Ontario

Integrated Range Assessment for Woodland Caribou and their Habitat

Kesagami Range 2010

Ministry of Natural Resources and Forestry
Species at Risk Branch

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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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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 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 Approach). 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, supports 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 range condition relative to its ability to sustain caribou.

The Kesagami Range is located in northeastern Ontario and is approximately 47,400 km^2 in size. The landscape is largely characterized as James Bay Lowlands with extensive wetland complexes in the north and boreal forest in the south with many rivers and few small lakes throughout. There is high caribou occurrence in the northern part of the range where quality refuge habitat is provided by open fens, conifer forests, linear riparian forest stands, and disturbance is low. In contrast, the south is highly impacted by human activity most notably timber harvest and settlement and caribou occurrence is minimal – although recent sightings in the Hicks-Oke Bog area at the southern range boundary is encouraging. Developmental activities include ongoing mineral exploration, forest harvest, and construction of a winter road to the community of Moose Factory is underway.

Collaring data shows a strong connection to adjacent habitat in Quebec indicating that the Kesagami Range of Ontario is a piece of what appears to be a larger geography used by caribou in the area.

A two-stage (fixed-wing followed by rotary-wing) aerial winter distribution survey for caribou was conducted during January, February, and March 2010 in which observations of caribou or their signs were recorded. During the rotary-wing flights, caribou were identified as adult males or females, calves, or caribou of unknown age and sex. Data collected during the survey work as well as Moose Aerial Inventory survey data was used to estimate population state metrics including a minimum animal count of 178 caribou and provide an estimate of calf recruitment. Additional aerial surveys were conducted during late winter 2011-13 to further assess calf recruitment to support estimates of population trend. Recruitment rates over the four recent survey years (13-15 calves per 100 adult females) were much lower than expected values thought to support a stable to increasing population trend (28 calves per 100 adult females). Twenty four (24) adult female caribou were collared as part of the range assessment in 2010 and 2011; another 69 were collared as part of another research project between 2010 and 2012. Geometric mean annual survival of these animals was 0.88, and ranged from 0.79-0.95, suggesting survival is good. However, the short-term population trend is likely declining with a geometric mean of $\lambda = 0.94$. This estimate suggests a declining trend and is the result of comparatively low calf recruitment and is supported by other long-term trend indicators.

A geospatial analysis estimated that 43.8% 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 Kesagami Range is capable of sustaining the caribou population.

Analysis of the amount and arrangement of caribou habitat does not align with that expected in a natural landscape.

The Integrated Range Assessment concludes risk to caribou is uncertain within the Kesagami Range and the range condition is insufficient 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 Kesagami Range is approximately 47,400 km^2 in size and is located in northeastern Ontario (Figure 1). It neighbours the Pagwachuan Range, the James Bay Range, James Bay, and the Quebec border. The range includes much of the Abitibi River Forest Management Unit (FMU) and some parts of the Gordon Cosens and Romeo Malette FMUs. This range has abundant caribou telemetry data from the last decade which when combined with other current and historic occupancy data informed the range boundary delineation (MNRF 2014c).

The range is bordered by Lake Abitibi in the southeast, and the Northern Claybelt Forest Reserve Complex (Hicks-Oke Bog) to the southwest. Evidence was based on historic ranges and records of calving/nursery functions associated with those areas. The provisional range in the north is bounded by the Moose and Mattagami rivers in the west, James Bay in the north and the Quebec border in the east. The range extends into Quebec and caribou move freely across the Ontario-Quebec border. The north-south axis is the largest of the southern ranges, extending up to 300 km (Figure **2**).

The southern boundary represents a compromise between the dominant risk factors associated with complex urban and agricultural developments including the towns of Smooth

Rock Falls, Cochrane, and Iroquois Falls and the longer term potential for connectivity within the southern extent of the range. The decision to establish the southern boundary of the range where it currently exists was based on this potential for connectivity, recent sightings of caribou and the current forest condition within the areas of Lake Abitibi and the Hicks-Oke Bog. The stands within these areas are coming of age to allow caribou re-occupation and this has been supported through recent winter sightings of caribou and caribou sign. High occupancy occurs in the northern half of the range where quality refuge habitat is provided by open fens, conifer forests, and linear riparian forest stands.

Quebec believes that they too have relatively continuous range of forest-dwelling woodland caribou. They have informally delineated caribou ranges based on winter use areas, although there is considerable overlap during the snow-free period. These include the LaSarre, Nottaway, Assinica and Temiscamie herds from west to east, respectively (V. Brodeur (Quebec MRNF) personal communication 2012; Rudolph et al. 2012). They also recognize that they share caribou with Ontario. These shared caribou are most often referred to as the LaSarre herd but other names such as the Quebec-Ontario Frontier herd have also been used (Hovington et al. 2010). The eastern boundary delineation of range use varies among authors but primarily encompasses the area from the provincial boundary to just east of the Harricanaw River and from the 49°30’ latitude north to 51°30’ latitude (Paré et al. 2006). Aerial inventory and information from collared animals were the primary data sources used.

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

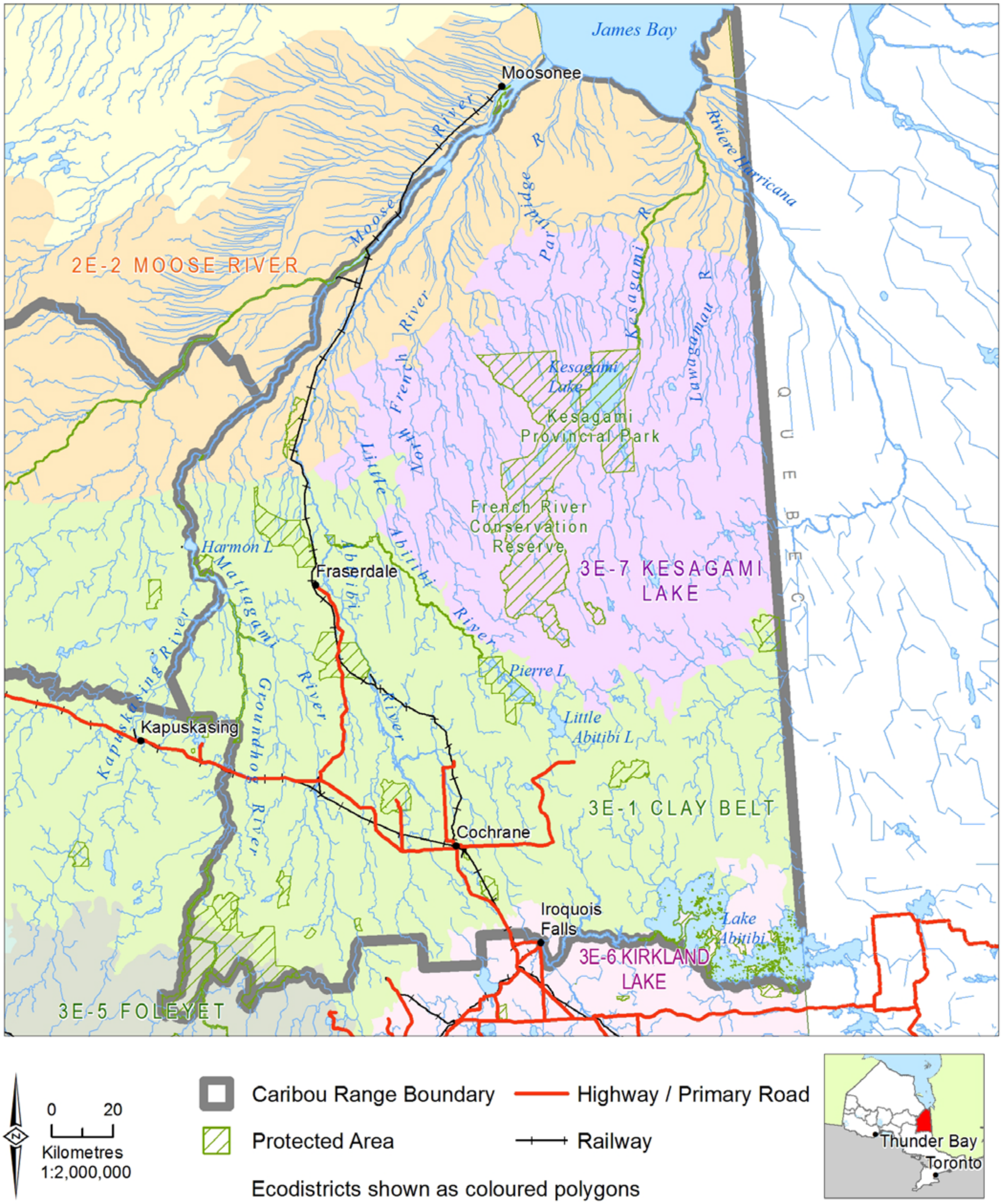


Figure 2. The Kesagami Range and associated ecodistricts and protected areas.

3.0 Background Information and Data

3.1 Land management history and management direction

Caribou occupying the southern and western portions of the Kesagami Range have been exposed to a wide variety of factors influencing the amount and arrangement of various forest conditions including natural and anthropogenic factors including large fires, blowdown, and forest harvest (Figure 3, Table 1), as well as infrastructure such as town sites, roads, railways, transmission corridors, hydroelectric facilities, mineral development, protected land, and federal land (Figure 4, Table 1). The northern and northeastern portions of the range have relatively low levels of anthropogenic disturbances. It is imperative to document and interpret the disturbance history within the range in order to better understand current caribou use. Implementation of the Range Management Approach is set against a backdrop of this management direction (Table 1). Figure 3, Figure 4, and Table 1 include land management history as well as natural and anthropogenic disturbances up until 2010.

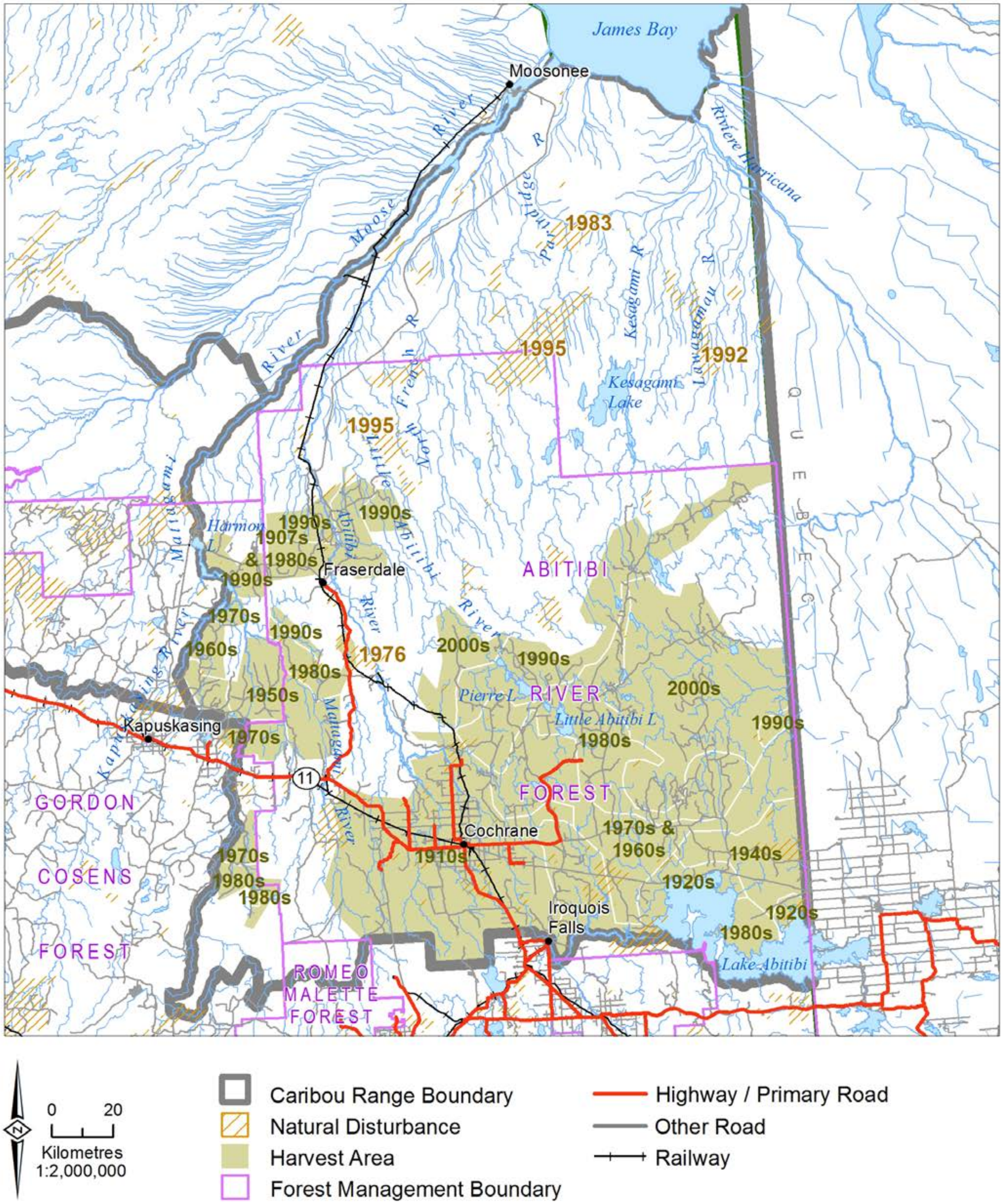


Figure 3. Dates and locations of significant historical natural and anthropogenic disturbances that have occurred within the Kesagami Range.

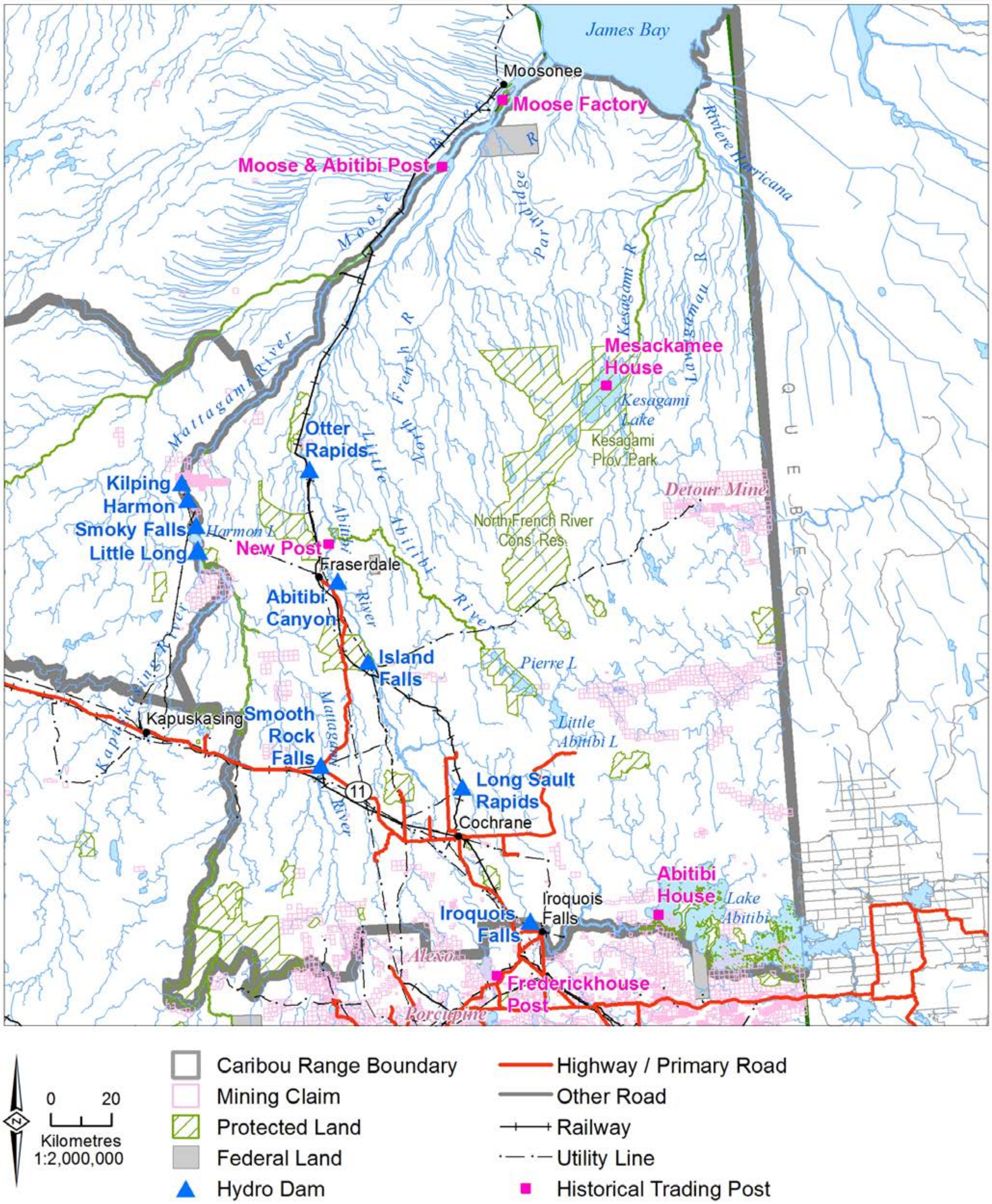


Figure 4. Human infrastructure and historical developments occurring within the Kesagami Range.

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

Significant event, activity or direction **Natural and anthropogenic disturbance (significant fire or blowdown)**	**Dates**	**Description**	**Likely influence on caribou or its habitat**
Fires	1902	777,000 hectares (ha)	Reduced large area of older forest in vicinity of Kesagami Lake
152 documented fires	1920s - 2000	Four largest were 44,000 ha, 35,000 ha, 14,000 ha, and 10,000 ha	The overall fire regime allowed for mostly a relatively old conifer forest that had the capability to support caribou in the absence of logging. The relatively small contribution of fires meant that logging and natural succession were the dominant factor influencing forest age class distribution.

Significant event, activity or direction **Forest Management**	**Dates**	**Description**	**Likely influence on caribou or its habitat**
	Early 1900s	Logging very active within Timiskaming District during settlement of the Little Claybelt; following logging, land clearing with bush fires was used to help establish agricultural fields.	Reduced amount of older forest and converted land use to agriculture.
	1910	Forestry operations along north shore of Lake Abitibi and establishment of community of Lowbush.	Habitat disturbance around what was likely a regionally significant calving lake; may have reduced access to Lake Abitibi islands.

1930	Northwest Industrial Road constructed around this time as logging extended north of Transcontinental Railroad; logs transported by railway to Iroquois Falls until conversion to road in 1950s	Broad-based habitat disturbance resulting in increase in alternate prey species (e.g. moose)
1960s	Timber operations in Fraserdale area, wood shipped by railway; Hwy 632, Translimit Road between Cochrane and Quebec; Pierre Lake Road constructed with extensive timber harvest occurring south and north of Pierre Lake into the 90s	Habitat disturbances resulting in increase in alternate prey species (e.g. moose)
1983	Opening of Hwy 652 to Detour Lake Gold Mine, opened up new access for forestry operations	Permanent loss of late winter habitat due to aggregate extraction for roads (e.g. highway, mining, and forestry). Potential loss of use of habitat as highway travels along major esker ridge. Habitat conversion to more mixedwood along major roads benefiting alternate prey species (e.g. moose and potentially deer).
2000	Construction of Chabbie Lake Road and associated branch and operations roads	West-east linear corridor through contiguous caribou habitat – third major corridor (Translimit to south and mine road to north); associated habitat disturbance through logging; increased density of linear corridors; permanent loss of late winter habitat due to aggregate extraction for road construction

Significant event, activity or direction Infrastructure Development	Dates	Description	Likely influence on or its caribou habitat
Agricultural development	1891	Farming of Little Clay Belt began	Permanent loss of caribou habitat and invasion by alternate prey species (e.g. moose and deer). Conversion of habitat to agriculture
Mining	1907-09	Mineral rush associated with Cobalt and Porcupine	Influx of mineral explorers throughout the region at a time when caribou were still legally hunted.
Community construction	1908	Settlers arrived and founded town of Cochrane	Conversion of habitat to agriculture, timber harvesting at a time when caribou were still legally hunted.
Railroad	1909	Temiskaming and Northern Ontario Railway. Construction started in 1903 near Temagami and reached Cochrane area in 1908. National Transcontinental Railway construction (1908-13) from Quebec to Cochrane and Hearst. Construction (1921-32) from Cochrane to Moosonee.	East-west linear corridor which may have impacted caribou movement south to the Hicks-Oke bog. NTR was constructed on the north shore of Lake Abitibi potentially limiting lake access. The Cochrane to Moosonee construction (along with the transmission line corridor) created a north-south linear corridor.
Human settlement	1910	European settlements along railways became established, resulting in land clearing for agricultural sustenance and bush cutting for residential, commercial and industrial buildings.	Conversion of habitat at a time when caribou were still legally hunted and invasion of alternate prey species (e.g. white-tailed deer) during late 1920s.

Community construction	1913	Towns of Smooth Rock Falls and Iroquois Falls became established as a result of timber mill construction. Other small communities appeared along the railway both west (Frederickhouse, Hunta, Jacksonboro, Strickland and Fauquier) and north (Gardiner, Wurtele, Maher, McInnis, Brownrigg, Fraserdale, Foxville and Coral) of Cochrane.	Conversion of habitat to agriculture, timber harvesting at a time when caribou were still legally hunted.
Water Power Construction	1914-1966	Hydroelectric development at Iroquois Falls, Smooth Rock Falls, Island Falls, Abitibi Canyon, Otter Rapids, Smoky Falls, Little Long, Harmon, Kipling; Newpost Diversion	Created linear corridors for roads, transmission lines and railway at a time when caribou were still legally hunted; increased timber harvest for construction and fuel
Mining	1917, 1974, 1983	Alexo Mine in Dundonald Twp (east of Frederickhouse Lake) had two periods of production (1917 and 1943) shipping 49,000 tonnes of ore. Discovery of gold (1974) led to the opening of Detour Lake gold mine in 1983. Access first established via winter road through Quebec; Opening of the Detour Highway (652) to Detour Lake gold mine which provided access for forestry	Influx of mineral explorers at a time when caribou were still legally hunted. Increased caribou habitat disturbance and creation of habitat for alternate prey species (e.g. moose); linear corridor density increase in mine site area; loss of habitat through aggregate extraction and open pit mining; increased recreational use

		companies to more northern areas for timber harvesting (1983)	
Highway Construction	1925, 1966	Construction of Hwy 11 between North Bay and Cochrane (Ferguson Hwy.); later extended west to Thunder Bay (TransCanada); Highway 632 constructed from Smooth Rock Falls to Fraserdale	Resulted in influx of settlers and land clearing for agriculture, as well as forestry for construction of buildings or timber sale
Trans Canada Pipeline	1950s	TransCanada Pipeline construction through Cochrane	East-west linear corridor

Significant event, activity or direction			
Land Management Direction	**Dates**	**Description**	**Likely influence on caribou or its habitat**
Cochrane District Land Use Plan	1981	Introduced concept of protecting caribou habitat from development in order to protect existing population.	Impact of plan was limited because Plan was largely inaccessible.
Cochrane District Land Use Guidelines	1983	Objective to manage caribou for the conservation and maintenance of the species and its habitat with a target of eventually viewing or hunting caribou on a sustained basis.	Developed strategy for identifying, managing, and protecting caribou habitat.
Kesagami Lake Provincial Park	1983	56,000 ha. Includes Kesagami Lake and Kesagami River to James Bay; established as a	The area is well used by caribou as has been documented by satellite collars and First Nation traditional knowledge.

