Ontario

Integrated Range Assessment for Woodland Caribou and their Habitat

Nipigon Range 2010

Ministry of Natural Resources and Forestry
Species at Risk Branch

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Version 1.1

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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 Policy). The Range Management Policy provides the direction needed to conserve and recover caribou in Ontario through a Range Management Approach. The Range Management Approach provides spatial and ecological context for planning and management decisions. This *Integrated Range Assessment* 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 can 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 the ability of the range to sustain caribou.

The Nipigon Range is approximately 38,600 km² in size, includes all of Lake Nipigon (4,500 km^2) and includes a portion of Wabakimi Provincial Park. Relative to other ranges, the Nipigon Range is rich in historical occupancy data. Caribou occupancy and movement on or near Lake Nipigon and to the east and north have been studied for decades. Caribou occur throughout the range and to the southern extent of Lake Nipigon. Caribou occupancy is highest in the north and lowest in the south with a general avoidance of disturbed areas and a tendency to be associated with larger areas of conifer forest, peatlands, and the shorelines and islands of Lake Nipigon. Forest on the islands and east of Lake Nipigon has been subject to historical harvest starting with horse logging and water-based log drives to present. There are also numerous development activities along the shoreline of Lake Nipigon including proposed transmission lines, wind power sites, recreation and tourism sites, as well as a major utility and access corridor to northern mineral deposits and ongoing forest harvest.

Aerial surveys included a fixed-wing hexagon-based survey during February and March 2010, in which all caribou and sign of their presence were recorded. A helicopter was used between February 20, and March 16, 2010, to revisit areas of significant caribou presence to identify caribou as adult males or females, calves, or caribou of unknown age and sex. Data collected during the survey was used to estimate population state metrics including a minimum animal count of 172. However, the total number of caribou within the Nipigon Range is likely considerably more. Additional recruitment surveys were conducted in late winter of 2011, 2012, and 2013. Recruitment rates varied from 22.9-39.2 calves per 100 adult females over four years.

Six, 47, and nine female caribou were fitted with GPS collars in February 2010, March 2011, and February 2012, respectively. Annual survival estimates varied from 80-88% based on three biological years of data and when modelled with the calf recruitment levels resulted in a geometric mean of $\lambda = 0.98$. This estimate suggests the population may be declining, but the metric was close to the point where the population may be considered stable.

A geospatial analysis estimated that 38% of the range can be currently characterized as natural and anthropogenic disturbance. The resulting likelihood of stable or increasing population growth is estimated to be 0.55 and at this level it is uncertain whether the Nipigon Range is capable of sustaining the caribou population.

Analysis of the amount of caribou habitat (which includes refuge habitat and winter habitat) indicates alignment with that expected in a natural landscape. Habitat is fragmented in the Nipigon Range relative to what would be expected in a natural landscape.

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

1.0 Overview

The Ministry of Natural Resources and Forestry (MNRF), then the Ministry of Natural Resources (MNR), adopted a Range Management Approach as directed by *Ontario's Woodland Caribou Conservation Plan* (CCP) (MNR 2009a). An *Integrated Range Assessment Report* (IRAR) is a major component of the Range Management Approach and informs 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 Nipigon Range is centrally located in northwestern Ontario (Figure 1). It is approximately 38,600 km² in size and is unique because it encompasses Lake Nipigon (4,500 km^2). It also includes a portion of Wabakimi Provincial Park, four ecodistricts, and calving and nursery areas important to caribou including Lake Nipigon, as well as Onaman, Esnagami, Mojikit, Ogoki, and Caribou lakes (Figure 2).

There are a number of small communities and First Nation within the range including Armstrong, Aroland, Nakina, Gull Bay, MacDiarmid, Rocky Bay, Beardmore, Jellico, and the tiny railway villages of Auden, and Ferland. Major transportation corridors within the range include a small portion of the Trans-Canada Highway 11 that runs nearly parallel to the southeastern boundary, Highway 527 that runs north-south along the western boundary of the range, Highway 584 and 643 near the eastern border, and the Canadian National Railway that bisects the range in half. The range also contains a dense network of secondary and tertiary roads, particularly in the southern half.

Lake Nipigon has a significant influence on caribou within the range, especially the southern end; it is used year-round by caribou and enables predator avoidance in the summer. It also has a strong influence on movement and occupancy patterns within the range, although other caribou appear to spend their lives away from the lake. Historically, movement patterns tended to radiate out from Lake Nipigon with north-south movement north of the lake and northeast-southwest movement east of the lake.

The geographic extent of the Nipigon Range is primarily influenced by wintering and calving areas within the range and identified movement patterns. The western boundary is delineated by caribou activity and habitat potential along the western shore of Lake Nipigon as well as wintering and calving activity in the vicinity of the Armstrong Airport and Caribou Lake and borders with the Brightsand Range and some parts of Highway 527. The eastern boundary of the Nipigon Range is influenced by known calving activity on Esnagami and Ogoki lakes, which are within close proximity to the James Bay Lowlands and borders with the Pagwachuan Range. Calving areas on Mojikit Lake and the Ogoki Reservoir form part of the connecting matrix between Lake Nipigon and the Albany River. The northern extent of the range shares boundaries with the Kinloch, Ozhiski, and Missisa ranges.

The Nipigon Range excludes portions of ecodistrict 2W-2 which appear to be used extensively by caribou from the James Bay Lowlands in the winter. The southern extent of the range was determined through a capability analysis, existing occupancy by caribou, and consideration of future connectivity to the Lake Superior Coast Range via the Discontinuous Distribution. A number of factors beyond the limited movement data available contributed to the decision to identify the Albany River as the northern extent of the range: it limits the north-to-south axis of the range to 190-250 km within the broader Continuous Distribution of caribou; it allows for the inclusion of all areas currently licensed for commercial forestry; and acknowledges the aboriginal and recreational use patterns along the river (MNRF 2014c).

The Nipigon Range exhibits a full spectrum of anthropogenic-based disturbances which are heavily concentrated in the southern half of the range. The north half of the range is less disturbed and appears to exhibit a shift in disturbance types including fewer large fires in the past 30 years, but increased road building and forest harvest activity within the last 12 years.

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

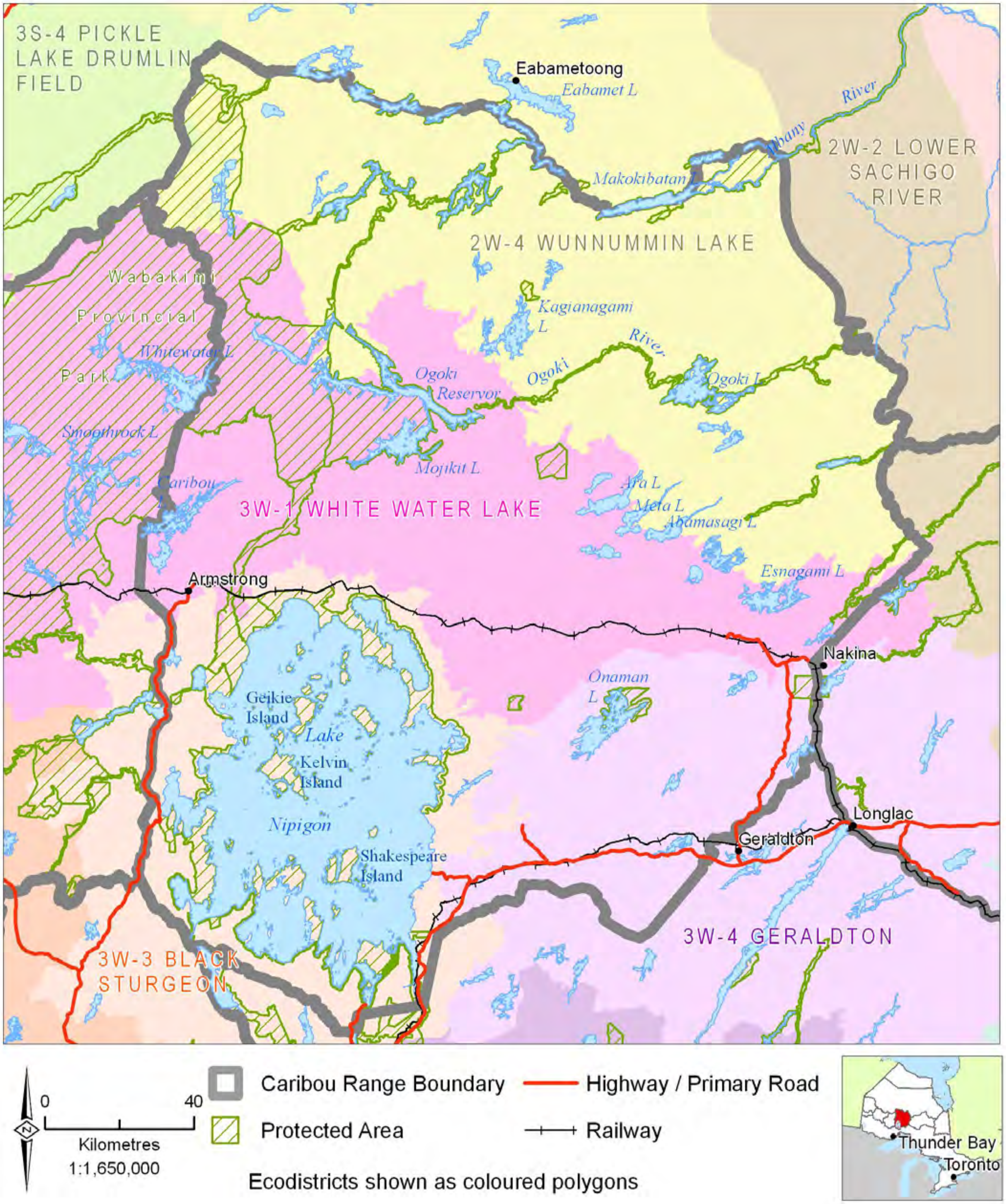


Figure 2. The Nipigon Range and associated ecodistricts and protected areas.

3.0 Background Information and Data

3.1 Land management history and management direction

It is likely that caribou numbers and distribution on the Nipigon Range have been influenced by a wide variety of 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). Past land use planning decisions, infrastructure development, and land management direction on the Nipigon Range all have potential implications for the current distribution, abundance, and survival of caribou in the range. Therefore, it is imperative to document and interpret the disturbance history within the range in order to better understand current caribou use. Implementation of Ontario's CCP is set against a backdrop of these evolving developments.

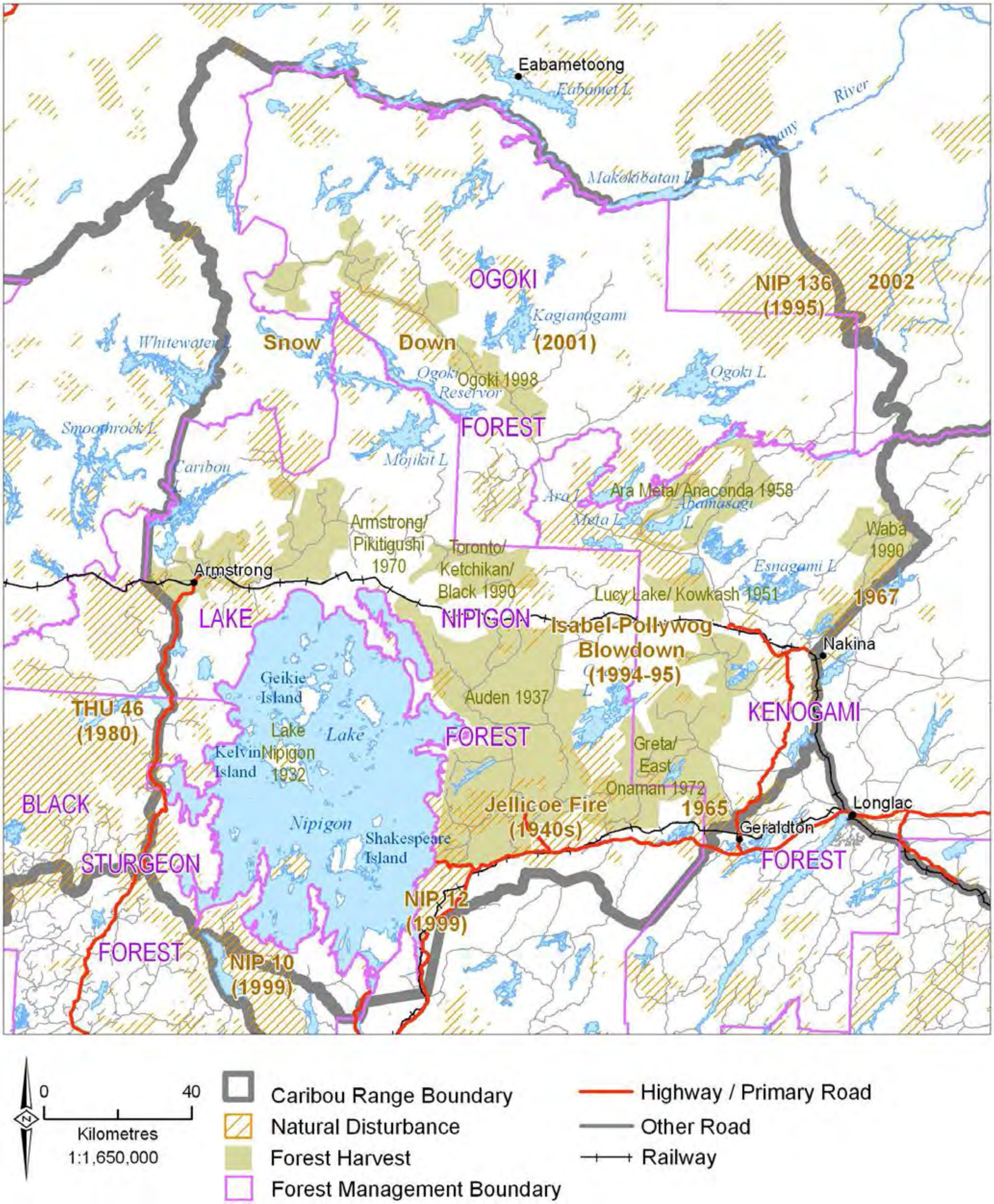


Figure 3. Dates and locations of significant historical natural and anthropogenic disturbances that have occurred within the Nipigon Range.

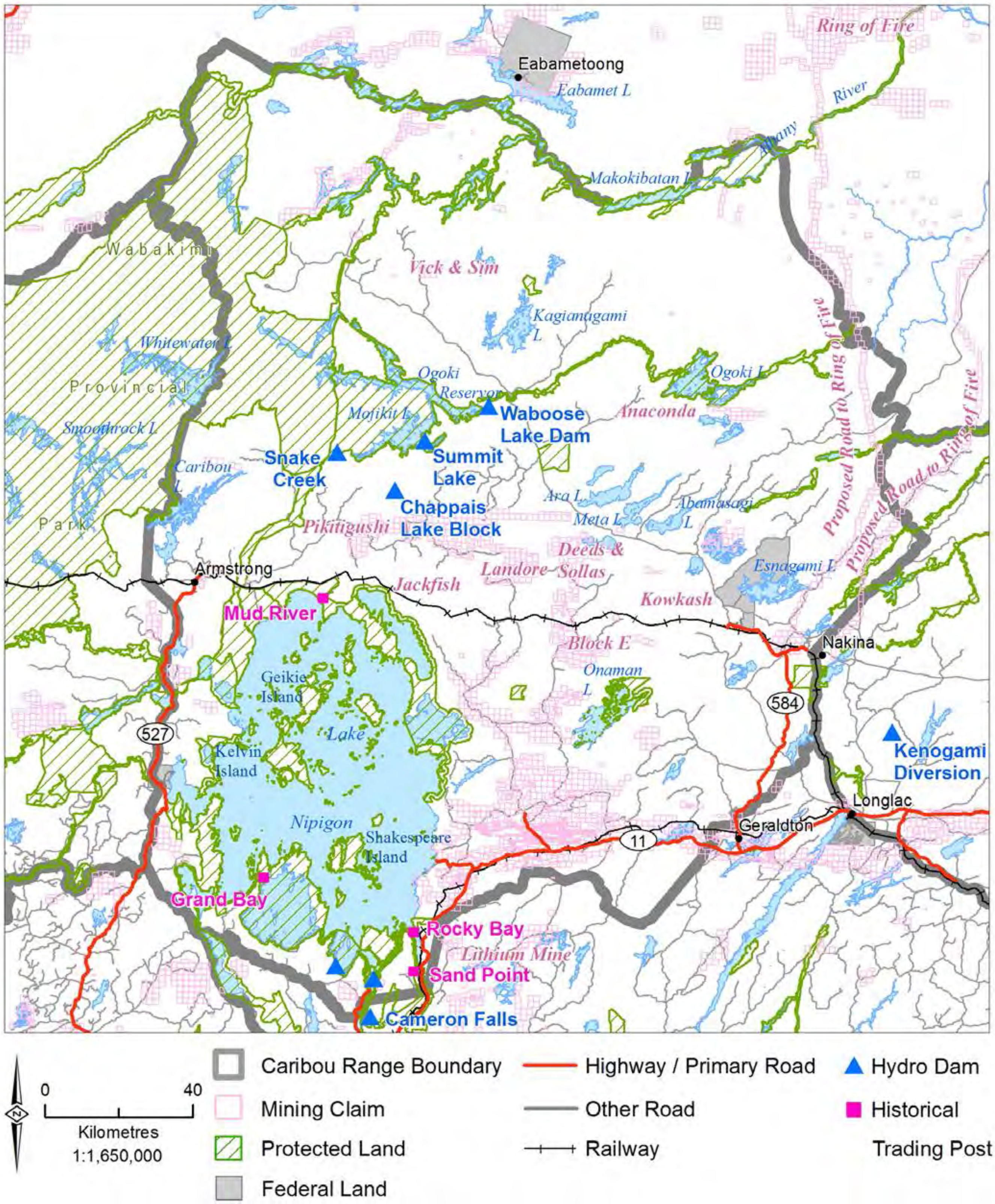


Figure 4. Human infrastructure and historical developments occurring within the Nipigon Range.

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

Significant event, activity or direction			
Natural and anthropogenic disturbance (significant fire or blowdown)	**Date**	**Description**	**Likely influence on caribou or its habitat**
Jellicoe fire	1940s	Large fire in vicinity of human developments along Highway 11. Also near Greenstone belt in vicinity of Lake Nipigon	Created a large natural disturbance along the east side of Lake Nipigon at the same time as significant lake-based forest harvest activity was occurring to the north; resulted in potential short-term reduction in habitat quality along the east side of Lake Nipigon.
THU 46	1980	Fire in Obonga Lake area (127,000 ha)	Renewed a large tract of forested land tracking towards quality caribou habitat while other forest management and development activities occurred to the east, south, and north.
Isabel-Pollywog blowdown and Kowkash blowdown	1994-95	Blowdown east of Onaman Lake. Partially salvaged; but not in vicinity of Kowkash.	Loss of used wintering area at southern portion of range and Continuous Distribution; implications for caribou mosaic development.
NIP136	1995	Fire originally 113,000 ha. 2002 fire added to total area.	Burned caribou wintering areas identified in 1994 aerial winter survey; currently exhibiting high moose densities.
NIP10	1999	Fire in Black Sturgeon Lake area towards southern shore of Lake Nipigon (50,500 ha)	Burned a previously logged area; regeneration of mixed forest with limited habitat potential.
NIP 12 (Beardmore Fire)	1999	Fire on east side of Lake Nipigon (30,100 ha)	Potential to renew caribou habitat and create a more even-aged forest in a large tract on southeast shores of Lake Nipigon.

Snow-down event	2001	Forest damage from wind/snow from Wabakimi Park south of Albany River and east to Ogoki Lake area	Abundant coarse woody debris on ground. Anticipated number of changes in moose and caribou behaviour. Additional fire risk with fuel. Repetitive blowdowns within affected areas since 2001.

Significant event, activity or direction **Forest Management**	**Dates**	**Description**	**Likely influence on caribou or its habitat**
Lake Nipigon	1932 -72	Log driving on Lake Nipigon	Initial forest harvest pressure on shoreline refuge habitats and islands of Lake Nipigon.
Auden horse logging	1937-60	Horse logging near Ombabika Bay and near mouth of Onaman River; log drive down Lake Nipigon to move logs to Thunder Bay	Initial habitat disturbance between Lake Nipigon and Onaman Lake; some habitat renewal accounting for current caribou habitat utilization; some interaction of forest harvest and fire in the vicinity of Jellicoe. Suitable habitat near Kowkash, Onaman Lake and Lake Nipigon sustained caribou occupancy nearby.
Lucy Lake/ Kowkash Lake	1951-53	Horse logging off railroad (clear-cutting)	Persistent caribou use in the vicinity of cutovers before and after forest harvest; white tail deer use has also been documented.
Auden Road	1964-79	Jellicoe to Onaman road-based logging with wood destined for mills in Thunder Bay and Red Rock	Road-based logging moved forest harvesting into more remote areas and away from main rivers setting the stage for the current forest pattern. Areas not readily accessible from rivers had previously remained available as refuge habitat.
Armstrong Airport and Pikitigushi Lake	1970 to present	Harvest in NW corner of Lake Nipigon and associated road access east of Armstrong	Reduction in amount of winter habitat NW of Lake Nipigon used by caribou that spend their summers on the lake.

