Integrated Range Assessment for Woodland Caribou and their Habitat

The Far North of Ontario 2013

Ministry of Natural Resources and Forestry
Species at Risk Branch

December 2014

Version 1.1

Cite as: MNRF. 2014. Integrated Range Assessment for Woodland Caribou and their Habitat in the Far North of Ontario: 2013. Species at Risk Branch, Thunder Bay, Ontario, xviii + 124pp.

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

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Acknowledgements

The Integrated Range Assessment for the Far North of Ontario was led by Gerry Racey, Lindsay McColm, Kevin Green, and Darren Elder following established protocols. Knowledge of caribou population state and habitat was supported in large part by the *Far North Information and Knowledge Management Plan* and the Far North Caribou Project. Tricia Greer and Michael Gluck provided valuable leadership and advice in all phases. Significant contributions in data collection and analysis was received from Ken Abraham, Nancy Berglund, Glen Brown, Kevin Downing, Lee Gerrish, Chris Stratton, and Lyle Walton.

Many people contributed to the collection and analysis of field data for the Far North Caribou Project and their contributions are listed in Berglund et al (2014). We wish to acknowledge the valuable contributions to field data collection provided by survey crews composed of district and regional staff, observers from participating First Nations, and volunteers. All field work and survey activities were conducted out of remote northern First Nations communities and we thank them for their cooperation and support. We also acknowledge and thank the pilots, engineers, and fuel managers for their efforts and patience with conducting the logistically challenging surveys.

Thank you to Rosemary Hartley and Paul Sampson for providing valuable comments to improve the quality of this Integrated Range Assessment report.

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, support management decisions and lead to conservation of caribou occupying the range. It provides essential historical, ecological and contextual knowledge relevant to the range and its management. It relied on quantitative lines of evidence to identify the level of risk and range condition relative to its ability to sustain caribou.

Six ranges in the Far North of Ontario ('Far North Ranges') were delineated in 2013. These ranges include Swan, Spirit, Kinloch, Ozhiski, Missisa and James Bay. Delineation was informed by information and knowledge gained through the Far North Caribou project and documented in *Woodland Caribou (Rangifer tarandus caribou) in the Far North of Ontario: Background Information in Support of Land Use Planning* (Berglund et al. 2014).

Swan, Spirit, Kinloch and Ozhiski ranges are located within the Ontario Shield ecozone and have an aggressive fire regime, abundant lakes, and many isolated peatlands and peatland complexes. The forests are dominated by jack pine and black spruce of various ages with a common but minor component of aspen where soils and other site conditions support it. The James Bay Range is within the James Bay Lowlands, which is an area dominated by complex hydrology and peat-dominated ecosystems with spruce-dominated conifer forest. The Albany and Attawapiskat river systems are the controlling hydrological features with conifer forests most closely associated with more well-drained portions of these rivers and their tributaries. Just west of the James Bay Range, the Missisa Range largely represents the broad ecozonal transition between the James Bay Lowlands and the Ontario Shield. The Missisa Range contains higher amounts of peatland systems in the east and a more aggressive fire regime in the west.

Caribou occur throughout the ranges as part of the Continuous Distribution in Ontario. However, the ranges exhibit various levels of caribou occupancy and movement patterns. Furthermore, forest-dwelling and forest-tundra caribou ecotypes overlap during winter in the northern portions of the Swan, Missisa and James Bay Ranges.

Caribou are an important traditional food source for many First Nation communities. Many remote First Nation communities that have traditional areas associated with these six ranges are engaged in various stages of the community-based land use planning process.

Caribou occupancy, distribution, movement, genetic similarity, and habitat information used in the Integrated Range Assessment was derived in large part from Berglund et al. 2014. Furthermore, two project components were instrumental in informing the range assessments; the two-stage aerial survey and caribou collaring activities.

Two-stage winter distribution surveys were completed across all six ranges in February and March of 2009-2011. During the fixed-wing survey, all observations of caribou and signs of their presence were recorded. During subsequent rotary-wing flights, caribou were identified as adults, males or females, calves, or unknown age and sex. Data collected during the survey work was used to estimate population state.

GPS collars were deployed in the ranges during February and March of 2009 and 2010. Collars were placed prior to range delineation and assignment of collared caribou to specific ranges occurred later. There was therefore unequal representation of collared caribou among ranges; Swan (6); Spirit (21); Missisa (34); James Bay (25); Kinloch (20) and Ozhiski (0). An additional 30 caribou were collared in the vicinity of the Kinloch Range in 2010 and 2011 as part of a related research project.

Integrated Range Assessments for each of the ranges were completed following the *Integrated Assessment Protocol of Woodland Caribou Ranges in Ontario*.

Swan Range

The minimum animal count is 491. It is based on winter distribution survey results from 2009 and 2011. Recruitment estimates ranged from 11.40-20.99 and are below expected values thought to support a stable to increasing population trend (28 calves per 100 adult females). Annual survival and trend were not estimated for the Swan Range as not enough collared caribou were present within the range during the Integrated Range Assessment.

A geospatial analysis of the natural and anthropogenic disturbances within the range revealed an estimate of 23.5% disturbance and was primarily natural. The resulting likelihood of stable or increasing population growth is estimated to be 0.78 and at this level it is likely the Swan Range is capable of sustaining the caribou population.

The Integrated Range Assessment concludes risk to caribou is low in the Swan Range. At present, the range is sufficient to sustain caribou.

Spirit Range

The minimum animal count is 373. It is based on winter distribution survey results from 2009 and 2010. Recruitment estimates ranged from 12.51-41.05 and, with the exception of 2009, are below expected values thought to support a stable to increasing population trend. Mean annual survival estimate was good (88%) based on three biological years of data, but when modelled with the calf recruitment levels resulted in a declining population trend with a geometric mean of $\lambda = 0.95$. This estimate suggests a short-term declining trend and is the result of both one year of low survival, and three years of low recruitment.

A geospatial analysis of the natural and anthropogenic disturbances within the range revealed an estimate of 28.6% disturbance and was primarily natural. The resulting likelihood of stable or increasing population growth is estimated to be 0.7 and at this level it is likely the Spirit Range is capable of sustaining the caribou population.

The Integrated Range Assessment concludes that risk to caribou is intermediate in the Spirit Range. At present, it is uncertain whether the range is sufficient to sustain caribou.

Kinloch Range

The minimum animal count is 113. It is based on winter distribution survey results from 2010. Recruitment estimates ranged from 7.59-20.62 and are below expected values thought to support a stable to increasing population trend. Mean annual survival estimate was good (89%) based on three biological years of data, but when modelled with the calf recruitment levels, resulted in a declining population trend with a geometric mean of $\lambda = 0.95$. This estimate suggests a declining trend and is the result of generally low recruitment.

A geospatial analysis of the natural and anthropogenic disturbances within the range revealed an estimate of 19.6% disturbance and was primarily natural. The resulting likelihood of stable or increasing population growth is estimated to be 0.8 and at this level it is likely the Kinloch Range is capable of sustaining the caribou population.

The Integrated Range Assessment concludes that risk to caribou is intermediate in the Kinloch Range. At present, it is uncertain whether the range is sufficient to sustain caribou.

Ozhiski Range

The minimum animal count is 148. It is based on winter distribution survey results from 2010 and 2011. Recruitment estimates ranged from 7.0-60.0 were generally below expected values thought to support a stable to increasing population trend, but the 2010 winter distribution survey estimate (28.7) could be representative and is comparable to expected values thought to support a stable population trend. Annual survival and trend were not estimated for the Ozhiski Range as not enough collared caribou were present within the range during the Integrated Range Assessment.

A geospatial analysis of the natural and anthropogenic disturbances within the range revealed an estimate of 27.6% disturbance and was primarily natural. The resulting likelihood of stable or increasing population growth is estimated to be 0.7 and at this level it is likely the Ozhiski Range is capable of sustaining the caribou population.

The Integrated Range Assessment concludes that risk to caribou is low in the Ozhiski Range. At present, the range is sufficient to sustain caribou.

Missisa Range

The minimum animal count is 745. It is based on winter distribution survey results from 2009 and 2013. Recruitment estimates ranged from 0.0-22.21 and are below expected values thought to support a stable to increasing population trend. Mean annual survival estimate was low (80%) based on three biological years of data, and when modelled with the calf recruitment levels resulted in a declining population trend with a geometric mean of $\lambda = 0.86$. This estimate suggests a declining trend and is the result of generally low recruitment and one year of low survival.

A geospatial analysis of the natural and anthropogenic disturbances within the range revealed an estimate of 14.4% disturbance. The resulting likelihood of stable or increasing population growth is estimated to be 0.86 and at this level it is likely the Missisa Range is capable of sustaining the caribou population.

The Integrated Range Assessment concludes that risk to caribou is intermediate in the Missisa Range. At present, it is uncertain whether the range is sufficient to sustain caribou.

James Bay Range

The minimum animal count is 177. It is based on winter distribution survey results from 2010 and 2011. Recruitment estimates ranged from 9.45-45.91 and with the exception of 2012 (45.91), were below expected values thought to support a stable to increasing population trend. Mean annual survival estimate was slightly low (84%) based on three biological years of data, and when modelled with the calf recruitment levels resulted in a declining population trend with a geometric mean of $\lambda = 0.91$. This estimate suggests a declining trend and is the result of generally low recruitment and survival.

A geospatial analysis of the natural and anthropogenic disturbances within the range revealed an estimate of 6.6% disturbance and was primarily natural. The resulting likelihood of stable or increasing population growth is estimated to be 0.9 and at this level it is likely the James Bay Range is capable of sustaining the caribou population.

The Integrated Range Assessment concludes that risk to caribou is intermediate in the James Bay Range. At present, it is uncertain whether the range is sufficient to sustain caribou.

1.0 Overview

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

This *Integrated Range Assessment Report* documents the methods, results, and range condition for each of the six ranges in the Far North of Ontario ('Far North Ranges') (Figure 1). It differs from other Integrated Range Assessment Reports in that some information is summarized across all six Far North Ranges due to common and shared values, shared background information or similar comparisons. Most of the data to inform this report came from *Woodland Caribou (Rangifer tarandus caribou) in the Far North of Ontario: Background Information in Support of Land Use Plannin*g (Berglund et al. 2014) as there is common and overlapping information that informs the determination of range condition for multiple ranges. Documentation about range history as well as natural and anthropogenic disturbances is less available in the Far North of Ontario than for range assessments completed in the southern part of Continuous Distribution**.**

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

Figure 1. Location of six ranges in the Far North of Ontario within the Continuous Distribution. The southern boundary of the Northern Taiga Ecoregion (Crins et al. 2009) loosely defines the transition between forest-tundra (north of boundary) and forest-dwelling (south of boundary) caribou ecotypes.

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 delineation of ranges in the northern portion of the Continuous Distribution of woodland caribou (forest-dwelling boreal population) in Ontario was completed in 2013. The addition of these six ranges to the eight ranges along the southern boundary of Continuous Distribution (including the Lake Superior Coast Range) concluded the delineation of ranges in the province. Further detail and rationale for delineation of each range is described in the Delineation of Woodland Caribou Ranges in Ontario – Technical Report (MNRF 2014c).

Range delineation in the Far North of Ontario considered current and historical caribou location data as well as the diversity of biophysical features characterizing northern Ontario landscapes such as lake size and density, fire history, and prevalence of wetlands. The location data that was used included caribou winter distribution data and spatial extent (as informed by caribou movement data including home range sizes and general orientation of seasonal movements) whereas landscape characterizations were based on the ecological regions as described by Crins et al. (2009) (Figure 2). The three major ecological regions in the Far North of Ontario define the primary biogeographical context for caribou in this area. The Big Trout Lake (2W) and Lake St. Joseph (3S) ecoregions are the colder, dryer northern portions of the Ontario Shield Ecozone. Black spruce is the predominant forest cover on both upland and lowland sites. These ecoregions are susceptible to fire, however the fires are generally smaller than those in more southerly areas of northwestern Ontario (Crins et al. 2009). Caribou have smaller home ranges here than in other parts of the province, likely due to the more aggressive fire regime (more disturbance on the landscape) and closer proximity with moose and wolves. The primary occupations and land uses within this ecological context include trapping, hunting, fishing, and services associated with resource-based tourism; mineral exploration is widespread and growing (Crins et al. 2009). The ranges within this broader ecological context include Swan, Spirit and Ozhiski within the Big Trout Lake Ecoregion, and the Kinloch Range within the Lake St. Joseph Ecoregion.

The James Bay Ecoregion (2E) is a relatively flat landscape with very poor drainage and is dominated by extensive peatland ecosystems representing a very different biophysical landscape within which caribou must meet their life requirements, including coping with predation pressures. Its vegetation is predominantly comprised of relatively stunted stands of black spruce and tamarack interspersed with open fens and bogs with larger trees located primarily along the major river systems and their tributaries. The predominance of wet organic substrates and a cool humid climate result in very few major fires, although small fires occur from time to time. Animal movement patterns in the northern portion of the James Bay Lowlands appear to have larger home ranges, larger aggregate groups in winter, and different seasonal movement patterns than those in the Ontario Shield. Many animals show a close affinity to the Shield-Lowland interface and use large areas of wetland complexes seasonally.

The James Bay Range is situated entirely within the James Bay Ecoregion whereas the Missisa Range is situated on the transition between the James Bay and Big Trout Lake ecoregions.

2.1 Swan Range

The Swan Range is approximately 25,000 km^2 and is located along Ontario's western border with Manitoba. The range encompasses the western portion of the Big Trout Lake Ecoregion (2W) and it is comprised of ecodistricts 2W-1, 2W-3 and a small portion of 2W-2. The western edge of the Swan Range is defined by the provincial boundary whereas the southern boundary is shared with the Spirit Range. This boundary connects from the Manitoba border at Pierce Lake southeast to Ponask and Sachigo lakes. It runs east from the southern shore of Sachigo Lake to approximately 15 km south of Big Trout Lake where it turns north and connects with the boundaries of the Ozhiski and Missisa Ranges. This eastern boundary, shared by the Missisa Range, follows the Fawn River north until the Northern Taiga Ecoregion. The northern boundary is defined by the Northern Taiga Ecoregion, which approximates the shift from predominantly forest-dwelling to forest-tundra ecotypes, particularly during the summer when forest-tundra caribou reside closer to Hudson Bay (Berglund et al. 2014). Periodically, large numbers of forest-tundra animals move into this range during winter. Four remote First Nation communities are within the southern part of the range and are connected to the south by a network of winter roads. These include Sachigo Lake, Bearskin Lake, Kitchenuhmaykoosib Inninuwug, and Wapekeka. The Swan Range captures the northwestern end of Shield-Lowland interface.

2.2 Spirit Range

The Spirit Range is approximately 47,000 km^2 and is located along Ontario's western border with Manitoba. The range encompasses the western portion of the Big Trout Lake Ecoregion (2W), and it is comprised of ecodistricts 2W-1, 2W-3 and a small portion of 3S-1. This range has an aggressive fire regime, high frequency of natural disturbance events (e.g. blowdown), and high moose and wolf densities as compared to ranges further east. The northern boundary is shared with the Swan Range. The eastern boundary is shared with the Ozhiski Range and follows the Pipestone River north to Misamikwash Lake, along the Asheweig River, connecting with Nemeigusabins Lake at the northeast corner of the range. The southern boundary is shared with the Berens and Kinloch Ranges, and is loosely based on the ecodistrict boundary of 3S-1 / 3S-3 and 2W-3. This southern boundary also bisects Deer Lake and joins up at the Manitoba border at the northern edge of the Atikaki-Berens Range in Manitoba.

Six First Nation communities are located in the Spirit Range including North Spirit Lake, North Caribou Lake, Muskrat Dam, Sandy Lake, Keewaywin, and Deer Lake. These communities are connected to the south by a network of winter roads as well as an all-weather road to Windigo Lake and Musslewhite Mine.

Seasonal animal movement appears to be associated with the peatland complex southeast of Sandy Lake and mature conifer northeast of Deer Lake; however this may be an artifact of GPS collar placement and clustering.

2.3 Kinloch Range

The Kinloch Range is approximately 26,700 km^2 and is associated with the northern portion of the Lake St. Joseph Ecoregion (3S). It is comprised of ecodistricts 3S-2, 2S-3, and 3S-4. The range is characterized by morainal features and a similar disturbance regime as Spirit Range. It is surrounded by six ranges including the Swan and Ozhiski Ranges to the north, Nipigon Range to the east, Berens Range to the west and Churchill and Brightsand Ranges to the south. The northern boundary follows the boundary of ecoregion 3S. The eastern boundary coincides with the ecodistrict 3S-4. The southern boundary loosely follows the Lake St. Joseph waterway northwest to Zionz Lake, along the boundary of the Whitefeather Forest to the MacDowell Lake area.

Three First Nation communities are located within the range including Mishkeegogamang, Cat Lake, and MacDowell, and the Town of Pickle Lake. There is a winter road that runs from Pickle Lake to the First Nation communities of Cat Lake and Slate Falls.

GPS collar data and winter survey observations show more discrete distribution of caribou within the range.

2.4 Ozhiski Range

The Ozhiski Range is approximately 38,700 km^2 and consists of the eastern portion of the ecoregion 2W, specifically 2W-3. It is bordered to the north and east by the Missisa Range, to the south by the Nipigon and Kinloch Ranges, and to the west by the Spirit Range and a small portion of the Swan Range. The southern boundary follows the 2W-3 ecodistrict and the Albany River. The north and eastern boundary loosely follows the ecodistrict 2W-2. The western boundary follows the Pipestone River up to Misamikwash Lake, northwest to Nemeigusabins Lake, to the eastern shore of Big Trout Lake.

Four First Nation communities are located within the range including Kingfisher Lake, Wunnumin Lake, Nibinamik, Neskantaga, and Eabametoong. These communities are connected to the south by a network of winter roads.

Our current knowledge of caribou distribution and movement data is limited.

