6.0 APPENDIX

6.1 Science Advisory Group Members

Mandate

The Boreal Caribou Science Advisory Group is responsible for providing scientific and technical advice to Environment Canada's review and preparation of a consolidated, scientifically defensible identification of Critical Habitat, and/or a valid Schedule of Studies to obtain such information, to be posted within a Recovery Strategy on the Public Registry (SARA S. 41 (1)(c)).

Responsibilities

The Science Advisory Group will provide open and transparent, continuous peer review and advice throughout the process of the Boreal Caribou Critical Habitat Science Review. The Science Advisory Group is not responsible for managing or directing the Critical Habitat Identification for boreal caribou.

Science Advisory Group Members

Dr. Fiona Schmiegelow, Chair of the Science Advisory Group
Dr. Stan Boutin
Dr. Carlos Carroll
Dr. Réhaume Courtois
Dr. Vince Crichton
Dr. Marie-Josée Fortin
Dr. Mark Hebblewhite
Mr Dave Hervieux
Mr. John Nagy
Dr. Tom Nudds
Dr. Richard Pither
Mr. Gerry Racey
Dr. Justina Ray
Dr. Jim Schaefer
Dr. Isabelle Schmelzer
Dr. Dale Seip
Dr. Don Thomas
Mr. Tim Trottier

6.2 Delineating Units of Analysis for Boreal Caribou Critical Habitat Identification

Background

Application of the Critical Habitat Identification Framework for boreal caribou and associated decision tree requires delineation of population analysis units and their associated ranges. These analysis units form the basis for analysis to determine probability of persistence, based on range quality and population parameters.

For the purposes of Critical Habitat Identification, units of analysis were provided by jurisdictions and accepted as the best available knowledge. Several jurisdictions with large continuous areas of occupied habitat have not completed local population delineation and therefore only provided extent of occurrence for continuous distribution areas. Local population delineation for these areas is a high priority as indicated in the schedule of studies.

During the Science Review process, it became evident that there was a need for a standardized protocol for identifying local populations and delineating range. There is also a need to reconcile methods for the delineation of local populations and range with variation in local population patterns, habitat fragmentation, and data availability across and within jurisdictions. The discussion below provides guidance that should be used for development of a protocol for local population identification and range delineation as part of the schedule of studies.

Local Population Pattern

Populations often function demographically at scales that are different from those suggested by genetic indicators, therefore we need to distinguish **units of analysis that are based on demography** from those that are genetically distinct (e.g., Esler et al. 2006). Based on simulation modeling, Hastings (1993) suggested a threshold of <10% migration for defining independent demographic units. Dey et al. (2006) also used simulation modeling to demonstrate that sub-populations act as one large population once migration rates reach 20%. Although the question is fundamental to understanding population processes, this topic has received limited study (Waples and Gaggiotti, 2006).

For the purposes of the Critical Habitat Identification Framework, we have defined local population as a group of caribou occupying a defined area that can be distinguished spatially from areas occupied by other groups. (Note that in most cases, the unit of analysis is the local population.) Local populations experience limited exchange of individuals with other groups, such that population dynamics are driven by local factors affecting birth and death rates, rather than immigration or emigration among groups. Ecological conditions, as well as patterns and intensity of anthropogenic disturbance, vary tremendously across the national distribution for boreal caribou in Canada, resulting in variation in local population patterns.

A local population is the smallest demographic unit with an annual rate of emigration and immigration of ≤10%. Some local populations may be spatially discrete and experience little or no exchange of individuals (≤5%). Local populations may also exist as part of a broader, continuous distribution where periodic exchange of individuals may be greater (> 5% but ≤ 10%). Alternatively, a local population could occupy a large continuous distribution whereby regular exchange of individuals occurs (> 10% immigration and emigration).

Therefore, there are three possible hypotheses proposed for local population patterns for boreal caribou, based on movement patterns:

1) discrete local populations with spatially discrete ranges
2) multiple local populations **within a large area of relatively** continuous habitat
3) one large local population across a large area of relatively continuous habitat

From a population dynamics perspective hypothesis 1 and 3 are the same, differing only in the extent of area occupied by a single population. However, there are implications for Critical Habitat Identification and delineation of the units of analysis that require differentiating these two situations as different population patterns.

There are examples in the literature of the use of animal movement data to determine immigration and emigration rates that can be in turn used to assess population patterns. McLoughlin et al. (2002) were able to determine annual exchange rates of 3.4 – 13% for females and 7-35% for males and concluded that grizzly bears populations (determined by cluster analysis of movement data) in their study area should be considered a continuous (open) population. Bethke et al. (1996) concluded, from their analysis of polar bears in the western Canadian Artic, that three populations identified in their study were relatively closed (e.g., with little immigration/emigration of radio-collared females among populations that overlapped for part of the year). The examples presented above are based on short-term studies. Dynamics of boreal ecosystems and caribou biology would need to be addressed in studies designed to assess immigration and emigration rates for boreal caribou over the long term. It should also be noted that populations fitting one hypothesis may be reassigned to an alternate hypothesis under changed environmental conditions, such as large burns and barriers imposed through human activity, or if new information is provided. Therefore, it is important that population patterns and range be periodically re-assessed and updated.

From a practical perspective, the lack of caribou movement data in some regions will preclude the ability to determine immigration/emigration rates for the purpose of determining spatial population structure. In the absence of sufficient immigration/emigration data, available animal movement and survey data and the degree of geographic separation of area of occupancy should be used to determine the most plausible hypothesis for local population pattern. The amount and quality of data used to delineate local populations and associated range varies across and within jurisdictions, and the level of certainty to support local population delineation varies accordingly. Uncertainty should be addressed through a schedule of studies and adjustments should be made to local population identification and associated unit of analysis over time.

How does range relate to the unit of analysis for application of the critical habitat decision tree?

Where natural geographic boundaries and/or habitat alteration have resulted in discrete local populations, and range boundaries have been delineated based on animal movement data and forest dynamics data, local populations and associated range are identified and constitute the unit of analysis for purposes of Critical Habitat Identification.

In areas where caribou local populations are not restricted by natural geographic boundaries or habitat alteration and are distributed across large areas of relatively continuous habitat, the delineation of range for local populations becomes more difficult. The entire extent of occurrence for a relatively continuous habitat distribution area should be included in the delineation of units of analysis. This addresses the concern that defining discontinuous ranges would eventually result in fragmentation of the continuous distribution, with loss of connectivity among local populations. In the absence of evidence to the contrary, it is also consistent with a precautionary approach.

Range Identification

Range identification can be confounded by multiple factors, which may differ among local populations, and may not be fully understood:

- the definition of range includes factors that constrain vital rates such as predation, food abundance, and other features of habitat quality;
- caribou often occupy distinct seasonal ranges, especially during summer and winter, so conditions required to maintain connectivity among landscapes used during different seasons needs to be understood;
- caribou may occupy different and shifting areas within ranges over relatively short time periods, although ‘core areas’ may be consistent over these periods;
- caribou may occupy different and shifting ranges over long time frames due to factors that are likely related to disturbances, food supply, and predator abundance, as well as direct and indirect anthropogenic disturbances and other stressors that contribute to alter natural disturbance regimes and food availability;
- ranges of local populations of caribou have changed historically and contracted in many parts of the country, so a decision needs to be taken about a ‘start date’ for range delineation;
- boreal forests change in response to natural perturbations (fire, insect outbreak, wind) and through natural vegetation succession with age. Climate change may also influence range conditions, in the short- and long-term. Even in the absence of humans, caribou respond to such changes by shifting their ranges. Hence range should not be viewed as a static condition in time or space;
- small remnant caribou populations may exist within smaller ranges than they require for long-term persistence; therefore, future range may be larger than the present range; and

- cow and bull caribou may have different range use strategies. Sexual differences in range (or total range) will not be understood unless both sexes are observed.

Therefore, 'range use' is a dynamic concept and delineation will require regular assessment and updating (e.g., Racey and Arsenault 2007).

Owing to these dynamics, range could be defined in probabilistic terms, based on various sources of information, but especially including data for animal locations. Ranges should be assigned in a manner analogous to home ranges derived for individual animals from location data. In this case guidelines are required for some minimum number of animals from which data are collected, including data from both sexes, and dispersal of collars across the suspected range. There are three commonly used methods for delineation of range based on location data: minimum convex polygon, a parametric kernel estimator of probability, or a non-parametric kernel estimator of probability. The former (MCP) is the least conservative and the latter two methods provide 'probability of occupancy surfaces' that are affected by the number of observations in the dataset. Where range is based on limited number of observations, it may be possible to assign surrounding habitat components a probability of occupancy based on niche modelling and then to use this information to improve the range estimate. Future work is required to ensure that range delineation protocols adequately address large-scale factors influencing the movement and occupancy behaviour of caribou.

