

The OFAH Alternative Approach for Managing Woodland Caribou (Boreal Population) in Ontario

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Submitted by the **Ontario Federation of Anglers and Hunters (OFAH)**

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To the Species at Risk Branch of the Ontario Ministry of Natural Resources

EXECUTIVE SUMMARY

The OFAH has compiled a set of recommendations that provide a science-based blueprint for managing woodland caribou in Ontario. The recommendations are intended to outline the strategic direction needed to prioritize and focus management in a way that optimizes woodland caribou conservation with the multitude of other benefits supplied by the natural resources of our Crown forests. This document is titled: *The OFAH Alternative Approach for Managing Woodland Caribou, Boreal Population, in Ontario*.

The boreal population of woodland caribou (*Rangifer tarandus caribou*), hereafter referred to as boreal caribou, are listed as a threatened species in Ontario under the Endangered Species Act (ESA), 2007. This designation has initiated a process to develop species-specific habitat regulation for boreal caribou. As a part of this process, the Ontario Ministry of Natural Resources (MNR) released *A proposed approach for habitat protection for woodland caribou (forest-dwelling boreal population) under the Endangered Species Act, 2007* in January 2011. The MNR describes a species-specific habitat regulation under the ESA as a means of providing “greater certainty of what is meant by a species habitat.” The OFAH believes that the MNR’s proposed approach for creating a boreal caribou habitat regulation is fundamentally flawed. A lack of specific management objectives, inappropriate size and scale of management efforts and the continued use of biased information are a few of our major concerns. The proposed approach has the potential to significantly reduce the ecological, social and economic productivity of all Boreal forest values with no certainty of effective conservation of boreal caribou.

The scientific literature widely acknowledges that boreal caribou show a habitat preference for large tracts of undisturbed land, especially mature even-aged conifer forests; however, this preference has been grossly oversimplified, overstated and commonly misused as the primary or sole requirement for boreal caribou habitat management. The proposed ‘blanket’ application of habitat management over large geographic areas grossly oversimplifies the biological needs of boreal caribou, the variability of habitat availability (quantity, quality and connectivity) on the landscape and complex species interactions (e.g. predator-prey). The existing scientific literature describes a much more complex relationship between boreal caribou and the ecological factors that limit their productivity on the landscape. The OFAH has undertaken a comprehensive review of boreal caribou ecology and developed an alternative approach that draws on fundamental biological principles and up-to-date research. Our alternative approach makes recommendations that aim to maximize the effectiveness of boreal caribou management, while supplying other important ecological, economic and social benefits of northern Ontario’s Crown forests.

In general, the OFAH has recommended that the MNR create clear and biologically defensible management objectives for boreal caribou management in Ontario. More specifically, we have developed a set of science-based recommendations that are intended to provide strategic direction during the development of any regulations or policy that could influence boreal caribou conservation. The OFAH alternative approach has five primary goals:

1. Illustrate the importance of herd-specific management;
2. Provide a detailed overview of boreal caribou ecology to illustrate the importance of identifying biological (and non-biological) factors that influence individual herd productivity and assist with a biologically-based prioritization of management efforts;
3. Emphasize the importance of specific population and management objectives for individual herds that are based on biologically defensible criteria (and data);
4. Provide rationale for non-habitat management considerations (e.g. predator management; moose and deer harvest management; road use management; etc.); and
5. Illustrate the importance of geographical prioritization of management based on empirical evidence of current boreal caribou occupation and utilization.

Our alternative management approach is largely based on the ecological principles of source-sink dynamics. In the simplest terms, source-sink dynamics describe the productivity (growth or decline) of populations as a function of habitat quality. The natural variability of the boreal forest creates a landscape of source and sink habitats for boreal caribou. In many cases, boreal caribou populations occupy both source and sink habitats at densities that depend on the geographic location, environmental fluctuations, availability of habitats and human disturbance. This document outlines the importance of different habitat types for boreal caribou populations in Ontario as they relate to sources and sinks, as well as the recommended priority for management of those habitat types. In general, critical habitats (i.e. calving refuges) and high quality habitats (e.g. winter refuges) can serve as sources enabling populations to grow. In most cases, critical habitats and high quality habitats (with current occupation and utilization) should be managed with the highest priority. Areas with low quality habitat (e.g. highly productive for deer and moose) are often sinks for boreal caribou and result in a net loss of individuals from a population. Sink habitats should have a lower priority for boreal caribou management.

The OFAH approach to boreal caribou management incorporates the overall direction of the Cervid Ecological Framework (CEF), which provides high-level direction that considers all cervid species (i.e. caribou, moose, deer, and elk). In general, the OFAH has recommended that boreal caribou management should not be emphasized in areas that are highly productive for other cervid species (as identified in the CEF), especially in areas where boreal caribou are not currently present. Therefore, our alternative approach recommends different management priorities for similar habitat types depending on what Cervid Ecological Zone they are located in.

Our alternative approach uses source-sink dynamics to target boreal caribou management where it is needed the most in Ontario. The approach is based on two fundamental principles: management objectives must reflect the biological needs of individual herds and management should only be applied in areas that are critical for current occupation and utilization. Habitat is only one of many biological factors that are known to influence boreal caribou productivity and as a result, there is a need to assess other contributing factors such as predation, reproduction, recruitment and food availability. In other words, if habitat is not limiting boreal caribou productivity, then habitat management may not need to be a high priority for that particular herd. Therefore, the OFAH has recommended that habitat should not be managed in isolation. Predator management (i.e. wolves, black bears, etc.), alternative prey management (i.e. moose and deer harvest), unregulated boreal caribou harvest, climate change, as well as habitat alternation due to natural processes (e.g. forest fires) and human disturbance must all be assessed during the development of population and management objectives for each herd.

