Integrated Range Assessment for Woodland Caribou and their Habitat

Brightsand Range 2011

Ministry of Natural Resources and Forestry
Species at Risk Branch

December 2014

Version 1.1

Cite as: MNRF. 2014. Integrated Range Assessment for Woodland Caribou and their Habitat: Brightsand Range 2011. Species at Risk Branch, Thunder Bay, Ontario, xi + 74pp.

For a copy of the *Integrated Assessment Protocol for Woodland Caribou Ranges in Ontario* (2014) and/or *Delineation of Woodland Caribou Ranges in Ontario* (2014), please email caribou@ontario.ca

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Acknowledgements

This Integrated Range Assessment was a team effort. Science and Information Branch representatives Gerry Racey, Tricia Greer, Glen Brown, and Lyle Walton coordinated the provincial effort including training, standards development and oversight, and were supported by the Species at Risk Branch, Forests Branch, and the Provincial Caribou Technical Committee. The Integrated Range Assessment was further supported by other Caribou Conservation Plan Implementation team members: Kevin Green, Glen Hooper, and Lindsay McColm. Analytical support was provided by Glen Brown, Kevin Downing, Phil Elkie, Kevin Green, and Lyle Walton. The following district, regional, Species at Risk Branch, and Ontario Parks staff were involved in the provision and review of data, participation in the aerial survey activities, or coordination and oversight of district activities: Rik Aikman, Danielle Berube, Dennis Bonner, Dorothy Bruner, Natasha Carr, Joe Cassidy, John Coady, John Connor, Jen Chikoski, Kelvin Davenport, Christine Debruyne, Phil Dodwell, Darren Elder, Ed Evens, Fritz Fischer, Bert Hennessey, Brian Kilgour, Melody Kiss, Sarah McKenzie, Herb Neubrand, Sheldon Newman, Thomas Nodin, Bob Paterson, Michelle Robinson, Irene Schneider, Ray Schott, John Thomson, Mike Walker, Shannon Walshe, Graham Yule, as well as JJ Mathie, Todd Stenburg, and Tyson Williams. Thanks to the aerial survey pilots Dan Baron, Pat Dickey, Rob Fletcher, Kevin Grigsby, and Brent Wood from Aviation, Forest Fire and Emergency Services Branch.

Preface

This Integrated Range Assessment Report is intended to support management decisions leading to the conservation of caribou and their habitat. It describes quantitative analysis and interpretation of four lines of evidence related to risk and range condition. It also documents ecological and management insight of resource managers who are familiar with present and past caribou occupancy and management history within the range. Implementation experience has also been documented where caribou conservation and habitat management activities have been applied.

Caution is warranted in the interpretation of the Integrated Range Assessment results due to the limitations of available data and conditions or circumstances that are not readily integrated in the analysis framework. This caution should be expressed by considering the context and results of the Integrated Range Assessment as a whole and not taking individual lines of evidence or data summaries out of context or interpreting them outside of their intended purpose as described in the *Integrated Assessment Protocol for Woodland Caribou Ranges in Ontario* ('Protocol'). The Protocol describes the specific intent and role for each section of the Integrated Range Assessment Report and its scientific basis.

The quantitative analysis was completed using the best and most current land-base and resource inventory information available for the year in which the winter distribution survey was conducted unless otherwise stated. These data vary substantially across Ontario in terms of availability, year of update, and conditions or standards under which the inventory was completed. Forest inventory data is periodically updated, improved and managed to track changes in forest condition; caribou distribution and recruitment surveys may be conducted during years of good or poor survey conditions and be subject to many extraneous influences;linear feature, and infrastructure data may reflect a wide diversity of physical expressions and biological implications, and roads data used in the analysis may include some older legacy roads for which current vegetative state is unknown or is not discerned from the database.This type of variability is quite normal and expected, but presents challenges in interpretation and application of results. Data and analysis uncertainties are explicitly described in each Integrated Range Assessment Report to support thoughtful interpretation of the results within the flexibility provided by Ontario's *Range Management Policy in Support of Woodland Caribou Conservation and Recovery* (Range Management Policy).

While the assessment is information intensive, the interpretation of the four quantitative lines of evidence is strongly science-based, relying heavily upon fully documented scientific findings. Specific data sets used in the analysis were selected to represent the most appropriate trade-off between ecological and management relevance.

As this document represents an assessment of the conditions of this caribou range according to the year of the report, it does not consider socio-economic factors. Caribou ranges that are assessed as uncertain or insufficient to sustain caribou should not be interpreted as policy direction to stop sustainable resource management. The Range Management Policy and other planning documents (e.g., forest management guides, caribou best management

practices) provide resource managers with the tools that support sustainable use of Ontario's natural resources while maintaining or improving conditions for caribou.

Managers are encouraged to be fully aware of the scientific assumptions, data and analysis uncertainties and ecological and historical context when considering management actions informed by the Integrated Range Assessment.

Executive Summary

The vision in *Ontario's Woodland Caribou Conservation Plan* is to conserve Woodland Caribou (Forest-dwelling, boreal population; *Rangifer tarandus caribou*) (referred to as caribou herein) within the province to ensure self-sustaining populations in a healthy boreal forest. This vision is set in motion through Ontario's *Range Management Policy in Support of Woodland Caribou Conservation and Recovery* (Range Management Policy). The Range Management Policy provides the direction needed to conserve and recover caribou in Ontario through a Range Management Approach. The Range Management Approach provides spatial and ecological context for planning and management decisions. This *Integrated Range Assessment Report* is a fundamental component of the Range Management Approach because it provides the information required to identify the level of risk to caribou within a range, will help to support management decisions and lead to conservation of caribou occupying the range. It provides essential historical, ecological and contextual knowledge relevant to the range and its management. It relied on quantitative lines of evidence to identify the level of risk and overall range condition relative to its ability to sustain caribou.

The Brightsand Range is located in northwestern Ontario and is approximately 22,000 km^2 in size. The landscape is largely characterized as boreal forest with an aggressive fire regime and many small and medium sized lakes scattered throughout. The south is primarily dominated by jack pine and black spruce forest; the northern portion of the range is dominated by conifer and conifer-mixed forest. Historical occupancy shows that caribou occurred throughout the range and some of the highest concentrations of caribou activity are within Wabakimi Park where peatland complexes, lakes, and old conifer forests are abundant. Caribou are known to use many of the lakes around and within the Brightsand Provincial Park as well as Sturgeon and Savant lakes. Human settlements within the range are small and few, and there are currently few developmental activities in the Brightsand Range. The most prominent ongoing human impact on the range is forest harvesting and the southern portion of the range in particular has been subjected to extensive harvest in the past. In contrast, much of the northern half of the range is protected from major human activity within Wabakimi Provincial Park.

A two-stage (fixed-wing followed by rotary-wing) aerial winter distribution survey for caribou was conducted during February and March 2011 in which observations of caribou or their signs were recorded. During the rotary-wing flights, caribou were identified as adults, males or females, calves, or unknown age and sex. Data collected during the survey work was used to estimate population state metrics including a minimum animal count of 224 caribou, as well as provide an estimate of calf recruitment. Additional aerial surveys were conducted during late winter 2012 and 2013 to further assess calf recruitment to support estimates of population trend. Recruitment rates over the three survey years (18-26 calves per 100 adult females) were lower than expected values thought to support a stable to increasing population trend (28 calves per 100 adult females).

Twenty (20) adult female caribou were collared during March 2011. Annual survival estimates of these animals was comparatively low based on two biological years of data (77-80%), and when modelled with the calf recruitment levels resulted in a declining population trend with a

geometric mean of λ = 0.87. This estimate suggests a declining trend and is the result of comparatively low adult female survival and calf recruitment and is supported by other long-term trend indicators.

A geospatial analysis estimated that 43.5% of the range can be currently characterized as natural and anthropogenic disturbances. The resulting likelihood of stable or increasing population growth is estimated to be 0.45 and at this level it is uncertain whether the Brightsand Range is capable of sustaining the caribou population.

Analysis of the amount of caribou habitat (which includes refuge habitat and winter habitat), indicates alignment with that expected in a natural landscape. Winter habitat was fragmented and refuge was not fragmented relative to what would be expected in a natural landscape.

The Integrated Range Assessment concludes risk to caribou is intermediate within the Brightsand Range and it is uncertain whether range condition is sufficient to sustain caribou.

1.0 Overview

The Ministry of Natural Resources and Forestry (MNRF), then the Ministry of Natural Resources (MNR), adopted a Range Management Approach as directed by *Ontario's Woodland Caribou Conservation Plan* (CCP) (MNR 2009a). An *Integrated Range Assessment Report* (IRAR) is a major component of the Range Management Approach and will help to inform subsequent management decisions. This assessment evaluates habitat conditions, population trends, and cumulative impacts and relates these to measurable indicators of population health or habitat status. The Range Management Approach sets the spatial and ecological context for planning and management decisions within an adaptive management framework. The general components and mechanisms involved in the Integrated Range Assessment are described in the *Integrated Assessment Protocol for Woodland Caribou Ranges in Ontario* ('Protocol', MNRF 2014a) and are directed by the *Range Management Policy in Support of Woodland Caribou Conservation and Recovery (Range Management Policy,* MNRF 2014b).

The year of the report represents when the winter distribution survey was completed; three subsequent years of recruitment surveys were conducted; disturbance assessment included data current as of the winter distribution survey; habitat assessment data included the best available information for the range.

2.0 Range Description and Delineation

The delineation of ranges within the Continuous Distribution of caribou in Ontario includes areas that are currently not occupied by caribou. Ontario's Range Management Approach provides an adaptive and transparent framework for defining, assessing and documenting risk to caribou. This framework accounts for the dynamic nature of boreal forest landscapes and the ability of caribou to tolerate some temporary or permanent disturbance within a range.

The Brightsand Range is approximately 22,000 km^2 in size and is located in northwestern Ontario (Figure 1) between the Churchill Range to the west, the Nipigon Range to the east, and the Kinloch Range in the north. The range includes portions of the English River, Caribou, Black Spruce, Lake Nipigon, and Lac Seul Forest Management Units, as well as a significant portion of Wabakimi Provincial Park. The southern extent of the Brightsand Range is considered to be one of the southernmost extents for woodland caribou occurrence within Ontario, other than the Lake Superior coastal population (MNRF 2014c).

The Brightsand Range boundary was determined using ecological and administrative features. The range concept evolved from two decades of aerial and ground survey information identifying north-south seasonal connectivity between the south end of Wabakimi Provincial Park (WPP) and the southern portion of the English River Forest Management Unit within the range. Refuge and winter habitat, and calving and nursery habitat all appear to be in close proximity.

The western portion of the boundary is shared with the Churchill Range and partly coincides with the boundaries separating the English River Forest and the Lac Seul Forest, just south of St. Raphael Provincial Park. The southern boundary is limited by the extent of the Continuous Distribution. The eastern boundary coincides mainly with Highway 527 and is shared with the Nipigon Range; there are also large patches of mixedwood along the east side used to delineate the boundary. The northern boundary is largely based on the Far North boundary as well as ecodistrict 3W-1(Figure 2).

The ecology within the Brightsand Range is typical of Canadian Shield landscape. Lakes within the range are abundant in number and vary in size. Many of the lakes have irregular shorelines and island archipelagos making them ideal caribou calving and nursery areas. Shallow soils and bedrock exposure are characteristic with coarse and loamy soils that support jack pine and black spruce forest. The fire return interval is relatively short and a number of fires that have occurred in the last three decades likely influence current caribou land use and movement throughout the range.

Figure 1. Location of the Brightsand Range within the Continuous Distribution in Ontario.

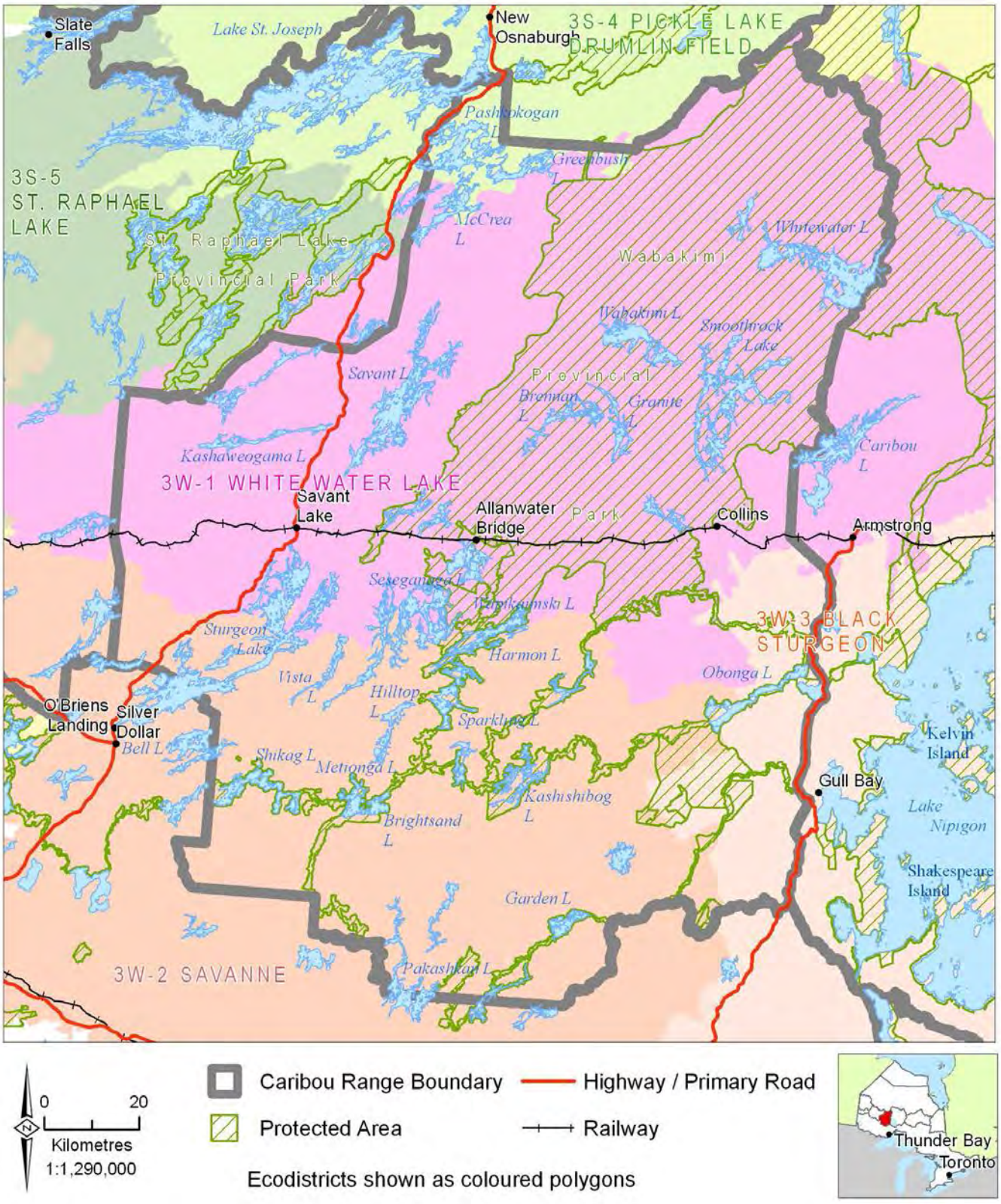


Figure 2. The Brightsand Range and associated ecodistricts and protected areas.

3.0 Background Information and Data

3.1 Land management history and management direction

It is likely that caribou numbers and distribution on the Brightsand Range have been influenced by a wide variety of natural and anthropogenic factors but primarily by a very aggressive fire regime with frequent, large and intense wildfires (Figure 3, Table 1). Past land use planning decisions, infrastructure development, and land management direction on the Brightsand Range all have potential implications for the current distribution, abundance, and survival of caribou in the range (Figure 4). Subsequent to some early forest harvest (1950s) off the CN rail line, much of the harvest within the Brightsand Range followed the moose habitat guidelines or a relaxed application of these guidelines forming a more diverse landscape than would be natural or that would be beneficial to caribou. It is imperative to document and interpret the disturbance history within the range in order to better understand current caribou use. Implementation of Ontario's Range Management Approach is set against a backdrop of this evolving management direction (Table 1). Figure 3, Figure 4, and Table 1 include land management history as well as natural and anthropogenic disturbances up until 2011.

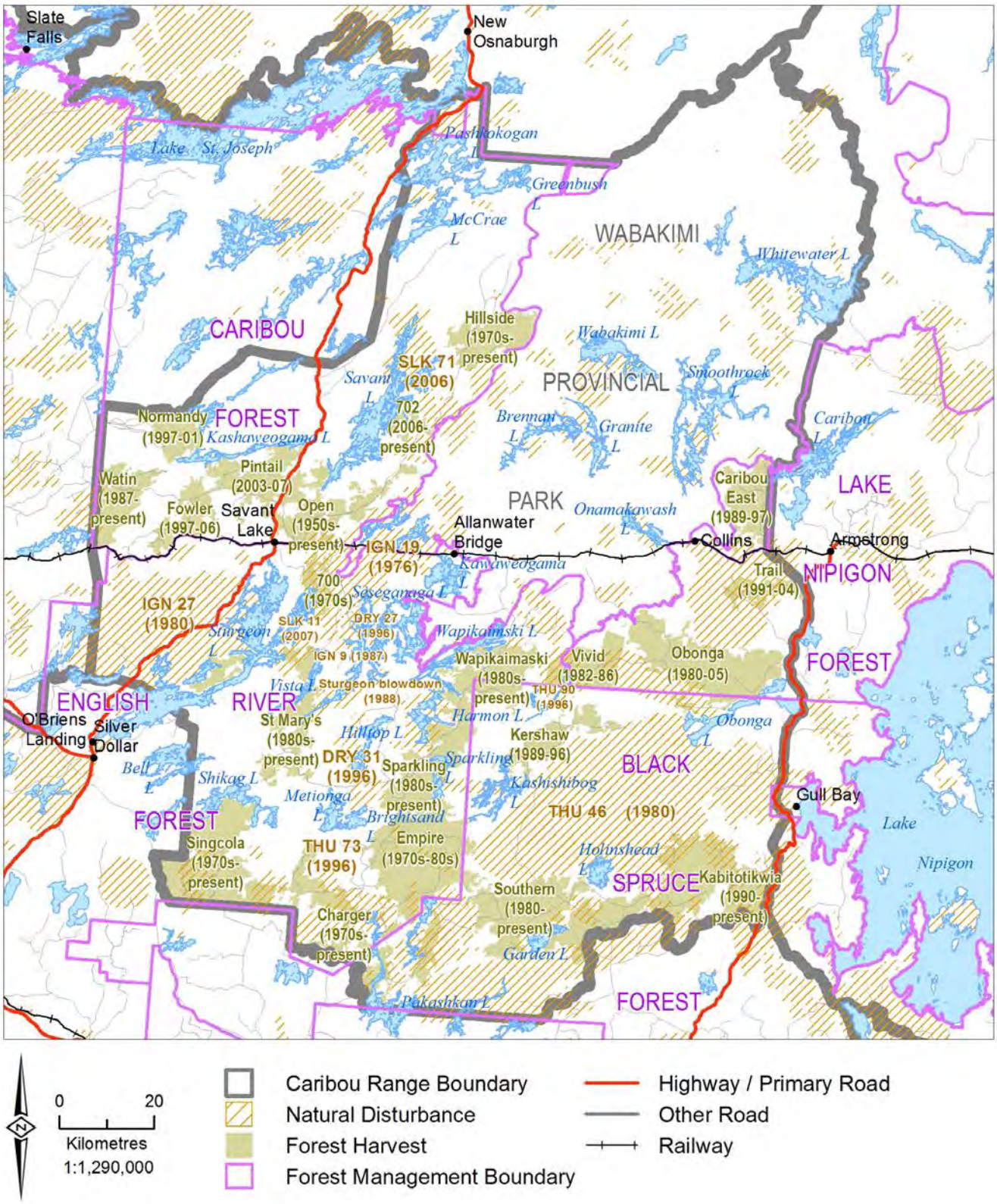


Figure 3. Dates and locations of significant historical natural and anthropogenic disturbances that have occurred in the Brightsand Range.

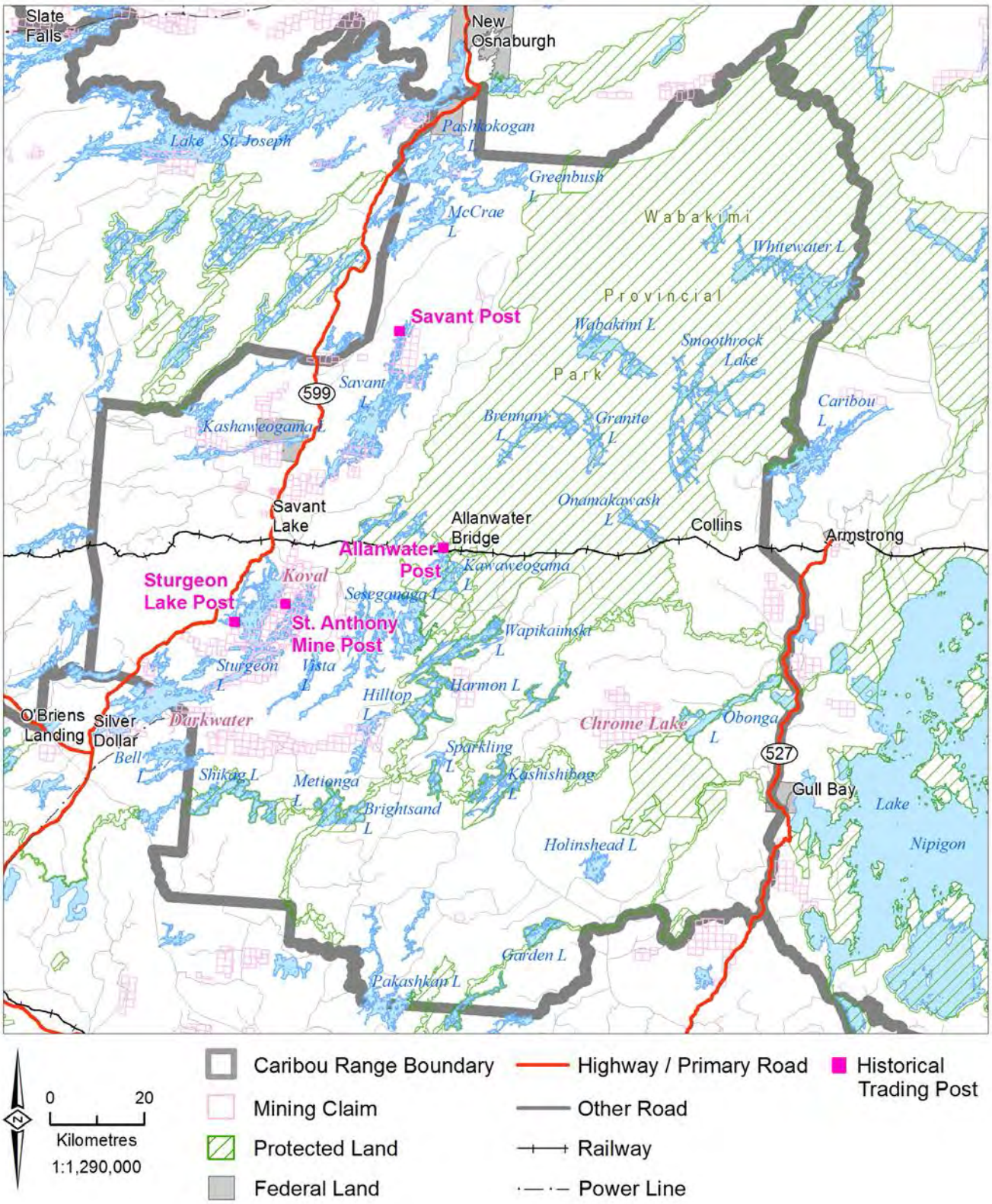


Figure 4. Human infrastructure and historical developments occurring within the Brightsand Range.

