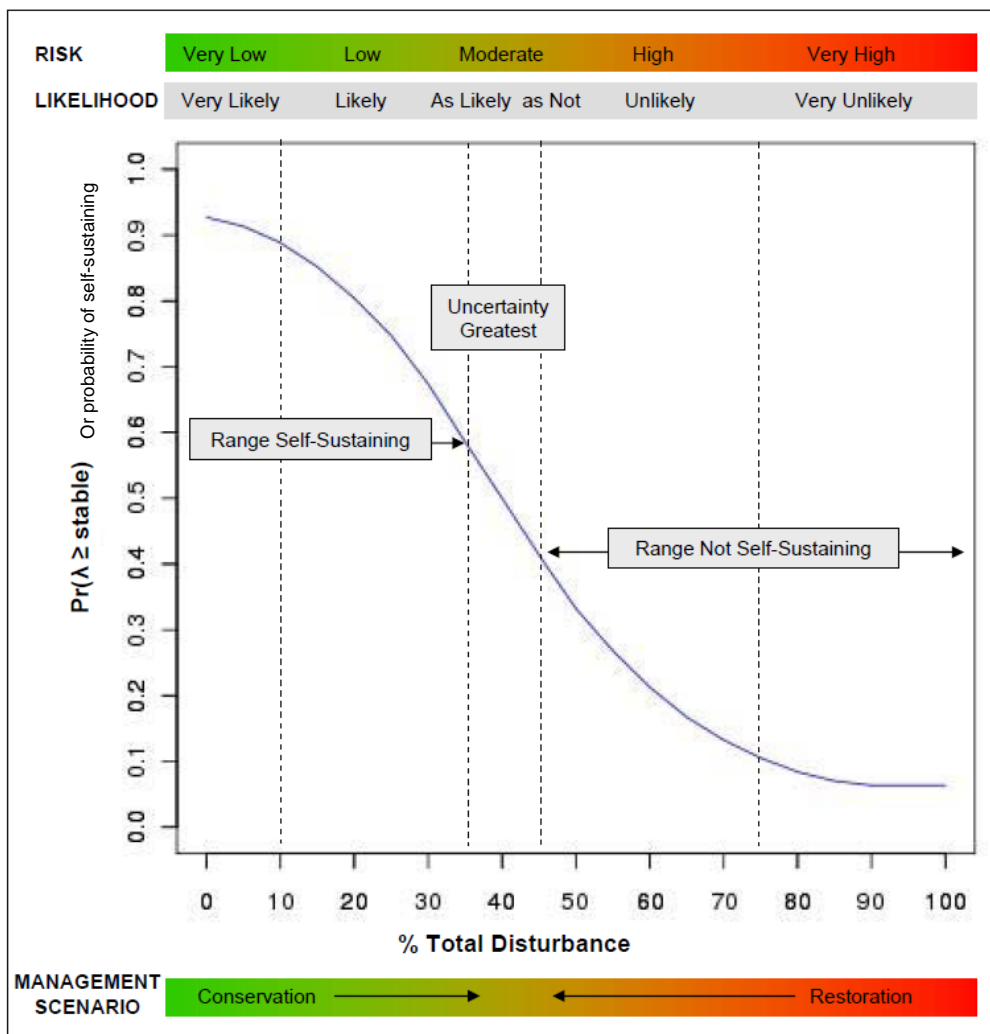
- **Most boreal caribou ranges in Canada have not been fully described owing to a lack of standardized animal location data and poor understanding of movement within and between ranges. While a total of 57 ranges are still currently recognized by jurisdictions in Canada, changes to the delineation of boreal caribou ranges have been made since the 2008 Scientific Review, by various jurisdictions, based on different criteria. The issue of appropriate delineation of trans-boundary ranges remains unresolved.**
- **Demographic data are lacking for many boreal caribou ranges in Canada. Monitoring and assessment programs to provide data on population size, population trend, recruitment and adult mortality are required to improve understanding of factors affecting boreal caribou survival and recovery, increase certainty in assessment results, and to monitor response of populations to recovery actions and 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 MANAGEMENT THRESHOLDS

A methodology was developed for consideration of disturbance-based management thresholds in Environment Canada’s 2011 Assessment of Critical Habitat for Boreal Caribou (Environment Canada, 2011b) and is described in this Annex. Establishing disturbance-based thresholds requires a recovery target and an acceptable risk from a management perspective.