Auden Road	1990s to Present	Renewed harvest off Kinghorn and Auden roads with wood going	Primarily targeted larger, older, and more remote blocks of timber residual from earlier forest harvest activity.
Toronto/ Ketchikan Block	2001/2002 Forest Management Plans	Harvest off NE corner of Lake Nipigon. Extension of forest harvest that took place in Armstrong/ Pikitigushi area	Caribou mosaic planning within the Forest Management Plan for the Armstrong Forest and Lake Nipigon Forest directed harvesting to these blocks. Continued disturbance in area with known caribou use.
East Onaman , Gretta Road	1972-2002	Early harvest, later becoming mosaic block with subsequent clean-up harvest activities	Harvest of mosaic block in vicinity of existing calving areas, wintering areas, and travel corridors near southern boundary of Continuous Distribution.
Anaconda Block	Early 1980s to present	Forest harvest initiated prior to mosaic development	Harvest in areas of known and existing caribou winter habitat as identified from Aboriginal knowledge.
Wababamiga (Waba) Block	1990-2005	Originally harvested under moose guidelines and later incorporated into caribou guidelines for 2011 Kenogami Plan. Harvest disturbance > 10,000 ha including moose corridors.	Allocation and harvest of areas of known caribou use; adjacent to known calving and nursery areas to the NE and wintering areas to the east.
Ara-Meta Lakes	1994 to present	Forest harvest initiated during initial mosaic development	Harvest in vicinity of known caribou calving area.

Ogoki Forest Harvest	1998 to present	Road-based forest harvesting. Initiated anthropogenic disturbances on newly activated Ogoki Forest. First FMU to initiate harvest scheduling according to caribou habitat guidelines at beginning of MU operations.	Initial planned disturbance into a landscape occupied by caribou; significant concerns over caribou habitat renewal effectiveness given economic constraints associated with distance from mills.

Significant event, activity or direction **Infrastructure development**	**Dates**	**Description**	**Likely influence on caribou or its habitat**
Community development associated with railway	1880 to early 1900s	Three Trans-Canada railroad linkages: Canadian Pacific (CP) in south; Kinghorn Line along southeast edge of Lake Nipigon; and Canadian National link north of Lake Nipigon.	Initial and sustained human activity corridors dissecting the range from east to west contributed to early harvest of animals and documented rail collisions with caribou in various areas.
Seasonal and permanent residency	Late 1880s	Early settlement of private lands established on southeast and west shores of Lake Nipigon (Pijitiwabik, Rocky, McIntyre bays, Sand Point and Jackfish Island).	Potential early hunting pressure prior to 1929 along southeast shore of Lake Nipigon. Resulted in habitat disturbance in the area linking Lake Nipigon to Lake Superior; concurrent with CP railroad development along north shore of Lake Superior.
Armstrong (community)	1912	Population of 1,398. The Northern Transcontinental Railway cut railroad through (what is now known as) the Armstrong Forest in 1908.	Initial hunting pressure and disturbance of winter habitat NW of Lake Nipigon.

		Armstrong was established along railroad as a repair and refuelling station.	
Jellicoe (community)	1916	Service center to railroad (5,000 people)	Supported thousands of people during the Sturgeon River gold rush in 1934 which likely disturbed and displaced caribou in the area. Major human development on the eastern side of Lake Nipigon; potential hunting pressure prior to 1929 and supported local timber harvesting activities.
Nipigon River Hydro development	1918 to mid-1930s	Development of Virgin Falls (1920) and Cameron Falls dams; support for Hwy 585 with Alexander Dam constructed in 1930	Changed water levels on Lake Nipigon by 62 cm which affected beaches and shorelines traditionally used by caribou both on the islands and the mainland; influenced near-shore vegetation patterns.
Trans-Canada Highway 11	1920-42	Construction began in 1920 (Ferguson Hwy); Longlac portion completed in 1942; Hwy 11 north from Nipigon began in 1939	Large and heavily used linear disturbances with associated human activity contributed to early fragmentation of caribou habitat and likely habitat use patterns.
Nakina (community)	1923	Main switching site for CN railroad; town site population up to 1,500	Northern-most significant non-Aboriginal settlement within the Nipigon Range; settlement introduced human harvest and disturbance.
Mineral exploration and mining development along Highway 11 greenstone belt.	1930-40s	More than 30 mines along corridor with heaviest concentrations in Geraldton and Beardmore areas.	Primary trigger to development along rail and road corridor, the development of town sites, and the passage of trails and early roads prior to development of the Trans-Canada highway.
Auden road systems Auden and Onaman	1930-50	Forest access road to wood supply and support of horse logging between Onaman Lake and Lake Nipigon	Initial and significant road system and associated human activity influencing the connectivity between Lake Nipigon and Onaman Lake, both regionally significant calving and nursery lakes.

Poplar Point Campgrounds	1940s	Campgrounds established to support access to mine and seasonal camps	Contributed to human disturbance along southeast shores of Lake Nipigon, possibly influencing use of shorelines by caribou.
Ogoki River Hydro developments: Waboose Dam, Little Jackfish Diversion, and Summit Dam	1943-50	Construction of Waboose Dam north of Lake Nipigon. Diversion of water from the Ogoki system southward via the Jackfish Diversion; Ogoki Reservoir and Pine Portage Dam (1950). Raised water level by 35 cm; Significant construction activity with work camp of more than 800 people and associated blasting, local railroad, etc.	Large amount of human activity, habitat loss and habitat degradation north of Lake Nipigon.
Highway 11 between Geraldton and Nipigon	1947-48	Portion of Trans-Canada Highway opened to traffic	Introduced significant and steady cross-Canada traffic, tourism, recreation, and additional options for road-based forest harvest and created a linear disturbance within the range
Hwy 527 (to Armstrong)	1950-60	North-south corridor on western side of Lake Nipigon (Hwy 527)	Linear disturbance created potential disruption of caribou movement west of Lake Nipigon.
Hwy 801 (Kinghorn Road)	1950s-present	Primary road access to wood supply north, south, and west of Onaman Lake and east side of Lake Nipigon	Linear and clear-cut disturbances contribute to fragmentation and disruption of connectivity between Lake Nipigon and Onaman Lake.
Hwy 584 (Nakina Hwy)	1957	Highway linked Nakina (CN railroad) and Geraldton (Trans-Canada Hwy)	N-S road opened road based forest harvest in caribou range and created a gap in caribou occupancy reflected in current distribution of caribou.

Fishing and Hunting Lodges	Mid-1900s-present	Tourist outfitter camps; often consisting of multiple buildings.	Encourages activities in remote hunting and fishing sites and increases chances of encountering caribou and potentially creating a sensory disturbance on calving lakes.
Anaconda Mine and road	1961	Short-lived copper mine and supporting road system was used later on for development of Anaconda forest harvest blocks in 2000-2003	Led to forest harvest activity using a 1-20 year harvest block in the local caribou mosaic.
Kowkash	1960s-present	Prolonged exploration with major developments in 2000s (varying degrees of exploration depending on markets)	Sensory disturbance and linear features in known caribou winter habitats north of Onaman Lake.
Ogoki Road	1970? Late 1980s	Road constructed between O'Sullivan Lake and Ogoki River and a bridge over the river. Constructed as part of "Roads to Riches" program and intended to support economic activity	Supported initial forest harvest activity and disturbance patterns in the northern portion of the range.
Deeds and Sollas Lake area and Marshall (mining)	1980s-present	Ongoing exploration with 50 -person camp	Human disturbance in vicinity of calving and wintering areas.
Sim Lake/ Vick Lake (mining)	1980s-present	Initial mineral exploration	Human disturbance within both calving and wintering areas.
Block E north of Onaman Lake (mining)	1990s-present	A large ongoing mineral exploration area north of Onaman Lake	Human disturbance in close proximity to Onaman Lake – a regionally significant calving lake in the Kowkash area.

Landore (mining)	Late 1990s-present	Advanced exploration. Mine currently under development with 50-person camp	Habitat loss; landscape constraints.
Ogoki Road forest access	1998	Road built to access timber on Ogoki Forest after licensing in 1998	Accelerated primary access to operationalize a new caribou mosaic. Established linear feature network for large portion of the Ogoki Forest.
Jackfish (mining)	2002	Mineral exploration with permanent 50-person camp	Human disturbance in vicinity of calving and wintering areas.
Pikitigushi	2005 to present	Initial mineral exploration	Human disturbance in vicinity of calving and wintering areas.
Lithium Mine	Opened in 1960, reactivated in 2009	Building of roads, the reinstallation of bridges and culverts, and ongoing drilling	Human activity with road access, snow machine trails, waste management, and heavy machinery operation; suspected to have improved wolf mobility and increased predator densities; habitat loss associated with exploration activities in areas with shallow soils and lichen; soils are stripped to blast rock features.

Significant event, activity or direction			
Land management direction	**Dates**	**Description**	**Likely influence on caribou or its habitat**
Hudson's Bay Company posts	1890	Mud River, Sand River, Grand Bay, Bay View	Human associated activity has likely influenced caribou distribution and habitat in the area. Caribou were also hunted for food and hide.
Onaman Crown Game Preserve	1933	Protected 4,734 ha under Living Legacy Land Use Strategy (MNR 1999a). Regulated as a Conservation Reserve (2000)	Initial forest deferral in the vicinity of Onaman Lake; Preservation of known calving areas on islands of Onaman Lake.

Wolf control	1945-72	Wolf bounty in effect in Lake Nipigon area	Early depression of the wolf population that may have helped caribou persist through periods of early road-based forest harvest.
	1957-present	Wolf hunting permitted on Lake Nipigon over period when islands were protected by Game Preserve	It is estimated that 700 to 800 wolves were shot by an aircraft hunter on Lake Nipigon between 1952 and 1972.Wolves seals and a valid small game licence required since 2005 (2012 Hunting Regulations Summary).
Geikie Island Crown Game Preserve	1965	Game preserve created	Afforded wildlife protection on significant Lake Nipigon islands
Trapline boundaries regulated	1947	Initiation of Ontario trapline system	Formed the basis for early reporting on wildlife occupancy and relative abundance which provided preliminary insight into historical occupancy.
Wildlife Management Units were implemented for big game management	1975	Under Game and Fish Act, 1983; moose targets then reduced in 2010	Formed the basis for reporting on moose populations and trends as well as other species (where applicable).
Wabakimi Provincial Park	1983	Original size was 155,000 ha	Specific intent and direction for the conservation of caribou.
Integrated Resource Management Plan for Lake Nipigon	1987	Replaced by Lake Nipigon Basin Signature Site	Strategic direction issued for development on the islands and shoreline areas of Lake Nipigon including special reference to caribou habitat and conservation directives.
Draft Caribou Guidelines	1992	First draft of forest management guidelines for conservation of woodland caribou habitat	These guidelines established a mosaic concept in support of planning for a sustainable supply of year-round habitat.

Public consultation	1993	Broad public consultation of caribou habitat management across northwest region	Increased awareness and regional commitment to caribou conservation.
Northwest Region Interim Caribou Habitat Management Direction	1994	Regional mandate to address caribou habitat management on all Forest Management Plans within the Continuous Distribution	Supported initial efforts towards caribou habitat conservation in northwestern Ontario.
Draft of forest management guidelines for the provision of woodland caribou habitat	1994	All forest management plans within northwest Region committed to addressing caribou conservation.	These guidelines established a mosaic concept in support of planning for a sustainable supply of year-round habitat. (Kenogami in 1995, expanded in 2005, and 2011; Auden in 1997; Ogoki and Nakina North in 1998; amalgamated Ogoki in 2003, and 2008; Armstrong Forest in 1995, 2000, 2005 and 2011).
Wabakimi Park Expansion	1997	Park was expanded, conserving 890,000 ha	Increased preservation to valuable caribou calving and nursing habitat.
Onaman Lake Fisheries Management Plan	1997	Prevented people from fishing on Onaman Lake in March – a time when caribou relocate to the lake area	Reduced potential disturbance to pregnant cows that calve on Onaman Lake.
Ontario's Living Legacy	1999	Creation of dedicated protected areas and Enhanced Management Areas (EMA) with specific conservation considerations for woodland caribou	Creation of the three major Enhanced Management Areas for caribou: 1) Pikitugushi - 40,551 ha specific to caribou; associated with caribou strategy. Areas provide the linkage between Lake Nipigon, the Armstrong airport area (a wintering area), Wabakimi Park, and the Ogoki Reservoir. 2) Onaman/Humbolt specific to caribou; southern boundary corresponded to previous mosaic boundary. These areas provided a linkage between Lake Nipigon and Onaman Lake; EMA planning is ongoing. 3) Ogoki Lake Conservation Reserve (reservoir); partially determined by caribou habitat.

Forest Management Guidelines for the Provision of Caribou Habitat: A Landscape Approach	1999	Final forest management guidelines for the provision of caribou habitat. Comprehensive and endorsed management direction that implemented a landscape-based approach to habitat conservation including mosaic development and a strategic evaluation of habitat retention or allocation and renewal.	It aimed to maintain continuous supply of year-round caribou habitat distributed across the landscape and through time to ensure permanent range occupancy. (i.e. Lake Nipigon Forest Plan 2001, 2006, 2011 (Old Onaman Unit amalgamated with new Lake Nipigon Forest; no previous timber harvest; flexibility for mosaic harvesting)), Black Sturgeon Forest 2001, 2006, Black Spruce Forest 2011. Armstrong FMP 2005, 2011.
A Management Framework for Woodland Caribou Conservation in Northwestern Ontario	1999	Regional policy direction regarding caribou conservation and forest management.	Reaffirmation of regional interim direction for the application of caribou guidelines in NW Ontario with additional guidance in support of other management actions to conserve caribou.
Lake Nipigon Basin Signature Site	2004	Replaced 1987 Integrated Resource Management Plan for Lake Nipigon. Strategic development for Lake Nipigon direction including caribou.	Restricted development on Lake Nipigon islands.
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.

North of Lake Nipigon road link decision	2006	Forest management planning team explored option to develop a permanent E-W road to create linkage across the north end of Lake Nipigon within caribou habitat between Armstrong and Lake Nipigon.	The planning team determined the development of a road linkage would create a known threat associated with caribou range recession. The road link would increase risk of forest fragmentation, loss of refuge habitat, and improve predator mobility, increasing caribou mortalities. The value of Lake Nipigon for maintaining the southern limits of caribou was recognized. The Northwest Regional Director supported Nipigon and Thunder Bay District's direction to maintain the area without a road linkage. MNR report "Toronto Lake – Ketchikan Lake Road Link North East of Lake Nipigon – Implications to Caribou Management" (Hartley 2006)

The progression of anthropogenic disturbances within the Nipigon Range (Table 1, Figure 3, and Figure 4,) has largely had a south-to-north progression with early activity, especially forest harvest, around Lake Nipigon. The Trans-Canada highway and associated natural gas and hydro transmission corridors in the southern portion of the range coincide with historical mineral exploration, mining, and community establishment that has created a significant band of disturbance at the southern portion of the range. The cumulative contribution of these historical developments and wildfire has created a forest and infrastructure landscape heavily weighted towards high levels of disturbance in the south and lower levels of disturbance to the north. Overall, forest harvest has been the primary driver of disturbance within the range.

3.2 Caribou occupancy history and assessment

Caribou observations within the Nipigon Range have been identified and recorded within Land Information Ontario (LIO 2014). Observations documented in this report are current to August 2013 (Figure 5, Figure 6, and Figure 7). Table 2 briefly summarizes previous caribou assessments within the range that estimate or describe population size, health, or occurrence providing historical context and assist with the interpretation of the current Integrated Range Assessment results. 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. Extensive efforts occurred within various portions of the Nipigon Range to engage the public in reporting caribou observations, especially in the vicinity of Lake Nipigon. These efforts resulted in extensive knowledge of occupancy patterns within the range.

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

Date	Caribou occupancy assessment	Reference
circa 1890	Caribou were plentiful and moose scarce in the Lake Nipigon area prior to 1890 (Peterson 1955). Caribou were replaced after this time by moose due to changes in habitat caused by fire (Gibson 1970).	Gollat, R.L. 1975. A preliminary investigation into the fish and wildlife values of the islands of Lake Nipigon. MNR. Unpublished Report. Nipigon District
1932	Seventy-five (75) caribou reported to have been relocated to Tashota (20 miles NW of Lake Nipigon) from Flin Flon, Manitoba.	Gollat 1975
1954	Lake Nipigon caribou estimates represented by trapper estimates and aerial survey estimates are between 40-61 animals. Caribou populations thought to be increasing on Lake Nipigon islands during the 1950s.	
1960	Caribou populations increased moderately and appeared to remain stable. The estimated population at that time was 250-300 animals; 100-135 animals found on the islands of Lake Nipigon of which 35-45 winter near Armstrong.	Nipigon District Land Use Guidelines. 1983. MNR.
1969	Reports of sighting 36 caribou in one group on the south peninsula of Lake Nipigon. Belief that caribou are as common now as when fishing began on the lake in 1924.	Gollat 1975

1970	Caribou range receded northward, retreating to the northern half of Lake Nipigon Basin.	Swainson, R. and K. McNaughton. 2001. Wildlife of the Lake Nipigon basin. Ontario's Living Legacy Lake Nipigon Basin Signature Site. MNR.
1975	Population estimate of 100-200 caribou in the Lake Nipigon area (Bergerud and Butler 1975). An estimate of 100 animals inhabiting the northern islands alone.	Gollat 1975
1975	Nipigon-Onaman herd and possibly the Armstrong caribou herd use the Lake Nipigon islands for summer calving to escape predation.	Gollat 1975
1988	Population of 100-135 animals found on Lake Nipigon islands which represents almost half of the documented caribou population in the Nipigon District	Swainson, R. 1988. Lake Nipigon Integrated Resource Management Plan (final version). MNR.
2005	Caribou collaring projects on Lake Nipigon has provided a population estimate of 30-40 animals using the lake, islands, and area in close proximity to the lake.	McNaughton, K. (pers. comm.) 2011

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

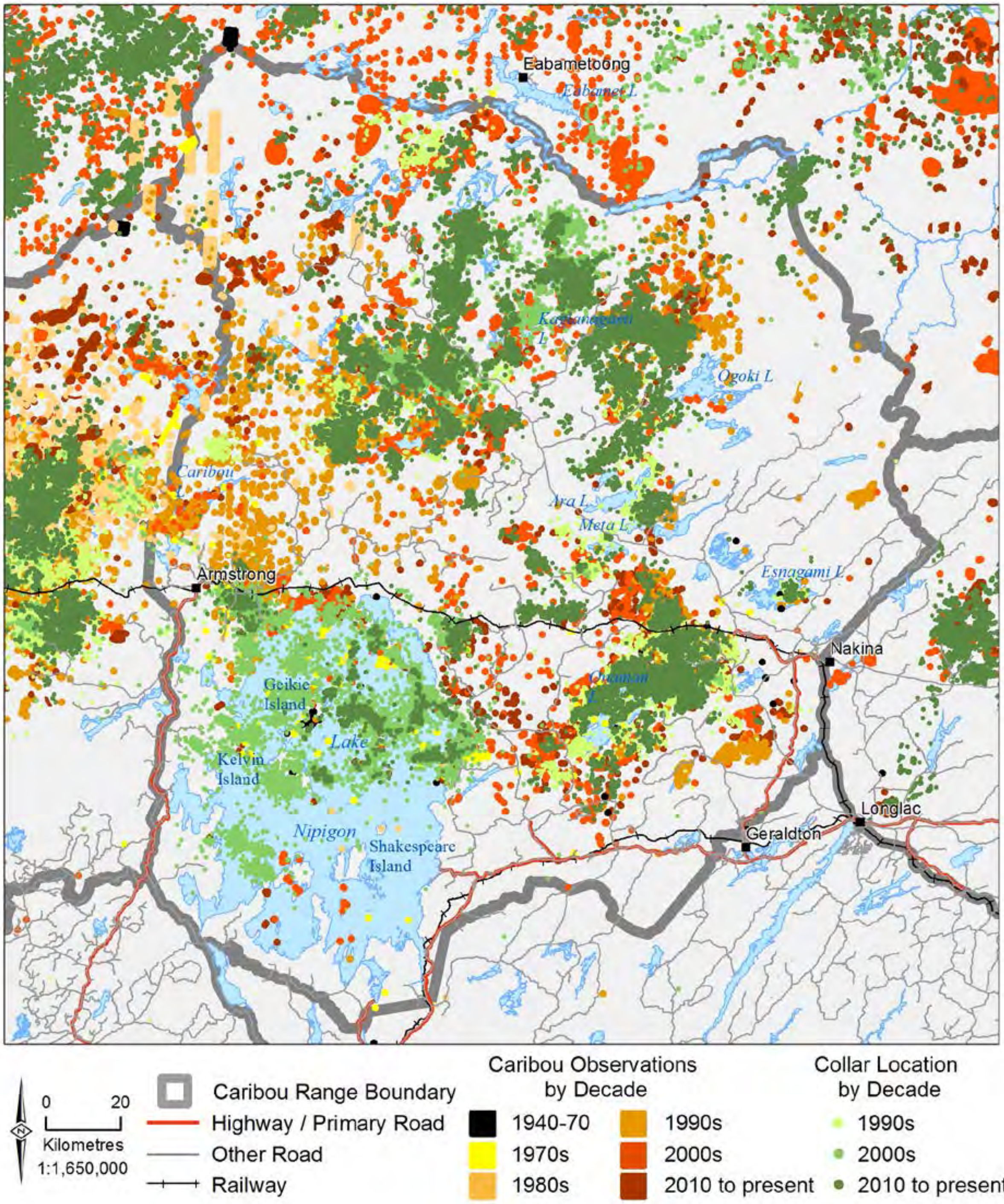


Figure 6. Historical caribou observations[1] within the Nipigon Range and surrounding area including observations from aerial surveys, collared caribou locations, research projects, and casual observations.