		Wilderness Class Park in 1983 and expanded in 1984	
Crown Land Use Policy Atlas (CLUPA)	1983	Compilation of land use policies with minimal mention of caribou protection	Critical caribou areas protected in the Wekwayauwkastik River General Use Area(G1761), Northern Resource and Commercial Recreation (G1754) General Use Area, Remaining ('straggler') Lakes (B) (G2085) General Use Area and Two Peaks General Use Area (B) (G2083)
Little Abitibi Provincial Park	1985	20,000 ha. First established pre-1985 as Pierre-Montreuil Park Reserve, then re-classed as a Natural Environment Park and included the Little Abitibi River downstream to Newpost Creek and Newpost Falls	Numerous caribou observations were reported by anglers during the off-ice season. The area to the north was not harvested prior to 1985 and is known caribou habitat
Ontario's Living Legacy	1999	Creation of a number of dedicated protected areas and enhanced management areas with specific conservation considerations for caribou	Protected areas within the Kesagami Range increased by 65%. and the following areas provide current or potential protection for caribou habitat: • Nahma Bogs and Poor Fens (3,606 ha) C1598 – 2004 • North Muskego River Mixed Forest (3,283 ha) C1578 – 2004 • Coral Rapids Wetland (6,105 ha) C1712 – 2004 • Kesagami River Outwash Plain (2,251 ha) C1607 – 2004 – caribou mentioned • Pinard Moraine (18,201 ha) C1582 – 2004 • Mahaffy Township Ground Moraine (640 ha) C1586 – 2004 • Seguin River Conifer and Fens (6,833 ha) C1612 – 2004 • Tembec Wetland (8,149 ha) C1711 – 2004 –

			caribou mentioned • North of the North French River (158,286 ha) C1606 – 2004 – caribou mentioned
Cochrane Moose River Management Unit (CMRMU) Forest Management Plan (FMP)	1998-2003	First Northeast Region FMP to consider elements of caribou habitat management. In the absence of NER caribou habitat management guidelines, the planning team designed an adaptive management approach that included management objectives and strategies for ensuring known caribou habitat values were protected to gather and document information on forest operations and to carry out silviculture aimed to the regeneration of caribou habitat.	This initiative led to a comprehensive science-based study over the next several years (1998-2001) to document animal movement, habitat use and knowledge of habitat selection/avoidance.
Woodland Caribou Management in Northeastern Ontario – Interim Habitat Management Direction	1999	Provided interim direction on forest management activities to protect caribou values within the Continuous Distribution. Direction was based on information gained from a research study (1998-2001).	Resulted in a focused landscape approach to consolidate disturbed areas and seek current and future large retention patches for the conservation of caribou.
Forest Management Planning (FMP) - Cochrane Moose River	 2003-08	Expansion of caribou habitat management into Forest Management Units abutting the CMRMU as new	Resulted in the protection of current habitat use and strategic placement of forest pattern deferrals to maximize connectivity between known use areas. Additionally, planned timber harvest blocks focused

MU - Smooth Rock Falls Forest - Gordon Cosens Forest - Iroquois Falls Forest - Cochrane Moose River MU - Abitibi River Forest (Invitation to Participate State)	2005-10 2005-10 2005-10 2008-10 September 2010	occurrence information became available.	on the creation of future habitat through clean-up of past disturbance events or building on existing disturbances to minimize both road development and a scattered disturbance event landscape. Operational based management objectives and strategies were developed to varying degrees for road strategies and silvicultural renewal to maintain caribou habitat utility. The Abitibi River Forest FMP was the first FMP on this geography to meet the requirements of the CCP.
Provincial Forest Access Road Funding Program	2005	Intended to maintain primary access roads; later expanded to include construction and maintenance of primary and secondary access roads.	Maintained or encouraged road building into previously inaccessible areas in support of resource development increasing linear disturbances within caribou habitat.
Cervid Ecological Framework	2009	Strategic ecological landscape level policy on how to manage caribou, moose, deer, and elk in relation to each other.	Within caribou landscapes, maintain and manage densities of other cervids that reflect natural ecological conditions with caribou having a higher consideration.
Moose Population Setting Guidelines and Moose Harvest Management Strategy Guidelines	2009	The Moose Management Policy is complimented with these two guiding documents in setting moose population objectives within an ecological context with appropriate harvest management strategies.	Provides guidance on setting moose densities and appropriate harvest management strategies to reflect natural ecological conditions within caribou landscapes.
Caribou Conservation Plan	2009	Vision is to have self-sustaining caribou populations	To maintain self-sustaining genetically-connected local populations of caribou where they currently

		in a healthy boreal forest. .	exist, improving security and connections and facilitating the return of caribou to key areas.
Science and Information in support of Policies that address the Conservation of Woodland Caribou in Ontario- Ontario Landscape Tool	2009	Package which contains historic occupancy maps, descriptions of habitat and disturbance models, habitat tracts, simulation results and estimates of natural variation prepared as of the analysis, science and information that was used in preparing supporting background for the Forest Management Guide for Boreal Landscapes and in support of the CCP.	This package describes techniques, methods and results specific to caribou habitat for both landscape and range level indicators. Such science and information packages have been used in the development of Forest Management Plans since 2009.
Forest Management Guide for Boreal Landscapes	2014 (has been implemented since 2009 draft)	Objective of the guide is to direct forest management activities to maintain or enhance natural landscape structure, composition, and patterns that provide for the long-term health of forest ecosystems in an efficient and effective manner.	Guide implementation has influenced caribou habitat retention strategies in FMPs.

Range disturbance history (Table 1, Figure 3, and Figure 4) shows a progression of forest harvest from Lake Abitibi and the southern boundary northwards. The construction of the Hwy 652 accelerated the disturbance into the northeast portion of the range. The construction of hydroelectric dams, railway, transmission lines and Hwy 634 increased the disturbance in the west.

The cumulative contributions of these historical developments have created a forest and infrastructure landscape described by this range assessment along with the existing status of the caribou population.

3.2 Caribou occupancy history and assessment

Caribou observations within the Kesagami Range have been identified and recorded within Land Information Ontario (LIO 2012). Observations documented in this report are current to June-August 2013 (Figure 5, Figure 6). The summary of previous caribou assessments within the range that estimate or describe population size, health, or occurrence providing historical context and assisting with the interpretation of the current Integrated Range Assessment results (Table 2). These observations may include data results from surveys, collared caribou, research projects, as well as credible casual observations from MNRF staff and the general public (Figure 5, Figure 6, and Figure 7). Historically, these observations reflect our knowledge of caribou occurrence within the range and the possible response to changes in range condition. Habitat use, movement patterns, survival and recruitment of caribou have been well monitored within the Kesagami Range and Quebec as a result of the deployment of 113 satellite/GPS collars on adult female caribou between 1998 and 2012.

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

Date	Caribou Occupancy	Reference
1925	Caribou appeared regularly during winter at Lake Abitibi up to 1921; now do not come closer than 25 km to north of Lowbush; some used to summer on Lake Abitibi islands (locally the disappearance has been attributed to forest fires (1916 especially), moose presence and more deer; logging activity on north side of Lake Abitibi).	Snyder 1928
1950	Little caribou information for Cochrane District but appear to be decreasing numbers; caribou observed in townships of Hicks, Oke, Poulett, and Aitken southeast of Kapuskasing	de Vos 1948.
1951	Caribou listed as “sole big game animal” of Lake Nipissing but had disappeared by 1900. Caribou were reported at New Liskeard in 1905 but with settlement they disappeared. Very few caribou herds remain in Cochrane District but a fair population in neighbouring Quebec; undoubtedly movement occurs across boundary	de Vos and Peterson 1951
1958	Caribou map showing distribution across Ontario during 1956-57 winter as reported through trapline surveys. Caribou in Hicks-Oke	Dept. of Lands and Forests 1958.

	Bog area, along Mattagami River north of Rene Brunelle Provincial Park and from just south of Kesagami Lake north.	
1967	Wahgoshig First Nation member indicated no caribou observed south of Lake Abitibi since 1967 although two observations were recorded in the late 1990s	George Sackaney, pers. comm. 2009
1977	A "conservative non-statistical estimate" of population was 200-1,000 caribou in Wildlife Management Unit 26.	Stewart, R.W. 1977. The 1976-77 caribou aerial inventory of Wildlife Management Unit 26. MS. Rep. Ont. Min. Nat. Res., Cochrane, Ont.
1981	200-1000 caribou in WMU 26, small scattered herds. Big Island on Kesagami Lake is known rutting and part of migratory route. Grace and Day lakes occasionally inhabited by caribou. A relic population of 5-9 animals was reported to be in WMU 30, most likely the Hicks-Oke Bog. Large increases of caribou on lands they currently occupy not feasible. First Nation subsistence harvest is estimated to be 10-15 caribou/year.	Cochrane DLUP Background Document
1984	Aerial transect moose survey in WMU 26 in which a caribou density estimate of 0.014/km^2 with a calculated population estimate of 403. This was based on 56 caribou observed during the transect survey.	Dawson, F.N. and D.A. Payne. 1985. The 1984-85 aerial survey of moose and woodland caribou in W.M.U. 26. MS. Rep. Ont. Min. Nat. Res., Cochrane, Ontario.
1997	Large number of caribou (200+) over-wintered near Detour Gold Mine; synthesis of historical and recent sightings information on the landscape	MNR Cochrane
1998-2001	Research study near Detour Gold Mine to track 30 adult female caribou. Provided information on range use, habitat selection, population parameters. Flights in 1999-2001 were conducted to count all caribou groups	Brown 2003, 2005, 2006, 2007 Lantin 2003, Lantin et al. 2003

	that were located using telemetry monitored animals and ranged from 65 animals to as many as 232 between years. Survival was estimated to be 0.79 and λ=0.88.	Proceviat 2003, Proceviat et al. 2003 Wilson 2000
2001/2006	Quebec inventory – 2001 minimum animal count of 196; 2006 minimum animal count of 142 (see survey summary Table 7). Similar surveys in this area occurred in 2001, 1999, 1996 and 1993. Survey conducted in 2011.	Paré et al. 2009
2005-2009	Surveys generating minimum animal counts ranging from 23-142.	MNR Cochrane

Figure 5. Caribou occurrence across Ontario summarized by date of most recent observation as of June 2013. Assessment activities within the Kesagami Range have been variable. Absence of observations may reflect low survey effort, lack of reporting, or the absence of caribou.

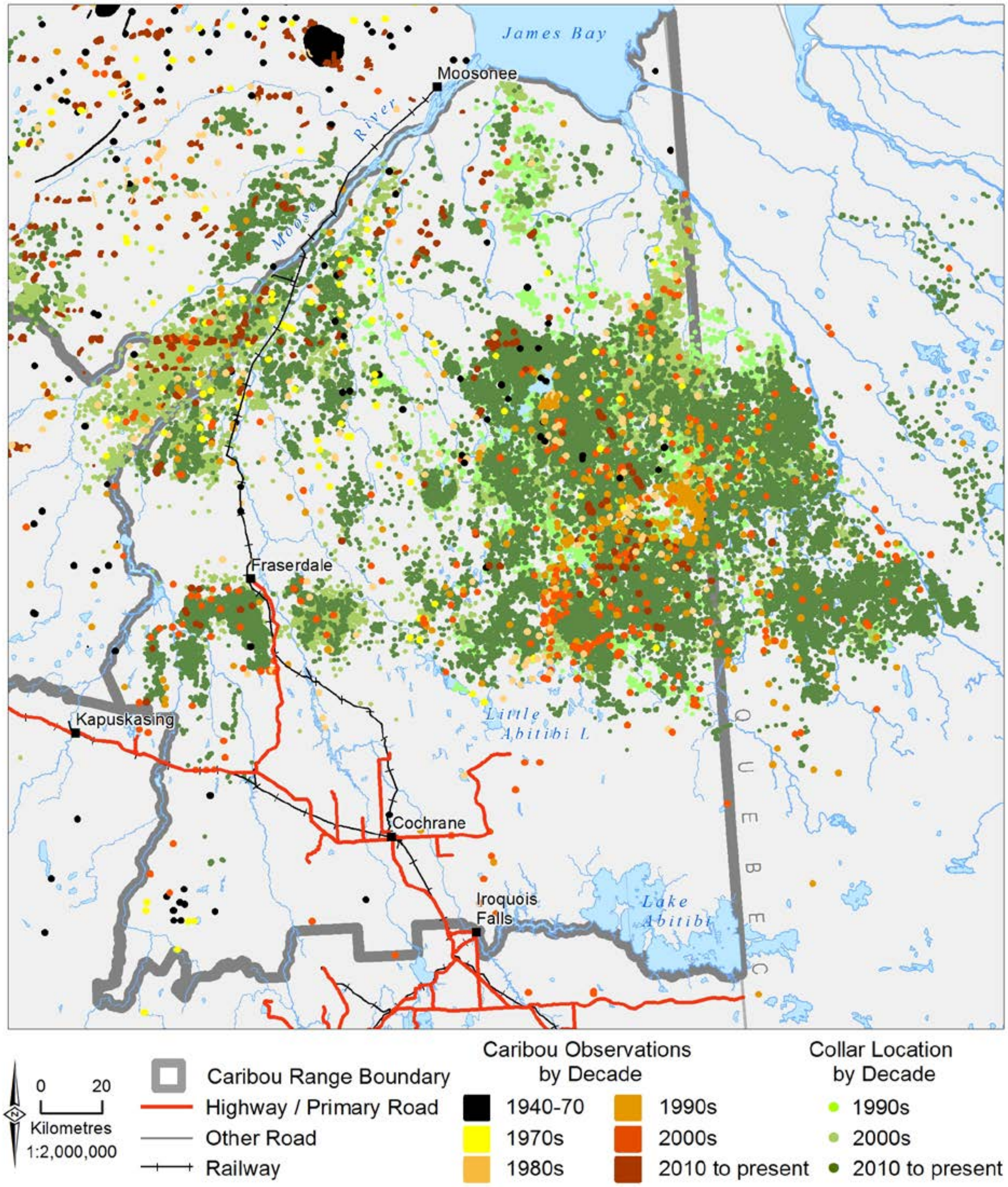


Figure 6. Historical caribou observations[1] within the Kesagami Range and surrounding area including observations from aerial surveys, collared caribou locations, research projects, and casual observations as of August 2013.

[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 the caribou is much larger as they move throughout the year.

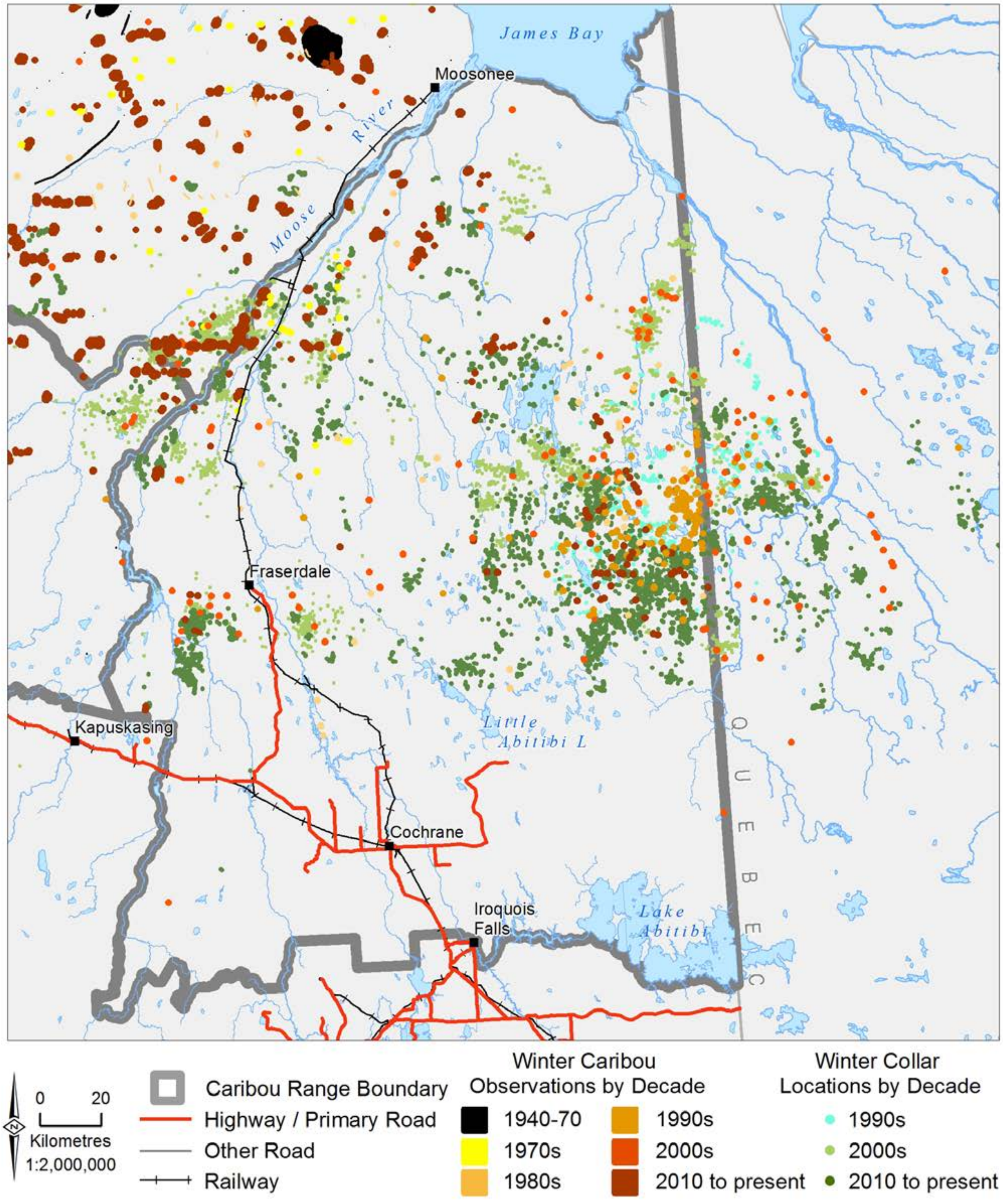


Figure 7. Caribou observations in the Kesagami Range during February and March from all observation sources (i.e. aerial surveys, collared caribou locations, and casual observations) as of August 2013.

3.3 Probability of occupancy survey and analysis

Presence of caribou was identified during an aerial fixed-wing transect survey conducted in February and March, 2010 as well as the moose aerial inventory (MAI) of WMU 26 conducted during January 2010. The pooling of data from two independent surveys was required due to the deterioration of snow conditions that prevented the completion of the hexagon-based transect survey. 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 and the moose aerial inventory survey consisted of flying 5 km interval linear transects (Figure 8). Each hexagon is approximately 100 km^2 and 10.6 km across. Between two and four repeat visits were conducted on a portion of hexagons. Spatial patterns in occupancy (i.e. probability of occupancy) within the Kesagami Range were estimated using methods described by MacKenzie et al. (2002).

No animals were physically observed in the southern half of the range, roughly south of Pierre Lake (Figure 8). A number of caribou signs or sightings were observed in the vicinity east and southeast of Kesagami Lake to the Quebec border.