The long term recovery target or goal for boreal caribou was identified as achieving self-sustaining local populations. In Environment Canada’s 2011 Assessment of Critical Habitat for Boreal Caribou this recovery target was expressed as the likelihood of observing a mean lambda (population growth) over a 20-year period of a stable or increasing population, at varying levels of total range disturbance (Figure A1). This relationship was derived by combining information on the negative effects of disturbance on caribou recruitment with a mean annual adult survival rate for mature females.



**Figure A1.** Management thresholds: The probability of observing stable or positive growth ( $\lambda \geq \text{stable}$ ) of caribou populations over a 20-year period at varying levels of total range disturbance (fires  $\leq$  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 population can be used to express the relative risk of not achieving a self-sustaining population (Table A1). 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 A1.** Intervals of total range disturbance associated with varying levels of certainty in outcome and assigned risk relative to achieving the recovery objective of stable or positive population growth.

Probability of Sustained Stable or Positive Growth <sup>1</sup>	Likelihood of Desired Outcome	Disturbance Interval <sup>2</sup>	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

<sup>1</sup> Intervals adapted from IPCC 2005; time frame for assessing mean growth rate is 20 years.

<sup>2</sup> See Figure A2.

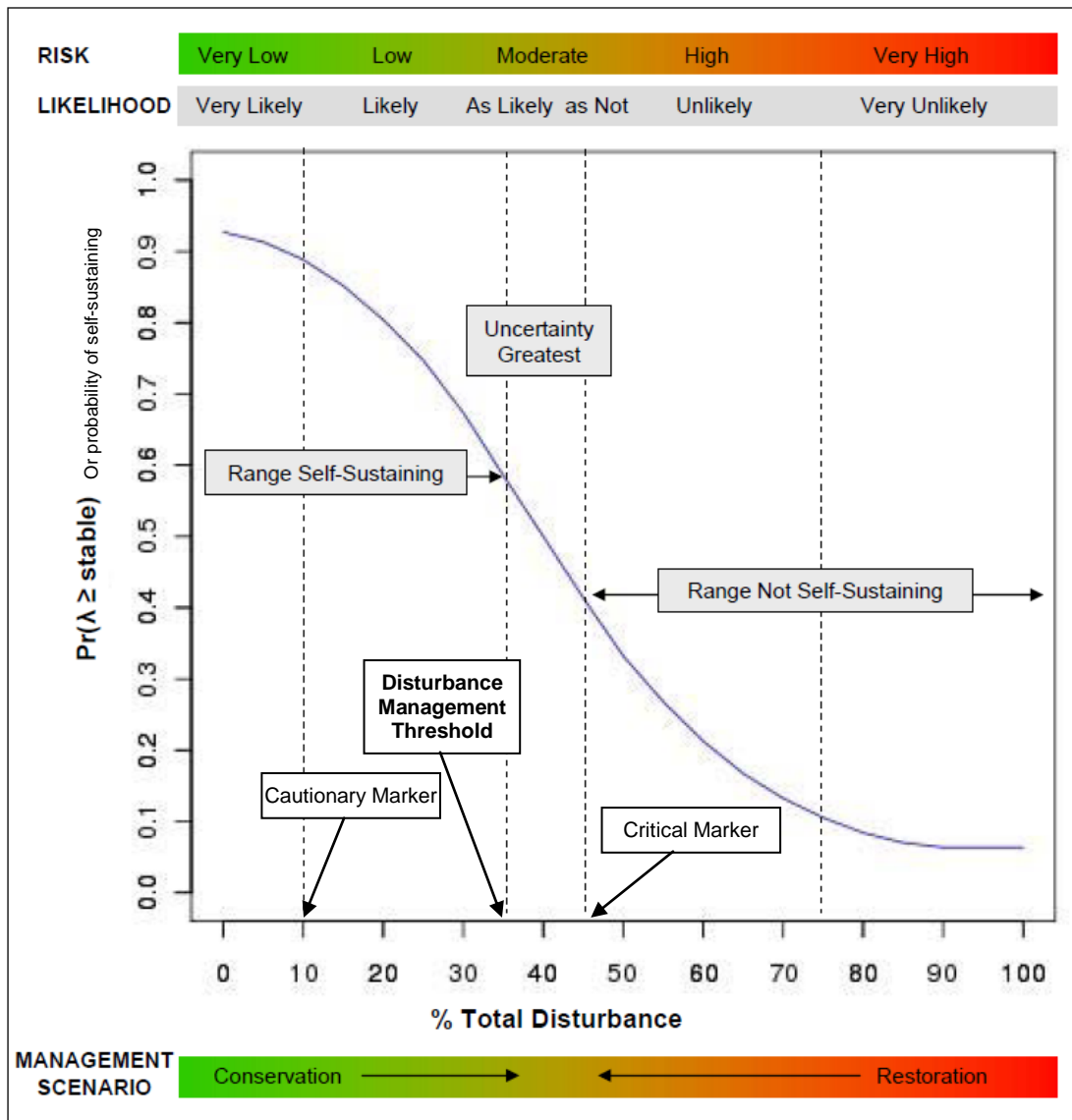
A tiered approach to identifying management thresholds for boreal caribou is proposed (Figure A2):