Considerations in defining range for a local population

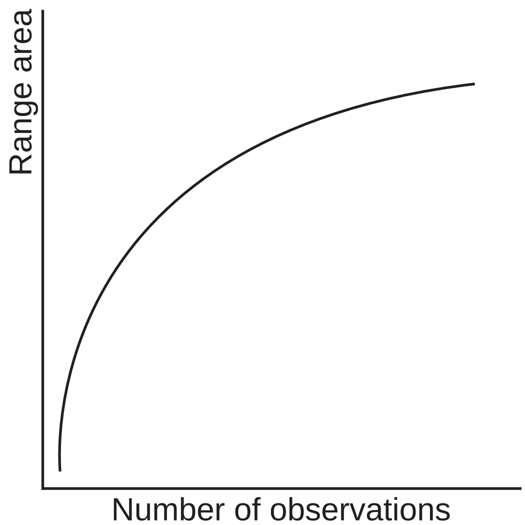
1. How is 'current range' defined?

Current range is defined as a geographic area within which there is a high probability of occupancy by individuals of a local population that are all subjected to the same influences affecting vital rates over a defined time frame. This definition incorporates the idea of probabilistic occupancy, functional influences, time, and space.

2. How many observations, over what time period, are required to provide a high probability that the defined range is accurate?

The number of observations required likely changes depending on the size of the population and its circumstances. An approximate answer can be determined by plotting range size against the number of observations and looking for an asymptote (Figure 1). The probability that range has been accurately defined will also depend on the quality of the data used (casual observation and aerial survey vs. radio-telemetry study, dispersion of observations across the population spatially and between sexes).

Observations made over the past 20 years should be accepted as evidence to delineate range of a local population. That amount of time allows for temporal variability in areas occupied among years and lag effects due to change. However, the final decision on appropriate time period for inclusion of observations should be based on landscape dynamics for the local population of interest.



Appendix 6.2 - Figure 1. Hypothetical plot of range size against a number of animal observations required to accurately define range.

3. Among the area estimators (MCP, parametric kernel, non-parametric kernel), which method should be used (subject to sample size considerations)?

Application of the parametric kernel and non-parametric kernel would define a smaller area that an MCP due to the removal of outliers. A precautionary approach would use the minimum convex polygon method to provide a conservative estimator of range. It is important to note that all methods are influenced, to some extent, by the number of locations (Girard et al. 2005).

4. After what time period should a range should be re-examined?

Defined ranges should be re-examined as new data becomes available and at least every 5 years.

What additional factors should be considered when delineating ranges as units of analyses for multiple local populations within a large area of continuous habitat?

The guidance below essentially provides recommended criteria for subdividing a continuous distribution into local population ranges. Therefore, the emphasis is on considerations for decisions on where to place local population range boundaries within a large area of continuous habitat. It should be noted that in areas where data availability is low, boreal caribou populations may seem to lack any obvious structure. In such cases, this guidance would be equally relevant during the process of acquiring new knowledge.

1. Animal movement and animal survey data

The most defensible and robust method to delineate units of analysis for multiple local populations in continuous habitat is to infer “surfaces” based on monitored animal movement (where the animals have been selected from a wide variety of locations across the landscape). For multiple local populations within a continuous habitat, cluster analysis of movements can be used to define group membership (Taylor et al. 2001). Bethke et al. (1996) used radio-telemetry data and cluster analysis to delineate populations of polar bears (*Ursus maritimus*) in the high Canadian Arctic. They tested for the presence of spatial clusters of animals based on movement data, then applied a home range estimator to identify the geographic range of populations for conservation purposes. Schaefer et al. (2001) and Courtois et al. (2007) used fuzzy cluster analyses to delineate caribou populations.

Systematic or non-systematic aerial or ground surveys can also be used to delimit seasonal and total range when telemetry data are not available. However, because forest-dwelling caribou are typically most dispersed in spring and summer, winter observations alone are prone to underestimation of range area.

The following criteria should be considered, in addition to, or in the absence of adequate collaring-type data and/or animal survey data, when delineating range for multiple local populations within a continuous occupied habitat distribution.

2. Spatial extent

The amount of physical area identified as range for a local population within a continuous distribution is fundamentally important for providing a large enough area to support a potentially self-sustaining local population of boreal caribou.

Available animal movement or survey data should be considered first in determining the spatial extent of the range. Further coarse level guidance for the spatial extent of range for local populations within a continuous distribution can be derived by determining the area required to support a persistent population under density and target population size assumptions. Literature and heuristic PVA results (Callaghan pers. com.) suggest somewhat greater than 300 animals for long-term population viability, given moderate rates for calf and female survival. As an example, if range-wide densities of boreal caribou are 2-3 per 100 km^2, and if a population is 300 animals, then a reasonable guideline for a unit of analysis may be in the order of 10,000 to 15,000 km^2.

Additional insight into the sizes of ranges required could be derived by examining the sizes of ranges occupied by local populations that are exhibiting $\lambda \geq 1$ and have population size > 300 occupying similar geographic areas or habitats.

3. Modifiers to spatial extent

The spatial extent must be large enough to account for natural forest dynamics and the presence of alternate habitats. Frequency and size of natural disturbance events should be considered and larger areas defined if there is a very aggressive natural dynamics cycle.

4. Evidence of shared geography

Consider any evidence, collaring or otherwise that indicates caribou move from one location to another on a seasonal basis, or share common geography for part of a year. Aboriginal knowledge can be very good in determining these connections. The fact that animals share a common connection would mean they likely need to be considered as belonging to the same range.

5. Habitat functions and behavioural responses

Large areas sharing a similar expression of habitat functions and behavioural responses warrant being kept within the same range. This would benefit caribou with behavioural patterns suited to specific landscape features or functions, and would facilitate prescription of effective protection measures. The habitat functions associated with caribou life history are expressed in many ways across Canada depending on the topography, hydrology, and surficial geology. Ultimately, this reflects how the animals appear to be achieving refuge (predator avoidance), forage (resources for subsistence) and other requirements on an annual cycle. For refuge and forage, significant behavioural responses of caribou to mountains, foothills, or other rugged terrain, lakes with islands, peatlands, large areas of older conifer forest, nutrient poor landforms, large areas of bedrock exposure etc. warrant consideration in delineating range.

Variations in habitat functions occur at all scales and only very large and significant trends should be considered here. A good example in Ontario would be the apparent linkage and interaction of animals that share Lake Nipigon and the mainland, or animals that rely on both the Hudson Bay Lowlands and the shield.

6. Predominant Risk Factors

Broad types of risk factors, both natural and human, should be considered in the delineation of range. Anthropogenic disturbance regimes and their cumulative contributions to natural ecological drivers should be considered but do not supersede ecological factors. Dominant risk factors can include forestry, oil and gas and associated roads; fire or succession, predation by wolves, disease (e.g., brainworm); or aboriginal subsistence harvest. Recognizing that risk factors can exist in many combinations, consideration of broad trends that may occur over specific geographic areas will provide additional information for decisions on where to subdivide a larger portion of continuous distribution into local population ranges.

Should the range of a single local population with a large continuous distribution be sub-sampled to identify Critical Habitat?

Delineating single local population areas that are very large (e.g., the NWT distribution as one local population analysis unit, or all of Quebec) may result in a mean condition that masks the variation across the large continuous population range. This could allow for substantial occupied range to be lost (major range recession) and erosion of the national population while still supporting a self-sustaining local population. This would be contrary to the goal and objectives in the NRS (National Recovery Strategy), which stipulates maintaining the current distribution. Such large areas would also fail to have strong demographic connections across their breadth – an important practical and theoretical consideration in Critical Habitat Identification. Therefore, it may be necessary to subdivide large continuous population ranges into smaller contiguous analysis units, as an application of the precautionary principle. These may be best derived along ecological boundaries.

Should Forest Management Unit (FMU) boundaries be used to delineate sampling units within the range of local populations within a continuous distribution?

Our recommendation is to delimit large units of analysis based exclusively on animal movement data and ecological factors as listed above. General objectives for caribou habitat (particularly forest composition and connectivity) could be determined at the scale of the range with specific objectives assigned to each FMU partly or totally included in the range. In other words, fit FMU's into the defined ranges for local populations in a continuous distribution rather than the other way around. If the FMU conforms to most of the factors identified as criteria for delineating range as above then it is likely a reasonable unit. As the FMU diverges from the criteria above, then it becomes less acceptable.