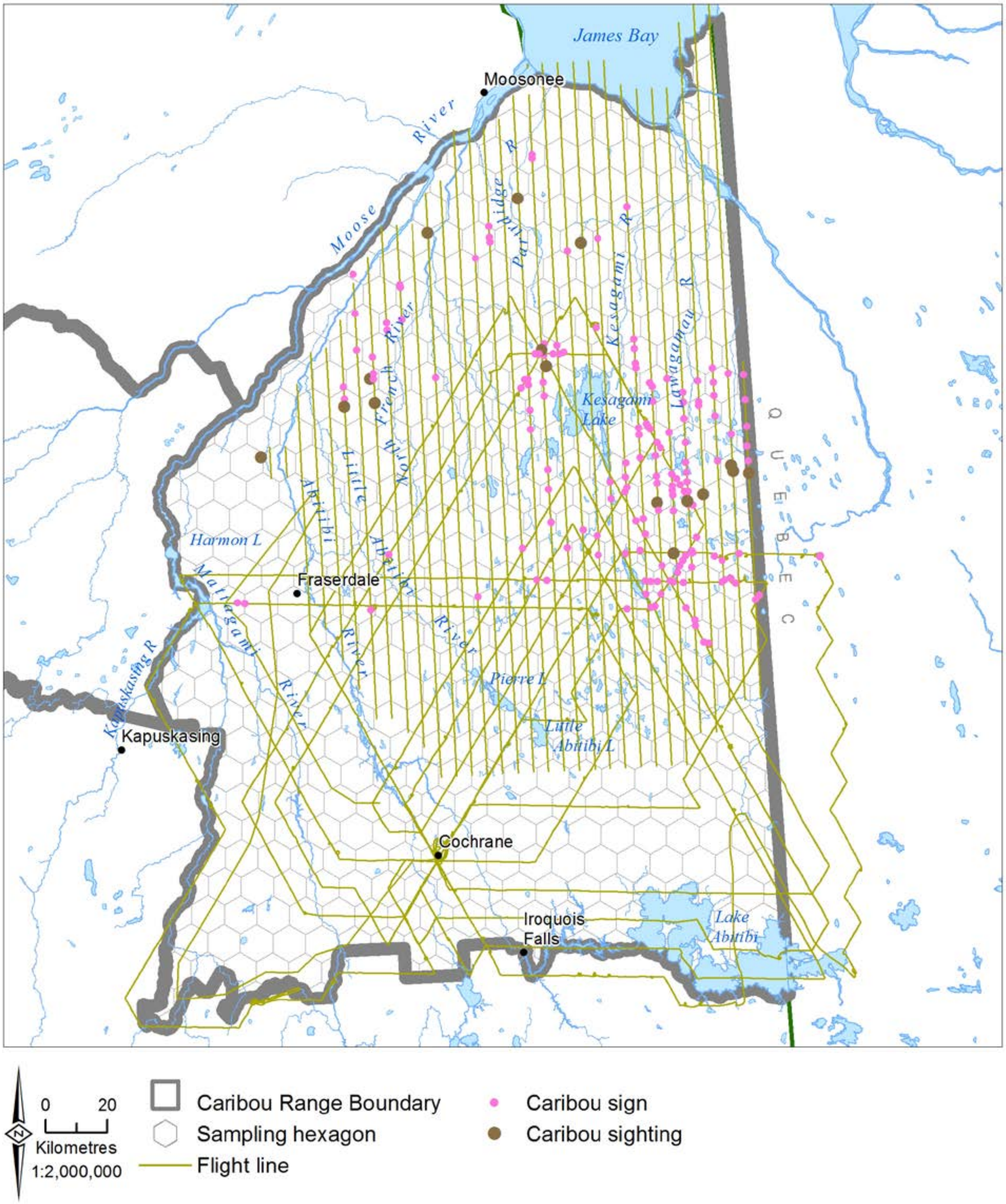


Figure 8. Fixed-wing aerial survey transects on the Kesagami Range following the hexagon sampling grid as well as survey transects from moose aerial inventory surveys flown on a linear grid during the winter of 2010. Observations of caribou and their sign are also shown from the surveys; any evidence of caribou presence from either survey 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. 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. Survey conditions during the year may have influenced detection, and modified caribou distribution and behaviour.

The occupancy model without covariates suggested that overall probability of caribou occupancy (ψ) on the Kesagami Range was relatively low (ψ = 0.35, S.E. = 0.05, 95% C.I. = 0.26-0.45). The uncertainty in the occupancy estimate, represented by the standard error and confidence interval, suggests that existing levels of survey effort will detect moderate to large changes in occupancy of caribou with respect to a single estimate for the entire range.

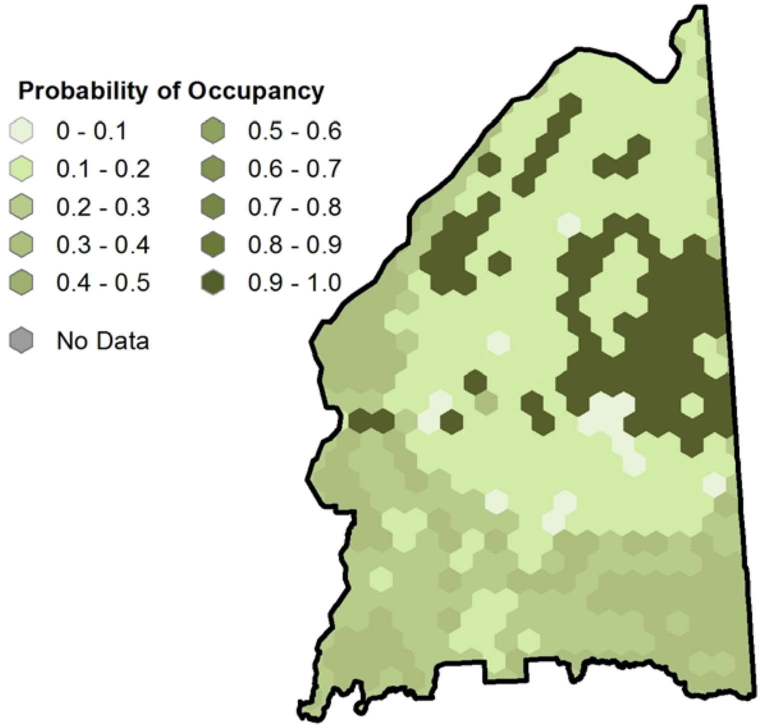


Figure 9. Probability of occupancy across the Kesagami Range conditional on detection (i.e. ψ = 1) where caribou were confirmed to be present from data collected during the winter 2010 aerial survey.

The probability of caribou occupancy was significantly correlated with habitat covariates (Table 3, Figure 10, and Figure 11). The best predictive model suggested the probability of occupancy was negatively correlated with disturbance and positively correlated with the amount of treed bog (Table 3).

Table 3. Untransformed estimates of coefficients for habitat covariates used in the caribou occupancy model for the Kesagami Range. The model detection probability is 0.35. Parameters shown in bold have confidence intervals that do not contain zero.

Parameter	Estimate[1]	Standard Error	Lower Confidence Interval	Upper Confidence Interval
intercept	**-2.65**	**0.63**	**-1.42**	**-3.88**
Treed bog	**0.09**	**0.03**	**0.15**	**0.03**
Sparse forest	0.08	0.05	0.18	-0.02
Conifer	**0.02**	**0.01**	**0.04**	**0.00**
Disturbance	**-0.05**	**0.02**	**-0.01**	**-0.09**

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

This model differentiated among areas of low and high probability of occupancy. Disturbance has a negative relationship with occupancy (Figure 12) whereas preferred suitable habitat (i.e. conifer, sparse forest, treed bog) has a positive relationship. Although distance to roads was not retained as a significant variable in the model, the negative relationship to caribou occupancy is evident from the lower probability of caribou occupancy along the main highway in the southern portion of the range (Figure 12). The occupancy model that contains habitat covariates permits estimation of individual estimates of caribou occupancy (ψ) for each hexagon, based on their unique habitat composition. Generally, hexagons with caribou known to be present at the time of the survey have a relatively high probability of occupancy (0.6 to 0.7). The spatial pattern of occupancy values among hexagons indicated patchy distribution with many hexagons having low occupancy values (Figure 10). Reliable estimates of occupancy for individual hexagons will be particularly important for tracking changes in caribou distribution within the Kesagami Range.

The predicted occupancy of caribou may be overestimated southwest of Kesagami Lake (Figure 10). Patches of suitable habitat occur in this area; however, evidence suggested that caribou were not regularly observed here during aerial winter surveys or through telemetry monitoring of collared animals throughout the year from 1998-2001 and 2006-12. It is not clear why caribou are not frequently observed in this area of apparently suitable habitat. Possible reasons may include the relatively low density of caribou, range fidelity, and availability of suitable habitat elsewhere on occupied portions of the range. While the model may overestimate the actual occupancy of caribou on the Kesagami Range in this respect, this aspect of the model also provides a useful tool for mapping potentially important priority areas for future range management decisions intended to restore caribou in those areas.

Negative effects of anthropogenic landscape disturbance on caribou distribution and population persistence have been documented both in this range (Brown et al. 2007) and other jurisdictions (Wittmer et al. 2007). The relatively low occupancy rates of caribou on the southern portion of the Kesagami Range are consistent with the prevalence of disturbance. Also, the positive correlation between caribou occupancy and treed bog and conifer forest is consistent with findings from a local study of fine-scale caribou habitat selection (Brown et al. 2007).

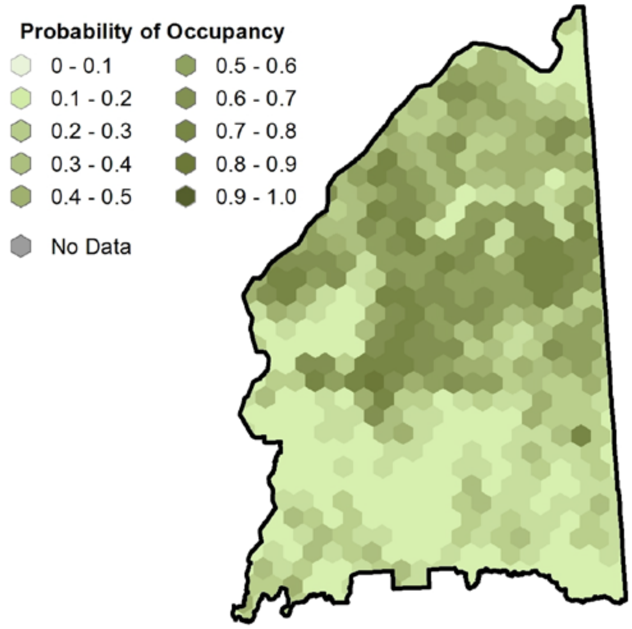


Figure 10. Probability of occupancy derived using habitat covariates across the Kesagami Range using the best predictive model based on the winter 2010 aerial surveys.

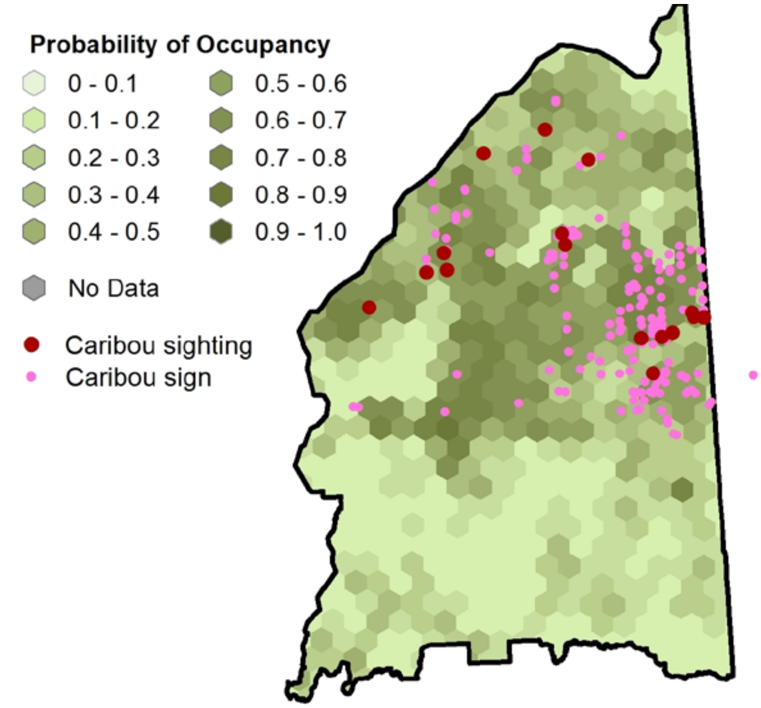


Figure 11. Probability of occupancy derived using habitat covariates across the Kesagami Range overlaid with caribou observations from the winter 2010 aerial surveys.

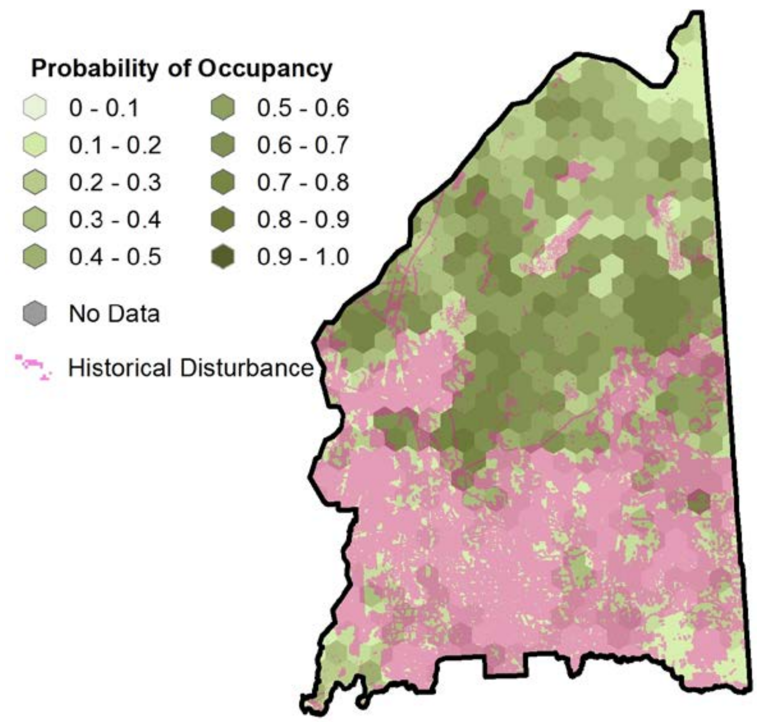


Figure 12. Probability of occupancy determined using habitat covariates from data collected during the winter 2010 aerial survey as well as historical natural and anthropogenic disturbances within the Kesagami Range.

3.4 Caribou ecology and range narrative

Caribou within the Kesagami 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, 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 lesser abundance of prey such as moose or deer, 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.

Current and historical caribou observations are well dispersed across the Kesagami Range, with a decline in observations in the southern part of the range (Figure 5, Figure 6, and Figure 7). These observations represent a combination of results from past research studies, moose aerial inventories, casual observations and locations of collared caribou. Habitat use and movement patterns of caribou have been well monitored within the Kesagami Range and Quebec as a result of the deployment of 113 satellite/GPS collars between 1998 and 2012. The delineation of the southern boundary is based on recent observations and collared caribou movement indicating the potential for reoccupation of areas with past disturbance.

Within the Kesagami Range, the occupancy patterns and habitat selection for forage, refuge, calving, and travel may be heavily influenced by the large peatland complexes, proximity to the James Bay Lowlands within the northern boundary of the range and the longer fire return intervals and more spruce dominated forests associated with ecoregion 3E within the Abitibi River Forest.

Wetland complexes comprised of mature conifer (black spruce) and treed/open bogs are the primary summer habitat used for calving and nursery throughout the range, including Quebec. This range has few large lakes suitable for calving however it is known that those lakes with islands have a high probability of use (Kesagami and Hopper lakes have been confirmed as being used for calving, as well as Lake Abitibi prior to 1921). Forage quality may be an important indicator for selection by adult females rearing a calf (Lantin et al. 2003).

Winter habitats used vary depending on snow depth (Wilson 2000). In normal to deep snow years, caribou use upland sites containing mature conifer and lichen mats. Weather conditions appear to determine whether caribou remain in or around one area the entire winter or whether they move from site to site. During early winter, regardless of snow depth caribou mobility does not appear to be restricted however mild conditions and freezing rain events have resulted in reduced movement at this time of year. In low snow years, stunted larch fens are used due to their abundance of arboreal lichens. This type of habitat is located sporadically within the Kesagami Range mostly in the northern portion but is more prominent in areas to the northwest just outside the range. In general, winter use areas vary each year, especially when large numbers of animals (e.g. 100+) are concerned, and may be related to weather (e.g. rain events, snow depth) rather than habitat.

Information related to caribou movement and habitat use within the Kesagami Range indicate that many animals exhibit seasonal movements back and forth across the eastern border of the range between Ontario and Quebec. Movements across the north western boundary (Mattagami and Moose rivers) are also apparent; however, preliminary genetic analysis suggests that historical gene flow may be limited between the Kesagami Range and populations to the west (Berglund et al. 2014). Seasonal range use varies among individual adult female caribou within and among years. Although all females collared since 2009 were only captured within the Kesagami Range boundary, it was not predictable as to where each individual would spend most of their time. Some females never seemed to leave the range whereas others moved out of the range post-collaring and had yet to return.

Although it is difficult to determine whether there are individual herds, it does appear that there are three main groupings, based primarily from data on collared females (Figure 6). Depending on winter conditions animal movement can overlap between all groups.

The Detour/LaSarre group predominantly range from the North French River east to the Harricanaw River in Quebec and from north of Lake Abitibi to the James Bay coast. This group contains the largest number of individuals and ranges over 40,000 km^2 within Ontario and Quebec. Research conducted between 1998 and 2001 indicated the mean home range of an individual female caribou was 4,000 km^2 (Brown et al. 2003).

The Fraserdale group can be found from the Kapuskasing River in the west to the North French River in the east. Most animals seem to use the area between Smooth Rock Falls to Fraserdale although some individuals travel north to Moosonee/Moose Factory. Range use and movement patterns appear to vary by individual. Some females remain in the area throughout the year whereas others spend the snow-free season here but move to other areas during the winter. The number of animals inhabiting this area may be less than 20 individuals; however, there is connectivity to other groups and other undisturbed parts of the range.

The Onakawana group can be found from the Missinabi River east to the North French River but appear to spend much of their time between the Mattagami and Abitibi Rivers. There is connectivity (especially during the winter season) between these animals and animals north of the neighbouring Pagwachuan caribou range. As with the Fraserdale group, there is variation in individual use of the area. Some females remain between the Abitibi and Mattagami rivers all year whereas others spend the snow-free season in the area but travel outside of the Kesagami Range northwest during winter.

Outside of the three main groupings described above, there are two areas which appear to receive limited use (excluding the southern disturbed region). The northern portion of the range within ecodistrict 2E-2 and the western portion of ecodistrict 3E-7 (Figure **2**) are less used than would be expected.

Ecodistrict 2E-2 contains more open bog, less mature conifer (found primarily along streams and rivers) and more mature larch stands containing sphagnum ground cover which may indicate less suitable habitat and reduced forage to support large numbers of woodland caribou. Animals use this area during all seasons however group sizes were relatively small.

The habitat in the western portion of 3E-7 appears to be similar to other areas within this ecodistrict. Upland conifer stands containing abundant lichen can be found throughout the area. Treed peatlands also abound although smaller in size than in the east or around Kesagami Lake. Both anthropogenic and natural disturbance is low. Although forage and suitable seasonal habitats exist, caribou use has been limited to a few animals during the summer and migration at other times of the year. The reason for this limited use is not known at this time.

Most of the anthropogenic disturbance has occurred in the southern half of the range and includes forestry operations, mining and mining exploration. The decision to establish the southern boundary of the range where it currently exists was based on recent sightings of caribou and the current forest condition within the areas of Lake Abitibi and the Hicks-Oke Bog. Some of the stands within these areas are coming of age to allow caribou re-occupation and this has been supported through recent winter sightings of caribou and caribou sign. Although several esker systems extend south of Lake Abitibi (including Ontario’s longest esker, Munro Esker) and Hicks-Oke Bog with old jack pine forest stands (>95 years) that have abundant terrestrial lichen, severe habitat fragmentation may prevent caribou reoccupying this area.

Forestry operations in the lowland areas use careful logging methodology and can retain a large amount of young residual forest which may provide suitable habitat for caribou. A major change to the caribou landscape occurred in 1983 when Highway 652 (Detour Highway) from Cochrane to the Detour Lake gold mine 180 km northeast of Cochrane was constructed. The highway provided access to recreation groups, forest harvesters and mining exploration companies which resulted in the expansion of the disturbance footprint that otherwise may not have occurred.

Two major recent fire occurrences are found northwest and northeast of Kesagami Lake. Relative to the boreal forest in northwestern Ontario, fire return intervals are significantly longer and the size of burns are generally smaller. However, climate predictions suggest that the length of the fire season is predicted to increase with a higher frequency of fires (Wotton et al. 2005).

Within the boreal forest of Ontario, other wildlife species such as moose, white-tailed deer, wolves and black bear can have effects on caribou population distribution and health (Bergerud et al. 2006; Bowman et al. 2010). In the Kesagami Range, moose densities have remained relatively stable at low densities, with the highest densities occurring in the south. White-tailed deer abundance is currently relatively low and also concentrated primarily in the south. However, numbers and distribution may be expected to increase with a warming climate and reduced snowfall. The threat of disease and parasitism (meningeal worm and liver fluke), and higher wolf densities and associated predation on caribou may be expected to increase with expansion of white-tailed deer.

Habitat use patterns and occupancy trends inform local habitat management actions related to forest management, environmental assessments, or land use planning. The following areas are important to the Kesagami Range as they have demonstrated caribou occurrence and habitat use:

- The islands of Lake Abitibi were once used by caribou as calving islands (Snyder 1928) but landscape disturbances (fire and forestry) in the early part of the 20th century resulted in abandonment of Lake Abitibi as a calving location. The current forest condition is of an age to perhaps allow for reoccupation and use of these islands. One impediment to re-occupation and use of these islands is the summer recreational use by Quebec residents for swimming, camping and picnicking.
- The Hicks-Oke Bog in the southwest portion of the range has had recent sightings of caribou and a collared female crossed Hwy 11 near the town of Smooth Rock Falls to spend a short time during the spring of 2010 just north of the bog. Much of the forest in this area is patent land (Abitibi Freehold) and cannot be managed as Crown forest. However there is suitable habitat that would allow caribou movement to the bog.
- The area north of the town of Smooth Rock Falls (Marceau, Avon, Clay, and Beardmore townships) has been heavily disturbed although mostly through careful logging. The remaining intact forest is comprised of large wetland complexes interspersed with ridges of mature conifer. Caribou still persist in this area and utilize the habitat year-round. The remaining forested area will be exempt from forest operations until surrounding blocks become suitable for caribou use.
- Seguin River Conifer and Fens Conservation Reserve may provide connectivity for caribou to access previously disturbed jack pine stands in the Whitewater River area which are now coming of age to be suitable for caribou use. Recent winter and spring sightings of caribou have been recorded.
- The north central portion is undisturbed and encompasses the North of the North French Conservation Reserve. There are areas with extensive lichen mats and mature conifer stands however caribou use of these areas has been minimal in the last two decades.

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

3.5 Influence of current management direction

Recent and current management direction – up to the time of this Integrated Range Assessment, has had both positive and negative influences on the current state of caribou within the Kesagami Range.

During the late 1990s, forest management direction in north-eastern Ontario incorporated a management approach of protecting specific caribou values such as calving/nursery areas and then evolved into protecting caribou habitat at a landscape level. Current direction has incorporated a Dynamic Caribou Habitat Schedule (Abitibi River Forest (ARF) 2012-2022 Forest Management Plan (FMP)) which covers a 140 year period comprised of seven 20-year planning terms. This schedule allows for forestry operations to be conducted within selected blocks while maintaining large tracts of currently suitable caribou habitat across the landscape (Figure 13). The Gordon Cosens Forest to the west has also implemented a schedule that covers portions of the Kesagami and Pagwachuan ranges. The implementation of these habitat schedules are intended to reduce the fragmentation across the landscape and provide for a better arrangement and increased amount of mature conifer and winter suitable habitats than currently exists. Although harvest scheduling has been implemented in northwestern Ontario since the 1990s, this is the first time it has been implemented in the northeast.