For many years, the OFAH has provided recommendations to the MNR and Environment Canada regarding the management of boreal caribou in Ontario. This document is intended to provide the up-to-date technical detail and rationale for our management recommendations. In their entirety, the recommendations provide an alternative approach that would provide a sound, biologically-based framework for the development of regulations and policies, such as the impending habitat regulation.

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BACKGROUND

Current Delineation of the Continuous Caribou Zone

The Caribou Conservation Plan (CCP) established a southern boundary for continuous distribution and ten preliminary ranges for woodland caribou (*Rangifer tarandus caribou*), hereafter referred to as boreal caribou, herds across Ontario (excluding the discontinuous zone and Lake Superior Coast population). The boundaries of these ten preliminary ranges are directly adjacent to each other with no interceding areas in between. This implies that boreal caribou are present throughout the entire area north of the continuous distribution boundary, which is likely a gross oversimplification of the actual herd boundaries.

Current Habitat Management for Woodland Caribou: a flawed approach

Current forest management activities in the continuous caribou zone are intended to produce large tracts of even-aged, pure conifer forests (i.e. jack pine or black spruce) that are connected through time and space. First and foremost, this approach does not prioritize management activities based on the biological needs of boreal caribou. Furthermore, this approach applies management broadly across the entire landscape regardless of where caribou herds currently exist or habitat is considered to be suitable. This has the potential to spread resources too thin and reduce the overall effectiveness of boreal caribou management. The operational prescriptions for forestry that are used in the caribou zone are largely based on a relatively narrow definition of boreal caribou habitat requirements. As a result, habitat management is intended to reduce predators (i.e. wolves) by limiting the productivity of alternative prey (i.e. moose), as much or more than it is intended to restore a continuous supply of habitat. Reductions in the density of linear corridors (i.e. roads) have also been targeted as a means of reducing the hunting efficiency of predators. To date, there is limited evidence to support the effectiveness of these management strategies in enhancing critical habitat or protecting boreal caribou on the landscape. Furthermore, a comprehensive assessment of the biological rationale for the current approach suggests a number of fundamental flaws that undermine its overall practicality and sustainability.

Co-existence of boreal caribou and moose is not a recent phenomenon; however, it has been widely acknowledged that moose have increased their densities and distributions in the boreal forest in recent years. Climate change and human-related development activities are often cited as major contributing factors in the moose range expansion; however, the legacy of logging and other anthropogenic activities have been hypothesized to have the greatest influence (Bergerud 1974; Schaefer 2003; Vors et al. 2007). It has been suggested that boreal caribou historically occupied a greater diversity of habitats due to lower moose (and predator) densities in some areas of Ontario, but have recently been excluded from shared marginal habitats. Consequently, herds mostly remain in areas where winter predation can be minimized (Cumming et al. 1996). This supports the idea that there has always been a diversity of habitats on the landscape with varying productive capacities for boreal caribou. Therefore, it would be inappropriate to apply a blanket approach that manages the 'continuous' caribou zone as a uniform habitat type for boreal caribou. There have been, and will always be areas that are more productive for moose than boreal caribou. A greater understanding of the complex interactions between moose and caribou will be critical for optimizing the management of these two important cervid species.

The prescribed silvicultural regeneration of pure conifer forests reduces the variability of disturbance regimes and homogenizes the structure and composition of the landscape. Furthermore, Dynamic Caribou Habitat Schedules (commonly called caribou mosaics) connect these homogenized forest tracts in both space and time across the landscape. The resilience theory suggests that greater homogenization and connectivity of forests can ultimately lead to greater susceptibility to disturbances (i.e. fires, insects, and diseases) and facilitate the rate and extent of their spread across the landscape (Bergeron et al. 1998). The Ministry of Natural Resource's current (and proposed) approach to boreal caribou habitat management could have severe negative impacts on the capability of our Crown forests to supply ecological goods and services in the future.

Forest fires are often more intense and spread faster in pure conifer stands than mixed or deciduous forests. The potential impacts could be exacerbated given that the number and magnitude of forest fires are predicted to increase due to climate change (Wotton et al. 2010). Pure conifer stands are also more susceptible to insect infestations and disease outbreaks. Jack pine budworm, spruce budworm and forest tent caterpillars are expected to increase in regions where climate change will produce warmer, drier growing seasons (i.e. northwestern Ontario). The mountain pine beetle is not currently found in Ontario, but it was recently predicted that it could reach Ontario in the next two to three decades. The elevated temperatures and drier conditions associated with climate change, coupled with forest management activities that produce large, even-aged stands of conifers is likely to cause large-scale deforestation (Raffa et al. 2008). Raffa et al. 2008 summarizes the causal factors and potential implications of bark beetle outbreaks in British Columbia: “Collectively, reduced beetle mortality, a shortened life cycle, and the increased area and connectivity of climatically and demographically susceptible forest have increased the likelihood of an outbreak being initiated within stands and spreading across landscapes.” British Columbia’s Ministry of Forests and Range estimated that the total area of provincial Crown forest affected (to some degree) was about 16.3 million hectares, including 675 million m³ of timber. Ontario’s existing and proposed caribou habitat management promotes landscape-level forest characteristics (i.e. large tracts, even-aged, pure conifer) that will provide a more homogenous distribution of susceptible hosts for mountain pine beetle (Raffa et al. 2008). A greater susceptibility to bark beetle outbreaks will have long-lasting ecological, economical and social implications for northern Ontario.