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

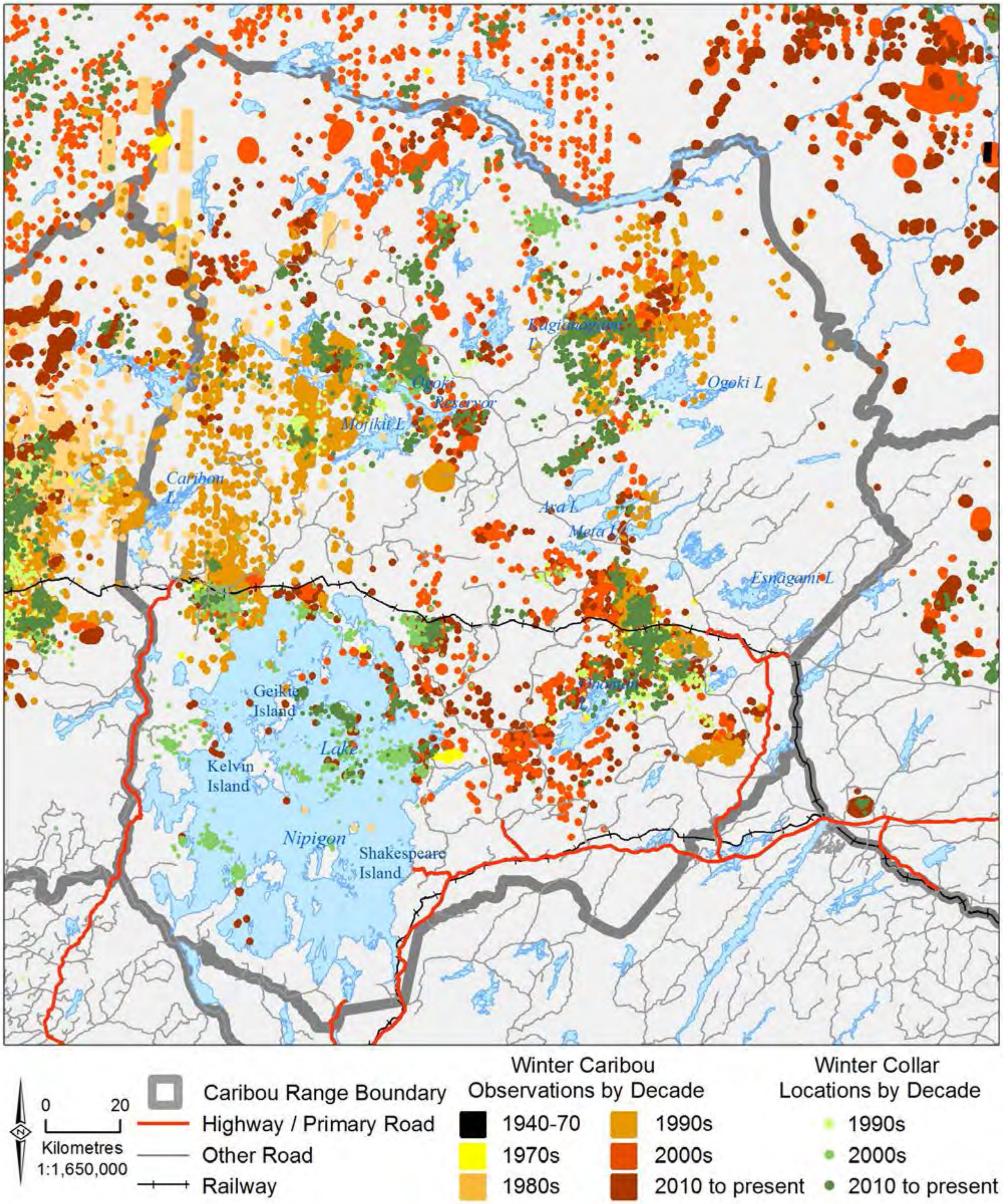


Figure 7. Caribou observations in the Nipigon Range during February and March from all observation sources (i.e. aerial surveys, collared caribou locations, and casual observations) as of August 2013.

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. 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, or flightlines, on a 10 km interval hexagonal sample grid (Figure 8). Each hexagon is approximately 100 km² and 10.6 km across. Between two and four repeat visits were conducted on a portion of hexagons. Occupancy survey efforts were delivered by two survey teams: 1) Turbo Beaver aircraft with an experienced crew of MNRF staff completed transects in the southern half, including specific transects to sample islands and peninsulas on Lake Nipigon; and 2) a Supercub aircraft with an experienced big game survey crew completed transects in the northern half of the Nipigon Range including some repeat visits in order to determine the optimal number of hexagons that require repeat visits to generate known and desirable levels of probability of occupancy (G. Brown pers. comm.). The Supercub flights were flown between February 25th and March 1st, 2010. Spatial patterns in occupancy (i.e. probability of occupancy) within the Nipigon Range were estimated using methods described by MacKenzie et al. (2002).

No animals were physically observed in the southern half of the range, although numerous signs of caribou were present (Figure 8). Caribou were physically sighted more than 50 km north of Lake Nipigon and sign across many areas in the northern half were also present.

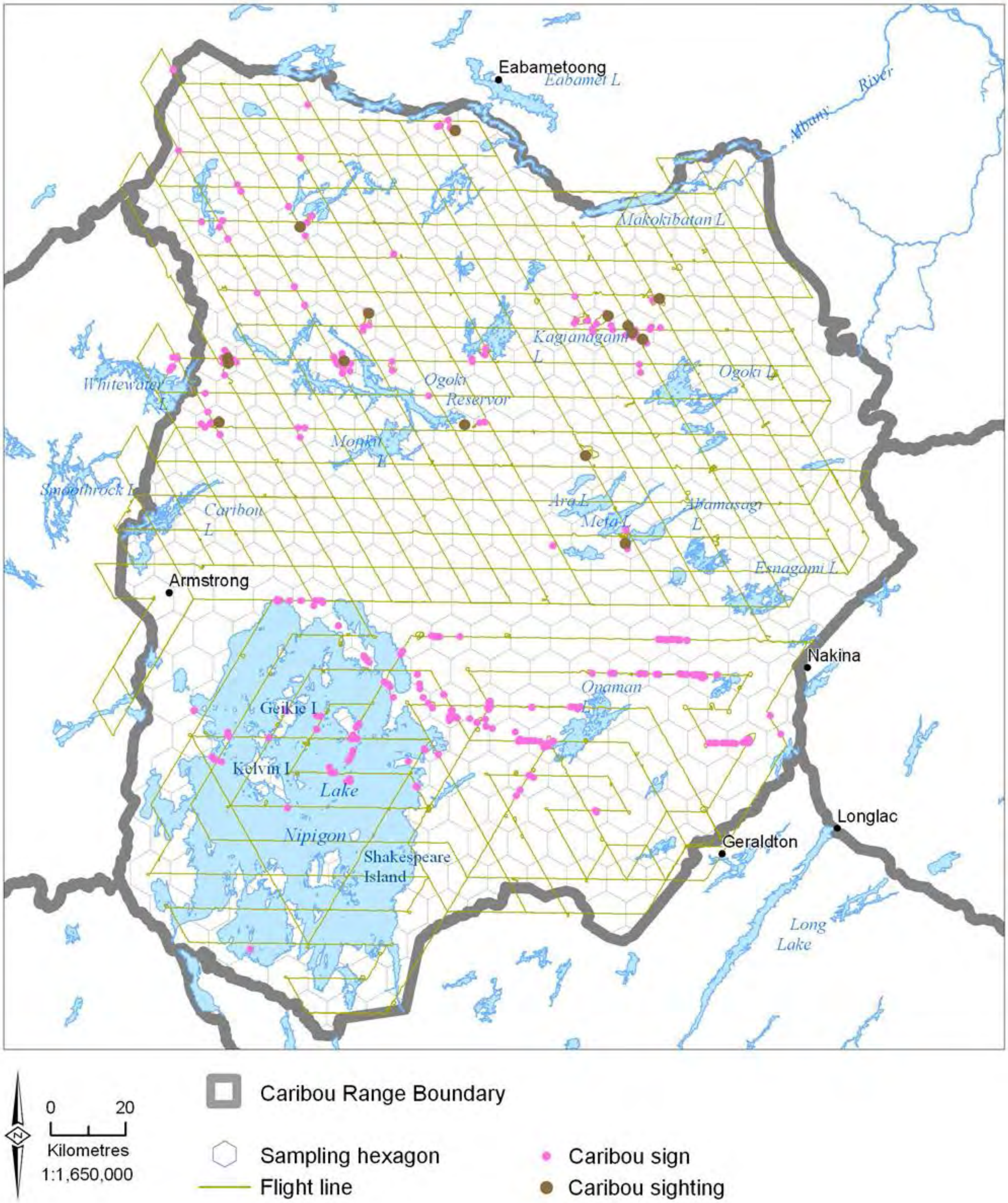


Figure 8. Fixed-wing aerial survey transects on the Nipigon Range hexagon sampling grid during the winter of 2010. Observations of caribou and their sign are also shown; any evidence of caribou present within a hexagon contributes to the probability of occupancy calculation.

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

The occupancy model without habitat covariates suggests that the overall probability of caribou occupancy on the Nipigon Range was relatively low and that the estimate had good precision (ψ =0.27, S.E. = 0.04, 95% C.I. = 0.20-0.35). These standard errors suggest that existing levels of survey effort will detect changes in caribou occupancy with respect to a single estimate for the entire range. Precision may be improved in future surveys through increased visits to each hexagon.

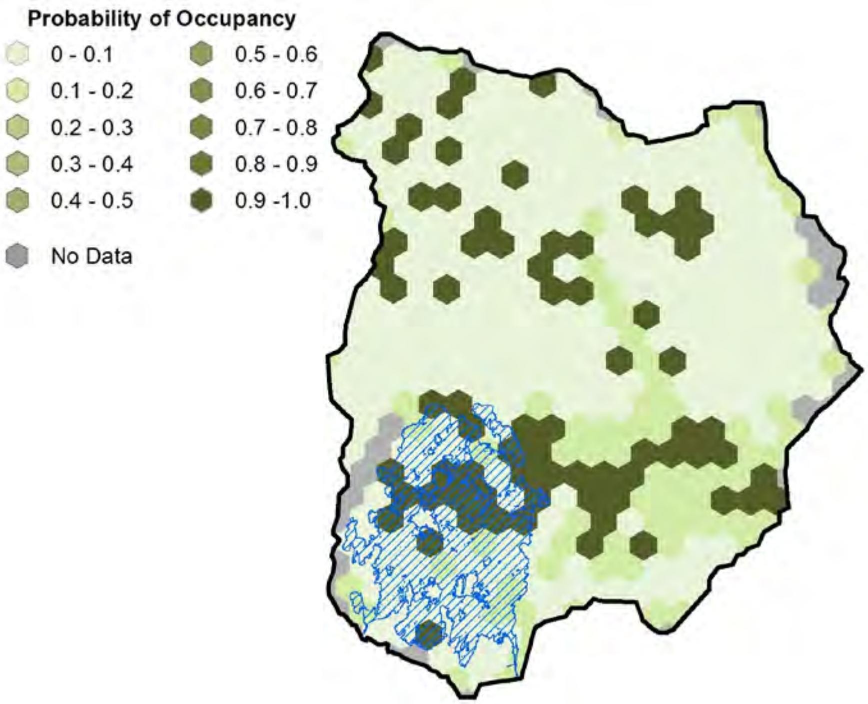


Figure 9. Probability of occupancy across the Nipigon Range based on a model without occupancy covariates and conditional on observation (Probability = 1 for hexagons with detection(s)) from the winter 2010 survey. Lake Nipigon is represented as blue hatching.

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

Table 3. Untransformed estimates of coefficients for habitat covariates used in the caribou occupancy model for the Nipigon Range. The model detection probability is 0.45. Parameters shown in bold have confidence intervals that do not contain zero.

Parameter	Estimate[1]	SE	Lower CI	Upper CI
intercept	**-1.08**	**0.21**	**-1.50**	**-0.66**
Disturbance	**-0.63**	**0.14**	**-0.90**	**-0.36**
Treed Bog	0.30	0.15	0.00	0.60
Conifer	0.18	0.15	-0.11	0.47
Sparse	0.14	0.15	-0.15	0.44

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

The amount of disturbance had the greatest effects in predicting caribou occupancy. Although treed bog, conifer, sparse treed were retained in this model, they had lesser influence in predicting occupancy as indicated by the large standard errors relative to coefficient values. This model differentiated among areas of high and low probability of occupancy and the distribution of forest depletions (Figure 12). Reliable estimates of occupancy for individual hexagons will be particularly important for tracking changes in caribou distribution within the Nipigon Range in response to management activities. The predicted probability of occupancy of caribou was potentially underestimated on the islands of Lake Nipigon. This resulted from the broad-scale nature of the aerial survey design and modeled relationships that were highly influenced by the abundance of caribou in more contiguous patches of conifer and bog in the northern portions of the Nipigon Range. These islands contain an abundance of mixed deciduous forests; however, they were used extensively by caribou, particularly during the summer calving and post-calving period due to the refuge provided from predation (Bergerud 1985; Cumming and Beange 1987). Occupancy of these islands in winter was also evident from the raw observation data of the fixed-wing portion for the aerial survey as well as non-systematic surveys of the islands by helicopter during the same survey period. Caribou occupancy has also been documented to be greater in areas with less fire disturbances reflecting their need for mature stands of forest.

The predicted occupancy of caribou may be overestimated in isolated portions of the southern end of the Nipigon Range (Figure 10), where caribou are thought to be currently absent but where potentially suitable habitat exists; this phenomenon is attributed to the habitat covariates. While the model may overestimate the actual occupancy of caribou on the Nipigon Range, this aspect of the model may be useful in identifying areas of potential recovery interest.

The relatively low occupancy rates of caribou on the Nipigon Range is consistent with an abundance of young forest, the intensity of human activity and other anthropogenic disturbances on this range, particularly at the southern extent. There is evidence in other jurisdictions of the negative effects of anthropogenic landscape disturbances on caribou distribution and population persistence (Brown et al. 2007; Wittmer et al. 2007). Also, the positive correlation between caribou occupancy and treed bog and conifer forest is consistent with evidence of the positive effect of these forest types on caribou habitat selection using finer resolution telemetry data (Brown et al. 2007).

The results of the analysis likely do not reflect either the extent or variation in occupancy of the islands of Lake Nipigon. The fixed-wing survey transects through the hexagon sample grid is likely inadequate for detecting and documenting occupancy on island systems on Lake Nipigon.

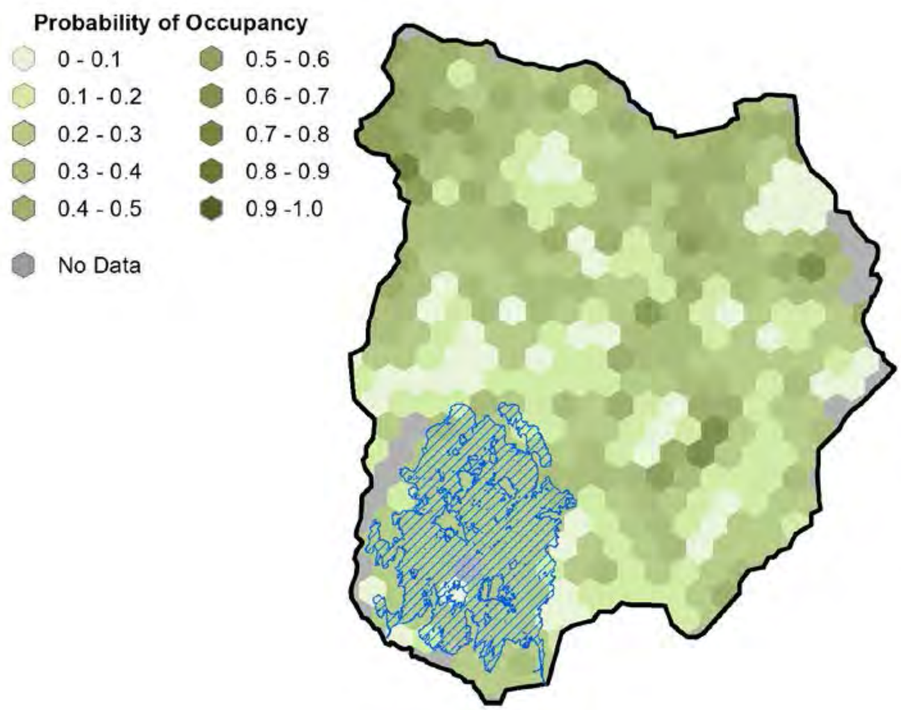


Figure 10. Probability of occupancy determined using habitat covariates across the Nipigon Range based on model-averaged estimates using observations for the winter 2010 aerial survey. Lake Nipigon represented as blue hatching.

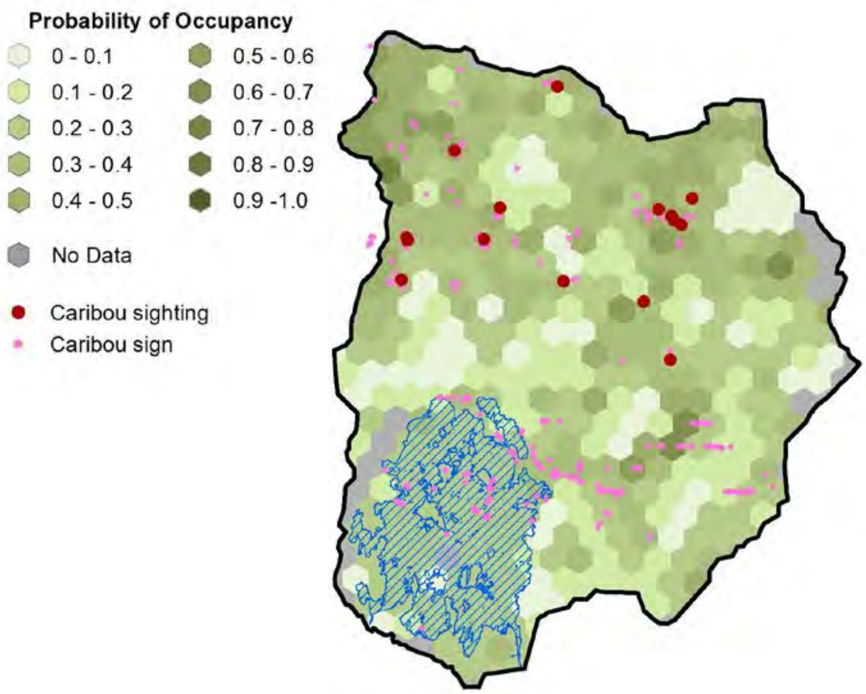


Figure 11. Probability of occupancy determined using habitat covariates in the Nipigon Range overlaid with caribou observations and sightings from the winter 2010 aerial survey. Lake Nipigon represented as blue hatching.

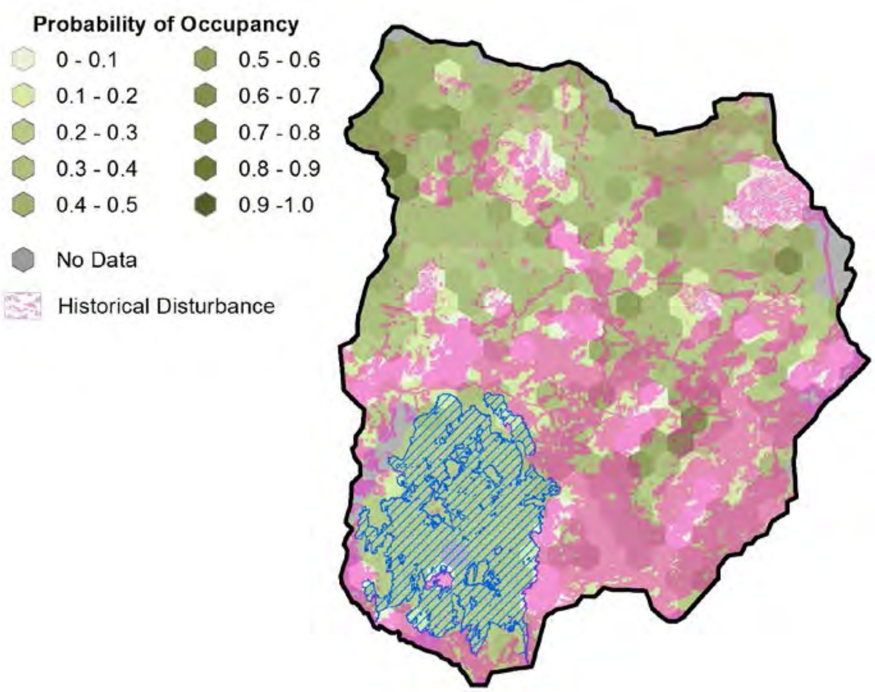


Figure 12. Probability of occupancy determined using habitat covariates across the Nipigon Range using observations for the winter 2010 aerial survey overlaid with disturbed areas (i.e. cuts, burns, regenerating depletions). Lake Nipigon represented as blue hatching.