The rationale for this approach is supported by the following:

- FMU's look very different from one jurisdiction to the other (and even within a jurisdiction) varying dramatically in size and shape, and seldom conform to ecological drivers. In some jurisdictions, they are surprisingly dynamic with new configurations and amalgamations occurring frequently. In some cases FMU's may represent more than one discrete block of land separated by large distances.

- Social planning considerations should not override fundamentally important ecological drivers. However, if ecological drivers and social planning considerations are geographically close, boundaries of range may be reconciled with other existing management unit boundaries.

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6.3 Literature Review of Boreal Caribou (Ranfiger tarandus caribou) Habitat Use in Ecozones across their Distribution in Canada

Introduction

Woodland caribou (*Rangifer tarandus caribou*) are distributed in the boreal forest across nine ecozones in Canada. Several ecotypes of woodland caribou have been classified, including boreal, forest tundra, northern mountain and southern mountain, based on their adaptation to various environments (Thomas and Gray 2002). In 2002, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed the boreal caribou ecotype as threatened (Thomas and Gray 2002). The boreal caribou is a forest-dwelling sedentary ecotype of woodland caribou. The range of the listed boreal caribou extends throughout the boreal forest in nine provinces and territories, from southwest Northwest Territories to Labrador (Figure 1).

Habitat encompasses the broad suite of biotic and abiotic resources and conditions that govern the survival, reproduction, and presence of a species (Caughley and Gunn 1996). The limiting factors assembled for caribou populations include predation (Bergerud 1974, 1980, Bergerud and Elliot 1986, Seip 1991, Stuart-Smith et al. 1997, Rettie and Messier 1998, Whittmer et al. 2005), meteorological conditions (Brown and Theberge 1990), food availability (Schaefer 1988), insect harassment (Downes et al. 1986; Walsh et al. 1992), and harvesting by humans (Bergerud 1967; Edmonds 1988).

The key to understanding habitat is scale. Individual animals select habitat at multiple scales to meet their life history requirements and avoid hazards. Johnson (1980) proposed a hierarchy of habitat selection, including species range scale, home range scale, within range (seasonal) habitats, and finer scales of resource selection, driven by efforts to minimize effects of limiting factors.

Rettie and Messier (2000) hypothesized that, across spatial scales, population-limiting factors can be linked to habitat selection. This argument has two components: First, habitat selection may occur simultaneously on multiple scales, often framed as a nested hierarchy. For instance, animals may select a home range, feeding sites within the home range, and dietary items within a site (Senft et al. 1987). Second, selection at each of these scales represents a ranking of limiting factors. Animals are hypothesized to select resources (or perhaps avoid some condition) in an attempt to overcome the chief limitation at each scale; if unable to do so, they continue to select that resource at successively finer scales. The scales of habitat selection can thus reveal an ordered list of limiting factors. The broadest scales are most pertinent to survival and reproduction (Rettie and Messier 2000).

There is wide agreement that the primary proximate limiting factor for boreal caribou populations is predation, driven by natural or human-induced landscape changes that favour early seral stages and higher densities of alternative prey (Bergerud and Elliott 1986, Bergerud 1988, Ferguson et al. 1988, Seip 1992, Cumming et al. 1996, Stuart-Smith et al. 1997, Rettie and Messier 1998, Schaefer et al. 1999, Courtois 2003, Courtois et al. 2007, Vors et al. 2007). The distribution of woodland caribou appears to occur in refugia, often away from high densities of predators and their alternate prey (Bergerud et al. 1984, Bergerud 1985, Cumming et al. 1996, Rettie 1998, James 1999, Racey and Armstrong 2000). If caribou can find such refugia, then snow appears to act as a factor at slightly finer scales, such as foraging areas with softer and shallower snow cover (Stardom 1975, Brown and Theberge 1990). Finally, selection for lichens occurs at even finer scales such as feeding craters chosen for their high lichen content (Schaefer and Pruitt 1991) or graminoids and equisetum.

The scale of habitat selection should reflect the relative importance of limiting factors, whereby a limiting factor should drive selective behaviour at increasingly finer scales until the next most dominant limiting factor supersedes selection (Rettie and Messier 2000). Bergerud et al. (1984) hypothesized that minimizing exposure to predation is the strongest driver of coarse-scale caribou habitat selection. For example, at a broad scale, boreal caribou select mature conifer forests and peatland complexes, both of which support few predators or alternative prey. During calving season, cows typically select treed islands surrounded by open water in peatlands or lakes to further reduce risk of predation. The open water is hypothesized to facilitate escape from predators. Although some of these islands may support sub-optimal forage quality and quantity, the inference is that the risk of predation exceeds the need for high quality forage and that predation still remains the chief limiting factor within a home range.

At fine spatial scales, food availability and microclimate factors are considered important drivers of caribou habitat selection (Rettie and Messier 2000). During spring, female caribou feed on nutrients important for lactation (equisetum and graminoids), and during winter the exploit protein-rich sedges (*Carex spp.*) and equisetum and terrestrial and in some areas arboreal lichens (e.g., *Bryoria spp. and Alectoria sarmentosa*; Helle 1980, in Rettie and Messier 2000). During summer, when biting insects are abundant, boreal caribou have been reported to use sparsely treed ridgelines near lakeshores, purportedly to reduce insect harassment (Shoesmith and Storey 1977, Hillis et al. 1998).

Although boreal caribou are considered non-migratory, movements made between seasonal ranges (particularly pre-calving and pre-rutting) vary considerably, from almost no between-season movements in Alberta, central Saskatchewan, and southeastern Manitoba (Fuller and Keith 1981, Darby and Pruitt 1984, Bergerud 1985, Edmonds 1988, Stuart-Smith et al. 1997, Rettie and Messier 2000), to more than 20 km in northwestern Ontario (Ferguson and Elkie 2004a) or 40.5 km mean distance (range 12 – 119 km) in northeastern BC (Culling et al. 2006) and 75 km in Labrador (range 10 - 520 km; Brown et al 1986). Boreal caribou in Manitoba have been recorded moving distances of greater than 200 km (V. Crichton pers. comm.). Connectivity between seasonal habitats fulfills a potentially critical function in reducing risk of predation for boreal caribou during times of increased movement. Caribou migrating to and from their wintering areas used coniferous forests (Ferguson and Elkie 2004a, Darby and

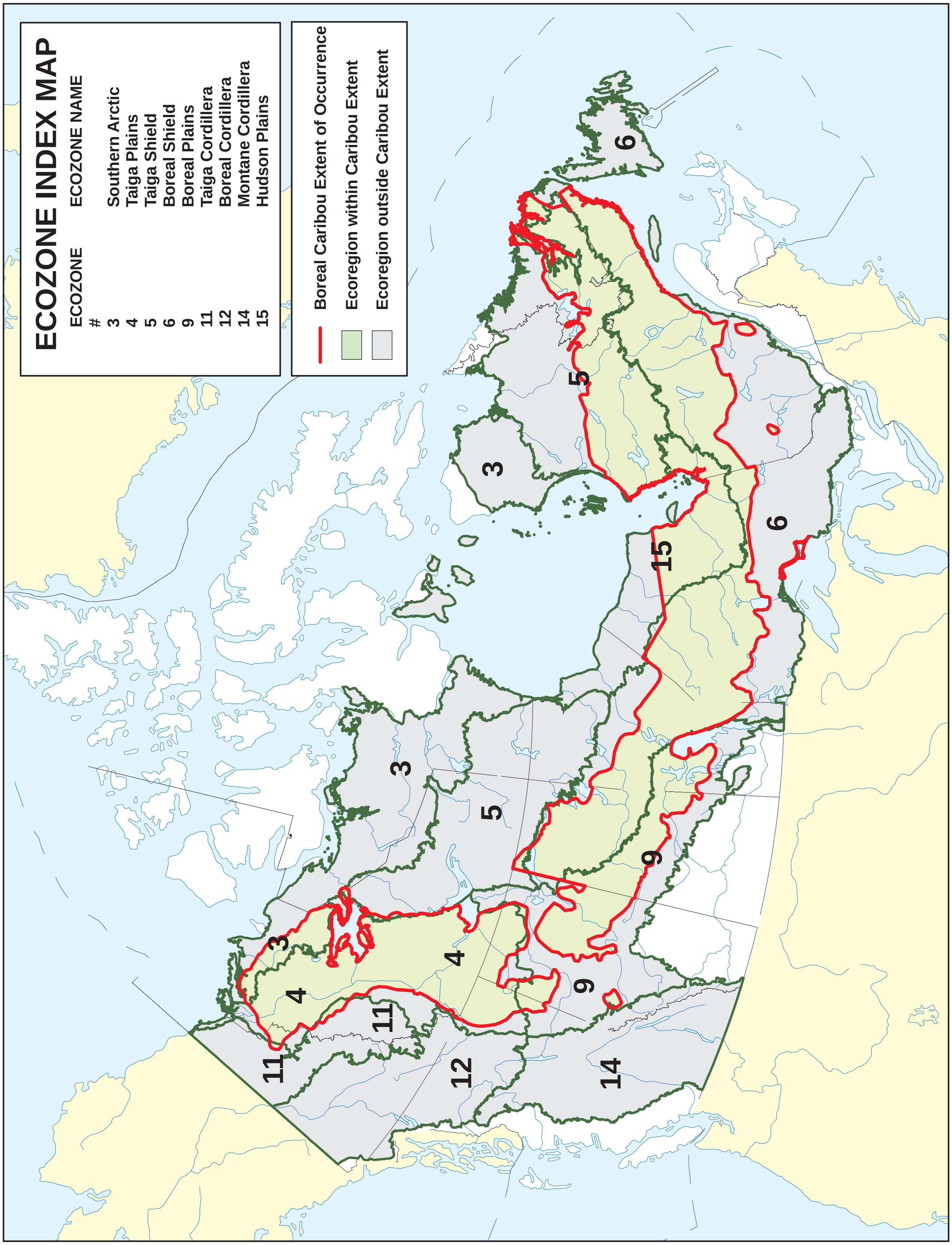
Pruitt 1984, Lefort et al. 2006). In northwestern Ontario, caribou were more likely to avoid open water, disturbed and open areas while using coniferous forests during migration to and from wintering areas (Ferguson and Elkie 2004a).