2.5 Missisa Range

The Missisa Range is the largest range at almost 70,000 km^2. It covers much of the Shield-Lowland interface and the western portion of the James Bay Ecoregion. More specifically, it is comprised of ecodistricts 2W-2, 2E-1, and 2E-4. It is bordered by the Swan Range to the northwest, the Ozhiski Range to the west, the James Bay Range to the east and Nipigon and Pagwachuan Ranges to the south. The northern boundary is defined by the Northern Taiga ecoregion whereas the 2W-3 ecodistrict loosely defines the western boundary. The southern boundary is defined by the Albany, Kenogami and Little Current rivers. The eastern boundary does not reflect any major ecological pattern. Caribou in this area are generally widespread and make larger movements as compared to animals in the Ontario Shield. This border was delineated for logistical purposes (i.e. a combined Missisa-James Bay Range would be too large to survey, etc.) and attempted to bisect the east caribou movements from the west caribou movement, within the James Bay Lowlands.

Four First Nation communities are located within the range including Marten Falls, Ogoki, Webequie, and Kasabonika. These communities are connected to the south by a network of winter roads.

Larger numbers of caribou appear to be seasonally associated with Shield-Lowland interface and are distributed broadly in this portion of the range. Therefore, this is identified as one of the key features for caribou in the Far North of Ontario.

This range contains the majority of proposed resource development activities associated with the Ring of Fire mineral exploration and mining.

2.6 James Bay Range

The James Bay Range is approximately 60,300 km^2 and includes the eastern portion of the James Bay Ecoregion (2E). It is comprised of ecodistricts 2E-1, 2E-2 and a small portion of 2E-4. It is bordered by the Missisa Range to the west and the Pagwachuan and Kesagami Ranges to the south. The northern boundary is defined by the Northern Taiga Ecoregion (1E). The eastern boundary coincides with the James Bay coast. The Moose and Mattagami rivers form the boundary between the James Bay and Kesagami Ranges in the southeast, whereas the Minnisaibi and Rabbit river network to the Albany River forms the southwest boundary that is shared by the Pagwachuan Range. The boundary in this area is largely based on approximations of treed density gradients on the lowlands.

There is one winter road within the range that travels north from Highway 634 to Moosonee then along the coast of James Bay to Fort Albany, Kashechewan and Attawapiskat, and inland to the Victor Diamond Mine.

Caribou appear to have larger home ranges in the James Bay Range than caribou in other Far North Ranges, and utilize large areas of wetland complexes seasonally within the range.

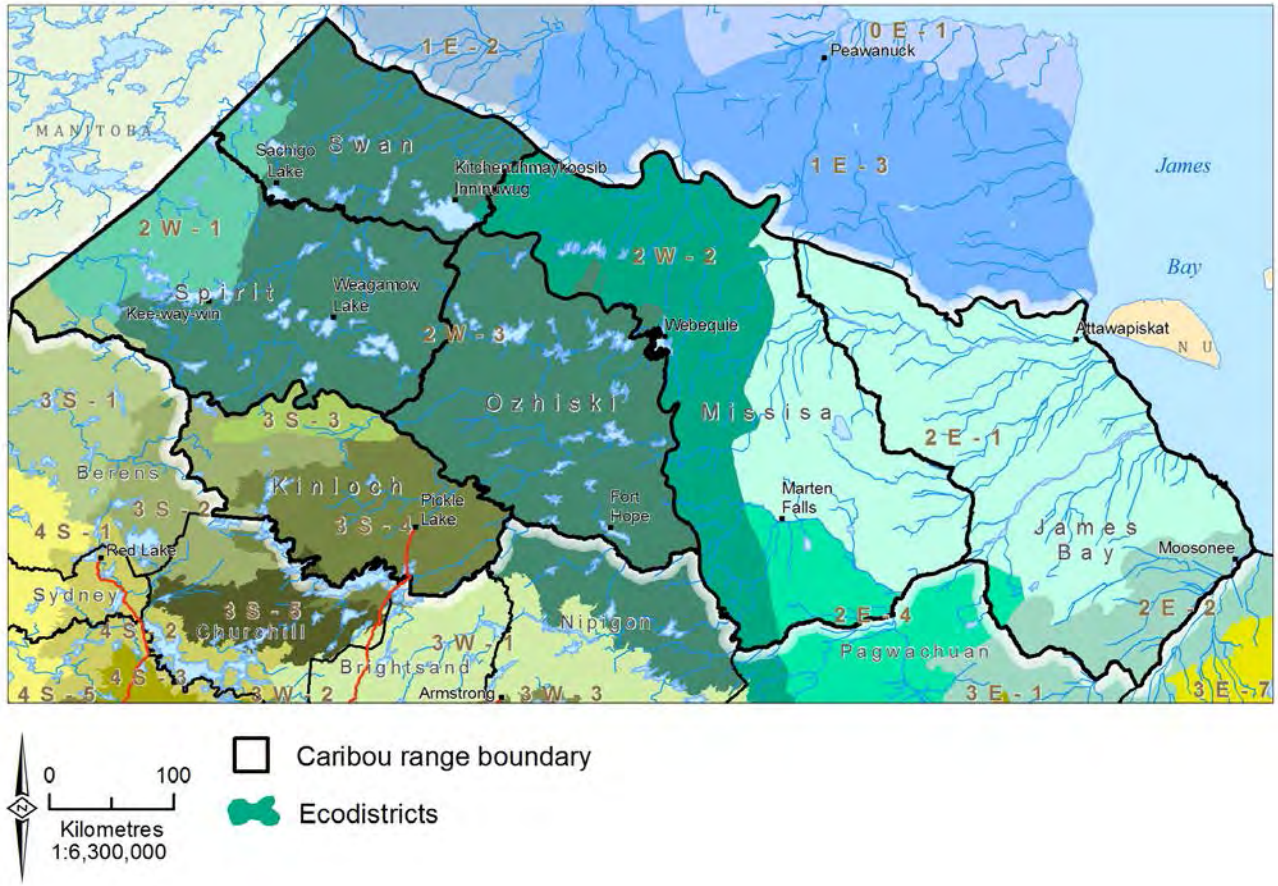

Figure 2. Relationship between the six ranges in the Far North of Ontario (Swan, Spirit, Kinloch, Ozhiski, Missisa, and James Bay) and the ecodistricts of Ontario.

3.0 Background Information and Data

3.1 Land management history and management direction

Caribou numbers and distribution within the six ranges in the Far North of Ontario have been influenced predominantly by natural factors such as large fires (Figure 3), blowdown, forest composition and structure, distribution and type of peatland ecosystems, as well as topographical and geological features. Anthropogenic features such as mineral exploration and mining activities, roads, town sites, transmission corridors, hydroelectric facilities, and forest harvest have affected a relatively small proportion of the landscape, (Figure 4 to Figure 9) although mineral exploration is highly clustered in a few strategic areas. Infrastructure such as permanent and winter roads, communities, and transmission corridors also occupy a relatively small portion of the landscape, but have influenced the distribution and intensity of human activity in a manner that differs from the traditional water-centric land uses. Development interests associated with renewable energy, mining, and access to communities and natural resources have resulted in ongoing and proposed developments across the north. Caribou in the Far North of Ontario will be coping with a different landscape than in the past. Implementation of Ontario's CCP (2009a) is set against a backdrop of these evolving developments.

Some of the existing developments and decisions in the Far North of Ontario have likely influenced the distribution and abundance of caribou while others have the potential to do so in the future.

The winter road network provides seasonal access to communities. This network may vary with snow and temperature conditions and is always evolving. Over the decades, routes have been modified or improved, resulting in many linear features over the same general area providing alternate access. In general, this road network may influence the amount and distribution of subsistence harvest during the winter when the road is in active use. Year round, it represents a set of linear features which may influence predator movement and hunting efficiency.

Highway 808 is an all-weather road to Windigo Lake and Musselwhite Mine. The road is a hub for the movement of supplies along the winter road network and is used year-round for recreational interests including hunting and fishing. The level of activity on this road system appears, based on collared caribou movement data, to partially sever the connectivity of caribou between the Kinloch and Ozhiski Ranges.

A community-based land use plan was completed for the Cat Lake-Slate Falls Planning Area in 2011 representing the majority of the Kinloch Range. This plan, which was developed jointly by Ontario and First Nations, recognized the conservation of species at risk, including caribou. It is too early to determine whether the land use intent associated with the plan has had an impact on caribou or their habitat. However, the plan increased the awareness of community members of caribou and the need for conservation efforts. Other communities are involved in various stages of community-based land use planning under the *Far North Act, 2012.* The Act includes objectives for the protection of areas of cultural value and protection of ecological systems, by including at least 225,000 square kilometres of the Far North of Ontario in an interconnected network of protected areas; and the maintenance of biological diversity, ecological processes and ecological functions, including the storage and sequestration of carbon. Far North Community based land use planning is a consensus-based process (including dialogue with neighbouring communities) that considers social, environmental and economic concerns in making decisions about land use.

A Far North Land Use Strategy is currently being developed and will assist in the preparation of individual community based land use plans, and guide the integration of matters beyond individual planning areas, such as caribou migration. It is too early to determine whether or how the pending strategy will influence the well-being of caribou or their habitat.

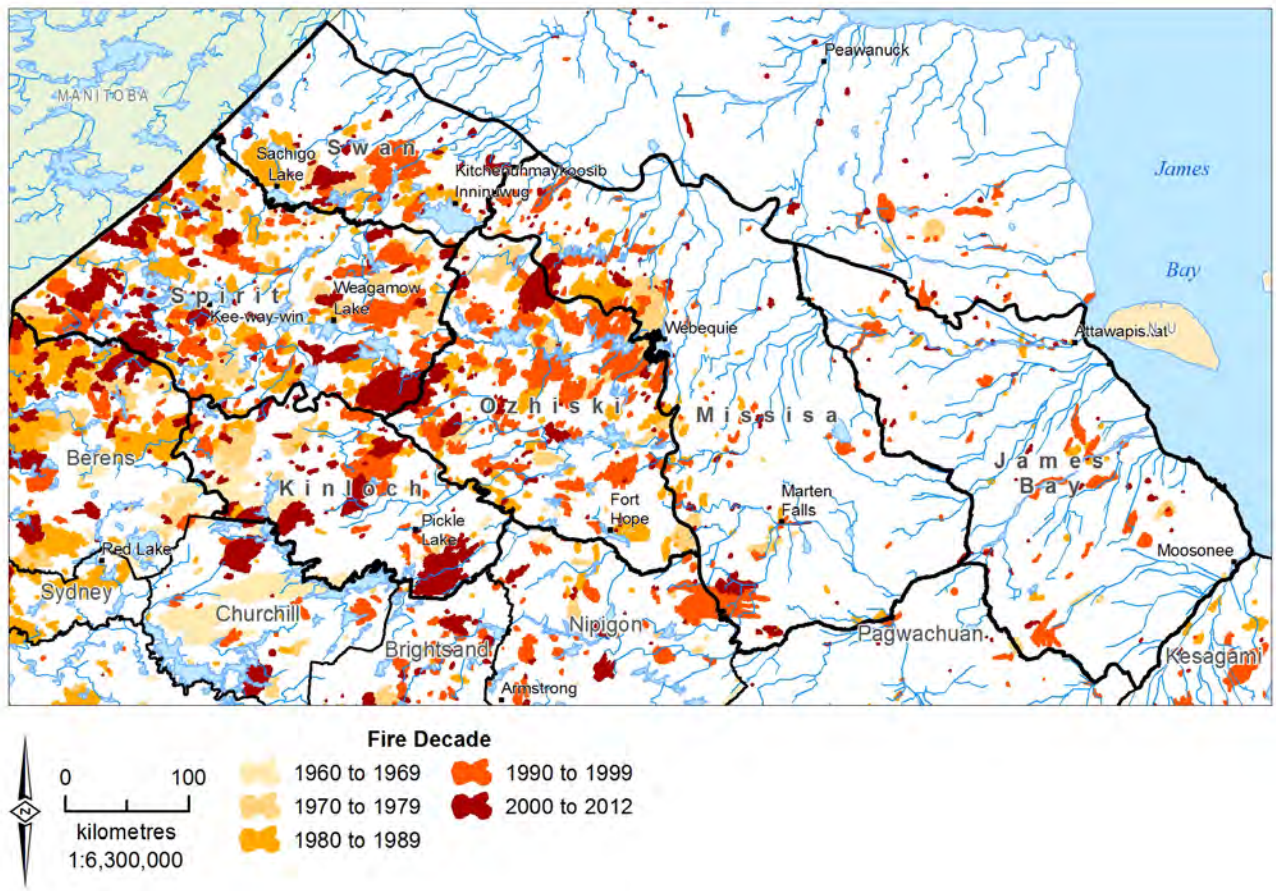

Figure 3. Dates and locations of significant natural disturbances that have occurred within the Far North Ranges since 1960.

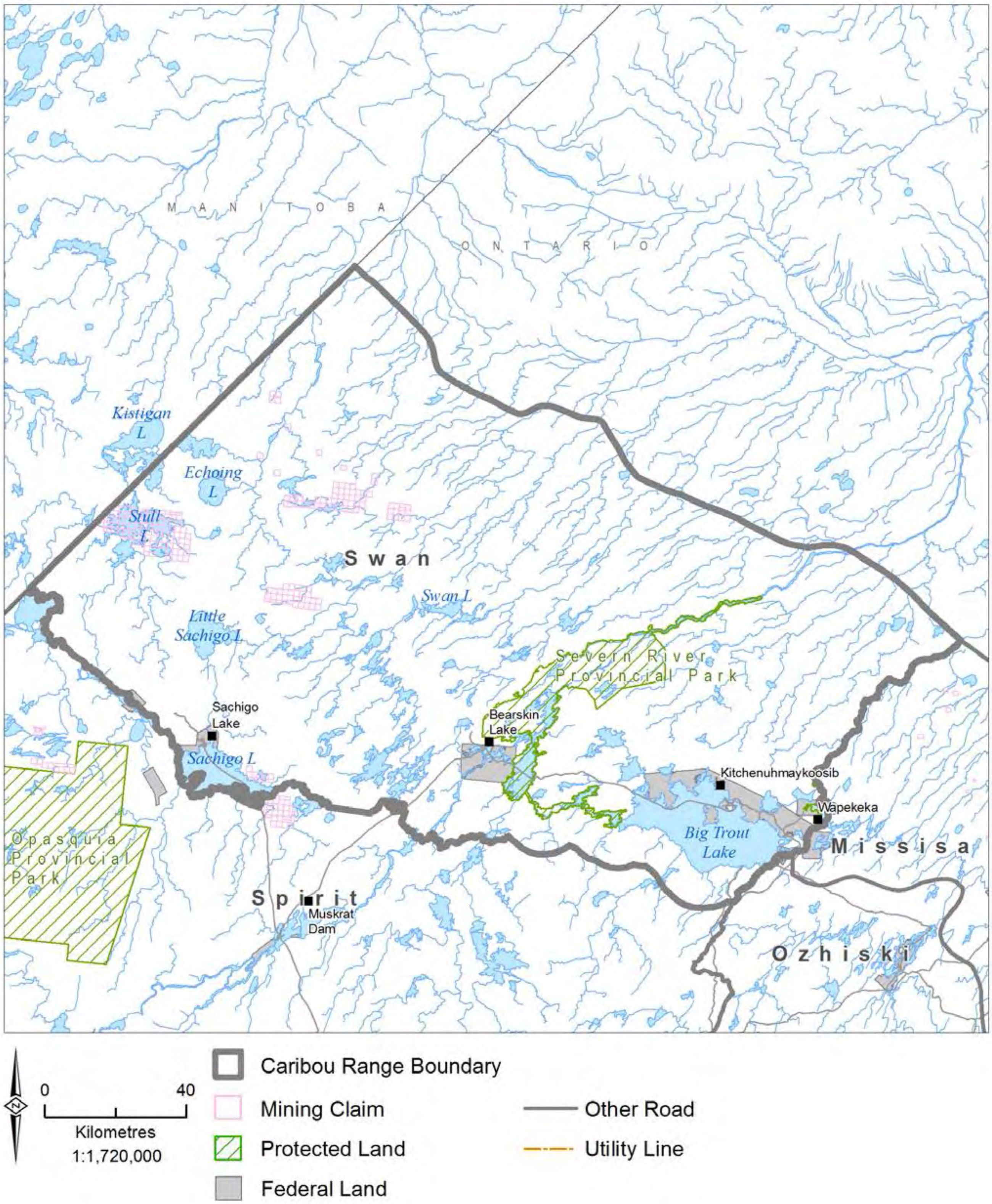

Figure 4. Human infrastructure and historical developments occurring within the Swan Range.