3.4 Caribou ecology and range narrative

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

Within Ontario, regional differences in habitat use appears to be associated with variations in climate, disturbance regime, forest types, topographic features, and the distribution and abundance of other wildlife populations. Caribou may exhibit habitat use patterns that take advantage of habitat types available (Moreau et al. 2012) and may use atypical vegetation conditions in more isolated areas such as on islands where refuge value is provided by topographic features instead of vegetation composition and structure (Rudolph 2005).

Current and historical caribou observations are well dispersed across the Nipigon Range (Figure 5 and Figure 6, and Figure 7) and represent observations from past research studies, casual observations from the public and the MNRF, and locations of collared caribou. Survey efforts were not consistent across the entire range so intensity of observation effort varied substantially. Most of the historical observation efforts occurred around Lake Nipigon or in the areas northwest or east of Lake Nipigon and south of the CN railroad. Therefore, comparisons of historical range occupancy between the northern and southern portion of the range are difficult. However, the data strongly supports the past and continued occupancy of Lake Nipigon and the land areas around Lake Nipigon.

Within the Nipigon Range, the occupancy patterns and habitat selection for refuge, forage, calving, and travel may be heavily influenced by topographic factors such as the size, shape, and location of Lake Nipigon and other large lakes such as Onaman, Esnagami, or Ogoki. On the east side of the range, the proximity to the James Bay Lowlands, long fire return intervals, and more spruce dominated forests associated with ecoregion 2W likely influence the distribution and use of year round habitat.

Lake Nipigon, a water body of more than 4,480 km² is most likely the key feature that keeps caribou in the southernmost portion of Continuous Distribution in Ontario. Lake Nipigon has many peninsulas and large and small islands that help caribou isolate themselves from predators. Caribou appear to prefer the smaller islands but also appear to use most of the islands to some degree. Caribou and their calves are excellent swimmers so waterbodies with islands and peninsula features likely provide better escape opportunities, thereby improving survival, especially during calving and raising young.

The highly irregular shoreline of Lake Nipigon is used extensively, especially along the west, north, and north-eastern shores that have low levels of human development. Caribou winter in the Armstrong Airport area (northwest of Lake Nipigon), the Bowser Creek area (northeast of Lake Nipigon), and Livingstone Point (east), but have also wintered on MacIntyre Peninsula and Caribou Island (south/southwest). There are fewer caribou-use areas in the south and southeast. Caribou are less likely to be observed near areas with human development or large burns such as the areas around the town of Beardmore.

The islands of Lake Nipigon are part of the Lake Nipigon Basin Signature Site that was identified as a protected area in *Ontario's Living Legacy* (OLL) (MNR 1999a) and have management strategies to support caribou use. Forest cover on the islands exhibit vegetation conditions such as young succession forest and older mixed and pure conifer forest conditions which caribou use for calving, nursery, and winter habitat. Several of the larger islands were subject to early forest harvest activities which contributed to the current mixed forest conditions. Caribou using Lake Nipigon tend to be somewhat confined to the islands and adjacent shorelines, still providing for relatively large home ranges but restricted to relatively small land areas. This may be partly attributed to the relatively high levels of disturbance and human activity inland from the lake shoreline. The number of caribou using the Lake Nipigon islands is considered to be declining from historical numbers reported from Nipigon District studies (K. McNaughton, R. Swainson, and R. Hartley pers. comm. 2010).

Higher wolf activity may be expected on Lake Nipigon during winters when ice conditions support easy travel (e.g. little snow or slush) which also increases winter and commercial fisheries activities. Wolves find a supplementary food source in discarded non-commercial by-catch from commercial fishing and this food subsidy can support wolf activity in otherwise remote areas of the lake possibly allowing a higher number of wolves to be supported in the vicinity of the islands. However, caribou continue to use the islands of Lake Nipigon.

Biologists familiar with caribou in the Lake Nipigon area agree on the strategic significance of the lake and its limitations. They believe the connectivity between the lake habitats, larger mainland forest habitats, and the movement it supports is essential to sustain caribou activity on Lake Nipigon. Currently, there is concern about the present and future status of connectivity for caribou between Lake Nipigon and the mainland areas around the Armstrong Airport, Onaman Lake, and northward towards the Ogoki Reservoir. Although the 20-30 km band along the lakeshore has the potential to support these connectivity functions, in many places this band has been reduced to 2-10 km as a result of forest harvesting or other development activities.

There are two notable areas of demonstrated past and present caribou habitat use requiring this connectivity which are the Armstrong Airport area and Livingstone Point. The Armstrong Airport area northwest of Lake Nipigon has traditionally provided quality winter habitat featuring sparsely treed dry, sandy jack pine and spruce-lichen forest. Caribou tend to move to the Armstrong Airport area or further north in the winter from the islands of Lake Nipigon where they spend the summer. Winter caribou use of the area surrounding the Armstrong Airport has been in decline, likely due to encroachment by forest harvest, wildfire, road use, and other anthropogenic activities (Racey and Honsberger 2009) which may restrict caribou travel options between Lake Nipigon and the Armstrong Airport area.

Caribou use Livingstone Point, an older forested area on the eastern shore of Lake Nipigon, in winter and summer. The point likely provides refuge for the caribou and reduces risk from predation. It also provides a potential linkage between Lake Nipigon and the Humboldt-Onaman corridor, but it is unknown how much movement this corridor currently supports. In the areas east of Livingstone Point, caribou are using areas that were harvested in the 1960s. This area is south of the Humboldt-Onaman corridor between Lake Nipigon and Onaman Lake and had extensive silviculture efforts to support conifer content (Racey et al. 2010). Livingstone Point is considered to be one of the important biological anchors for this section of the Lake Nipigon shoreline. Evidence of the importance of this area is supported by the aerial survey results and probability of occupancy identified in this range assessment (Figure 12).

Other shoreline areas around Lake Nipigon are also occupied by caribou. The shoreline around Caribou Island, Jackfish Island, West Bay, Mud River, and north towards Wabinosh Bay, Windigo Bay, and Bowser Creek off of Ombabika Bay are used by caribou, as documented from winter observations and collaring monitoring conducted by Nipigon District staff (K. McNaughton, R. Swainson, and R. Hartley pers. comm. 2010).

Further inland, six significant areas of current caribou habitat use have historical documentation of connectivity to Lake Nipigon. These areas include the Kopka River corridor to the west, Humboldt-Onaman corridor and Onaman Lake, the areas around Kowkash and the former Onaman Crown Game Preserve, and the Ogoki Reservoir to the north. Small groups of caribou occupy older conifer forests adjacent to peatlands in the Onaman Lake and Kowkash areas which may form another anchor of caribou occupancy in the south central portion of the range. These areas likely provide refuge value within an area otherwise surrounded by forestry activities and younger forest. There is potential connectivity between the Onaman Lake and Kowkash areas and Lake Nipigon through the Humboldt-Onaman corridor via waterways and moraine features. This location has the potential to provide and support east-west and north-south connectivity of caribou within the Nipigon Range.

The Ogoki Reservoir supports caribou calving and nursery activity and appears to provide an important linkage between northern and southern portions of the range. It has a higher probability of occupancy (Figure 9, Figure 12) likely due to lower levels of disturbance to the north, abundant peatlands, and older conifer forest.

Caribou may be adjusting their distribution in response to forest harvest activities initiated in the Ogoki Forest in 1998 which could influence the degree of connectivity between the Ogoki Reservoir and land to the north. The areas with the lowest probability of occupancy in the Ogoki Forest are associated with this recent forest harvest activity and large regenerating burns. However, the Ogoki Forest still represents a broad expanse of habitat in a relatively natural landscape pattern. Caribou appear to be using previously logged areas and mixed wood areas to the north and east of Lake Nipigon which is inconsistent with conventional understanding of habitat selection. How these areas provide for forage or refuge is unclear although numerous patches of older conifer forest, rugged terrain, bedrock, and sandy outcrops with terrestrial lichen growth may collectively benefit caribou to the point of supporting occupancy. Elsewhere in the more black spruce dominated portions of the range, the importance of the remaining mature conifer forests, bogs, fens, and lowland forests with bedrock outcrops appears to provide enough habitat value to support caribou occupancy.

Habitat use patterns and occupancy trends, inform local habitat management actions related to forest management, environmental assessments, or land use planning. The following areas have been known to support caribou occurrence and habitat use:

- The Kowkash area north of Onaman Lake and west of Aroland has historically supported and continues to support caribou occupancy. This area is currently managed under a caribou habitat mosaic and is part of a planned future harvest block when use expands into currently regenerating forests. Documented winter habitat was placed in larger, long-term deferrals as part of the dynamic habitat schedule for the 2010-20 Nipigon FMP. Additional information may be useful to identify the number of caribou using the area and to identify the timing and extent of use of regenerating habitat.
- The Onaman Lake area also supports currently-used winter and summer habitat. Part of this area used to be managed as part of the Onaman Crown Game Preserve. Caribou are suspected to travel between this area and the eastern edge of Lake Nipigon through the Humboldt-Onaman Corridor EMA. Caribou-specific habitat conservation measures in this area are challenged by the long history of natural disturbances, linear infrastructure, and past forest harvest and renewal practices. Increasing white-tailed deer populations may place further pressure on caribou in this area, though harsh winter conditions may reduce that threat. Additional information on occupancy patterns in this area and extent and type of use in both the mature and regenerating forests may be informative for ensuring connectivity to Lake Nipigon and the northern portions of the range.
- The southern islands of Lake Nipigon and the southern extent of the range near the Highway 11 corridor are used by caribou, though infrequently and generally in low numbers. The extent and degree of use is uncertain and difficult to determine in a highly disturbed landscape where it is difficult to survey and very difficult to locate caribou for the installation of telemetry collars. Additional local information on use patterns may be informative.
- The areas northwest and north-central to Lake Nipigon, representing the vicinity around the Armstrong Airport wintering area, Windigo Bay, and Caribou Lake, has an apparent declining trend in caribou use. This area is subject to considerable pressure from natural and anthropogenic disturbances, as well as development pressures. Although historical information in this area is quite comprehensive, tracking of current use patterns will be informative in evaluating responses to past management.
- The areas north of the Ogoki Reservoir and east of Wabakimi Provincial Park do not have a long history of caribou occupancy data. At present, these habitats are subject to forest management activities. Changes in use patterns are difficult to document due to the lack of historic data. Movement of caribou from outside the range in this area is

considered likely. Additional information on the north-south and east-west movement of caribou and habitat selection patterns in this area may be informative to maintaining connectivity across the landscape.

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

3.5 Influence of current management direction

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

Implementation of *Northwest Region Interim Caribou Habitat Management Direction* (MNR 1994) and the early implementation drafts of the *Forest Management Guidelines for the Conservation of Caribou Habitat: a Landscape Approach* (Racey et al. 1999), and the subsequent *A Management Framework for Woodland Caribou Conservation in Northwestern Ontario* (MNR 1999b) were instrumental in initiating and integrating caribou conservation efforts into forest management planning. Although imperfect, implementation of caribou habitat tract mapping, mosaic planning, and priority retention of larger areas of high value habitat components contributed to continued range occupancy and ecologically sustainable forest management. Over the last 15 years, this intent to manage the landscape and prevent further range recession has resulted in an existing landscape condition that may allow for an easier transition to implement the RMA.

Ontario’s Living Legacy (MNR 1999a) established the Humboldt-Onaman Corridor EMA, the Pikitigushi EMA, and the collective network of Parks and Conservation Reserves and recognized the importance of the Lake Nipigon and its islands to woodland caribou. The subsequent Lake Nipigon Basin Signature Site Ecological Land Use and Resource Management Strategy identified the strategic significance of habitat north of Lake Nipigon and limited the amount of development on the islands of Lake Nipigon to allow caribou continued access. Collectively this investment in protection and management may be considered beneficial to securing habitat value on and around Lake Nipigon.

Parks, protected areas, and conservation lands are managed as important components of a broad landscape approach to caribou conservation. Expanded in 1997, Wabakimi Provincial Park, northwest of Lake Nipigon, acts as an “anchor” of caribou habitat for both the Nipigon and Brightsand Ranges.

The *Forest Management Guidelines for the Conservation of Caribou Habitat; a Landscape Approach* (Racey et al. 1999) provided direction for habitat renewal and the rehabilitation of roads after forest harvesting, ongoing monitoring of these two key habitat management strategies will determine if effectiveness. MNRF continues to improve implementation with management partners. This direction was reviewed and improved through development of the *Forest Management Guide for Boreal Landscapes* (OMNR 2014).

The Lake Nipigon Basin Signature Site consists of an array of land use designations including provincial parks, conservation reserves, forest reserves, EMAs, and general use areas designated through Ontario's Living Legacy. It provides land use direction to protect, enhance, and where necessary, restore values including caribou and its habitat. Further refinement and clarification of management intent and direction is in development for conservation reserves, provincial parks, and EMAs (Pikitigushi, West Lake Nipigon, Gull Bay, south Lake Nipigon, Orient Bay, and the Lake Nipigon-Beardmore area) in the Nipigon Range.

Fire management policies over the last 30 years may have encouraged an older forest condition in some portions of the range such as the islands or shores of Lake Nipigon, or the Ogoki Forest prior to the initiation of forest harvesting activities.

3.6 Major data and analysis uncertainties

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

Aerial survey flights in 2010 encountered challenging survey conditions. Snow conditions near the end of the survey period made detection difficult and may have decreased chances of locating groups.

The range contains some areas where forest management occurred more than 40 years ago. In some of these previously harvested areas, the forest is now older than 36 years of age; the associated forest harvest roads are still present but many are not drivable by standard road vehicles. Some of those regenerating forest areas adjacent to currently suitable habitat are being used by caribou as documented by Racey et al. (1996; 2010). There is some uncertainty as to the contributions these areas provide caribou and whether these areas represent renewed habitat.

A significant blowdown disturbance event in the Armstrong Airport area was described briefly by Racey and Honsberger (2009). It included 3.1 million has of light damage and 1.2 million has of moderate-to-severe damage. This disturbance type is seldom fully addressed in forest resource inventory updates and may not be adequately accounted for in the analysis of the amount and arrangement of caribou habitat or the disturbance footprint (Figure 24 and Figure 25). The large natural forest disturbance depicted on the northeastern corner of Figure 24 likely extends further south and west suggesting that the habitat available in this area may actually be less than what is projected from the forest resource inventory.

In areas without FRI coverage, the Provincial Land Cover 2000 (PLC 2000) and Provincial Land Cover 2010 (PLC 2010) were used to quantify caribou habitat. These two products differ in the methodology used to produce them, and therefore accuracy. This is most noticeable when comparing the open fen, treed fen, open bog, and treed bog land cover classes. In general terms, the PLC 2000 over-represents the amount of tree cover, often classing an open area or sparsely treed area as treed fen or treed bog (Stratton 2012). In comparison, the PLC 2010 under-represents the amount of tree cover, often classing a sparsely treed or treed area as open fen or open bog (Stratton 2012). When considering that the habitat model for determining winter and refuge habitat (conventional boreal model) classifies treed fen and bog as habitat, but not open fen or bog, it may be important to consider these variations when interpreting the habitat values.

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). This relationship was intended to be refined as improved data was provided by various jurisdictions across Canada. There may be substantial differences between forest cover, forest disturbance, and linear features represented in this analysis compared to the Global Forest Watch data. In general, the current range analysis included more complete data related to road and mineral development activities, documented fires, and non-fire forest disturbances. The calculated habitat disturbance using Ontario data is estimated to be approximately 10 to 12% greater than that generated using the Global Forest Watch data. There is some uncertainty in the interpretation of the results of the disturbance analysis using these different datasets in light of the desire to use the best data available.

There is considerable uncertainty in the appropriate treatment of water during the disturbance analysis. The sensitivity of the “total disturbance” parameter to removal of waterbodies of different sizes was identified to inform interpretation of the likelihood of a stable or increasing population growth and evaluation of range status. In the Nipigon Range, waterbodies account for a substantial portion (20.4%) of the range extent. It is unknown whether the inclusion of these waterbodies in the range extent for the purpose of the disturbance analysis introduces a positive or negative bias.

3.7 Special considerations within the range

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

No other range in Ontario has a waterbody as large as Lake Nipigon. This massive lake with abundant islands and peninsulas likely contributes significantly to caribou values at the southern portion of the range. Caribou use of the lake and habitat values associated with the lake likely interact in many complex ways with population dynamics and habitat use patterns well back from the shoreline of the lake. The lake may have allowed for the persistence of caribou in the vicinity of the lake even where levels of habitat disturbance are higher than what might support caribou elsewhere.

White-tailed deer numbers and range extent appear to be increasing within the southern part of the Nipigon Range, attributed in part to a series of milder than normal winters and less snow, and in part to increasing levels of landscape disturbance. The increase in white-tailed deer has the potential to increase caribou mortality through an increase in brainworm (*Paralaphostrongylus tenuis*), or liver flukes and may also support higher wolf densities (Latham et al. 2011). It may also be an additional factor warranting consideration when interpreting the probability of occupancy over and above the direct habitat covariates used in the calculation.

Current estimated wolf densities in the Nipigon Range are at the suggested threshold for caribou persistence (0.65 wolves/100 km^2 from Bergerud and Elliot 1986; Bergerud 1988). If alternate prey densities increase with increasing levels of landscape disturbance, additional concern is warranted for caribou persistence in the range.

No specific assessment of habitat renewal was conducted. However, there is evidence that some areas harvested in the 1960s and in which substantial silvicultural activity was applied are currently being used by caribou within and south of the Humboldt-Onaman Corridor EMA.

Although much variation in snow depth remains, reduced snow depth likely influences the habitat use patterns of caribou allowing them to forage in areas that are 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 assessment was conducted during a substantially warm winter with reduced snow depths and this factor warrants consideration when interpreting the suggested trend in caribou numbers or recruitment.

Human caused mortality has been documented and attributed to train collisions. Large train kill numbers can occur with a single incident. For example, caribou collisions on the Cavell Railroad killed 20-30 animals with one train (Armstrong pers. comm. 2011). A major railroad bisects the range and contributes a significant risk factor in the area north of Onaman Lake and in the vicinity of Kowkash. Roadways present similar risks or collisions with motor vehicle.

3.8 Other wildlife

The boundaries of the Nipigon Range include all or parts of Wildlife Management Units (WMU) 17, 16C, 18A, 19, 20, 15B, and 21A (Figure 13), within cervid ecological zones A and B (MNR 2009b).

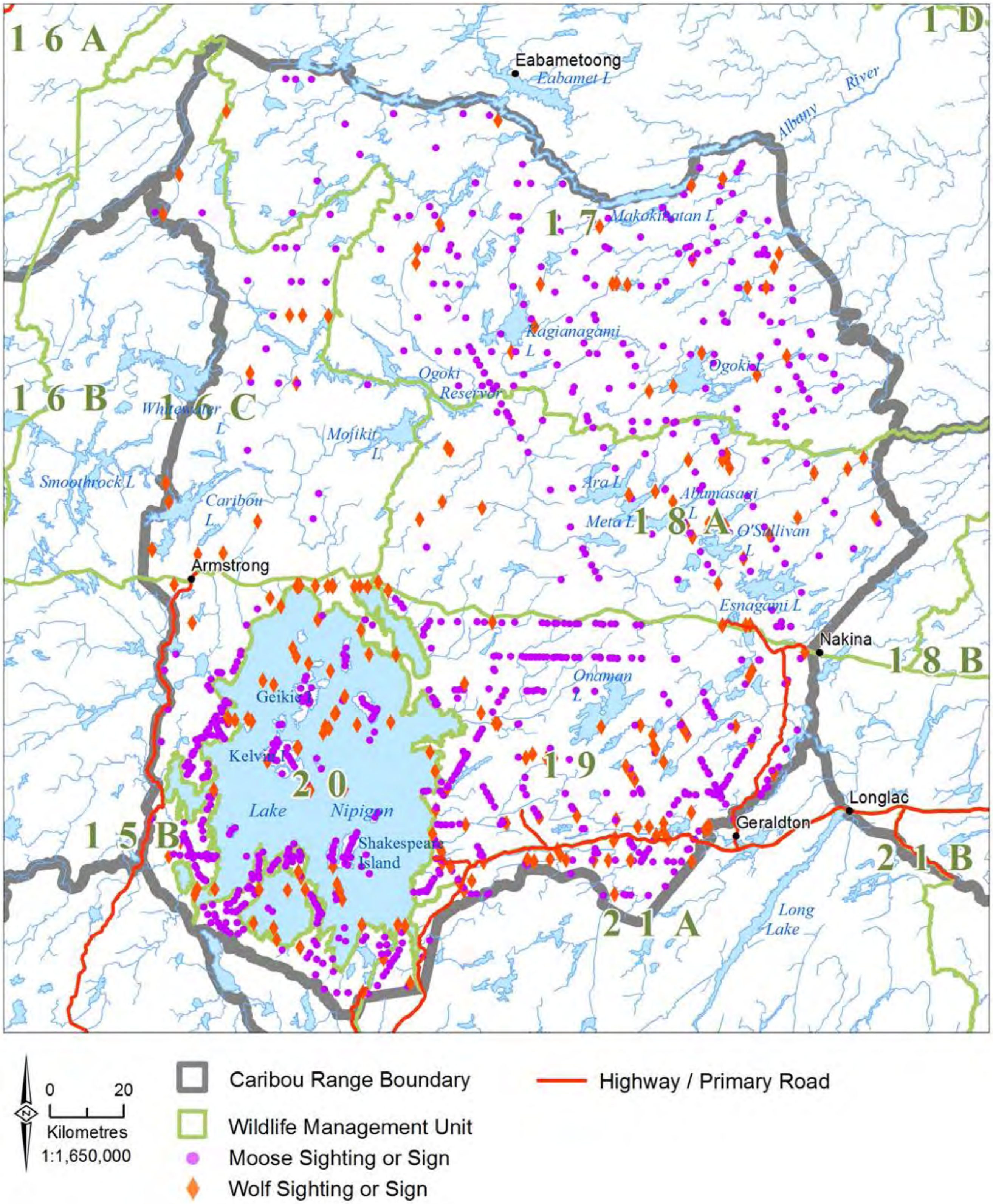


Figure 13. Wildlife Management Units overlapping the Nipigon Range with moose and wolf signs or sightings observed during the winter 2010 aerial surveys.