Table 1. Historical timeline of significant events occurring in or near the Brightsand Range.

Significant event, activity or direction			
Natural and anthropogenic disturbance (significant fire or blow down)	**Date**	**Description**	**Likely influence on caribou or its habitat**
IGN 19	1976	20,000 ha fire from Wellington Lake to northeast as far as Kawaweogama Lake and north of CN railroad.	May have temporarily disrupted connectivity between Seseganaga Lake and Savant Lake. Area has regenerated to conifer, and is approaching 40 years old when it is expected to begin providing for caribou habitat.
IGN 27	1980	66,300 ha fire burned from Lake of Bays area to west shore of Sturgeon Lake and across Horizontal Bay area of Sturgeon Lake.	Caribou use of the area was documented prior to fire, but stopped thereafter. Anticipated future suitable coniferous dominated caribou habitat.
THU 46	1980	125,000 ha fire between Weaver and Obonga Lake.	This fire occurred near the southern limit of Continuous Distribution. It is believed caribou utilized this area before the fire for both summer and winter habitat. Regeneration is primarily conifer, and is expected to provide quality habitat for caribou in the future.
IGN 9	1987	Fire along southwest arm of Seseganaga Lake, from Rocker to Button Lake.	Area was used by caribou both before fire. Winter activity is consistent through residual forest on the east half of the old burn despite of the young age of the forest.

Sturgeon Lake blowdown	1988	Blowdown event from Coveney Island on Sturgeon Lake eastward to bottom of Seseganaga and Harmon Lake. Mature pine was flattened.	Caribou use of the Seseganaga area was documented prior to the blow down. The blow down likely blocked movement through a portion of the core caribou habitat.
THU 73	1996	Fire burned from southwest shore of Bishop Lake to area south of North Mawn Lake and south of Moberly Road.	Fire may have temporarily disrupted caribou use; In 2009 caribou occupation was documented in residual forest.
THU 90	1996	6,600 ha around Harmon Lake. Area was harvested, burned then salvaged. Area had high moose densities, but habitat is becoming less conducive to moose.	Caribou were noted in the area before the fire. Caribou are still utilizing residual forest in the area during the winter.
DRY 31	1996	Fire south of Hilltop Lake including shores of Mountairy Lake, east ends of Longneck and Gosling lakes, Hard Dog Lake, and north side of Brightsand Lake.	Caribou utilized this area before the fire. They have continued to use the surrounding area in summer and winter. Winter observations are common in the Longneck, Mountairy and Hilltop areas. The unburned shores of Gosling Lake and Hilltop Lake have continued to be used for calving.
DRY 27	1996	1,100 ha fire burned northern peninsula of Seseganaga Lake up to Boat Lake.	Peninsula on Seseganaga is a regionally significant calving environment. The fire likely disrupted caribou use of the area but is regenerating as conifer. Future use of the area for calving is anticipated. It currently has summer use.
SLK 71	2006	8,700 ha fire burned to shore of Savant Lake, consumed mature and regenerated forest. A portion of area was previously harvested, and regeneration was establishing.	This area is expected to contribute to caribou habitat but within a longer time span than originally anticipated due to the fire setting back forest renewal. Silviculture activities have since occurred to enhance any natural fire regeneration.

SLK 11	2007	20,000 ha fire to east of Savant Lake (town). Burned south to west side of Seseganaga Lake and south to Vanessa Lake. Area burned was primarily regenerating cutover.	The area was not used by caribou prior to the burn. This area now has high densities of moose. There is high potential for future caribou habitat but uncertainties regarding the chances of future caribou occupation exist.

Significant event, activity or direction			
Forest Management	**Dates**	**Description**	**Likely influence on caribou or its habitat**
Open Block	1950s - present	Harvesting was limited from 1950 to early 70s but increased from mid-70s to mid-80s. Operations ceased in mid-80s when Camp 700 (live-in logging camp) was closed. Harvesting commenced again in 1997 and continues to present.	Low potential value to caribou due to the number of years of past and planned future forest operations, proximity to human infrastructure and a more mixed forest condition than was originally present.
Hillside Block	1970s - present	Ongoing forest harvest activities for prolonged period. Additional allocations to 2018. Renewal has occurred subsequent to harvest.	This block is adjacent to Wabakimi and may provide future linkage to Savant Lake which is a regionally significant calving lake. The extended period of operations will likely lead to delayed contributions to future caribou habitat.
700 Block	Late 1970s	Harvested in late 70s to early 80s. Regeneration treatments have been ongoing and include seeding, planting and pre-commercial thinning. Regenerated forest burned in SLK 11 (2007).	Separates regionally significant calving lake (Seseganaga) from an area with high habitat potential associated with Sturgeon Lake. This area has high potential for caribou occupation; however conifer regeneration has been delayed due to forest fire.
SingCola, Charger and	Late 1970s-	SingCola block accessed off Graham Road and Charger block are accessed	These harvest blocks represent future habitat along the southernmost portion of the Brightsand Range.

Empire blocks	present	through Moberly Road, opened in the 70s and are associated with many peat land complexes, and the Charger block has some pre-commercially thinned jack pine. Harvest in late 70s-early 80s under moose guidelines. Subsequent operations under caribou guidelines including defragmentation allocations. Good conifer renewal but high road density in places.	These areas were presumed to have caribou use prior to harvest. Significant current caribou use in the Charger Block.
Southern Harvest blocks	1980 - present	Early harvest under moose guidelines with various defragmentation allocations under the caribou guidelines. Access and sequence of harvest progressing in from Armstrong Hwy and Graham Road. Regeneration efforts focussed on conifer renewal but some portions are mixedwoods due to fine textured soils. Includes areas known as Pakashkan, Loganberry, Rufo, Garden and Grimm blocks.	These harvest blocks, when combined with natural disturbance account for a high level of natural and anthropogenic disturbance in the southeastern portion of the range and Continuous Distribution in Ontario. Anecdotal historical information of caribou use prior to harvest. Expected to produce suitable future habitat and secure southern extent of range.
Sparkling, Wapakimaski and St Mary's blocks	1980s - present	Harvest occurred in late 80s under moose guidelines and operations have continued with defragmentation allocations under caribou guidelines. Harvest supported off Graham Road.	These blocks are located in core caribou habitat in the south central portion of the range and were used by caribou prior to allocation and harvest. These areas are expected to be renewed to suitable habitat and contribute to both north- south and east-west connectivity within the range, especially the Wapakimaski Block which should support north-south connectivity between the Kopka River System and Wabakimi Park.
Obonga and Vivid blocks	1980-2005	Harvest initiated under moose guidelines off Armstrong Hwy or	These harvest blocks, when combined with natural disturbance created a broad band of young forest

		Graham Road. Some defragmentation occurred under caribou guidelines.	south of and parallel to the CN rail line. These areas are expected to return to high quality winter habitat given the winter and summer habitat potential, silvicultural effort applied and proximity to Wabakimi provincial Park. This area is expected to provide connectivity between Wabakimi Park and the southeastern portion of the range.
Watin Block	1987 - present	Ongoing harvest operations with further allocations through 2018.	Persistent ongoing operations and lack of road decommissioning may delay onset of desirable caribou habitat attributes.
Kershaw Block	1989-1996	This block was harvested under moose guidelines. Road decommissioning was completed with a majority of roads regenerated.	Prior to harvest caribou were present in this block along the Kopka River. This block provided good quality habitat and is expected to provide good quality caribou habitat in the future.
Caribou East and Trail blocks	1989-2004	Harvesting occurred under moose guidelines. These blocks had defragmentation allocations under caribou guidelines with some road decommissioning. Renewal primarily to conifer.	These blocks provide a linkage for caribou between Wabikimi park along the west boundary and caribou habitat in the adjacent Nipigon Range. The caribou east block is expected to provide for habitat in the future and is scheduled for retention for 100 years.
Kabitotikwia Block	1990 - present	Harvested under moose guidelines. Currently fragmented and productive for moose. A portion of this block burned in 1998 and salvaged in 2000. Salvaged areas were planted with jack pine.	This area is on the very southern edge of the Continuous Distribution. This block is intended to contain large even age stands of conifer to enhance both refuge value and connectivity to Lake Nipigon and the Nipigon Range. Degree of future caribou occupancy is uncertain.
Fowler and Normandy blocks	1997-2006	Clearcut harvest with road decommissioning in northern Normandy block but absent from Fowler block.	Major forest disturbance in westernmost portion of the Brightsand Range, potentially influencing connectivity to the eastern portion of the Churchill range.

Pintail and 702 blocks	2003-present	Harvest scheduled under caribou guidelines with activity ongoing to 2018. Habitat renewal is occurring with caribou habitat objectives.	Previously used habitat that is no longer used by caribou. May influence caribou movement between Savant Lake which is a regionally significant calving lake and Wabakimi Park.

Significant event, activity or direction			
Infrastructure development	**Dates**	**Description**	**Likely influence on caribou or its habitat**
Hudson's Bay Company and North West Company posts	1700s-mid 1900s	A number of trading posts were established including Allanwater Post, Savant Post, Pashkokogan Lake Post, Sturgeon Lake Post, St Anthony Mine Post, and Shikag Lake Post. Today, some of these sites are now small communities.	Human-associated activity has likely influenced caribou distribution and habitat in the area. Caribou were also hunted for food and hide.
Canadian National Railway	1888	Trans-Canada railway divides the Brightsand Range in almost equal parts north and south of rail line.	Possible impediment to north/south movement within with the Brightsand Range, and potential source of collision mortality.
Allanwater Bridge (community)	1930s	Railroad truss bridge part of CN railroad; initially established as a Hudson's Bay Company trading post, now a small seasonal community area.	Supports seasonal human presence in remote northern landscapes. Increases access into caribou habitat.
Highway 527	1950s	Secondary highway connecting Armstrong to Thunder Bay. First constructed as a forest access road known as 'Highway 800'.	Likely functions as a partial barrier between the Brightsand Range and the high summer habitat potential of Lake Nipigon and the Nipigon Range.
Highway 599	1950s - 1960s	Secondary highway constructed between Savant Lake and Pickle Lake	Likely influences the degree of connectivity between the Churchill and the Brightsand Ranges through

		in the mid-50s. Connection with Hwy 17 was completed in the 60s.	habitat fragmentation and both sensory and physical disturbance.
Graham Road	1980-present	Primary logging road to access timber resources within central portion of the Brightsand Range.	Provides primary access to the delineated southern edge of Continuous Distribution. Has contributed to the development of present logging patterns and allows for persistent access to the central portion of the southern half of the range for mineral exploration, hunting and remote tourism.
Fishing and Hunting Lodges	Mid-1900s-present	Tourist outfitter camps; often consisting of multiple buildings.	Encourages activities in remote hunting and fishing sites and increases chances of encountering caribou and potentially creating a sensory disturbance on calving lakes.
Active mining claims, drill holes,		Spatially clustered, east of Sturgeon Lake and along its northeast arm. Activity has been noted at the old Mattabi Mine site and interest has been expressed for sites along Brightsand Road. Mining activity is likely to be a continued source of anthropogenic disturbance.	There are sensory disturbances associated with mining exploration on the Brightsand Road (which is otherwise closed to vehicle traffic). Sensory disturbances along Sturgeon Lake may be discouraging caribou from using this high-potential site.
Collins/ Namaygoosisagagun (community)		Small First Nation community located at northern end of Collins Lake, along CN rail line west of Armstrong.	Permanent human infrastructure and associated activity has likely influenced caribou distribution and habitat in the area. Caribou were also hunted for food and hide.
Saugeen (community)		Small First Nation community located on Kashaweogama Lake off Hwy 599, north of Savant Lake (community).	Permanent human infrastructure and associated activity has likely influenced caribou distribution and habitat in the area. Caribou were also hunted for food and hide.

Savant Lake (community)	Small community located where Hwy 599 and CN railroad intersect.	Permanent human infrastructure and associated activity has likely influenced caribou distribution and habitat in the area. Caribou were also hunted for food and hide.
Utility lines	Utility line corridors and accompanying distribution stations connecting to communities such as Pickle Lake, Silver Dollar, and northwest shores of Sturgeon Lake.	Supports levels of recreational activity and remote access, particularly in the winter. Habitat fragmentation and sensory disturbance associated with permanent land features.

Significant event, activity or direction

Land management direction	Dates	Description	Likely influence on caribou or its habitat
Wolf control	1945-1972	Ontario wolf bounties in effect.	Early depression of the wolf population that may have helped caribou persist through periods of early road-based logging.
Trapline boundaries regulated	1947	Initiation of Ontario's trap line system.	Formed the basis for early reporting on wildlife occupancy and relative abundance which provided preliminary insight into historical occupancy.
Wildlife Management Units were implemented for big game management	1975	Implemented under Game and Fish Act, 1983.	Formed the basis for reporting on moose populations and trends as well as other species (where applicable).

District Land Use Guidelines (DLUG)	1980	Land use guidelines based on district boundary lines that existed at the time. Focus was on increasing moose populations and ensuring a high annual moose harvest.	Encouraged growth of moose habitat to increase moose populations.
Moose Aerial Surveys Implemented	1982	Aerial surveys of ungulate presence and occupation in Ontario's Wildlife Management Units.	Details moose occupation and movement across landscapes. Documents evidence of caribou and winter activity. Helps delineate important winter habitat along district landscapes.
Wabakimi Park	1983	A recreational area approximately 9,000 km^2.	Created and expanded partially based on its value to caribou and its habitat potential.
Draft Caribou Guidelines	1992	First draft of forest management guidelines for conservation of woodland caribou habitat. Former Brightsand Forest (a portion of the Brightsand Range) was first to adopt this concept.	These guidelines established a mosaic concept to ensure a sustainable supply of year-round habitat.
Public consultation	1993	Broad public consultation of caribou habitat management across northwest region.	Increased awareness and regional commitment to caribou conservation.
Northwest Region Interim Caribou Habitat Management Direction	1994	Regional mandate to address caribou habitat management on all Forest Management Plans within the zone of Continuous Distribution.	Supported initial efforts towards caribou habitat conservation in northwestern Ontario.

Draft of forest management guidelines for the provision of woodland caribou habitat	1994	All forest management plans within northwest Region committed to addressing caribou conservation.	These guidelines established a mosaic concept to ensure a long-term sustainable supply of year-round caribou habitat. Applied on the following plans: Brightsand Forest (1989, 1994, 1999), English River Forest (2004, 2009), Black Spruce Forest, Lac Seul Forest, Caribou Forest (1992, 1998, 2002, 2007 and 2008).
Wabakimi Park Expansion	1997	Park was expanded to conserve a total of 890,000 ha.	Increased preservation of valuable caribou calving and nursing habitat.
Ontario's Living Legacy	1999	Creation of dedicated protected areas and Enhanced Management Areas with specific conservation considerations for woodland caribou.	Creation of Enhanced Management Areas for caribou. Established: Brightsand River Provincial Park - Caribou are mentioned specifically in the management plan. It is recognized that the Brightsand River Park is a component in maintaining connectivity between Wabakimi Park and the southernmost limit of the Continuous Distribution. Upper English River Conservation Reserve - no specific objectives set for caribou and they are not mentioned in the interim management statement. The park encompasses known caribou calving lakes (Shikag, Pipio, Dasent) and is at the southernmost limit of occupation. This area could be integral to maintaining adequate habitat along the southern boundary of Continuous Distribution. Additionally created - Gull River Provincial Park, Kopka Provincial Park, Obanga-Ottertooth Provincial Park, Pantagruel Creek Provincial Nature Reserve, Kaiashk Provincial Nature Reserve, Garden-Pakashkan Conservation Reserve.

Forest Management Guidelines for the Provision of Caribou Habitat: A Landscape Approach	1999	Final forest management guidelines for the provision of caribou habitat. Comprehensive and endorsed management direction that implemented a landscape-based approach to habitat conservation including mosaic development and a strategic evaluation of habitat retention or allocation and renewal.	It aimed to maintain continuous supple of year-round caribou habitat distributed across the landscape and through time to ensure permanent range occupancy. Applied on the following plans: Brightsand (1994, 1999), English River Forest (1999, 2009), Black Spruce Forest, Lac Seul Forest, Caribou Forest (1992, 1998, 2002, 2007 and 2008)
A Management Framework for Woodland Caribou Conservation in Northwestern Ontario	1999	Regional policy direction regarding caribou conservation and forest management.	Reaffirmation of regional interim direction for the application of caribou guidelines in Northwestern Ontario with additional guidance in support of other management actions to conserve caribou.

3.2 Caribou occupancy history and assessment

Caribou observations within the Brightsand Range have been identified and recorded within Land Information Ontario (LIO 2014). Observations documented in this report are current to August 2013 (Figure 5, Figure 6, and Figure 7) and the summary of documented caribou assessments within the range (Table 2) provide historical context to assist with the interpretation of the current Integrated Range Assessment results. These observations span more than two decades and include aerial survey results, observations of collared caribou, data and results from previous research projects, as well as observations from MNRF staff and the public.

Historically, these observations reflect our knowledge of caribou occurrence within the range and the possible response to changes in range condition. Recently, there have been persistent reports of occupancy (2009-present) by a relatively large group of caribou.

Much of the Brightsand Range has been previously been managed for moose habitat and more recent management decisions have emphasized improvement of caribou habitat value. The highly disturbed southern portion of the range has been actively managed for caribou habitat over the last 20 years.

Extensive efforts occurred within various portions of the Brightsand Range to engage the public in reporting caribou observations, especially in the vicinity of Seseganaga Lake. This "Caribou Watch" program was successful in improving knowledge of summer occupancy in the south-central portion of the range.

Table 2. Past assessments and reports for caribou relevant to the Brightsand Range

Date	Caribou occupancy assessment	Reference
1987	20-30 caribou estimated to be present on the portions of the Brightsand Forest within the Ignace District.	J. Carson personal communication 1987.
1989	Caribou aerial transect survey conducted in Wabakimi Park in 1989. Sixty-one (61) caribou were within the park while 66 were observed throughout the flights. Population estimates based on animal track observations suggested there was approx. 145-197 caribou within Wabakimi. Recruitment was estimated to be 29 calves/100 adult females.	Bergerud, A.T. 1989. Aerial census of caribou and wolves in Wabakimi Provincial Park.
1987-90	Caribou aerial transect survey conducted in Seseganaga Lake and Shikag Lake areas between 1987-1990. A population estimate of 31 caribou was derived from 1989 track and caribou observations. The mean group size	Harris, A. 1990. Woodland caribou studies and habitat management plan for the Brightsand Forest.

	from the '89 survey was used to estimate group size when direct animal observations did not occur.	
2003	Based on an aerial survey conducted in 2003, a rough estimate of 54 caribou were present in the English River FMU (previously known as Brightsand Forest) (based on the number of activity sites located and group size).	Dodwell, P. 2003 Winter Woodland Caribou Survey, Ignace Area.
2009	Six caribou were observed during an aerial transect survey in the English River FMU in February, 2009. The area was re-surveyed in March, 2009, and 38 caribou were observed including a group of at least 32 caribou (including five calves) near South Allely Lake; an estimated 62 caribou are using the area. The estimate was based on the number of groups (estimated from track observations) and the average group size (calculated from caribou observations) for both surveys.	Dodwell, P. and M. Kiss. 2009. Woodland Caribou Winter Habitat/Activity Survey February/March 2009.
2010	Forty-nine (49) caribou were observed during an aerial transect survey in the English River Forest, January 2010. The area was re-surveyed in March 2010 and 26 caribou were observed. An estimated 77 caribou were using the English River Forest from January to March 2010. Estimate was based on the number of groups (estimated from track observations) and the average group size (calculated from caribou observations) for both surveys. A significant number of these animals were at the southern edge of the range in the Twining, South Allely, Charger lakes area.	Dodwell, P. and Kiss, M. 2010. Woodland Caribou Winter Habitat/Activity Survey January-March 2010.
2011	An aerial transect survey was flown over the Charger block in the Ignace area over two days, one in February and one in March 2011. A group of 9 caribou were located near Twining Lake on February 10th, and a group of 15 caribou were located in the same area on March 8th, 2011. Based on analysis of the photos taken during the flights, it was confirmed that at least 23 caribou were using the Charger block area during the winter of 2011, including two calves and one yearling.	Kiss, M. 2011. Woodland Caribou Winter Habitat/Activity Survey, Charger Area.

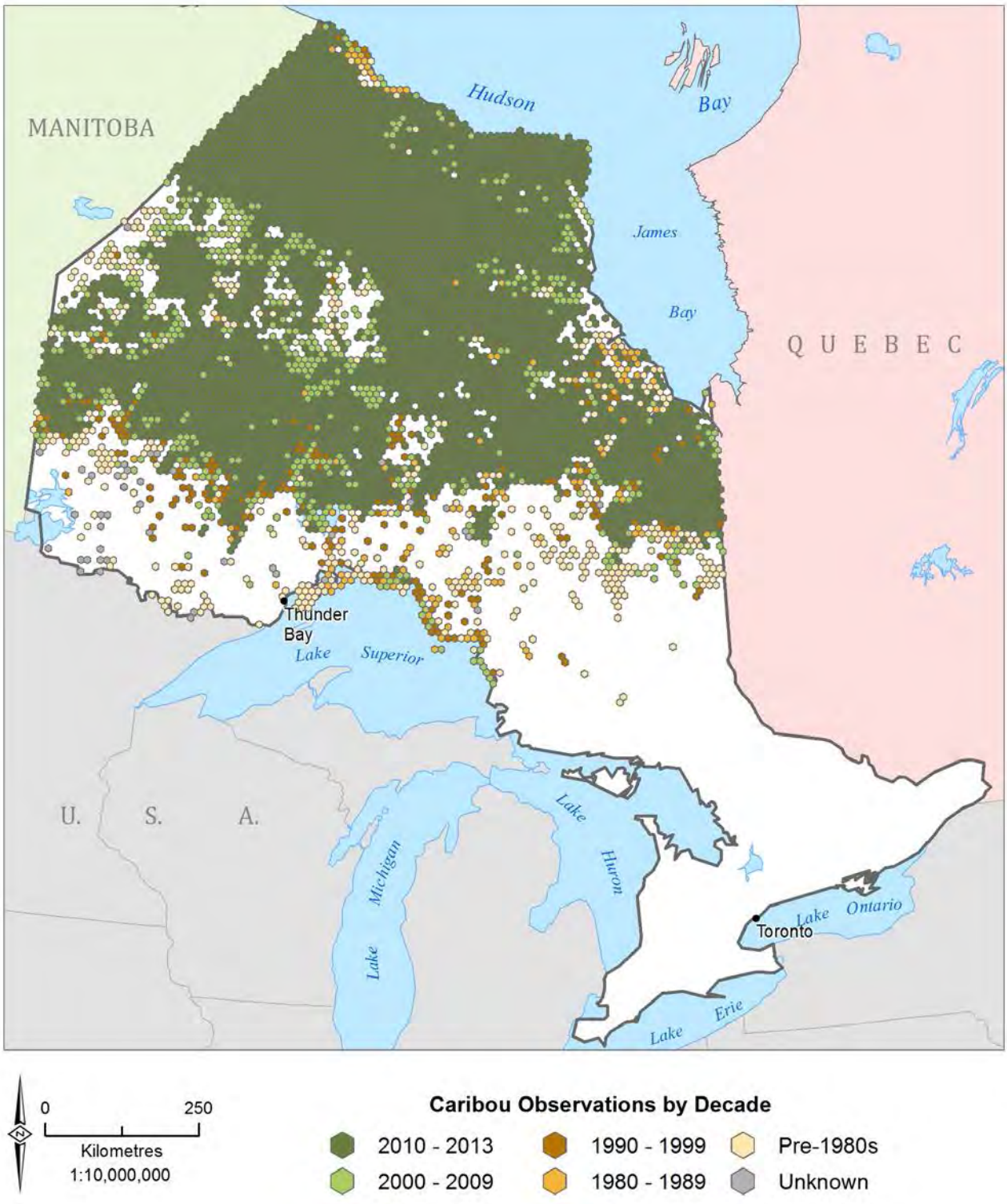


Figure 5. Caribou occurrence across Ontario summarized by date of most recent observation as of June 2013. Absence of observations may reflect low survey effort, lack of reporting, or the absence of caribou.