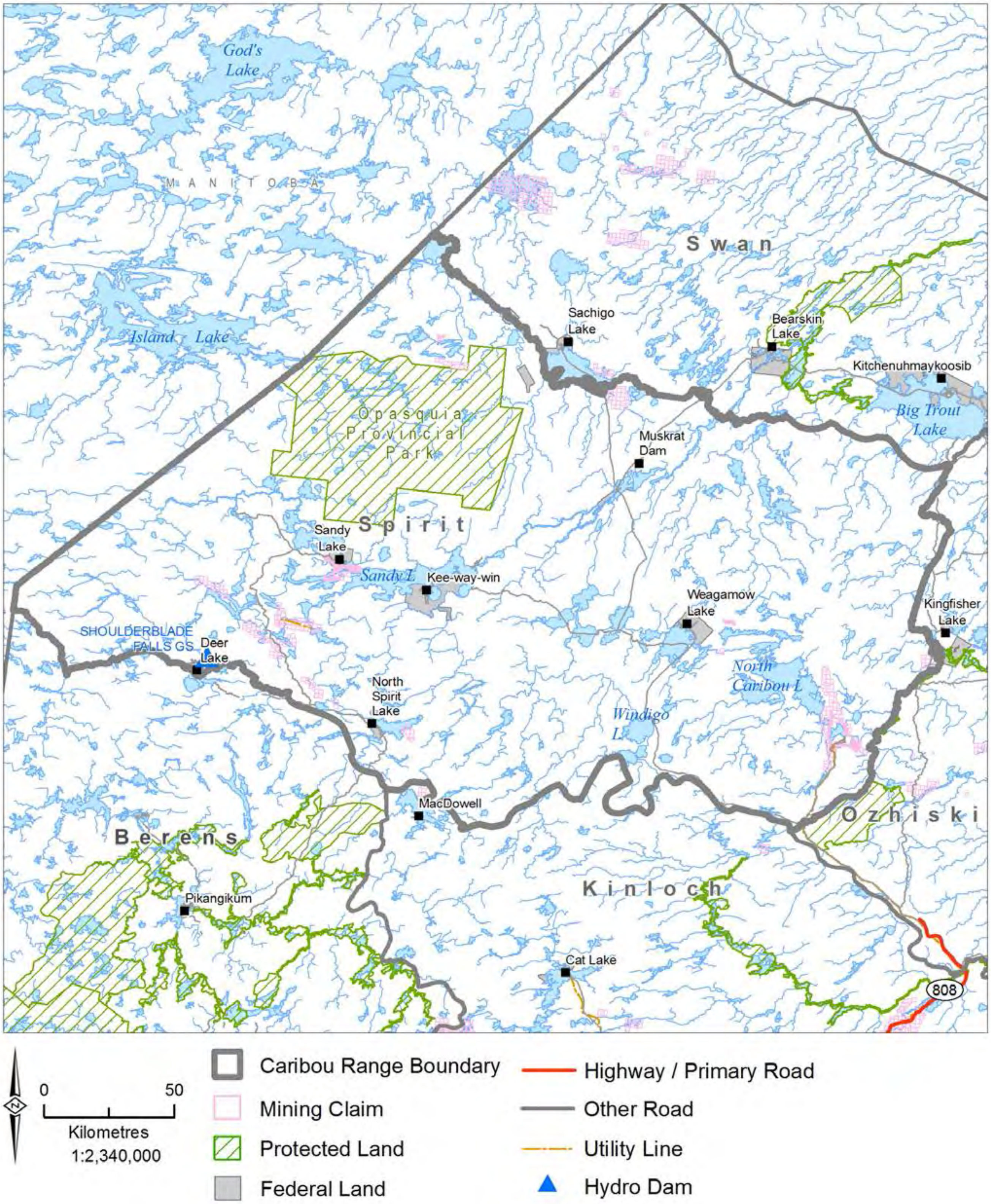

Figure 5. Human infrastructure and historical developments occurring within the Spirit Range.

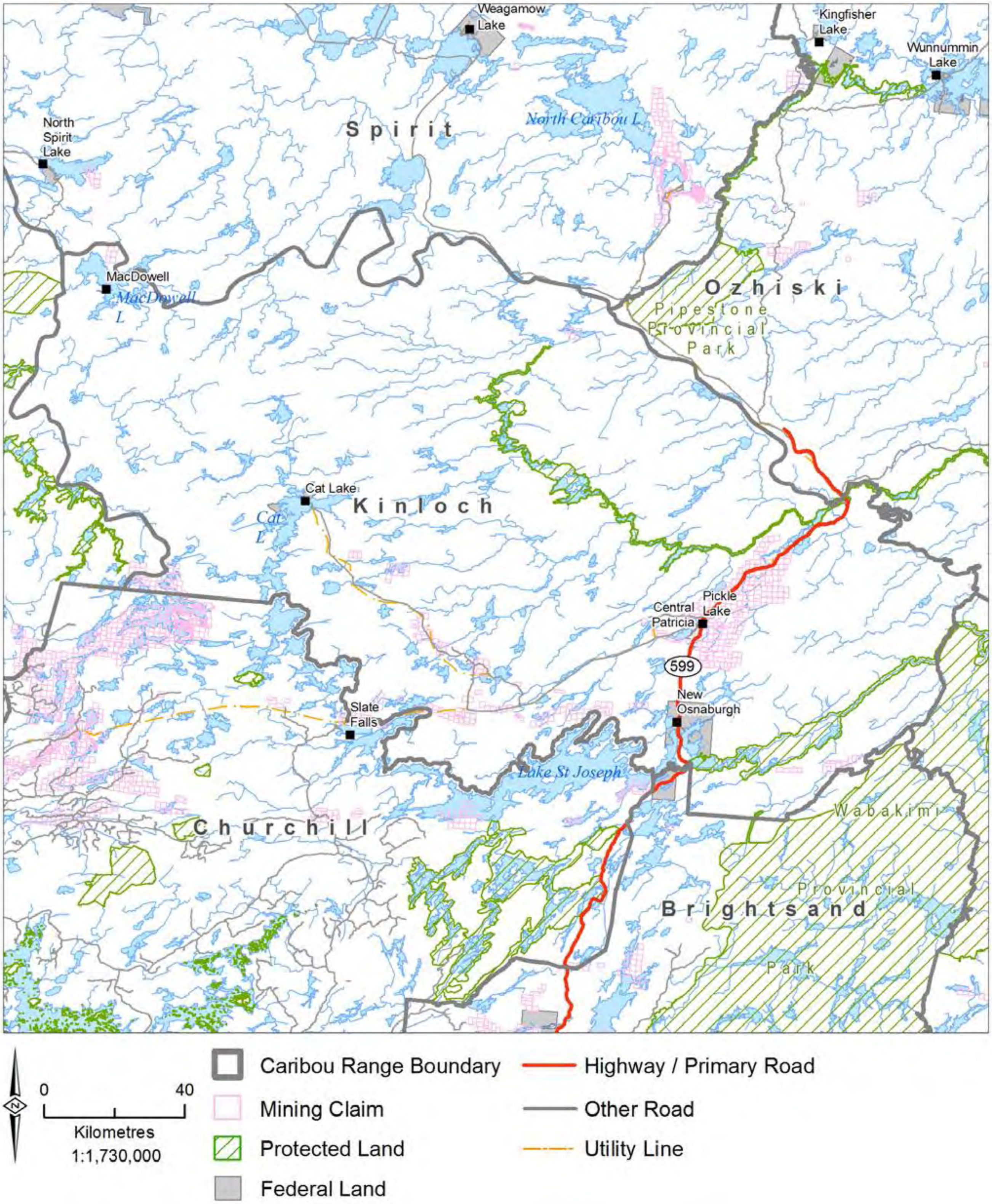

Figure 6. Human infrastructure and historical developments occurring within the Kinloch Range.

Figure 7. Human infrastructure and historical developments occurring within the Ozhiski Range.

Figure 8. Human infrastructure and historical developments occurring within the Missisa Range.

Figure 9. Human infrastructure and historical developments occurring within the James Bay Range.

3.2 Caribou occupancy history and assessment

Historical observations of caribou in the Far North of Ontario have been identified from all available sources and recorded within the Land Information Ontario (LIO 2014) database. These observations include aerial survey results, locations of collared caribou, as well as credible casual observations from MNRF staff and the general public. They include the results of extensive surveys of ungulates in the Far North of Ontario between 1958-1962 and more recently (2008-1012) from the Far North Caribou Project (Berglund et al. 2014) that contributed information related to winter distribution, movement, and calving activities as well as general insight on genetic connectivity. The synopsis of these observations to summer 2013 (Figure 10 to Figure 22) provide historical context to assist with the interpretation of the current Integrated Range Assessment results. Historically, these observations reflect our knowledge of caribou occurrence within the range and the possible response to changes in range condition. The Far North Caribou Project (Berglund et al. 2014) also contributed substantially to contemporary knowledge of caribou ecology within the Far North of Ontario and informed many aspects of these range assessments.

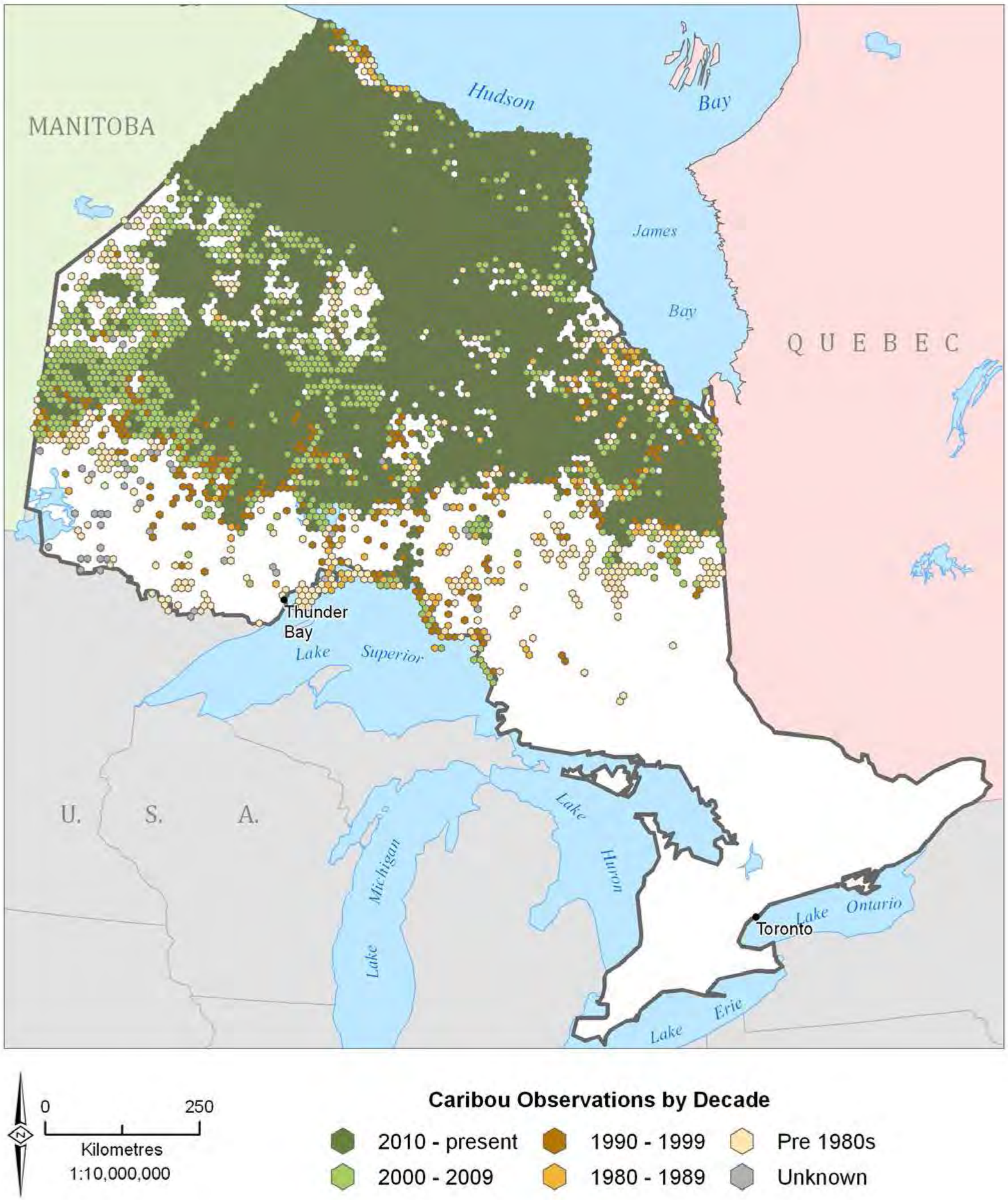

Figure 10. Caribou occurrence across Ontario summarized by date of most recent observation as of June 2013.

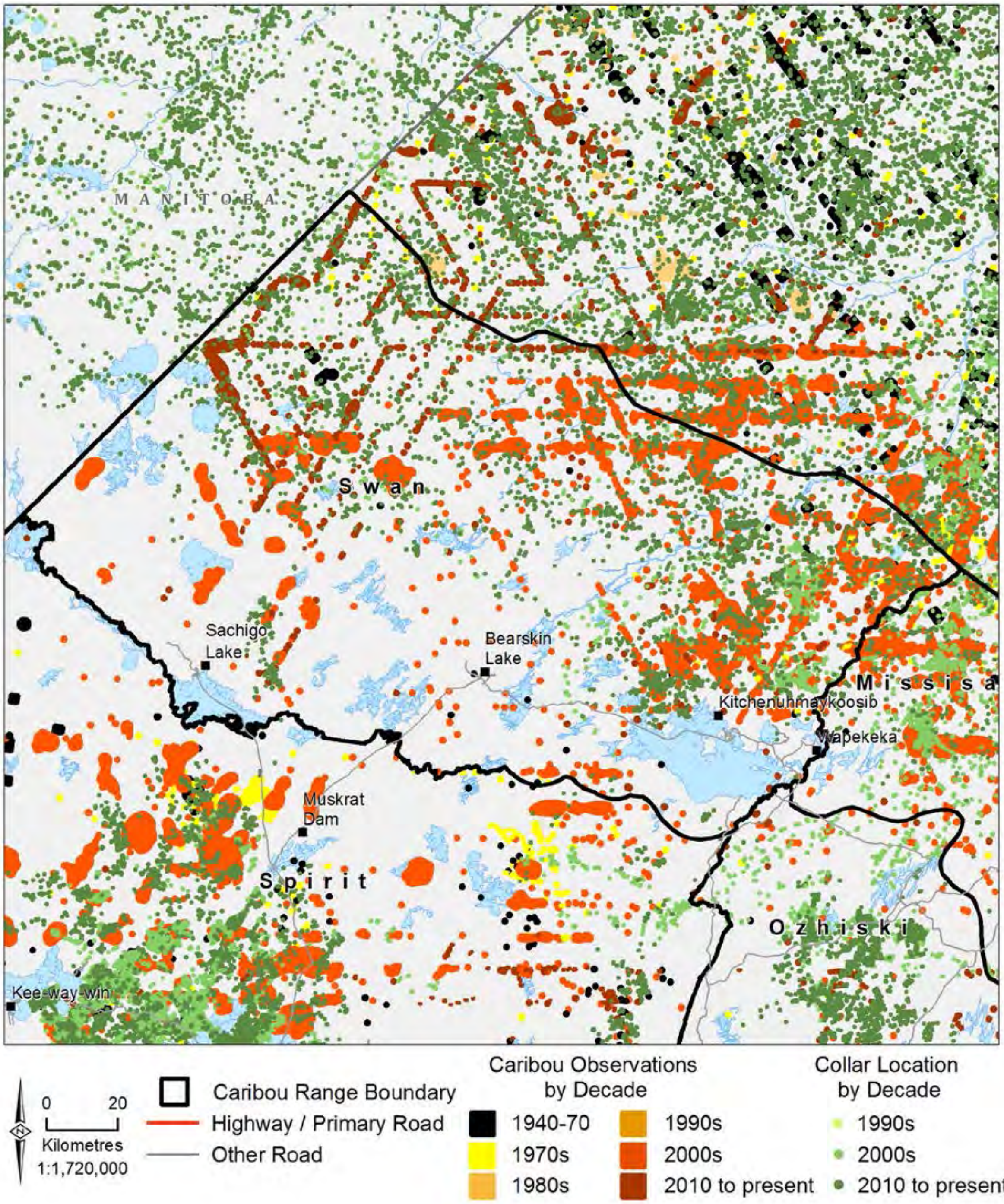

Figure 11. Historical caribou observations[1] within the Swan Range and surrounding area including observations from aerial surveys, collared caribou locations, research projects, and casual observations.

1Home 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 includes group sightings. The actual area used by caribou is much larger as they move throughout the year.

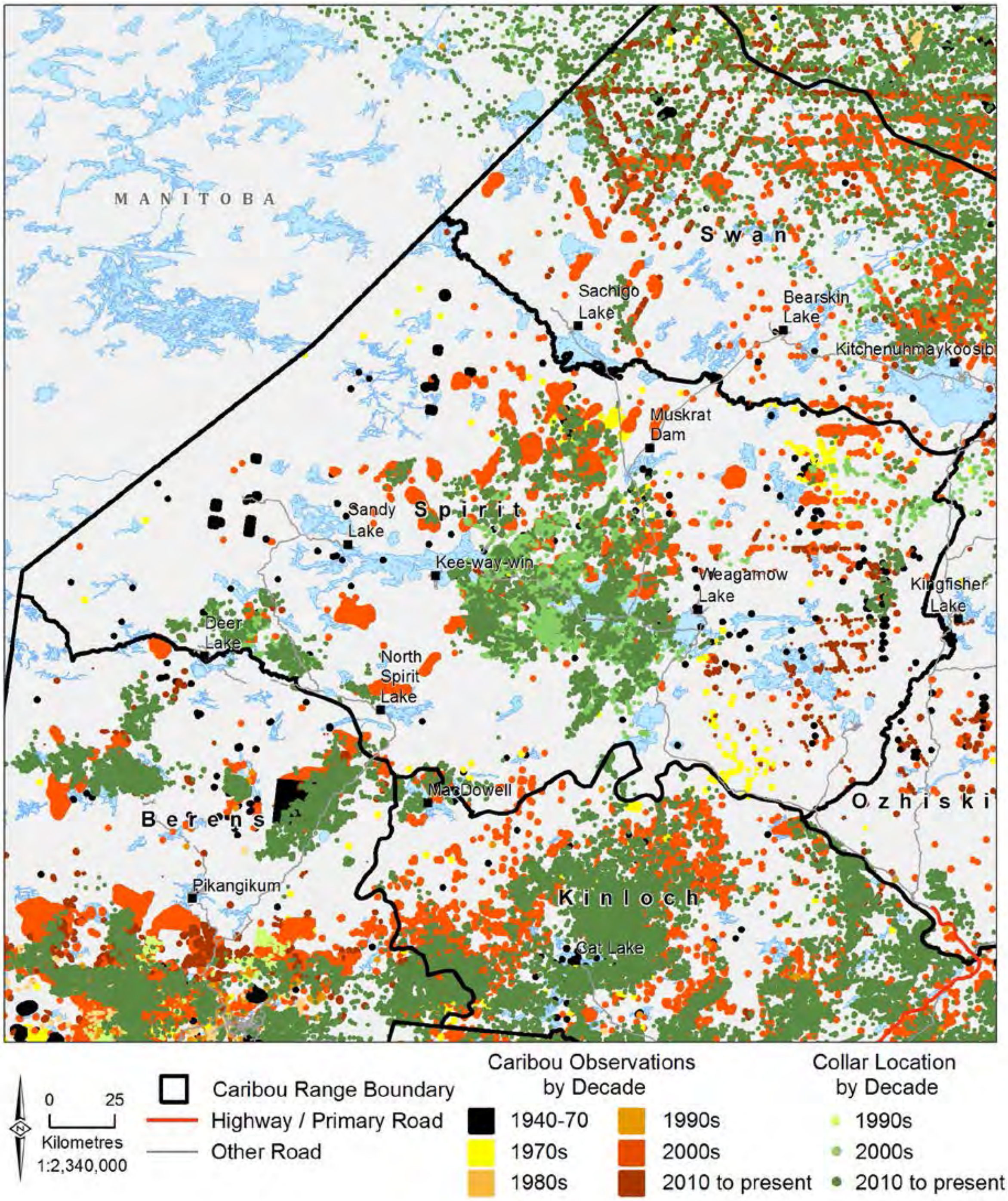

Figure 12. Historical caribou observations[1] within the Spirit Range and surrounding area including observations from aerial surveys, collared caribou locations, research projects, and casual observations.