Moose densities are considered to be somewhat stable across the Nipigon Range and are currently estimated from 5-32 moose per 100 km^2 (Table 4) where they are managed towards WMU targets.

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

WMU	Cervid ecological zone	MAI strata area (km^2)[1]	Moose population estimates no. of moose (survey year)	Current density (moose / 100 km^2)
15B	B	14,950	4,640 (2009)	31.0
16C	A	10,775	1,241 (2005)	11.5
17	A	11,415	531 (2004)	5.0
18A	A	7,095	1,009 (2008)	11.9
19	B	10,825	1,649(2010)	15.2
20	B	4,861	110 (2001)	32.0[2]
21A	B	13,625	3,708 (2012)	27.2

[1]Area is for the WMU.
[2] Values as taken from Wildlife of the Lake Nipigon Basin (Swainson and McNaughton 2001).

White-tailed deer are found in the southern part of the Nipigon Range with less frequent observations further north. Densities are low (R. Hartley pers. comm. 2011), but there is an apparent rapid increasing trend in the southern portion of the range near Lake Nipigon (L. Nyman pers. comm. 2011). Deer may function as both alternate prey for wolves and as a vector for disease, specifically brainworm (*Paralaphostrongylus tenuis)*, and may be expected to increase with northward expansion.

Black bear density estimates derived through the implementation of barbed-wire hair trap (BWHT) protocol indicates that black bear densities are relatively low in most of the WMUs within the Nipigon Range (12-24 bears per 100 km^2) (Table 5) (M. Obbard, MNR unpublished data). Relatively high densities occurred in the western-most units (15B and 16C), where densities were similar or above average values for WMUs across Ontario's northwest region and black bear ecological zone D. However, these zones only overlap a small portion of the Nipigon Range. The remaining WMUs are below average densities from other WMUs within Ontario's northwest region and black bear ecological zone D.

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

WMU	BBEZ[1]	Year	Density (# bear/100km^2) ± SE	Density relative to BBEZ mean	Density relative to regional mean
15B	D	2005/2010	17.0 ± 6.3	Similar	Similar
16C	D	2008/2009	23.8 ± 7.4	Above	Similar
17	D		Unknown		
18A	D	2006/2009	11.8 ± 4.1	Below	Below
19	D	2008	12.5 ± 3.4	Below	Below
20	D		Unknown		

[1]Black bear ecological zone

Wolf densities are thought to be increasing based on increased observations by district staff and the public, between 2000 and 2010 (R. Swainson, K. McNaughton, W. Beckett pers. comm., 2010) and are supported by the results of the Moose Hunter Post Card Survey (PCS) wolf sighting index (Figure 14). There were frequent observations of wolves during the 2010 survey, especially in the southern portion of the Nipigon Range (Figure 13). Wolf numbers and activity on Lake Nipigon and in the vicinity of the lake appear to be increasing. During the winters of 2010 and 2011, wolf densities were estimated at 0.67 wolves per 100 km^2 during a radio-collaring study of wolves in the Nipigon Range (primarily WMU 17, 18, and 19; B.R. Patterson (MNR), unpublished data). This density is at a level predicted to negatively affect caribou populations (Bergerud and Elliot 1986; Bergerud 1988). This information is included to provide context with other wildlife population trends, and is not used in determining range condition.

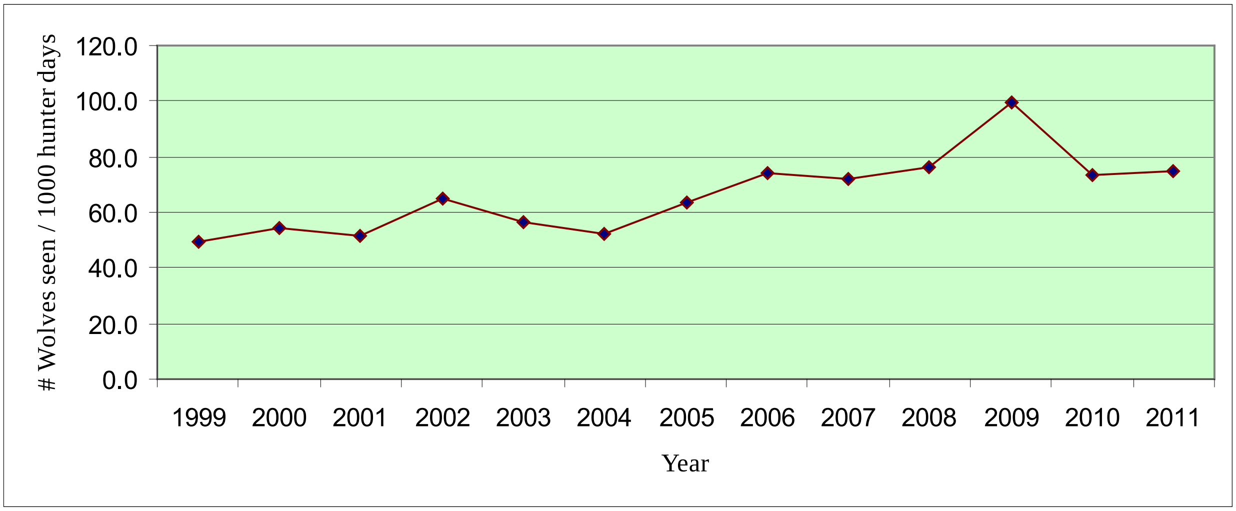


Figure 14. Trend in number of wolves sighted by moose hunters, 1999-2011; pooled data for WMU 15B, 16C, 17, 18A, 19, and 21A – MNR, Science and Research Branch, moose hunter post card survey database.

3.9 Results of past range assessments

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

4.0 Integrated Range Assessment Framework

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

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

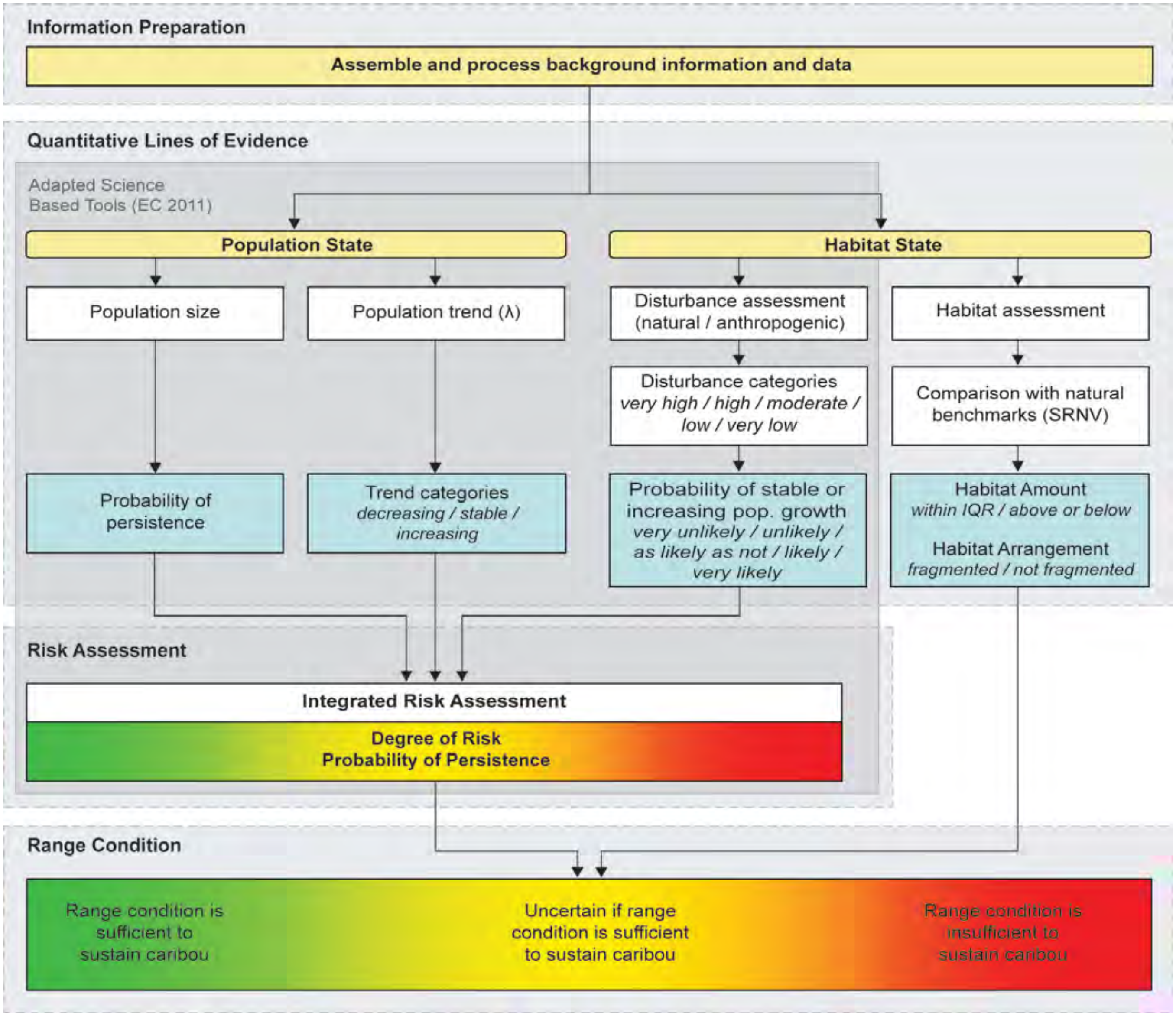


Figure 15. The integrated assessment framework with four quantitative lines of evidence. Three lines of evidence related to population size, trend and habitat disturbance assessment contribute to an integrated risk assessment. The results of the integrated risk assessment are combined with habitat assessment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

5.0 Quantitative Lines of Evidence Methods and Results

5.1 Population state: size and trend

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

The ability to establish population trends improves with the addition of more indicator estimates. In this assessment the short-term population trend is approximated by: 1) estimates of recruitment expressed as per cent 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, there were local studies involving the deployment of telemetry collars on caribou within the Nipigon Range (Table 2). These studies were primarily intended to document caribou movement and habitat use within specific areas (such as the islands and shoreline of Lake Nipigon), and provide caribou information in areas of immediate interest for resource management decisions. Recruitment was not consistently assessed for these caribou and never for the whole range. However, the historical studies and related aerial surveys provide the only source of historic population estimates. Darby et al. (1989) estimated there were 278 caribou in the population and Cumming (1998) estimated there were 178 caribou. These estimates are mainly associated with the southern portion of the range around Lake Nipigon and areas east of the lake.

In February 2010, an attempt to deploy up to 50 GPS collars on adult female caribou throughout the Nipigon Range was abandoned due to difficulty in locating sufficient caribou because of poor snow conditions. This resulted in only six deployed GPS collars. Subsequent efforts in March 2011 and February 2012 resulted in collaring an additional 56 adult female caribou. The intent was to retain 50 adult caribou collared in each year (through partnerships among several projects). Data generated from collared caribou will be used in this and in future reports to determine annual survival, recruitment, and refine trend estimates.

5.1.1.2 Winter aerial surveys

Between February 17^{th} and March 2^{nd}, 2010, a fixed-wing hexagon-based aerial survey was conducted (Figure 8). All caribou and signs of their presence were recorded. Where possible, observed caribou were counted and classified as adults or calves. Survey efforts were strictly controlled to support occupancy analysis (Section 3.3). Additional searching for caribou off the transect lines was discouraged once sign was confirmed.

The second stage of the survey was conducted by helicopter between February 20, and March 16, 2010, and included areas where caribou were sighted and/or where there was significant evidence of caribou presence. Caribou group size and age/sex composition were determined at this time. The helicopter survey crews counted and classified caribou as: unknown adults, adult males, adult females, calves, or unknown age and sex. Sex of adults was determined through observation of the presence or absence of a vulva patch, animal behaviour, and/or body morphology.

These two survey methods 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 from aerial surveys was used to estimate the number of adult females present in the groups containing unknown adults. The adjusted number of adult females (AF_{adj}) was used to estimate recruitment.

5.1.1.4 Trend

Generally, in forest-dwelling caribou, a stable population requires a late-winter estimate of at least 12 to 15% calves in a non-hunted population with a density of 0.06 caribou per square kilometre (Bergerud 1992; 1996). Recruitment rates exceeding 28.9 calves per 100 AF_{adj} would suggest the population is increasing. Recruitment rates below this value would suggest the population is decreasing based on assumed average adult mortality rates (EC 2008). The relationship between annual estimates of recruitment and adult female survival was used to provide an estimate of trend (λ) (Hatter and Bergerud 1991).

Trend Estimation

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

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

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

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

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

5.1.1.5 Size

The aerial survey methodology used to conduct a probability-based occupancy survey (Section 3.3) supplemented with a helicopter to obtain improved age and sex information was used to generate a minimum animal count (MAC). This is interpreted as an absolute minimum number of animals occupying the range in February and March, 2010. The MAC was calculated based on all caribou observations that were not deemed to be duplicate observations (MNRF 2014a).

5.1.2 Population state results

One hundred and ninety-five (195) caribou observations were recorded as part of 31 groups during the 2010 aerial surveys; 115 resulting from the fixed-wing survey and 80 resulting from the rotary wing survey. Ninety three (93) caribou were observed in 13 independent groups during the fixed-wing and 79 caribou were observed in 15 independent groups during the rotary wing aerial surveys for a total of 172 (Table 6). This represents the minimum animal count (MAC) present in the Nipigon Range during February and March 2010. 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 Nipigon Range. Most caribou were seen in the northern portion of the range and no caribou were physically observed during the fixed-wing portion of the survey in the southern portion of the range (Figure 8).

Table 6. Minimum animal count observed during a fixed-wing and rotary-wing aerial survey conducted in the Nipigon Range, February 21-March 16, 2010.

	Caribou Age and Sex Identification[1]						
Survey Method	**UA**	**AM**	**AF**	**Calves**	**UN**	**Total Adults**	**Total Caribou**
Fixed-wing (FW)	16	24	21	12	6	61	79
Rotary-wing (RW)	79			14		79	93
Total	**79**			**26**		**140**	**172**

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

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 ratio and recruitment. Using the observed sex ratio (0.525) during the winter 2010 survey, the number of adjusted adult females (AF_{adj}) was determined to be 70.9 with a recruitment estimate of 36.7 calves per 100 AF_{adj} (Table 7 and Figure 16)

In 2011, recruitment surveys observed 24 caribou and 13.7 AF_{adj} with a recruitment estimate of 36.6 calves per 100 AF_{adj}. In 2012, recruitment flights recorded157 caribou and 74.0 AF_{ad} with a recruitment estimate of 39 calves per 100 AF_{adj}. In 2013, recruitment flights yielded 116 caribou and 74.2 AF_{adj} with a recruitment estimate of 23 calves per 100 AF_{adj} (Table 7 and Figure 16).

During the first three years (2010-2012), recruitment levels were above the suggested threshold of 29 calves per 100 AF_{adj} (EC 2008). However, the most recent recruitment estimate (2013) is below the threshold.

Observations of caribou on the Lake Nipigon islands and the area in close proximity to Lake Nipigon from 1988 to 2005, suggest that caribou in this area have declined over the long-term which likely also represents the general long-term trend for the whole southern portion of the range (Table 2). No long-term trend information is available for the northern portion of the range due to infrequent and inconsistent survey effort on that landscape. However, the northern portion of the range exhibits fewer disturbances (Section 5.2.3) and has a higher probability of caribou occurrence (Section 3.3) which may lead to the expectation that the caribou population in the northern portion of the range is relatively stable.

Table 7. Counts of caribou and estimates of recruitment in the winters of 2010, 2011, 2012, and 2013.

Caribou age and sex identification[1]												
Year	**Survey**	**UA**	**AM**	**AF**	**Calf**	**UN**	**Total adults**	**Total caribou**	**Sex ratio**	AF_{adj}	**Calf: 100** AF_{adj}[2]	**% calves[3]**
2010	Winter Distribution (FW/RW)	95	24	21	26	6	140	172	0.525	70.9	36.7	15.1
2011	Recruitment	2	3	12	5	2	17	24	0.833	13.7	36.6	n/a[4]
2012	Recruitment				29		128	157	0.575	74.0	39.2	n/a[4]
2013	Recruitment	10	23	66	17	0	99	116	0.824	74.2	22.9	n/a[4]

[1]UA=Adult of unknown sex, AM= Adult male, AF=Adult female, UN=Caribou of unknown age or sex, AF_{adj}= Adjusted Adult Females
[2]Recruitment estimate using the ratio of calf: 100 adjusted adult female
[3]Percentage of calves observed. Only reported for the winter distribution survey, as this survey was not targeting radio-collared adult females and therefore represents a less biased survey for calculating percentage of calves in the population.
[4] Due to bias created by targeting collared adult female caribou during recruitment surveys, % calves not applicable from recruitment survey data

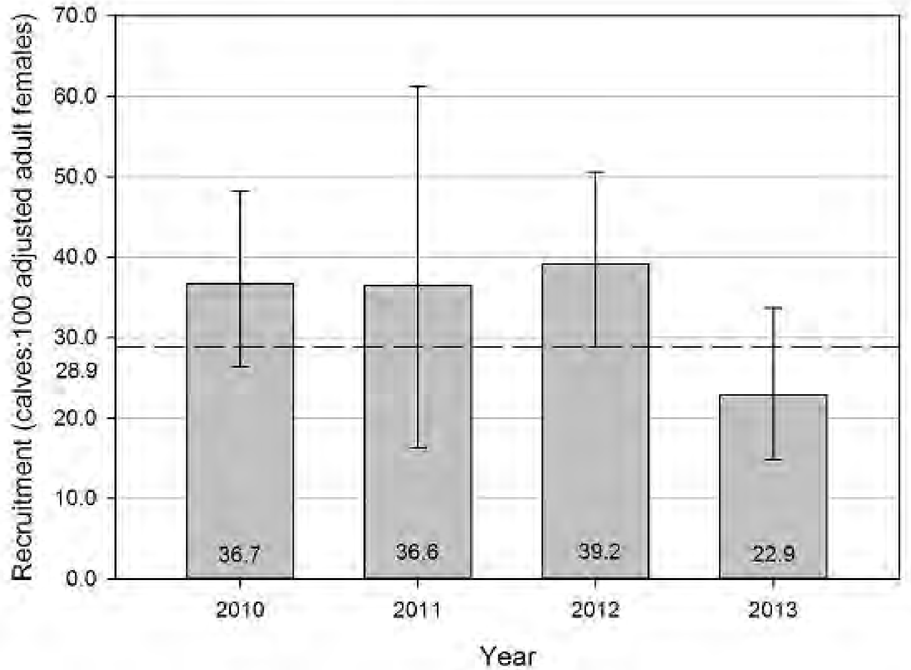


Figure 16. Recruitment estimates (calves/100 AF_{adj}) with associated 95% confidence intervals from 2010-2013 in the Nipigon Range. Dashed line indicates recruitment levels expected for a stable or increasing population (EC 2008).

Annual survival was estimated for all collared adult females which spent the majority of their time within the Nipigon Range during each biological year (April 1st to March 31st). The geometric mean annual survival rate was 0.84 and varied from 0.80-0.88 during 2010-2012 (Table 8 and Figure 17). The sample size for calculating the 2010 survival estimate was very low (based on 6 collared female caribou), however the estimated survival rate was not much different than in years when sample sizes were much larger. Similarly, the recruitment estimate for the 2010 biological year (2011 recruitment rate) was based on a relatively small sample size, but again was very similar to estimates occurring in both the year before and after. Therefore, all available recruitment and survival data to calculate annual estimates of population growth (λ) for caribou occupying the Nipigon Range was used. The geometric mean estimated population growth rate (λ) from 2009-2012 was 0.98, with all annual estimates being similar ranging from 0.96-0.99, which would suggest that the population is in short-term decline.