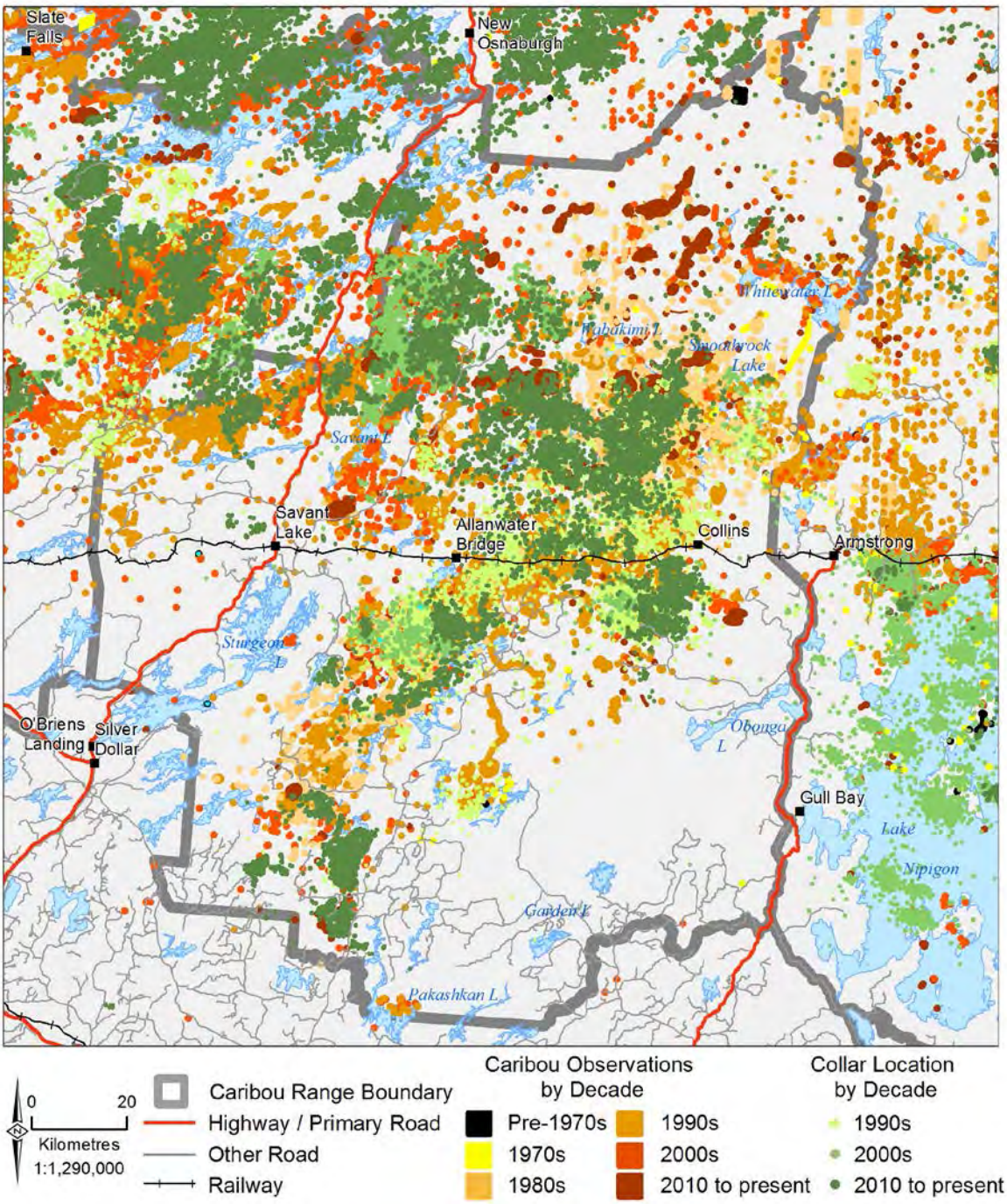


Figure 6. Historical caribou observations[1] within the Brightsand Range and surrounding area including observations from aerial surveys, collared caribou locations, research projects, and casual observations.

[1]Home ranges for individual caribou are large, averaging 4,000 km^2 (Brown et al. 2003), and location observations of caribou should not be interpreted as just a single observation point, as it is only one point in time and include group sightings. The actual area used by caribou is much larger as they move throughout the year.

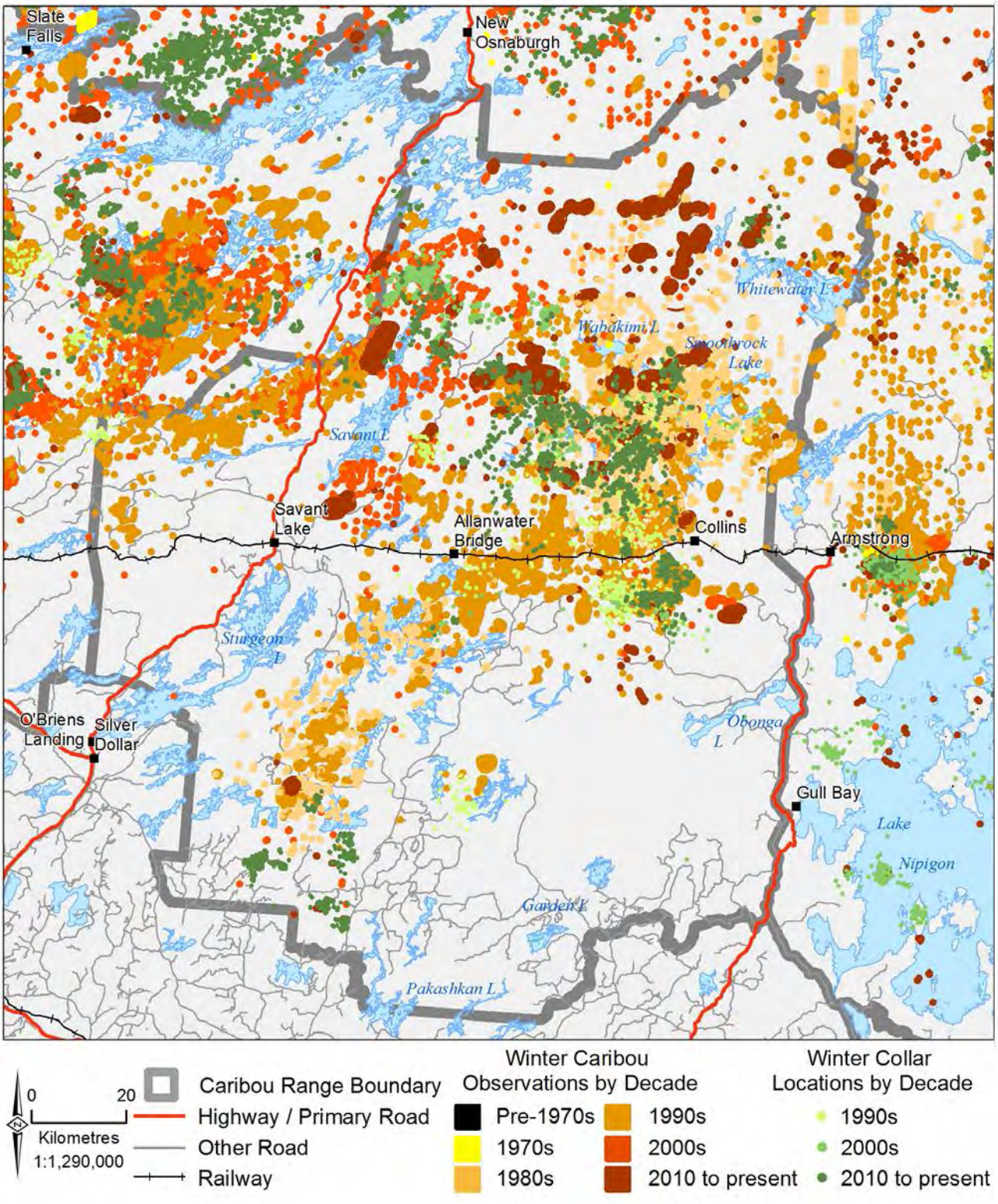


Figure 7. Caribou observations in the Brightsand Range during February and March from all observation sources (i.e. aerial surveys, collared caribou locations, and casual observations) as of August 2013.

3.3 Probability of occupancy survey and analysis

Presence of caribou was identified during an aerial fixed-wing transect survey conducted in February 2011. Details of the fixed-wing survey design and sampling effort standards can be found in the Protocol (MNRF 2014a). The fixed-wing portion of the aerial survey consisted of flying linear transects on a 10 km interval hexagonal sample grid (Figure 8). Each hexagon is approximately 100 km² and 10.6 km across.

Between two and four repeat visits were conducted on a portion of hexagons in each range. Within the Brightsand Range, occupancy survey efforts were delivered by Turbo Beaver aircraft with an experienced crew of MNRF staff. The crew completed transects and repeat visits designed to optimize the numbers of re-visits to generate statistically sound levels of probability of occupancy (Brown et al.2007).

Spatial patterns in occupancy (i.e. probability of occupancy) within the Brightsand Range were estimated using methods described by MacKenzie et al. (2002).

No animals were physically observed in the southern portion of the range and signs of caribou were scarce. No caribou were observed in the northern portion of the range but signs of caribou activity were much more abundant. Caribou were only physically sited in a few locations, all near the core of the range (Figure 8).

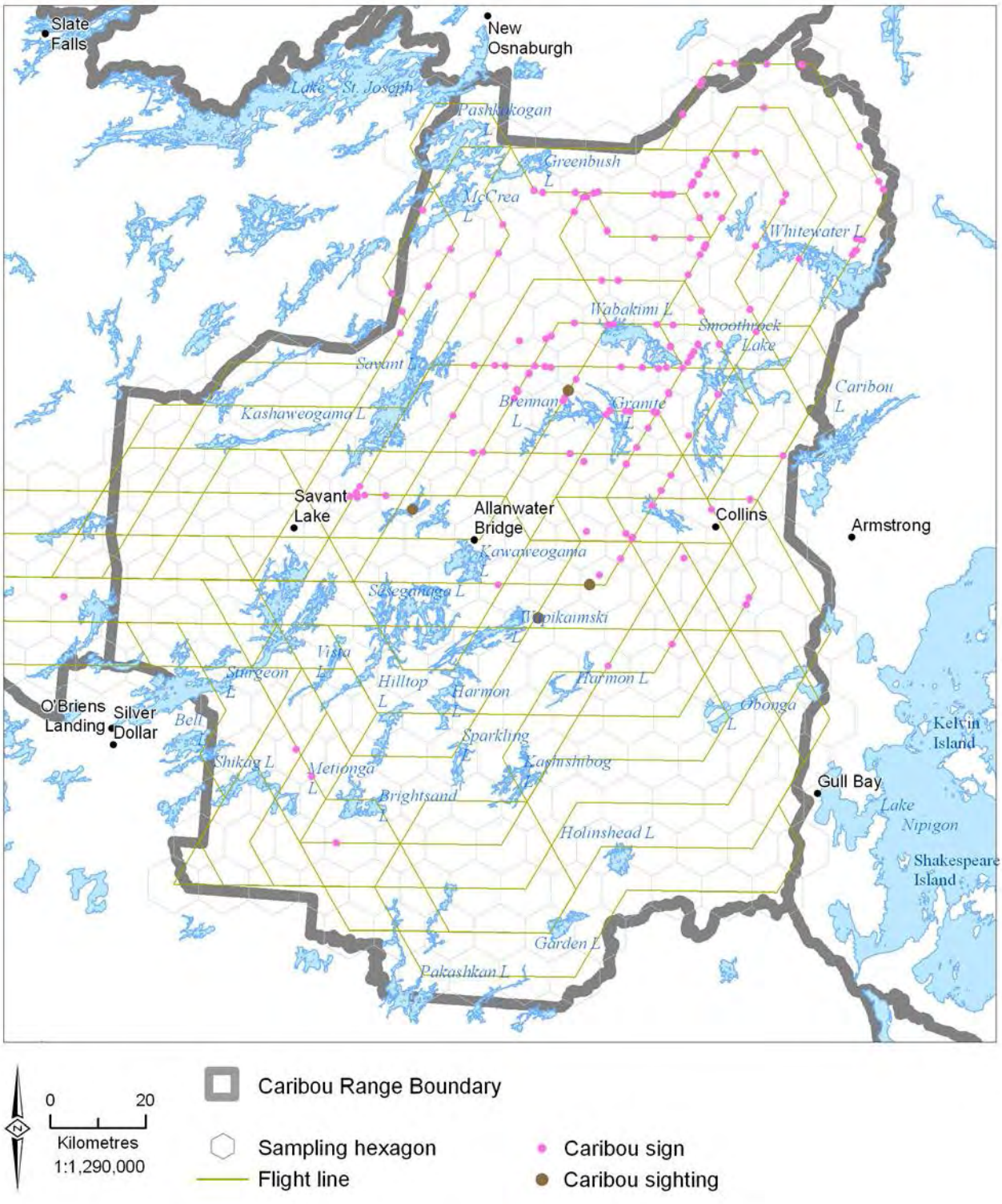


Figure 8. Fixed-wing aerial survey flightlines on the Brightsand Range hexagon sampling grid. Observations of caribou and their tracks are also shown from the 2011 survey; any evidence of caribou present within a hexagon contributes to the probability of occupancy calculation.

The probability of occupancy index (ψ) varies from 0 to 1, where higher values reflect greater likelihood of observing caribou. Generally, hexagons with caribou likely to be present at the time of the survey have a relatively high probability of occupancy (> 0.5). The general patterns from the probability of occupancy analyses provide insight into the broad-scale distribution and relative abundance of caribou. Figure 9 depicts the estimated probability of occupancy for a model conditional on detection (i.e. occupancy = 1 where caribou sign was detected) and without habitat covariates. Uncertainty exists as to the true winter distribution of caribou inferred from this map, particularly in survey hexagons with low probabilities that are adjacent to hexagons with caribou detection or high probabilities without caribou present. Conditions during the year may have influenced detection, and modified caribou distribution and behaviour.

The occupancy model without habitat or detection covariates suggests the probability of caribou occupancy in the Brightsand Range was relatively low (ψ =0.32, S.E. = 0.04, 95% C.I. = 0.25-0.39). The uncertainty in the occupancy estimate, represented by the standard error and confidence interval, suggests that existing levels of survey effort may only detect moderate changes in caribou occupancy with respect to a single estimate for the entire range. This may be partially due to the relatively low number of sampling hexagons in this range. As a result, a statistically significant change in this occupancy indicator may not be evident until large changes in caribou distribution occur. Precision may be improved in future surveys by increasing visits to each hexagon.

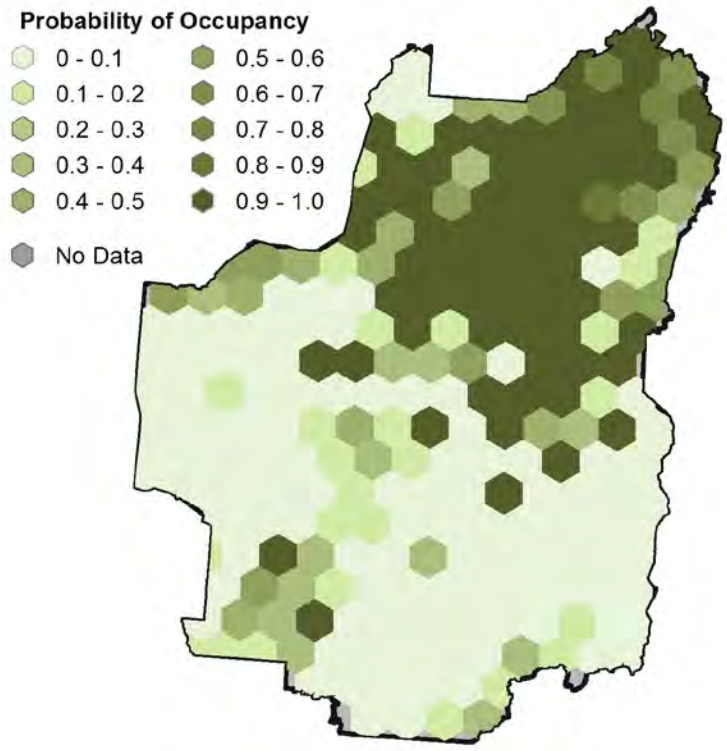


Figure 9. Predicted probability of occupancy of caribou on the Brightsand Range based on a model without occupancy covariates and conditional on observation (Probability = 1 for hexagons with detection(s)) from the winter 2011 survey.

The probability of caribou occupancy was significantly correlated with habitat covariates. No single best model containing habitat covariates could be identified and so habitat covariates retained in the five best models supported by the data were used to generate model-averaged estimates of occupancy (Table 3, Figure 10, and Figure 11). The averaged model used to generate mean estimates of caribou occupancy was:

Table 3.Untransformed estimates of coefficients for habitat and detection covariates used in the caribou occupancy model for the Brightsand Range. Parameters shown in bold have confidence intervals that do not contain zero.

Occupancy					Detection				
Parameter	Estimate[1]	SE	Lower CI	Upper CI	Parameter	Estimate	SE	Lower CI	Upper CI
ψ	-0.99	0.18	-1.34	-0.65	p	-0.09	0.21	-0.51	0.32
Conifer	0.27	0.27	-0.25	0.79	day	-0.37	0.19	-0.75	0.01
Sparse	0.72	0.33	0.07	1.36	time	-367.94	38.34	-443.10	-292.79
Mixed	-1.08	0.27	-1.61	-0.56	time^2	367.47	38.30	292.40	442.54
Roads	0.54	0.28	-0.001	1.09					
Settlement	0.33	0.14	0.05	0.61					

[1]The sign before the covariate estimate indicates the direction of the relationship with species occupancy (positive or negative).

Caribou occupancy on the range is more abundant in areas with limited disturbance (Figure 12). Occupancy occurred primarily in the northern half of the Brightsand Range, particularly in Wabakimi Park, where large tracts of suitable habitat exist and human disturbance is minimal. Conversely, the southern half of the range has lower occupancy and is dominated by young forest and high fragmentation from roads, forest harvest, and fire. Caribou occupancy outside of the park was high where conifer forest was abundant. Furthermore, occupancy was positively correlated with sparse forest class which is conifer dominated (medium to high density) with a lichen, shrub, and moss component. Although distance to roads and settlements were retained in the model, they had little influence in predicting occupancy due to the large standard errors relative to coefficient values.

Occupancy may be overestimated in isolated portions of the southern end of the Brightsand Range where caribou are thought to be currently absent but where potentially suitable habitat exists; this phenomenon is attributed to the use of habitat covariates. While the model may overestimate the actual occupancy of caribou on portions of the Brightsand Range, this aspect of the model provides a useful tool for mapping potentially important priority areas for future range management decisions.

There is evidence in other jurisdictions for the negative effects of anthropogenic landscape disturbance on caribou distribution and population persistence (Brown et al. 2007; Wittmer et al. 2007). Also, the positive correlation between caribou occupancy and winter suitable conifer forest is consistent with evidence of the positive effect of these forest types on caribou habitat selection using finer resolution telemetry data (Brown et al. 2007).

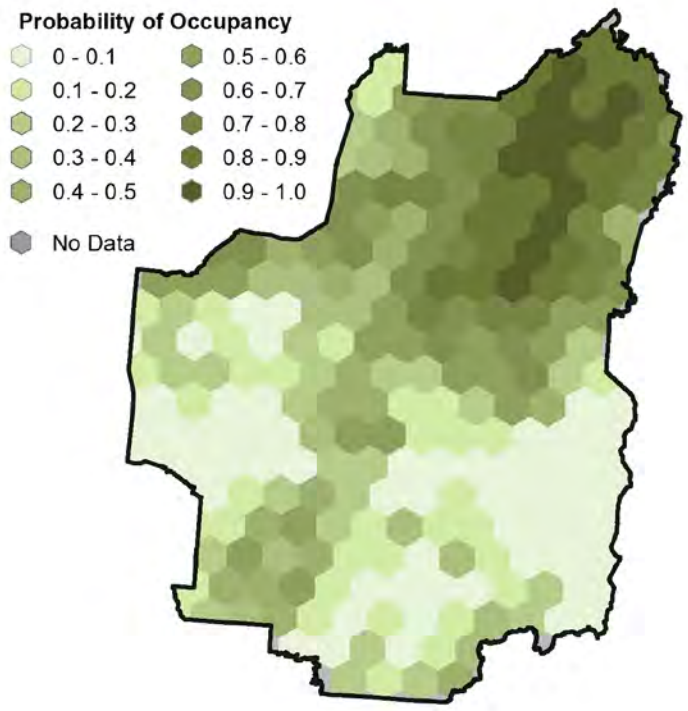


Figure 10. Probability of occupancy determined using habitat covariates across the Brightsand Range based on model-averaged estimates using observations for the 2011 winter aerial survey.

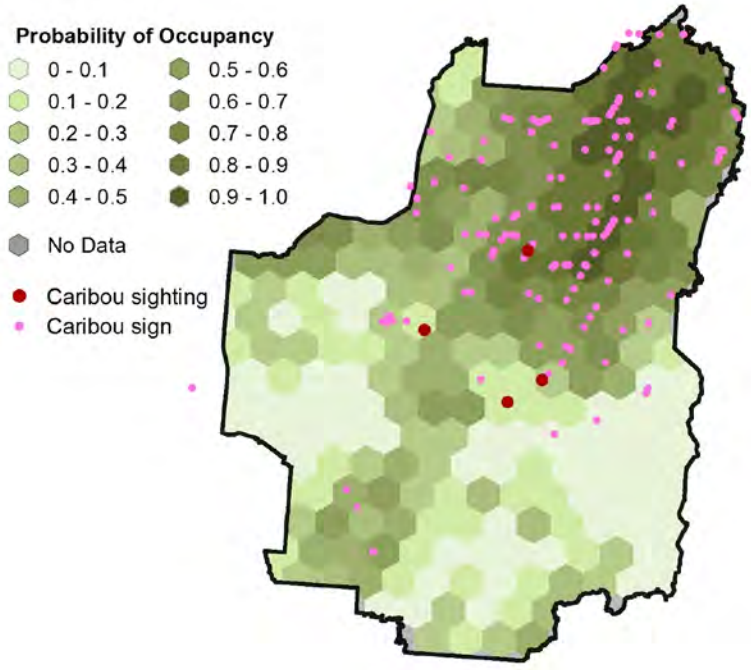


Figure 11. Probability of occupancy determined using habitat covariates in the Brightsand Range overlaid with caribou observations and sightings from the winter 2011 aerial survey.