[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 includes group sightings. The actual area used by the caribou is much larger as they move throughout the year.

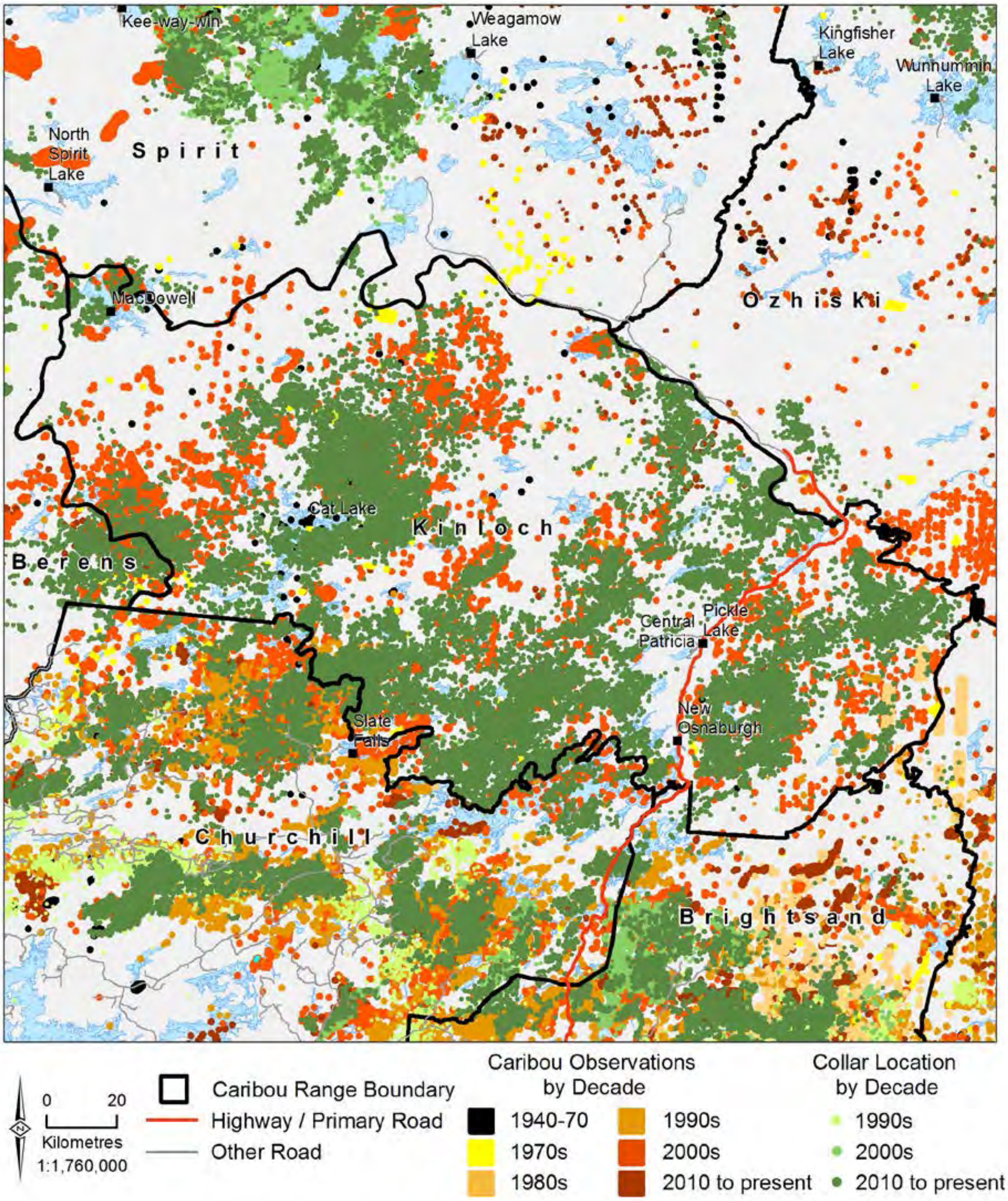

Figure 13. Historical caribou observations[1] within the Kinloch Range and surrounding area including observations from aerial surveys, collared caribou locations, research projects, and casual observations.

[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 includes group sightings. The actual area used by the caribou is much larger as they move throughout the year.

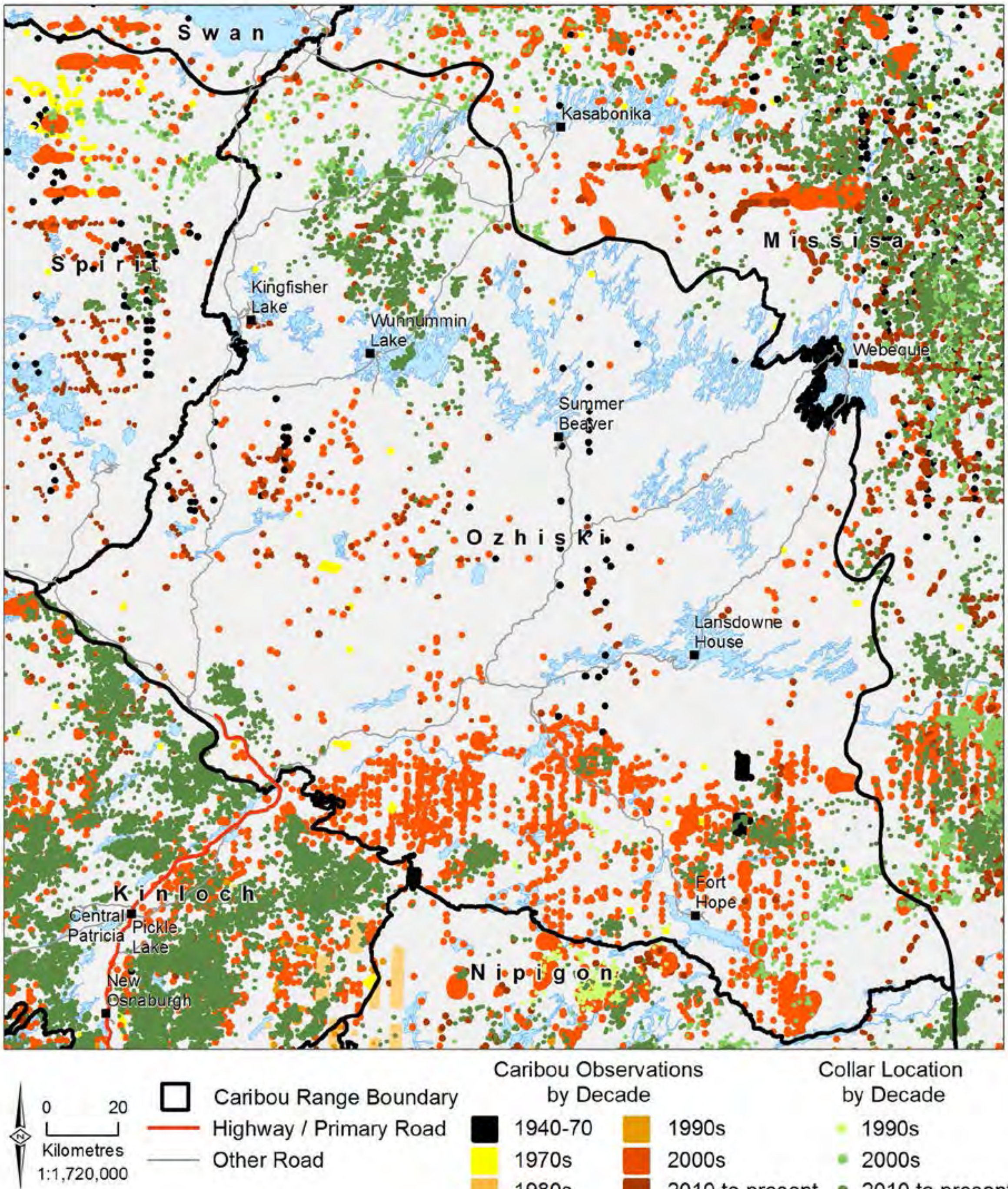

Figure 14. Historical caribou observations[1] within the Ozhiski Range and surrounding area including observations from aerial surveys, collared caribou locations, research projects, and casual observations.

[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 includes group sightings. The actual area used by the caribou is much larger as they move throughout the year.

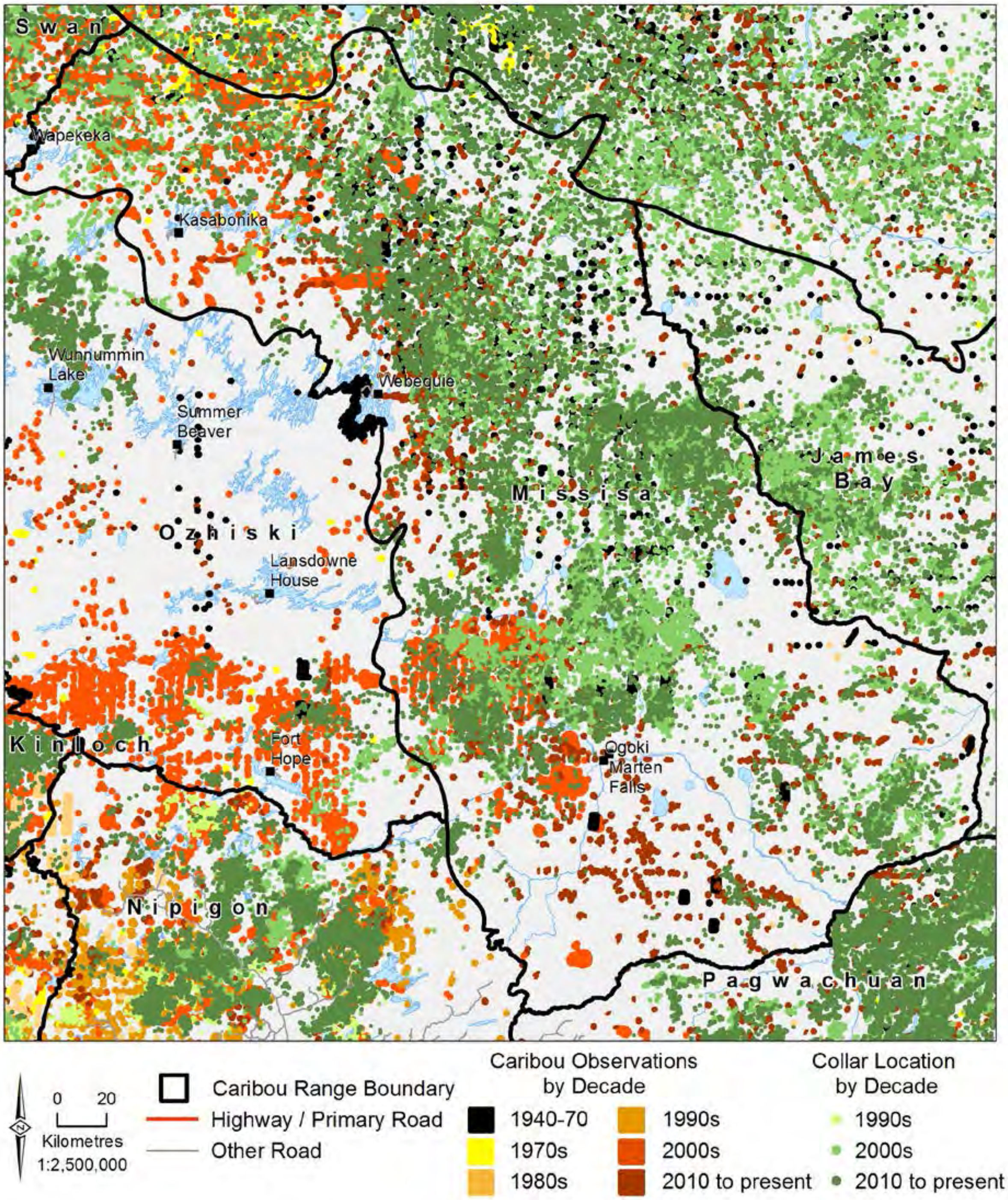

Figure 15. Historical caribou observations[1] within the Missisa Range and surrounding area including observations from aerial surveys, collared caribou locations, research projects, and casual observations.

[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 includes group sightings. The actual area used by the caribou is much larger as they move throughout the year.

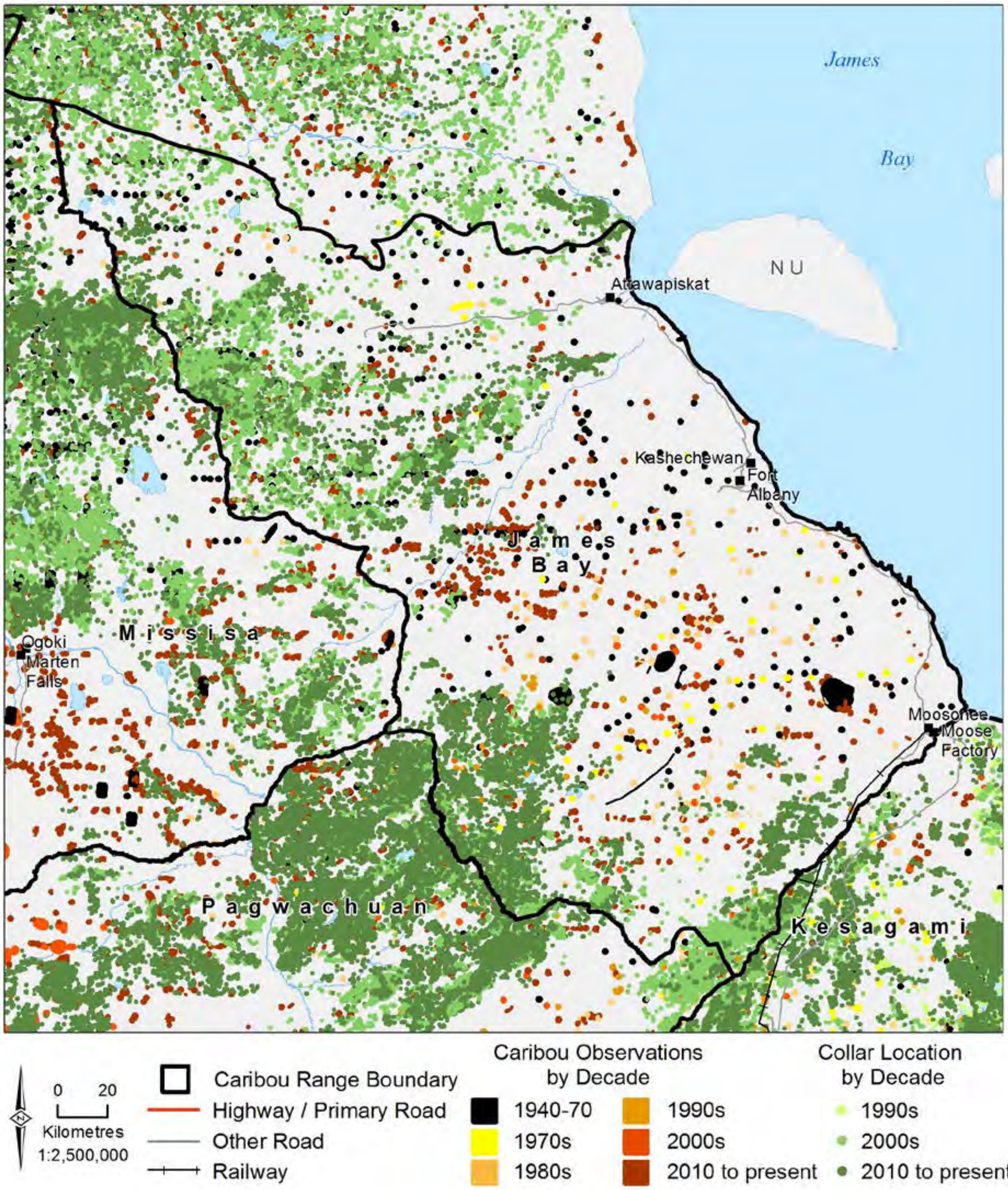

Figure 16. Historical caribou observations[1] within the James Bay Range and surrounding area including observations from aerial surveys, collared caribou locations, research projects, and casual observations as of August 2013.