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

Biological year	*n*	*d*	Exposure days	Daily survival rate	Survival (S) [1]	Upper 95% CI	Lower 95% CI	Lambda (λ)[2]
2009					0.84			0.99
2010	6	1	1955	0.9995	0.83	1.00	0.58	0.98
2011	46	8	13268	0.9994	0.80	0.93	0.69	0.96
2012	39	4	11721	0.9997	0.88	1.00	0.78	0.98
			Geometric mean		**0.84**			**0.98**

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

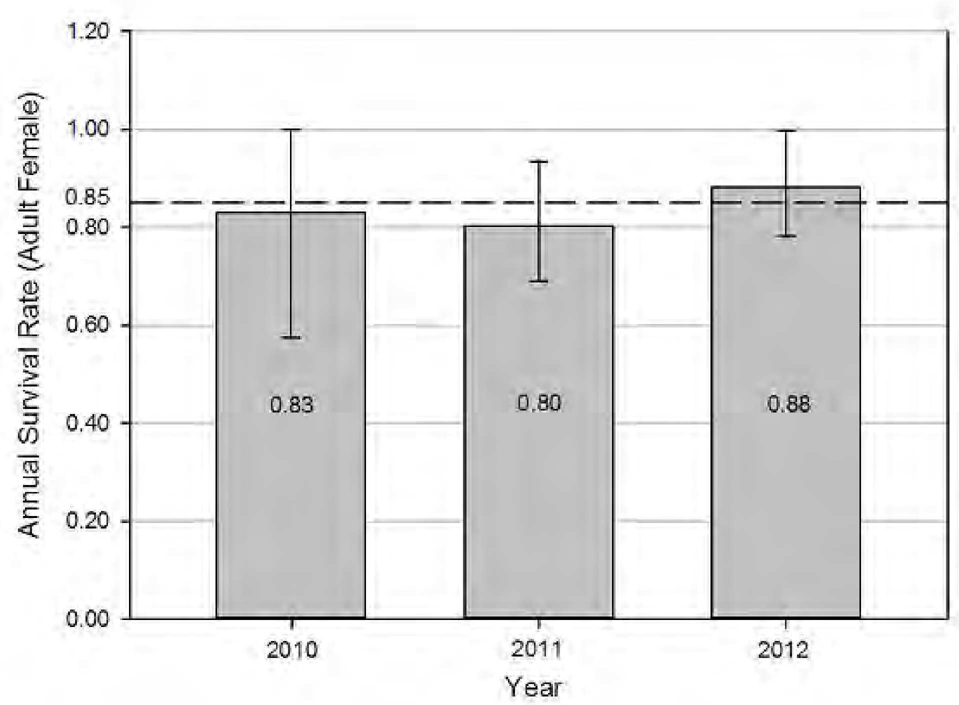


Figure 17. Annual survival rate and 95% confidence intervals of collared adult female caribou which spent the majority of the biological year (April 1st-March 31st) within the Nipigon Range. Dashed line represents the 0.85 survival rate (EC 2008).

5.2 Habitat state: disturbance and habitat

5.2.1 Disturbance assessment

The disturbance assessment is completed by doing an analysis that is intended to reflect the loss or conservation of functional habitat and 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 (e.g. Provincial Parks, areas above the Area of the Undertaking), the 2012 Provincial Satellite Derived Disturbance Mapping data, PLC 2000, and various Lands Information Ontario (LIO) layers were used (Figure 18).

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

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

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

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

Anthropogenic disturbances were buffered by 500 metres (MNRF 2014a). When buffers overlapped water polygons, the buffer area over water was counted as anthropogenic in the disturbance statistics.

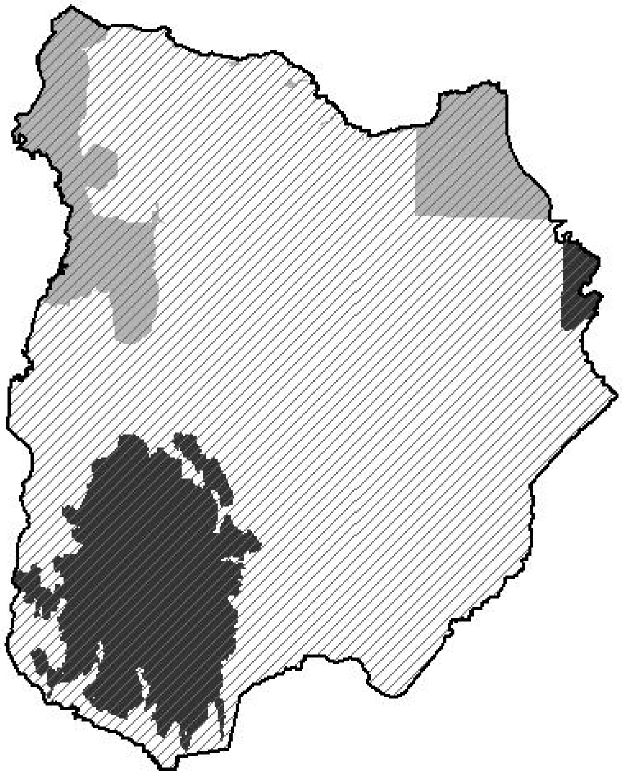


Figure 18. The Nipigon Range including the extent of the FRI) data (■), the extent of 2012 Provincial Satellite Derived Disturbance Mapping data (■), the extent of PLC 2000 data (■), and the extent of relevant data from LIO (▨).

5.2.2 Disturbance analysis results

The physical disturbance from various sources within the Nipigon Range (Figure 19 to Figure 24) contributes to the cumulative disturbance footprint (Figure 25). Sections 5.2.2.1 to 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

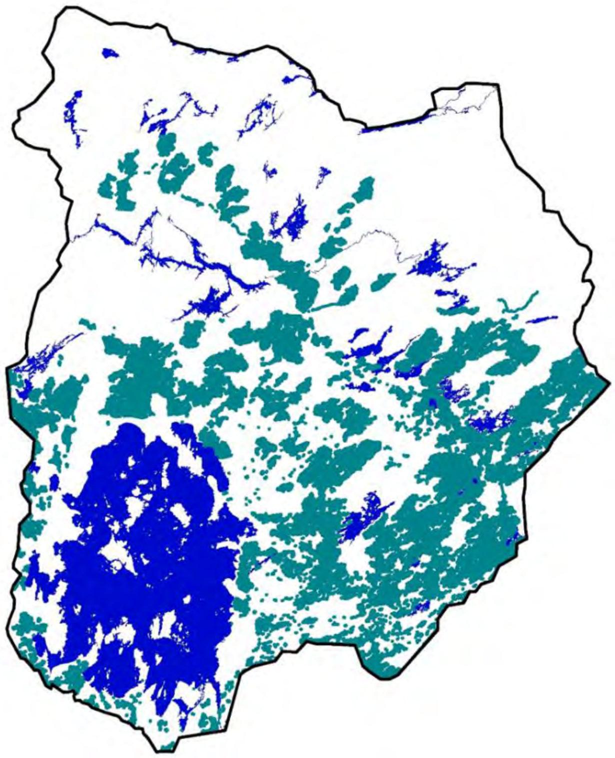


Figure 19. Forest harvest disturbances (■) including 500 m buffers in the Nipigon Range.

Table 9. Forest harvest statistics the Nipigon Range.

Harvest features	Count (n)	Area (ha)	Buffer area (ha)
Harvest stands (FRI)	41,673	331,739	603,081
Harvest areas (2012 Provincial Satellite Derived Disturbance Mapping)	n/a[1]	0	0
Harvest areas (PLC 2000)	n/a[1]	1,459	4,434

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

5.2.2.2 Other industry disturbance

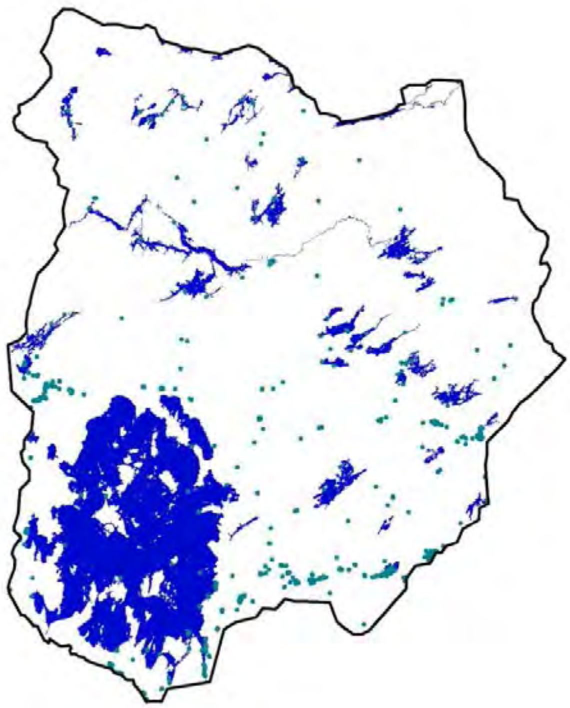


Figure 20. Other industry features (■) including 500 m buffers in the Nipigon Range.

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

Other industry feature	Count (n)	Area (ha)	Buffer area (ha)
Agriculture	n/a[1]	0.4	93
Airports	26	279	3,117
Buildings	2,114	n/a[2]	22,072
Dams	2	n/a[2]	162
Forest processing facilities	n/a	n/a[2]	0
Infrastructure	n/a[1]	60	1,163
Towers	41	n/a[2]	2,812
Utility sites	1	n/a[2]	79
Waste disposal sites	43	7	2,494
Water power generating stations	3	n/a[2]	157
Work camps	1	n/a[2]	682

[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

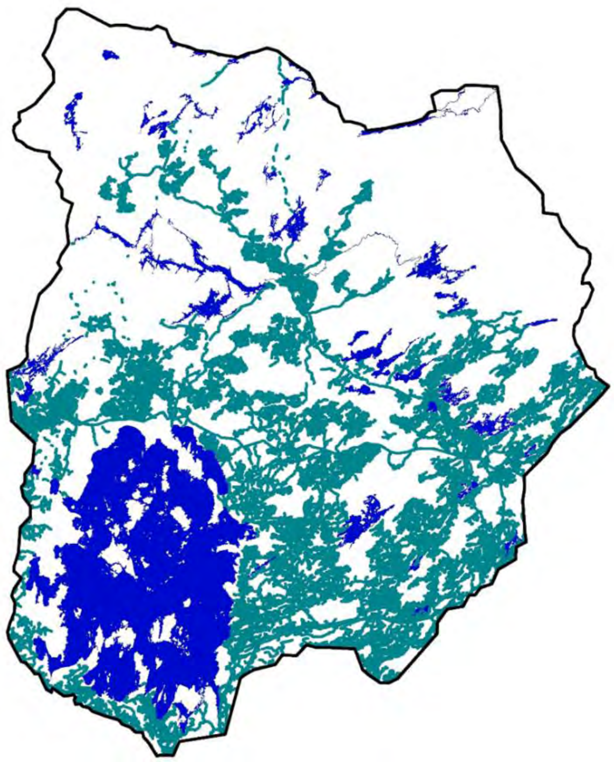


Figure 21. Linear features (■) including 500 m buffers in the Nipigon Range.

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

Linear feature	Count (n)	Area (ha)	Buffer area (ha)
Roads	n/a[1]	n/a[2]	1,303,237
Trails	n/a[1]	n/a[2]	27,207
Railways	n/a[1]	n/a[2]	32,488
Utility lines	n/a[1]	n/a[2]	17,959

[1] single line features crossing entire range boundaries or multi-part features
[2]features used in analysis represented by centre-line, not right-of-way; area not available

5.2.2.4 Mineral development disturbance

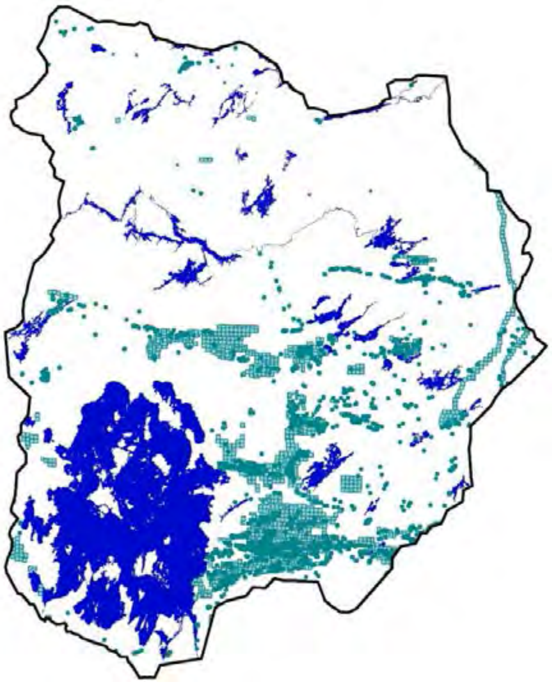


Figure 22. Mining and mineral exploration features (■) including 500 m buffers in the Nipigon Range.

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

Mining feature	Count (n)	Area (ha)	Buffer area (ha)
Active mining claims	2,102	257,980	n/a[2]
Aggregate sites – authorized	116	382	9,323
Aggregate sites – un-rehabilitated	0	0	0
Drill holes	6,630	n/a[1]	78,096
Mining locations	2	44	394
Mine shafts	7	1	516
Pits and quarries	288	405	19,757

[1] Drill holes are “point features”. Disturbance extent is represented by the buffer area.
[2]Active mining claims are not buffered. As no specific disturbance records representing the amount or extent of clearings, drill pads, trails, cut lines, etc. are digitally available for these analyses, the entire claim area is considered disturbed.

5.2.2.5 Tourism infrastructure disturbance

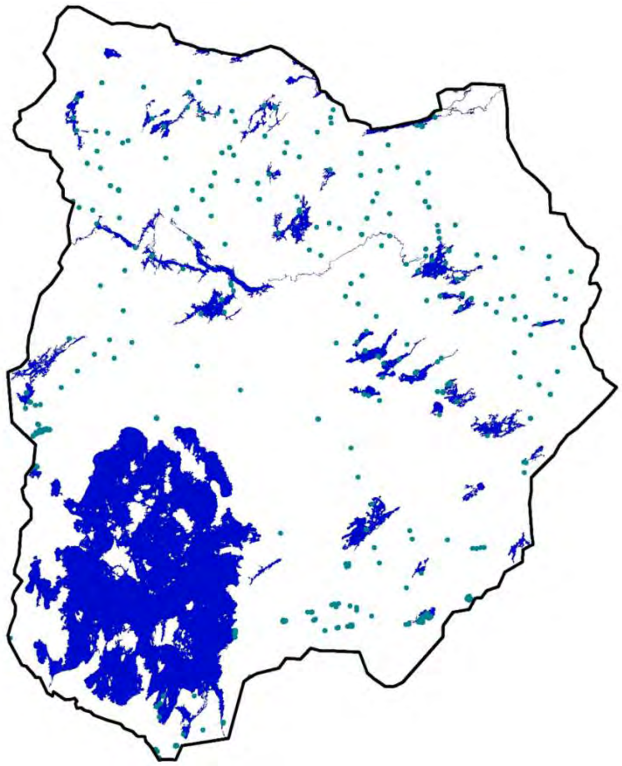


Figure 23. Tourism infrastructure features (■) including 500 m buffers in the Nipigon Range.

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

Tourism feature	Count (n)	Area(ha)	Buffer area (ha)
Cottage areas	120	159	3,609
Cottage and residential sites	117	2	3,085
Commercial campgrounds	1	18	164
Main base lodges (remote/non-remote)	45	20	3,415
Recreational camps	48	24	3,830
Remote outposts	139	22	10,998
Shooting range	1	1	107

5.2.2.6 Natural disturbance

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

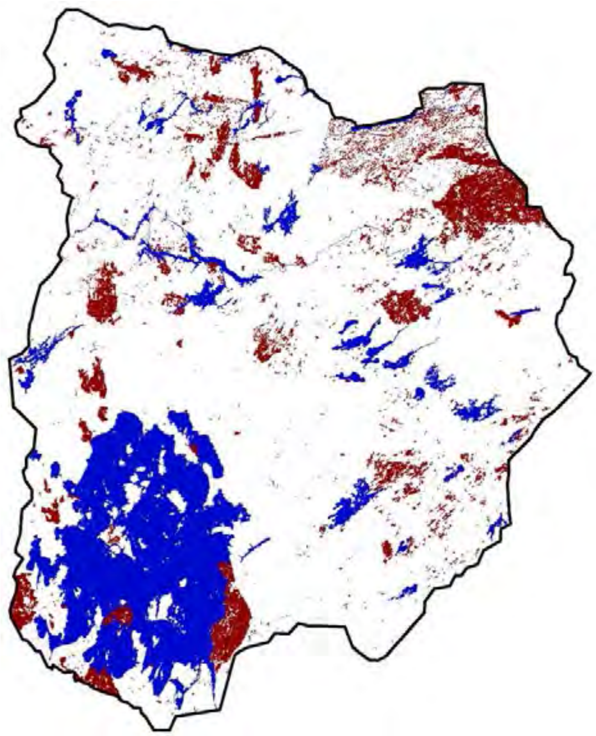


Figure 24. Natural disturbances from fire, blow-down, snow, and insect damage (■) in the Nipigon Range.

Table 14. Natural disturbance statistics in the Nipigon Range.

Natural feature	Count (n)	Area (ha)	Buffer Area (ha)
Fire (FRI)	n/a	160,527	n/a[2]
Fire (2012 Provincial Satellite Derived Disturbance Mapping)	n/a [1]	43,821	n/a[2]
Weather (2012 Provincial Satellite Derived Disturbance Mapping)	n/a [1]	19,499	n/a[2]
Unknown causes (2012 Provincial Satellite Derived Disturbance Mapping)	n/a [1]	62	n/a[2]
Fire (PLC 2000)	n/a [1]	1,996	n/a[2]
Fire (LIO)	n/a	5,665	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 20.4% of the area within the Nipigon Range; about half of this area is comprised of Lake Nipigon (Table 15). Approximately 24.2% of the land area of the range is represented by data sources other than the FRI. Table 155 includes range statistics which assist with the interpretation of disturbance statistics and map (Figure 25). The amount of area, inferred as functional habitat loss identified from the disturbance analysis amounts to 1,483,781 ha, or 38.4% of the Nipigon Range. Natural disturbance accounts for 4.6% and anthropogenic disturbance accounts for 33.8% of the range. The overlap of natural and anthropogenic disturbances accounts for 1.4% of the range area and 3.6% of the total disturbance, this value is counted as anthropogenic disturbance.

Table 15. Nipigon Range landscape statistics.

Range component	Area (ha)	%
Total range area	3,863,840	100.0
Water	787,837	20.4
Lake Nipigon	448,567	11.6
Non-water	3,076,002	79.6
FRI extent[1]	2,927,119	75.8
Non-FRI extent[1]	936,721	24.2
Total disturbance within range	1,483,781	38.4
Natural[2]	178,434	4.6
Anthropogenic[2]	1,305,347	33.8
- Overlap of natural and anthropogenic disturbance[3]	53,062	1.4
Not disturbed within range	2,380,059	61.6

[1]FRI and non-FRI extents include water.
[2]Anthropogenic disturbances include a 500 m buffer. When an anthropogenic disturbance overlaps with a natural disturbance it is counted as an anthropogenic disturbance.
[3]Overlap is included in the total amount of anthropogenic disturbance.

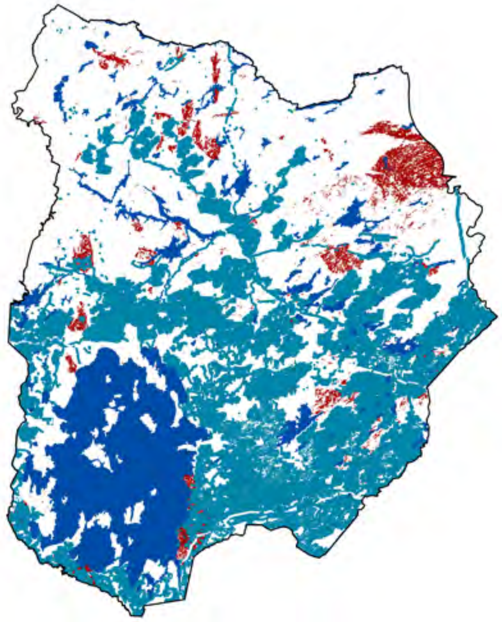


Figure 25. Anthropogenic[1] (■) and natural (■) disturbances (i.e. forest <36 years) in the Nipigon Range.
[1]Anthropogenic disturbances include a 500 m buffer. When anthropogenic disturbances overlap with natural disturbances it is counted as anthropogenic.

The pattern of disturbance across the Nipigon Range is reflected in 100 km^2 hexagons (Figure 26). Disturbance is greatest in the southern portion of the range. Some areas surrounding Lake Nipigon area are highly disturbed.