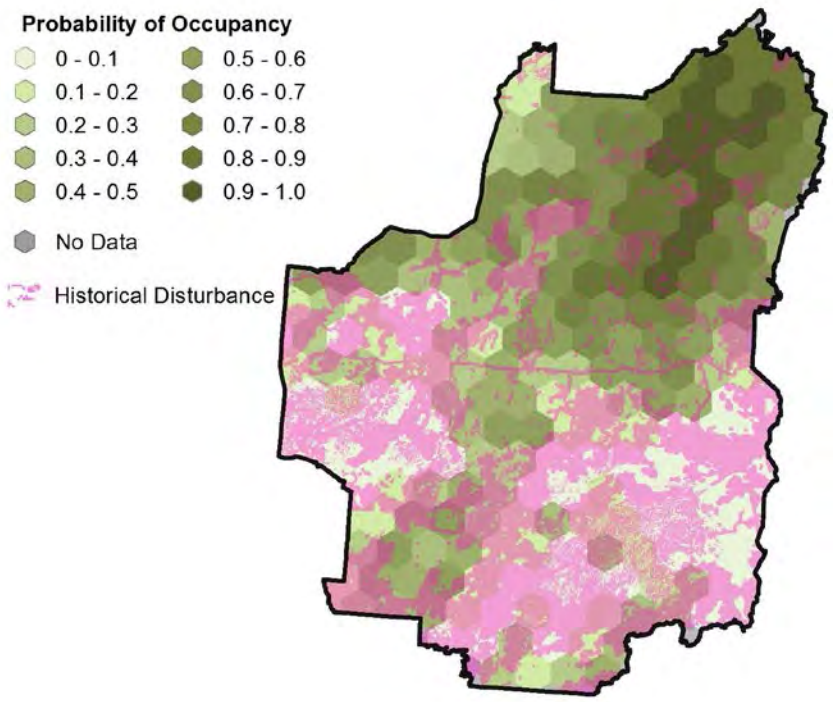


Figure 12. Probability of occupancy determined using habitat covariates across the Brightsand Range using observations for the 2011 winter aerial survey overlaid with disturbed areas (i.e. cuts, burns, regenerating depletions).

3.4 Caribou ecology and range narrative

Caribou within the Brightsand Range reflect our general understanding of caribou habitat use in the boreal forest as described by the Ontario Woodland Caribou Recovery Team (2007). Caribou occur at low densities over large areas, associating most closely with large tracts of older conifer forest, peatland complexes, and areas exhibiting low densities of moose and deer, and associated predators. These conifer forests are believed to provide caribou with a source of arboreal and terrestrial lichens which are important winter forage for many populations (Schaefer and Pruitt 1991) while primarily reducing the likelihood of predator encounters as a means of reducing adult and calf mortality. Female caribou appear to separate themselves from predators by dispersing into areas where wolves exist at lower density due to fewer sources of prey such as moose, or to isolate themselves from other caribou prior to calving (Bergerud and Page 1987). They exhibit hierarchical habitat selection favouring predator avoidance at a broad scale and forage availability at scales of daily feeding area selection (Rettie and Messier 2000). Caribou exhibit fidelity to calving and post-calving areas (Brown et al. 1986; Schaefer et al. 2000) and the fate of calves may often be determined during the summer months. As a result, the sensitivity of caribou to habitat disturbance may be heightened during the summer, post-calving period (Johnson et al. 2005).

Within Ontario, regional differences in habitat use appears to be associated with variations in climate, disturbance regime, forest types, topographic features, and the distribution and abundance of other wildlife populations. Caribou may exhibit habitat use patterns that take

advantage of habitat types available (Moreau et al. 2012) and may use atypical vegetation conditions in more isolated areas such as on islands where refuge value is provided by topographic features instead of vegetation composition and structure (Rudolph 2005).
The Brightsand Range has a wide variety of soil and vegetative conditions. The southern-central portion of the range is dominated by extensive sand and gravel deposits that are occupied by jack pine and black spruce forests. Much of the remainder of the forest is dominated by shallow-to-deep coarse loamy till soils which tend to support conifer dominated and conifer-mixed forest conditions suitable for refuge habitat under natural fire conditions. Some areas in the southcentral portion and western portion of the range have fine textured and more productive soils with a higher proportion of mixedwood forests and higher moose densities. Typically, these habitat types are infrequent and surrounded by conifer-dominated forest. Caribou on the Brightsand Range are known to use conifer uplands, areas with many small lakes, island archipelagos within lakes, and peatlands for calving.

Within the range, there are features that are likely ecologically significant to caribou including much of Wabakimi Provincial Park and Savant and Seseganaga Lakes, all in the northcentral portions of the range. It is thought that maintaining connectivity between these features and the southcentral portion of the range has been instrumental to the maintenance of caribou occupancy across the range and at the southern extent of Continuous Distribution.

Wabakimi Park provides an anchor for the Brightsand Range with extensive areas of shallow soils, abundant lakes, conifer dominated forests and the relative absence of large anthropogenic disturbances such as timber harvest, roads, or infrastructure. Though some extensive natural disturbances such as fire and wind events occur within the park, it contains the highest concentrations of caribou within the Brightsand Range. There are many older stands within Wabakimi Park exceeding 100 years of age, thought in part to be due to past fire management strategies. However, it is believed that habitat quality may decline in stands 140 years of age or older (Racey et al.1999), therefore the aging stands in Wabakimi may become a future concern.

Parks such as Wabakimi and protected areas collectively occupy a large portion (37%) of the range. The role of the provincial parks on the range is essential given that the Brightsand Range contains one of the southernmost occurrences of caribou within Continuous Distribution. Management on lands adjacent to Wabakimi Park has attempted to maintain refuge value and connectivity to other areas within the range in order to support caribou persistence.

The southern portion of the Brightsand Range is heavily disturbed through a combination of natural and anthropogenic disturbances including roads, harvest blocks, fire, and the Canadian National Rail line which divides the Brightsand Range into nearly equal north and south halves. Highway 599 in the west likely limits caribou movement and connectivity to the Churchill Range and Hwy 527 in the east likely limits connectivity to Lake Nipigon and the Nipigon Range (Table 1). The overall effect of these two highways is currently unknown, as is the extent of historical caribou movement between the Brightsand Range and Lake Nipigon. However, caribou observations as recently as the summer of 2011 suggest some connectivity to the east may exist. Overall, caribou movement has been documented from northern

locations around Whitewater Lake south to Caribou Lake and southwest to Brightsand Provincial Waterway Park.

Historical development around the periphery of the range and the primary roads network was largely established under Ontario's moose guidelines (MNR 1988). These guidelines encouraged the creation of small cut blocks and abundant edge. Older harvest areas have been subject to substantial and ongoing efforts since 2009 to defragment the southern portion of the range to create a landscape condition more conducive to caribou persistence. Age class structure, particularly in the southern portion of the range, has been partially influenced by accelerated harvest scheduling associated with forest policies of the 1970s and 80s.

Seseganaga Lake and Savant Lake provide for calving and nursery habitat and are considered regionally significant caribou sites. Seseganaga Lake is regularly used by caribou in the summer despite a main base lodge and five remote outpost camps. Caribou are routinely observed in the yards of outpost camps. Caribou movement between Seseganaga Lake, Savant Lake and Wabakimi Park is well documented. Similarly, movement between the north and south portions of the range is noted despite a high concentration of both anthropogenic and natural disturbances. Maintenance of connectivity between the southern range limit and these regionally significant landforms is attributed to large forest patches adjacent to the park.

Caribou occupancy has persisted in the vicinity of North Mawn, South Allely, and Allely lakes; for instance, South Allely Lake, its main island, and the surrounding area are used year-round. This southern portion of the range has been harvested over the last 40 years with concerted efforts in the 1970s and early 80s (currently known as the Charger and Allely blocks) and recent harvest operations within the last 10 years (Rose and Racey 2011). Recent occupancy patterns (Figure 10-Figure 12) largely reflect the management efforts over the last 20 years to maintain north-south connectivity. Although large deferral blocks exist and are used by caribou in this area, caribou have also been observed using some of the old cutovers, burns, and areas in close proximity to human activity.

Recent caribou sightings near the south end of the Graham Road, south of the Continuous Distribution, suggest there may be suitable habitat south of the Brightsand Range. There is a need to identify the extent of this use and to try and understand whether this is an expansion of the range, caribou displaced from further north, or just a normal part of caribou exploring new areas on the landscape. Caribou have also been known to use mixedwood stands on coarse loamy soils in the English River Forest adjacent to areas with year-round use.

Summer caribou use is widespread in the many small and large lakes and peatland complexes in the portions of the range exhibiting older conifer dominated forest. The southern portion of Brightsand River Provincial Park, as well as Metionga, Duggan, Gridiron, Sassafras, Hilltop, Shikag and Pipio lakes, are also known to be used in the summer by cows and calves. These lakes are known to be some of the southernmost summer use areas within Ontario's Continuous Distribution (Elder 2003).

Furthermore, documentation of summer use on Pakashkan Lake at the southernmost extent of the Brightsand Range has occurred over several years but the extent of their movements is

unknown and whether the same caribou use the area year round or whether different caribou may use this area in winter. Their presence may indicate an increasingly suitable habitat condition in the southern portion of the range, resulting from the growth and maturation of the extensive 30-40 year old pine plantations within the vicinity.

There are high levels of disturbance within the Brightsand Range but there are also significant portions of the range expected to provide caribou habitat in the near future. These include two very large 1980 fires: THU 46 (120,000 ha) in the southeastern corner of the range and IGN 27 (66,000 ha) near Sturgeon Lake. Both of these fires have high levels of conifer composition and exhibit abundant bedrock and shallow soils conducive to lichen regeneration. Caribou have been observed in the portions of THU 46 that have lichen on bedrock outcrops as well as in areas just outside the burn. However, some of the areas within the burn are abandoned in the winter as snow depth increase making lichen less accessible. Many of the former logging roads in the harvested areas are becoming impassable, even by snow machine, and human use is declining. IGN 27 exhibits high biological potential for future caribou habitat but may be unlikely to realize that potential in the short-term due to the recent harvest blocks to the north and separation from Sturgeon and Seseganaga lakes to the east by Hwy 599.
Forest harvest has influenced recent caribou occupancy patterns. Noname and Chapelle lakes were previously used for calving and nursery functions but no use has been documented since logging occurred nearby in 1987. Caribou used the area adjacent to Sparkling Lake until fire and logging occurred in the vicinity in 1996. However, some areas in the southern portion of the Brightsand Range have caribou occupying areas with a long and extensive management history. Although these areas are small and relatively discrete, they suggest some aspects of the managed landscape are continuing to provide (or are once again providing) habitat for caribou (Rose and Racey 2011). The isolated nature of caribou occupancy in this southern portion of the range suggests an element of risk to continued occupancy in this area.

This range narrative does not represent a detailed synopsis of all important caribou use areas within the Brightsand Range.

3.5 Influence of current management direction

Recent and current management direction up to the time of this Integrated Range Assessment, has had many positive influences on the current state of caribou within the Brightsand Range. Direction from the Crown Forest Sustainability Act (1994) to “emulate natural disturbances” was significant to support the landscape and stand-level approaches necessary to sustain caribou habitat and provide an integrated and receptive policy environment for other caribou habitat conservation direction.

The importance of the current Brightsand Range to maintaining caribou was recognized in the late 1980s and spurred explicit management efforts to sustain caribou and their habitat starting in 1991 (Racey 1991). Implementation of *Northwest Region Interim Caribou Habitat Management Direction* (MNR 1994) and the early implementation drafts of the *Forest Management Guidelines for the Conservation of Caribou Habitat: a Landscape Approach* (Racey et al. 1999), and the subsequent *A Management Framework for Woodland Caribou Conservation in Northwestern Ontario* (MNR 1999b) were instrumental in initiating and

integrating caribou conservation efforts into forest management planning. Implementation of caribou habitat tract mapping, mosaic planning, and priority retention of larger areas of high value habitat components contributed to continued range occupancy and ecologically sustainable forest management. This, along with a commitment to manage the landscape with the intent of preventing further range recession over the last 20 years, has established an existing landscape condition and a management approach that will allow for an easier transition to a RMA.

The progressive set of Forest Management Planning decisions strived to secure the southern end of occupied caribou habitat. This was achieved through defining and adapting the boundary line of southern Continuous Distribution based on new science and information. Mosaic development under the caribou guidelines supported the development of a deferral strategy that maintained older, used forest and tried to maintain connectivity to the west. These efforts were coupled with a forest management strategy to defragment the diverse cutover patterns associated with the pre-1991 application of moose guidelines. The current occupancy of caribou in this area can largely be attributed to these actions. However, the process of applying caribou guidelines also met with some difficult and challenging decisions that allocated some areas in or adjacent to currently used habitat (e.g. Shikag/Noname /Chapelle /Sparking lakes). Had some of those allocations not occurred, the current status of habitat within the range may have been better.

In 1991, an early and measured application of the precautionary principle was employed by conserving the southern portion of the range through deferrals despite the fact that knowledge of caribou occupancy and habitat use was largely incomplete and only preliminary guidance was available. These early landscape management actions received essential executive support as there was a legitimate conservation concern. The caribou occupancy at the southern portion of the range is credited to these actions and it is largely believed that these populations would not exist had those decisions not been undertaken.

As described earlier, strategic decisions on the allocation and retention of forest that have maintained habitat connectivity between both Seseganaga Lake and Savant Lake to Wabakimi Park have been important to the persistence of caribou on the landscape. Wabakimi Park is an anchor for caribou habitat and populations within the range. The well-being of caribou using the park is linked, at least in part, to their well-being in the surrounding landscape. Strategic decisions in landscape management have been made to recognize the contributions made by both the Park and the broader landscape matrix in contributing to a sustainable supply of year round habitat for caribou. Ontario Parks recognizes that natural fires are an important process in maintaining the ecological integrity of forest ecosystems. Long-term deferrals in areas adjacent to the Park, as part of the Dynamic Caribou Habitat Schedule are an important part of addressing risk associated with natural dynamics.

North-south connectivity within the range was supported, in part through *Ontario's Living Legacy* (MNR 1999a) which established the Brightsand River Provincial Park, Gull River Provincial Park, Kopka Provincial Park, Obanga-Ottertooth Provincial Park, Pantagruel Creek Provincial Nature Reserve, Kaiashk Provincial Nature Reserve, Garden-Pakashkan

Conservation Reserve and Upper English River Conservation Reserve (LIO 2012). These protected areas help support a landscape approach to caribou conservation.

Several access management decisions have been instrumental to maintaining the integrity of portions of the range. These include the decision to maintain no road linkage between the Graham Road and Hwy 599 which would have fragmented core caribou habitat. Additionally, road management strategies for the Brightsand Road have reduced the amount of physical and sensory disturbance through known calving and winter habitat. Similarly, the 1 km Area of Concern prescription around Savant Lake requires that all roads be decommissioned, closed with a berm and regenerated. This reduces the level of disturbance associated with human activity and provides a greater likelihood of operational roads becoming rehabilitated.

The relationship established with tourist outfitters on and around Seseganaga Lake has produced valuable observational data and has contributed to conservation awareness in the central portion of the Brightsand Range. Maintaining these relationships has been achieved through the development and distribution of public observation cards, signage, and outreach/stewardship programs.

There have also been challenges in applying current management direction to fulfil its intended purpose related to caribou conservation. Provincial Forest Access Road Funding Program initiated in 2005 promoted the construction and maintenance of primary and secondary access roads which encouraged access into previously unroaded areas. Additional roads potentially increase vulnerability of caribou in these areas before previously harvested areas elsewhere mature and provide for caribou habitat.

Renewal has been deemed successful in the Caribou Forest (Arbex Forest Consultants Ltd. 2009) despite silvicultural success estimated between 10-20%. The renewal program was considered effective, particularly regarding conifer, in the English River Forest although silvicultural success was estimated between 20-30% and road decommissioning was insufficient (Craig Howard 2010). These results, suggest that management decisions in forest renewal outcomes may not be fully consistent with the conservation and renewal of suitable future caribou habitat.

3.6 Major data and analysis uncertainties

There are several major data uncertainties associated with the estimation of risk and the determination of range condition within the Brightsand Range.

It is believed that poor winter conditions influenced the results of the survey and that more caribou would have been sighted if given more flying days with the rotary-wing aircraft (M. Kiss pers. comm. 2011; L. Walton pers. comm. 2011).

Habitat assessment within Wabakimi Park was conducted using Provincial Land Cover 2000 (PLC 2000) data and the remainder of the forest was assessed using Forest Resources Inventory (FRI) data. The greater the proportion of the range that relied upon PLC 2010 data, the more uncertainty there is about the habitat assessment results. This uncertainty may affect

the calculated amount and arrangement of caribou habitat and to the disturbance analysis both in terms of age and of forest composition.

There is the assumption that old forest is suitable habitat. Substantial areas of forest within Wabakimi Park are very old, with some upland forest areas exceeding 140 years of age. There is some uncertainty if they are (or will be) suitable for the provision of refuge and forage value. It has been suggested that caribou may use these older forests less as it they succeeds into either a mixed forest condition or to balsam fir dominated forest.

In areas without FRI coverage, such as Wabakimi Park, the Provincial Land Cover 2010 (PLC 2010) was used to quantify caribou habitat. This product under-represents the amount of tree cover, often classing a sparsely treed or treed area as open fen or open bog (Stratton 2012). Furthermore, the Conventional Boreal habitat model used in the SRNV analysis classifies treed classes of fen and bog as habitat, not open fen or bog, it may be important to consider these variations when interpreting the habitat values.

A significant blowdown disturbance event occurred across the central portion of the range in October 2001. It lightly damaged 3.1 million hectares and moderately or severely damaged 1.2 million hectares. This disturbance type is seldom fully incorporated into FRI updates and is likely underrepresented in the determination of disturbance as well as the amount and arrangement of caribou habitat. It is thought that this blowdown may negatively affect habitat value in some areas determined to have good caribou habitat. The effects of the blowdown and implications may be similar to those described by Racey and Honsberger (2009) although they may vary substantially on other site conditions.

National meta-analysis of the relationship between caribou recruitment and the total amount of anthropogenic and natural disturbance relied on data from the Global Forest Watch database (EC 2008), which was updated by Environment Canada in 2011 (EC 2011). This relationship was intended to be refined as improved data was provided by various jurisdictions across Canada. There may be substantial differences between forest cover, forest disturbance, and linear features represented in this analysis compared to the 2011 Environment Canada data. In general, the current range analysis included more complete data related to road and mineral development activities, documented fires, and non-fire forest disturbances. The calculated habitat disturbance on the Brightsand Range using Ontario data is estimated to be approximately 1.3% greater than that generated using the Environment Canada data. There is some uncertainty in the interpretation of the results of the disturbance analysis using these different datasets in light of the desire to use the best data available.

There is considerable uncertainty in the appropriate treatment of water during the disturbance analysis. The sensitivity of the “total disturbance” parameter to removal of water bodies of different sizes was identified to inform interpretation of the likelihood of a stable to increasing population growth and evaluation of range status. In the Brightsand Range, waterbodies account for a substantial portion (15.5%) of the range extent. It is unknown whether the inclusion of these waterbodies in the range extent for the purpose of the disturbance analysis introduces a positive or negative bias.

3.7 Special considerations within the range

Special circumstances exist within the Brightsand Range that should be considered when interpreting the Integrated Range Assessment. These include significant physical and biological factors influencing the status of caribou, trends, or habitat use that are unaccounted in population and habitat modeling. Such factors should give context to results of the Integrated Range Assessment Framework.

No specific assessment of habitat renewal was conducted within the range. However, there is evidence that some forested areas that were harvested and regenerated in the 1960s are currently being used by caribou in the vicinity of South Allely Lake and the Charger Block (Rose and Racey 2011) and in the vicinity of Pakashkan Lake.

Recreational hunting and fishing activity is extensive on the Graham Road network. It is suspected that this activity may have a confounding effect on the distribution of caribou through human presence and sensory disturbance. Heavy vehicular traffic, especially during hunting season and during log hauls could represent a sensory disturbance that may discourage caribou occupation within an undetermined proximity. On the other hand, moose hunting pressure is significant which may be related to the amount of access (Racey et al. 2000). For the portion of WMU 15A within the Brightsand Range, moose densities are low. Collectively, the balance of access and the moose populations are important considerations that may affect caribou persistence in the southern portion of the range.

Human-caused mortality has been documented and attributed to train collisions along portions of the CN mainline within the Nipigon Range (E. Armstrong pers. comm. 2011). It is unknown to what extent similar collisions occur where the rail line bisects the Brightsand Range.

Aboriginal subsistence harvest occurs within the range.

3.8 Other wildlife

The boundaries of the Brightsand Range include Wildlife Management Units (WMU) 15A, 15B, 16B and 16C, with small parcels of 4 and 5 (Figure 13), within cervid ecological zones A and B (MNR 2009b).

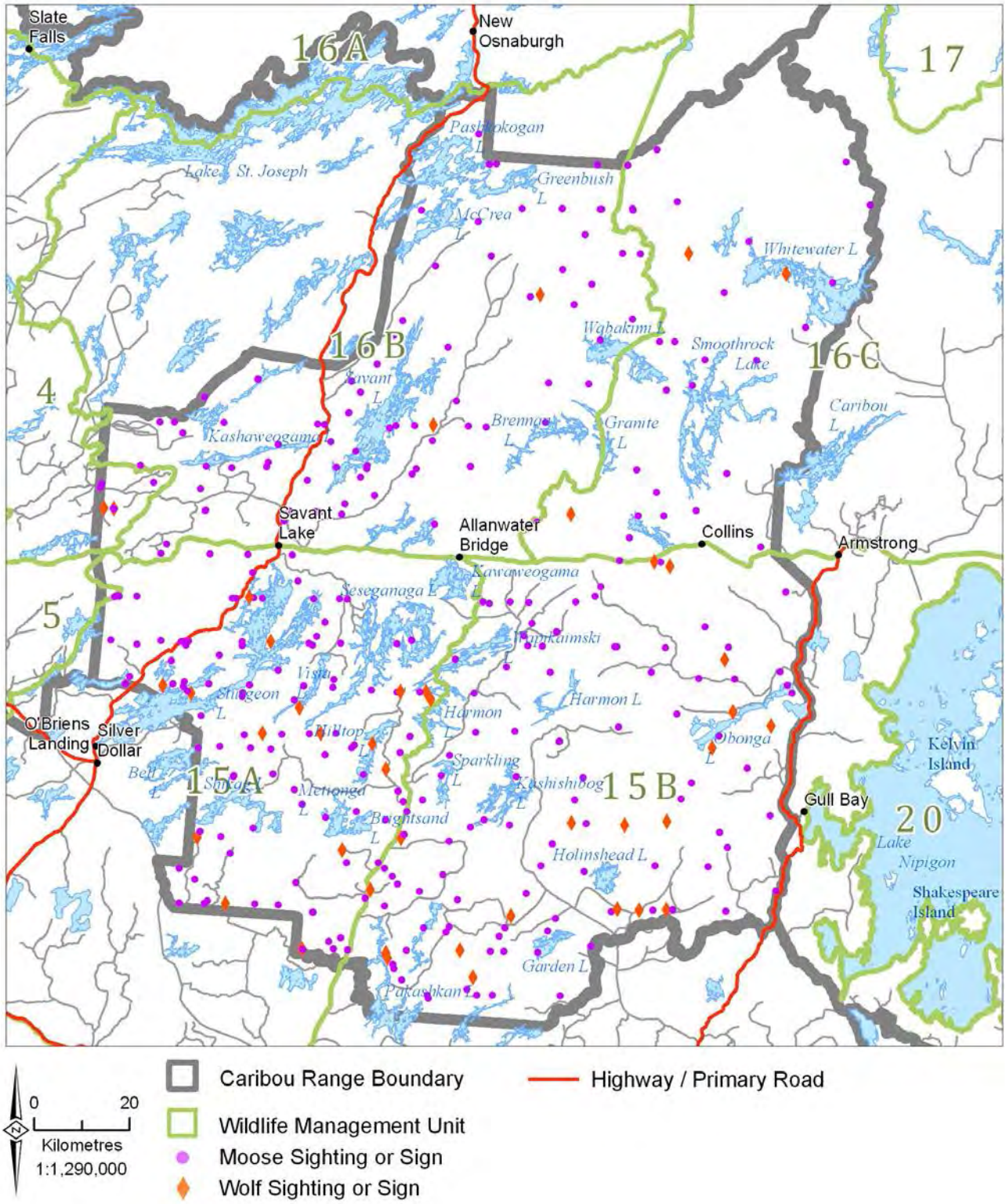


Figure 13. Wildlife Management Units overlapping the Brightsand Range with moose and wolf signs or sightings observed during the winter 2011 aerial surveys.