THE MNR-PROPOSED HABITAT MANAGEMENT APPROACH

In January of 2011, the Ministry of Natural Resources (MNR) released *A Proposed Approach for Habitat Protection for Woodland Caribou (Forest-dwelling boreal population) under the Endangered Species Act, 2007 (Environmental Registry # 011-2303)*. In March of 2011, the MNR hosted stakeholder consultation sessions in Toronto, Dryden, Thunder Bay, Hearst and Cochrane. At these sessions, the proposed criteria for delineating the protection zone were described as:

1. Large areas that have not been previously harvested;
2. Large areas not planned for forest harvest for at least 30 years;
3. Currently contribute to an amount of woodland caribou habitat consistent with what would be provided in a boreal ecosystem; and
4. Do not prevent strategic access into the Far North Planning Area

The above criteria completely ignore the locations of existing boreal caribou in Ontario. In addition, it appears that there are critical biological requirements of boreal caribou that have been excluded from consideration. The first three criteria outline a zone that would protect suitable habitat on the landscape, but does not consider actual occupation (i.e. presence, density, etc.) of those areas. The objective of a habitat regulation should not strive to solely achieve a non-spatial threshold of habitat on the landscape. The proposed criteria for developing habitat regulation zones should incorporate spatial considerations that reflect the biological requirements of existing boreal caribou herds.

The OFAH has compiled our previous recommendations for managing boreal caribou in Ontario into an alternative approach that provides additional technical detail and the necessary biological rationale.

AN ALTERNATIVE HABITAT MANAGEMENT APPROACH

The OFAH has undertaken a comprehensive review of boreal caribou ecology to develop an alternative framework for the establishment of a habitat regulation. The following is intended to be an overview of the biological criteria and process that could be used for boreal caribou management in Ontario, with specific references for regulating habitat protection. This alternative approach is based on developing management objectives and strategies that would appropriately balance boreal caribou conservation with other forest values.

Prioritizing Habitat Management for Boreal Caribou

The entire area north of the southern boundary of the continuous caribou zone (as described in the CCP) should not be regulated as caribou habitat. A ‘blanket’ strategy that attempts to manage boreal caribou over large geographic areas will disperse overall effort and waste valuable resources in areas where it is not appropriate, thus limiting its effectiveness. First and foremost, boreal caribou should be managed as individual herds in the geographical locations that are the most critical for their survival. Specific objectives should attempt to maximize management effectiveness and therefore must reflect herd-specific needs (determined using sound biological criteria). Boreal caribou management in areas where they do not currently exist and/or in occupied locations where habitat is not limiting herd for productivity would not be appropriate.

Recommendation: Management should be prioritized by delineating biologically defensible boundaries that are based on empirical evidence of current occupation and utilization (habitat use) of individual boreal caribou herds. Management should not be applied using a ‘blanket’ north/south boundary approach.

Herd-specific Assessment

The CCP describes the range management approach that Ontario will adopt for boreal caribou recovery. *“Caribou ranges will be the basis for evaluating habitat conditions and identifying caribou habitat, assessing population trends, and assessing and addressing cumulative impacts.”* Section 2.2 states that: *“Ontario will identify local caribou population ranges, as units of analysis.”*

Habitat is only one of many factors that are known to influence boreal caribou productivity. The level of influence that each factor will have on overall herd productivity can vary significantly depending on the geographic location, environmental fluctuations and human disturbance. As a result, there is a need to assess other contributing factors such as predation, reproduction, recruitment and food availability.

Recommendation: Habitat should not be managed without consideration of other factors such as predator management, alternative prey management (i.e. moose and deer harvest), unregulated caribou harvest, climate change, as well as habitat alteration due to natural processes (e.g. forest fires) and human disturbance.

The following considerations (in order) are necessary to prioritize herd-specific boreal caribou management:

1. **Identification of Range:** Where they do and do not exist on the landscape
2. **Identification of Range Utilization:** By season; sex; habitat type
3. **Identification of Limiting Biological Factors:**
 - a. Recruitment
 - b. Adult Mortality
4. **Prioritize Management Efforts (based on Limiting Biological Factors):**
5. **Establish Herd-specific Population Objectives**
6. **Develop and Implement Management Strategies:**
 - a. **Habitat Management:**
 - i. Develop herd-specific criteria for delineating Habitat Regulation Zones
 - b. **Wildlife Management:**
 - i. Develop objectives for other wildlife species (e.g. moose, deer, wolves, bears) that reflect the priority of caribou management efforts, including the modification of population and harvest objectives (on a sub-WMU basis where appropriate)
7. **Monitor and Evaluate the Effectiveness of Management Strategies**

Boreal Caribou Habitat Management: Biological Rationale

The bioclimatic models produced by the MNR indicate that there is significant potential for the range expansion of moose and deer to continue in the future. Therefore, it is likely that the area of range overlap between boreal caribou and other cervids will continue to grow. It will become increasingly important to understand the complex relationships between boreal caribou, their predators and other cervids.

Source and Sink Habitats for Boreal Caribou

Our alternative approach is largely based on the ecological principles of source-sink dynamics. In the simplest terms, source-sink dynamics describe the productivity (growth or decline) of populations as a function of habitat quality. The natural variability of the boreal forest creates a landscape of source and sink habitats for boreal caribou. Individual herds will occupy source and sink habitats to varying degrees depending on where they are located, interspecific competition, natural processes and human disturbance. The following information will describe the importance of different habitat types for boreal caribou populations in Ontario in terms of sources and sinks. In general, critical habitats (i.e. calving refuges) and high quality habitats (e.g. winter refuges) can serve as population sources that enable herds to grow. In most cases, critical habitats and high quality habitats (with current occupation and utilization) should be managed with the highest priority. Areas with low quality habitat boreal caribou habitat (e.g. highly productive for deer and moose) are often sinks and result in a net loss of individuals from a population. Sink habitats should have a lower priority for boreal caribou management.

Habitats such as refuges may be sources for populations because they minimize predation risk and subsequently lower mortality. Habitats with greater predation risks for boreal caribou may be considered to be sinks and are often associated with relatively high densities of moose and their associated predators. High priority management in these areas would be inappropriate because they are not critical for survival and will likely remain as sink habitats on the landscape. This emphasizes the need for proximate factors of occupation to be assessed prior to generalizing geographical areas for management.

Recommendation: The primary objective for management of each boreal caribou herd should focus on identifying source and sink habitats.

Recommendation: Sink habitats for boreal caribou should not be regulated for specific protection under the ESA.