Habitat conditions over their entire range impact the viability of boreal caribou populations. The major threat to boreal caribou is increased predation that appears to be related to habitat changes that increase the number and distribution of alternative prey species and their associated predators in caribou habitat. Consequently, although special management practices may be required to protect seasonal foraging habitats, calving habitats, and migration connectivity, it is also important to manage the surrounding habitats to reduce the risk of predation, even if the caribou rarely or never “use” those habitats. Caribou do not respond to the landscape at human-centred scales; their “use” of habitats appears to extend for kilometres (Mayor et al. 2007), well beyond the bounds of conventional human perceptions. The importance of managing the matrix habitat surrounding the core habitat to reduce predation risk is recognized for the mountain ecotype of boreal caribou, which face similar issues of increased predation risk where the number and distribution of early seral ungulates has changed following habitat change (Government of British Columbia 2005).

The purpose of this report is to summarize boreal caribou habitat use from studies published in primary literature as well as government and non-government reports.

The description of habitat use is organized by Ecozone (Figure 1), the most generalized classification of the Canadian ecological unit hierarchy framework (ESWG 1995). The largest Ecozone, the Boreal Shield, is further divided into five forest regions adapted from Rowe (1972). Habitat use is reported for populations existing outside of the boreal caribou range (e.g. southern mountain or Newfoundland) if the results were thought to be informative for defining boreal caribou Critical Habitat. For each Ecozone, broad-scale caribou habitat is described, followed by, finer scale habitat for each season (calving, post calving, rutting, winter [early and late]) as well as for the travel period between seasons.

Consistent common names of plant species and habitat type were used where possible. In some cases, variations in common names occurred among Ecozones (e.g. bog, string bog, basin bog, peatland complex, treed muskeg, treed wetland, etc.).



Appendix 6.3 - Figure1. Boreal caribou distribution within nine Ecozones in Canada.

TAIGA SHIELD ECOZONE

Coppermine River Upland, Tazin Lake Upland, Selwyn Lake Upland, La Grande Hills, Southern Ungava Peninsula, New Quebec Central Plateau, Ungava Bay Basin, Kingarutuk-Fraser River, Smallwood Reservoir-Michikamau, Coastal Barrens, Winokapau Lake North, Goose River West, Mecatina River, Eagle Plateau, Harp Lake, Nipishish Lake (68, 69, 71, 72, 73, 74, 75, 77 (81), 78, 79, 80 (83, 86), 82, 84, 85)

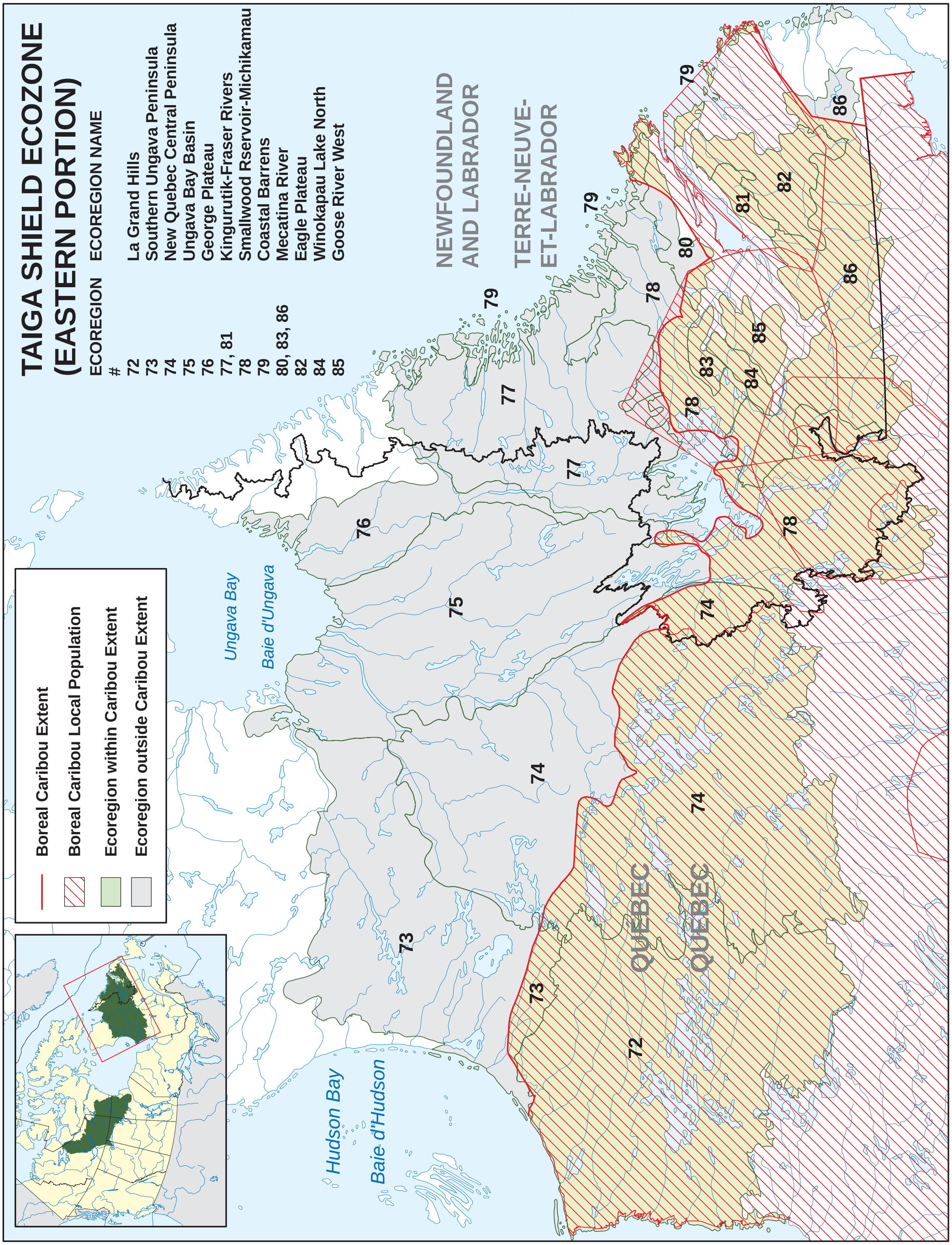
The Taiga Shield Ecozone occurs east of Hudson Bay, in northern Quebec and southern Labrador (Figure 2) and is comprised of the Taiga Forest and the Canadian Shield on broadly rolling terrain (ESWG 1995). The landscape is dominated by bedrock erratics, eskers, and hummocky and ridged morainal deposits. Many lakes, peatlands, and open forests with intervening shrublands and meadows exist in this Ecozone. Black spruce (*Picea mariana*) is the dominant tree species in the Ecozone, although open mixedwood stands of white spruce (*Picea glauca*), balsam fir (*Abies balsamea*), trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), and white birch (*Betula papyrifera*) dominate the southern portion of the Ecozone and open arctic tundra dominates the northern portion of the Ecozone. Open black spruce and jack pine (*Pinus banksiana*) forests dominate the centre of the Ecozone, and lichen (*Cladonia* and *Cladina*) are the primary understory species. Lichen woodlands generally occur in nutrient poor sandy soils of glacial deposits. Upland areas are well drained and prone to fire. White birch and tamarack (*Larix laricina*) are considered the dominant pioneer species post fire, and are eventually replaced by black spruce. Throughout the southern and central portion of the Ecozone, higher elevations are dominated by open arctic tundra and low shrubs. Precipitation ranges from 500 mm to over 1,000 mm per year. Mean annual area burned by forest fire is 0.14% (NRCAN 2002).