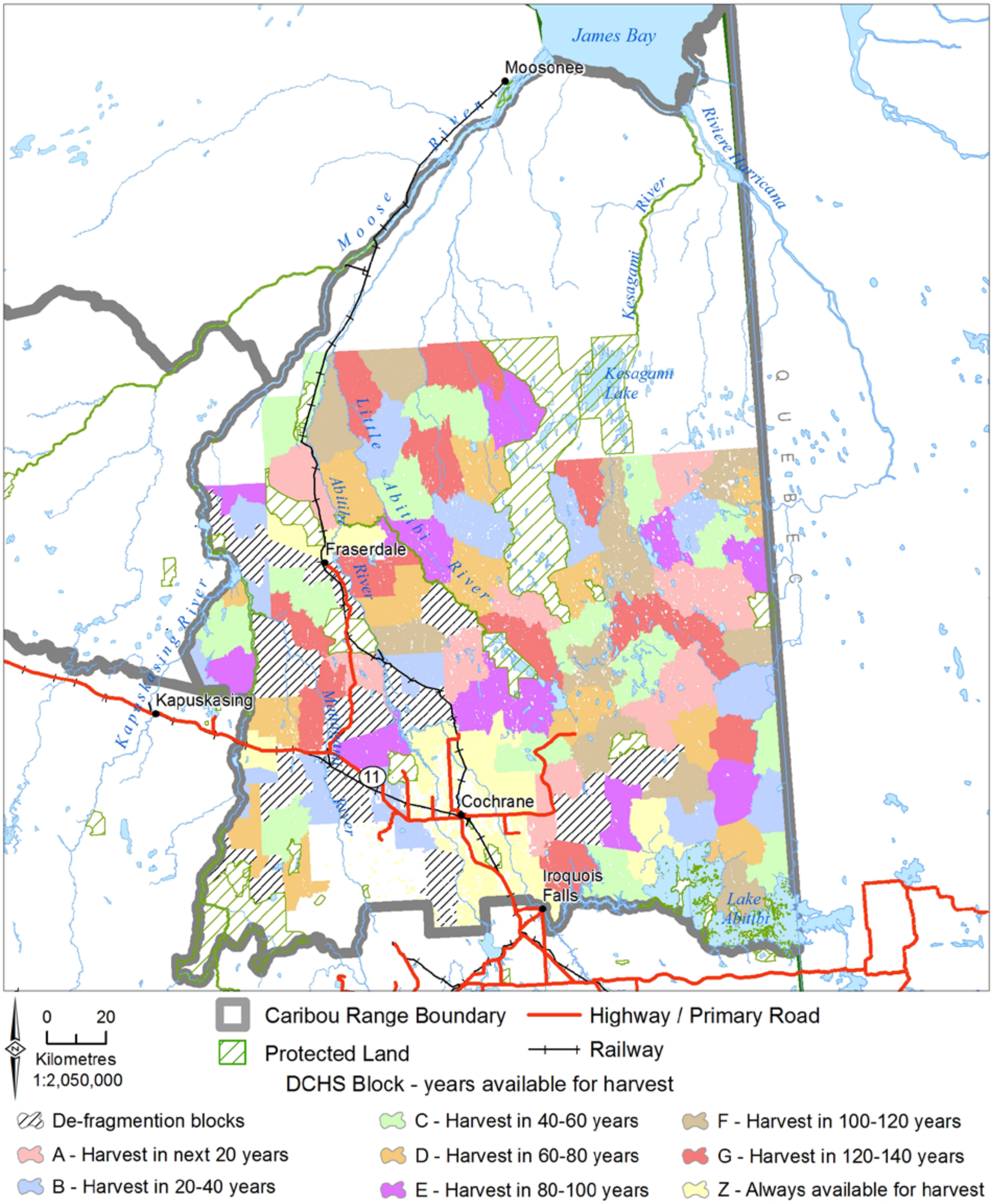


Figure 13. Dynamic caribou habitat schedule (DCHS)[1] for the Kesagami Range as reflected within contemporary Forest Management Plans (FMPs).

[1]Details on Dynamic Caribou Habitat Scheduling and management can be found in the most recent Forest Management Planning documents (2010 Gordon Cosens FMP; 2012 Abitibi River Forest Ltd.).

The 1995-2015 Gordon Cosens Forest Management Plan included a Biological Diversity Strategy for the Gordon Cosens Forest. The strategy focused on landscape ecology and ecosystem management through the emulation of natural disturbance of which wildfire is the dominant influence. While the document does not separate out caribou considerations, it did set the framework for local caribou management by providing objectives, targets, and implementation strategies for wildlife habitat at various scales. For biodiversity reasons, the 1995 Gordon Cosens FMP included a large harvest deferral along the northeast boundary of the unit that resulted in the maintenance of north-south connectivity for caribou utilizing this portion of the range.

Conservation Reserves established through Ontario's Living Legacy (MNR 1999) did not consider caribou values. However their locations on the landscape may provide for connectivity in strategic areas of the range. These reserves along with Parks and other protected areas are managed as important components of a broad landscape approach to caribou conservation.

The *Range Management Policy* (MNR 2014b) and supporting technical guidance documents, including the *Forest Management Guide for Boreal Landscapes* (OMNR 2014), provide an adaptive and transparent framework for defining, assessing and documenting risk to caribou. This framework has evolved to enable the consistent assessment of impacts to caribou and caribou habitat required to support natural resource management across Ontario. In the past, there have been some decisions that would have been considered inconsistent with this approach. For example, the harvest of a significant occupied caribou habitat component in the southwestern portion of the Kesagami Range was approved in 2010.

The *Cervid Ecological Framework* (MNR 2009b) provides policy advice for cervid management at the broad landscape level. It consolidates and integrates Ontario's approach to managing cervid species in relation to each other with consideration of the broader ecosystem(s) they share. This Framework is an important step in Ontario's progress toward the management of cervids within an ecosystem context, and will guide opportunities to enhance cervid-specific management programs at the regional and provincial scale.

Fire management over the last 30 years may have contributed to a more natural forest condition especially within the northern areas of the range where fire suppression was only implemented where values (e.g. tourism camps) were present. Other areas within the managed forest where fire suppression was more aggressive to protect forestry values may have a more unbalanced age structure and may have increased the amount of current suitable habitat but this may have come at the expense of forest pattern and younger forest habitats which would otherwise soon be available for use by caribou. Consequently, this older forest may also be more susceptible to blowdown and non-fire forest disturbance. The availability of a continuous supply of caribou habitat is a key premise of the conservation of caribou habitat.

3.6 Major data and analysis uncertainties

Aerial survey flights in 2010 encountered challenging survey conditions. Although snow depth was adequate for surveying (61cm on March 1st, 2010) temperatures during the day rose to

+10 °C during the following weeks, with night time lows falling below 0 °C. This resulted in tracks melting out during the day and crust formation at night making it difficult to ascertain track identification and freshness. Because of these poor conditions, follow-up rotary-wing surveys designed to determine more robust estimates of caribou group size and age/sex composition were not completed. Some caribou observations were obtained from a January and February 2010 MAI conducted on WMU 26 (Figure 8). This mixing of methods may provide some uncertainty regarding the minimum animal count (MAC) and 2010 recruitment estimates

Forest management activities on the Abitibi River Forest involve careful logging practices on a large portion of the landbase, especially in lowland black spruce stands. In some cases the amount of residual post-harvest can be abundant and does not appear much different from treed bog areas adjacent to the harvest blocks. Currently these stands are treated as "clear-cut" in the forest resource inventory even though they do have some structure remaining (i.e. stocking, height, and age are currently assigned a zero value post-harvest and the residual is not considered during Free-to-Grow surveys). The disturbance analysis is based on less than 36 years of age. Some of these stands may in fact be older and therefore incorrectly classed as disturbance. The contribution of these stands to caribou habitat is an unknown even though collar data indicates caribou use within these areas. The Silviculture Effects Monitoring Program is now assessing these harvest areas to determine their attributes. Many of these areas are also void of surfaced roads.

The LANDSAT analyses used to determine winter suitable habitat for the Simulated Range of Natural Variation requires further refinement to identify forage and cover attributes suitable to caribou which cannot be differentiated within current land cover classes (e.g. mature larch stands vs. other preferred conifer stand types). This is especially important in the northern portion (ecodistrict 2E-2) where extensive mature larch dominant wetlands (which are suspected to be of low quality forage and cover), are currently classed as winter suitable habitat. Much of the remaining area is open wetland and the few mature black spruce stands are limited to watercourse shorelines. The result is that the amount of winter suitable habitat (Figure 32) may be over-estimated in the area between Kesagami Lake and James Bay.

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 Environmental 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 MNRF range analysis compared to the Global Forest Watch 2011 Environmental Canada data. In general, this MNRF 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 Kesagami Range using Ontario data is estimated to be approximately 5.4% greater than that generated using the Environment Canada data. There is some uncertainty as to how to interpret the results of the analysis using these different contradictory datasets in light of the desire to use the best data available. These differences may be considered when interpreting the range analysis results.

There was considerable uncertainty in the appropriate treatment of water during the disturbance analysis. The sensitivity of the “total disturbance” parameter to the removal of waterbodies of different sizes was identified to inform interpretation of the likelihood of stable or increasing population growth and evaluation of range status.

Due to the lack of detailed forest data (i.e. forest resource inventory) in the northern part of this range, the Provincial Landcover 2010 (PLC 2010) was used to quantify the caribou habitat above the Area of the Undertaking within the range. 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).

3.7 Special considerations within the range

Caution is warranted in the interpretation of the Integrated Range Assessment results due to the limitations of available data and conditions or circumstances not readily integrated in the Integrated Range Assessment Framework. Improved estimates of the probability of persistence will depend on the collection of reliable population data that incorporates sampling error and stochastic population variation, in relation to realized habitat alteration.

The highly disturbed areas in the southern portion of the range have resulted in an inflated disturbance assessment value, especially as it pertains to the permanent disturbance area around local communities. However, recent observations of caribou and caribou sign has led to the decision to include these southern portions to allow for continued use or future recovery into areas that are beginning to be of age to support caribou use.

Population status and trend estimates will require careful interpretation due to the extensive movement in and out of the Kesagami Range. Collar data indicates that the eastern boundary is relatively fluid and annual winter use areas could occur within or outside the range in any given year which could affect measured population parameters. Both adult survival and calf recruitment are influenced by where they are at any time of the year and changes to factors (e.g. predation rates, habitat change, or disease) occurring outside the range boundary may influence the status and trend of caribou in the Kesagami Range.

Although white tail deer numbers do not appear to be increasing to any major extent, they are observed in more northerly areas where they were not expected to range. This has the potential to increase caribou mortality due to brainworm (*Paralaphostrongylus tenuis*), and support higher wolf densities (Latham, Latham, McCutchen, and Boutin 2011). This may be a factor in the survival of adult caribou and their calves.

Average winter snow depths appear to be declining across the range since 1997 (MNR *unpublished data*). This trend in snow depth may influence the habitat use patterns of caribou, allowing them to access forage in areas normally inaccessible when snow is deeper. Winters with less snow are also known to change habitat use by wolves, in which they may spend more time in dense conifer and open fens, where they may encounter caribou (Anderson 2012). However, the exact influence is unknown. This factor warrants consideration when interpreting the suggested trend in caribou numbers or recruitment.

Current estimated wolf densities in the southern portion of WMU 26 (see Section 3.8) are below that suggested as a threshold for caribou persistence (0.65 wolves/100 km^2 in Bergerud 1988). However, estimates of wolf density are not available throughout the southern portion of the Kesagami Range (WMU 27 and 30) where densities are expected to be higher due to the higher densities of moose and white-tailed deer. Current management direction (MNR 2009a) is to maintain caribou distribution throughout the range. The lack of wolf abundance data is an acknowledged gap in our understanding of conserving caribou in the southern portion of the Kesagami Range. Because of the relatively low disturbance levels and low moose and expected white tailed deer densities in the northern portion of the range, expected wolf densities are likely low and comparable to those found above the Area of Undertaking.

Black bear predation of adult female caribou has been documented within the Kesagami Range (MNR *unpublished data*). The extent of this predation as well as the impact on calf survival is unknown relative to other mortality factors. Because areas harvested within lowland black spruce areas are adjacent to calving and nursery areas, black bear predation may be of greater concern than anticipated (Pinard et al. 2012; Latham, Latham, and Boyce 2011). Use by black bear of mature coniferous forests, bogs and fens is limited but areas disturbed by logging are preferred for foraging (Brodeur et al. 2008; Mosnier et al. 2008). Density estimates of bears are currently relatively low, but no population trend estimates are currently available. An increase in black bear numbers or increased use by black bear of harvested stands adjacent to caribou calving/nursery areas could greatly influence caribou calf survival.

3.7.1 Quebec

Jurisdictional boundaries pose a unique problem in the Kesagami Range. Evidence over the past several decades has demonstrated annual caribou movement across the Ontario-Quebec boundary (Figure 6); and understanding how disturbances on the Quebec side influence caribou ecology is an important piece of the cumulative effects assessment. At present there is no data sharing agreement to allow for information exchange with respect to spatial databases related to disturbance.

The habitat within this portion of Quebec is similar to most of the Kesagami Range with wetland complexes interspersed with lowland conifer forests (i.e. jack pine and black spruce) as well as conifer, deciduous and mixed-wood forests on upland areas. Forestry operations also incorporate the careful logging methodology and the majority of the harvest is carried out in winter, especially north of the Turgeon River, resulting in few surfaced roads. Mining and mining exploration along with linear corridors are prominent in the southern portion. The area south of the demonstrated annual caribou movement is predominantly upland with municipalities, forestry and agriculture being the predominant disturbances.

Estimates of adult female survival based on collared animals originally collared in the Kesagami Range, but then emigrated, spending the majority of their biological year(s) in Quebec had similar survival rates (2010-2012 mean 0.87 (Quebec) vs. 0.88 (Kesagami)). The three herds of caribou in the James Bay region of Quebec (Nottaway, Assinica, Temiscamie) all show similar declines in both recruitment and adult survival rates and disturbance levels in Quebec range from 34 to 51% (Rudolph et al. 2012). Activities that promote improvements in the caribou population or habitat conditions will need to be carried out in unison or range use could potentially be compromised.

3.8 Other wildlife

The boundaries of the Kesagami Range include all or parts of Wildlife Management Units (WMU) 24, 26, 27 and 30 (Figure 14) and is within cervid ecological zones A and B (MNR 2009b) and black bear ecological zone C (MNR 2011).

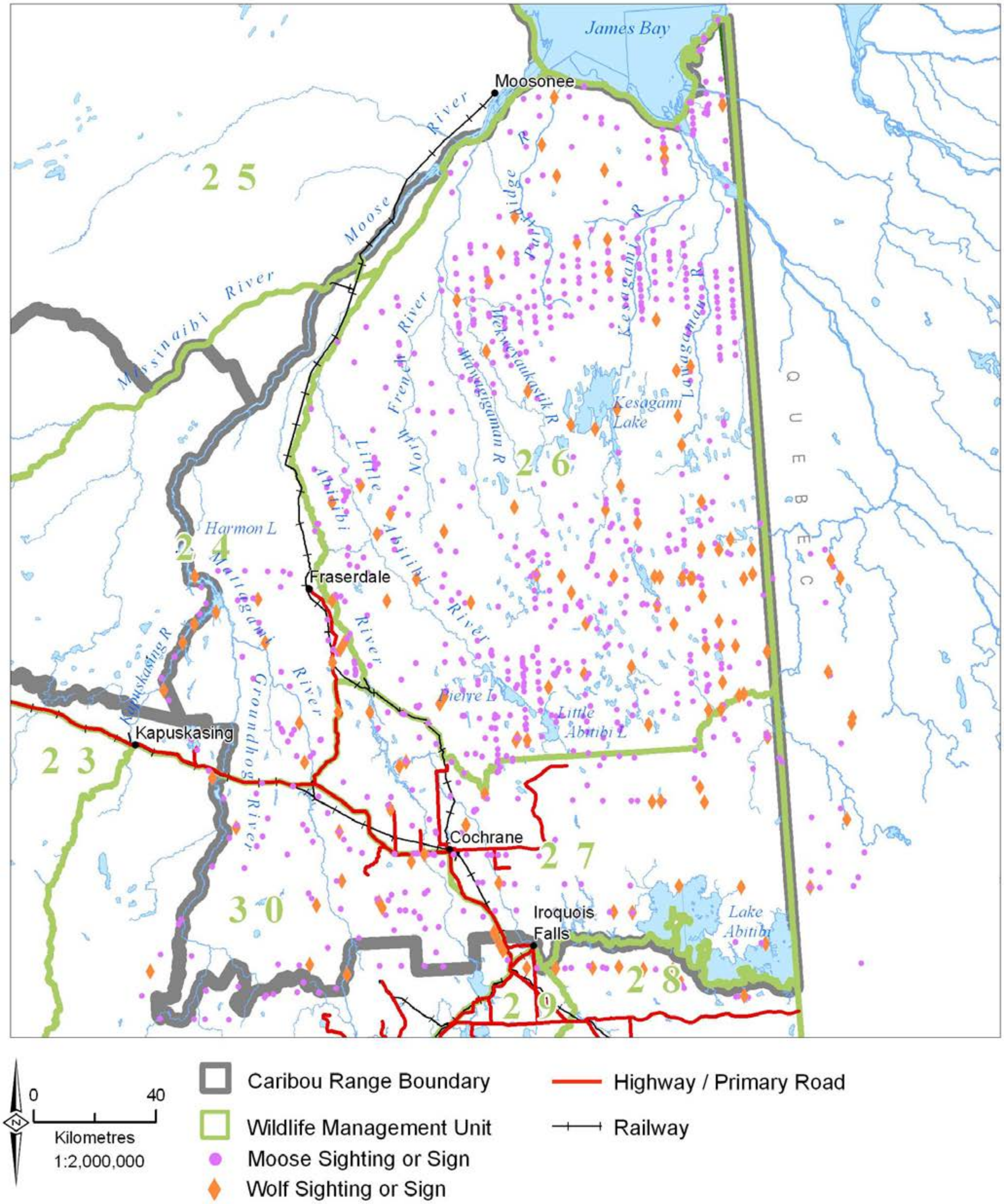


Figure 14. Wildlife Management Units with moose and wolf sightings or sign observed during the winter 2010 aerial surveys in the Kesagami Range.

Moose densities have historically been low across much of Kesagami Range and at the WMU level are currently estimated at densities from 6.0-17.6 moose per 100 km^2 (Table 4). Moose population trends are generally low and stable in WMUs 24 and 26 and relatively higher with more variable density estimates in WMUs 27 and 30 (Figure 15).

Table 4. Recent moose population & density estimates for WMUs within Kesagami Range

WMU	Cervid Ecological Zone	MAI strata area (km^2)[1]	Moose population estimates no. of moose (survey year)	Moose density # moose per 100 km^2 +/- 90% confidence interval
24	A	19,475	1589 (2008)	8.16 +/- 1.82
26	A	27,750	1655 (2010)	5.96 +/- 0.18
27	A	8,800	1141 (2009)	14.34 +/- 4.35
30	B	13,600	2397 (2010)	17.63 +/- 5.29

[1]Area is for the WMU.

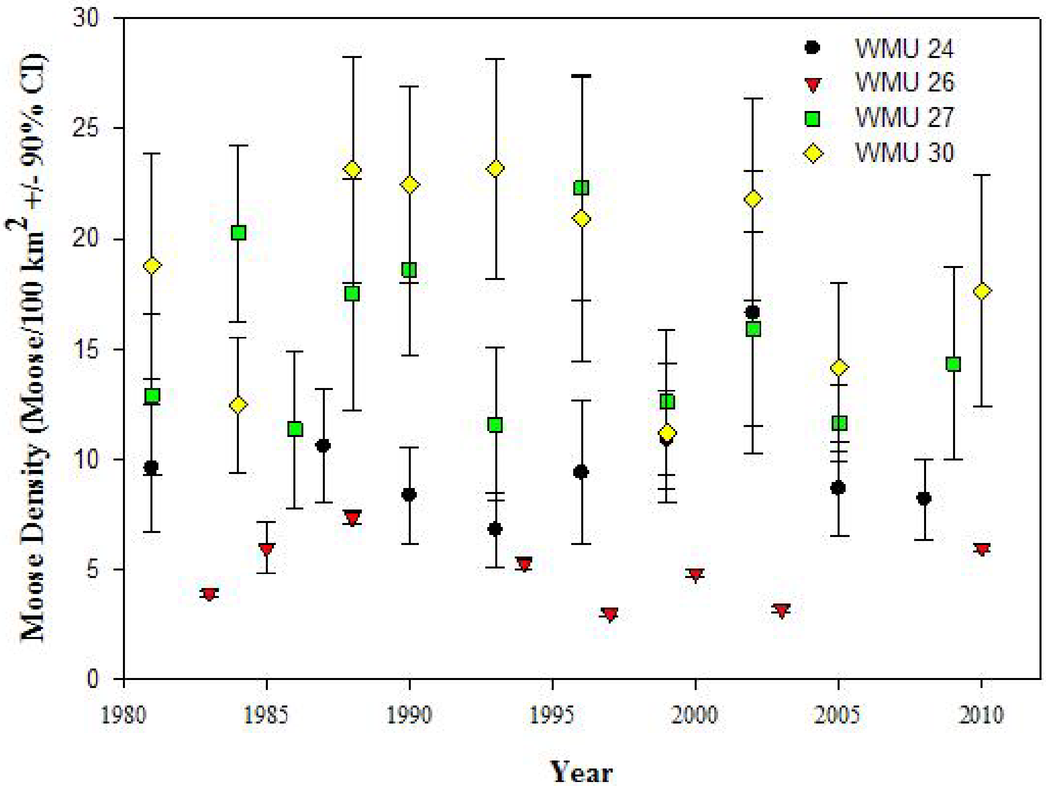


Figure 15. Moose density estimates with 90% confidence intervals for WMUs 24, 26, 27, and 30 from 1981-2010.