Seasonal Ranges of Boreal Caribou

Contrary to wintering habits, boreal caribou tend to be more solitary during the spring-summer months with much broader ranges (Stuart-Smith et al. 1997). Messier and Rettie (1998) found that the summer group size of 1.3 individuals was the annual low (compared to winter group sizes of 8.2 individuals). In addition, it has been well documented that summer habitat is not limiting for woodland caribou in Ontario (OMNR 1996). This is likely due to the lack of distinct habitat preferences and widespread distribution of individuals. During this time, boreal caribou are known to show reduced habitat selectivity, often feeding on a variety of plants including the leaves of deciduous trees (Cringan 1957; Bergerud 1972; Mahoney and Virgil 2003). With an increased range during the summer, there is a greater likelihood that boreal caribou will experience patches of habitat with varying degrees of habitat suitability.

Boreal caribou in Ontario are known to use distinct seasonal ranges, often with very little overlap (Darby and Duquette 1986; Ferguson and Elkie 2004a). Ultimately, seasonal habitat use differences emphasize the importance of seasonal assessments to determine the appropriate boundaries for habitat protection. Areas of occupancy during the non-winter months that are transitory or represent the widespread distribution of solitary individuals are likely to have limited value for boreal caribou habitat protection and should therefore have a lower priority for management.

Recommendation: The summer ranges of woodland caribou are not well defined by habitat and should therefore not be regulated for specific protection under the ESA.

Travel Corridors

The routes travelled by boreal caribou between summer and winter ranges are often poorly defined, especially during the fall (Cumming and Beange 1987). Ferguson and Elkie (2004a) found that boreal caribou in northwestern Ontario did not select specific travel habitat and some wandering occurred during the travel season. Woodland caribou in these areas were observed using hardwood-dominated stands and recent cutovers while travelling between core areas (Ferguson and Elkie 2004b). The poorly defined (based on habitat) and non-selective nature of boreal caribou travel routes would make protection challenging and relatively ineffective. At the population level, important routes between seasonal ranges would likely be represented using a telemetry analysis of occupied range distribution (discussed in more detail below). Travel corridors exemplify locations where boreal caribou will use (and even select) less suitable habitats regardless of a higher predation risk. As described previously, occupation of these sink habitats could result in significant mortality.

Recommendation: **Boreal caribou travel corridors are not generally well defined by habitat and therefore should not be regulated for specific protection under the ESA.**

Critical and Limiting Habitats: Recruitment

Each boreal caribou herd in Ontario will have biological factors that regulate their productivity. The recruitment of yearlings in a herd must exceed adult mortality for populations to grow (Bergerud 1988). Recruitment is considered to be one of the primary limiting factors for boreal caribou in Ontario. Therefore, understanding the role of recruitment as a regulating factor for each individual herd will be critical during the development of management strategies.

Maternal Condition

Maternal condition plays an important role in cervid life-history, particularly reproduction and recruitment. High pregnancy and parturition (birth) rates, as well as early calving are all indices of good maternal condition (Rettie and Messier 1998). Maternal condition is often directly related to the quantity and quality of forage. Inadequate summer forage (i.e. poor nutrition) in cervids can result in poor condition during the rut and a subsequent reduction in pregnancy rates (Cameron 1994; Rettie and Messier 1998). Inadequate winter nutrition can result in lower parturition rates, poor calf condition (i.e. low birth weight) and late parturition dates (Cameron et al. 1993; Rettie and Messier 1998; Mahoney and Virgil 2003). This would indicate a need to manage habitat for greater winter foraging areas.

Recommendation: **Boreal caribou maternal condition should be assessed to determine if there is a need to manage habitat for forage.**

Calving Refuges

High quality calving refuges should be considered as source habitats because they help reduce calf mortality and increase recruitment. High quality calving areas are often located on islands, peninsulas and lake shorelines. Calving refuges tend to be localized and discrete areas with repeated use over time (Schaefer et al. 2000; Ferguson and Elkie 2004; Racey and Arsenault 2007). The relatively fixed locales and importance for recruitment should make them a primary management focus. Protection of calving refuges and consideration of other critical components related to recruitment (e.g. predation) will have the most direct influence on boreal caribou populations.

Recommendation: **Boreal caribou calving refuges should be identified and protected as high-priority habitats.**

Calf Predation

In addition to the protection of habitat, other factors impacting recruitment such as predation must be considered. Wolves are widely recognized as the primary predator of boreal caribou in Ontario; however, the boreal forest is a multi-predator system where calf predation by black bears has been identified as an important factor for boreal caribou recruitment (Adams et al. 1995). The overlap of black bear spring

foraging habitat and boreal caribou calving locations increase the likelihood of predation events (Rettie and Messier 1998; Latham et al. 2011). The omnivorous and generalist foraging strategy of black bears, in combination with opportunistic predation of boreal caribou calves results in a density independent predator-prey interaction (Rettie and Messier 1998). Density independent predation by black bears could act as a limiting factor for some boreal caribou herds and therefore must be considered for boreal caribou management (Latham et al. 2011).

Recommendation: Boreal caribou calf mortality should be assessed to determine if habitat availability or predation is the limiting factor. If high calf predation is limiting recruitment, predator management should be strongly considered.

Critical and Limiting Habitats: Adult Mortality

Adult mortality caused by predation further illustrates the importance of considering habitats as sources and sinks on the landscape.

Habitat Refuges as a Predator Avoidance Technique

Research studies have indicated that boreal caribou are generally not limited by forage (Ferguson et al. 1988). More often, adult mortality caused by predation is believed to be the primary limiting factor for boreal caribou herds (Rettie and Messier 1998). Although the proximate causes are not yet known, there is a growing evidence to suggest boreal caribou partition their habitat in ranges overlapping with high moose densities (Cumming et al. 1996; Mahoney and Virgil 2003; James et al. 2004). It is hypothesized that this strategy enables boreal caribou to limit indirect effects of higher moose densities (e.g. predation by wolves). The indirect interaction with moose is often referred to as apparent competition. This spatial separation strategy illustrates the importance of managing boreal caribou based on source-sink dynamics.