Moose densities have historically been stable to decreasing across much of the Brightsand Range and at the WMU level are currently estimated at densities from 6.0 to 45.1 moose per 100km^2. In recent years, moose populations within WMU 15A, 16B may be increasing whereas those in 15B are declining.

Table 4. Recent moose population estimates for Wildlife Management Units (WMU) within the Brightsand Range.

WMU	Cervid Ecological Zone	MAI strata area (km^2)[1]	Moose population estimates no. of moose (survey year)	Current density (moose / 100 km^2)
15A	B	11,000	3,295 (2012)	30.0
15B	B	14,950	4,640 (2009)	31.0
16B	A	10,625	650 (2006)	6.0
16C	A	10,775	1,241 (2005)	11.5
4	B	10,991	2,130 (2011)	22.6
5	C1	8,4452	3,811 (2010)	45.1

[1]Area is for the WMU

White-tailed deer populations in 5B and 16B are believed to be at low densities but are stable and possibly increasing (J. Connor and F. Fisher pers. comm. 2011). In 15A, deer populations peaked around 2004 and are now likely declining (D. Elder and M. Kiss pers. comm. 2013). It is likely that deer are moving northward into areas with formerly low populations. Deer may function as both alternate prey for wolves and as a vector for disease, specifically brainworm (*Paralaphostrongylus tenuis)*, and may be expected to increase with northward expansion.

Black bear density estimates derived through the implementation of barbed-wire hair trap (BWHT) protocol indicates that black bear densities are relatively abundant in most of the WMUs that overlap the Brightsand Range (17-24 bears/100 km$^{2)}$ (Table 4) (M. Obbard, MNR unpublished data). Estimated bear densities were similar or above average values for WMUs across both Ontario's northwest region and black bear ecological zone D.

Table 5. Recent black bear density estimates for Wildlife Management Units (WMU) within the Brightsand Range derived from barbed-wire hair trap protocol.

WMU	BBEZ[1]	Year	Density (# bear/100km^2) ± SE	Density relative to BBEZ mean	Density relative to regional mean
15A	D	2010	23.3 ± 6.2	Above	Similar
15B	D	2005/2010	17.0 ± 6.3	Similar	Similar
16B	D	2009	17.5 ± 6.4	Similar	Similar
16C	D	2008/2009	23.8 ± 7.4	Above	Similar
4	D	2005	20.9 ± 9.3	Similar	Similar
5	E_1	2004/2011	19.5 ± 7.1	Below	Similar

[1]Black bear ecological zone

Traditionally, there is little information about wolf densities. Anecdotal evidence may suggest that wolf populations in WMUs 15A, 15B, 16B and 16C may be stable, possibly increasing (J. Connor and F. Fischer pers. comm. 2011), as is generally supported by the results of the Moose Hunter Post Card Survey (PCS) wolf sighting index (Figure 14). This information is included to provide context with other wildlife population trends, and is not used in determining range condition.

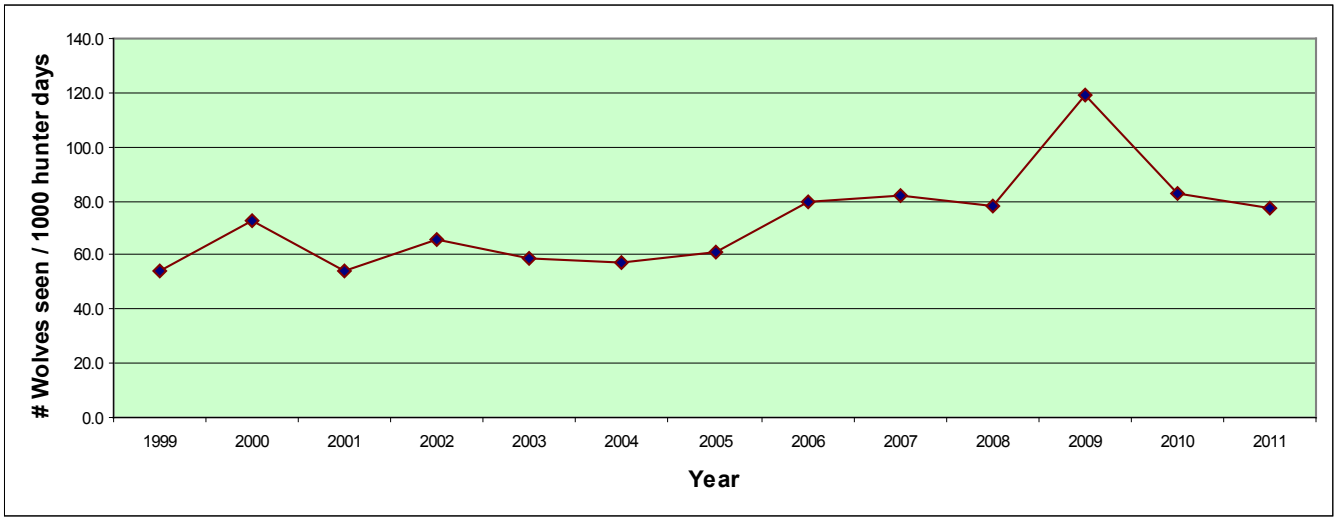


Figure 14. Trend in number of wolves sighted by moose hunters, 1999-2011; pooled data for WMU 15A, 15B, 16B, and 16C (MNR, Science and Research Branch, moose hunter post card survey database).

3.9 Results of past range assessments

No previous range assessments have been completed for the Brightsand Range. Range level summaries of data and models pertaining to the Brightsand Range are described in Elkie et al. (2012).

4.0 Integrated Range Assessment Framework

The Protocol (MNRF 2014a) identifies the process to conduct an Integrated Range Assessment (Figure 15) involving: 1) collection of data to inform four quantitative lines of evidence and their interpretation; 2) an Integrated Risk Assessment; and 3) determination of range condition. The Integrated Risk Assessment considers the influence of habitat disturbance and population trend on the likelihood of stable or positive population growth, and the influence of population size on the probability of persistence. This assessment is supported by scientific findings adapted from Environment Canada (2011).

The process of determining range condition (section 7.5) will be based on the best available information that supports the lines of evidence. Range condition is reflected in the IRAR as a statement pertaining to the ability of the range to sustain caribou. Range condition is declared with full acknowledgement and understanding of the current risk to caribou but with the additional insight provided by the habitat assessment which describes the amount and arrangement of habitat. If the fourth line of evidence representing the amount and arrangement of habitat is not available for the range, results of the integrated risk assessment will be used to determine range condition as follows: if risk to caribou is low, then range condition is sufficient to sustain caribou; if risk to caribou is intermediate, it is uncertain whether range condition is sufficient to sustain caribou; if risk to caribou is high, then range condition is insufficient to sustain caribou.

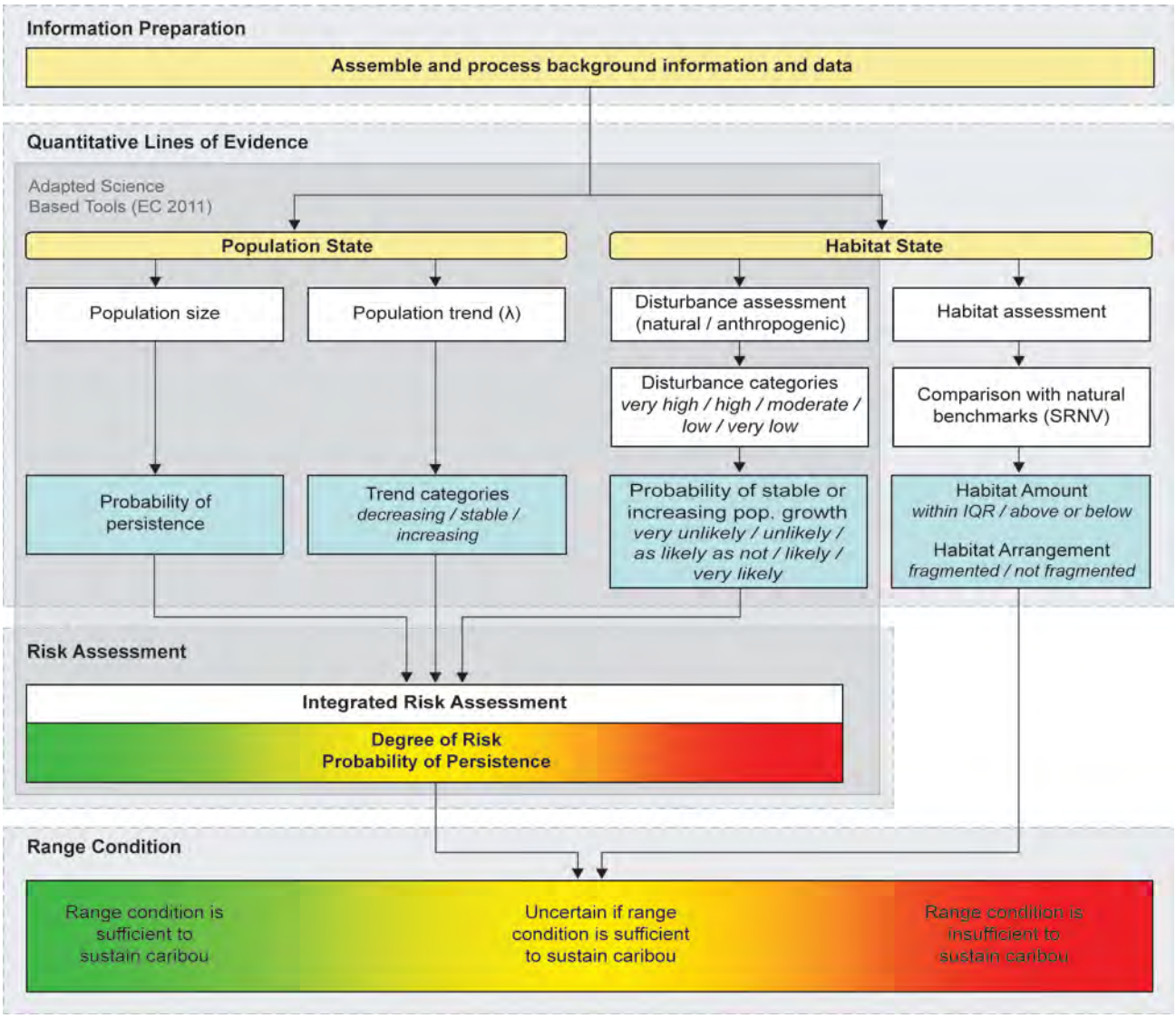


Figure 15. The integrated assessment framework with four quantitative lines of evidence. Three lines of evidence related to population size, trend and habitat disturbance assessment contribute to an integrated risk assessment. The results of the integrated risk assessment are combined with habitat assessment (fourth line of evidence), to inform the determination of range condition (MNRF 2014a).

5.0 Quantitative Lines of Evidence Methods and Results

5.1 Population state: size and trend

Caribou population health is conventionally measured in terms of population size (i.e. the number of caribou) and trend. It is preferably described by average intrinsic rate of growth, lambda (λ). The best available data is used to estimate the number of caribou and the demographic trend within the range. These are used in the integrated caribou range assessment decision framework (Figure 15).

The ability to establish population trends improves with the addition of more indicator estimates. In this assessment the short-term population trend is approximated by: 1) estimates of recruitment expressed as percent calves in the population or number of calves per 100 adult females as an index of population condition (EC 2008), 2) an estimate of lambda (MNRF 2014a) and 3) a minimum estimate of the population size based on a minimum animal count (MAC). The long-term population trend is approximated by using historical data compared to recent data.

5.1.1 Population state methods

5.1.1.1 Telemetry

Historically, 15 collars were placed on caribou between 1995 between 2004. In March 2011, 20 GPS collars were deployed on adult female caribou in the Brightsand Range. Data generated from these collared caribou will be used in future reports to determine survival rates and refine recruitment and trend estimates.

5.1.1.2 Winter aerial surveys

Between February 16th and March 3rd, 2011, a fixed-wing hexagon-based aerial survey was conducted for the Brightsand Range (Figure 10). All caribou and signs of their presence were recorded. Where possible, observed caribou were counted and classified as adults or calves. Also recorded was evidence of wolves, moose and wolverine. Survey efforts were strictly controlled to support occupancy analysis (Section 3.3). Additional searching for caribou off the transect lines was discouraged once sign was confirmed.

The second stage of the survey was conducted by helicopter between February 28th and March 5th, 2011, and included areas where caribou were sighted and/or where there was significant evidence of caribou presence. Caribou group size and age/sex composition were determined at this time. Caribou were counted and classified as: unknown adults, adult males, adult females, calves, or unknown age and sex. Sex of adults was determined through observation of the presence or absence of a vulva patch, animal behaviour, and/or body morphology.

5.1.1.3 Recruitment

Recruitment estimates follow the Protocol (MNRF 2014a). The observed sex ratio of known adults obtained from aerial surveys was used to estimate the number of adult females present in the groups containing unknown adults. The adjusted number of adult females (AF_{adj}) was used to estimate recruitment (MNRF 2014a).

5.1.1.4 Trend

Generally, in forest-dwelling caribou, a stable population requires a late-winter estimate of at least 12-15% calves in a non-hunted population with a density of 0.06 caribou per square kilometre (Bergerud 1992; 1996). Recruitment rates exceeding 28.9 calves per 100 AF_{adj} would

suggest the population is increasing. Recruitment rates below this value would suggest the population is decreasing based on assumed average adult survival rates of 85% (EC 2008). The relationship between annual estimates of recruitment and adult female survival was used to provide an estimate of trend (λ) (Hatter and Bergerud 1991).

Trend Estimation

Annual population growth (λ) was estimated based on the following female –only survival and recruitment equation (Hatter and Bergerud 1991):

$$\lambda = (1 - M) / (1 - R) \qquad \text{Equation 1}$$

Where *M* is adult female mortality (or 1 - S, the survival rate) and *R* is the recruitment rate of female calves: 100 adult females (assuming a 50:50 sex ratio) at 12 months of age.

Baseline estimates of annual survival (S) were calculated using three equations described in the Protocol (MNRF 2014a).

$$\textit{Daily survival rate} = 1 - (\#\ \textit{of mortalities} / \#\ \textit{of animal days}) \qquad \text{Equation 2}$$

$$\textit{Annual survival rate} = (\textit{Daily Survival Rate})^{365} \qquad \text{Equation 3}$$

$$\textit{Annual mortality rate} = 1 - \textit{Annual Survival Rate} \qquad \text{Equation 4}$$

As some caribou moved between ranges, data from all adult female collared caribou that had the majority of their telemetry locations (>50%) within the Brightsand Range was utilized.

5.1.1.5 Size

The aerial survey methods used to conduct a probability-based occupancy survey (Section 3.3) supplemented with a follow-up helicopter survey to obtain improved age and sex information (MNRF 2014a) was used to generate a minimum animal count (MAC). This is interpreted as an absolute minimum number of caribou occupying the range in February and March 2011. The MAC was calculated based on all caribou observations that were not deemed to be duplicate observations (MNRF 2014a).

5.1.1.6 Population state results

Two hundred and twelve caribou (212) in 33 groups were observed during the 2011 aerial surveys; 13 from the fixed-wing survey and 199 from the rotary-wing survey. After removing recounts, four caribou were observed in one group during the fixed-wing portion and 199 caribou were observed in 29 independent groups during the rotary-wing portion. An additional 21 animals were observed on March 30th, 2011 (four weeks following the survey's completion) but were not believed to be recounts by observers (R. Schott pers. comm. 2011). Therefore, the total minimum animal count (MAC) was 224, including 15 calves (7.4%), in the Brightsand Range during February and March, 2011 (Table 6 and Table 7).

During the fixed-wing portion of the survey, no caribou were observed in the southern part of the range and signs of caribou activity were scarce. Although no caribou were observed in the northern portion of the range, signs of caribou activity were much more abundant. Caribou were only physically sighted in a few locations, all near the central core of the range (Figure 8).

During the rotary-wing flights, caribou were observed as far south as the South Allely and North Mawn lakes area and as far north as the Winn Lake. Caribou were also observed near the western boundary close, to Hwy 599 in the Neverfreeze Lake area, west of the northern arm of Savant Lake. All other caribou observed by the rotary-wing were loosely based in the centre of the Brightsand Range.

Detection of caribou from aerial surveys is known to be incomplete and the detection rate is unknown; as a result, the MAC only represents a proportion of the actual number of caribou present within the Brightsand Range. Poor winter conditions likely influenced the results of the survey and more caribou would have been sited if given more flying days with the rotary-wing aircraft (M. Kiss and L. Walton pers. comm., 2011).

Table 6. Minimum animal count observed during a fixed-wing and rotary-wing aerial survey conducted in the Brightsand Range, February 10-March 5, 2011.

	Caribou age and sex identification[1]						
Survey method	**UA**	**AM**	**AF**	**Calves**	**Unknown**	**Total adults**	**Total caribou**
Fixed-wing	3	0	0	0	1	3	4
Rotary-wing	41	75	61	15	7	177	199
Other					**21**		**21**
Total	**44**	**75**	**61**	**15**	**29**	**180**	**224**

[1]UA=Adult of unknown sex, AM= Adult male, AF=Adult female, U=Caribou of unknown age or sex

Only caribou groups for which 50% or more of the group was successfully identified to age or sex were included in the estimation of adult sex ratio and recruitment (Table 7). In 2011, recruitment was estimated to be 18.2 calves per 100 AF_{adj} (Table 7; Figure 16). During 2012 and 2013, targeted relocation flights for collared animals observed 99 and 111 caribou, yielding recruitment estimates of 22.9 and 25.5 calves per 100 AF_{adj}, respectively. These levels of recruitment are lower than the estimated threshold of 28.9 calves per 100 AF_{adj}, and are comparable to studies in which populations were known to be stable or in decline (Rettie and Messier 1998; McLoughlin et al. 2003; EC 2008).

Observed sex ratios in 2012 and 2013 were higher than in 2011, as the survey was targeting radio-collared adult females and therefore sex ratios would logically be higher, as they are less likely to encounter groups of bulls (Table 7; Figure 16).

Table 7. Counts of caribou and estimates of recruitment from rotary-wing surveys conducted in the Brightsand Range during the winters of 2011, 2012, and 2013.

		Caribou age and sex identification[1]										
Year	**Survey**	**UA**	**AM**	**AF**	**Calf**	**U**	**Total Adults**	**Total Caribou**	**Sex Ratio**	AF_{adj}	**Calf: 100** AF_{adj}[2]	**% Calves**[3]
2011	Winter Distribution (RW)[4]	44	75	61	15	8	180	203	0.488	82.5	18.2	7.4
2011	Other[5]					21		21				
2012	Recruitment				13		86	99	0.661	56.9	22.9	n/a[6]
2013	Recruitment	22	22	45	15	10	86	111	0.762	58.8	25.5	n/a[6]

[1]UA=Adult of unknown sex, AM= Adult male, AF=Adult female, =Caribou of unknown age or sex, AF_{adj} = Adjusted Adult Females
[2]Recruitment estimate using the ratio of calf: 100 adjusted adult female
[3]Percentage of calves observed, only reported for the winter distribution survey, as this survey was not targeting collared adult females and therefore represents a less biased survey for calculating percentage of calves in the population
[4]Note that only rotary-wing data was used in these calculations
[5]An additional 21 animals were observed on March 30th, 2011 (four weeks following winter distribution survey completion)
[6] Due to bias created by targeting collared adult female caribou during recruitment surveys, % calves not applicable from recruitment survey data

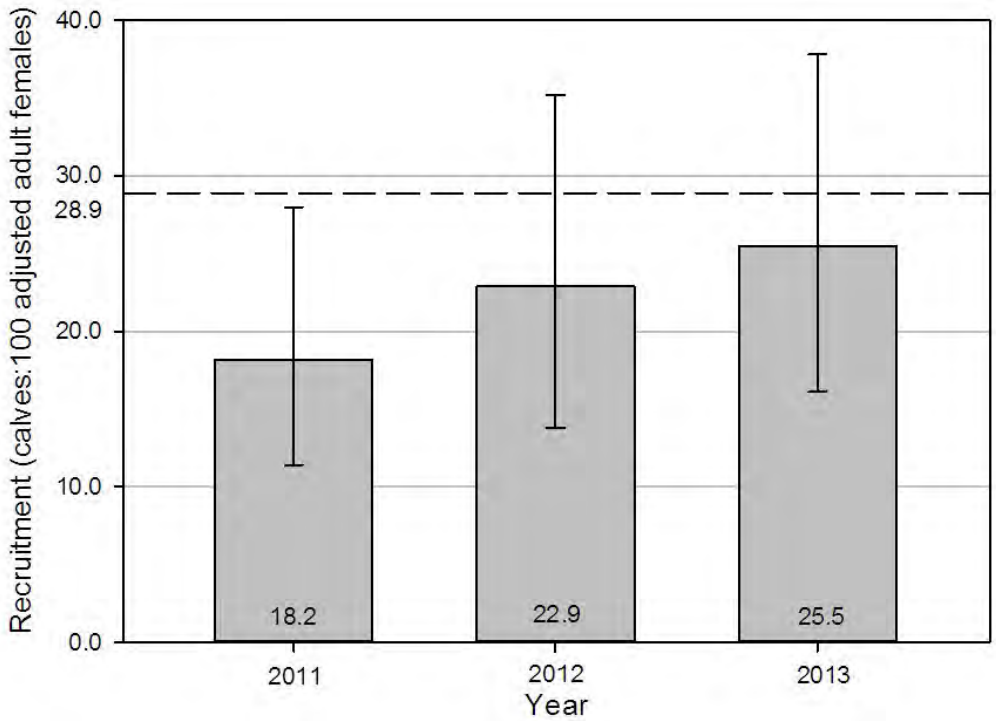


Figure 16. Recruitment estimates (calves/100 AF_{adj}) with associated 95% confidence intervals from 2011-2013 in the Brightsand Range. Dashed line indicates recruitment levels expected for a stable to increasing population (EC 2008).

Annual survival was estimated for all collared adult females which spent the majority of their time within the Brightsand Range during each biological year (April 1st to March 31st). The annual survival rate was 0.79 (95% CI= 0.60-1.00) (Table 8 and Figure 17), and resulted in an estimated mean population trend (λ) of 0.87 (ranging between 0.86-0.90) suggesting that the short-term population trend is likely declining.

Table 8. Annual survival rates (*S*) and population trend (λ) of collared female caribou (*n*) and number of mortalities (*d*) during 2010-2012 biological years (April 1st-March 31st) in the Brightsand Range.

Biological Year	n	d	Exposure Days	Daily Survival Rate	Survival (S)[1]	Upper 95% CI	Lower 95% CI	Lambda (λ)[2]
2010					0.79			0.86
2011	18	4	5651	0.9993	0.77	0.99	0.60	0.86
2012	15	3	4963	0.9994	0.80	1.00	0.62	0.90
		Geometric Mean		**(2011-2012)**	**0.79**	**(2010-2012)**		**0.87**

1 The geometric mean survival rate from 2011-2012 was used to estimate population trend (λ) for the 2010 biological year.
[2] λ calculated from recruitment (Table 7) from the end of the biological year (i.e. biological year 2012 and recruitment from 2013).