White tailed deer densities are low and sparsely distributed across the range, but have been observed as far north as near Moosonee. They are predominately found in WMU 27 and along the Highway 11 and 101 corridors. New deer seasons were implemented in 2009 within WMUs 24, 26, 27, and 30 with additional deer seal quotas starting in 2010. Trends in deer sightings by deer and moose hunters are not yet available. Deer may function as both alternate prey for wolves and as a vector for disease, specifically brain worm, and may be expected to increase with northward expansion.

Four cervid farms are currently known to reside within or immediately adjacent to the Kesagami Range (one reindeer farm, one fallow deer farm, one white tailed deer farm, and one elk farm).

Black bear density estimates derived through the implementation of barbed-wire hair trap (BWHT) protocol indicates that black bear densities are relatively low (10-15 bears per 100 km^2 (M. Obbard, MNR unpublished data), when compared with average bear densities from WMUs across Ontario's northeast region (Table 5). Densities of bears were similar or above average values from other WMUs within black bear ecological zone C, except WMU 27 which was below.

Table 5. Recent black bear density estimates for WMUs within the Kesagami Range derived from barbed-wire hair trap (BWHT) protocol.

WMU	BBEZ[1]	Year	Density (# bear/100 km2) +/- SE	Density relative to BBEZ mean	Density relative to regional mean
24	C	2010	11.7 +/- 3.0	similar	below
26	C	2010	15.2 +/- 3.3	above	below
27	C	2010	9.6 +/- 2.4	below	below
30	C	2007	12.3 +/- 4.8	similar	below

[1]Black bear ecological zone.

Wolf densities were estimated in winter 2009 from aerial surveys conducted south of the Area of Undertaking (AOU) within the Kesagami Range and was 0.27 wolves per 100 km^2 (B.R. Patterson, MNR unpublished data). This estimate was approximately six times higher than the estimate of wolf density north of the AOU (0.05 wolves/100 km^2) just to the west of the Kesagami Range (Figure 16). These observed wolf densities are consistent with patterns of occupancy and abundance of wolves and their prey in natural versus human altered landscapes of the boreal forest (Bowman et al. 2010; Latham et al. 2011). Wolf densities would be expected to be higher in the southern portion of the range (e.g. WMU 27), where moose, white tailed deer, and likely beaver abundance are higher.

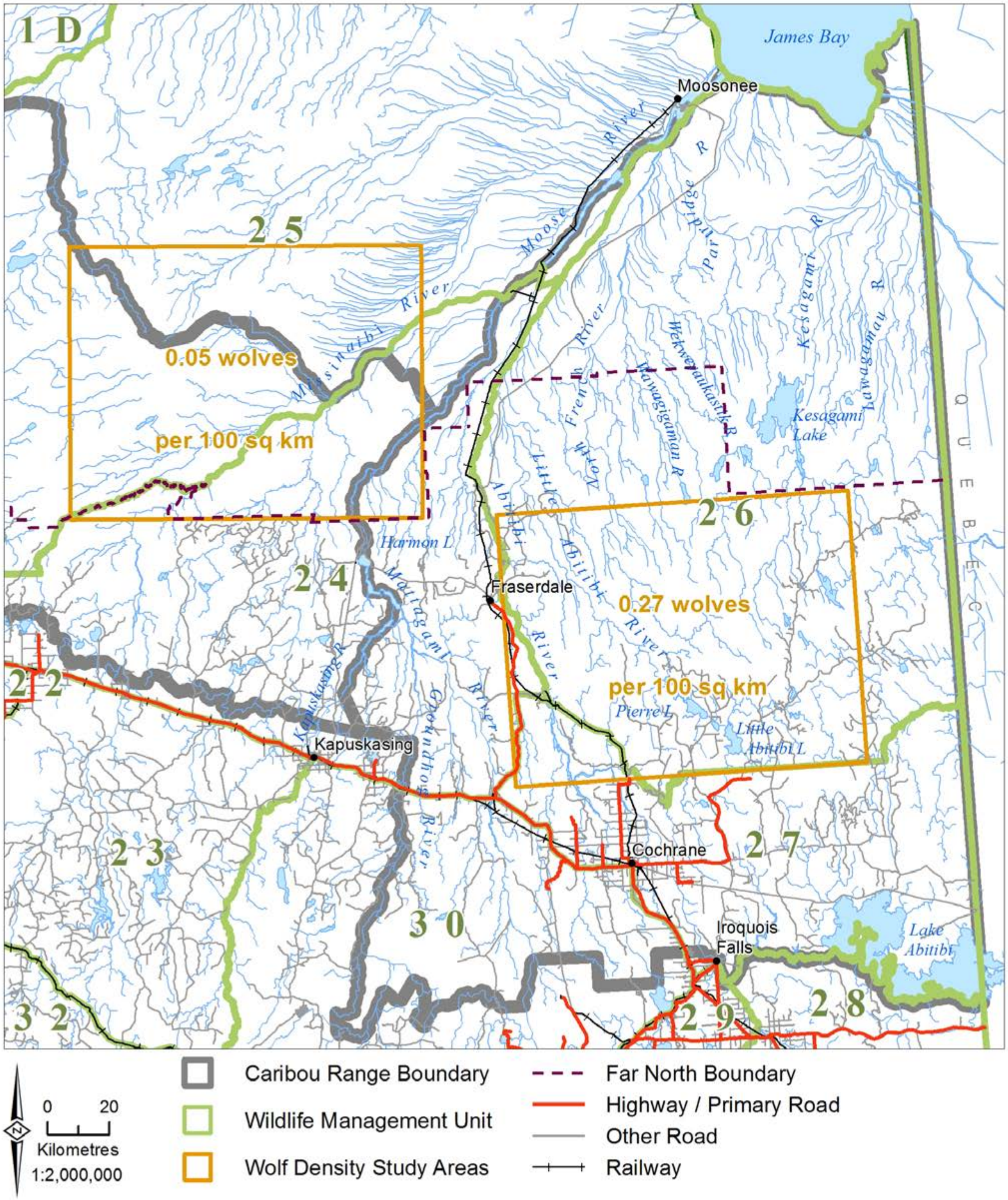


Figure 16. Estimates of wolf density (wolves/100 km^2) in two study areas during winter aerial surveys, 2009 (B.R. Patterson, MNR unpublished data). Area of Undertaking /Far North boundary is shown as a dashed line.

Trends in wolf population index (moose hunter post card survey) illustrate some annual variation with wolf sightings peaking in 2007, followed by decreasing trend through to 2010 with an increase again in 2011 (Figure 17). The relationship between sightings and actual annual wolf abundance is unknown, but sightings may suggest that the wolf population trend is likely stable, perhaps increasing slightly since 1999. This information is included to provide context with other wildlife population trends, and is not used in determining range condition.

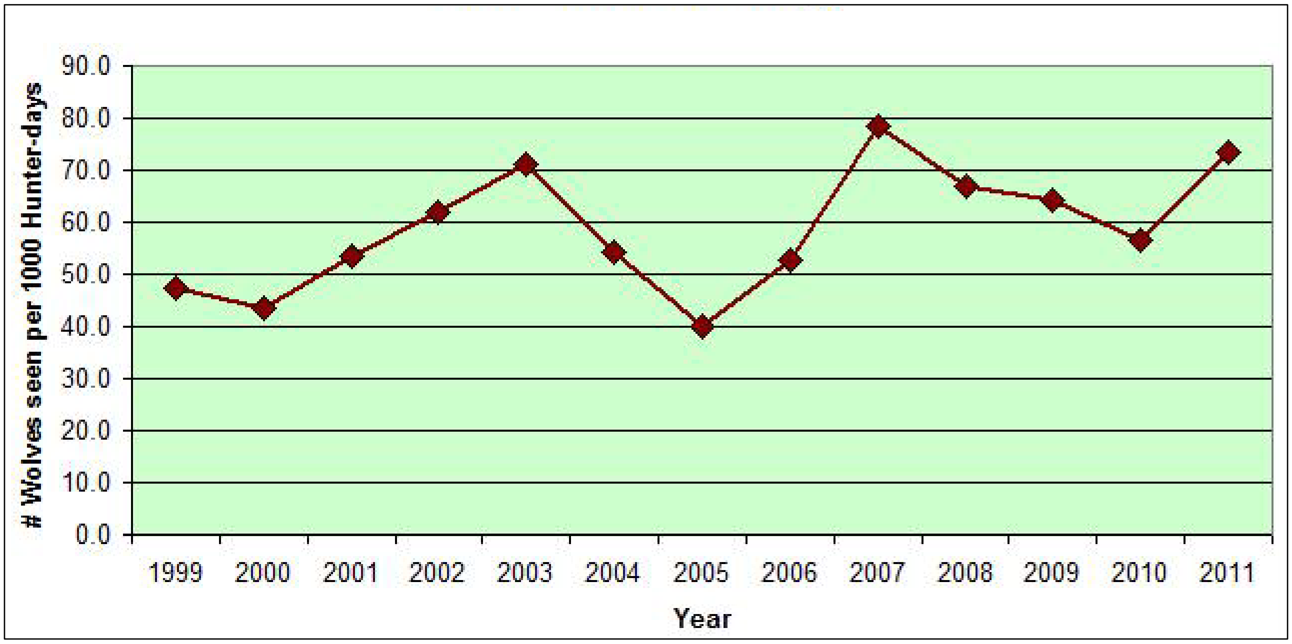


Figure 17. Trend in number of wolves sighted by moose hunters, 1999-2011; pooled data for WMUs 24, 26, 27, and 30 (MNR, Science and Research Branch, moose hunter post card survey database).

3.9 Results of past range assessments

No previous range assessments have been completed for the Kesagami Range. However, range level summaries of data and models pertaining to the Kesagami 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 18) 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 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.

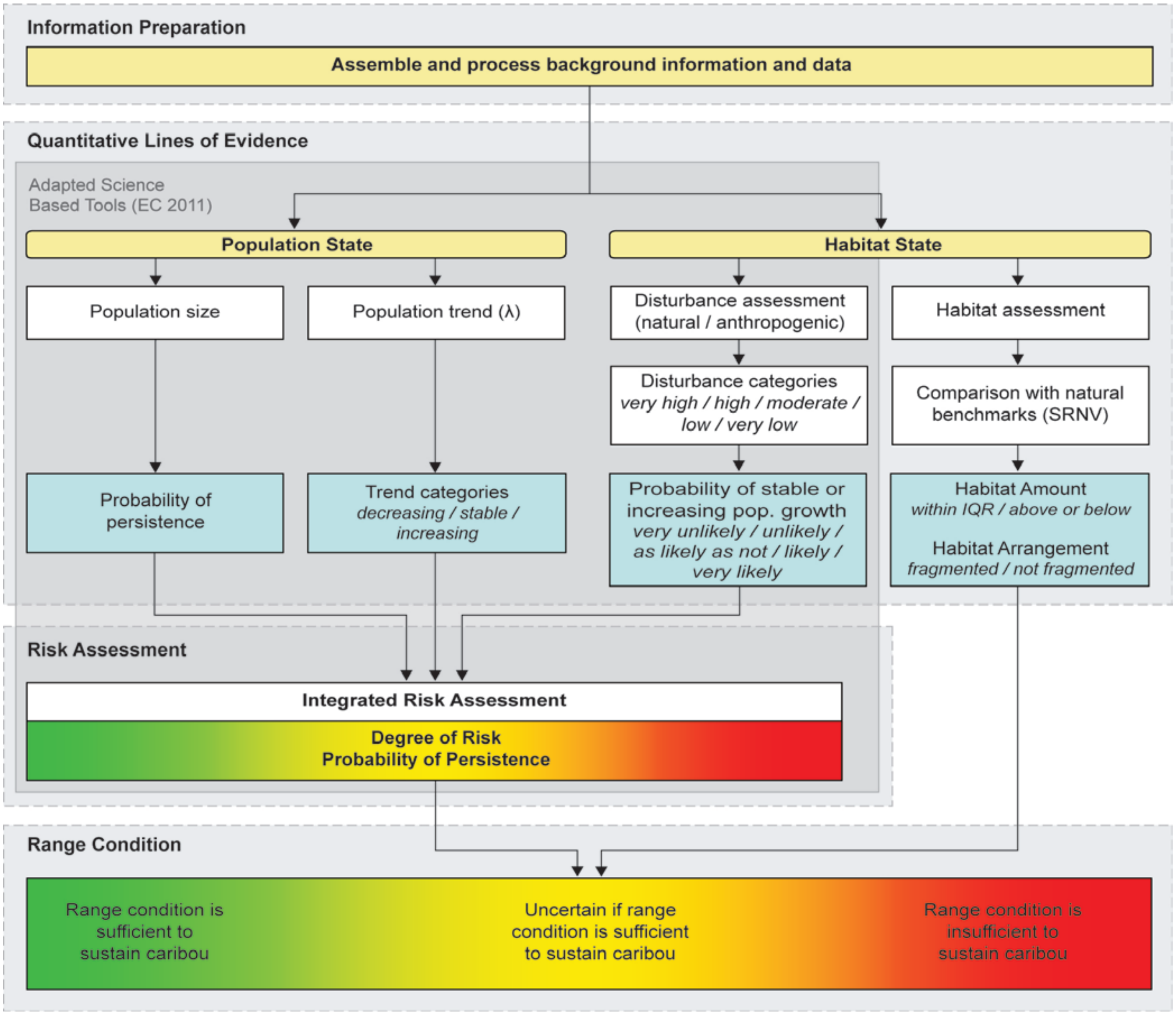


Figure 18. The integrated assessment framework with four quantitative lines of evidence. Three lines of evidence related to population size, trend and habitat disturbance assessment contribute to an integrated risk assessment. The results of the integrated risk assessment are combined with habitat assessment (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 range assessment framework (Figure 18).

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, several initiatives resulted in the deployment of telemetry collars on adult female caribou in the Kesagami Range (Table 2). Approximately 46 collars were deployed on adult females between 1998 and 2009. Twenty-four (24) collars were deployed as part of the Integrated Range Assessment effort between 2010 and 2011. Sixty-nine (69) collars associated with a research project were deployed between 2010 and 2012.

5.1.1.2 Winter aerial surveys

Historical aerial surveys for caribou were conducted during some years and estimates of group composition (age and sex) were determined (Table 6). During March 2nd through 10th, 2010, a fixed-wing hexagon-based aerial survey was conducted (see Section 3.3). Only 9 of 19 flight lines were completed due to warming temperatures and deteriorating snow conditions. However, in January and February 2010, a moose aerial inventory (MAI) was conducted using a fixed-wing aircraft in Wildlife Management Unit 26 (Figure 8). During the first half of this survey observations of caribou and their sign were identified and a follow-up rotary-wing survey was conducted on January 26th, 2010 to determine group size, age, and sex composition. Caribou observed were counted and classed as unknown adults, adult males, adult females, calves, or unknown age and sex. Sex of adults was determined from the presence or absence of a vulva patch, animal behaviour, and/or by general morphology. These two survey projects collectively provided data in support of the MAC and recruitment estimates.

5.1.1.3 Recruitment

Recruitment estimates follow the Protocol (MNRF 2014a). The observed sex ratio of known adults obtained during 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.

5.1.1.4 Trend

Generally in forest-dwelling caribou, a stable population requires a mid-winter estimate of at least 12 to 15% calves in a non-hunted population with a density of 0.06 animals/km^2 (Bergerud 1996; Bergerud 1992). Recruitment rates exceeding 28.9 calves per 100 AF_{adj} would suggest a population is stable to increasing. Recruitment rates below that would suggest a population is decreasing based on assumed average adult female 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):

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

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).

Daily survival rate = 1- (# of mortalities/# of animal days) Equation 2

Annual survival rate = (Daily Survival Rate)^{365} Equation 3

Annual mortality rate = 1- Annual Survival Rate Equation 4

As some caribou move between the Kesagami Range and Quebec, and between the Kesagami Range and neighbouring Ontario ranges, annual data from all adult female collared caribou that had the majority of their telemetry locations (>50%) within the Kesagami Range was utilized.

5.1.1.5 Size

A reliable minimum animal count (MAC) was calculated based on all caribou observations that were not deemed as duplicate observations, and included caribou observed in the MAI as well as caribou observed in the hexagon based portion of the occupancy survey. The MAC is interpreted as an absolute minimum number of animals occupying the range during the time of the survey (January and February, 2010).

5.1.2 Population state results

One hundred and ninety-four (194) caribou were observed in 32 groups during the combined aerial surveys in winter 2010 (fixed-wing flights, MAI, rotary-wing flights, and recruitment flights). Two groups (16 individuals) were considered as recounts resulting in a minimum animal count (MAC) of 178 animals (Table 6). 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 Kesagami Range. Furthermore, because an occupancy-based survey was unable to be completed (see section 5.1.1.2) or the follow-up rotary-wing survey, the MAC value likely only represents a relatively small proportion of the actual number of caribou present in the Kesagami Range. During winters 2011, 2012, and 2013, 86, 278, and 109 caribou were observed, respectively within the Kesagami Range during recruitment surveys targeting only collared adult females.

Only caribou groups for which 50% or more of the group was successfully identified as being either adults or calves were included in the estimation of adult sex ratios and recruitment. Using the observed sex ratios to estimate the total number of adult females (AF_{adj}), resulted in recruitment estimates ranging from 12.9-25.2 calves per 100 AF_{adj} within the Kesagami Range (Table 7, Figure 19). The lowest recruitment estimates occurred during the most recent survey years (2010-2013) and are comparable to other studies in which populations were known to be in decline (Rettie and Messier 1998; McLoughlin et al. 2003; Environment Canada 2008).

Estimating the percent calves in a population is another metric that can be examined to assess the condition of the population. However, because many of these surveys were targeting radio collared adult females, the percent calves is likely biased high as encounters with groups of bulls were less likely. The 2005, 2006, and 2010 aerial surveys likely provide the least biased estimate of percent calves as these were not relocating radio collared females and therefore a better representation of the population. These three years yielded 11%, 12%, and 9% calves respectively, which also suggest a declining trend (Table 7).

Table 6. Minimum animal count observed during fixed-wing, rotary-wing, Moose Aerial Inventory survey, and recruitment flights conducted in the Kesagami Range, January-March, 2010.

	Caribou age and sex identification[1]						
Survey method	**UA**	**AM**	**AF**	**Calves**	**UN**	**Total adults**	**Total caribou**
Moose Aerial Inventory (MAI)	17	10	48	6	22	75	103
Recruitment survey	5	0	44	9	1	49	59
Fixed-wing survey	2	0	1	1	12	3	16
Sum	**24**	**10**	**93**	**16**	**35**	**127**	**178**

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

Table 7. Group composition and recruitment estimates obtained during aerial surveys and aerial relocations of radio-collared caribou in Ontario and Quebec from 1998-2013.

Survey [1]	**1998**	**1999**	**2000**	**2001**	**2001 (Quebec)**	**2005**	**2006**	**2006 (Quebec)**	**2007**	**2008**	**2010**	**2011**	**2012**	**2013**
Survey type[2]	RW	RW	RW	RW	RW	RW	N/A	2-stage	N/A	N/A	FW/ RW	RW	FW	RW
Month	Mar	Mar	Mar	Feb	Mar	Mar	Feb	Mar	Feb	Feb	Jan-Feb	Feb-Mar	Feb	Feb
No. of males	8	53	43	37	48	10	16	44	2	0	10	7	N/A	9
Females	24	120	68	94	68	26	23	74	27	20	93	67	N/A	65
Calves	7	29	16	23	23	9	9	20	6	3	16	9	31	13
Unknown adults	4	0	7	12	7	38	20	4	0	0	24	3	247	22
Unknowns (age/sex)	22	30	0	36	50	0	8	0	0	0	35	0	0	0
AF_{adj}[3]	33.4	120	72.4	102.7	72.4	56.1	35.7	76.5	27	20	112.6	69.7	221.6	84.8
Total caribou	65	232	134	202	196	83	59	142	35	23	178	86	278	109
Sex ratio (% female)	0.767	0.778	0.623	0.728	0.634	0.793	0.637	0.627	0.961	1	0.818	0.897	0.897	0.901
Calves:100 females	29.2	24.2	23.5	24.5	47.9	34.6	39.1	27.0	22.2	15.0	17.2	13.4	N/A	20.0
Calves:100 AF_{adj}	21.0	24.2	22.1	22.4	31.8	16	25.2	26.1	22.2	15.0	14.2	12.9	14.0	15.3
Calves:100 adults	16.3	16.8	13.6	16.1	18.7	12.2	15.3	16.9	20.7	15.0	12.6	11.7	12.6	13.5
% calves					11.7	10.8	11.8	14.1			9.0			
No. of groups	7	24	16	13	N/A	11	15	N/A	5	5	25	17	33	20

[1] The first four surveys were rotary-wing based on 30 collared adult females from the Detour Lake Research study (1998-2001) and covered the eastern portion of the Kesagami Range into Quebec. The two Quebec surveys were scheduled moose/caribou surveys and covered the Quebec portion east of the Ontario-Quebec boundary between 49° 30' and 50° 15' latitude and from the provincial boundary east to longitude 78° 42' (Paré et al. 2009). The 2005 survey was a transect survey conducted on the east side of Kesagami Lake east into Quebec and from Detour Gold Mine northward to just south of James Bay. The 2006 survey was a two-stage survey of the Northern Boreal Initiative area above the AOU. The 2007 and 2008 collar surveys were based on six collared females at the west side of the range. The 2010 survey includes a fixed-wing and rotary-wing transect aerial moose survey within WMU 26, the occupancy survey as well as a targeted telemetry survey. The 2011,2012, and 2013 recruitment surveys were based on a larger number of collared adult females across the range, however, the data used only included those animals observed within the range boundary at the time of the survey.

[2]RW=Rotary-wing, FW=Fixed-wing.

[3]-AF_{adj} = Adjusted Adult Females.