The potential for boreal caribou to partition habitat is largely dependent on the availability of refuges (O'Brien et al. 2006). Therefore, refuges are often identified as one of the most limiting and critical components of a boreal caribou's range (Cumming 1996; Cumming et al. 1996; Seip and Cichowski 1996). In fact, studies have indicated that all existing herds in Ontario must have refuge habitats within their ranges that facilitate persistence despite wolf predation (Bergerud 1985; O'Brien et al. 2006).

Winter Refuges

Boreal caribou are highly selective of winter habitats and often show site fidelity for these areas (Cumming and Beange 1987). This often results in individuals aggregating into groups within high quality habitats (Fuller and Keith 1981). Cumming et al. 1996 found that boreal caribou wintering areas were actually refuges from predation (due to their distance to the nearest wolf). The association with high-quality habitats is strongest during the late-winter as a result of limited foraging opportunities in other areas based on the depth and hardness of snow (Schaefer 1996; O'Brien et al. 2006). Lichen becomes an important winter food source for boreal caribou and is often associated with open, upland conifer forests that also serve as refuges (Bergerud 1972; Brown and Theberge 1990; Schaefer 1996).

Recommendation: Boreal caribou winter refuges should be identified and managed as high-priority habitats where empirical evidence shows high-density occupation.

Calving and Post-Calving Refuges

During the spring, evidence shows that woodland caribou group size decreases and cows tend to space themselves out and often calve alone (Fuller and Keith 1981; Rettie and Messier 1998). It is believed that this dispersal strategy provides the greatest protection from predators during calving. Cows tend to be more selective in the spring and summer, occupying habitats that act as predator refugia for calving and calf-rearing (Bergerud and Page 1987; Bergerud et al. 1990; Rettie and Messier 2001).

Bulls tend to use a greater diversity of habitats than cows in the late spring and summer months. This may be due in part to less selective summer feeding habits, when boreal caribou are known to feed on a wide

variety of plants, especially the leaves of deciduous trees (Cringan 1957; Bergerud 1972; Mahoney and Virgil 2003). As discussed previously, the lack of habitat selectivity is likely to result in a greater occupation of sink areas during the summer and while travelling between seasonal ranges.

Recommendation: The sex of individuals should be considered during home range assessment because of sex-specific differences in movement behaviours and habitat use. For example, areas occupied by boreal caribou bulls during the spring and summer should not be regulated for specific protection under the ESA.

Determination of Limiting Factors

Management should reflect the needs of boreal caribou on a herd-by-herd basis using biological criteria. The following questions can be used to determine the biological needs of each herd:

Herd status – *Is the herd self-sustaining, growing or declining?*

Limiting Factors – *What is the limiting factor for herd productivity?*

1. RECRUITMENT – *Is the herd limited by recruitment?*

- a. **Maternal Condition** – pregnancy rate, parturition rate/date, calf condition (birth mass)
 - ii. **High** – No Forage Limitation
→ see **CALF PREDATION**
 - iii. **Low** – Potential Forage and/or Calving Refuge Limitation
 - 1. **Low Pregnancy Rate** – **HABITAT MANAGEMENT (Summer Forage)**
 - 2. **Low Parturition Rate** – **HABITAT MANAGEMENT (Winter Forage)**
 - 3. **Late Parturition Date** – **HABITAT MANAGEMENT (Winter Forage)**
 - 4. **Low Calf Birth Mass** – **HABITAT MANAGEMENT (Winter Forage)**
- b. **Calving Refuges** – *If limited by parturition, is it related to the accessibility, quality or quantity of calving refuges on the landscape?*
HABITAT MANAGEMENT (Calving Refuges)
- c. **Calf Predation** – *If limited by recruitment, is it related to calf predation?*
 - i. **Wolves** – *If limited by calf predation, is it due to wolf predation?*
WILDLIFE MANAGEMENT (Wolves, Moose, Deer)
 - ii. **Bears** – *If limited by calf predation, is it due to bear predation?*
WILDLIFE MANAGEMENT (Bears)
 - iii. **Other Predators** – *If limited by calf predation, is it due to other predators?*
WILDLIFE MANAGEMENT (Other Predators)

2. ADULT MORTALITY – *Is the herd limited by adult mortality?*

- a. **Predation** – *If limited by adult mortality, is it related to predation?*
 - i. **Apparent Competition** – *If limited by predation, is it related to refuges?*
HABITAT MANAGEMENT
 - a. **High Summer Predation (Refuges)**
 - b. **High Winter Predation (Winter Refuges)****WILDLIFE MANAGEMENT (Moose/Deer/Predators)**
 - ii. *If limited by predation, but not as it relates to habitat; or*
 - iii. **Malnutrition** – weaker condition; foraging in high-risk predator areas
WILDLIFE MANAGEMENT (Moose/Deer/Predators)
- b. **Disease** – *If limited by adult mortality, is it related to disease (e.g. meningeal worm)?*
WILDLIFE MANAGEMENT (Deer)
- c. **Unregulated Harvest/Poaching** – First Nation harvest, illegal harvest
PROHIBITION OF HARVEST

NOTE: Many factors may simultaneously limit boreal caribou productivity. Although proximate limiting factor(s) may not be explicit, the questions will provide insight for management priorities.

Research Principles: Determining Occupation & Utilization (Habitat Use)

To supplement our management recommendations for boreal caribou in Ontario, we have provided a brief overview of the biological research methodologies that could be used to fulfill them. The goal of this section is to provide an overview of commonly used research techniques, rather than suggesting the detailed methodologies that should be used.