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

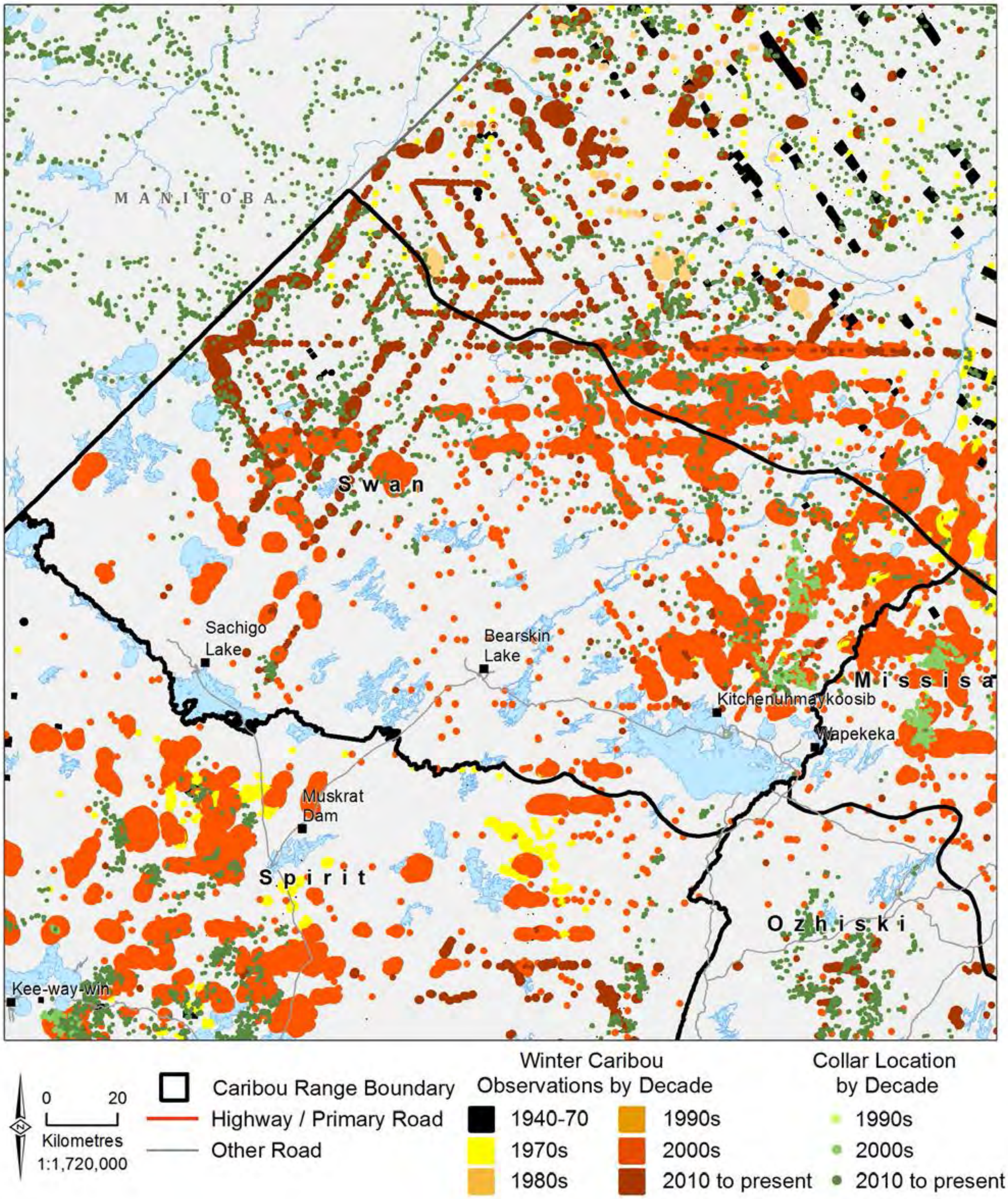

Figure 17. Caribou observations within the Swan Range for the months of February and March from all observation sources (i.e. aerial surveys, collared caribou locations, and casual observations) as of August 2013.

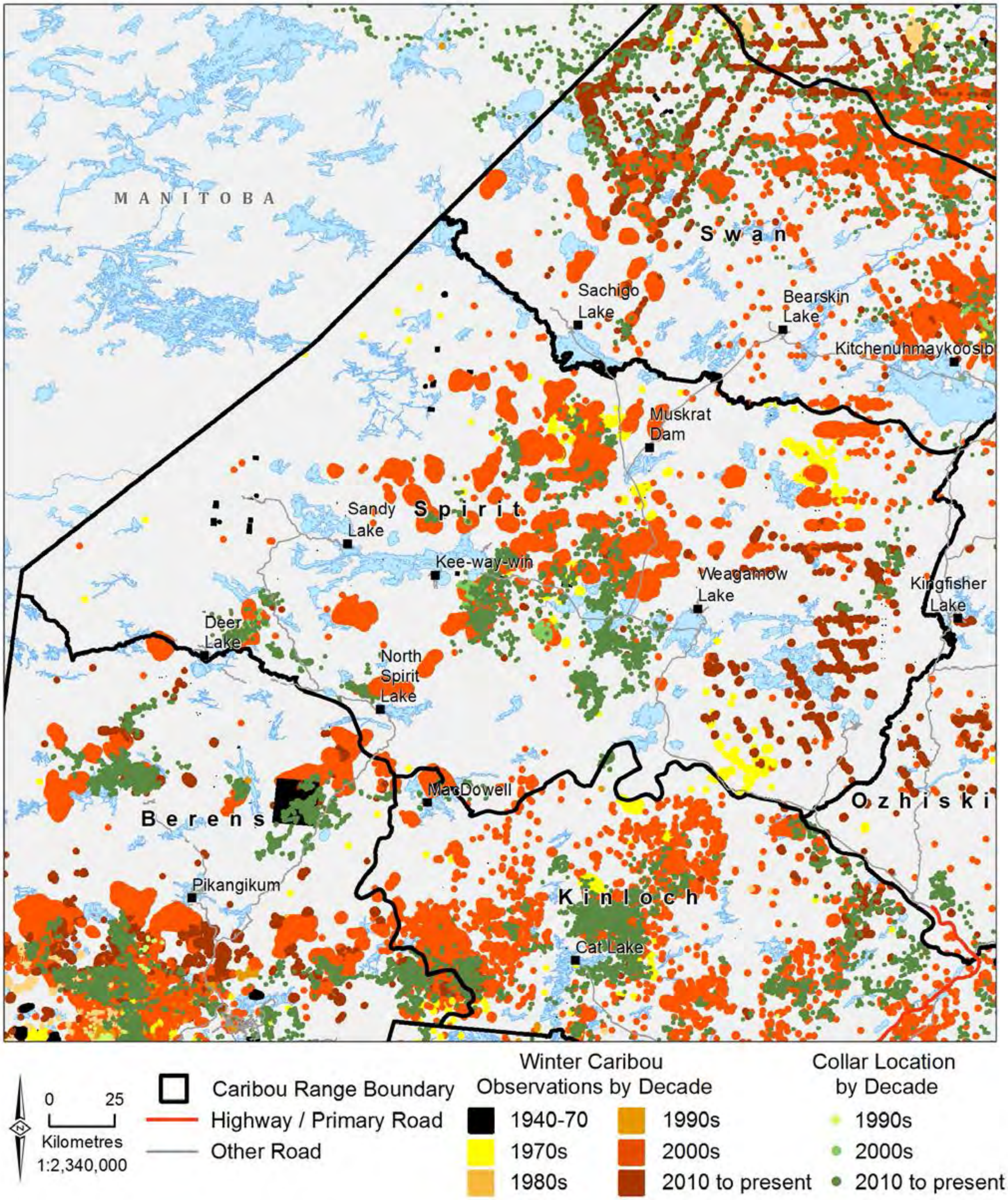

Figure 18. Caribou observations within the Spirit Range for the months of February and March from all observation sources (i.e. aerial surveys, collared caribou locations, and casual observations) as of August 2013.

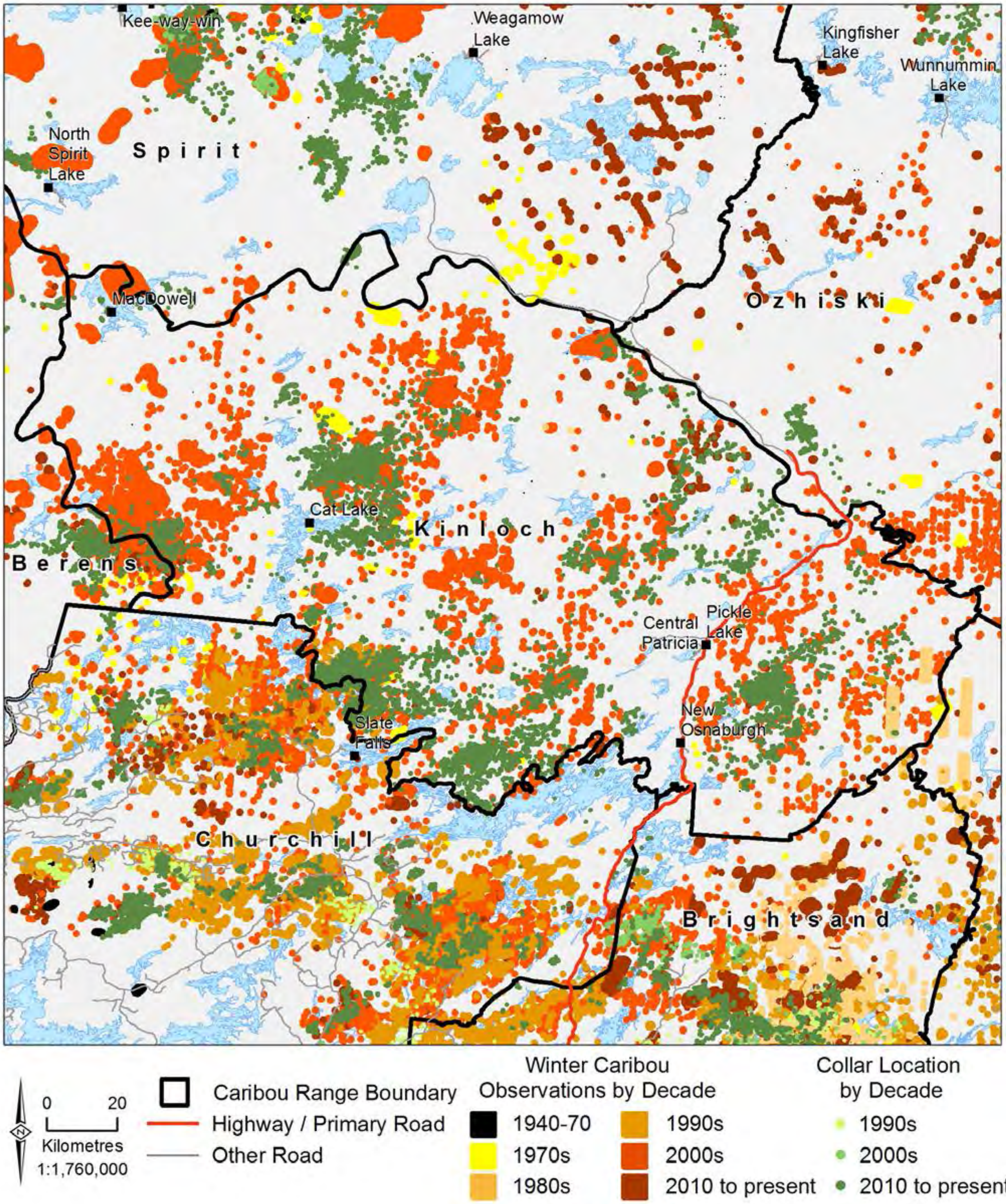

Figure 19. Caribou observations within the Kinloch Range for the months of February and March from all observation sources (i.e. aerial surveys, collared caribou locations, and casual observations) as of August 2013.

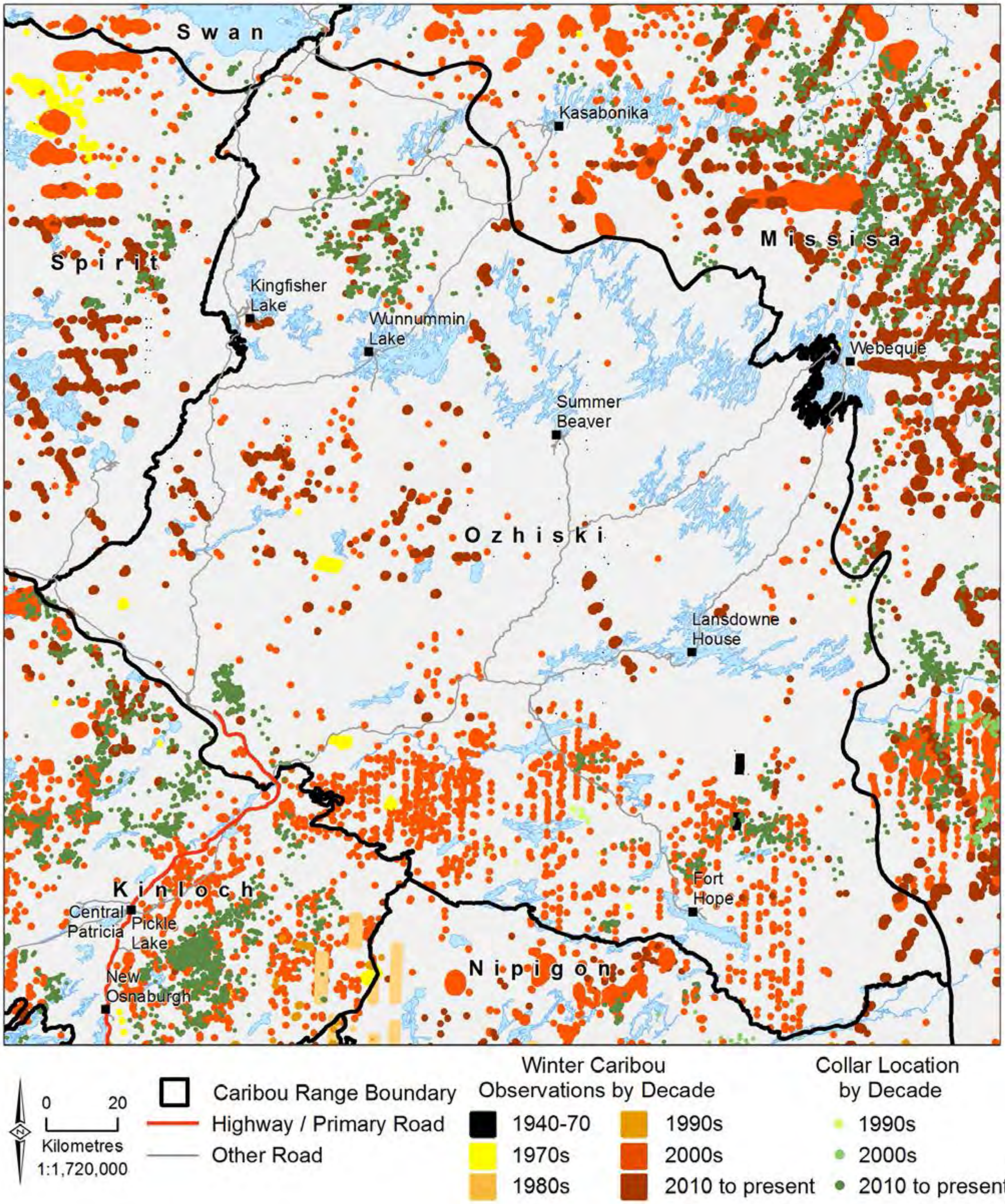

Figure 20. Caribou observations within the Ozhiski Range for the months of February and March from all observation sources (i.e. aerial surveys, collared caribou locations, and casual observations) as of August 2013.

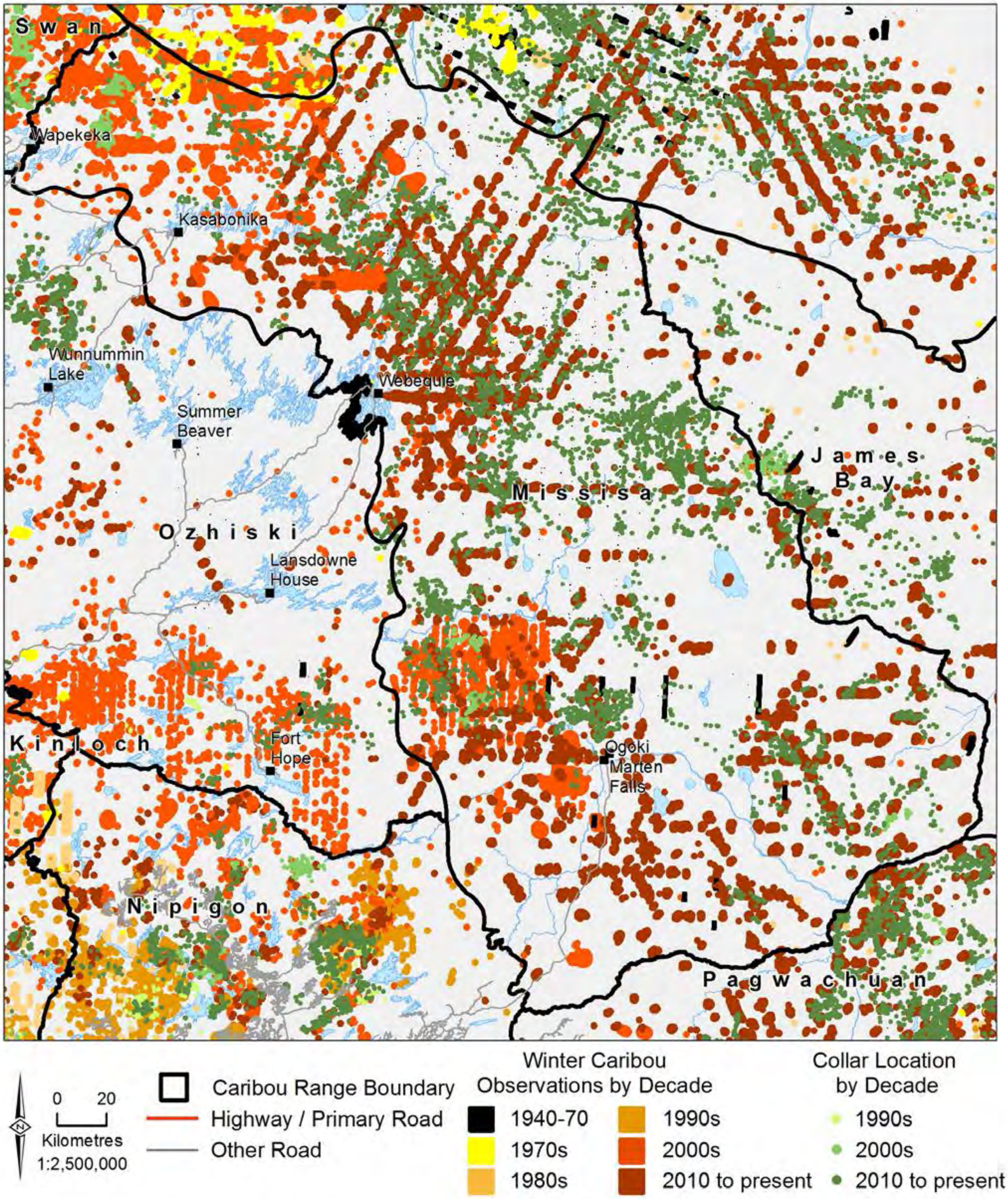

Figure 21. Caribou observations within the Missisa Range for the months of February and March from all observation sources (i.e. aerial surveys, collared caribou locations, and casual observations) as of August 2013.