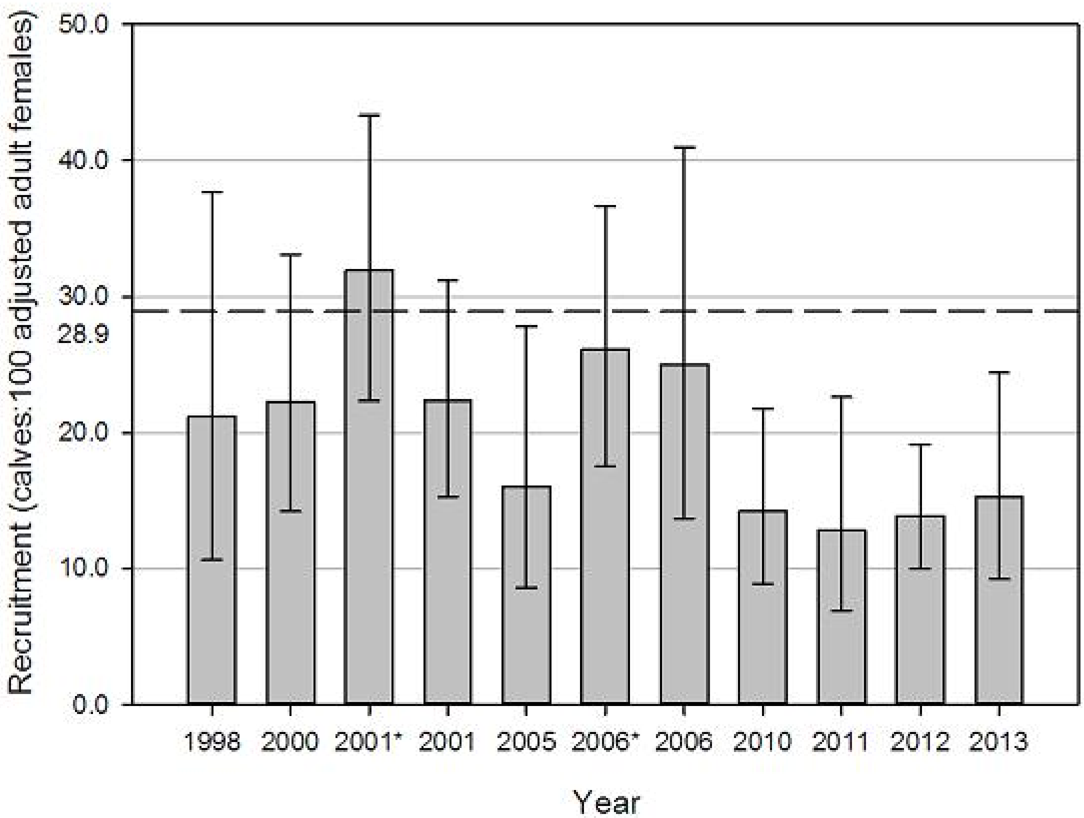


Figure 19. Recruitment estimates (calves/100 AF_{adj}) with associated 95% confidence intervals from 1998-2013 in the Kesagami Range. Dashed line indicates recruitment levels expected for a stable to increasing population (EC 2008). 2001* and 2006* are estimates from Quebec just to the east of the Kesagami Range.

Annual survival was estimated for all collared adult females which spent the majority of their time within the Kesagami Range during the 2010-2012 biological years (April 1st-March 31st). The geometric mean annual survival rate was 0.88 and varied between 0.84-0.95 (Table 8, Figure 20). The geometric mean survival rate from 2010-2012 was used to provide an estimate of population growth rate (λ) for 2009. Using all available survival and recruitment data from 2009-2012, a geometric mean population growth rate (λ) of 0.94 (Table 8) was calculated, suggesting that the population is currently in decline. During 1998-2000 a radio collaring study in the eastern portion of the Kesagami Range also suggested that the population was in decline (λ = 0.88) (W.J. Rettie unpublished data; EC 2008).

Table 8. Annual survival rates (*S*) and population growth rates (λ) of collared adult female caribou (*n*) and number of mortalities (*d*) during 2009-2012 biological years (April 1st - March 31st).

Biological year	*n*	*d*	Exposure days	Daily survival rate	S	Upper 95% CI	Lower 95% CI	λ
1998-2000[1]					0.79			0.88
2009					0.88[2]			0.94[2]
2010	53	3	6417	0.9995	0.84	1.00	0.69	0.90
2011	44	2	12946	0.9998	0.95	1.00	0.87	1.01
2012	32	4	9509	0.9996	0.86	1.00	0.74	0.92
				Geometric S mean (2010-2012)	**0.88**		**Geometric λ mean (2009-2012)**	**0.94**

[1] Estimated survival rate and population growth rate from EC (2008).
[2] The geometric mean survival rate from 2010-2012 was used to estimate population growth rate (λ) for the 2009 biological year.

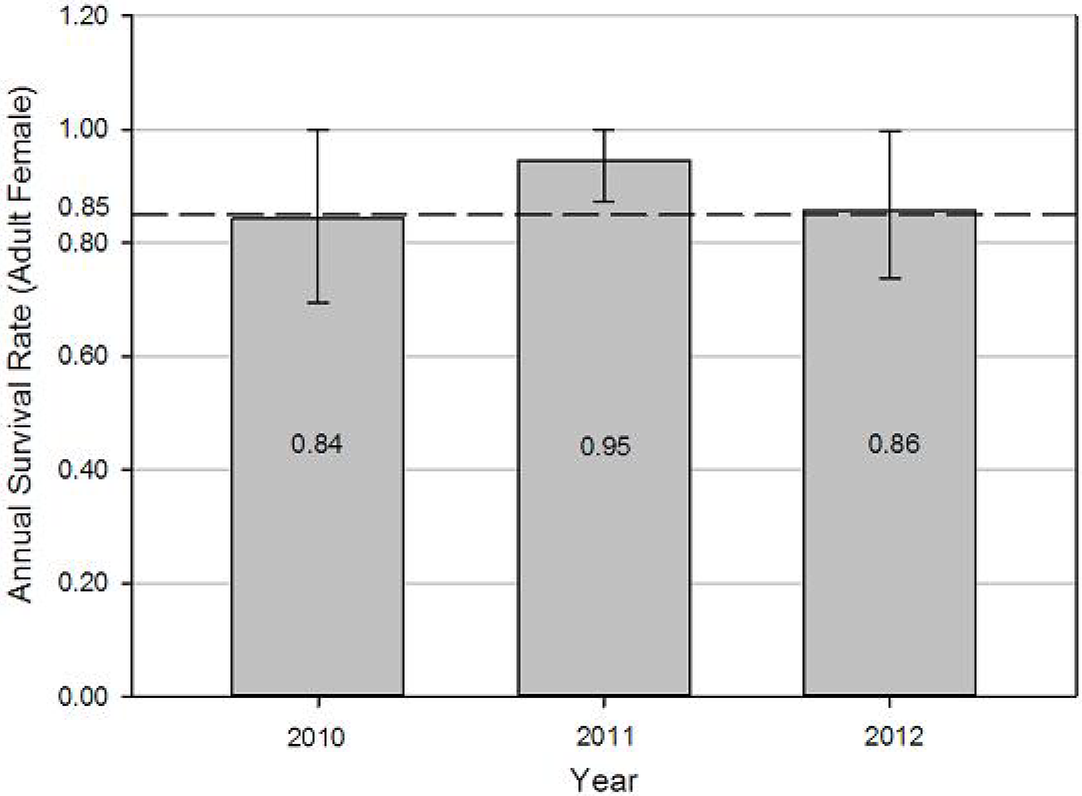


Figure 20. Annual survival rate and 95% confidence intervals of collared adult female caribou which spent the majority of the biological year (April 1st- March 31st) within the Kesagami Range. The dashed line represents adult female survival rate (85%) expected for a stable to increasing population (EC 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 can be an independent and indirect predictor of recruitment and likelihood of stable or increasing population growth (MNRF 2014a).

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 (MNRF 2014a). In areas without FRI coverage (i.e. areas beyond 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 21).

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 (MNRF 2014a). When buffers overlapped water polygons, the buffer area over water was counted as anthropogenic in the disturbance statistics.

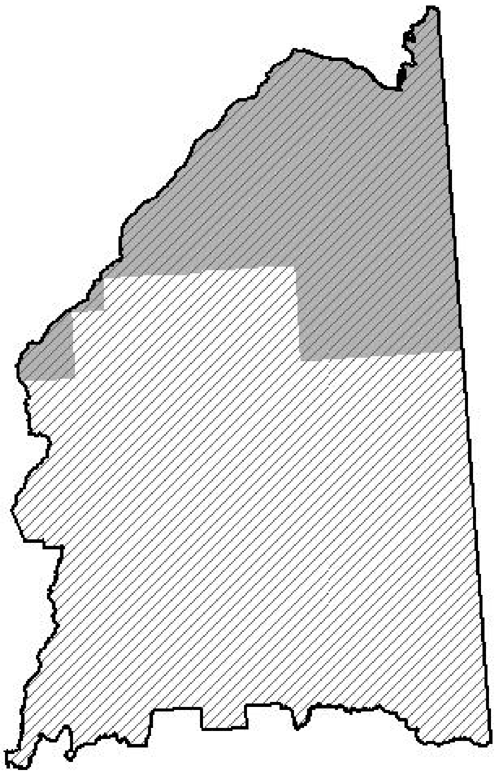


Figure 21. The Kesagami Range including the extent of the forest resource inventory (FRI) data (), the extent of 2012 Provincial Satellite Derived Disturbance Mapping data (), and the extent of relevant data from LIO, including PLC 2000 data ().

5.2.2 Disturbance analysis results

The physical disturbance from various sources within the Kesagami Range (Figure 22-Figure 27) contributes to the cumulative disturbance footprint (Table 15, Figure 28, and Figure 29). Sections 5.2.2.1-5.2.2.6 describe the contributions of forest harvest, other industry, linear features, mineral development, tourism, and natural disturbances relevant in 2010.

5.2.2.1 Forest harvest

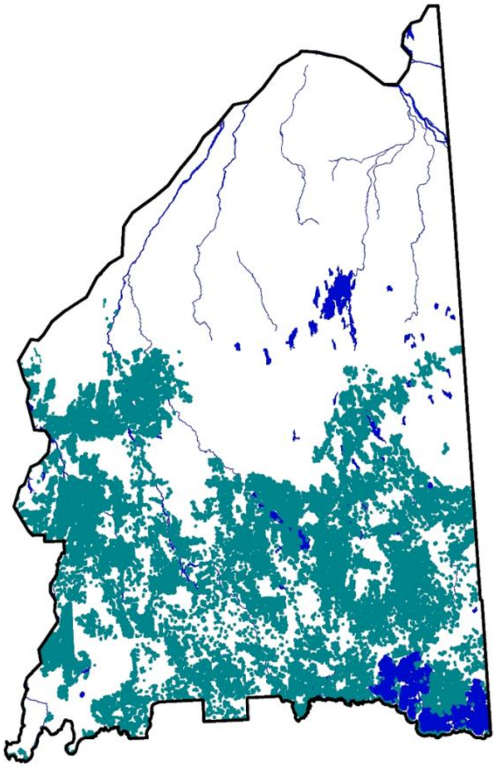


Figure 22. Forest harvest disturbance (■) including 500 m buffers in the Kesagami Range.

Table 9. Forest harvest statistics for the Kesagami Range.

Harvest features	Count (n)	Area (ha)	Buffer area (ha)
Harvest stands (FRI)	51,033	540,665	950,497
Harvest areas (PLC 2000)	n/a[1]	5,120	26,745

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

5.2.2.2 Other industry disturbance

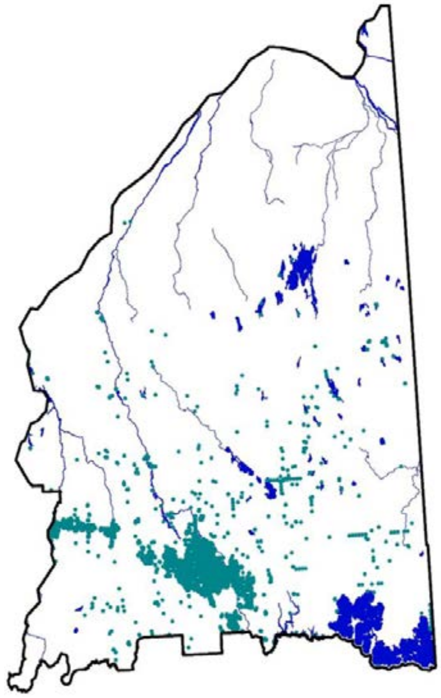


Figure 23. Other industry features (■) including 500 m buffers in the Kesagami Range.

Table 10. Other industry disturbance statistics for the Kesagami Range.

Other industry feature	Count (n)	Area (ha)	Buffer area (ha)
Agriculture *(multiple data sources)*	0	5,512	36,096
Airports	9	235	1,808
Buildings	5,209	n/a[2]	65,048
Dams	3	n/a[2]	81
Forest processing facilities	5	n/a[2]	237
Grass	n/a[1]	9,231	69,608
Infrastructure	n/a[1]	35	682
Towers	25	n/a[2]	1,913
Utility sites	4	n/a[2]	314
Waste disposal sites	23	84	2,486
Water power generations stations	11	n/a[2]	828
Work camps	7	n/a[2]	550

[1]Derived from land cover (raster) and count of number features not available.
[2]Features are represented by point data types; area not available.

5.2.2.3 Linear features disturbance

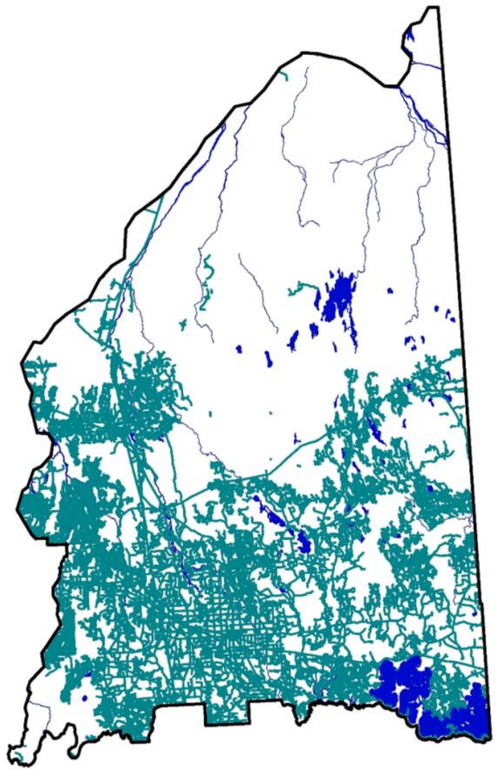


Figure 24. Linear features (■) including 500 m buffers in the Kesagami Range.

Table 11. Linear features disturbance statistics for the Kesagami Range.

Linear feature	Count (n)	Area (ha)	Buffer area (ha)
Roads	n/a[1]	n/a[2]	1,413,595
Trails	n/a[1]	n/a[2]	72,332
Rail lines	n/a[1]	n/a[2]	35,800
Utility lines	n/a[1]	n/a[2]	78,736

[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

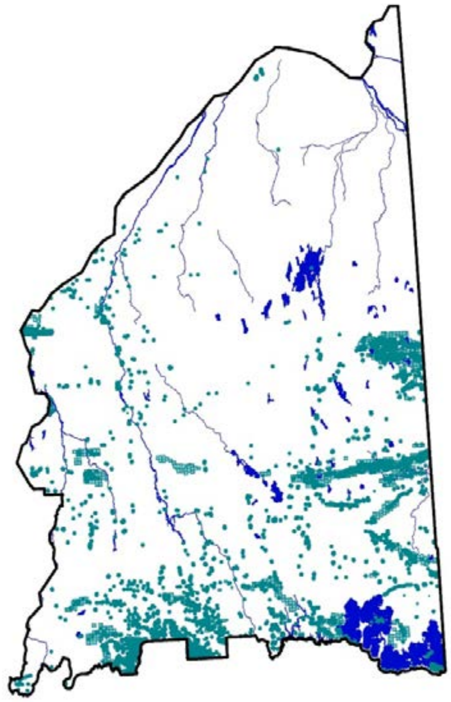


Figure 25. Mining and mineral exploration features (■) including 500 m buffers in the Kesagami Range.

Table 12. Mining feature disturbance statistics for the Kesagami Range.

Mining feature	Count (n)	Area (ha)	Buffer area (ha)
Active mining claims	1,519	188,412	n/a[2]
Aggregate sites – authorized	153	2,664	20,502
Aggregate sites – un-rehabilitated	298	n/a[1]	19,108
Drill holes	5,128	n/a[1]	139,666
Mining locations	0	0	0
Petroleum wells	22	n/a[1]	1,535
Mine shafts or open pits	7	32	472
Pits and quarries	459	2,641	40,788

[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

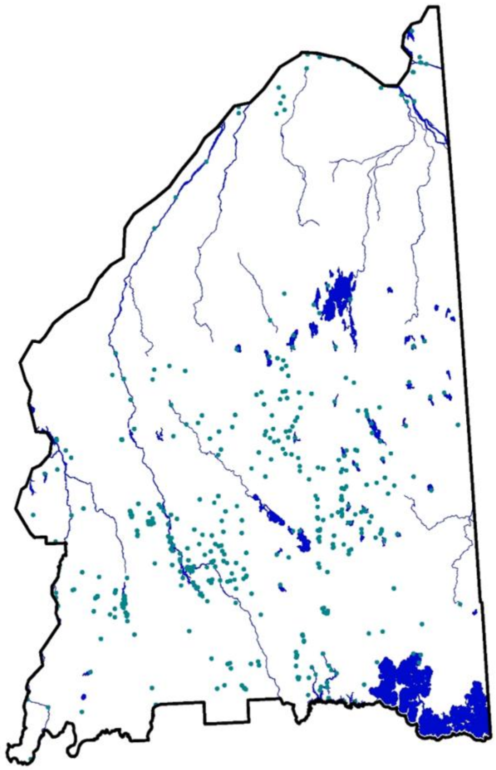


Figure 26. Tourism infrastructure features (■) including 500 m buffers in the Kesagami Range.

Table 13. Tourism infrastructure disturbance statistics for the Kesagami Range.

Tourism feature	Count (n)	Area (ha)	Buffer area (ha)
Cottage areas	5	13	512
Cottage and residential sites	261	83	19,727
Commercial campgrounds	1	<1	78
Main base lodges (remote/non-remote)	3	<1	253
Recreational camps	34	7	2,704
Remote outposts	137	31	11,689

5.2.2.6 Natural disturbance

There were several cases where the same natural disturbance existed in two or more datasets. In these cases, the most up-to-date source and the source that contained the finest resolution was utilized.

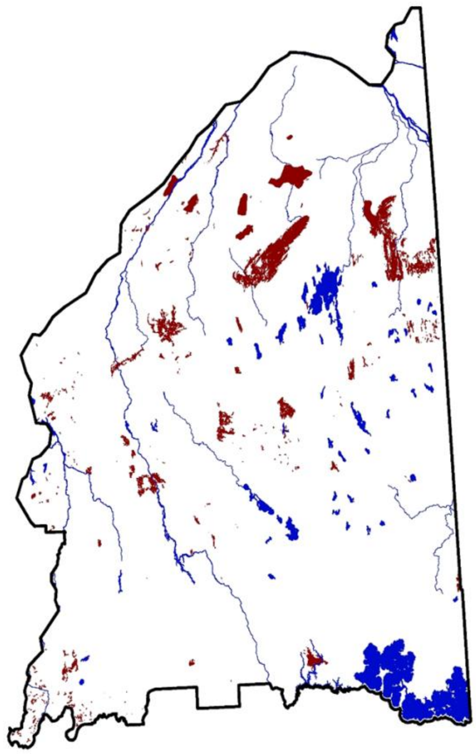


Figure 27. Natural disturbances from fire, blow-down, snow, and insect damage (■) in the Kesagami Range.

Table 14. Natural disturbance statistics for the Kesagami Range.

Natural feature	Count (n)	Area (ha)	Buffer area (ha)
Fire (FRI)	n/a	49,927	n/a[2]
Fire (PLC 2000)	n/a [1]	33,705	n/a[2]
Fire (LIO)	n/a	28,516	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 5.4% of the area within the Kesagami Range; about a third of this area is comprised of Lake Abitibi (Table 15). Approximately 29% 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 disturbance statistics and map (Figure 28). The amount of area, inferred as functional habitat loss identified from the disturbance analysis amounts to 2,069,825 ha, or 43.7% of the Kesagami Range. Natural disturbance accounts for 2.0% of the range and anthropogenic disturbance accounts for 41.7% of the range. The overlap of natural and anthropogenic disturbances accounts for 0.3% of the range area and 0.8% of the total disturbance, this value is counted as part of anthropogenic disturbance.

Table 15. Kesagami Range landscape statistics.

Range component	Area (ha)	% of Range Area
Total range area	4,738,794	100.0
Water	257,431	5.4
Lake Abitibi	77,629	1.6
Non-water	4,481,363	94.6
FRI extent[1]	3,365,770	71.0
Non-FRI extent[1]	1,373,024	29.0
Total disturbance within range	2,069,825	43.7
Natural[2]	94.894	2.0
Anthropogenic[2]	1,974,931	41.7
- Overlap of natural and anthropogenic disturbance[3]	15,883	0.3
Not disturbed within range	2,668,969	56.3

[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.

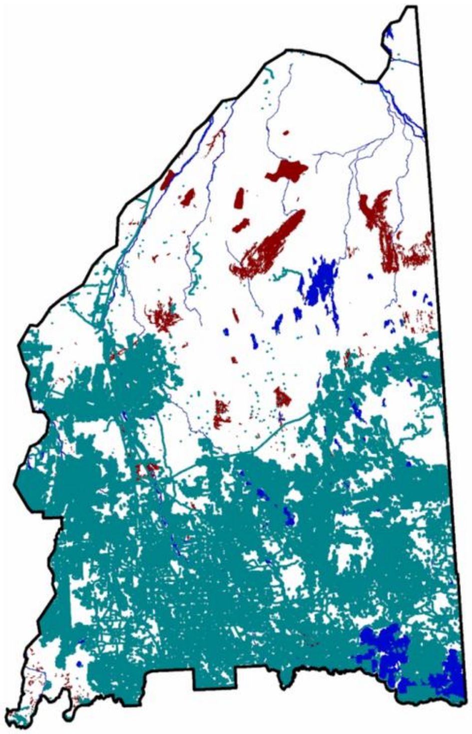


Figure 28. Anthropogenic[1] (■) and natural (■) disturbances (i.e. forest <36 years) in the Kesagami Range.
[1]Anthropogenic disturbances include a 500 m buffer. When anthropogenic disturbances overlap with natural disturbances it is counted as anthropogenic.

Disturbance distribution is heavily weighted to the southern portion of the range. The distribution of landscape disturbance reflected in 100 km^2 hexagons (Figure 29) illustrates the high levels of habitat disturbance particularly in the south. Hexagons showing higher levels of disturbance in the northern part of the range are attributed to large fires (Figure 28).