Assumptions of the Alternative Approach

The following research principles are based on a set of assumptions:

1. The MNR has (or will soon have) range assessments for all boreal caribou herds in Ontario;
2. The range assessments will be herd-specific, as opposed to an Ontario “metapopulation”;
3. The caribou herd range assessments will provide telemetry location estimates; and
4. That the telemetry data is sufficient for kernel density estimation.

Defining Boreal Caribou Herds

The CCP designates ten population ranges for boreal caribou in Ontario (excluding the discontinuous zone and Lake Superior Coast population). It is likely that distinct herds exist within a CCP-designated range or that ranges are not uniformly occupied. Therefore, it will be important that individual herds (not necessarily CCP-designated ranges) are established where necessary to provide an appropriate scale for management. The ranges of individual caribou herds should be relatively easy to determine using telemetry location data. The location data for all individual caribou can be pooled to estimate overall herd utilization of their range.

Recommendation: Pooled telemetry data for boreal caribou should be used to provide herd-specific estimations of occupation and utilization.

Using Telemetry Location Data

Kernel density estimates (KDE) can use a sample of the telemetry location data to produce a probability density estimate of boreal caribou utilization. The KDE can be interpreted as a kernel utilization distribution (KUD), which estimates the smallest area that explains a given percentage of total use (Powell 2000; Topping et al. 2005). The KUD contours can be used to establish total and core use areas for boreal caribou herds. The application of KUD contours (using knowledge of biological requirements) will provide relevant and appropriate boundaries of where habitat should and should not be regulated in Ontario.

Assessment of Individual Boreal Caribou: Removal of Unique Events

Prior to a range analysis for a boreal caribou herd, it is important to examine the location estimates for each individual animal to identify and remove any unique events. For example, if an individual was located a large distance from core areas for a short duration (e.g. a few days), then it could be considered an anomaly in the overall data. This will help to minimize the inclusion of areas that are not critical for boreal caribou conservation – and thus minimize unnecessary and inappropriate management in those areas.

Determining the Range (Total Area of Occupation)

Boreal caribou herd range analyses should not include the entire area of occupation (100% of location estimates). Boreal caribou are known to wander while traveling between core use areas or temporarily use areas not reflective of general utilization patterns (Ferguson and Elkie 2004). Therefore, we recommend using a 95% KUD to describe caribou ranges. This will incorporate all relevant areas of utilization, while eliminating an excursive activity such as wandering.

Recommendation: Total area of occupation could be used as an empirical population range boundary, but should not be used as an indicator of where specific habitat management is required.

Determining the Core Areas (Core Area of Occupation)

As described above, boreal caribou do not exhibit uniform utilization of their entire range and therefore it will be necessary to determine which areas are more likely to be used. This is often referred to as the core use area and accounts for a smaller (and often more biologically relevant) percentage of the total utilization area. Core areas are often represented by the 50% KUD of an individual animal's total utilization area (smallest area representing 50% of the total use). A different percentage may be required to accurately reflect boreal caribou biology and/or incorporate the cores of multiple individuals in a herd. A greater percentage may be necessary to provide adequate linkages between closely associated core areas (described below). The KUD should be based on the biological needs of boreal caribou.

Analysis of Range and Range Utilization by Season

Analysis should also incorporate seasonal ranges because boreal caribou tend to show patterns in movement and distribution during different times of the year. A habitat regulation that is based on the biological requirements of boreal caribou must consider seasonal ranges because it will provide further insight as to why a herd may be utilizing some areas more frequently than others. Many studies identify winter, calving and summer (post-calving) as the important seasonal delineations (Faille et al. 2010); however, other studies further categorize seasonal delineations using early winter, late winter, spring, calving and post-calving (Ferguson and Elkie 2004a; 2004b). For example, high-use of an area during the spring may represent a calving refuge and high-use of an area during the winter may represent critical winter refuges.

Analysis of Range and Range Utilization by Sex

The differences in habitat selectivity between bulls and cows emphasize the need to establish assessment criteria that incorporates the sex of individuals. Sex-specific range behaviour may explain some of the variation in boreal caribou occupation of the landscape.

Linkages between Core Areas and Critical Habitats

It is expected that the majority of critical and limiting habitats will be represented as core areas due to their 'high use' and/or high densities. Furthermore, it is expected that any routinely used corridors or 'routes' between these habitats will also be represented. Using a more precautionary level of probability (i.e. 60% or 70%) would ensure that important corridors (with habitual use) will be represented as critical areas for boreal caribou occupation.

A Precautionary Approach

In order to provide a precautionary buffer between habitat regulation zones, particularly core habitats, it may be necessary to use a relatively large smoothing factor (h) for KDE. This would apply a greater variance to location estimates and overestimate the actual range. Although this method would not provide the most detailed estimate of boreal caribou herd ranges, it would provide a built-in buffer that is still based on empirical information. A larger smoothing factor would also contribute to a greater likelihood of critical linkages between cores being managed as high priority habitats.

Recommendation: A density estimator should be used to determine the total and core areas of occupation (and utilization) from boreal caribou location (telemetry) data. These estimates should incorporate factors that may influence utilization (e.g. season, sex, etc.) and be precautionary enough to include all critical habitats.

Monitoring and Assessment

The way boreal caribou utilize the landscape and habitat features themselves are dynamic and will change over time. Regulated areas will need to be periodically reviewed (i.e. 10 – 20 years). There will need to be continuous monitoring and assessment so that management activities can be dynamic and best reflect the specific needs of each individual herd.

Habitat Regulation Zones

Although it could be argued that the most appropriate strategy for managing boreal caribou habitat would allow a natural disturbance regime to shape the forest, it is widely recognized that the socioeconomic sustainability of these areas is dependent on the continuation of forestry operations. Forest managers are now using a Dynamic Caribou Habitat Schedule and other operational prescriptions to control the texture and composition of the forest in a way that will provide a continuous supply of habitat, while maintaining a sustainable wood supply. Therefore, we have proposed habitat regulation zones that take forestry operations into consideration. The occupied range and core areas of boreal caribou herds should provide the basis for determining habitat regulation zones. Other development (e.g. mining, renewable energy, etc.) were not specifically considered for this alternative approach; however, these activities would need to be incorporated into any habitat regulation. Please refer to the Summary (Table 1) for a quick reference comparison of the zones.