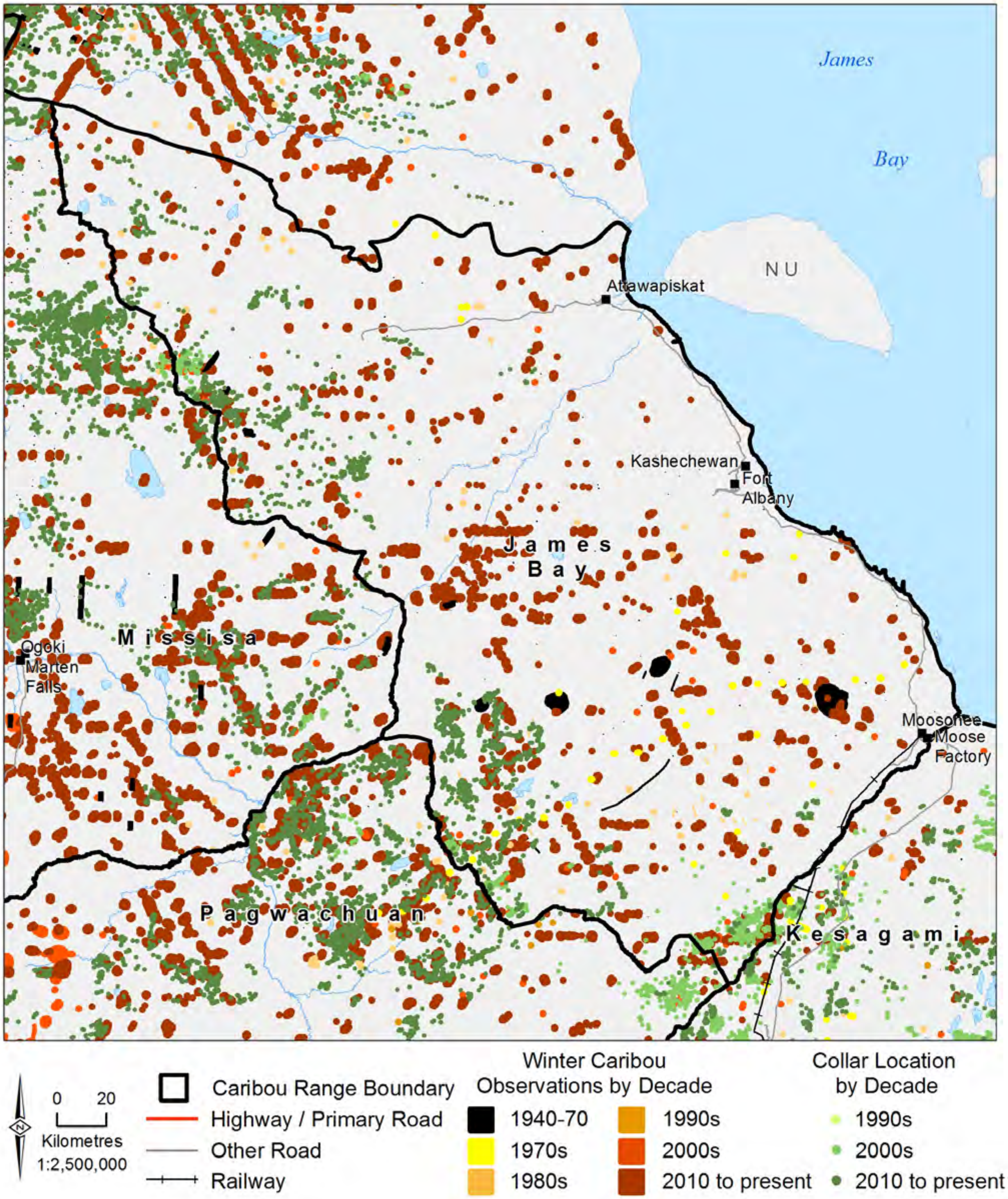

Figure 22. Caribou observations within the James Bay Range for the months of February and March from all observation sources (i.e. aerial surveys, collared caribou locations, and casual observations) as of August 2013.

3.3 Probability of occupancy survey and analysis

Caribou occupancy and the methods by which it was calculated within the Far North Ranges were summarized by Berglund et al. (2014). Presence of caribou was identified during aerial fixed-wing surveys conducted in February and March 2009-2011. The fixed-wing survey consisted of flying linear transects on a 10 km interval hexagonal sample grid (Figure 23). Each hexagon is approximately 100 km² and 10.6 km across. Between two and four repeat visits were conducted on a portion of hexagons in each range. The occupancy analysis for the majority of the Far North Ranges was subdivided into two models based on ecozone: Ontario Shield or the Hudson Bay Lowlands. The occupancy analysis described by Berglund et al. (2014) did not include the Cat Lake-Slate Falls Planning Area or the Mishkeegogamang and Eabametoong (Taashikaywin) Planning Area. These two areas were surveyed using north-south linear transects (Figure 23) and a different method of calculating probability of occupancy and assigning occupancy to the hexagonal grid was used. Flight transects that intersected a hexagon were of variable length and less than the intended ~10 km apart (length of transect in the hexagon affects amount of search effort and thus probability of detecting caribou). To minimize the impact of this variation in search effort among hexagons and visits, only flight transects greater than or equal to 5 km in length were included in the occupancy analysis. Analytical methods approximated those of Poley (2012) and the detection covariates are described in Berglund et al. (2014).

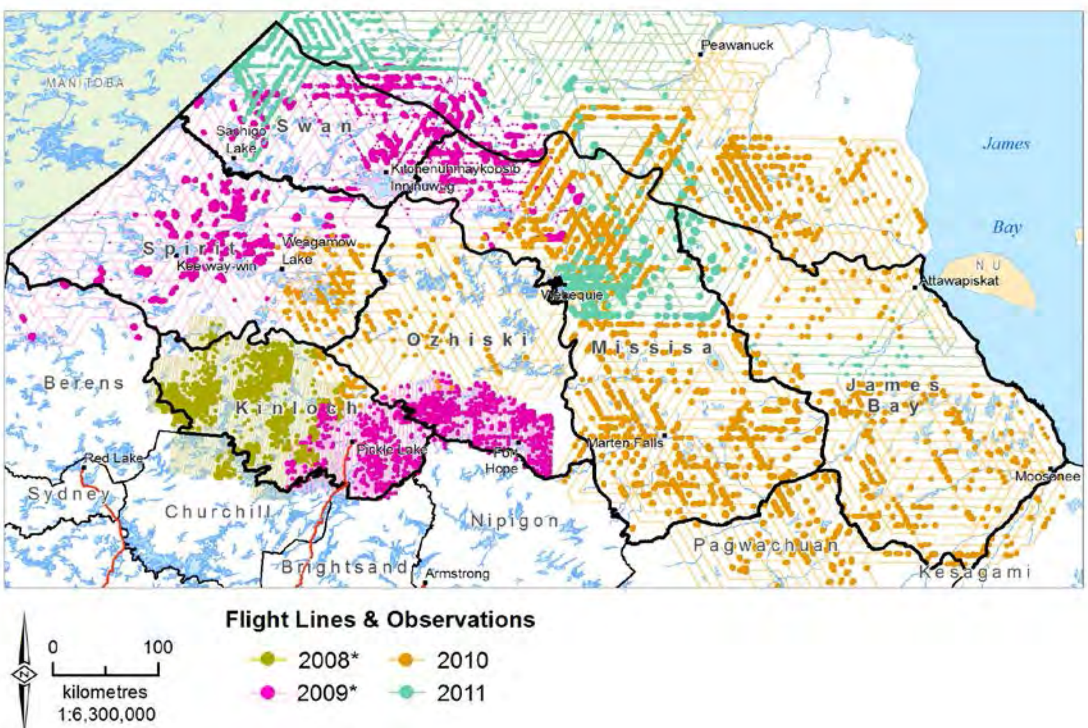

Figure 23. Fixed-wing aerial survey flight lines based on the Far North 10 km^2 hexagon sampling grid as well as linear transects* 2-5km apart (Kinloch Range and southern portion of Ozhiski Range). Observations of caribou and their sign are also shown. All evidence of caribou presence within a hexagon, including tracks, feeding craters, slushing, or observed caribou contributes to the probability of occupancy calculation.

The probability of occupancy index varies from 0 to 1, where higher values reflect greater likelihood of observing caribou. The general patterns from the probability of occupancy analyses provide insight into the broad-scale distribution and relative abundance of caribou. The probability of caribou occupancy was significantly correlated with habitat covariates in both the Ontario Shield and Hudson Bay Lowlands ecozones. The best predictive model in the Ontario Shield suggested the probability of occupancy was negatively correlated with deciduous forest and positively correlated with the amount of treed bog/fen, open bog/fen, sparse trees and the year the survey was completed. The Hudson Bay Lowlands Ecozone model suggested the probability of occupancy was positively correlated with the amount of sparse treed forest and negatively correlated with the amount of deciduous forest, tundra, anthropogenic disturbance, open bog/fen and the year (Table 1 and Table 2).

Table 1. Model averaged estimates of occupancy and detection parameters for caribou in the Ontario Shield Ecozone. Parameters shown in bold have confidence intervals that do not contain zero.

Occupancy					Detection				
Parameter	**Estimate[1]**	**SE**	**Lower CI**	**Upper CI**	**Parameter**	**Estimate**	**SE**	**Lower CI**	**Upper CI**
Ψ	**-2.29**	**0.52**	**-3.31**	**-1.27**	*p1*	0.13	0.10	-0.06	0.32
Treed bog/fen	**10.47**	**1.45**	**7.62**	**13.32**	***p2***	**0.62**	**0.13**	**0.37**	**0.87**
Open bog/fen	**6.26**	**2.18**	**1.99**	**10.54**	***p3***	**0.85**	**0.21**	**0.43**	**1.27**
Deciduous	**-29.78**	**6.82**	**-43.14**	**-16.42**	*p4*	0.06	0.34	-0.60	0.72
Sparse	**3.71**	**0.72**	**2.29**	**5.12**	*p5*	0.60	0.60	-0.78	1.58
Bedrock	-6.71	5.86	-18.20	4.79	**Date**	**0.17**	**0.07**	**0.04**	**0.31**
2010	**0.87**	**0.22**	**0.44**	**1.31**	**Length**	**0.38**	**0.08**	**0.22**	**0.54**
2011	**1.63**	**0.68**	**0.30**	**2.97**	**Visibility* Time of Day**	**1.71**	**0.65**	**0.44**	**2.98**
Moose psi	-0.20	0.33	-0.85	0.45	**Visibility* Time of Day^2**	**-1.14**	**0.46**	**-2.04**	**-0.25**
Wolf psi	-0.10	0.22	-0.54	0.33	Visibility * Flight Altitude	-0.01	0.02	-0.05	0.03
Water	-0.05	0.15	-0.35	0.25	Flight Altitude	-0.01	0.02	-0.04	0.02
					Aircraft Speed Flight Altitude	-0.01	0.01	-0.04	0.02
					Visibility	-0.011	0.24	-0.57	0.36
					Aircraft Speed	0.00	0.01	-0.02	0.02
					Visibility * Aircraft Speed	0.01	0.03	-0.05	0.06

[1]The sign before the covariate estimate indicates the direction of the relationship with species occupancy (positive or negative).
* *p1*-*p5* in the detection covariate estimates are the intercepts for each survey-specific detection probability (survey visits 1 through 5).

Table 2. Model averaged estimates of occupancy and detection parameters for caribou in the Hudson Bay Lowlands Ecozone. Parameters shown in bold have confidence intervals that do not contain zero.

Occupancy					Detection				
Parameter	Estimate[1]	SE	Lower CI	Upper CI	Parameter	Estimate	SE	Lower CI	Upper CI
Ψ	**23.39**	**4.45**	**14.67**	**32.11**	*p1*	-0.02	0.70	-1.39	1.36
Sparse	**5.73**	**0.84**	**4.09**	**7.37**	*p2*	-0.33	0.70	-1.71	1.04
Deciduous	**-68.43**	**15.39**	**-98.59**	**-38.26**	*p3*	-0.43	0.72	-1.85	0.98
2010	**-22.72**	**4.54**	**-31.62**	**-13.83**	*p4*	-0.64	0.84	-2.28	1.00
2011	**-23.82**	**4.54**	**-32.71**	**-14.93**	*p5*	-0.67	1.03	-2.68	1.34
Tundra	**-20.28**	**10.06**	**-39.99**	**-0.57**	**Date**	***-1.13***	***0.24***	***-1.60***	***-0.66***
Open Bog /Fen	**-1.28**	**0.74**	**-2.73**	**0.17**	**Transect Length**	***0.46***	***0.09***	***0.29***	***0.63***
Coniferous	-0.72	1.05	-2.78	1.34	**Time of Day**	***3.69***	***0.69***	***2.33***	***5.04***
Anthropogenic Disturbance	**-5.91**	**7.07**	**-19.77**	**7.95**	**Time of Day^2**	***-3.65***	***0.68***	***-4.99***	***-2.32***
Cuts/Burns	0.63	1.01	-1.36	2.61	**Flight Altitude x Visibility**	***-0.20***	***0.07***	***-0.35***	***-0.06***
					Visibility	0.11	0.09	-0.08	0.29
					2010	-0.41	0.59	-1.56	0.74
					2011	1.19	0.92	-0.61	2.99

[1]The sign before the covariate estimate indicates the direction of the relationship with species occupancy (positive or negative).
* *p1-p5* in the detection covariate estimates are the intercepts for each survey-specific detection probability (survey visits 1 through 5).

The probability of caribou occupancy was significantly correlated with habitat covariates for the Cat Lake-Slate Falls Planning Area and the Mishkeegogamang and Eabametoong (Taashikaywin) Planning Area. Habitat variables used in the occupancy models for these regions include the percent-cover of depletions, sparse forest, dense coniferous forest, mixed-deciduous forest, and treed bog within each hexagon. Depletions included the total area of cutovers (< 10 years in age), recent burns (< 10 years in age) and regenerating depletions (old burns > 10 years in age supporting sparse vegetation). Mean distance to roads and settlement were calculated for each hexagon from centroid distance raster grids (30 m resolution) for each layer. Covariates for the probability of detection included aircraft speed, altitude of the aircraft above ground (in metres), a quadratic term for time of day (time + time^2), and the length of the transect (m).

The best AIC model (wAIC = 0.9748) for probability of occupancy in the Cat Lake-Slate Falls Planning Area was the global model that included all occupancy covariates (Table 3).

Table 3. Estimates of coefficients for habitat covariates used in the caribou occupancy model for the Cat Lake-Slate Falls Planning Area. The model detection probability is 0.381. Parameters shown in bold have confidence intervals that do not contain zero.

Parameter	Estimate[1]	S.E.	Lower CI	Upper CI
Ψ	**0.48**	**0.18**	**0.19**	**0.77**
Distance to settlement	**0.35**	**0.21**	**0.00**	**0.70**
Distance to roads	**0.43**	**0.20**	**0.10**	**0.75**
Conifer	**0.74**	**0.34**	**0.19**	**1.30**
Treed Bog	**0.58**	**0.21**	**0.24**	**0.93**
Sparse	**0.38**	**0.22**	**0.01**	**0.74**
Mixed	**0.57**	**0.26**	**0.14**	**0.99**
Depletions	**0.76**	**0.35**	**0.19**	**1.32**

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

In the Mishkeegogamang and Eabametoong Planning Area, the distance to roads and mixed forest showed evidence of autocorrelation with other variables and were removed from the model. Percentage of treed bog was removed from the model due to the standard error being greater than the parameter estimate. All detection variables had standard errors less than the respective parameter estimate and were retained in the detection and occupancy model. The best predictive model in the Mishkeegogamang and Eabametoong Planning Area suggested the probability of occupancy was positively correlated with settlements, conifer, sparse forest, and depletions (Table 4).

Table 4. Estimates of coefficients for habitat covariates used in the caribou occupancy model for the Mishkeegogamang and Eabametoong Planning Area. The mean detection probability was 0.69 and represents an average value based on the pooling of hexagon and visit-specific estimates that incorporate detection covariate information. Parameters shown in bold have confidence intervals that do not contain zero.

Occupancy					Detection				
Parameter	Estimate[1]	SE	Lower CI	Upper CI	Parameter	Estimate	SE	Lower CI	Upper CI
Ψ	**2.68**	**0.60**	**1.69**	**3.67**	**p**	**7.43**	**0.32**	**6.91**	**7.95**
Settlement	**1.19**	**0.41**	**0.52**	**1.86**	**time**	**-53.82**	**0.29**	**-54.30**	**-53.35**
Conifer	**0.87**	**0.31**	**0.36**	**1.39**	**$Time^2$**	**53.69**	**0.29**	**53.21**	**54.17**
Sparse	**0.64**	**0.31**	**0.13**	**1.14**	**Flight Altitude**	**0.58**	**0.13**	**0.37**	**0.78**
Depletions	**1.09**	**0.56**	**0.17**	**2.01**	**Aircraft speed**	**-0.04**	**0.00**	**-0.05**	**-0.04**
					Transect length	**0.21**	**0.12**	**0.02**	**0.41**

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

These four models differentiated among areas of high and low probability of occurrence (Figure 24). Generally high levels of occupancy were identified along the Shield-Lowland interface (Missisa Range and upper portion of the Swan Range) as well as in the more heavily forested portions of the Kinloch Range and southern portions of the Ozhiski Range. A large patch of high probability of occupancy was associated with a massive peatland complex in the centre of the Spirit Range, east of Sandy Lake. The probability of occupancy on the Ontario Shield was heavily influenced by the distribution of burn areas and other natural disturbances, particularly in the Spirit, Ozhiski and Swan Ranges. Within the Taashikaywin area (Kinloch Range and southern portion of the Ozhiski Range), caribou occupancy was more evenly dispersed as compared to the Cat Lake-Slate Falls Planning Area, although both models suggest that caribou occupancy is less likely within the vicinity of a community.