Local Caribou Populations

Six local boreal caribou populations occurring within the Taiga Shield are described in the literature. The extent of occurrence of some of these local populations overlaps with the Boreal Shield Ecozone. The following local populations are listed in the habitat use literature: *QC: Magpie, Caniapiscau, and Lac Bienville. Labrador: Lac Joseph, McPhadyen River, Red Wine Mountains, Mealy Mountains. The McPhadyen River population was associated with the Lac Joseph population but no longer exists. The Red Wine Mountains population was associated with two local populations that no longer occur: Dominion Lake and St. Augustin. Lac Joseph and Magpie are the same population, sharing a border between Quebec and Labrador*

Broad-Scale Caribou Habitat

Caribou habitat in the Taiga Shield is described as upland tundra consisting of rounded, barren hills dominated by ericaceous shrubs (*Ericaceae spp*.), lichens, grasses (graminoids) and sedges and lowlands consisting of numerous peat bogs (muskegs and string bogs), lakes,



Appendix 6.3 - Figure 2. Boreal caribou distribution within the Taiga Shield Ecozone.

rivers, and riparian valleys. Forest-wetland habitat and closed conifer forests are extensive (Brown et al. 1986). Courtois et al. (2004) described caribou habitat as dense mature conifer and open conifer with abundant lichens. Coastal areas and off-shore islands are available to caribou in the eastern portion of the Taiga Shield (Schmelzer 2004).

Seasonal Habitat and Forage

Calving Habitat

Bergerud (1963, in Schmelzer et al. 2004) described traditional calving areas as string bogs and large muskegs. The use of peninsulas or islands varies by the amount of open water in the range. Females tend to calve on islands more frequently in the Caniapiscau and Lac Bienville populations, where there is more open water.

Fidelity to calving sites seems to vary among individual caribou; some caribou return to the same site in consecutive years, some have calving locations separated by several hundred kilometres in subsequent years, and many return to a general area within their range. General calving site fidelity was recorded by Brown et al. (1986; ~87% of 103 radio-collared caribou in three populations selected a calving site within 10 km of the previous year's calving site and 33% calved within 3 km of previous year's site) and Hearn and Luttich (1987; within 15 km of the previous year's calving site, in Schmelzer et al. 2004).

Some females traveled several hundred kilometres to these general calving areas. Brown et al. (1986) recorded female caribou in the Caniapiscau population traveling between 200 and 500 km to their calving areas each year. Calving areas represent a small portion of the range; Brown and Theberge (1985) reported that cumulative area of all calving locations represented less than 3% of the available range.

Caribou disperse widely across the range during calving period and densities were estimated at below 0.03 caribou per km^2 (Brown et al. 1986). Calving sites selected by caribou from the Red Wine Mountains population were located in treed bogs (Brown and Theberge 1985) or small open wetlands (<1 km^2) and typically one female per wetland was observed (Brown et al. 1986). Many calving sites were located in islands or peninsulas (Brown et al. 1986).

Post-Calving Habitat

Caribou were relatively sedentary throughout the summer and remained in forested wetland (Brown et al. 1986). Fidelity by adult females can be most pronounced at this time of year. Females in the Red Wine Mountains herd returned, on average, to within 6.7 km of the previous year's site (Schaefer et al. 2000).

Rutting Habitat

Caribou moved greater distances during the rutting season and formed larger rutting groups. Caribou were observed in open wetlands during the rutting season (Brown et al. 1986).

Winter Habitat

Bergerud (1994, cited in Schmelzer et al. 2004) described winter range as uplands and sand flats in proximity to rivers. During winter, Lac Joseph caribou used forested wetland more than upland tundra (Brown et al. 1986; Saint-Martin and Theberge 1986, in Schmelzer et al. 2004). The extreme snow depths in the Taiga Ecozone limit the ability of caribou to access terrestrial lichen. Brown and Theberge (1990) found that cratering activity in the Red Wine Mountains population did not occur in snow depths above 125 cm and ram-hardness values of approximately 500 kg. During deep snow conditions, caribou seek bedrock erratics, where snow sheds easily (I. Schmelzer pers. comm.). Caribou form small groups and selected lakes for loafing and rumination in winter, where a clear view of predators is maintained (I. Schmelzer pers. comm.). In snow conditions below the threshold, caribou formed groups and cooperatively dug craters to access food (Brown and Theberge 1990). During winter, caribou in the Red Wine Mountains of Labrador selected bog edges as well as glacial erratics, where terrestrial lichens were abundant (Brown and Theberge 1990). In the 1980s, some of the Red Wine Mountains population wintered in mature white spruce and fir stands that provided an important alternate food source in the form of arboreal lichens (Brown 1986). Folinsbee (1975, 1978; reported in Schmelzer 2004) found used areas in winter had significantly lower snow depths than non-used areas, and snow under forest canopy was softer and shallower than snow outside of forests. In deep snow years, Mealy Mountains caribou formed groups and traveled to the alpine, windswept Mealy Mountains or in bogs along lake or ocean shore (Bergerud 1967, Hearn and Luttich 1987). During winters with low snowfall, caribou did not congregate in groups and used heavily forested areas (Bergerud 1967).

Late Winter Habitat

Caribou whose range includes mountainous habitat moved to the tundra habitat of the mountains in late winter, possibly to avoid deep snow conditions at lower elevations (Brown et al. 1986, Brown and Theberge 1990). Movements from the forest wetland habitat to upland tundra ranged from 16 – 86 km.

Travel Season Habitat

Prior to calving, caribou dispersed widely from late winter aggregations and the greatest movements of radio-collared females between successive relocations occurred during the travel season prior to calving (Brown et al. 1986). The greatest daily movement rates occurred prior to calving (up to 38 km) and during fall after the rutting season (up to 51 km, I. Schmelzer pers. comm.).

HUDSON PLAINS ECOZONE

Hudson Bay Lowland, James Bay Lowland (216, 217)

The Hudson Plains Ecozone encompasses portions of northern Ontario, western Québec and northeastern Manitoba (Figure 3) and is a low elevation plain referred to as the James Bay Lowlands. The region is a transition zone between coniferous forests to the south and tundra to the north. Poorly drained areas supporting bogs and fens are extensive and interspersed with black spruce covered ridges or tamarack stands. Sedges, mosses and lichens dominate the ground cover. Mean annual precipitation ranges from 400 mm in the northwest to 800 mm in the southeast (ESWG 1995). Mean annual area burned by forest fire is 0.09% (NRCAN 2002).