NOTE: The following habitat regulation zone designations are based on a herd that is limited by mortality due to predation (both adults and calves).

PROTECTION ZONE: High-priority Habitat and Habitat Features

The majority of high-priority habitats are likely associated with core utilization areas; however, some high-priority habitat features may needed to be identified independently of telemetry studies.

Recommendation: All high-priority habitat and habitat features for boreal caribou (as described in this document) should be identified and incorporated into the protection zone. These areas should not be available for forestry operations or any other development and a buffer area should be established around high-priority habitats to provide spatial separation from habitats with high densities of alternative prey or predators (Gustine et al. 2006).

The scientific literature now widely acknowledges that calving locations and refuges are critical habitats that should be a priority for boreal caribou conservation.

Calving Refuges

Calving refuges are relatively small, discrete and fixed habitat features on the landscape. These habitat features are usually located on islands, peninsulas and near lake shorelines. The protection of high quality calving habitats is very important for overall population productivity and this is reflected in the existing Area of Concern (AOC) protection of known calving locations.

Recommendation: Calving refuges should receive the highest priority for protection. No development should occur in these critical areas.

Lowland Conifer Refuges

Lowland conifer sites (e.g. bogs, fens, muskegs, etc.) can provide important year-round refuges for boreal caribou. Alternative prey (i.e. moose and deer) are not known to occur in high densities in most lowland habitats, especially those with limited disturbance within or adjacent to them. Not only are they critical habitat for boreal caribou, but are often considered to be 'non-productive' or less profitable for forestry operations. Therefore, this type of prioritization of habitat protection can benefit caribou conservation with limited impact on forestry.

Recommendation: Lowland conifer refuges should be managed with high priority. No development should occur in these areas.

PROTECTION ZONE: Moderate-priority Habitat

Moderate-priority habitat and habitat features may be present on the landscape, but may or may not have actual importance for boreal caribou. The importance of habitats is likely to change as the landscape itself and utilization by boreal caribou changes over time. This would require all development activities that damage or destroy boreal caribou habitat to have a permit under the ESA.

Recommendation: Moderate-priority habitat for boreal caribou should not be regulated broadly across all upland habitats that provide potential suitable refuge habitat. In Cervid Ecological Zone (CEZ) B, moderate-priority habitats should only be applied in areas where high density occupation is observed. In CEZ A, moderate-priority habitats could be applied to the entire occupied range of boreal caribou.

Upland Conifer Refuges

Upland refuge habitats are critical components of boreal caribou management. These habitats are especially important because they provide conditions that are suitable for winter refuges. These areas are generally typified by open-canopy pure conifer stands with a relatively high abundance of lichens and low densities of alternative prey (and their associated predators). Upland refuge habitats that support high boreal caribou productivity (greater than 5 caribou/100 km²) and low moose productivity (less than 10 moose/100km²) would be appropriate areas to designate as moderate-priority habitats (Protection Zone).

Recommendation: Existing roads should be maintained to facilitate wildlife management; however, new development in these areas would require a permit, as described in the ESA.

Recommendation: Currently occupied upland refuges could be considered for future forestry operations to regenerate suitable habitat (and contribute to wood supply).

CEZ A Occupied Range

All habitats in CEZ A that support high boreal caribou productivity (greater than 5 caribou/100 km²) and low moose productivity (less than 10 moose/100km²) would be appropriate areas to designate as moderate-priority habitats (Protection Zone).

Recommendation: All 'Areas of Occupation' in CEZ A should be included in the protection zone as moderate-priority habitat. In these areas, a Dynamic Caribou Habitat Schedule could be used to maintain or enhance potential habitat for boreal caribou.

Recommendation: Existing roads should be maintained to facilitate wildlife management; however, new development in these areas would require a permit, as described in the ESA.

CONSERVATION ZONE: Strategic Recovery Areas

Large areas that have not previously been harvested or are not planned for harvest during the next 30 years (as proposed) could be designated as 'Strategic Recovery Areas' if they are located within a biologically relevant (based on the biological requirements of habitat connectivity) distance from currently occupied areas. These areas would not require forestry operations to create woodland caribou habitat in the short-term, but could be incorporated into a Dynamic Caribou Habitat Schedule to provide future caribou habitat.

Recommendation: Existing roads should be maintained to facilitate wildlife management; however, new development in these areas would require a permit, as described in the ESA.

CONSERVATION ZONE: Low-priority Habitat

Outside of refuge habitat, boreal caribou are known to be less selective in the habitat they occupy and have been observed to use habitats that are less optimal (from a foraging/predation risk perspective) during migration between seasonal habitats. In addition, boreal caribou often spread out and form smaller group sizes in the spring and summer, which would make it difficult to provide 'blanket' habitat protection. The designation of habitats in the Conservation Zone would allow for the protection of boreal caribou, while still managing for other commercial and recreational benefits provided by Crown forests. Development activities would be exempt from the ESA's prohibitions against damaging and destroying habitat provided the activities meet conditions aimed at the protection and recovery of boreal caribou and its habitat.

Recommendation: Where the occupied ranges of boreal caribou overlap with moderate to high moose densities (greater than 20 moose/100km²), habitat should be regulated with the lowest level of priority. Existing roads should be maintained to facilitate wildlife management; however, new development could occur in these areas if it satisfies the conditions of the habitat regulation.

CEZ B Occupied Range

Areas of CEZ B that are currently occupied by boreal caribou and support moderate or low moose productivity could potentially be designated as low-priority habitats (Conservation Zone). This would allow for the management of boreal caribou, as well as other cervids (e.g. moose) as per the Cervid Ecological Framework.