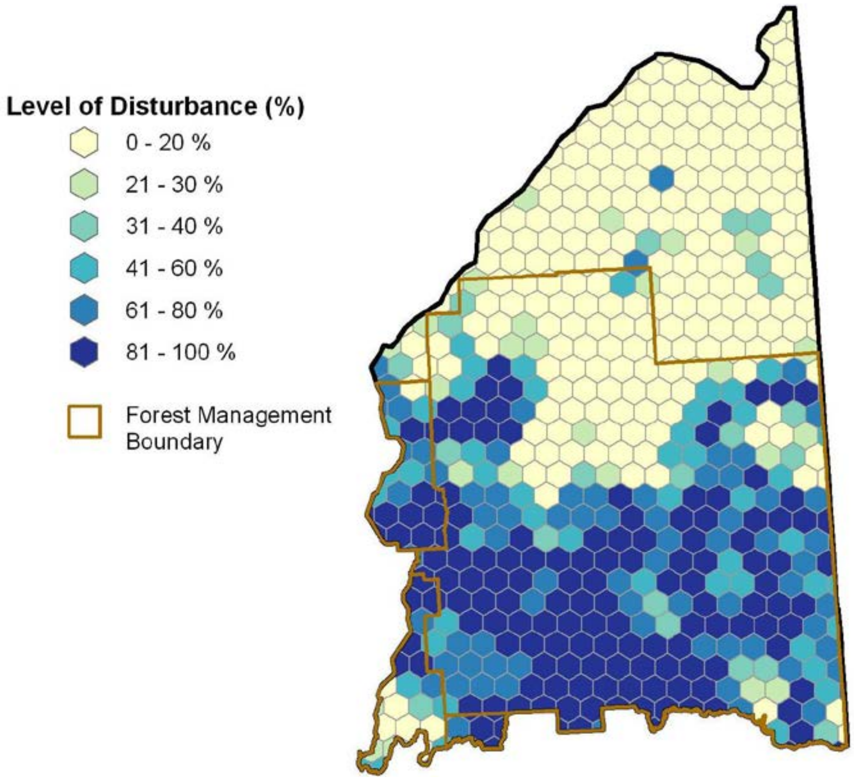


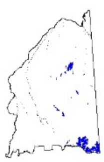
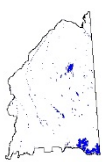
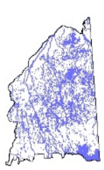
Figure 29. The distribution of natural and anthropogenic disturbances on the Kesagami Range partitioned into the 100 km^2 hexagon grid used for the probability of occupancy aerial survey (Section 3.3).

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 displacement of caribou due to human recreational or industrial activities.

5.2.4 Disturbance considerations related to water

The measurable indicators of natural and anthropogenic disturbances do not apply to the range area occupied by water. 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 lakes of different size classes were removed (Table 16) and the proportion of disturbance on the landscape was adjusted accordingly. The analysis indicates that disturbance accounts for 43.7%-46.2% of the range, depending on the treatment of water in the disturbance analysis. 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. Little change in the disturbance statistics was observed through this sensitivity analysis.

Table 16. Disturbance sensitivity analysis in the Kesagami Range. The percent disturbance is estimated by removing waterbodies of different 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).

Kesagami Range	Waterbody	Water ha (%)	Disturbance (%)		
			Natural	Anthropogenic	All
	Range extent	0 (0.0)	2.0	41.7	43.7
	> 10,000 ha removed	77,629 (1.6)	2.0	42.4	44.4
	> 5,000 ha removed	90,671 (2.0)	2.0	42.5	44.5
	> 1,000 ha removed	133,570 (2.8)	2.1	42.9	44.9
	> 500 ha removed	143,159 (3.0)	2.1	43.0	45.0
	> 250 ha removed	159,129 (3.4)	2.1	43.1	45.2
	All water removed	257,431 (5.4)	2.1	44.1	46.2

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 Kesagami Range, both the amount and arrangement SRNV are compared against 2012 amounts and 2010 arrangement as inferred from the FRI (Figure 30). The relative difference is a measure of how close or how far away the range condition is to the natural levels of habitat. The SRNV values may be compared to the land, water and inventory coverage for the Kesagami Range (Table 15).

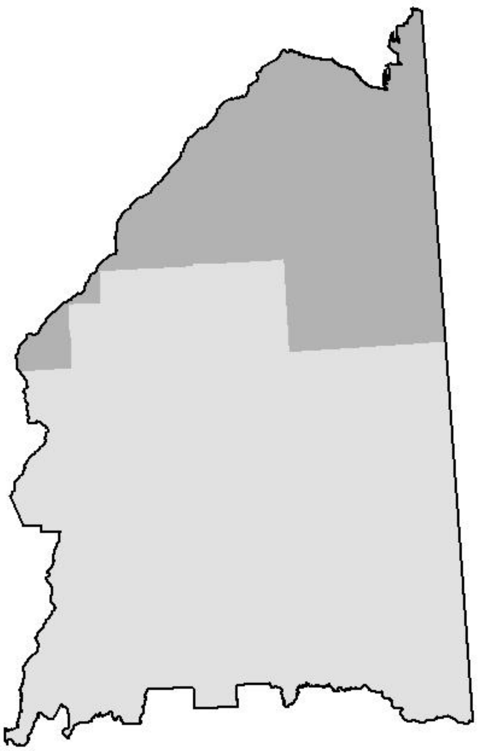
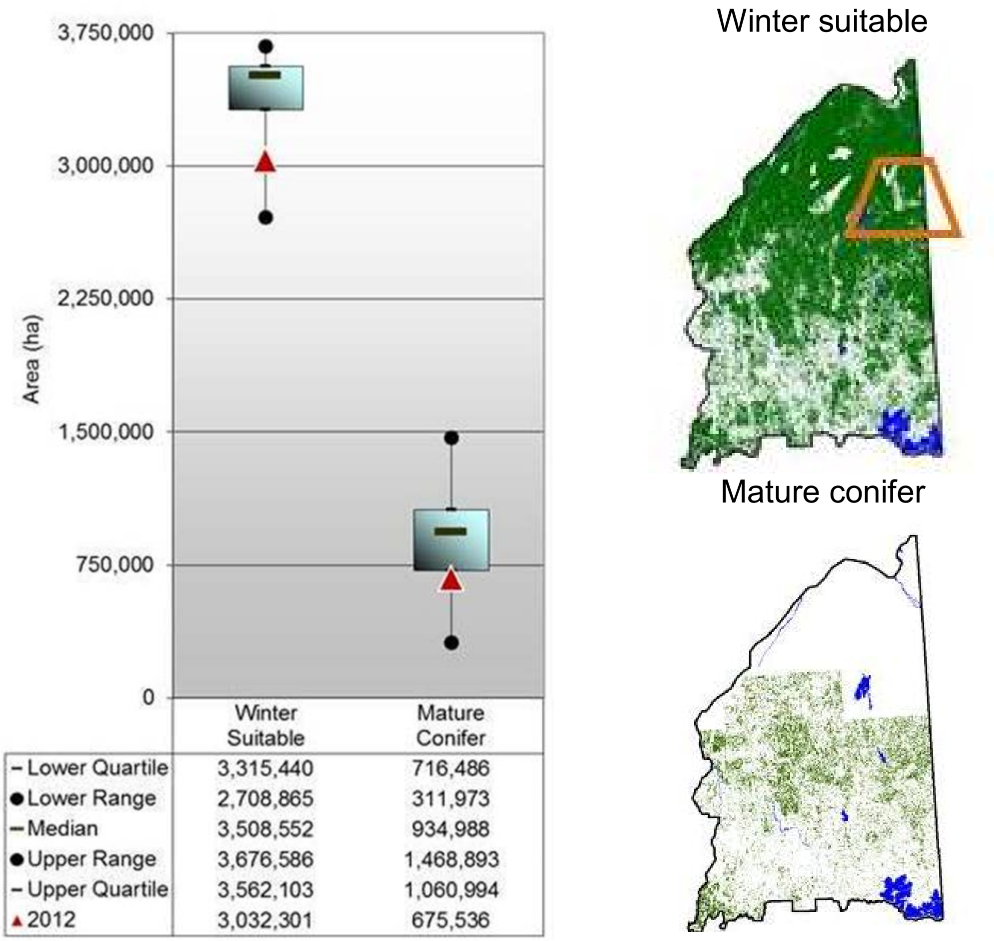


Figure 30. The Kesagami Range including the extent of the forest resource inventory (FRI) data (■) and the extent of 2010 Provincial Land Cover (PLC 2010) data (■).

5.2.6 Habitat assessment results

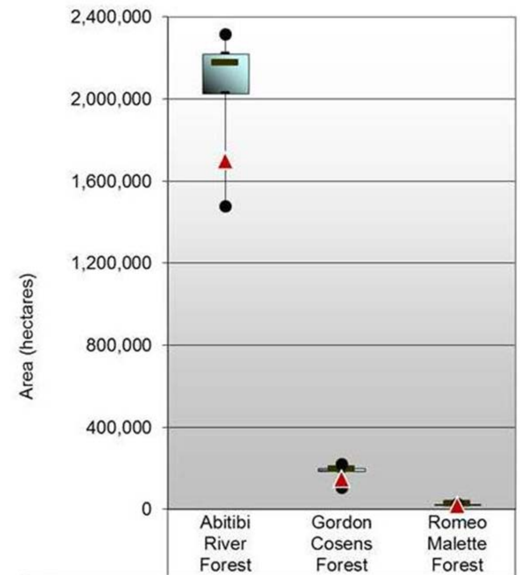
5.2.6.1 Caribou habitat SRNV amount

The current amount of suitable and mature conifer habitats are below the interquartile range in the caribou range and within range and within each FMU (Figure 32 and 33). The values shown for each FMU includes all land regadless of ownership. Consequently, the Integrated Range Assessment estimates are significantly higher than those used in forest management planning which would include managed crown land only. These results do not reflect the desirable levels of habitat or achievement within the currnet (2012) Abitibi River Forest Plan.



	Winter Suitable	Mature Conifer
Lower Quartile	3,315,440	716,486
Lower Range	2,708,865	311,973
Median	3,508,552	934,988
Upper Range	3,676,586	1,468,893
Upper Quartile	3,562,103	1,060,994
2012	3,032,301	675,536

Figure 31. Box and whisker plots of caribou winter suitable and mature conifer habitat SRNV in the Kesagami Range. North of the Area of Undertaking (AOU), winter suitable habitat may be over-estimated (area shown in orange polygon) (See Section 3.6).



	Abitibi River Forest	Gordon Cosens Forest	Romeo Malette Forest
Lower Quartile	2,026,982	185,062	23,904
Lower Range	1,477,515	104,949	4,965
Median	2,174,171	196,124	24,891
Upper Range	2,314,381	221,090	27,155
Upper Quartile	2,221,813	201,501	25,430
2012	1,697,235	146,466	17,842

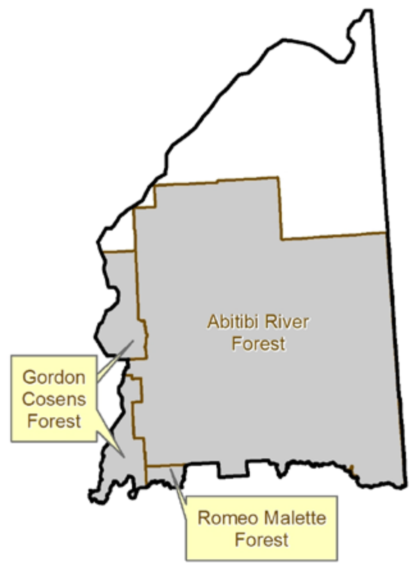
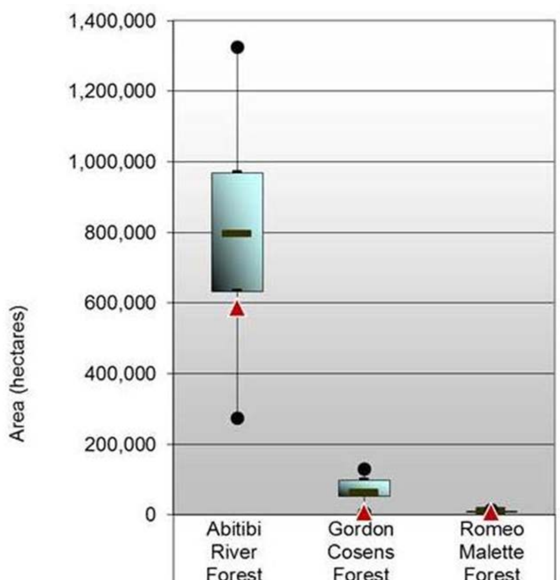


Figure 32. Box and whisker plot of winter suitable habitat amount as contributed by the Forest Management Units (FMUs) within the Kesagami Range.



	Abitibi River Forest	Gordon Cosens Forest	Romeo Malette Forest
Lower Quartile	633,990	54,210	8,472
Lower Range	274,626	4,740	7
Median	794,475	61,092	10,577
Upper Range	1,325,693	128,121	12,996
Upper Quartile	969,717	99,612	11,795
2012	586,227	8,233	6,892

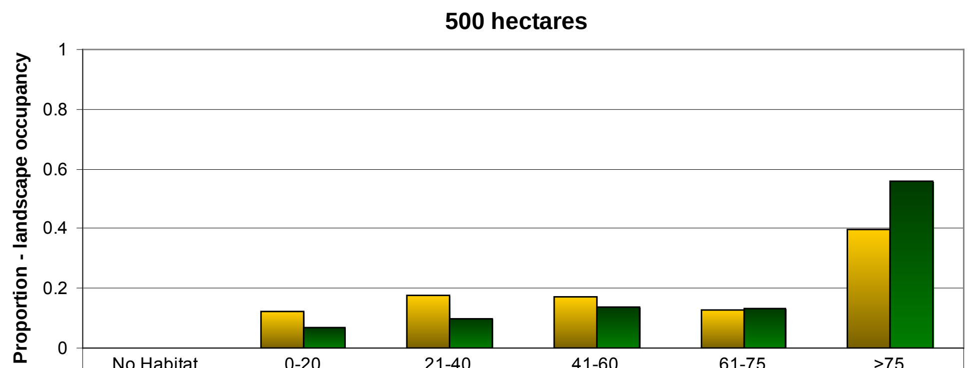
Figure 33. Box and whisker plots of mature conifer habitat amount as contributed by the three FMUs within the Kesagami Range.

5.2.6.2 Winter suitable habitat arrangement

At the 6,000 ha level, 51.4 % (0.161 + 0.353 = 0.514) of the hexagons have 61% or greater winter suitable caribou habitat. In contrast, the mean from the simulations is greater with 71.3% (0.177 + 0.536 = 0.713) of the hexagons having 61% or greater winter suitable caribou habitat. Most of this difference occurs in the >75% proportion class. Relative to a natural landscape, the Kesagami Range is 19.9% below the SRNV for winter suitable habitat arrangement.

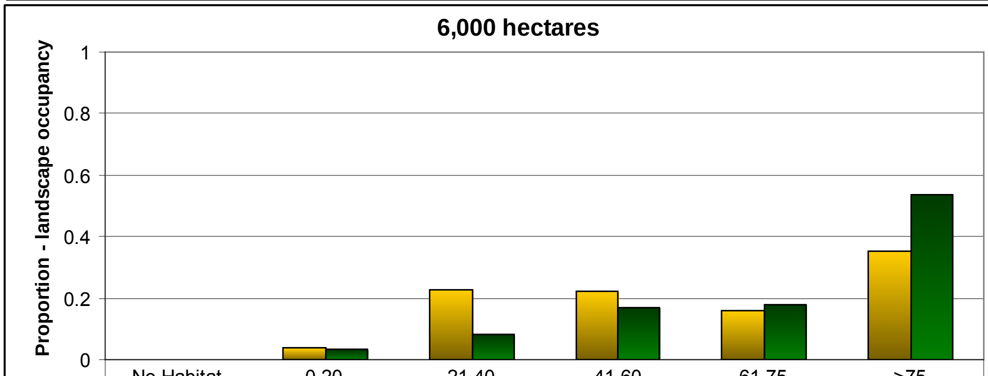
At the 30,000 ha level the current landscape has 48.5 % (0.158 + 0.327 = 0.485) of the hexagons had 61% or greater winter suitable caribou habitat. In contrast the mean from the simulations has 71.7% (0.208 + 0.509 = 0.717) of the landscape with 61% or greater winter suitable caribou habitat. Most of this difference occurs in the >75% proportion class. Relative to a natural landscape, the Kesagami Range is 23.2% below the SRNV for winter suitable habitat arrangement.

Caribou winter suitable habitat measured at the 6,000 and 30,000 ha levels is fragmented relative to the estimates of the natural landscape.



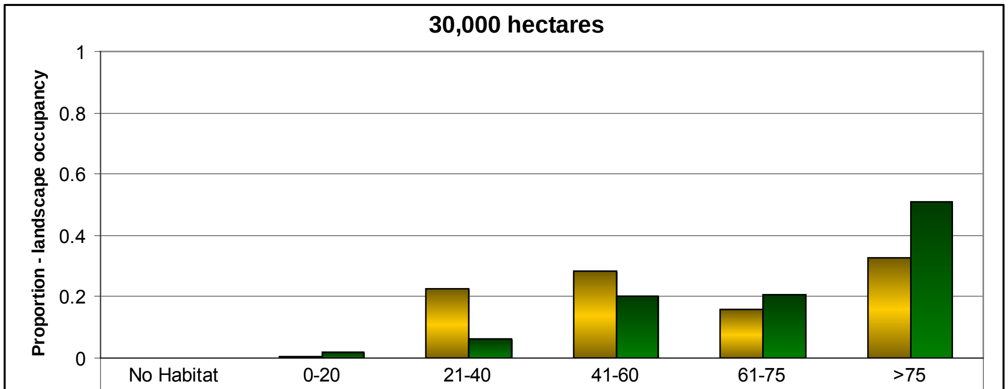
	No Habitat	0-20	21-40	41-60	61-75	>75
2010	0.001	0.122	0.178	0.171	0.129	0.399
SRNV	0.001	0.069	0.099	0.137	0.134	0.559

Proportion class - hexagon occupancy



	No Habitat	0-20	21-40	41-60	61-75	>75
2010	0	0.037	0.229	0.22	0.161	0.353
SRNV	0	0.036	0.08	0.171	0.177	0.536

Proportion class - hexagon occupancy



	No Habitat	0-20	21-40	41-60	61-75	>75
2010	0	0.004	0.227	0.283	0.158	0.327
SRNV	0	0.017	0.063	0.203	0.208	0.509

Figure 34. Caribou winter suitable habitat texture histogram compared to means from the SRNV at the 500, 6,000, and 30,000 ha levels for the Kesagami Range. Note: Winter suitable habitat arrangement is only calculated in the area where FRI coverage exists.

5.2.6.3 Mature conifer habitat arrangement

At the 6,000 ha level 48.2% (0.188 + 0.294 = 0.482) of the hexagons had >20% mature conifer caribou habitat. In contrast, the mean from the simulations is greater with 70.1% (0.163 + 0.538 = 0.701) of the hexagons having >20% caribou mature conifer habitat. Most of this difference occurs in the >28% proportion class. Relative to a natural landscape, and at the 6000 ha level the Kesagami Range is 21.9% below the SRNV for mature conifer habitat arrangement.

At the 30,000 ha level 51.8% (0.229 + 0.289 = 0.518) of the hexagons had >20% mature conifer caribou habitat. In contrast, the mean from the simulations has 74.6% (0.184 + 0.562 = 0.746) of the hexagons having >20% caribou mature conifer habitat. Relative to a natural landscape and at the 30,000 ha level, the Kesagami Range is 22.8% below the SRNV for mature conifer habitat arrangement.

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

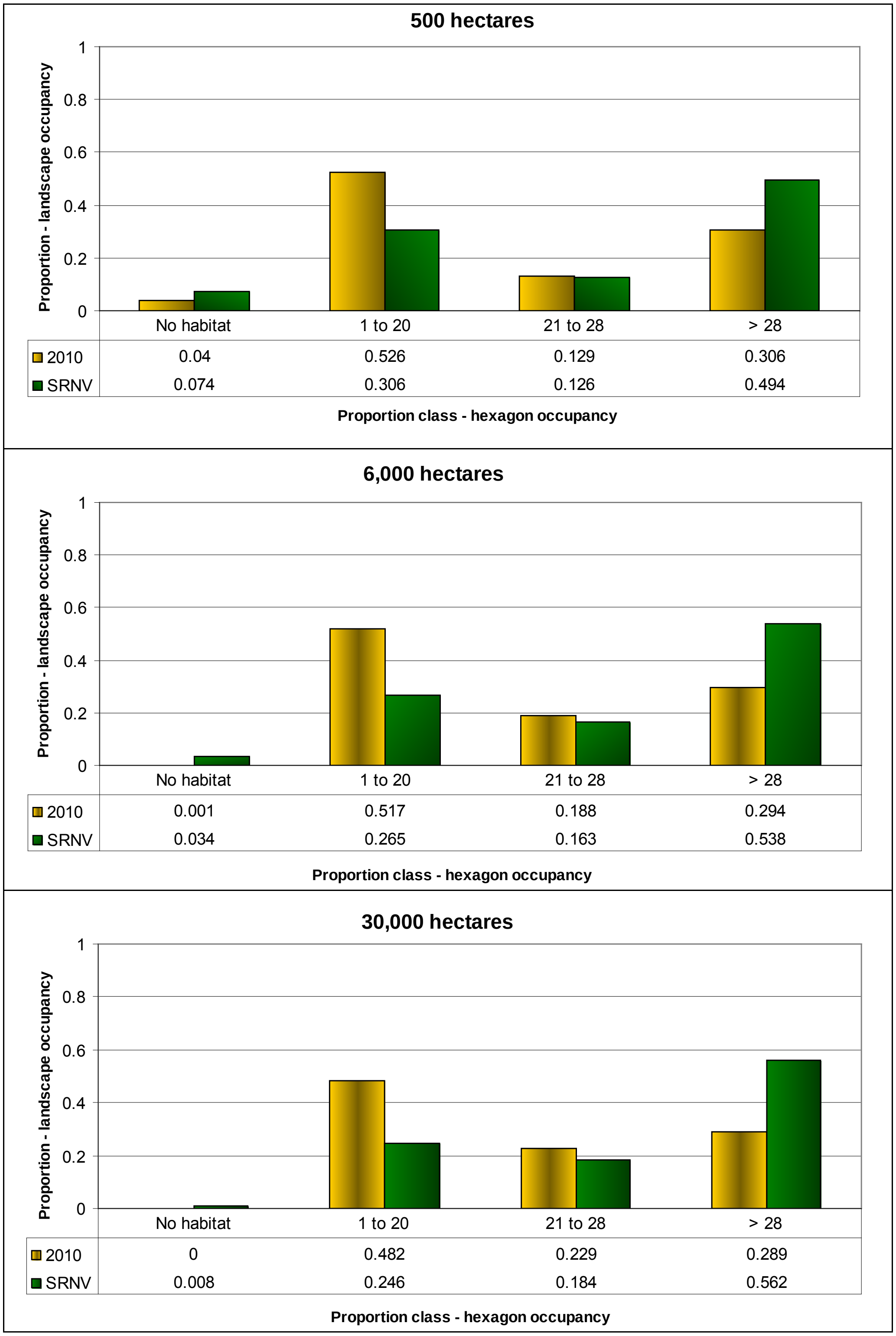


Figure 35. Caribou mature conifer habitat texture histogram compared to means from the SRNV at the 500, 6,000, and 30,000 ha levels for the Kesagami Range. Note: Mature conifer habitat arrangement is only calculated in the area where FRI coverage exists.