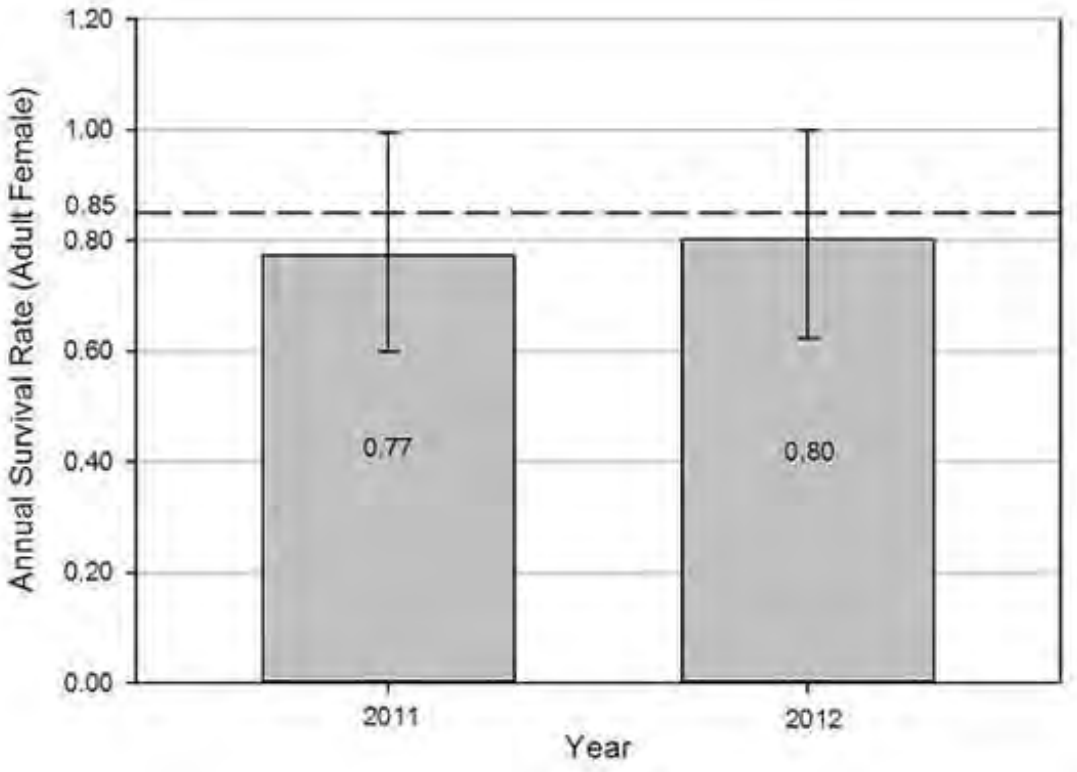


Figure 17. Annual survival rate and 95% confidence intervals of collared adult female caribou which spent the majority of the biological year (April 1st-March 31st) within the Brightsand Range. Dashed line represents the 85% survival rate (EC 2008).

5.2 Habitat state: disturbance and habitat

5.2.1 Disturbance assessment

The disturbance analysis is intended to reflect the loss or conservation of functional habitat and to be an independent and indirect predictor of recruitment and likelihood of stable or increasing population growth (MNRF2014a).

For the purpose of this analysis and in areas for which FRI coverage was available, young forest was defined as being less than 36 years of age (MNRF2014a). In areas without FRI coverage (e.g. Provincial Parks, areas above the Area of the Undertaking), the 2012 Provincial Satellite Derived Disturbance Mapping data, PLC 2000, and various Lands Information Ontario (LIO) layers were used (Figure 18).

Anthropogenic disturbance data included features associated with infrastructure, industrial and resource extraction, and recreation such as:

i. Infrastructure
   - airports sites
   - railroads

- transmission lines (e.g. electric, pipeline, fibre-optics)
- highways/primary/secondary/tertiary roads
- roads, trails, and landings
- water power stations / dams

ii. Industrial and resource extraction
- pits and quarries; mining-related sites
- forest harvest,
- forest processing facilities
- agricultural land
- wind farms

iii. Recreational
- recreational camps and cottages
- commercial campgrounds, outposts, and camps

Anthropogenic disturbances were buffered by 500 metres (MNRF2014a). When buffers overlapped water polygons, the buffer area over water was counted as anthropogenic in the disturbance statistics.

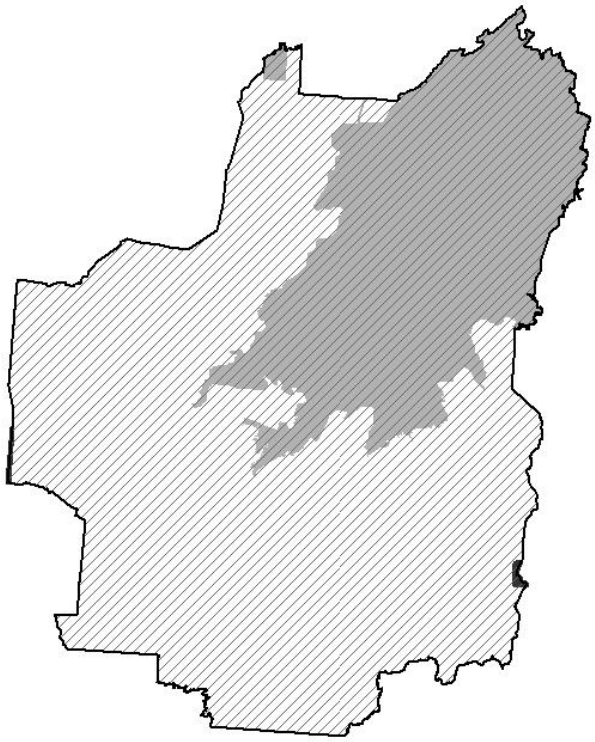


Figure 18. The Brightsand Range including the extent of the FRI data (), the extent of 2012 Provincial Satellite Derived Disturbance Mapping data (), the extent of PLC 2000 data (), and the extent of relevant data from LIO ().

5.2.2 Disturbance analysis results

The physical disturbance from various sources within the Brightsand Range (Figure 19-Figure 24) contributes to the cumulative disturbance footprint (Figure 25). Sections 5.2.2.1 to 5.2.2.6 describe the disturbance contributions of forest harvest, other industry, linear features, mineral development, tourism, and natural disturbances relevant in 2011.

5.2.2.1 Forest harvest

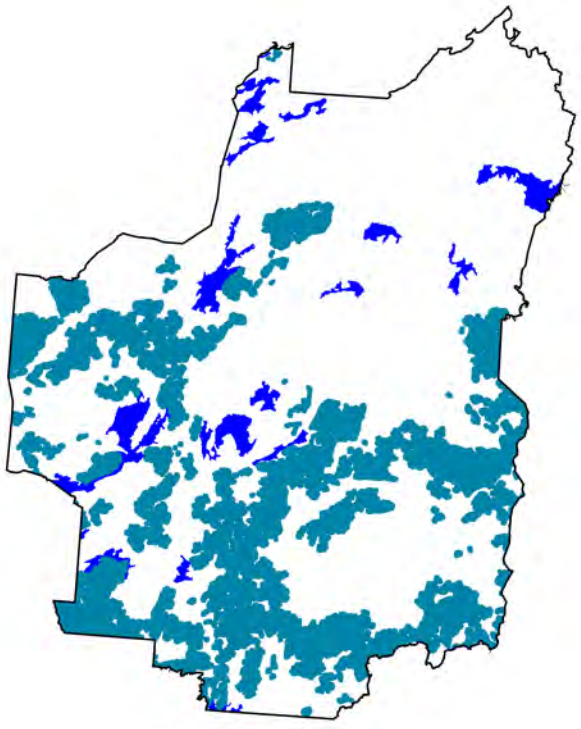


Figure 19. Forest harvest disturbance ( ) including 500 metre buffers in the Brightsand Range.

Table 9. Forest harvest statistics in the Brightsand Range.

Harvest features	Count (n)	Area (ha)	Buffer area (ha)
Harvest stands (FRI)	26,433	219,219	362,000
Harvest areas (2012 Provincial Satellite Derived Disturbance Mapping)	n/a[1]	286	7,699
Harvest areas (PLC 2000)	n/a[1]	321	2,406

[1]derived from land cover (raster) and count of number features not available

5.2.2.2 Other industry disturbance

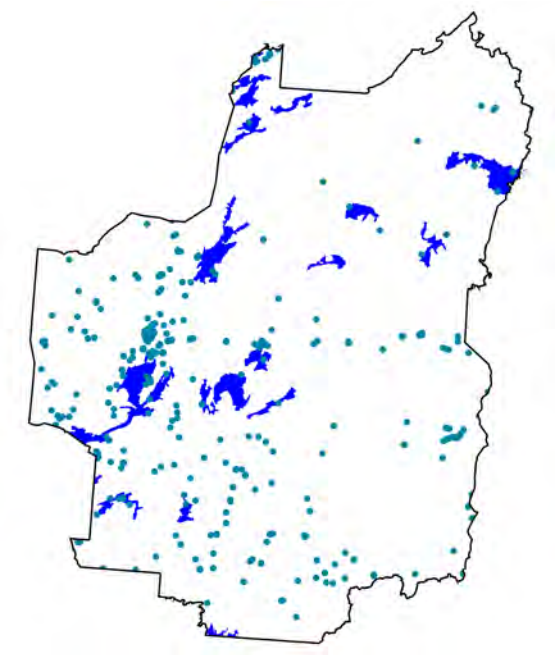


Figure 20. Other industry features ( ) including 500 metre buffers in the Brightsand Range.

Table 10. Other industry disturbance statistics in the Brightsand Range.

Other industry features	Count (n)	Area (ha)	Buffer area (ha)
Agriculture	0	0	0
Airports	10	27	1,074
Buildings	698	n/a[1]	11,760
Dams	1	n/a[1]	79
Forest processing facilities	0	0	0
Trap cabins	94	n/a[1]	6,873
Towers	11	n/a[1]	833
Utility sites	3	n/a[1]	236
Waste disposal sites	20	12	1,624
Water power generating stations	0	0	0
Work camps	21	n/a[1]	1,624

[1]Features are represented by point data types; area not available

5.2.2.3 Linear features disturbance

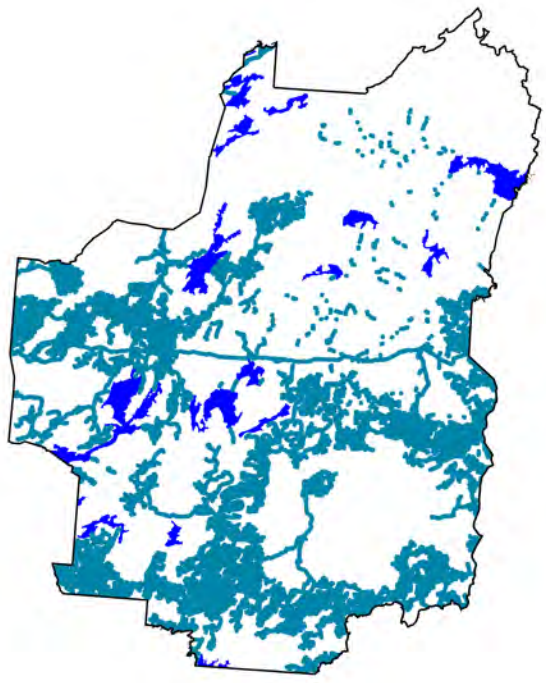


Figure 21. Linear features ( ) including 500 metre buffers in the Brightsand Range.

Table 11. Linear features disturbance statistics in the Brightsand Range.

Linear feature	Count (n)	Area (ha)	Buffer area (ha)
Roads	n/a[1]	n/a[2]	509,405
Trails	n/a[1]	n/a[2]	454
Railways	n/a[1]	n/a[2]	15,398
Utility lines	n/a[1]	n/a[2]	29,050

[1] single line features crossing entire range boundaries or multi-part features

[2]features used in analysis represented by centre-line, not right-of-way; area not available

5.2.2.4 Mineral development disturbance

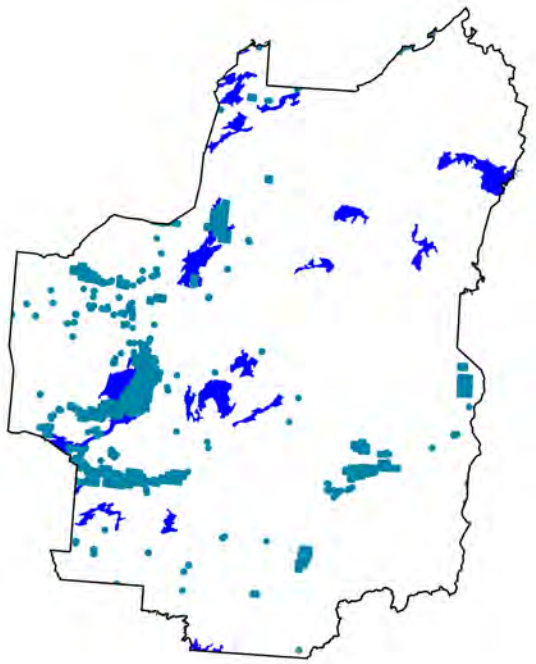


Figure 22. Mining and mineral exploration features ( ) including 500 metre buffers in the Brightsand Range.

Table 12. Mining feature disturbance statistics in the Brightsand Range.

Mining feature	Count (n)	Area (ha)	Buffer area (ha)
Active mining claims	307	54,893	n/a[2]
Aggregate sites – authorized	32	77	3,245
Aggregate sites – un-rehabilitated	3	n/a	236
Drill holes	508	n/a[1]	12,611
Mining locations	0	0	0
Mine (shafts, open pits)	10	<1	514
Pits and quarries	86	90	6,088

[1] Drill holes are “point features”. Disturbance extent is represented by the buffer area.

[2]Active mining claims are not buffered. As no specific disturbance records representing the amount or extent of clearings, drill pads, trails, cut lines etc. are digitally available for these analyses, the entire claim area is considered disturbed.

5.2.2.5 Tourism infrastructure disturbance

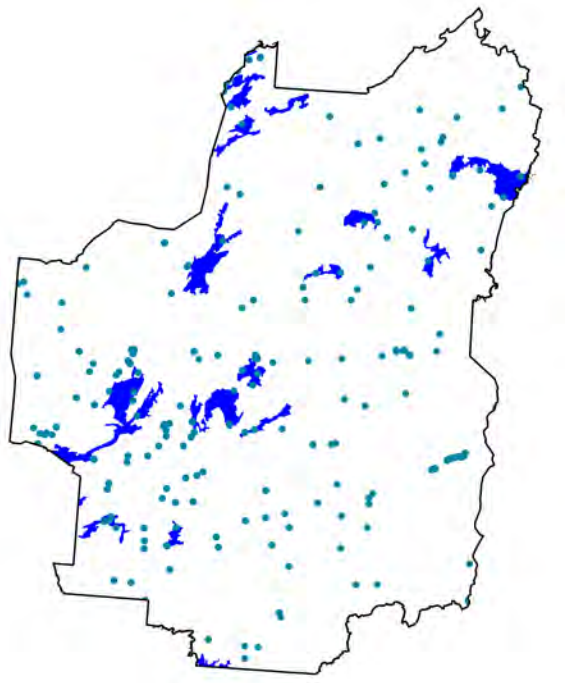


Figure 23. Tourism infrastructure features ( ) including 500 metre buffers in the Brightsand Range.

Table 13. Tourism infrastructure disturbance statistics in the Brightsand Range.

Tourism feature	Count (n)	Area (ha)	Buffer area (ha)
Cottage areas	109	36	1,075
Cottage and residential sites	94	22	3,818
Commercial campgrounds/parking lots/outpost camps/main base lodges	153	46	12,501
Recreational camps	11	<1	790

5.2.2.6 Natural disturbance

Similar to the anthropogenic disturbance analysis, there were several cases where the same landscape disturbance existed in two or more of these datasets. In these cases the most up-to-date source and the source that contained the finest resolution was used.

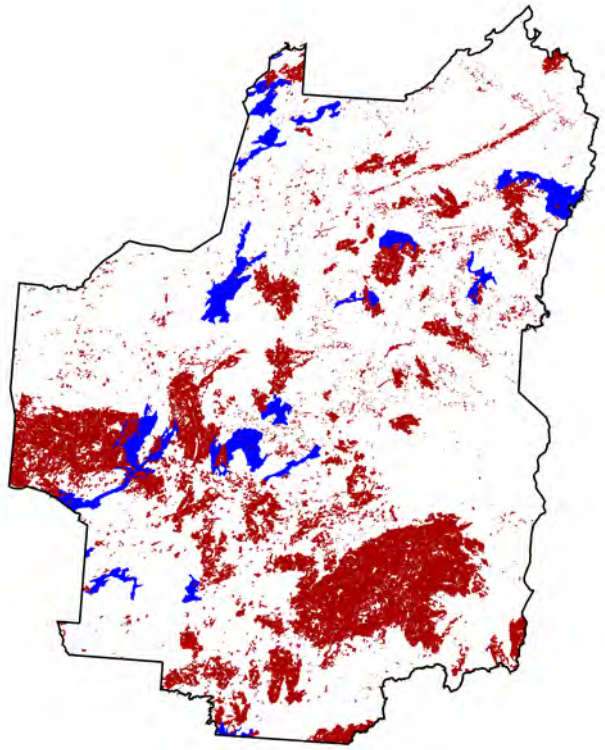


Figure 24. Natural disturbances from fire, blow-down, snow, and insect damage ( ) in the Brightsand Range.

Table 14. Natural disturbance statistics in the Brightsand Range.

Natural feature	Count (n)	Area (ha)	Buffer area (ha)
Natural (FRI)	14,598	232,407	n/a[2]
Fire (2012 Provincial Satellite Derived Disturbance Mapping)	n/a [1]	51,006	n/a[2]
Fire (PLC 2000)	n/a [1]	141	n/a[2]
Fire (LIO)	1	113	n/a[2]

[1]Derived from raster imagery; number of features not available

[2] No zone of influence (buffer) associated with natural disturbance

5.2.3 Disturbance analysis summary

Water accounts for 15.5% of the landscape within the Brightsand Range. Approximately 31.3% of the land area of the range is represented by data sources other than the FRI. Table 15 includes range statistics which assist with the interpretation of the disturbance map (Figure 25). The amount of area, inferred as functional habitat loss identified from the disturbance analysis amounts to 960,607 ha, or 43.5% of the Brightsand Range. Natural disturbance accounts for 10.4% and anthropogenic disturbance accounts for 33.1% of the range. The overlap of natural and anthropogenic disturbances accounts for 2.6% of the range area and 6.0% of the total disturbance, this value is counted as anthropogenic disturbance.

Table 15. Brightsand Range landscape statistics.

Range component	Area (ha)	%
Total range area	2,208,547	100.0
Water	343,406	15.5
Non-water	1,865,141	84.5
FRI extent[1]	1,516,495	68.7
Non-FRI extent[1]	692,052	31.3
Total disturbance within range	960,607	43.5
Natural[2]	229,483	10.4
Anthropogenic[2]	731,125	33.1
- Overlap of natural and anthropogenic disturbance[3]	57,696	2.6
Not disturbed within range	1,247,940	56.5

[1]FRI and non-FRI extents include water

[2]Anthropogenic disturbances include a 500 m buffer. When an anthropogenic disturbance overlaps with a natural disturbance it is counted as an anthropogenic disturbance.

[3]Overlap is included in the total amount of anthropogenic disturbance

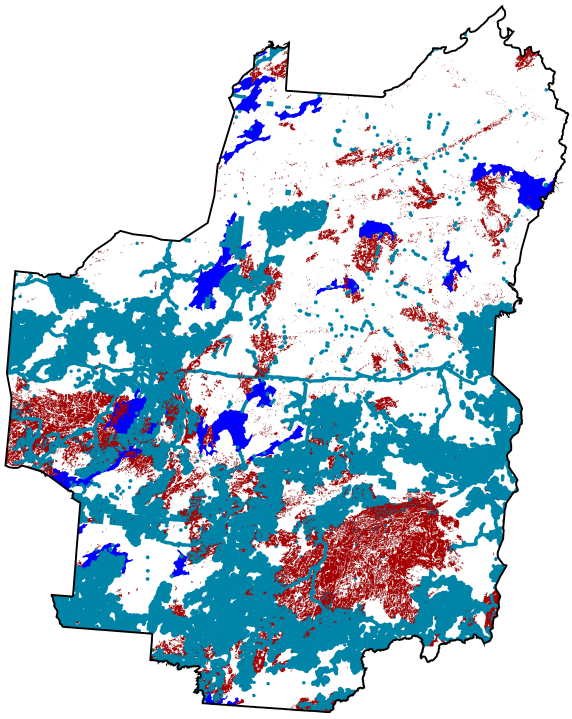


Figure 25. Anthropogenic[1] (■) and natural disturbances (■) (i.e. forest < 36 years) in the Brightsand Range.
[1]Anthropogenic disturbances include a 500 m buffer. When anthropogenic disturbances overlap with natural disturbances it is counted as anthropogenic.

The pattern of disturbance across the Brightsand Range reflected in 100 km^2 hexagons (Figure 26). Disturbance is concentrated in the southern portion of the range as a result of both natural and anthropogenic causes. The northern portion of the range is much less disturbed largely due to the protection provided by Wabakimi Park from resource extraction activities.

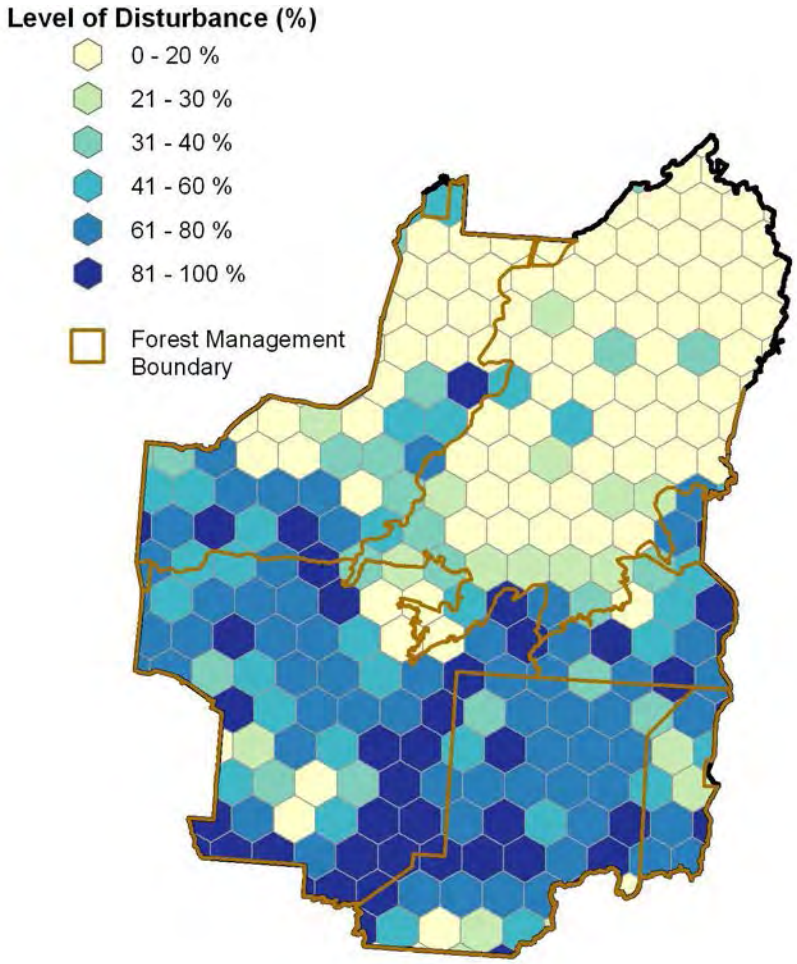


Figure 26. The concentration of natural and anthropogenic disturbances in the Brightsand Range within 100 km^2 hexagon grid cells (used for the probability of occupancy survey, Section 3.3).

In addition to the physical landscape disturbance representing functional habitat loss as described using these methods, sensory disturbance (not addressed in this analysis) may also contribute to range quality to some degree. Sensory disturbance includes the displacement of caribou due to human recreational or industrial activities.

5.2.4 Disturbance considerations related to water

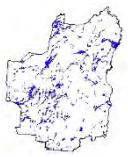
Water accounts for a substantial portion of the Brightsand Range (15.5%) and contributes to the ability of caribou to isolate themselves from predators and the provision of calving habitat. However, the footprint of natural and anthropogenic disturbances (such as wildfires and harvest blocks) does not directly apply to waterbodies within the range. Therefore, the intensity and extent of disturbances and the associated functional habitat loss is likely underestimated when represented as a proportion of the total range area.