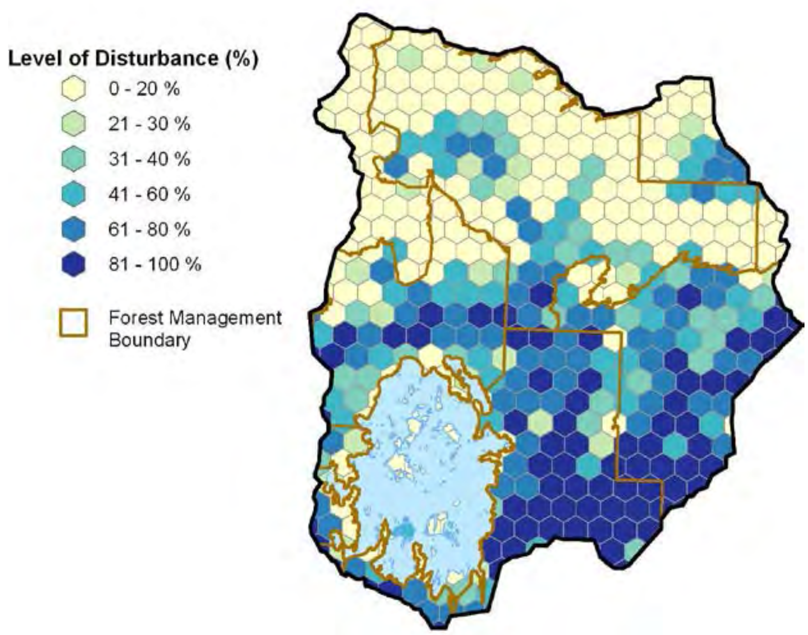


Figure 26. The concentration of natural and anthropogenic disturbances in the Nipigon Range within 100 km^2 hexagon grid cells (used for the probability of occupancy survey, Section 3.3).

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

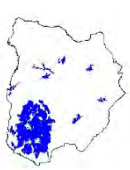
5.2.4 Disturbance considerations related to water

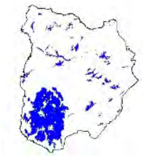
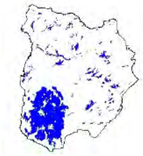
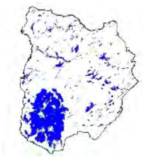
Water accounts for a substantial portion of the Nipigon Range (20.4%), particularly with Lake Nipigon, and contributes to the ability of caribou to isolate themselves from predators and the provision of calving habitat. However, the footprint of natural and anthropogenic disturbances (such as wildfires and harvest blocks) does not directly apply to waterbodies within the range. Therefore, the intensity and extent of disturbances and the associated functional habitat loss is likely underestimated when represented as a proportion of the total range area.

A sensitivity analysis was conducted in which waterbodies of different size classes were removed (Table 16) and the proportion of disturbance on the landscape was adjusted accordingly. This was completed to assist with interpretation of the disturbance analysis results and to inform the interpretation of the integrated probability of persistence calculated using the results of the disturbance analysis.

As the sensitivity analysis shows, water accounts for a combined area of 7,878 km^2 of the range and disturbance ranges from 38.4%-48.2%, depending on the inclusion of water.

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

Nipigon Range	Waterbody	Water ha (%)	Disturbance (%)		
			Natural	Anthropogenic	All
	Range extent	0 (0.0)	4.6	33.8	38.4
	Lake Nipigon removed	448,567 (11.6)	5.2	38.2	43.3
	> 5,000 ha removed	507,310 (13.1)	5.3	38.9	44.2

	> 1,000 ha removed	586,065 (15.2)	5.4	39.8	45.3
	> 500 ha removed	616,177 (15.9)	5.5	40.2	45.7
	> 250 ha removed	648,249 16.8)	5.5	40.6	46.1
	All water removed	787,837 (20.4)	5.8	42.4	48.2

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 Nipigon Range, both the amount and arrangement SRNV are compared against 2012 amounts and 2010 arrangement as inferred from the FRI. 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 Nipigon Range (Table 15).

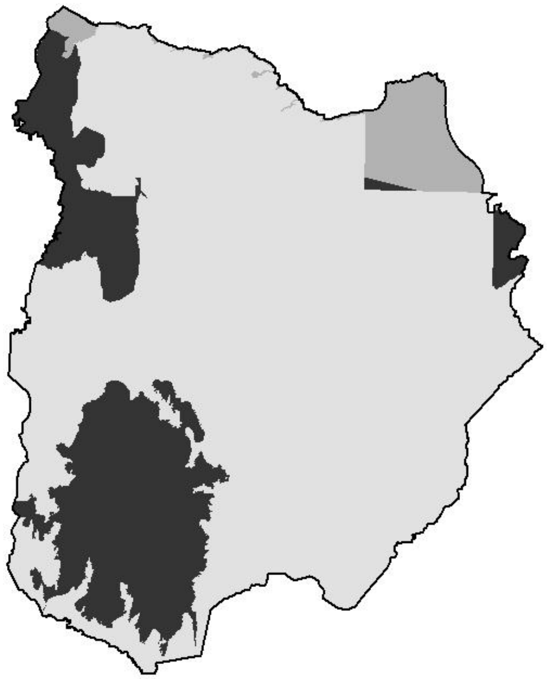
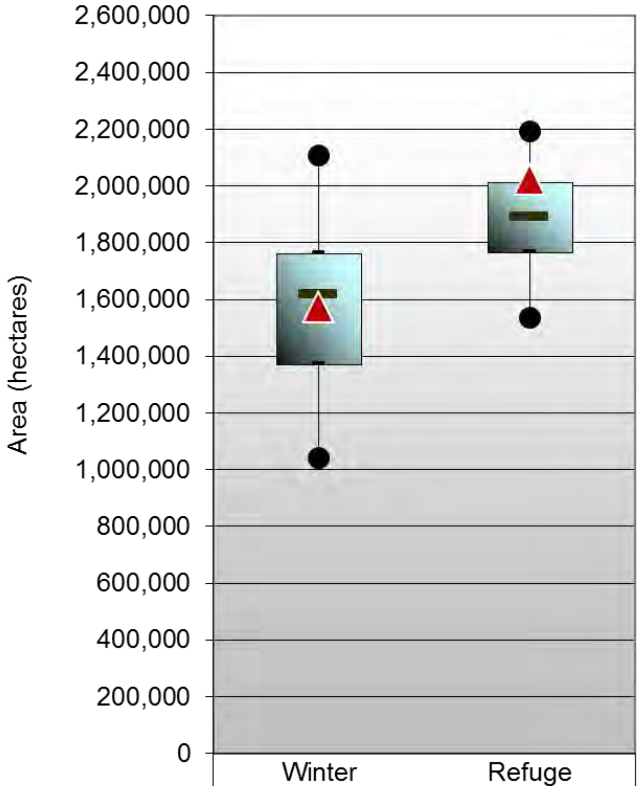


Figure 27. The Nipigon Range including the extent of the FRI data (▇), the extent of 2012 Provincial Land Cover data (▇), and the extent of PLC 2000 data (▇).

5.2.6 Habitat assessment results

5.2.6.1 Caribou habitat SRNV amount

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



	Winter	Refuge
Lower Quartile	1,371,692	1,766,113
Lower Range	1,039,966	1,536,676
Median	1,615,442	1,889,451
Upper Range	2,105,543	2,192,203
Upper Quartile	1,763,265	2,012,990
2012	1,573,623	2,022,989

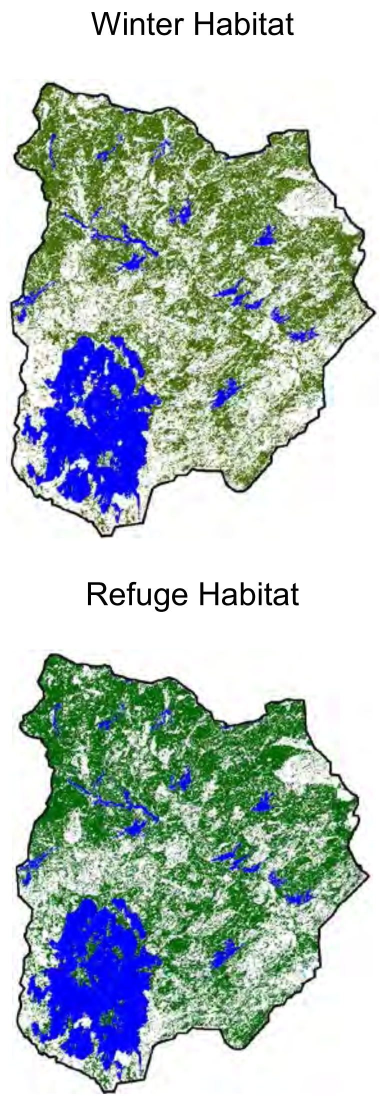
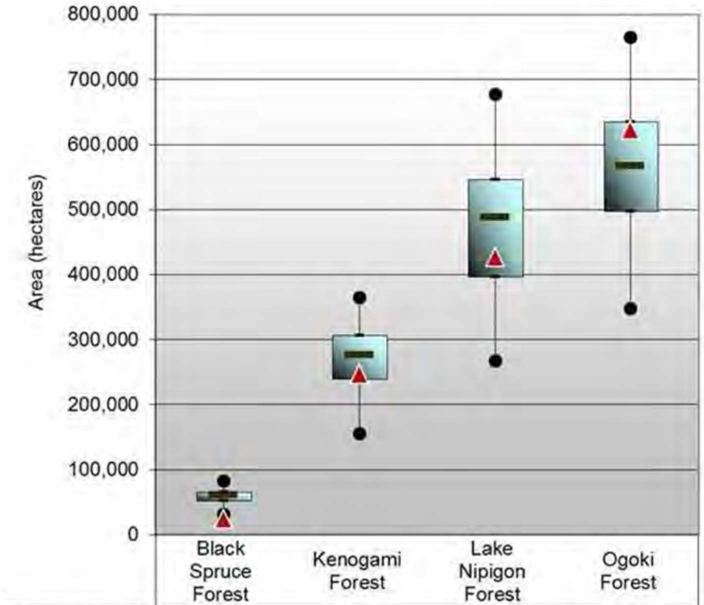


Figure 28. Box and whisker plot of caribou winter and refuge habitat amounts in the Nipigon Range as compared to the SRNV.

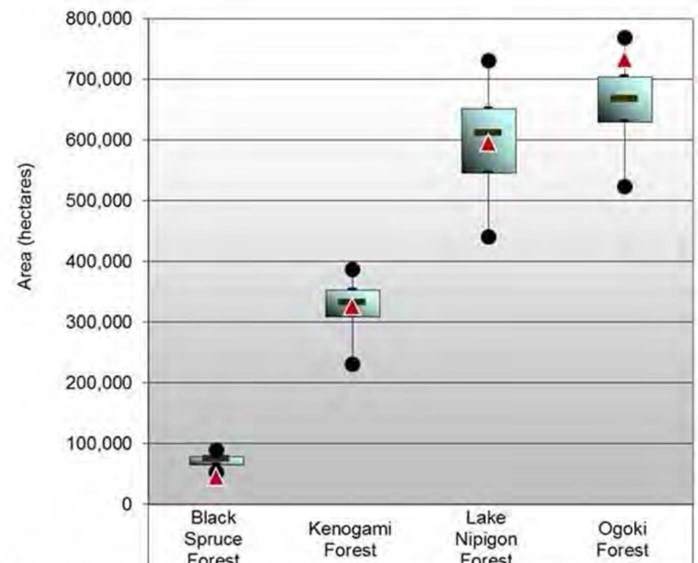
Current winter habitat amounts across the Nipigon Range were examined according to Forest Management Unit (FMU) (Figure 29). Current amounts within the Kenogami, Lake Nipigon, and Ogoki FMUs are within the interquartile range of the SRNV. Amount within the Ogoki Forest is above the median, close the upper quartile range. Winter habitat in the Black Spruce Forest is below the lower range.

Current refuge habitat amounts across the Nipigon Range were also examined according to FMU (Figure 30). Current amounts within the Kenogami and Lake Nipigon FMUs are below the median but within the interquartile range of the SRNV. Amount in the Ogoki Forest is above the upper range while amount in the Black Spruce Forest is below the lower range.



	Black Spruce Forest	Kenogami Forest	Lake Nipigon Forest	Ogoki Forest
– Lower Quartile	51,698	239,223	396,580	497,081
● Lower Range	31,299	155,395	267,893	347,734
– Median	60,601	276,238	487,844	567,139
● Upper Range	82,253	365,251	677,357	765,059
– Upper Quartile	65,459	306,200	546,101	635,194
▲ 2012	24,443	247,290	426,934	622,950

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



	Black Spruce Forest	Kenogami Forest	Lake Nipigon Forest	Ogoki Forest
– Lower Quartile	66,521	309,550	546,406	630,934
● Lower Range	53,266	230,545	440,000	522,966
– Median	75,112	331,842	610,917	667,328
● Upper Range	89,722	386,375	730,949	767,843
– Upper Quartile	78,897	353,828	652,634	704,972
▲ 2012	45,428	326,437	595,714	733,611

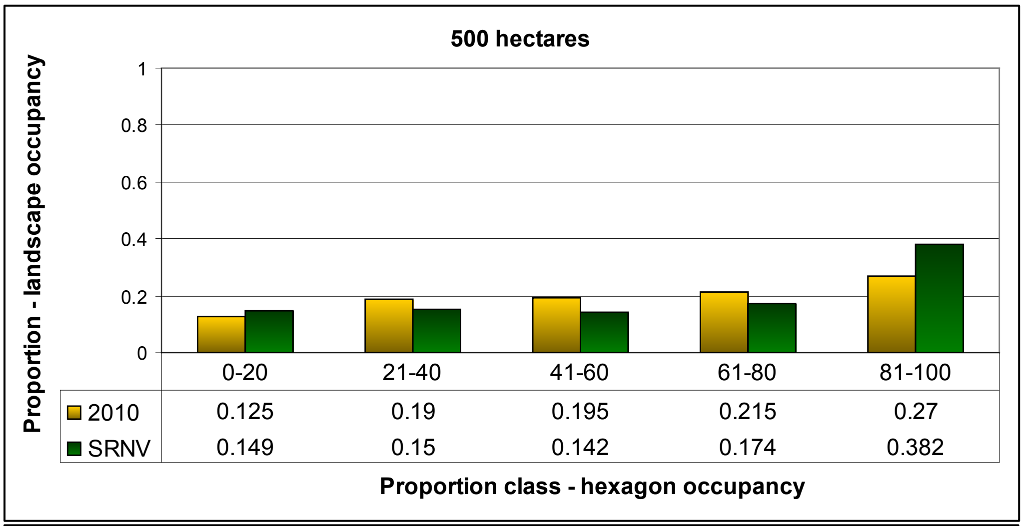
Figure 30. Box and whisker plots of refuge habitat amount for each of the Forest Management Units within the Nipigon Range as compared to the SRNV.

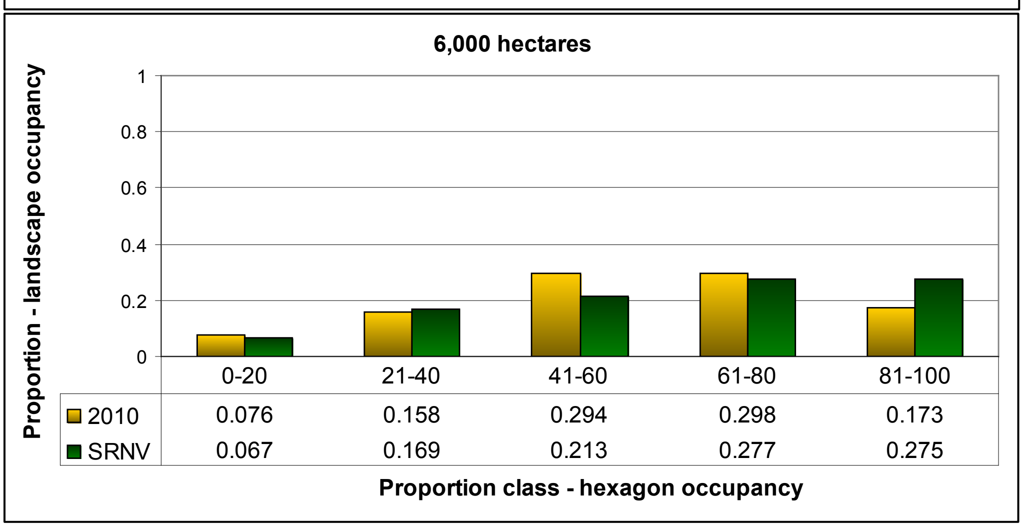
5.2.6.2 Winter habitat arrangement

At the 6,000 ha level (Figure 31), 47.1% (0.298 + 0.173 = 0.471) of the hexagons have 61% or more winter caribou habitat. The mean from the SRNV is greater with 55.2% (0.277 + 0.275 = 0.552) of the hexagons having 61% or more winter caribou habitat. Most of this difference occurs in the 81-100% density class. This represents a present arrangement value 8.1% below the SRNV.

At the 30,000 ha level, 47.5% (0.358 + 0.117 = 0.475) of the hexagons have 61% or more winter caribou habitat. The mean from the SRNV is greater with 55.3% (0.386 + 0.167 = 0.553) of the hexagons having 61% winter caribou habitat. This represents a present arrangement value 7.8% below the SRNV.

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





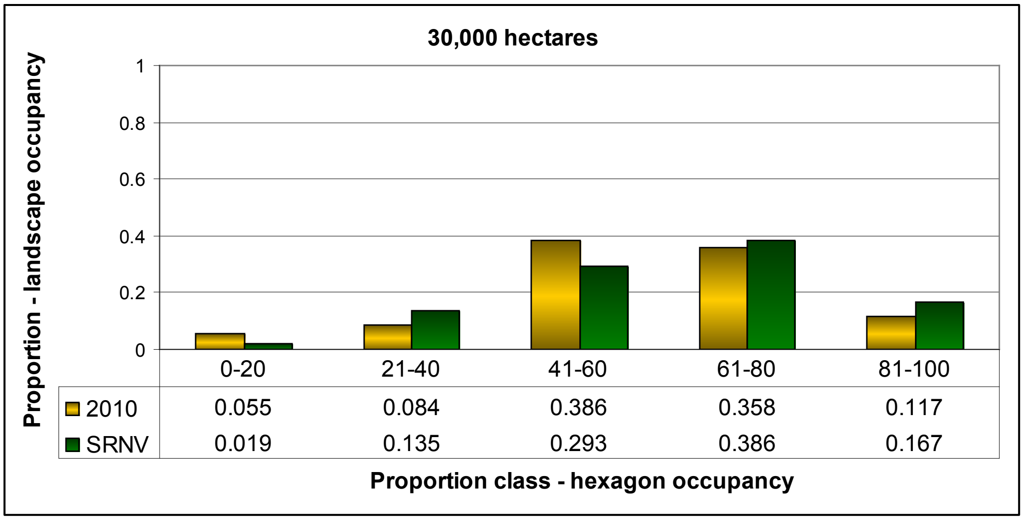


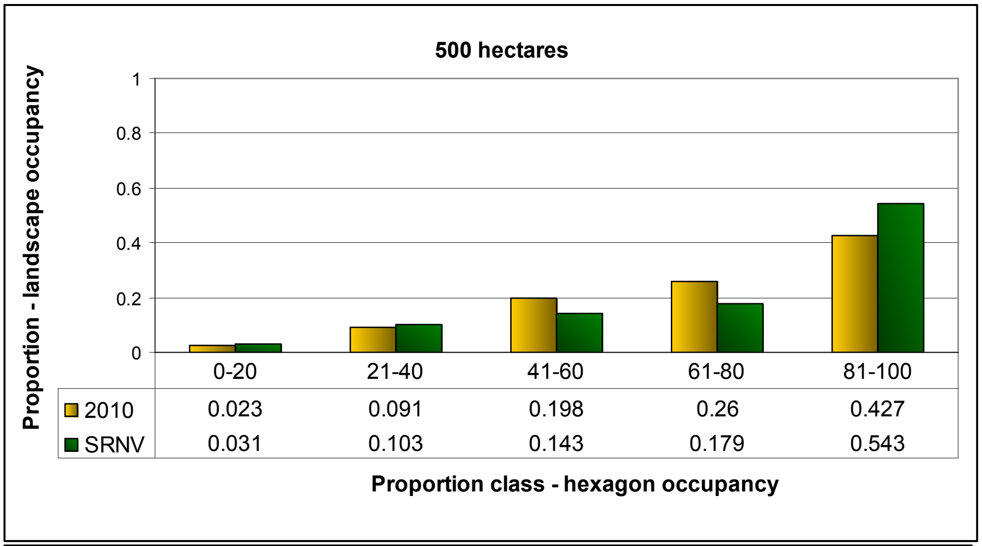
Figure 31. Caribou winter habitat texture histogram of 2010 forest conditions compared to the mean SRNV at the 500, 6,000, and 30,000 ha levels.