5.2.6.4 Young forest SRNV area results

The current amount of young forest is well above the interquartile range and median estimated by the SRNV (Figure 36). This young forest includes all young forests regardless of origin and includes forest areas created by fire, logging, blowdown and permanent disturbance. Likewise, for all FMUs within the Kesagami Range, the current amount is above the upper quartile range (Figure 37).

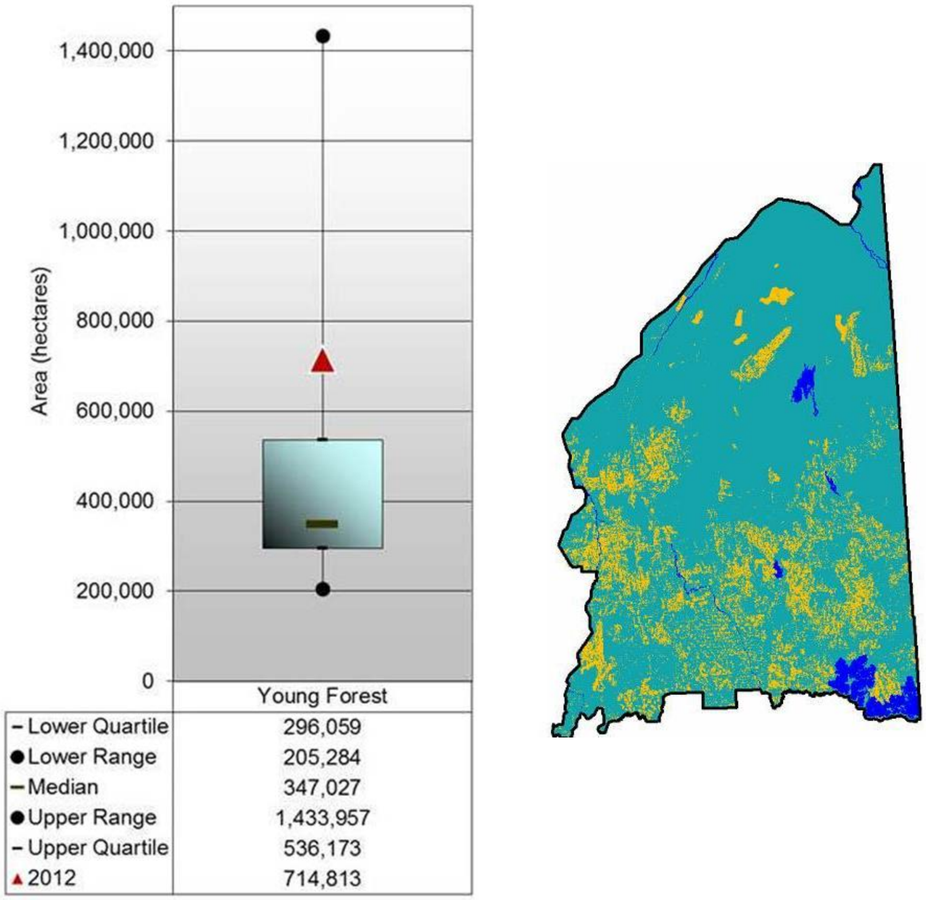
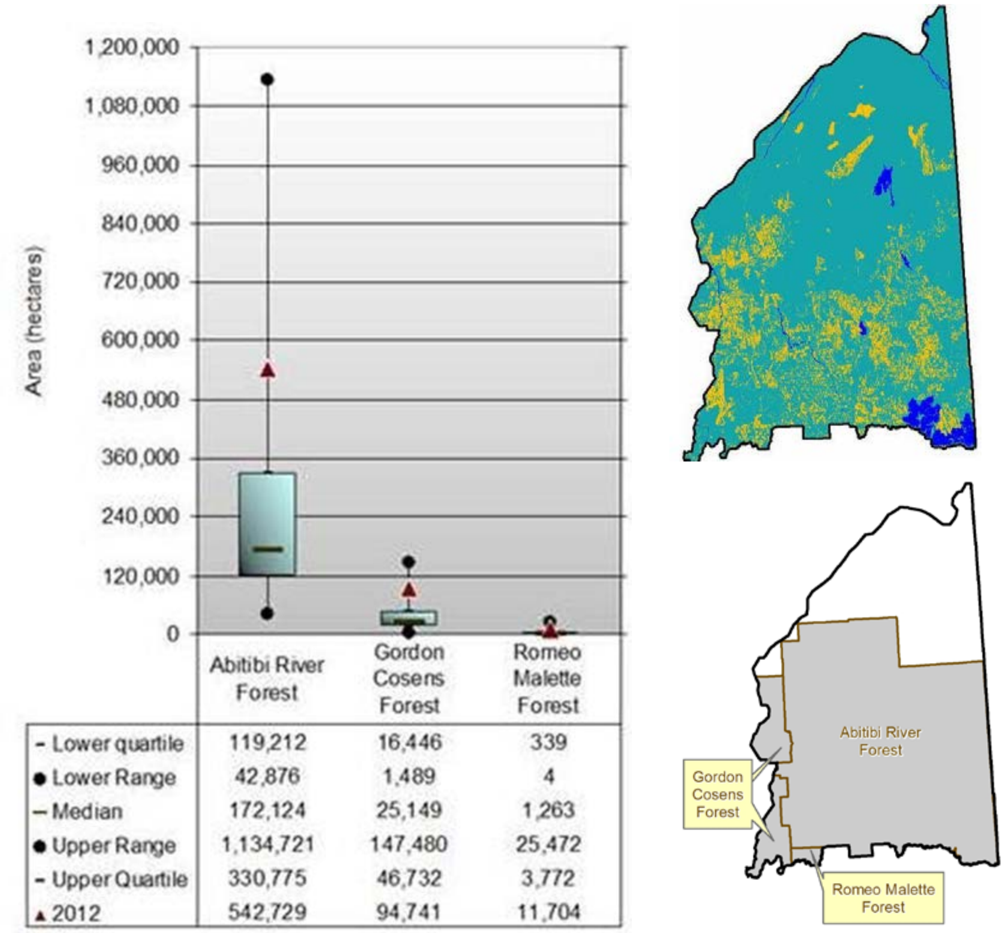


Figure 36. Box and whisker plots of young forest (i.e. <36 years) and permanent disturbance in the Kesagami Range as compared to the SRNV.



	Abitibi River Forest	Gordon Cosens Forest	Romeo Malette Forest
- Lower quartile	119,212	16,446	339
● Lower Range	42,876	1,489	4
– Median	172,124	25,149	1,263
● Upper Range	1,134,721	147,480	25,472
- Upper Quartile	330,775	46,732	3,772
▲ 2012	542,729	94,741	11,704

Figure 37. Box and whisker plots of young forest (i.e. <36 years) and permanent disturbance within the FMUs of the Kesagami Range as compared to the SRNV**.**

6.0 Interpretation of Lines of Evidence

6.1 Interpretation of the population state

The minimum number of caribou (MAC) occupying the Kesagami Range during winter 2010 was 178 based on the combined aerial surveys (Section 5.1). Considering that animals travel in and out of Quebec as well as cross the Mattagami and Missinabi rivers to the northwest, and that during winter 2010 only approximately 5% of the total range area (assuming an observable strip width of 0.5 km from aircraft) was surveyed, the actual number of animals is likely much greater, possibly over 300 animals. It should be noted that the majority of the caribou in the Kesagami Range likely reside in the northern portion of the range where disturbance levels are comparatively lower.

The population trend during the 1998-2000 study indicated that the caribou population was in decline ($\lambda = 0.88$) (W.J. Rettie, unpublished data; EC 2008). Current data appears to confirm this trend, suggesting that the population has undergone a long-term decline. Relatively low recruitment appears to be consistent since at least 1998 (Table 7, Figure 20), with the highest estimate of 25.2 calves per 100 AF_{adj} occurring in 2006 (from Ontario surveys), which is below the documented threshold for a stable population (28.9 calves per 100 adult females, assuming an adult female survival rate of 85%; EC 2008, EC 2011). In contrast to the older study (78% (1998-2000)), the adult female survival rate was high (88% (2009-2012)). However, with continued poor recruitment rates, the current estimated population trend is declining (λ= 0.94).

In general, occupancy estimates demonstrate higher probabilities of occupancy in the central and northern portion of the range and lower probabilities in the southern portion of the range. 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 (0.35) 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.

Although there is evidence that caribou traverse the eastern and northwestern range boundaries, the extent to which immigration and emigration contribute to population state in the Kesagami Range is unknown. Additional estimates of recruitment and adult female survival from collared caribou in the coming years will allow for refinement of these trend estimates.

6.2 Interpretation of habitat state

More than 40% of the Kesagami Range is disturbed, most as a result of human-caused activities. These disturbance activities are concentrated in the southern half of the range where over 95% of the hexagon cells are between 31-100% disturbed.

The level of disturbance on the Kesagami Range is 43.8% (all waterbodies included). As a result, the probability of a stable-or-increasing population growth is considered uncertain (as likely as not) with an estimated probability of 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 (section 5.2.4) demonstrated that the disturbance estimate for the Kesagami Range may be as great as 46.2% (all waterbodies excluded). At such a level it is unlikely that the range could sustain caribou. In some parts of Ontario, landscapes rich in large waterbodies with islands may help compensate for moderate levels of landscape disturbance, possibly by providing refuge. The Kesagami Range however, has few large lakes with islands. Within this range, large wetland complexes with treed islands, such as the Hicks-Oke Bog, may serve a similar function.

Collectively, there are a number of anthropogenic disturbance types not addressed in the above analyses including 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.

Current mature conifer and winter suitable habitat amounts on the Kesagami Range are below the interquartile range of the SRNV. Increasing the amount of mature conifer and winter suitable habitats throughout the Kesagami Range and on individual FMUs to within the interquartile range would create conditions that would more commonly have occurred in landscapes to which caribou have adapted. Currently, both mature conifer and winter suitable habitats are fragmented as compared to the SRNV at both the 6,000 and 30,000 ha scales. Similar to habitat amount, 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 Kesagami Range is well above the interquartile range of the SRNV. Retaining the amount of young forest within the interquartile range would create landscapes to which caribou adapted.

7.0 Integrated Risk Assessment

7.1 Population size

The minimum number of caribou on the Kesagami Range based on the MAC is 178 (Figure 38) and likely exceeds 300. The Kesagami Range is part of the Continuous Distribution in Ontario and some immigration and emigration occurs between neighbouring ranges. By using the minimum animal count of 178, estimates of probability of persistence are likely precautionary. The probabilities of persistence for 20 and 50 years, under the assumption of a stable-or-increasing population (see Section 7.2) are approximately 0.92-1.0 and 0.75-0.9 respectively (MNRF 2014a; EC 2011). However, these estimates of probability of persistence are likely high given that population trend indicators suggest a declining population.

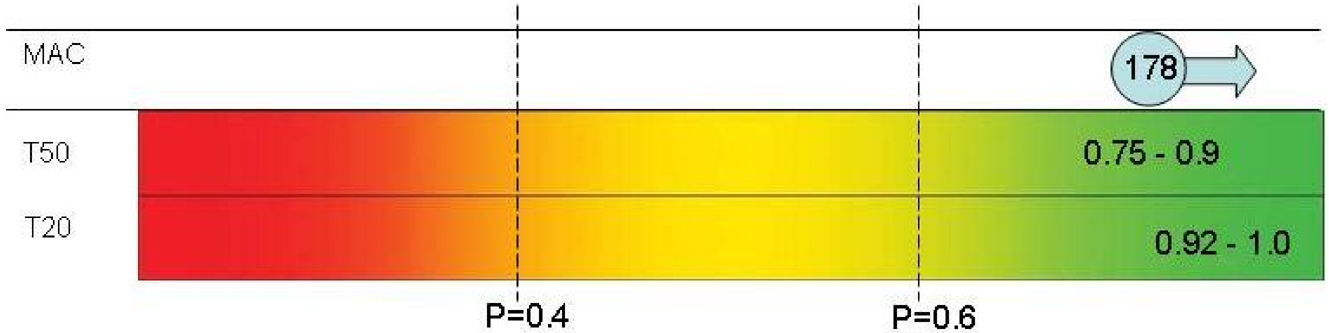


Figure 38. Minimum animal count (MAC) in the Kesagami Range, determined by the 2010 winter aerial surveys survey as compared to probability of persistence in 20 years (T20) and 50 years (T50).

7.2 Population trend

The caribou population in the Kesagami Range was in decline over the short-term study from 1998-2000 (λ = 0.88). This decline was a result of adult female survival and recruitment rates being below the EC (2008) threshold of 0.85 and 28.9 calves per 100 adult females, respectively.

Annual population trend estimates (λ) were variable, ranging from 0.9 to 1.01 during the most recent study period (2009-2012), although the geometric mean suggests that the population was in an overall decline (0.94). Adult female survival rates during this period were very close or above the EC (2008) threshold of 0.85, whereas recruitment estimates were substantially lower than the EC (2008) threshold of 28.9 calves per 100 adult females, and lower than the rates documented in the early study from 1998-2000. Therefore, the recent short-term decline might best be attributed to risk factors associated with calf survival as compared to adult female survival.

Population trend estimates inferred using only recruitment rates (i.e. no estimate of adult female survival) during the time period between these two studies also suggest that the population was in decline. The combination of these three periods of short-term trend estimates suggest that the population has been in a long-term decline (over the past 15 years) (Figure 39).

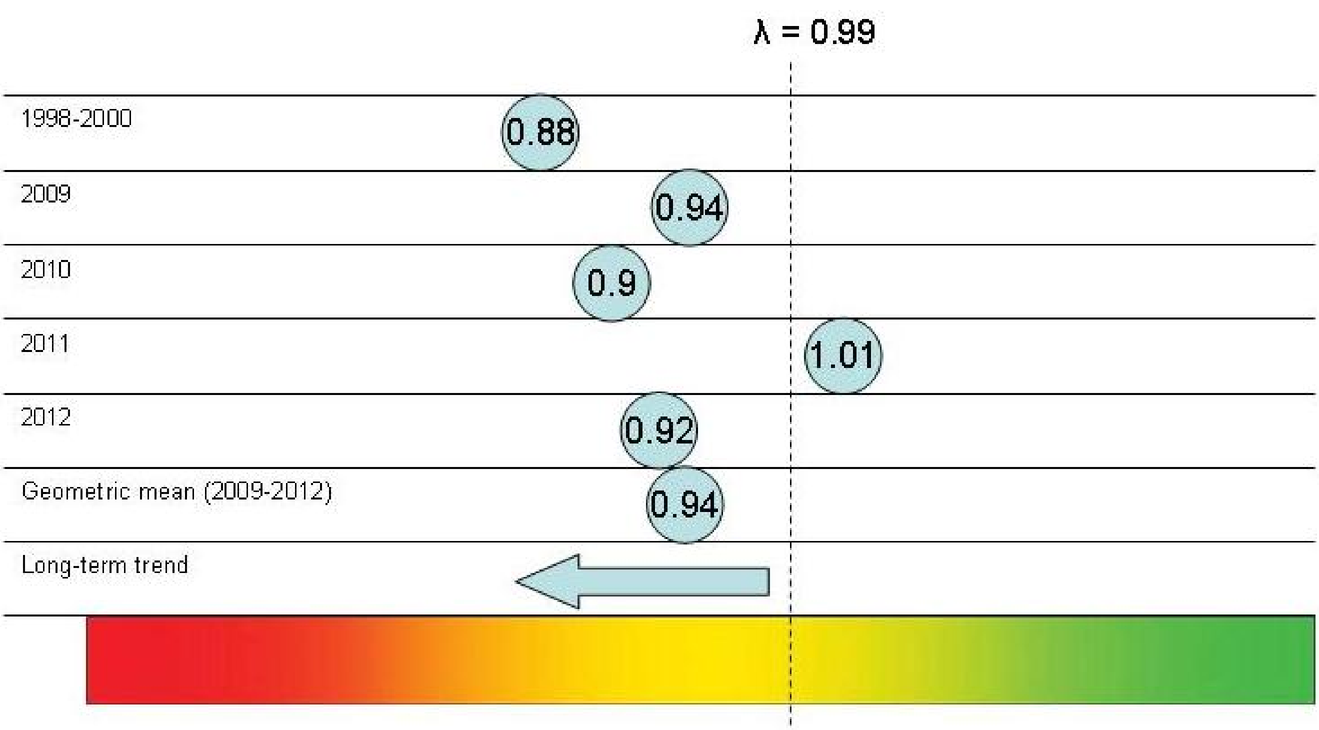


Figure 39. Estimated population trend (λ) for the Kesagami Range corresponding biological year (not the survey year), as well as the short-term trend (geometric mean) and long-term trend as determined from other trend indicators.

7.3 Disturbance analysis

The Kesagami Range is 43.7% disturbed. Calculated values of disturbance ranged from 43.7 to 46.2%, depending on the treatment of water (Table 16). This level of disturbance would suggest that the likelihood of stable or increasing population growth is approximately 0.45 (Figure 40).

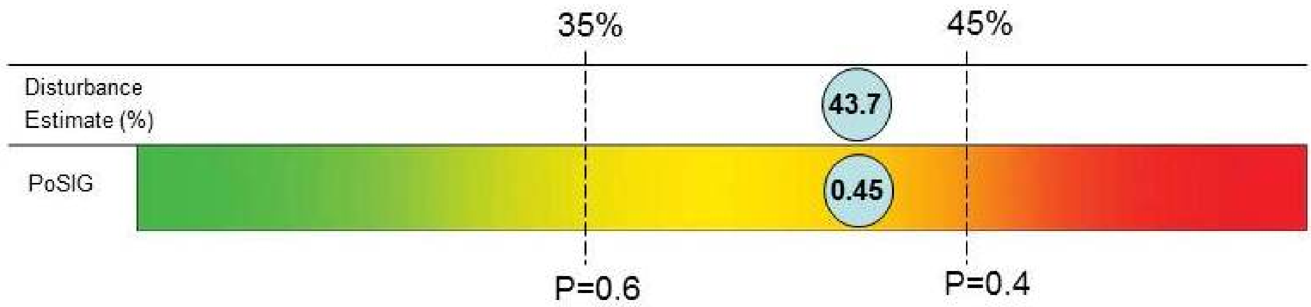


Figure 40. Disturbance estimates as a percentage of area within the Kesagami Range as it relates to the probability of stable or increasing population growth (PoSIPG).

7.4 Integrated risk assessment process

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

Step 1: Lambda is less than 0.99 and the 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 is not maintained by population management actions.

Step 6: Likelihood of stable or increasing population growth is greater than 0.4, lambda is less than 0.99; *AND* the probability of persistence based on the MAC of 178 is greater than 0.6 (for T=20).

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

7.5 Range condition

Risk is estimated to be intermediate in the Kesagami Range. The amount of habitat is below the interquartile range and the arrangement is fragmented relative to the SRNV, implying a strongly diminished range condition compared to that suggested by the integrated risk analysis alone. Therefore, the Assessment Team determined that range condition is insufficient to sustain caribou.

8.0 Involvement of First Nation Communities

Through the development of the 2012 Abitibi River Forest FMP, participating First Nation planning team members were updated on caribou population/recruitment data and research/management activities occurring on the Kesagami Range.

- During the 2012 FMP plan open houses in participating First Nation communities, information was presented to community members on past and present caribou management and research activities within the Abitibi River Forest.
- January 10, 2011: A conference call between MNRF staff and Moose Cree First Nation to explain caribou movements and collaring activity. It was also stated that wolves were being collared. It was stated that the MNRF was trying to work towards a data sharing agreement with Quebec concerning co-management of caribou (Detour/La Sarre herd).
- February 10, 2011: A meeting between MNRF staff and Taykwa Tagamou First Nation (New Post) occurred; MNRF gave a presentation on caribou collaring work, the Integrated Range Assessment process, and disturbance and forestry impacts.
- March 8, 2011: A letter was distributed describing ongoing research activities to update seven First Nation groups involved or expressed interest in involvement in the Abitibi River Forest FMP.

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* in 2011. Based on available information and specific methodologies, caribou occupying the Kesagami Range were determined to be very unlikely to be self-sustaining. EC concluded that the Kesagami Range was 38% disturbed, the population size was 492 caribou, and the long-term probability of persistence was 0.9 (≥ 50 years). These results were based on best available data at the time provided to Environment Canada from the MNRF. EC's conclusion aligns with the MNRF's conclusion of range condition identified within this report. 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. MNRF estimated a MAC of 178 and likely exceeds 300 caribou. These numbers differ from EC's finding because they are based on more up-to-date survey data.
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 Environment Canada. MNRF determined varied estimates of disturbance associated with stated assumptions relating to the treatment of water in the disturbance calculations.

3. Survival and trend estimates derived from winter aerial surveys and collared caribou suggest a slower population decline than estimated by EC. The difference may be attributed to differences in survey methods.
4. MNRF considered amount and arrangement of caribou habitat in the determination of range condition, which was not considered by EC.

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