A sensitivity analysis was conducted in which waterbodies of different size classes were removed (Table 16) and the proportion of disturbance on the landscape was adjusted

accordingly. This was completed to assist with interpretation of the disturbance analysis results and to inform the interpretation of the integrated probability of persistence calculated using the results of the disturbance analysis.

As the sensitivity analysis shows, water accounts for a combined area of 3,434 km^2 of the range and disturbance ranges from 43.5-51.5%, depending on the inclusion of water.

Table 16. Disturbance sensitivity analysis. The percent disturbance is estimated by removing lakes of differing sizes from the denominator (i.e. lakes > 10,000 ha, lakes > 5,000 ha, lakes > 1,000 ha, lakes > 500 ha, lakes > 250 ha and all water).

Brightsand Range	Waterbody	Water ha (%)	Disturbance (%)		
			Natural	Anthropogenic	All
	Range extent	0 (0.0)	10.4	33.1	43.5
	> 10,000 ha removed	40,524 (1.8)	10.6	33.7	44.3
	> 5,000 ha removed	60,531 (3.2)	10.7	34.0	44.7
	> 1,000 ha removed	241,893 (11.0)	11.7	37.2	48.8
	> 500 ha removed	273,887 (12.4)	11.9	37.8	49.7
	> 250 ha removed	299,648 (13.6)	12.0	38.3	50.3

	All water removed	343,406 (15.5)	12.3	39.2	51.5

5.2.5 Habitat state: habitat assessment

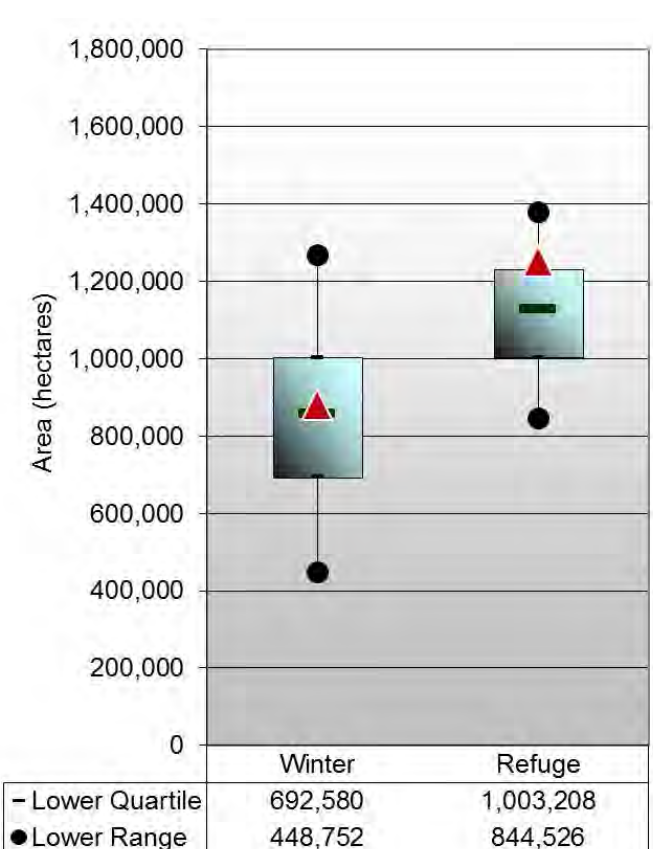
Habitat assessment compares the current amount and arrangement of habitat against that projected by the Simulated Range of Natural Variation, or SRNV (MNRF 2014a). For the Brightsand Range, both the amount and arrangement SRNV are compared against 2012 amounts and 2010 arrangement as inferred from the FRI (Figure 27). The relative difference is a measure of how close or how far away the range's habitat condition is to the natural levels. The SRNV values may be compared to the land, water, and inventory coverage for the Brightsand Range (Table 15).

Figure 27. The Brightsand Range including the extent of the FRI data ( ) and the extent of PLC 2000 data ( ).

5.2.6 Habitat assessment results

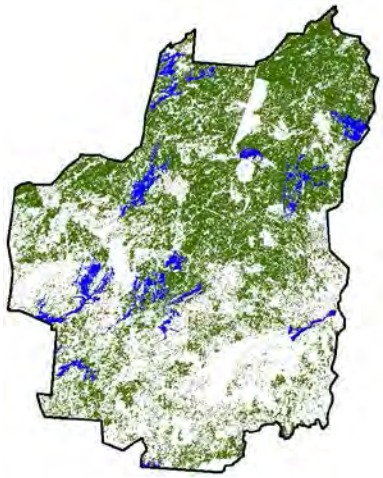
5.2.6.1 Caribou Habitat SRNV Amount

Relative to the SRNV estimate (MNRF 2014a), the amount of winter and refuge habitat are within and above, respectively the interquartile range of what is expected in a natural system projected by the SRNV (Figure 28). The values shown for each FMU include all land regardless of ownership. Consequently, the Integrated Range Assessment estimates are higher than those used in forest management planning which would include managed crown land only.



	Winter	Refuge
Lower Quartile	692,580	1,003,208
Lower Range	448,752	844,526
Median	859,950	1,128,682
Upper Range	1,266,154	1,378,072
Upper Quartile	1,002,864	1,232,110
2012	881,390	1,249,933

Winter Habitat



Refuge Habitat

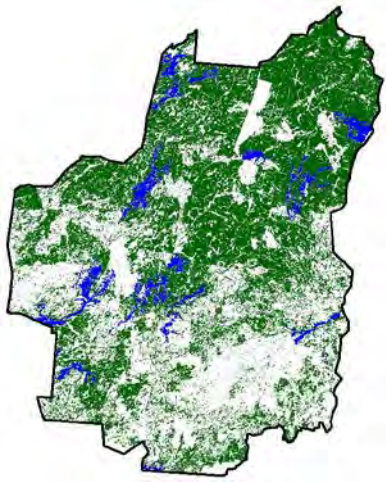
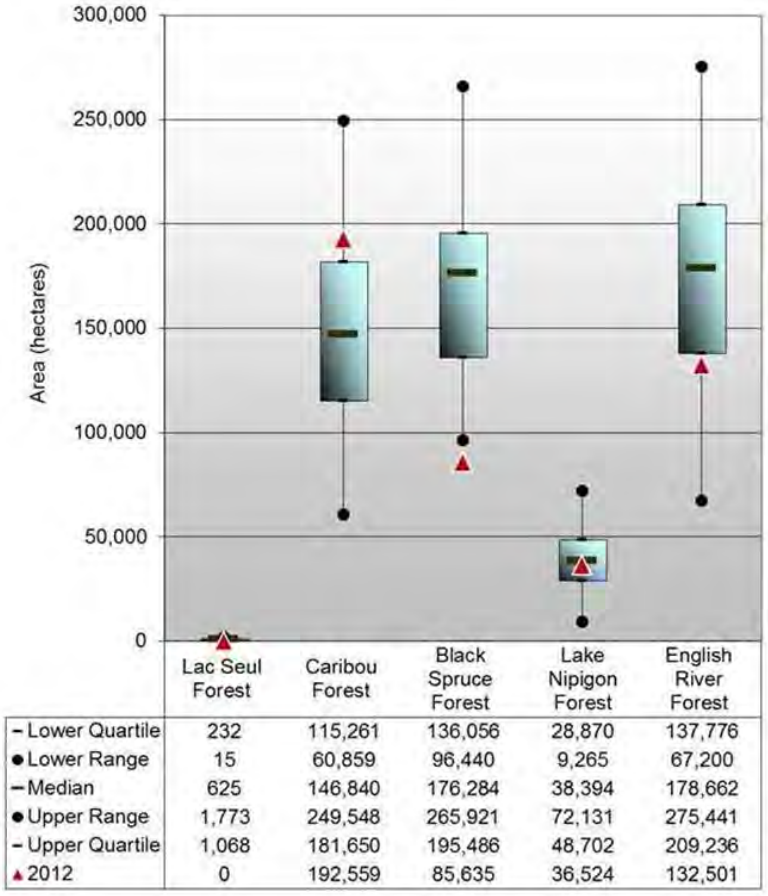


Figure 28. Box and whisker plot of caribou winter and refuge habitat amounts in the Brightsand Range as compared to the SRNV.

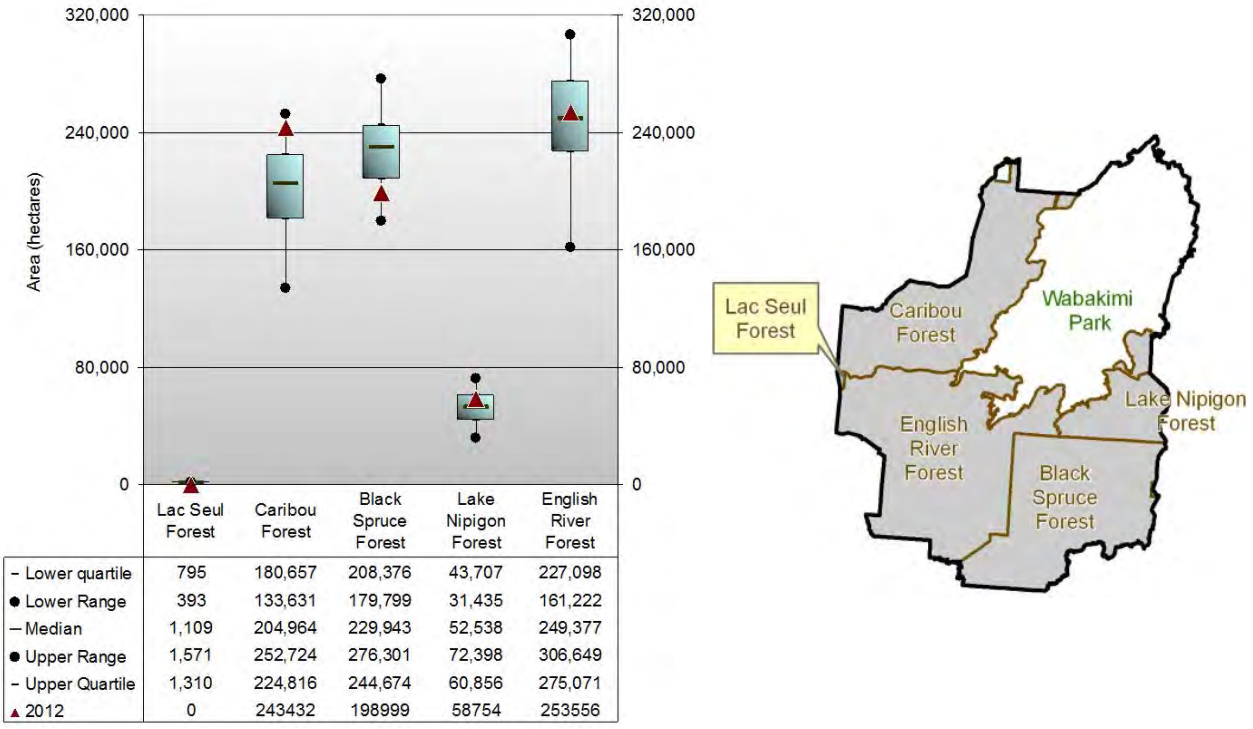
Current winter habitat amounts across the Brightsand Range were examined according to Forest Management Unit (FMU) (Figure 29). The Caribou FMU has a winter habitat value above the interquartile range. Winter habitat is below the median but within the interquartile range for the Lake Nipigon FMU and below the lower interquartile range for the Black Spruce and the English River FMUs.



	Lac Seul Forest	Caribou Forest	Black Spruce Forest	Lake Nipigon Forest	English River Forest
– Lower Quartile	232	115,261	136,056	28,870	137,776
● Lower Range	15	60,859	96,440	9,265	67,200
– Median	625	146,840	176,284	38,394	178,662
● Upper Range	1,773	249,548	265,921	72,131	275,441
– Upper Quartile	1,068	181,650	195,486	48,702	209,236
▲ 2012	0	192,559	85,635	36,524	132,501

Figure 29. Box and whisker plots of winter habitat amount for each of the Forest Management Units within the Brightsand Range as compared to the SRNV.

Current refuge habitat amounts across the Brightsand Range was also examined according to FMU (Figure 30). Refuge habitat within the Caribou, Lake Nipigon, and English River FMUs are above the median. Refuge is below the lower quartile range in the Black Spruce FMU.



	Lac Seul Forest	Caribou Forest	Black Spruce Forest	Lake Nipigon Forest	English River Forest
Lower quartile	795	180,657	208,376	43,707	227,098
Lower Range	393	133,631	179,799	31,435	161,222
Median	1,109	204,964	229,943	52,538	249,377
Upper Range	1,571	252,724	276,301	72,398	306,649
Upper Quartile	1,310	224,816	244,674	60,856	275,071
2012	0	243432	198999	58754	253556

Figure 30. Box and whisker plot of refuge habitat amount as contributed by the four Forest Management Units within the Brightsand Range as compared to the SRNV.

5.2.6.2 Winter habitat arrangement

At the 6,000 hectare level, 31% (0.251 + 0.058 = 0.309) of the hexagons having 61% or more winter caribou habitat (Figure 31). The mean from the SRNV is greater with 42% (0.259 + 0.165 = 0.424) of the hexagons having 61% or more winter caribou habitat. Most of this difference occurs in the 81-100% proportion class. This represents a present arrangement value 11% below the SRNV.

At the 30,000 hectare level, 26% (0.237 + 0.018 = 0.255) of the hexagons had 61% or more winter caribou habitat. The mean from the SRNV is greater with 38% (0.317 + 0.064 = 0.381) of the hexagons having 61% or more winter caribou habitat. This represents a present arrangement value 12% below the SRNV.

Currently, caribou winter habitat measured at the 6,000 and 30,000 ha levels are fragmented relative to our estimates of the natural landscape.

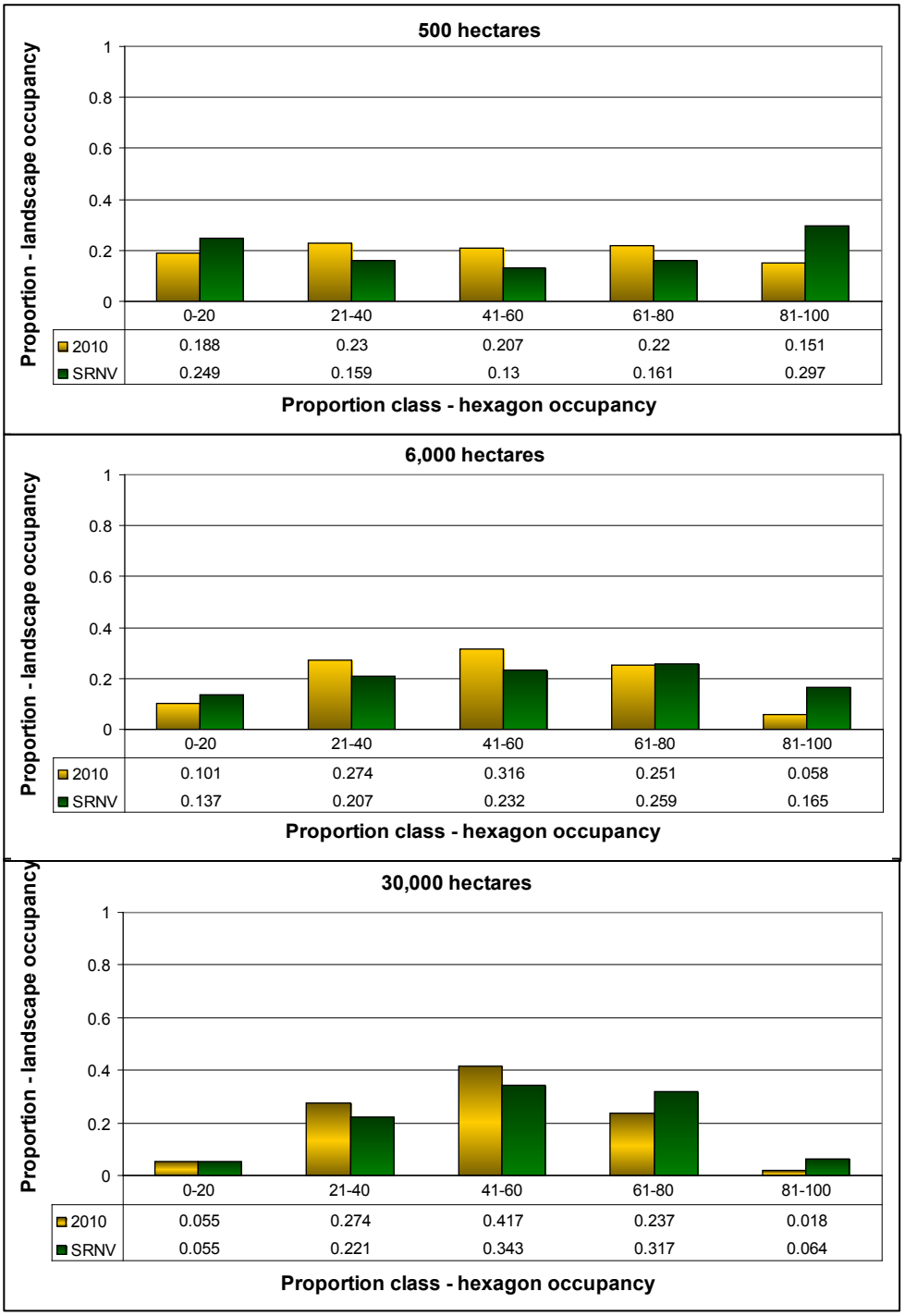


Figure 31. Caribou winter habitat texture histogram compared to means from the SRNV at the 500, 6,000, and 30,000 hectare levels for the Brightsand Range

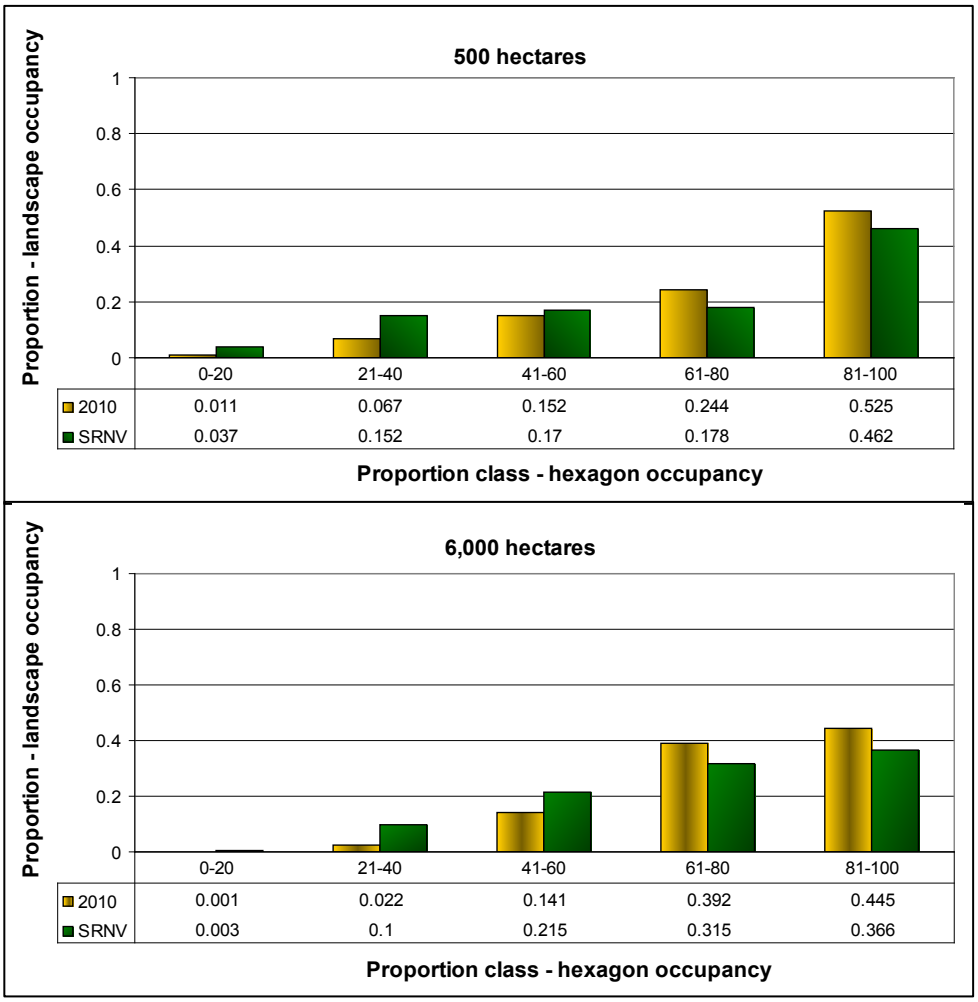
5.2.6.3 Refuge habitat arrangement

At the 6,000 hectare level, 83.7 % (0.392 + 0.445 = 0.837) of the hexagons have 61% or more refuge habitat (Figure 32). The mean from the SRNV is less with 68.1% (0.315+ 0.366 =

0.681) of the hexagons had 61% or more refuge habitat. This represents a present arrangement value 15.6% above the SRNV.

At the 30,000 hectare level, 87.4% (0.472 + 0.402 = 0.874) of the hexagons have 61% or more refuge habitat. The mean from the SRNV is less with 73.3% (0.468 + 0.265 = 0.733) of the hexagons with 61% or more refuge habitat. This represents a present arrangement value 14.1% above the SRNV.

Caribou refuge habitat measured at the 6,000 and 30,000 ha levels are not fragmented relative to the estimates of the natural landscape.



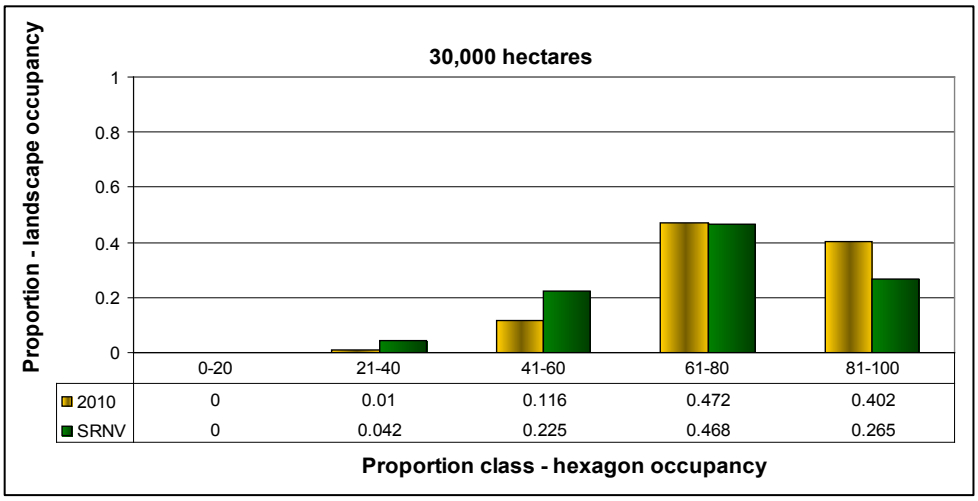


Figure 32. Caribou refuge habitat texture histogram compared to means from the SRNV at the 500, 6,000, and 30,000 hectare levels for the Brightsand Range.

5.2.6.4 Young forest SRNV area results

The current amount of young forest is below the median but above the lower quartile range estimated through the SRNV (Figure 33). This indicates that the current amount is about what would be expected in a natural system. Young forest includes all young forests regardless of source of origin such as fire, logging, or blowdown. Further increases in the amount of young forest above the median will result in expected deterioration in range habitat quality for caribou.