*Tier 1* – a **cautionary marker** indicating the point at which the likelihood of achieving the recovery objective moves from very likely to likely. At disturbance levels above the cautionary marker, general assessment and monitoring of the population is necessary to evaluate the effects of disturbance on caribou.

*Tier 2* – a **disturbance management threshold** marking the point below which (i.e., at lower levels of disturbance) conditions are likely to meet the recovery objective with an acceptable level of risk, and above which the outcome is either highly uncertain or unacceptable. The disturbance management threshold is the selection of a disturbance threshold below a critical marker (see Tier 3) that reduces the risk of unintended outcomes by providing a margin of error. In this recovery strategy a 0.6 or 60% probability of self-sustainability (i.e., population growth is stable/increasing) is applied to the maximum disturbance management threshold of 35% total disturbance (Figure A2). 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 is a reasonable starting point providing a likely to very likely certainty of recovery. It is important to emphasize that this is a maximum disturbance threshold because there still is a risk (0.4 or 40%) that local populations will not be self-sustaining. Local populations that have greater than 35% total disturbance will first be recovered to the 35% disturbance management threshold. Once a 35% total disturbance

is achieved, or for local populations that are currently at or above a 35% total disturbance, the range-specific disturbance threshold will be determined based on range-specific information. Given the variations in ecological conditions for local population ranges across the distribution of boreal caribou, it is expected that range-specific disturbance thresholds will vary between 10% and 35% total disturbance.

*Tier 3* – a **critical marker** indicating the point at which conditions suggest the likelihood of meeting the recovery objective is low. Disturbance above this marker means that resistance and resilience may have been compromised. The management emphasis is on restoring conditions to support self-sustaining populations. Monitoring is required to evaluate effectiveness of management interventions and restoration strategies.



**Figure A2.** Tiered management thresholds for managing risk associated with recovery planning for boreal caribou critical habitat.

## APPENDIX F: CRITICAL HABITAT FACTSHEETS

### a. Self-sustaining local populations (17 green local populations in Figure 4)

See factsheets for the following local populations:

Northwest Territories North (1) <sup>10</sup>	Coastal (44)
Suggi-Amisk-Kississing (26)	Pagwachuan (45)
Reed (31)	Far North (47)
Wabowden (34)	Manicouagan (52)
Wapisu (35)	Quebec (53)
Manitoba (36)	Lac Joseph (54)
Atikaki-Barens (37)	Mealy Mountain (56)
Churchill (41)	Labrador (57)
Nipigon (43)	

### b. Non self-sustaining local populations that are representative of ecological conditions and maintain connectivity across Canada (12 blue local populations in Figure 4)

See factsheets for the following local populations:

Northwest Territories South (2)	Richardson (15)
Calendar (4)	Davy-Athabasca (20)
Bistcho (9)	Clearwater (21)
Yates (10)	Highrock-Key (23)
Caribou Mountains (11)	Steephill-Foster (25)
Red Earth (13)	Kesagami (46)

### c. Remaining non self-sustaining local populations (28 grey local populations in Figure 4)

See factsheets for the following local populations:

Maxhamish (3)	Slave Lake (19)	Owl-Flinstone (38)
Snake-Sahtahneh (5)	Primrose-Cold Lake (22)	Sydney (39)
Parker (6)	Smoothstone-Wapawekka (24)	Berens (40)
Prophet (7)	Pasquia-Bog (27)	Brightsand (42)
Chinchaga (8)	The Bog (28)	Val d'Or (48)
Little Smoky (12)	Kississing (29)	Charlevoix (49)
West Side Athabasca River (14)	Naosap (30)	Pipmuacan (50)
East Side Athabasca River (16)	North Interlake (32)	Manouane (51)
Cold Lake (17)	William Lake (33)	Red Wine Mountain (55)
Nipisi (18)		

<sup>10</sup> Local population number as represented in Figures 2, 3 and 4.