Local Caribou Populations

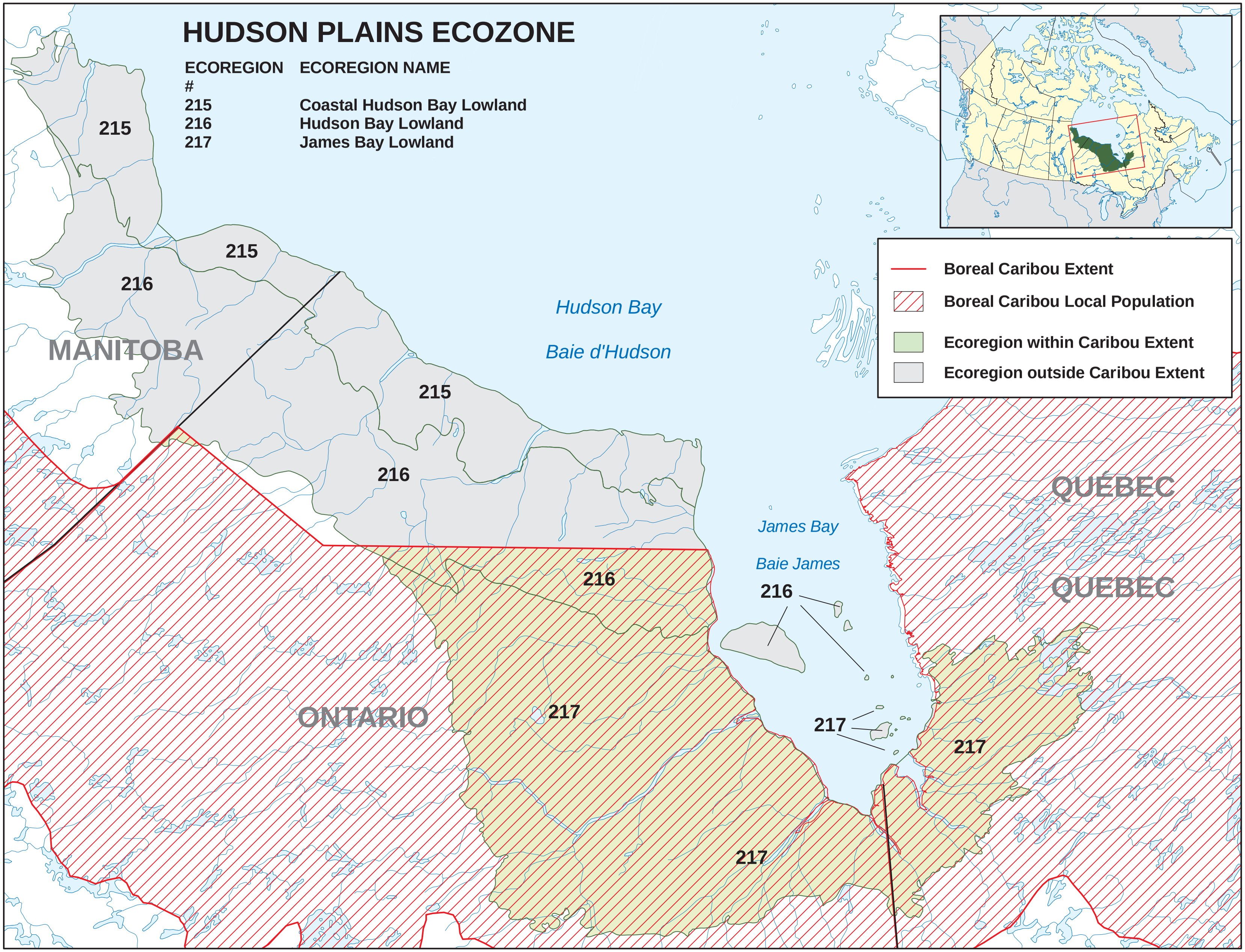
Three local boreal caribou populations occurring within the Hudson Plains Ecozone are described in the literature in addition to the continuous distribution of boreal caribou throughout the Ecozone. The extent of occurrence of some of these local populations overlaps with the Boreal Shield Ecozone. The following local populations are listed in the habitat use literature: *La Sarre, Rupert, and Michipicoton.*

Broad Scale Caribou Habitat

The most suitable caribou habitat in this region includes all ages of shrub-rich treed muskeg and mature conifer (Brown 2005). Magoun et al. (2005) described caribou habitat as poorly-drained landscapes dominated by sedges, mosses and lichens with scattered, open stands of black spruce and tamarack. The home ranges of caribou in this region were larger than those reported in the literature for other regions of Canada (Brown et al. 2003).

Seasonal Habitat and Forage

Caribou in the Hudson Bay lowlands avoided tamarack fens year round (Magoun et al. 2005). Courtois (2003) determined that at the home range scale, caribou preferred habitats susceptible to reduce predation risk by selecting mature conifers, water bodies, areas with lichens and wetlands and avoiding perturbed habitats. Forest fragmentation, however, constrained the pattern of habitat selection by caribou. Individuals living in highly fragmented landscapes did not select against perturbed habitats, presumably because they could not find enough suitable habitats in such landscapes or because they gave priority to dispersion as an anti-predator strategy. Core activity areas for winter and summer occurred did not overlap in this region and (Brown et al. 2003).



Appendix 6.3 - Figure 3. Boreal caribou distribution within the Hudson Plains Ecozone.

Calving Habitat

During calving, caribou preferred mature conifer stands without lichens, conifer stands with lichens and wetlands (Courtois 2003). Caribou were found more frequently at higher altitudes during calving than during other periods.

Post-calving

In the northeastern recovery zone of Ontario, caribou were associated with fens, bogs, and lakes during summer (Pearce and Eccles 2004).

Rutting Habitat

During the rut, caribou preferred conifer stands with lichens and wetlands, followed by mature conifer and conifer in regeneration (Courtois 2003).

Winter Habitat

In winter, caribou preferred dense conifer (Pearce and Eccles 2004), wetlands and mature conifer with lichens (Courtois 2003). Caribou selected areas where terrestrial lichens were abundant on ombrotrophic peat deposits (Brokx 1965). Lichen woodlands and lichen heaths were avoided. Most caribou wintered in raised bogs, especially in peatland complexes with abundant patches of bog (Brokx 1965).

Late Winter Habitat

In late winter, caribou used large patches of intermediate aged and mature black spruce, shrub rich treed muskeg, and mixed conifer and avoided forests with abundant deciduous species (Brown et al. 2007). In late winter, caribou selected areas with abundant mature black spruce and where contiguous patches of preferred habitat were larger. Caribou avoided forests with an abundance of deciduous trees (Brown et al. 2007).

Travel Season Habitat

In the James Bay Lowlands, home range size of caribou was positively correlated with moose (*Alces alces*) density during periods of long-range movements, and negatively correlated with moose density during sedentary periods, suggesting avoidance of moose to reduce risk of predation during most of the year (Brown 2005). Movements were greater during fall and late winter when caribou were travelling to and from summer and early winter ranges (Brown et al. 2003).

BOREAL SHIELD ECOZONE

The Boreal Shield Ecozone is vast, extending from northern Saskatchewan to Newfoundland, north of Lake Winnipeg, the Great Lakes, and the St. Lawrence River (ESWG 1995; Figure 4). The landscape is rolling, with abundant uplands and wetlands. Peatlands dominate the wetlands throughout central Manitoba, northwestern Ontario, and Labrador. Small to medium-sized lakes occur throughout the Ecozone. The dominant vegetation is coniferous trees in the northern reaches of the Ecozone, with greater abundance of mixed conifer and deciduous trees in the southern extent. Exposed bedrock outcrops and their associated lichen dominate the landscape. Shrubs and forbs occur and dominate non-forested areas. Mean annual precipitation ranges from 400 mm to 1600 mm (ESWG 1995). Mean annual area burned by forest fire is 0.36% (NRCAN 2002).

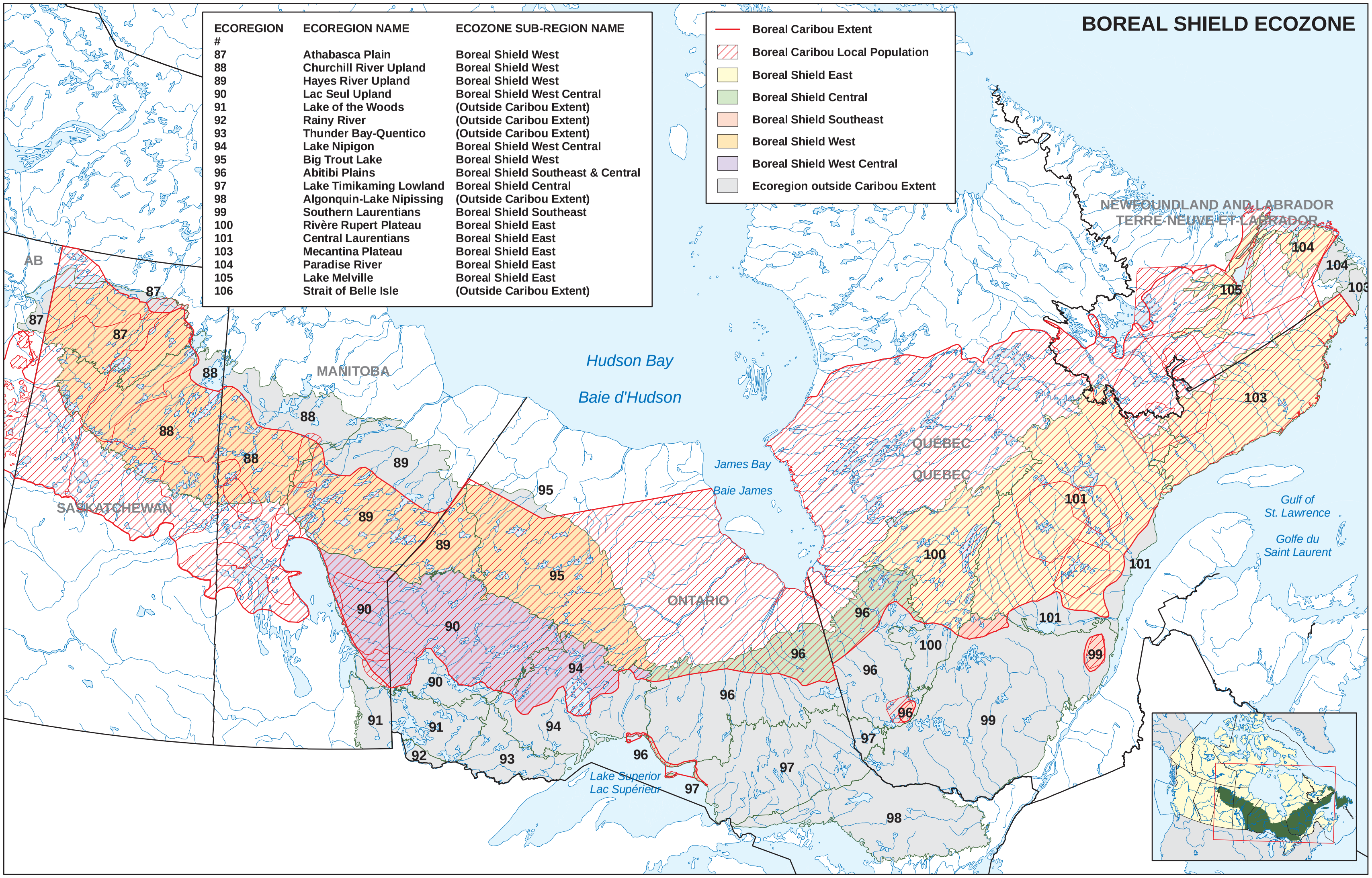
Due to the vastness of the Boreal Shield and the variation in climate, topography and types of vegetation, the habitat descriptions for boreal caribou in this Ecozone have been delineated to 5 sub regions:

1) **Boreal Shield East (Labrador/NE Québec): Rivere Rupert Plateau, Central Laurentians, Mecantina Plateau, Paradise River, Lake Melville Ecoregions (100, 101, 103, 104, 105)**
2) **Boreal Shield Southeast (Southern Québec): Abitibi Plains, Southern Laurentians Ecoregions (96, 99)**
3) **Boreal Shield Central (Western Québec, NE Ontario): Abitibi Plains, Lake Timiskaming Lowlands Ecoregions (96, 97)**
4) **Boreal Shield West Central (Lake Superior): Lac Seul Uplands, Lake Nipigon Ecoregions (90, 94)**
5) **Boreal Shield West (NW Ontario, Manitoba, Saskatchewan): Athabaska Plain, Churchill River Upland, Hayes River Upland, Big Trout Lake Ecoregions (87, 88, 89, 95)**

BOREAL SHIELD EAST

Rivere Rupert Plateau, Central Laurentians, Mecantina Plateau, Paradise River, Lake Melville Ecoregions (100, 101, 103, 104, 105)

This region extends from west-central Québec east to the northeastern extent of Québec (Figure 4). Closed stands of black spruce and balsam fir dominate the western extent of this sub region (ESWG 1995). Open stands of white spruce with lichen and white birch exist in well-drained sites. Closed stands of black spruce and balsam fir dominate the low lands, while open stand of black spruce and white spruce, with their associated lichens and feather moss dominate the well drained sites. White birch and trembling aspen also occur in well drained sites. Eastern white cedar (*Thuja occidentalis*) and black spruce dominate the wetland areas. Closed, dense stands of black and white spruce and balsam fir dominate the moist sites along riparian habitat. Bedrock outcrops are dominated by lichen. Bogs dominate



Appendix 6.3 - Figure 4. Boreal caribou distribution within the Boreal Shield Ecozone.

the lowlands and lower valleys and raised dome bogs occur in the eastern portion of the sub region. Krummholtz vegetation occurs on exposed hilltops. Mean annual precipitation ranges from 650 – 100 mm (ESWG 1995). Mean annual area burned by forest fire is 0.24% (NRCAN 2002).

Local Caribou Populations

The following local population names or local regions occur in the habitat use literature for this region: *Lac Joseph/Magpie, Petite Lac Manicouagan (Manic), and Manouane-Manicouagan (Manou); Pipmuacan (Pipmu).*

Broad Scale Caribou Habitat

Boreal caribou habitat in the northern part of their range in Québec includes continuous conifer-feather moss forests on poorly-drained sites and conifer uplands with nearly continuous terrestrial lichen ground cover (*Cladina spp., Cladonia spp.* and *Cetraria spp.*; Arseneault et al. 1997). Caribou preferred mature conifer with lichens, water bodies, and wetlands and avoided disturbed habitats (Courtois 2003).

Seasonal Habitat and Forage

Year Round Habitat

Caribou in the southern extent of this region avoided burns and clear-cuts, deciduous and mixed forests, and heath without lichens throughout the year (Courtois et al. 2007) as well as jack pine stands younger than 40 years (Crête et al. 2004). .

Calving Habitat

Caribou from four populations in the Boreal Shield East selected open wetlands, peninsulas and islands for calving habitat (Brown et al. 1986). During spring, caribou in Newfoundland selected sedges, ericaceous species, bryophytes, alder (*Alnus spp*.) and larch (Bergerud 1972). In the western extent of the region, caribou selected balsam fir, dense black spruce stands, mixed spruce-fir forests older than 40 years, and dry bare land that supported high densities of lichens (Crête et al. 2004). During the calving season, caribou avoided recent burns or harvested stands, pine stands less than 40 years-old, and jack pine stands. In the southern extent of the region, cows preferred mature conifer stands with and without lichens, and wetlands during calving season (Courtois 2003). Caribou cows did not use islands or water bodies for calving, but were found at higher altitudes than during other periods.

Post-calving Habitat

During summer, caribou selected open and forested wetlands in northeastern Québec and continued to use islands and peninsulas (Brown et al. 1986). In Newfoundland, caribou selected aquatic plants, dwarf birch (Betula glandulosa), deciduous shrubs, ericaceous species, and moss (Bergerud 1972).

Rutting Habitat

In the Boreal Shield East, caribou moved greater distances during the rutting season and formed larger rutting groups. Caribou were observed in open wetlands during the rutting season (Brown et al. 1986). In Newfoundland, caribou selected terrestrial and arboreal lichens, forbs, sedges, mosses, and coniferous and deciduous shrubs during fall (Bergerud 1972). In the southerly portion of the region, Rutting included balsam fir stands, dense spruce, spruce-fir forest older than 40 years, and dry bare land (Crête et al. 2004). Stands with abundant lichens and wetlands were preferred, followed by mature conifer and young seral stage conifer (Courtois 2003).

Winter Habitat

Caribou in this region avoided arboreal lichens, possibly because the lichen available was non-pendulous (Brown and Theberge 1990). Caribou from other Labrador/Northern Québec populations selected forested wetlands during winter (Brown et al. 1986). Some caribou used upland-tundra for loafing, but returned to lichen woodlands for feeding (Brown et al. 1986). In the southern extent of the region, caribou selected balsam fir stands, dense spruce stands, mixed spruce-fir older than 40 years, dry bare land (Crête et al. 2004), mature conifer, and wetlands. (Courtois 2003).

BOREAL SHIELD SOUTHEAST

Abitibi Plains, Southern Laurentians Ecoregions (96, 99)

This region encompasses two isolated boreal caribou populations, in southwestern Québec, and in the Laurentians of south-central Québec (Figure 4). The region is characterized by mixed forest of white spruce, balsam fir, white birch and trembling aspen (ESWG 1995). In dry sites, jack pine forests or mixed forests of jack pine, white birch, and trembling aspen occur and on wet sites, black spruce and balsam fir or tamarack stands occur. Forest understory is typically moss or lichen. Basin bogs are abundant in the northern portion of the sub region, and rock outcroppings occur more frequently in the southern extent. The eastern extent of the region is more undulating. Annual precipitation ranges from 725 mm to 1000 mm (ESWG 1995). Mean annual area burned by forest fire is 0.06% (NRCAN 2002).

Local Caribou Populations

This subregion contains only two isolated boreal caribou populations: *Charlevoix and Val-d'Or.*

Broad Scale Caribou Habitat

Boreal caribou habitat in this region includes late seral-stage black spruce-dominated lowlands and jack pine-dominated uplands (Duchesne et al. 2000). Within the range of the Charlevoix population, south of the continuous boreal caribou distribution, open black spruce forests with dwarf birch and *Ericaceae spp*. dominate (Duchesne et al. 2000). An extensive lichen community, the basis of the population's winter diet, includes *Cladina spp*., *Cladonia spp.* and *Cetraria spp*. (Duchesne et al. 2000).

Seasonal Habitat and Forage

Calving Habitat

During spring, caribou selected open, medium-closed conifer forests (Lefort et al. 2006)

Pre Rutting and Rutting Habitat

During the pre-rutting period, caribou selected open and dense mature conifer forests, including spruce, tamarack, jack pine, as well as younger coniferous forests aged 30 – 50 years (Lefort et al. 2006). During the rutting and post-rutting period, caribou selected open mature and young coniferous forests.