Caribou occupancy within the Hudson Bay Lowlands (James Bay Range and eastern half of the Missisa Range) was more evenly dispersed than within the Ontario Shield. Few caribou were observed along the James Bay coastline and as a result, the eastern portion of the James Bay Range had lower occupancy levels than the western portion. A detailed description of this interpretation is described in Berglund et al. (2014).

Reliable estimates of occupancy for individual hexagons will be particularly important for tracking changes in caribou distribution within the Far North Ranges in response to management activities.

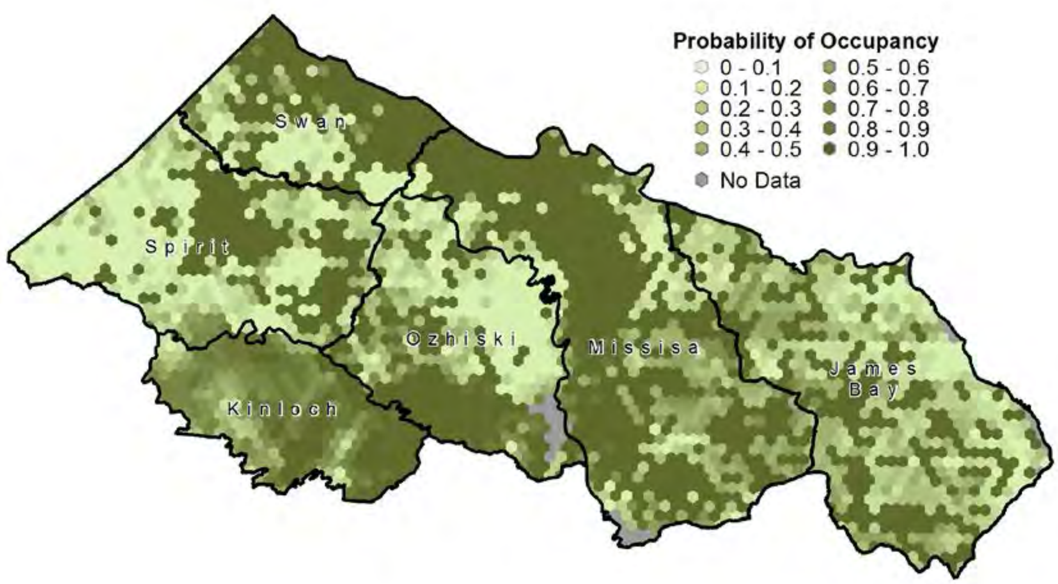

Figure 24. Probability of occupancy across the Far North Ranges determined using habitat covariates treed bog/fen, open bog/fen, deciduous forest, sparse treed forest, bedrock, water, year of survey and the occupancy patterns of moose and wolf. (Ontario Shield Ecozone model) and sparsely treed, conifer and deciduous forests, tundra, cuts and burns, open bog/fen and the survey year (Hudson Bay Lowlands Ecozone model).

3.4 Caribou ecology and range narrative

Forest-dwelling caribou within the Far North of Ontario appear to reflect our general understanding of caribou habitat use in the boreal forest as reflected by the Ontario Woodland Caribou Recovery Team (2007). Both the forest-tundra and the forest-dwelling caribou ecotypes exist in Ontario and their extent of occurrence overlaps. This overlap occurs in the northern portions of the Swan, Missisa, and James Bay Ranges. Lands south of the Northern Taiga Ecoregion (Figure 1) are considered to be relevant to the conservation and management of forest-dwelling caribou. Forest-dwelling caribou in this area occur at low densities over large areas associating most closely with large tracts of older conifer forest, peatland complexes, areas exhibiting low densities of moose and deer, and the associated low densities of predators. These older conifer forests are believed to provide caribou with a source of terrestrial and arboreal lichens which are important winter forage (Schaefer and Pruitt 1991) while 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). Forest-dwelling caribou south of the Northern Taiga Ecoregion appear to exhibit hierarchical habitat selection favouring predator avoidance at broad scales and forage availability locally as described by Rettie and Messier (2000). Some degree of fidelity to calving areas is expected (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.

Much of our understanding of how forest-dwelling caribou live within the Swan, Spirit, Ozhiski, Kinloch, Missisa, and James Bay Ranges is documented in Berglund et al. (2014). This document describes the methods, results, and insights resulting from the aerial survey, caribou collaring, recruitment survey, and calving survey activities, as well as the analysis of home range sizes, genetic connectivity, and general habitat use patterns. Much of this range narrative expands on, or places further context around, the findings described by Berglund et al. (2014).

Caribou of the forest-tundra ecotype annually enter the northern portions of the Swan, Missisa, and James Bay Ranges, especially in the fall and winter. This overlap of caribou ecotypes may have several implications for caribou ecology and conservation in the Far North of Ontario. There is evidence of occasional ‘cross-over’ of some collared individuals: caribou that exhibit the behaviour of forest-dwelling caribou one year and of forest-tundra caribou another year. This suggests there may be a possibility to replace losses of forest-dwelling ecotype by immigration from the forest-tundra ecotype but the frequency or likelihood of this happening appears to be low. It also suggests that habitat features in the northern portion of those ranges may face the demands of having to support and meet the winter life requirements of both ecotypes, a factor that may increase the conservation value of this area of overlap. Overlap of the two ecotypes in the breeding season may also support genetic mixing.

Generally, forest-dwelling caribou occupying the Far North Ranges exhibit high levels of genetic connectivity suggesting there is a mixing of caribou across the north, reinforcing the notion they are part of a relatively continuous distribution. At present, there is no obvious genetic difference between the forest-dwelling and forest-tundra ecotypes, although further investigations are ongoing. There is comparatively less genetic connectivity to the south in the Kesagami, Pagwachuan, Nipigon, Brightsand, Churchill and Berens Ranges. This may be attributed to the greater levels of anthropogenic and natural disturbances in the south and west. Connectivity across the Missisa and James Bay Ranges is demonstrated in part by the movement patterns of collared female caribou. Some caribou collared north of Hearst, northeast of Big Trout Lake, west of Attawapiskat, and east of Eabametoong travelled widely within the Missisa Range, with some into the James Bay Range, and some mixing with forest-tundra caribou. North-south movement along the Shield-Lowlands interface was strongly evident (Berglund et al. 2014).

Mean home range size for female forest-dwelling caribou varied across the Far North Ranges. Home ranges were larger in the east than in the west and larger in the north than in the south. Seasonal home ranges are smaller in the summer and larger in the winter and pre-calving period (Berglund et al. 2014). Caribou within the James Bay and Missisa Ranges meet their life requirements across larger areas than those in the Ozhiski, Kinloch and Spirit Ranges. Home range sizes tend to be smaller in the Ozhiski, Kinloch, and Spirit Ranges where natural disturbances are larger and more abundant.

The Shield-Lowlands interface appears to have special significance for caribou. Winter occupancy rates, annual movement patterns, and a high incidence of calving and nursery activities attest to this significance. The biological basis for this significance is uncertain but may be related to the unique expression of forest, peatland, or surficial geology features, or the relative ability of peatland or shield-based ecosystems to provide for the year-round life requirements of caribou. Surveyor notes speculate there may be a higher level of use in more severe winters compared to winters with less snow depths and warmer temperatures, which also may suggest a need for denser conifer forest cover in severe winters. Whatever the reason, it appears based on the degree and persistence of use, the interface represents an area of importance to caribou and therefore has a high conservation value.

Forest-dwelling caribou appear to use a variety of conditions to raise their calves, and there may be competition for some sites. Many areas are used year after year, sometimes by the same female caribou. If isolation is important during the calving period, and a quality nursery area is important for predator avoidance and calf-rearing success, measures may be warranted to ensure an adequate supply of potential calving sites and nursery areas are maintained across the landscape.

In the Missisa and James Bay Ranges, much of the calving activity appears to be associated with poor conifer swamp complexes, swamp and fen complexes, or parallel linear upland or swamp features separated by bogs or fens. Small bog islands or treed edges of a large fen complexes are also used (Berglund et al. 2014). Caribou tend to avoid intermediate and rich swamp conditions characterized by white cedar, white cedar/larch (*Larix laricina*), or white cedar/black spruce combinations, as well as impoundments of water with dead and dying trees and shrubs, or marginal lags. There also tends to be almost complete avoidance of large (> 200-300 km^2) open fens, even when there were small bog islands within them. The massive fens near the boundary between the James Bay and Missisa Ranges were largely avoided during winter and summer but there is caribou-use associated with the perimeter and bog islands within. Caribou in these ranges may travel extensively during the post-calving period even when accompanied by a calf.

In the northern portion of the Missisa and Swan Ranges, caribou often use conifer dominated uplands or conifer swamp forest conditions separated by bogs, fens, rivers, or lakes for calving. They also use islands on large lakes such as Big Trout Lake or Kasabonika Lake. Highly paludified islands and islands with abundant woody debris and blowdown do not appear to be used as frequently as ones with intact and mature conifer forest.

In the Spirit Range, there are massive peatland complexes and large lakes that are heavily used by caribou in winter and summer. Calving and nursery activity occurs throughout with many areas used year after year. Used areas consist of fen complex or conifer upland/swamp features separated by bogs, fens, rivers or lakes. In the western portion of the Spirit Range, where there is widespread natural disturbance, calving activity is mostly associated with small isolated bogs, lakes with islands, and patches of older conifer forest mixed with poor and intermediate conifer swamp.

The Spirit, Ozhiski, and Swan Ranges exhibit a very high level of natural disturbance, especially wildfire. Caribou occupancy patterns within these ranges exhibit an inverse relationship to the natural disturbance patterns (Berglund et al. 2014). The transient and dynamic nature of the forests in this fire-driven landscape means the specific pattern of caribou occupancy should also be dynamic over long periods consistent with the fire cycle. The occupancy pattern, as reflected by probability of occupancy, suggests low use of areas with fires less than 40 years of age and higher use of large areas where the forest has not burned in many years. Overall, the northern portion of the Ontario Shield Ecozone has relatively low levels of occupancy, which may be quite normal for this kind of a fire-driven landscape.

The Spirit, Swan, Ozhiski, and the western portions of the Missisa Range occur in ecoregion 2W which is dominated by calcareous soils. Disturbances on this soil typically exhibit higher productivity and may have more of a tendency to support hardwood trees and deciduous shrubs than non-calcareous soils. These highly disturbed portions of the landscape have a high probability of occupancy by moose (Berglund et al. 2014) which are an alternate prey species known to support higher densities of wolves. In addition, stand development patterns in these ranges when disturbed may maintain a juvenile condition (high densities of sapling and pole size trees, high shrub and herb densities) for a longer period of time than further south. As such, these landscapes, if disturbed, may have a longer lasting effect on caribou than those associated with ecoregion 3S. The Kinloch Range has largely non-calcareous soils (Racey 2008) and has large areas of older conifer forest, partly as a result of past fire management strategies to suppress fires. Forest productivity and moose densities within the James Bay Range and the eastern portion of the Missisa Range are low, with moose being largely associated with the small patches of burned upland forest and the shrub-rich edges of rivers and other drainage channels.

Not much is known of specific features of importance to caribou within the Far North Ranges. Most of the scientific knowledge has been generated with respect to broad patterns of use.

Aboriginal subsistence harvest occurs across the Far North Ranges but the full magnitude and extent is unknown. At the northern end of the Swan, Missisa, and James Bay Ranges, harvested caribou would be expected to include both the forest-dwelling and the forest-tundra ecotype. Of the 41 confirmed mortalities where the collars were retrieved, approximately 10% were suspected to be human-caused (Berglund et al. 2014).

Caribou within the Swan Range and, to a lesser degree, within the Spirit Range demonstrate some level of exchange across the Manitoba border. This is especially true for the Swan Range and the forest-tundra ecotype. It is presumed that the forest-dwelling ecotype in those two ranges move between Ontario and Manitoba where suitable habitat exists.

This range narrative does not represent a detailed synopsis of all important caribou use areas within the Far North Ranges.

Anthropogenic disturbance in the Far North Ranges is largely associated with remote First Nation communities and the related infrastructure including the system of current and former winter roads. The winter road networks have been upgraded with periodic changes in route to improve reliability. In addition, there is one major all-weather road that forms part of the boundary between the Kinloch and Ozhiski Ranges and a limited number of transmission corridors (e.g. electricity, fibre optics). Anthropogenic disturbance levels are generally considered low with the exception of areas with mineral exploration activity when there are high densities of linear features. Many communities have local fuel wood harvest and in some cases roundwood and pole harvest for local construction and small-scale sawmilling operations for local use.

3.5 Influence of current management direction

A number of initiatives exist to develop new policy and management direction that would apply to caribou within the Far North Ranges. These include the recently completed Cat Lake-Slate Falls Community - Based Land Use Plan (“Niigann Bimaadiziwin” – A Future Life) within the Kinloch Range, and ongoing joint processes between First Nations and Ontario to prepare draft plans in areas that address parts of all the ranges.

At the time of this assessment, five communities in the Far North of Ontario have worked with MNRF and have completed their community-based land use plans. An additional seven First

Nation communities have completed Terms of Reference. Terms of Reference formally initiate the public consultation process and means there communities are now working with the ministry towards a draft community based land use plan. Almost all First Nation communities in the Far North of Ontario are now engaged with the MNRF in the early stages of preparing a community based land use plan, from capacity building, mapping traditional knowledge, collecting background information, to preparing draft Terms of Reference.

The pace of land use planning will largely be driven by the communities. As these plans are completed and approved, there will be greater clarity on protection and development objectives within these ranges. It may be years before the plans are implemented to the stage where impacts on landscape structure or composition, or the well-being of caribou could be expected.

There is certainly increased awareness of caribou as a species at risk, the conservation concerns, and the information that was generated under the Far North Information and Knowledge Management Plan related to caribou distribution, movement, and ecology. There was also increased awareness generated by *Science for a Changing Far North* (Far North Science Advisory Panel 2010).

3.6 Major data and analysis uncertainties

Caribou of the forest-tundra ecotype annually enter the northern portions of the Swan, Missisa, and James Bay Ranges. Consequently, winter aerial surveys conducted as part of the Far North Caribou Project detected both forest-tundra and forest-dwelling caribou. It is impossible to differentiate, solely upon the winter survey data which of the observed caribou belong to which ecotype. Inferences of minimum animal count and recruitment, for the Swan Range in particular, may be heavily influenced by the presence of forest-tundra caribou. The Missisa and the James Bay Ranges have the majority of their extent occupied exclusively by the forest-dwelling ecotype.

Winter surveys conducted in 2009 and 2010 represented the first two years of a new survey technique and its application over vast landscapes. There were a large number of different observers. In the de-briefing at the end of the year, MNRF acknowledged there were challenges in the identification of adult sex ratios and the proportion of calves. There was a large number of caribou sighted that were assigned to the “unknown age and sex class”. It is possible, when applying the population trend analysis, as identified in the Protocol (MNRF 2014a), that there may be an under-estimation of the proportion of calves and an over estimation in the proportion of adult females, however, there is no way of knowing for sure.

The winter 2010 survey was terminated early due to deteriorated survey conditions including a lack of fresh snow, extreme snow-crusting, high temperatures, and rapid loss of remaining snow; some waterways were opening up as early as mid-March. This created difficulties in track identification and in the location of groups of caribou. The early termination of survey effort led to an under-representation of survey effort in the Ozhiski Range, and a repeat survey effort in parts of the Missisa Range.

Fixed-wing winter distribution surveys primarily consisted of flying linear transects on a 10 km interval hexagonal sample grid (Figure 23). However, the Kinloch Range and some southern portions of the Spirit and Ozhiski Ranges were surveyed differently using north-south linear transects that were less than 10 km apart. Observations from these surveys are used in the determination of population state as well as the occupancy analysis (specifically in the Kinloch and Ozhiski Ranges).

Most of the larger areas of disturbance in the Far North of Ontario are the results of wildfire or wind events. Several datasets are used to identify the areas disturbed. These include the fire polygons from Ontario's fire history (LIO 2014), the 2010 Far North disturbance data (LIO 2014) and the Provincial Land Cover 2012 (LIO 2012). The most accurate disturbance mapping, representing the last 20 years, is captured by the 2010 Far North disturbance dataset. Older disturbances, ranging in age from 20 to 50 years, were captured by the fire history data. Both these data sets present challenges in terms of the actual extent of the fire or wind events.

Following a disturbance event that creates a young forest condition, the forest begins to transition from young to mature when it reaches 36 years of age. In the Far North of Ontario, post-disturbance forest development patterns, particularly rates of growth, crown closure, and natural thinning, may warrant characterization of young forest as less than 50 years of age rather than 36 years of age or less. A sensitivity analysis compared of the amount of disturbance within each range when disturbance was characterized as forests < 36 years and forests < 50 years. It is unknown at this time which analysis best reflects caribou habitat value or functional habitat loss in the Far North. However the risk analysis and the range condition were based solely on the characterization of disturbance being forest less than 36 years of age.

Fire history data within the James Bay Range and the eastern portion of the Missisa Range may underestimate the amount of fire activity particularly for the time period between 1960 and 1980. At that time, aerial detection and monitoring efforts on the lowlands were not a priority.

An attempt was made to distribute assessment and collar placement activities across the Far North of Ontario. However, the remoteness of the landscape, logistical considerations, and community and airport locations had a major influence on the data collection effort. This influence was reflected in the location of re-surveyed areas during the aerial winter distribution surveys, as well as the location in which caribou were fitted with collars. Because of this, some ranges, such as the Ozhiski Range, did not have sufficient collared caribou and recruitment survey efforts to inform trend analysis in the Integrated Range Assessment. Furthermore, the delineation of the Far North Ranges occurred in 2013 and is therefore after data was collected for the Far North Caribou Project (Berglund et al. 2014). Data was retroactively apportioned to the ranges.

The James Bay Range and the east half of the Missisa Range are dominated by large peatland complexes, large river systems, and a unique expression of fire disturbance. Caribou movement patterns also vary between the shield-dominated landscapes and the lowlands. It is unclear to what degree the general application of the Environment Canada relationship between disturbance and population performance (EC 2011) applies to these types of landscapes as none were used in the development of that relationship. However, that relationship was developed based studies representing a wide variety of forest and peatland landscapes.