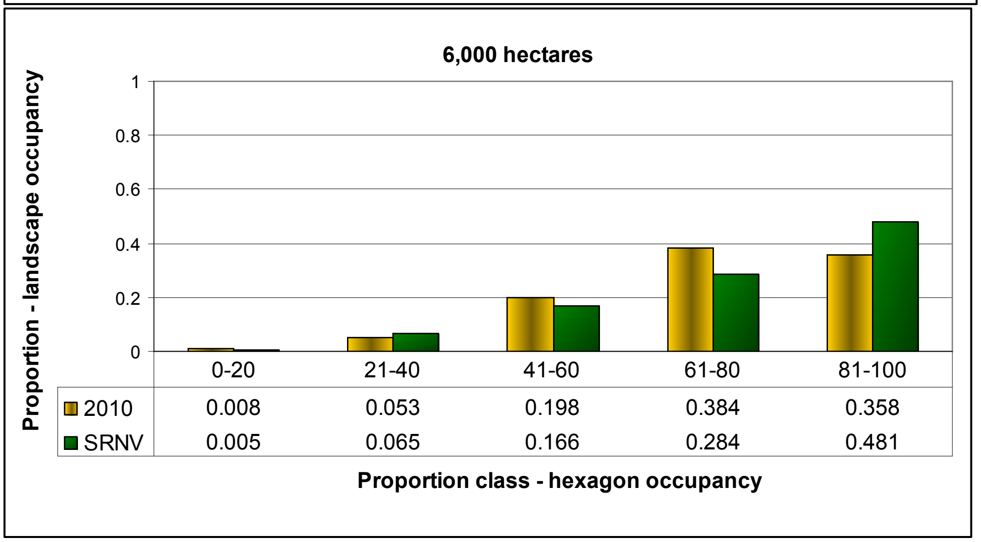
5.2.6.3 Refuge habitat arrangement

At the 6,000 ha level (Figure 32), 74.2 % (0.384 + 0.358 = 0.742) of the hexagons have 61% or more refuge habitat. The mean from the SRNV is greater with 76.5% (0.284 + 0.481 = 0.765) of the hexagons having 61% or more refuge habitat. Most of this difference occurs in the 81-100% proportion class. This represents a present arrangement value 2.3% below that represented by the SRNV.

At the 30,000 ha level, 83.0% (0.545 + 0.285 = 0.83) of the hexagons have 61% or more refuge habitat. The mean from the SRNV is less with 82.2% (0.400 + 0.422 = 0.822) of the hexagons with 61% or more refuge habitat. This represents a present arrangement value 0.8% above the SRNV.

Caribou refuge habitat measured at the 6,000 ha is fragmented relative to the estimates of the natural landscape – although, it is very close to the SRNV estimate. Refuge habitat at the 30,000 ha level is not fragmented relative to the SRNV. At both scales, the most pure refuge condition represented by the 81%-100% proportion class is fragmented compared to the SRNV.





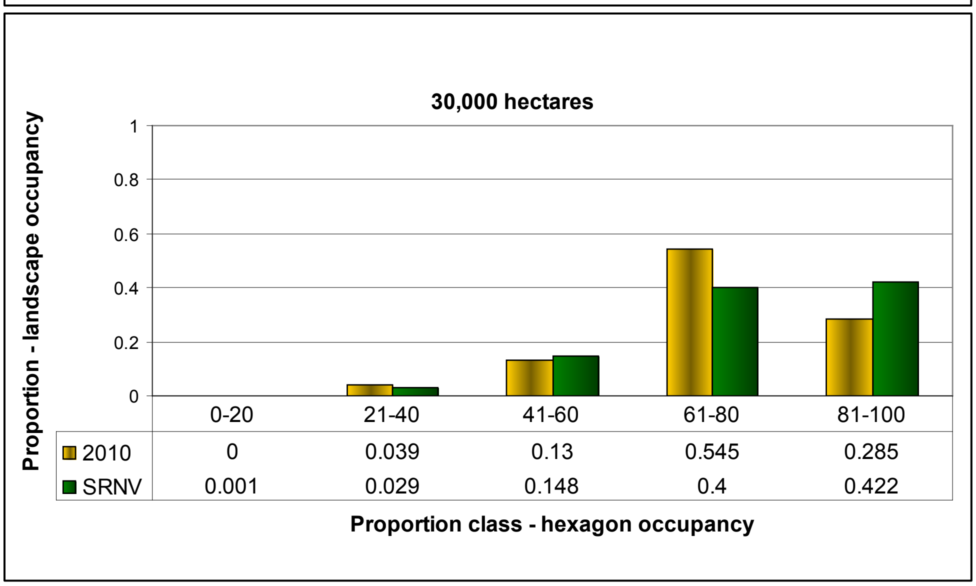
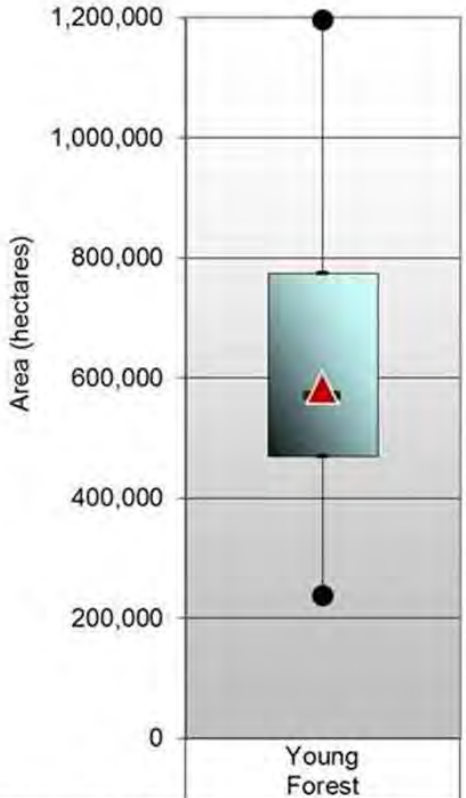


Figure 32. Caribou refuge habitat texture histogram compared to means from the SRNV at the 500, 6,000, and 30,000 hectare levels for the Nipigon Range.

5.2.6.4 Young forest SRNV area results

The current amount of young forest is close to the median estimated by the SRNV (Figure 33). This indicates that the current amount is approximately what would be expected in a natural system. Young forest includes all young forests regardless of origin and includes forest areas created by fire, forest harvest, or blowdown. Further increases in the amount of young forest will result in expected deterioration in range habitat quality for caribou.



	Young Forest
– Lower Quartile	469,340
● Lower Range	238,666
– Median	570,199
● Upper Range	1,196,193
– Upper Quartile	774,663
▲ 2012	583,774

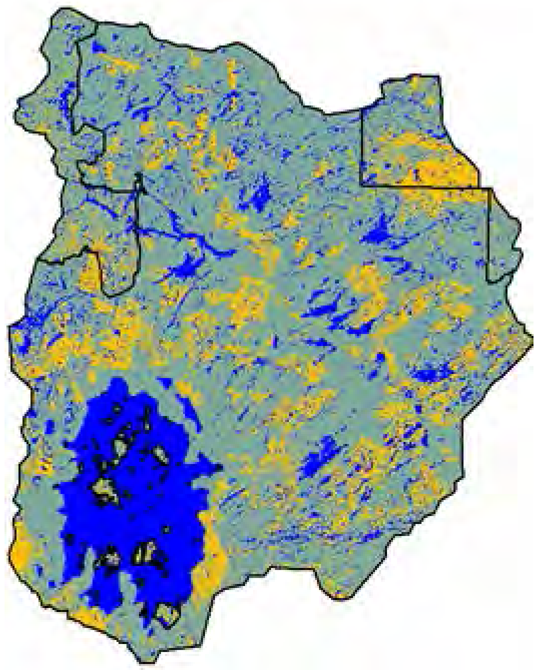


Figure 33. Box and whisker plot of young forest (i.e. <36 years) and permanent disturbance in the Nipigon Range as compared to the SRNV.

6.0 Interpretation of Lines of Evidence

6.1 Interpretation of population state

The minimum animal count of caribou (MAC) occupying the Nipigon Range was 172; seven of these were observed in the vicinity of Lake Nipigon. Given the expectation of 30-40 caribou occupying Lake Nipigon (Table 2) and the fact that surveys of this nature frequently detect only a portion of the caribou present, we concluded that this range is occupied by at least 200 caribou and possibly substantially more. Despite this conclusion, MNRF staff (R. Hartley and K. McNaughton pers. comm. 2010) believe there to be less than 100 caribou in the southern portion of the Nipigon Range.

With the exception of 2013, current recruitment estimates are above the threshold for a stable population (28.9 calves per 100 adult females, assuming an adult female survival rate of 85%; EC 2008, EC2011). One factor that may have contributed to the high recruitment rates is declining caribou densities. As the densities of caribou decline (as a result of a decreasing population), there is more geographic space to reduce encounters with predators, thus resulting in better calf survival (Bergerud et al. 2008). The consistent population growth rate (λ) and proximity to the value of 0.99 suggests that the population may be relatively stable or declining slowly. Furthermore, the relatively stable population growth rate coupled with generally high calf recruitment suggests that there is good potential for recovery in the Nipigon Range.

In general, probability of occupancy is higher in the northern portion of the range and lower in the south. There is an apparent inverse relationship between the occupancy estimates and the amount of disturbance (Figure 9 and Figure 12). The average range-wide probability of caribou occupancy without habitat covariates (0.27; ± 0.08) 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.

We believe caribou in the southern portion of the range are exhibiting signs of a long-term decline. This reduction may be inferred from documented declines in the vicinity of Onaman Lake, Armstrong Airport, and the islands of Lake Nipigon. The Nipigon District caribou estimate in 1996 was 178 caribou as compared to 278 caribou reported by Darby et al. (1989), and both estimates were only for the southern portion of the range. These estimates were based on general knowledge of MNRF personnel and a combination of flights, ground observations, and photographs (Cumming 1998). There appears to have been a long-term decline in available habitat in the southern portions of the Nipigon Range which would be consistent with the reported long-term declining population trend of caribou in that same area. There is little historical information on numbers of caribou in the northern portion of the range and it is assumed to be stable, based on the relatively low level of disturbance and the relatively recent initiation of forest harvest on the Ogoki Forest.

The degree of immigration and emigration across the Nipigon Range boundaries is unknown; although, there is evidence to suggest there is caribou movement eastward (James Bay Lowlands), northward (Albany River) and northwestward (Wabakimi Park) range boundaries. The extent to which immigration and emigration may contribute to the population state cannot be estimated at this time. Considering the high levels of landscape disturbance in the southern portion of the Nipigon Range, it is unlikely the population would be augmented by immigration from the south.

6.2 Interpretation of habitat state

More than a third of the Nipigon Range is disturbed, most as a result of human-caused activities. These disturbance activities are concentrates in the southern half of the range. Through the hexagonal disturbance analysis, it was determined that the concentration of disturbance in the south is quite high; in fact, the majority of the south is considered to be between 31-100% disturbed with a number of hexagons measuring between 81-100% disturbed.

Overall, 38.4% (all waterbodies included) of the Nipigon Range is considered disturbed. As a result, the likelihood of a stable or increasing population growth is considered uncertain with an estimated probability of 0.55. 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 Nipigon Range may be as great as 48.2% (all waterbodies excluded). At such a level it is unlikely that the range could sustain caribou. However, it is possible that landscapes containing large waterbodies with islands, such as Lake Nipigon, may help compensate for moderate levels of landscape disturbance by providing valuable caribou habitat because the surrounding body of water may provide additional refuge.

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

Current winter and refuge habitat amount in the Nipigon Range is within and above the interquartile range, respectively. However, winter and refuge habitats are fragmented at the 6,000 and 30,000 ha scales (with the exception of refuge at the 30,000 ha scale) as compared to the SRNV. 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 Nipigon Range is close to the median of the SRNV. Retaining the amount of young forest within the interquartile range would create landscapes to which caribou adapted.

The islands on Lake Nipigon and other large lakes are considered valuable caribou habitat, but the conventional assignment of winter and refuge habitat value does not apply well because the surrounding body of water may provide additional refuge. In this circumstance, the refuge value of islands is typically high, regardless of the underlying vegetation condition, although conifer forest conditions are generally more desirable than mixed forest conditions.

7.0 Integrated Risk Assessment

7.1 Population size

The minimum number of caribou on the Nipigon Range is 172 (Figure 34) based on the MAC, and likely substantially exceeds 200. The Nipigon Range is part of Continuous Distribution in Ontario, some immigration likely occurs. By using the minimum animal count of 172, 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 population trend) would be approximately 0.95-0.99 and 0.75-0.90 respectively (Figure 34) (MNRF 2014a; EC 2011). This estimate is precautionary as the population may be in long-term decline.

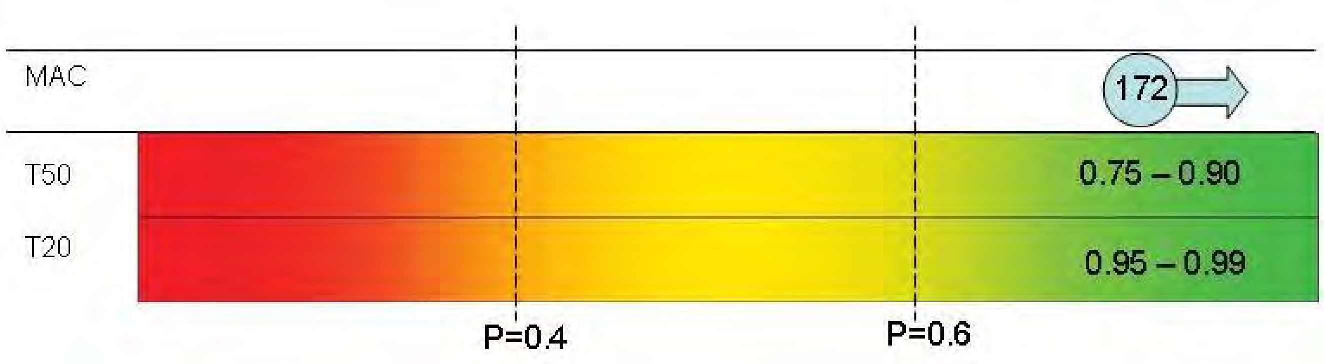


Figure 34. Minimum animal count (MAC) in the Nipigon Range estimated from the 2010 winter aerial survey as compared to probability of persistence in 20 years (T20) and 50 years (T50).

7.2 Population trend

The current estimate of trend, based on the 2009-2012 biological years, suggests the short-term population trend may be close to being stable (λ = 0.99) (Figure 35). Future recruitment and survival estimates from collared adult females will continue to inform and support the population trend information.

Estimates based on long-term trends for the southern portion of the range and local trend through time observations (e.g. Lake Nipigon islands, Onaman Lake, and the Armstrong Airport area) suggest that populations in these areas are declining (Table 2) (Figure 35).

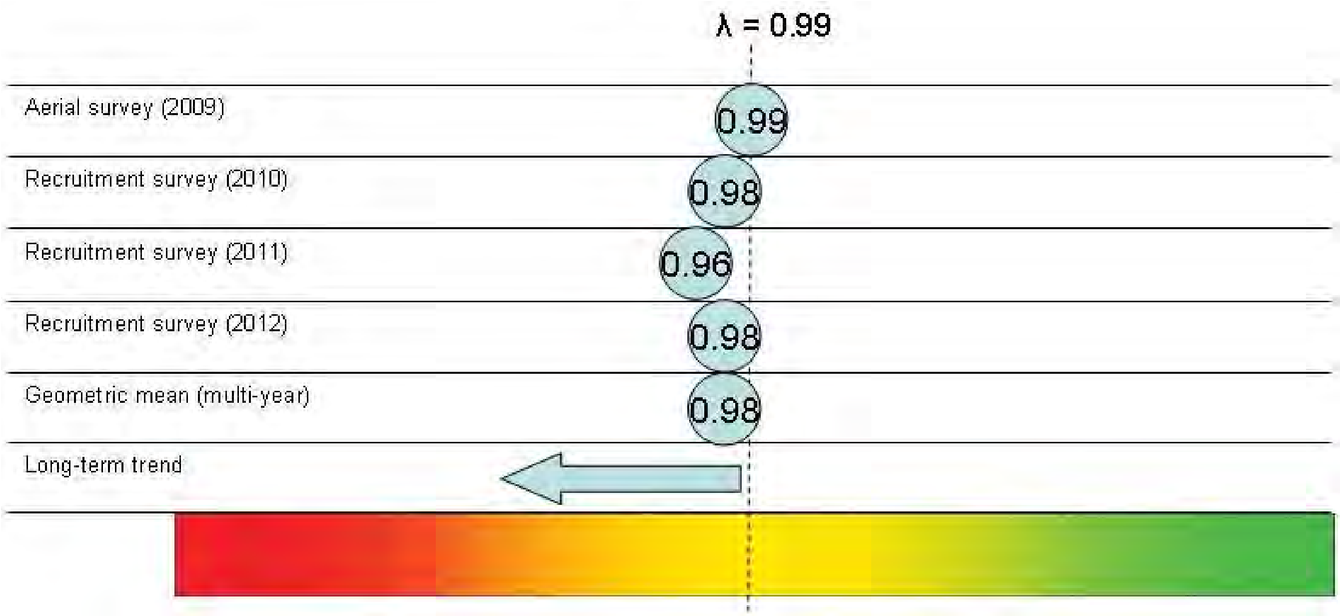


Figure 35. Estimated population trend (λ) for the Nipigon Range according to the source of the data (i.e. survey) and the corresponding biological year (not the survey year), as well as the short-term trend (geometric mean) and long-term trend as determined from other trend indicators.

7.3 Disturbance analysis

The Nipigon Range is 38.4% disturbed (Figure 36). Calculated values of disturbance range from 38.4-48.2%, depending on the treatment of water. When considering the accuracy of fine-scale data used in the disturbance analysis, we believe the calculated value of 38.4% provides a realistic depiction of the amount of disturbance in the Nipigon Range. This level of disturbance would suggest that the likelihood of stable or increasing population growth is approximately 0.55 and is considered uncertain.

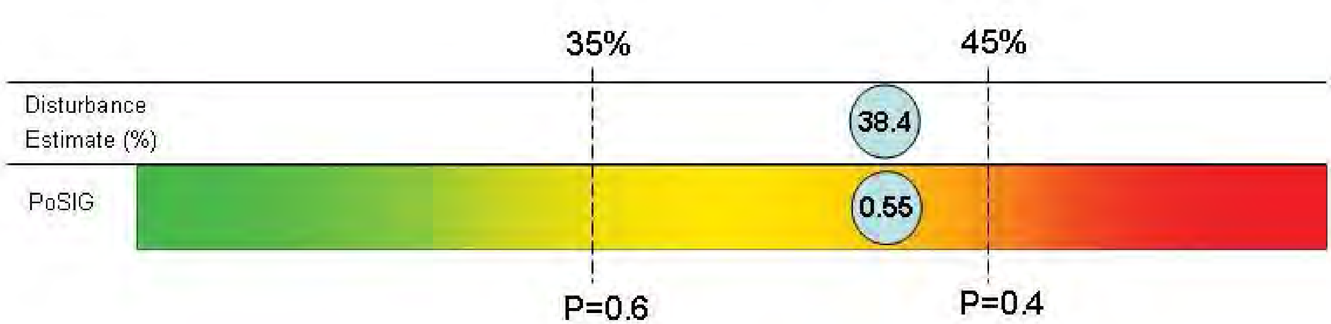


Figure 36. Disturbance estimates as a percentage of area within the Nipigon Range as it relates to the probability of stable or increasing population growth (PoSIPG).

7.4 Integrated risk assessment process

The six steps of the risk assessment process as identified in the Protocol (MNRF 2014a) lead to a conclusion of the 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; *AND* the probability of persistence based on the MAC of 172 is greater than 0.6 (for T=20).

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

7.5 Range condition

Risk is estimated to be intermediate in the Nipigon Range. Refuge habitat amount is above the interquartile range and winter habitat amount is within the interquartile range. Both winter and refuge habitat are fragmented relative to the SRNV, implying a diminished range condition compared to that suggested by the risk analysis alone. Therefore, the Assessment Team determined that it is uncertain if the range condition is sufficient to sustain caribou.

8.0 Involvement of First Nation Communities

No specific engagement of First Nation communities occurred within the Nipigon Range prior to the aerial survey activities or habitat analysis taking place.

9.0 Comparison with the Federal Generalized Approach

Environment Canada published a *Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada* (EC 2011). Based on the available information and specific methodologies used by EC (2011), it was determined that caribou occupying the Nipigon Range were likely self-sustaining. EC concluded that the Nipigon Range was 31% disturbed; the population size was more than 300 caribou, and the probability of persistence was 0.85. These results were based on best available data at the time provided to EC from the MNRF. Data presented in this IRAR will be used by EC to update their analysis in the future.

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

1. Ontario estimated a minimum animal count of 172, and suggests the population likely exceeds 200 caribou and is possibly much greater.
2. The amount of disturbance identified on the range includes additional disturbance associated with mining claims, linear features, and blowdown events which were not addressed by EC. MNRF used a finer grained depiction of fire disturbance than the broad polygonal fire disturbance used by EC. MNRF determined varied estimates of disturbance associated with stated assumptions relating to the treatment of water in the disturbance calculations.
3. Current recruitment and adult survival estimates derived from winter 2010 distribution surveys and collared caribou resulted in lambda calculations that suggest a declining trend over the short-term. Other long-term trend indicators also suggest a declining trend.
4. MNRF considered amount and arrangement of caribou habitat in the determination of range condition, which was not considered by EC.

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