Winter Habitat

In early winter through late winter, caribou from the Charlevoix population selected open stands older than 70 years of the following species: balsam fir, balsam fir-black spruce, black spruce, black-spruce-tamarack, and jack pine (Lefort et al. 2006). Caribou also selected dry bare land and stands of balsam fir or fir-black spruce 30 – 50 years, young jack pine 50 years, and dense stands of 70 years (Lefort et al. 2006). Sebbane et al. (2002) reported Charlevoix caribou selected mature conifer and arboreal and terrestrial lichens during winter.

BOREAL SHIELD CENTRAL

Abitibi Plains, Lake Timiskaming Lowlands Ecoregions (96, 97)

This region encompasses the contiguous boreal caribou population in the Claybelt region of northeastern Ontario and western Québec as well as the isolated populations along the north shore of Lake Superior (Figure 4). The landscape is dominated by mixed forest of white spruce, balsam fir, white birch and trembling aspen (ESWG 1995). On drier sites, pure stands of jack pine or mixed stands of jack pine, white birch, and trembling aspen occur. Wetter sites are characterized by black spruce, balsam fir, eastern white cedar, and tamarack. In proximity to Lake Superior, eastern white pine (*Pinus strobus*), red pine (*Pinus resinosa*), yellow birch (*Betula alleghaniensis*), sugar maple *(Acer saccharum*), and red maple (*Acer rubrum*)also occur. Moss and lichen form the understory throughout the region. Bedrock outcroppings supporting lichens are predominant in the southern extent of the region and basin bogs are predominant in the northern extent. Mean annual precipitation ranges from 725 mm to 1000 mm (ESWG 1995). Mean annual area burned by forest fire is 0.04% (NRCAN 2002).

Local Caribou Populations

The following local populations are described in the literature for this region: *Pukaskwa, Slate Islands, and Pen Islands*. The region also includes local populations *Rupert and La Sarre* in the Claybelt region of Québec and un-named populations in the Claybelt region of Ontario.

Broad Scale Caribou Habitat

Boreal caribou habitat in this region includes late seral-stage black spruce-dominated lowlands and jack pine-dominated uplands (Arseneault et al. 1997, Courtois et al. 2003, Lantin et al. 2003). Near the Québec/Ontario border, boreal caribou habitat is similar to that in neighbouring Ontario, mainly consisting of open black spruce lowlands (Lantin et al. 2003). Boreal caribou habitat in Ontario is primarily composed of low-density late seral-stage jack pine or black spruce forest, and black spruce/tamarack-dominated peatlands with abundant terrestrial and moderate arboreal lichens (Bergerud 1985, Cumming et al. 1996, Antoniak and Cumming 1998, Cumming and Hyer 1998, Webb 1998, Proceviat et al. 2003, Brown 2005, Carr et al. 2007, Vors 2006, Wilson 2000). Caribou used areas with dry to moist sandy to loamy soils and shallow soils over bedrock (Wilson 2000).

Seasonal Habitat and Forage

Year Round Habitat

Caribou in the Slate Islands population forage on arboreal lichens and appeared to be at or near their carrying capacity (Cringan 1957, Bergerud 1996).

Calving Habitat

Caribou in the Claybelt region that spans Québec and Ontario selected open canopies of mature black spruce and mesic peatland with ericaceous species for calving habitat and avoided recently downed woody debris, dense shrubs, and larch (Lantin et al. 2003). Ericaceous shrubs and terrestrial lichens were more abundant in calving areas where females were observed with a calf during summer than in areas where females were seen alone (Lantin et al. 2003). The amount of vegetation cover, which would provide seclusion from predators, was similar between calving areas with or without calves.

Winter Habitat

In late winter, the probability of caribou occurrence was greater where mature black spruce was abundant and contiguous patches of preferred habitat were larger. Caribou avoided mixed conifer and deciduous forest (Brown et al. 2007). Caribou in Pukaskwa National Park used open conifer with lichens along shorelines and avoided areas with deep snow conditions (Bergerud 1985). Caribou in northeastern Ontario used areas with lower relative stand densities, relatively abundant terrestrial and arboreal lichens and significantly less snow than non-used areas (Wilson 2000).

BOREAL SHIELD WEST CENTRAL

Lac Seul Upland, Lake Nipigon Ecoregions (90, 94)

This region extends from the east side of Lake Winnipeg, Manitoba to northeast of Lake Nipigon, Ontario (Figure 4). Closed stands of black spruce, along with some jack pine, white spruce, balsam fir, white birch, and trembling aspen with ericaceous shrubs, mosses, and lichens are typical of this region (ESWG 1995). In the southern extent of the region, trembling aspen, white birch, white spruce, and balsam fir are common. Many areas of exposed bedrock that support few trees and abundant lichen occur throughout the region. Lowlands include peat bogs with open or closed black spruce and sphagnum moss (*Sphagnum spp*.). Drier sites are typified by open stands of jack pine, trembling aspen and white birch, with some black and white spruce. Many lakes and wetlands occur throughout the region. Mean annual precipitation ranges from 450 – 800 mm (ESWG 1995). Mean annual area burned by forest fire is 0.38% (NRCAN 2002).

Local Populations

Local populations listed in the literature include *Owl Lake, Aikaki Berens, the former Aikens Lake population, Lake Nipigon*, and part of the contiguous population of northwestern Ontario.

Broad Scale Caribou Habitat

Caribou habitat in northwestern Ontario, from the Ontario-Manitoba border to Lake Nipigon, consists of mature conifer uplands and conifer/tamarack-dominated lowlands (Bergerud et al. 1990, Cumming and Beange 1987, Ferguson and Elkie 2004a, 2004b, Carr et al. 2007, Vors 2006). Boreal caribou habitat in the Owl Lake and Aikens Lake ranges, Manitoba is characterized by conifer/tamarack-dominated peatlands with abundant arboreal lichens, uplands dominated by mature conifers with dense cover of ground lichens, and sparsely treed rock (Darby and Pruitt 1984, Schaefer 1988, Metsaranta et al. 2003, O'Brien et al. 2006).

Seasonal Habitat and Forage

Year Round Habitat

Caribou in northwestern Ontario used bogs and large tracts of mature forest year round

(Racey and Armstrong 2000). Caribou in the Owl Lake population, Manitoba used treed muskeg, black spruce, and jack pine dominated forests older than 50 years and with a crown closure greater than 50% (Schindler 2005).

Calving Habitat

Boreal caribou calving habitat in northwestern Ontario is described as forested wetlands/ treed bog, old burns, sparse conifer, and dense spruce (Hillis et al. 1998). Caribou used peatlands with forested islands as calving habitat (Armstrong et al. 2000). Boreal caribou in northwestern Ontario frequently used shorelines and islands of large lakes for calving; these areas likely function as spatial refugia from predation (Bergerud et al. 1990, Cumming and Beange 1987, Ferguson and Elkie 2004a, Carr et al. 2007). Although some females showed strong seasonal fidelity to calving areas, others do not (Ferguson and Elkie 2004b). Caribou in Wabakimi and Caribou Provincial Parks used peatland with forested islands for calving habitat (Armstrong et al. 2000). In Northwestern Ontario, caribou selected treed bogs and avoided shrub-rich fens during calving season (Hillis et al. 1998). In the Whitefeather forest, islands on large lakes and raised hillrocks within large muskeg areas were important sites for calving (O'Flaherty et al. 2007).

In the former Aikens Lake range, Manitoba, caribou used mature upland conifer, heavily treed bogs, and jack pine or jack pine/black spruce forests as calving habitat (Darby and Pruitt 1984). Caribou also selected islands, lakeshores and heavily treed bogs for calving habitat (Darby and Pruitt 1984).

Post Calving Habitat

Caribou in northwestern Ontario used peatland with forested islands as well as islands and shorelines during summer (Armstrong et al. 2000). Caribou in northwestern Ontario selected shorelines with closed mature black spruce stands with lower shrub density and abundance of terrestrial lichens for nursery habitat post calving (Carr et al. 2006). Caribou in the Lake Nipigon area selected islands during summer and avoided tamarack fens (Cumming and Beange 1998). Caribou in the northwest recovery zone, Ontario used mature, dense forest stands and islands during summer (Pearce and Eccles 2004). Caribou in the former Aikens Lake, Manitoba population used mature coniferous uplands more often than other habitat types during summer (Darby and Pruitt 1984).

Rutting Habitat

Caribou in the Aikens Lake, Manitoba population selected semi-open and open bogs and mature conifer uplands during rutting season (Darby and Pruitt 1984). Their diet consisted of terrestrial and arboreal lichens, sedges, and bog ericoids (*Andromeda glaucophylla, Chamaedaphne calyculata, Kalmia polifolia, Ledum groenlandicum*).