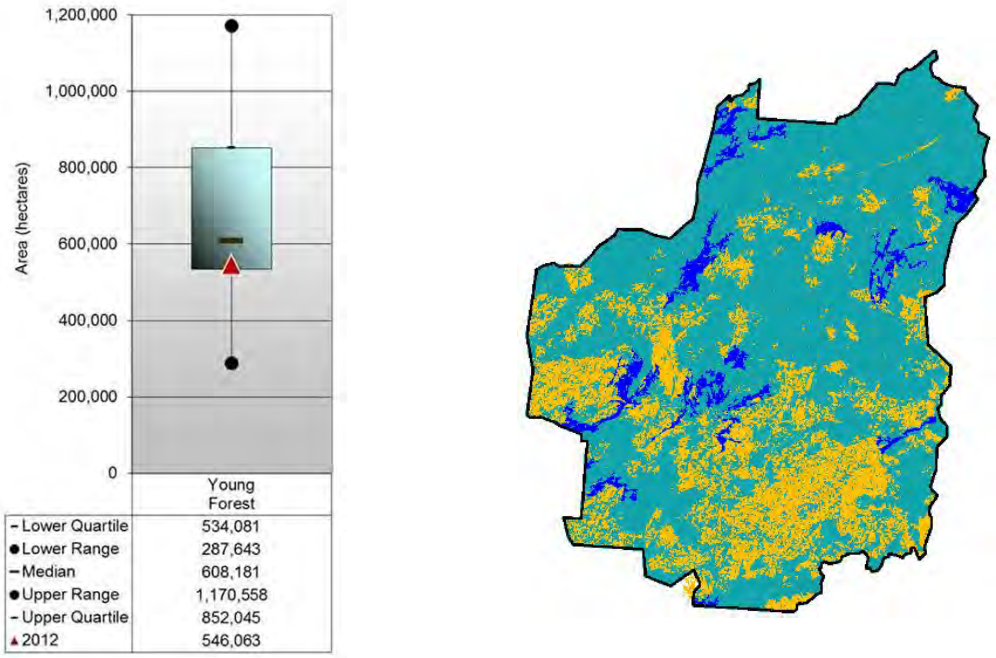


Figure 33. Box and whisker plots of young forest (i.e. <36 years) and permanent disturbance in the Brightsand Range as compared to the SRNV.

6.0 Interpretation of Lines of Evidence

6.1 Interpretation of the population state

The minimum animal count (MAC) of caribou occupying the Brightsand Range during winter of 2011 was 203, based on the combined aerial surveys, although an additional 21 caribou were observed during an incidental flight. Most observations of caribou activity were recorded in the northern part of the range, specifically in Wabakimi Provincial Park. We believe that 203 caribou observed within the Brightsand Range is low relative to the true number of caribou occupying the range. Considering the winter distribution survey covered approximately 5% of the total range area (assuming an observable strip width of 0.5 km from aircraft), the actual number of animals is likely much greater. It is known that surveys of this nature typically only detect a portion of the caribou present; we concluded that this range is occupied by at least 250 caribou and possibly substantially more.

Recruitment rates from 2011 to 2013 (18.2, 22.9 and 25.5 calves per 100 AF_{adj}, respectively) were below the threshold for maintaining a stable population (28.9 calves per 100 adult females, assuming an adult female survival rate of 85%, EC 2008, EC 2011) and indicate low recovery potential within the Brightsand Range. These data indicate that the current number of calves is likely inadequate to maintain the population unless adult female survival is above the 85% threshold. However, annual adult female survival within the Brightsand Range during the 2011 and 2012 biological years was only 77% and 80%, respectively. The resulting average population growth rate (λ) from 2011 to 2013 was in decline (0.87). Based on the current and historical observations, caribou in the Brightsand Range are likely in a long-term decline.

The probability of occupancy estimates were higher in the northern portion of the range, particularly in Wabakimi Provincial Park, as compared to the south. There is an apparent inverse relationship between occupancy estimates (Figure 10) and the amount of disturbance (Figure 12). The average range-wide probability of caribou occupancy without habitat covariates is low with moderate precision (0.32) and is best used as a quantitative benchmark against which to compare future assessment results. Modelled indices are sensitive to the data employed and care will need to be taken to ensure consistency in the survey design standards, data and analytical methods to ensure appropriate comparisons of change through time.

The degree of immigration and emigration across the Brightsand Range boundaries is unknown, although there is evidence from collared animals that they traverse the northern boundary and also the adjacent boundaries with the Churchill and Nipigon Ranges.

6.2 Interpretation of habitat state

More than 40% of the Brightsand Range is disturbed, which is heavily weighted to the southern half of the range. The hexagonal disturbance analysis determined that the concentration of disturbance in the south is high, where 78% of the cells below the CN rail line are over 40% disturbed. Most disturbances are a result of human-caused activities, although large wildfires have also contributed substantially to the disturbance, particularly below the CN rail line. The

northern half of the range has fewer disturbances, which is attributed to the protection provided by Wabakimi Provincial Park (comprising the majority of the northern half of the range) from resource extraction activities.

The level of disturbance on the Brightsand Range is 43.5% (all waterbodies included). As a result, the likelihood of a stable or increasing population growth is uncertain (0.45). The influence of waterbodies in the disturbance analysis should be considered when evaluating the level of disturbance within the range. The water sensitivity analysis (5.2.4) demonstrated that the disturbance estimate for the Brightsand Range may be as great as 51.5% (all waterbodies excluded). At such a level it is unlikely that the range could sustain caribou. However, it is possible that landscapes containing large waterbodies with islands may help compensate for moderate levels of landscape disturbance by providing valuable caribou habitat because the surrounding body of water may provide additional refuge.

Collectively, there are a number of anthropogenic disturbance types not addressed in the above analyses including winter commercial fishing, outfitter activities, access points, camps sites, and shore lunch activities; all of which are suspected to influence caribou, contribute to habitat alteration, as well as sensory disturbance. The extent and intensity of these disturbances are not quantified but the impacts are expected to be considerable at a local scale.

The amount of winter and refuge habitat on the Brightsand Range is currently within and above the interquartile range respectively. With the exception of the Caribou FMU, increasing the amount of winter habitat on all FMUs in the Brightsand Range, and increasing the amount of refuge on the Black Spruce and Lac Seul FMUs would create conditions that would more commonly have occurred in landscapes to which caribou have adapted. Winter habitats within the Brightsand Range are currently fragmented compared to the SRNV at both the 6,000 and 30,000 ha scales, whereas refuge habitat is not fragmented at these scales. Creating and retaining strategically placed large contiguous patches of mature conifer and winter suitable habitat would create conditions that would have more commonly occurred in landscapes to which caribou have adapted.

At present, the amount of young forest (including permanent disturbances) within the Brightsand Range is below the median value of the SRNV.

Islands on large lakes are considered valuable caribou habitat, but the conventional assignment of winter and refuge habitat value is not always appropriate. In this circumstance, the refuge value of islands is typically high, regardless of the underlying vegetation condition, although conifer forest conditions are generally more desirable than mixed forest conditions.

7.0 Integrated Risk Analysis

7.1 Population size

The minimum number of caribou on the Brightsand Range, based on the MAC from the winter 2011 survey is 224 (Figure 34) and likely exceeds 250. The Brightsand Range is part of Continuous Distribution in Ontario and some immigration and emigration likely occurs between neighbouring ranges. By using the minimum animal count of 224, estimates of probability of persistence are likely precautionary. The probabilities of persistence for 20 and 50 years, are approximately 0.92-1.0 and 0.75-0.9 respectively (MNRF 2014a; EC 2011).

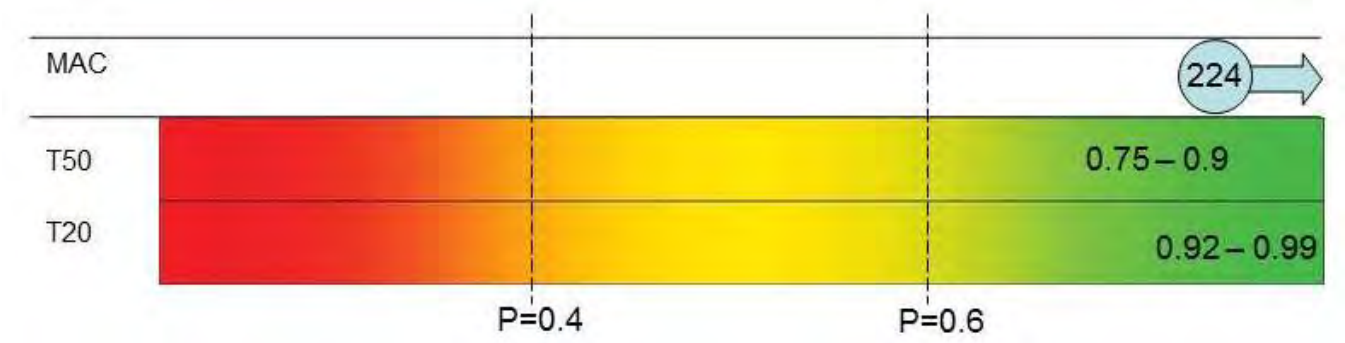


Figure 34. Minimum animal count (MAC) in the Brightsand Range estimated from the 2011 winter aerial survey as compared to probability of persistence in 20 years (T20) and 50 years (T50).

7.2 Population trend

The current estimate of trend, based on 2010-2012 biological years suggest the short-term population trend is declining ($\lambda = 0.87$) (Figure 35). The declining trend is the result of comparatively low adult female survival and calf recruitment. Long-term trends suggest that range recession has occurred within the Brightsand Range as some previously occupied areas in the southern portion of the range are no longer occupied by caribou.

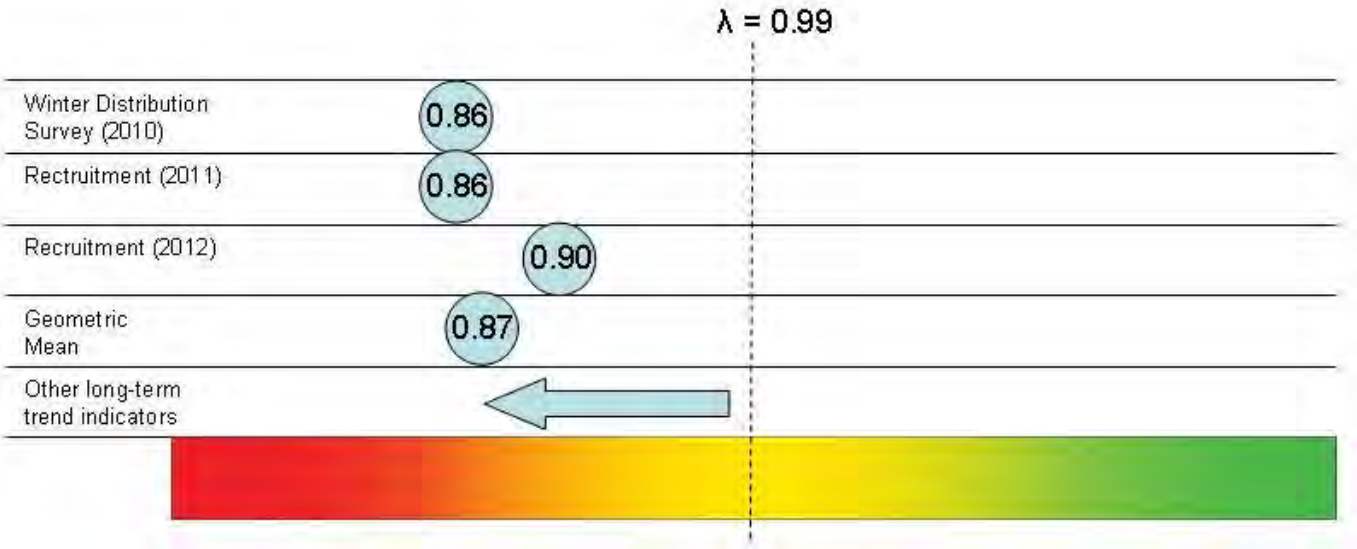


Figure 35. Estimated population trend (λ) for the Brightsand Range according to the source of the data (i.e. survey) and the corresponding biological year (not the survey year), as well as the short-term trend (geometric mean) and long-term trend as determined from other trend indicators.

7.3 Disturbance analysis

The Brightsand Range is 43.5% disturbed (Figure 36). Calculated values of disturbance range from 43.5-51.5%, depending on the treatment of water. When considering the accuracy of fine-scale data used in the disturbance analysis, we believe the calculated value of 43.5% provides a realistic depiction of the amount of disturbance in the Brightsand Range. This level of disturbance would suggest that the likelihood of stable or increasing population growth is approximately 0.45 and is considered uncertain.

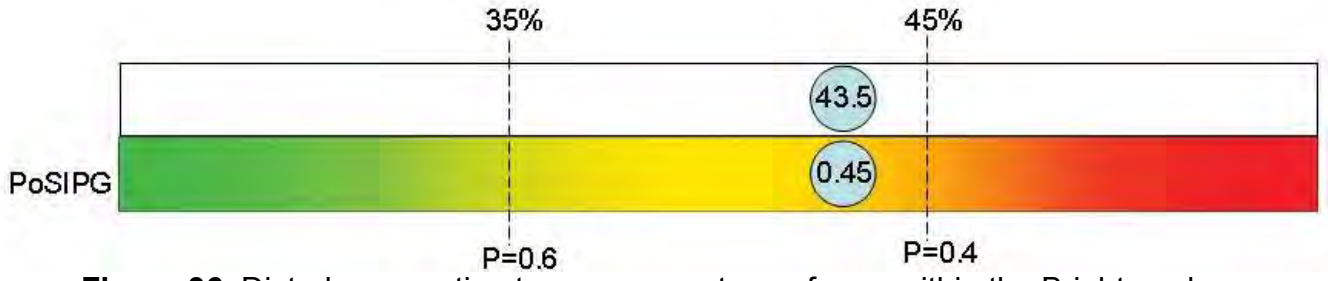


Figure 36. Disturbance estimate as a percentage of area within the Brightsand Range as it relates to the probability of stable or increasing population growth (PoSIPG).

7.4 Risk assessment process

The six steps of the risk assessment process as identified in the Protocol (Figure 15 in MNRF 2014a) lead to a conclusion on degree of risk.

Step 1: Lambda is less than 0.99 and likelihood of stable-or-increasing population growth is greater than 0.4; MAC is greater than 80 caribou.

Step 2: Lambda is available but is less than 0.99.

Step 5: Likelihood of stable or increasing population growth based on the level of landscape disturbance is less than 0.6; *AND* lambda is considered reliable; *AND* the population within the range is not maintained by population management actions.

Step 6: Likelihood of stable or increasing population growth is greater than 0.4.

Based on this analysis, risk to caribou in the Brightsand Range is intermediate.

7.5 Range condition

Risk is estimated to be intermediate in the Brightsand Range. Refuge habitat amount is above the interquartile range and the arrangement is not fragmented. While winter habitat amount is within the interquartile range and the arrangement is fragmented. Thus habitat amount and arrangement of habitat does not support range condition different from that suggested by the risk analysis. Therefore, the Assessment Team determined that it is uncertain if the range condition is sufficient to sustain caribou.

8.0 Involvement of First Nation Communities

The MNRF submitted letters of notification to the First Nation communities of Saugeen and Mishkeegogamang in the months prior to aerial survey work. A meeting with Whitesand community members also took place. A standing offer was in place for any member of these First Nation communities to participate in the rotary-wing survey.

9.0 Comparison with the Federal Generalized Approach

Environment Canada published a *Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada* (EC 2011). Based on available information and specific methodologies used by EC (2011), it was determined that caribou occupying the Brightsand Range as likely as not to be self-sustaining. EC concluded that the Brightsand Range was 42% disturbed; no population estimate or probability of persistence was given based on insufficient available data at that time. These results were based on best available data at the time provided to EC from the MNRF. Data presented in this IRAR will be used by EC to update their analysis in the future.

Differences between the Integrated Range Assessment documented in this report and the results of the EC assessment can be attributed to the following:

1. Ontario estimated a minimum animal count of 224, and suggests the population is larger;
2. The amount of disturbance identified on the range includes additional disturbance associated with mining claims, linear features, and blowdown events which were not

addressed by EC. MNRF used a finer grained depiction of fire disturbance than the broad polygonal fire disturbance used by EC. MNRF determined varied estimates of disturbance associated with stated assumptions relating to the treatment of water in the disturbance calculations.

3. Current recruitment and adult survival estimates derived from the winter 2011 distribution survey and collared caribou, resulted in lambda calculations that suggest a declining trend over the short-term. Other long-term trend indicators suggest a declining trend.
4. MNRF considered amount and arrangement of caribou habitat in the determination of range condition which was not considered by EC.

10.0 Literature Cited

Abex Forest Resource Consultants Ltd. 2009. Caribou Forest: Independent Forest Audit 2004-2009.Queen's Printer. 111 pp + Appendices.

Bergerud, A.T. 1992. Rareness as an antipredator strategy to reduce predation risk for moose and caribou. Pages 1008-1021 *in* Mccullough, D.R., Barrett, R.H. editors. Wildlife 2001: Populations. Elsevier Scientific Publications Ltd., London. 163 pp.

Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? *Rangifer* Special Issue 9: 95-115.

Bergerud, A.T. and R.E. Page. 1987. Displacement and dispersion of parturient caribou at calving as antipredator tactics. *Canadian Journal of Zoology*, 65:1597-1606.

Brown, W. K., Huot, J., Lamothe, P., Luttich, S., Pare, M., St-Martin, G., J. B. Theberge. 1986. The distribution and movement patterns of four woodland caribou herds in Quebec and Labrador. Rangifer, Special Issue 1:43-49.

Brown, G.S., F.F. Mallory, and W.J Rettie. 2003. Range size and seasonal movement for female woodland caribou in the boreal forest of northeastern Ontario. *Rangifer*, Special Issue 14:227-233.

Brown, G., Rettie, W.J., Brookes, R.J., and FF. Mallory. 2007. Predicting the impacts of forest management on woodland caribou habitat suitability in black spruce boreal forest. *Forest Ecology and Management*. 245: 137- 147.

Craig Howard, RPF. 2010. Report of an independent audit of forest management on the English River Forest for the period of 2005-2010. Queen's Printer. 28 pp + Appendices.

Elder, D. 2003. Provincial Species at Risk Year End Report FY 2002-2003: Results of a Woodland Caribou calving habitat survey on Metionga, Hilltop, Two, Gridiron, Sassafras and Duggan Lakes, July 2002. Ontario Ministry of Natural Resources. Northwest Region. Ignace. 20pp

Elkie P., K. Green, G. Racey, M. Gluck, J. Elliott, G. Hooper, R. Kushneriuk and R. Rempel, 2012. Science and Information in support of Policies that address the Conservation of Woodland Caribou in Ontario: Occupancy, Habitat and Disturbance Models, Estimates of Natural Variation and Range Level Summaries. Electronic Document. Ontario Ministry of Natural Resources, Forests Branch. Species at Risk Branch

Environment Canada [EC]. 2008. Scientific Review for the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada. Ottawa, Ontario, Canada. 238 pp.

EC. 2011. Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada: 2011 update. Ottawa, Ontario, Canada, 102 pp + Appendices.

Hatter, I.W. and W.A. Bergerud. 1991. Moose recruitment, adult mortality and rate of change. *Alces* 27: 65-73.

Johnson, C.J., Boyce, M.S., Case, R.L., Cluff, H.D., Gau, R.J., Gunn, A., and Mulders, R. 2005. Cumulative effects of human developments on Arctic wildlife. *Wildlife Monograph* 160: 1-36.

Land Information Ontario (LIO). 2012. Lands Information Ontario Warehouse. Peterborough, Ontario: Ont. Min. Natur. Resour. Digital database.

MacKenzie, D.I., J.D. Nichols, G.B. Lachman, S. Droege, J.A. Royle, and C.A. Langtimm. 2002. Estimating site occupancy rates when detection probabilities are less than one. *Ecology*, 83: 2248-2255.

McLoughlin, P.D., E. Dzus, B. Wynes, and S. Boutin. 2003. Declines in populations of woodland caribou. *Journal of Wildlife Management*, 67:755-761

Moreau, G., D, Fortin, S. Couturier, and T. Duchesne. 2012. Multi-level functional responses for wildlife conservation: the case of threatened caribou in managed boreal forests. *Journal of Applied Ecology*, 49:611-620.

Ministry Natural Resources [MNR]. 1988. Timber management guidelines for the provision of moose habitat. Ont. Min. Natur. Resour. Rep. Toronto, 33pp.

MNR. 1994. *Northwest Region Interim Caribou Habitat Management Direction.* Ont. Min. Natur. Resour. Northwest Region. Thunder Bay. 4pp

MNR. 1999a. Ontario's Living Legacy Land Use Strategy. MNR, Queen's Printer for Ontario, Toronto, Ontario. 40pp + Appendix.

MNR. 1999b. A management framework for woodland caribou conservation in northwestern Ontario. MS Report, MNR, Thunder Bay, Ontario.

MNR. 2009a. Ontario's woodland caribou conservation plan. MNR. 24 pp.

MNR. 2009b. Cervid ecological framework. MNR, Queen's Printer for Ontario, Toronto, 18 pp.

Ministry of Natural Resources and Forestry [MNRF]. 2014a. Integrated Assessment Protocol for Woodland Caribou Ranges in Ontario. Species at Risk Branch, Thunder Bay Ontario.

MNRF. 2014b. Range Management Policy in Support of Woodland Caribou Conservation and Recovery. Species at Risk Branch, Thunder Bay, Ontario.

MNRF. 2014c. Delineation of Woodland Caribou Ranges in Ontario. MNRF, Species at Risk Branch, Thunder Bay, Ontario.

Ontario Woodland Caribou Recovery Team. 2007. Recovery strategy for woodland caribou (*Rangifer tarandus caribou*) (Forest-dwelling, boreal population) in Ontario. MNR, Peterborough, Ontario. 93 pp.

Racey, G.D. 1991. Preparing for caribou management in the boundary areas between Northwestern and North Central Regions. MNR Internal Report. Northwestern Ontario Forest Technology Development Unit, Thunder bay, Ontario. 26 pp.

Racey, G., A. Harris, L. Gerrish, E. Armstrong, J. McNicol, and J. Baker. 1999. Forest management guidelines for the conservation of woodland caribou: A landscape approach. MNR, Thunder Bay, Ontario. 69 pp + Appendix.

Racey, G.D. and T.J. Honsberger. 2009. An Evaluation of Forest Disturbance in the Armstrong Airport woodland caribou (*Rangifer tarandus caribou*) wintering area after a severe winter storm event. Northwest Science and Information, MNR, Thunder Bay, Ontario. 24 pp + Appendix.

Rettie, W.J., and F. Messier. 1998. Dynamics of woodland caribou populations at the southern limit of their range in Saskatchewan. *Canadian Journal of Zoology* 76: 251-259.

Rettie, W.J. and F. Messier. 2000. Hierarchical habitat selection by woodland caribou: its relationship to limiting factors. *Ecography* 23: 466-478.

Rose, M. and G.D. Racey. 2011. Caribou in the New Forest: Lessons from South Allely Lake and 20 years of Caribou Habitat Management on the English River Forest. Northwest Science and Information, MNR, Thunder Bay, Ontario. 29 pp + Appendix.

Rudolph, T.D. 2005. Trout Lake Conservation Reserve Vegetation Management Strategy. Ontario Ministry of Natural Resources, Red Lake, Ontario. 74pp + Appendices.

Schaefer, J.A., Bergman, C.M., and S.N. Luttich. 2000. Site fidelity of female caribou at multiple spatial scales. *Landscape Ecology* 15: 731-739.

Schaefer, J.A. and W.O. Pruitt Jr. 1991. Fire and woodland caribou in south-eastern Manitoba. *Wildlife Monograph* No.116: 3-39.

Stratton, C. 2012. Far North Calibration Plot Sampling. Ring of Fire Summer 2010. File Report. Northwest Science and Information, Ontario Ministry of Natural Resources, Thunder Bay, Ontario. 56pp + tables and maps.

Wittmer, H.U., McLellan, B.N., Serrouya, R. and C.D. Apps. 2007. Changes in landscape composition influence the decline of a threatened woodland caribou population. *Journal of Animal Ecology* 76: 568-579.