Recommendation: Areas of CEZ B that are currently occupied by caribou at low to moderate densities (between 2 and 5 caribou/100km²) should be designated as conservation zones. Moose harvest should be prioritized over boreal caribou habitat management as the primary means for limiting apparent competition in these areas.

CEZ A Unoccupied Areas

Areas of CEZ A that support moderate moose productivity (10 – 20 moose/100 km²) where there are no existing boreal caribou populations would be inappropriate areas to target for habitat protection. However, areas of lower moose productivity (less than 10 moose/100 km²) in CEZ A could potentially be designated as low-priority habitats (Conservation Zone).

Recommendation: Areas of CEZ A that are not currently occupied by boreal caribou (less than 2 caribou/100km²) AND currently support less than 10 moose/100 km² could be designated as conservation zone areas. A Dynamic Caribou Habitat Schedule could be used in these areas to produce large even-aged patches of pure conifer forest to provide suitable habitat conditions for future occupation.

NON-CARIBOU ZONE

Areas that support high moose productivity (greater than 20 moose/100km²) or areas outside of CEZ A where no boreal caribou populations currently exist would be inappropriate areas to target for habitat protection or restoration.

Recommendation: All areas outside of CEZ A where there is no current occupation by boreal caribou (greater than 2 caribou/100 km²) should not be subject to a habitat regulation. These areas should be managed for other cervid species based on direction provided in the Cervid Ecological Framework.

Considerations Not Directly Related to Habitat

Wildlife Management

In areas where forestry operations occur, it has been well documented that moose densities will increase in response to the creation of early succession habitats, peaking 20-40 years post-harvest (Payne et al. 1985; Crete 1988; Timmerman and McNichol 1988; James et al. 2004; Maier et al. 2005). Therefore, the density of moose will increase in the short-term and likely result in greater numbers of predators. Given that predation is the most commonly cited limiting factor for boreal caribou, wildlife management (e.g. hunting) will need to be a high management priority. Direct management of alternative prey (e.g. moose and deer) and their predators would be the most effective strategy to help reduce the risk of predation (and disease). In other words, moose population and harvest objectives could be used to maintain the appropriate moose density that reflects boreal caribou management needs. Accessibility has been recognized as an essential consideration for the management of moose population densities (Rempel et al. 1997). Maintaining roads will be critical for maintaining alternative prey (and their predators) at appropriate densities.

Forest Access Road Decommissioning

Given the documented importance of roads in predator management (via harvest of alternative prey), road decommissioning should only occur if it is conclusively demonstrated that the absence of linear corridors is more beneficial for boreal caribou than their presence in the forest. In other words, a significant reduction in wolf predation of boreal caribou would have to occur in areas with decommissioned roads relative to areas where wolves are controlled by wildlife management. If no empirical evidence illustrates a significant benefit, then the economic costs of road rehabilitation and reduction in socioeconomic benefits of other forest values should make it prohibitive.

Recommendation: At the very least, roads should be maintained for a minimum duration that corresponds to the number of years that moose densities are expected to increase (as a result of forest harvesting).

Sub-WMU Management

The current population and harvest objectives for moose, deer and predators may need to be adjusted to reflect the needs of boreal caribou management. Some individual wildlife management units (WMU) will have areas where boreal caribou management is a priority, as well as areas where it is not a priority. There are a number of alternatives for optimizing wildlife management in these WMUs, including sub-WMU harvest objectives for species such as moose, deer, bear and wolves.

Recommendation: Some WMUs will need to be managed on a sub-unit level so that they are able to reflect the needs of boreal caribou management without compromising the important values of other game species such as moose.

Summary

Table 1. A summary of the activities that will be permitted in the various habitat types in the Protection, Conservation and Unregulated Zones of the boreal forest. The asterisk (*) indicates that road decommissioning should only be used if empirical evidence shows that is more beneficial for boreal caribou conservation than the maintenance of roads for wildlife management. † Indicates that the large habitat patches must be pre-existing on the landscape. A double asterisk (**) represents an area where forestry, Dynamic Caribou Habitat Schedule and road development are not currently necessary, but may be utilized in the future.

Habitat or Habitat Feature	CEZ	Caribou Occupation	Caribou Winter Density	Moose Density Obj.	Forestry	Dynamic Caribou Habitat Schedule	Road Development	Road Decommissioning	Other Development (i.e. mining)	Specific Wildlife Management
PROTECTION ZONE: High Priority Habitats										
Calving Refuges	All	N/A	N/A	N/A	No	N/A	No	N/A	No	N/A
Lowland Refuges	All	N/A	N/A	N/A	No	N/A	No	N/A	No	N/A
PROTECTION ZONE: Moderate Priority Habitats										
Upland Refuges	All	Occupied Core Areas	>0.05 /km ²	<0.10 /km ²	N/A **	N/A **	N/A **	40+ years post-harvest *	Permit	Yes
All Habitats	CEZ A	Occupied Range	>0.05 /km ²	<0.10 /km ²	Yes	Yes	Yes	40+ years post-harvest *	Permit	Yes
CONSERVATION ZONE: Strategic Recovery Habitats										
Adjacent Large Patches †	All	No/limited Occupation	<0.02 /km ²	<0.10 /km ²	N/A **	Yes	N/A **	Maintain Existing Roads	Permit	Yes
CONSERVATION ZONE: Low Priority Habitats										
All Habitats	CEZ B	Occupied Range	0.02-0.05 /km ²	<0.20 /km ²	Yes	No	Yes	Maintain Existing Roads	Exemptions	Yes
All Habitats	CEZ A	No/limited Occupation	<0.02 /km ²	<0.10 /km ²	Yes	Yes	Yes	40+ years post-harvest *	Exemptions	Yes
NON-CARIBOU ZONE: No Priority										
All Habitats	Non-CEZ A Areas	No/limited Occupation	<0.02 /km ²	>0.20 /km ²	Yes	No	Yes	No	N/A	No

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