No gender determination was completed in the 2012 recruitment survey. The best estimates of the proportion of the population consisting of calves were interpreted based on the proportion of adult males and adult females observed in the other years of the survey.

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 stable or increasing population growth and evaluation of range status. In the Spirit, Swan, Kinloch, Ozhiski, and the western side of the Missisa Range, lakes account for a significant portion 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.

There is no data available in the Far North Ranges to determine the amount and arrangement of habitat as described in the Protocol (MNRF 2014a). For the purpose of these assessments the amount and arrangement of habitat was not considered in the determination of range condition.

3.7 Special considerations within the range

Special circumstances or conditions necessary for insightful interpretation of the Integrated Range Assessment exist on each of the Far North Ranges. These are significant physical and biological factors influencing the status of caribou, trends, or habitat use. Such factors should be considered when interpreting the results from applying the Integrated Range Assessment Framework (Figure 26).

Improved estimates of the probability of persistence will depend on the continued collection of reliable population data that incorporates sampling error and stochastic population variation, in relation to realized habitat alteration.

3.7.1 Swan Range

The Swan Range will occasionally contain abundant forest-tundra caribou, especially in the winter, but not the summer. Habitat must be able to support enough winter forage to address the needs of both the resident forest-dwelling ecotype but also the transient forest-tundra ecotype.

Calving may occur in conifer dominated uplands or poor conifer swamps separated by bogs, fens, rivers or lakes, or isolated bogs surrounded by bedrock dominated uplands.

The northern portion of this range exhibits a transition to the Hudson Bay Lowlands Ecozone and a gradual increase in the amount of land area dominated by peatlands. This range appears to correspond to similar landform and caribou population patterns in Manitoba. There is documented caribou movement between Manitoba and Ontario associated with the forest-tundra ecotype, particularly the Pen Islands herd (Berglund et al. 2014). However, it is thought that movement of forest-dwelling caribou may also exist. Caribou well-being within the Swan Range may, at some time in the future, be considered along with population and habitat state information from Manitoba. At this time, little information exists on the extent of connectivity with Manitoba. Some forest-dwelling caribou may also use habitat in the Missisa Range.

3.7.2 Spirit Range

The Spirit Range contains the large crescent-shaped Opasquia moraine, a massive peatland complex, and a very aggressive fires regime.

The Opasquia moraine and Opasquia Provincial Park represent major landforms and land use designations within the Spirit Range. These features exhibit both a very aggressive fire regime and calcareous soils resulting in abundant young and sometimes deciduous dominated forest along with relatively abundant moose. Although caribou exist throughout this area, occurrence is low.

The massive peatland complex surrounding Nikip, Magiss, Petownikip, and Sakwas lakes and east of Sandy Lake are major winter and summer habitats for forest-dwelling caribou and exhibit numerous examples of calving and nursery habitat. Throughout this range, calving occurs in conifer-dominated uplands or conifer swamp separated by bogs, fens, rivers or lakes, or isolated bogs surrounded by bedrock or mineral soil.

This range appears to correspond to similar landform and caribou population patterns in Manitoba. Caribou well-being within the Spirit Range may, at some time in the future, be considered along with population and habitat state information from Manitoba. At this time little information exists on the potential connectivity with Manitoba.

3.7.3 Kinloch Range

The Kinloch Range was part of the Measured Fire Management Zone in previous fire management strategies and this fact could account for the lower levels of fire disturbance and relatively high levels of caribou occupancy. Calving and nursery activities appear to be associated with large lakes with islands, lake and river systems, or peatland complexes.

3.7.4 Ozhiski Range

The Ozhiski Range is more disturbed than most of the Far North Ranges but is expected to have high capability for production of the forest conditions required to sustain caribou.

Caution is warranted in the interpretation of the Integrated Range Assessment results due to the limitations of available caribou collaring data

3.7.5 Missisa Range

The Missisa Range exhibits the high levels of caribou occupancy associated with the Shield-Lowlands interface and a transition from the more upland dominated landscape to the west and a more lowlands dominated landscape to the east. This context is the defining bio-physical feature that dominates the landscape and also the caribou conservation concerns.

The northern portion of the range is expected to be used by forest-tundra caribou in the winter. The western portion of the range exhibits a much more aggressive fire regime, similar to the Ozhiski Range, and very low levels of natural disturbance in the east, similar to the James Bay Range.

Calving and nursery activities are mostly associated with peatland complexes and smaller pockets of poor conifer swamp separated by more open bogs, fens or drainage channels.

3.7.6 James Bay Range

The James Bay Range is restricted to the James Bay Lowlands, and is dominated by peatlands and large river systems and is sensitive to changes in hydrology.

Most calving and nursery activities tended to be associated with island-like features within large bog and fen complexes.

The northern portion of the range is expected to be used by forest-tundra caribou in the winter.

Moose densities are low, and bear densities are thought to be relatively low.

3.8 Other wildlife

The boundaries for the Far North Ranges include all or part of Wildlife Management Units (WMU) 1C, 1D, 2, 3, 16A, 17, 18B, 25 and 26. Moose and wolf observations from aerial surveys (Figure 25) suggest higher observation rates on the Ontario Shield. Probability of occupancy for moose (Berglund et al. 2014) was also higher on the Ontario Shield. The Far North Ranges are within Cervid Ecological Zones A and B (MNR 2009b).

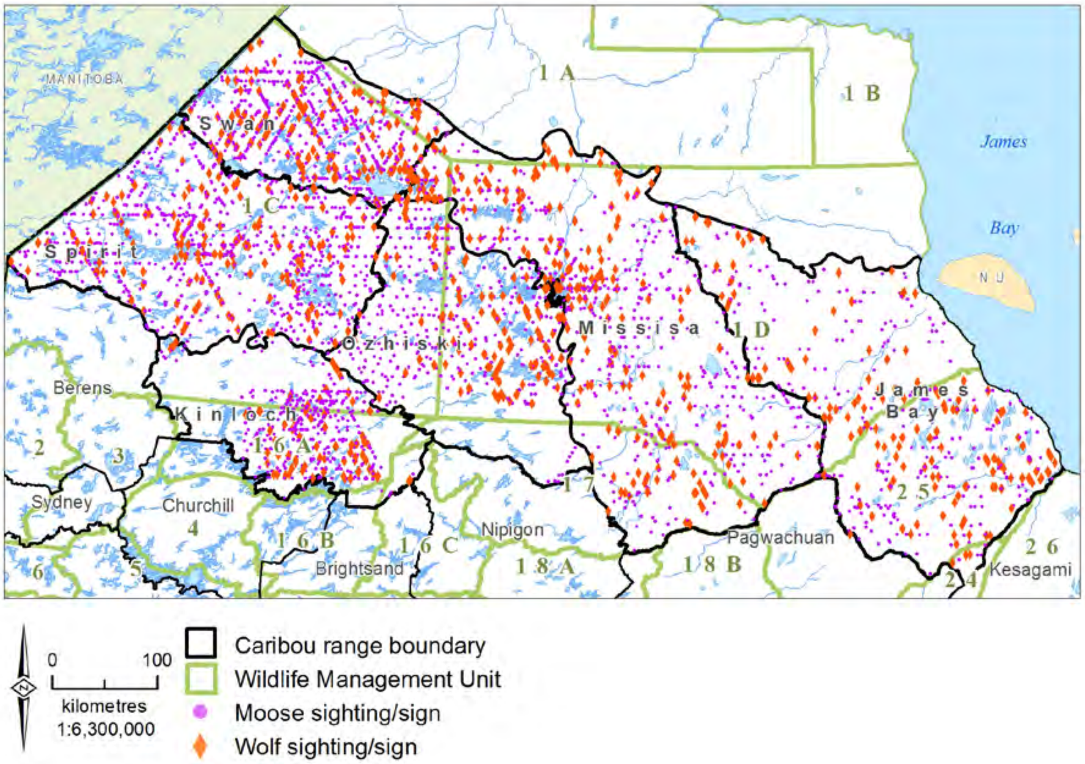

Figure 25. Wildlife Management Units overlapping the Far North Ranges[1]. Moose and wolf sightings and track observations from 2009-2011 aerial surveys.
[1]Portions of the Kinloch and Ozhiski Ranges were not surveyed from 2009-2012 (they were part of the Taashikaywin surveys in 2008-2009).

Estimated moose densities (Table 5) within the Far North Ranges are considered relatively low and likely stable. Probability of occupancy for moose and wolves is reported in Berglund et al. (2014). This information is included to provide context with other wildlife population trends, and is not used in determining range condition.

Table 4. Recent moose population estimates for Wildlife Management Units (WMU) within the Far North Ranges.

WMU	Cervid Ecological Zone	MAI strata area (km^2)	Moose population estimates no. of moose (survey year)	Moose density (moose/100km^2± 90% confidence interval)
1C	A	91,871	418 (total moose observed; 2002)	
1D	A	n/a	Has never been surveyed for moose	n/a
2	A	4,400	533 (2013)	0.12
3	B	13,000	2574 (2009)	

17	A	11,415	531 (2004)	0.05
16A	A	16,900	1300 (2010)	0.08 moose/km^2
25	A	39,593	727 (2006)	1.8 ± 0.2
26	A	27,750	1655 (2010)	5.96 +/- 0.18
18B	A	4,925	202 (2000)	4.1 ± 1.6

3.9 Results of past range assessments

No previous range assessments have been completed for these ranges in the Far North of Ontario.

4.0 Integrated Range Assessment Framework

The Protocol (MNRF 2014a) identifies the process to conduct an Integrated Range Assessment (Figure 26) 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 (Section 7) 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.

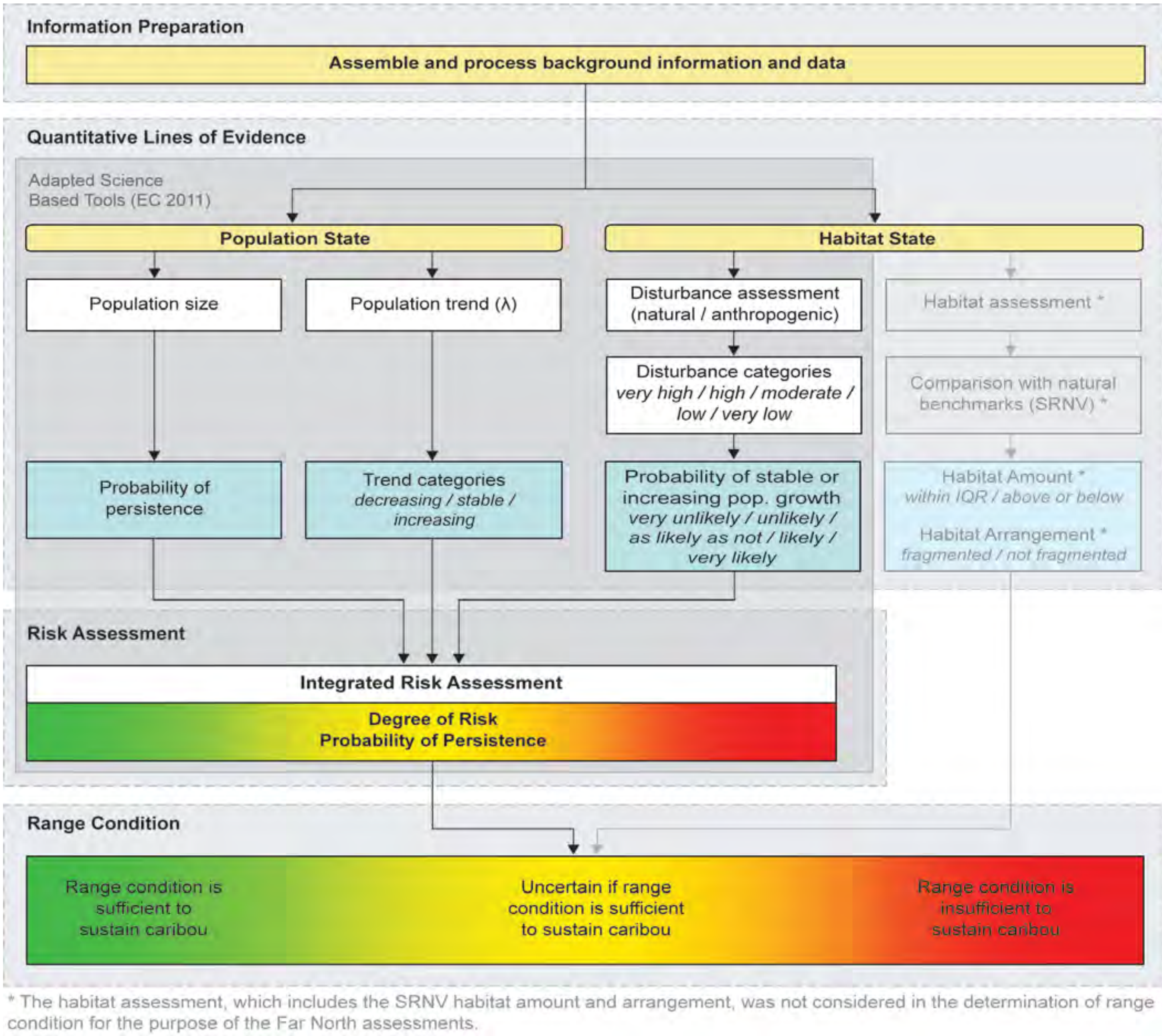

Figure 26. The integrated assessment framework with four quantitative lines of evidence. Three lines of evidence related to population size, trend and habitat disturbance assessment contribute to an integrated risk assessment. The results of the integrated risk assessment are combined with habitat assessment (fourth line of evidence), to inform the determination of range condition (MNRF 2014a).

5.0 Quantitative Lines of Evidence Methods and Results

5.1 Population state: size and trend

Caribou population health is conventionally measured in terms of population size (i.e. the number of caribou) and trend. It is preferably described by average intrinsic rate of growth, lambda (λ). The best available data is used to estimate the number of caribou and the demographic trend within the range. These are used in the integrated caribou range assessment decision framework (Figure 26).

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

Currently, estimates of survival/mortality are not available but estimates of short-term trend can be refined with the addition of survival data attained by monitoring caribou fitted with GPS collars in the late winters of 2009-2011.

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 Far North of Ontario, close to the Area of the Undertaking and within the Sioux Lookout district. These studies were primarily intended to document caribou movement and habitat use, and provide caribou information in areas of immediate interest for resource management decisions. Recruitment was not consistently assessed for these caribou and never for a whole range at any one particular time. However, the historical studies and related aerial surveys provide the best source of historic population estimates.

GPS collars were deployed in the Far North Ranges during February and March of 2009 and 2010 prior to the delineation of ranges. After range delineation occurred, individual collared caribou were considered to be representative of specific ecotypes based on demonstrated behaviour (Berglund et al. 2014), and to specific ranges based on the amount of time they spent within the range. Therefore the number of collars with which to estimate mortality estimates varied by range: Swan (6); Spirit (21); Missisa (34); James Bay (25); Ozhiski (0). Twenty collars were deployed in the Kinloch Range in 2010 with additional eight in 2011. This larger number of collars was attributed to the contributions of a larger caribou research project from which a subset of data was available to supplement the Kinloch Integrated Range Assessment.

5.1.1.2 Winter aerial surveys

Fixed-wing hexagon-based occupancy surveys were conducted over large areas throughout the Far North Ranges during the months of February or March of 2009 to 2011 (Berglund et al. 2014). All caribou and sign 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.

Rotary-wing surveys re-visited areas where caribou were sighted 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.

5.1.1.3 Recruitment

Recruitment estimates follow the Protocol (MNRF 2014a). For each range, observed sex ratios of known adults obtained from aerial surveys conducted in 2009-2013 were used to estimate the number of adult females present in the groups containing animals classified as unknown adults. This adjusted number of adult females was used to estimate recruitment (MNRF 2014a). Only caribou groups for which 50% or more of the group identified as being either adults or calves were included in the estimation of adult sex ratio and recruitment.

5.1.1.4 Trend

Generally, in forest-dwelling caribou, a stable population requires a late-winter estimate of at least 12-15% calves in a non-hunted population with a density of 0.06 caribou per square kilometre (Bergerud 1992; 1996). Recruitment rates exceeding 28 calves per 100 adult females would suggest the population is increasing. Recruitment rates below this value would suggest the population is decreasing based on assumed adult survival rates of 85% (EC 2008). The relationship between annual estimates of recruitment and adult female survival was used to provide an estimate of trend (λ) (Hatter and Bergerud 1991).

Trend Estimation

We estimated annual population growth (λ) 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, we used data from all adult female collared caribou that had the majority of their telemetry locations (>50%) within the Far North Ranges.

5.1.1.5 Size

The aerial survey methodology used to conduct a probability-based occupancy survey (Section3.3) 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 during the time of the survey. 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

5.1.2.1 Swan Range

Aerial surveys that contributed to the population state analysis for the Swan Range Integrated Range Assessment were flown in the winters of 2009, 2011, and 2012.

In 2009, a total of 233 caribou were observed during winter distribution flights after removing recounts. In 2011, 898 animals were observed during winter distribution flights and targeted recruitment flights. In winter 2012, 123 caribou were observed during targeted recruitment flights (Table 6).

The minimum animal count (MAC) in the Swan Range is 491 caribou, based on observations from the winter distribution survey results from 2009 and 2011. Estimates for the two survey years were combined for complete range coverage according to the hexagon grid with minimal overlap or spatial gaps between survey areas.

The number of calves varied somewhat from year-to-year with the greatest numbers counted in 2011 (57 calves). Only 11 calves were observed in 2009, and 16 calves were observed during flights in 2012.

In 2009, the sex ratio of known adult females to known adult males observed during the winter distribution survey was 0.401. Using the sex ratio to determine the number of adjusted adult females (AF_{adj}) resulted in recruitment of 11.4 calves per 100 (AF_{adj}) and 5.39% calves. Recruitment of the 2011 targeted recruitment flights was 17.35 calves per 100 AF_{adj}. Recruitment in 2012 was 20.99 calves per 100 AF_{adj} (Table 7; Figure 27& Figure 28). All estimates are well below the identified threshold of 28.9 calves per 100 AF_{adj} and consistent with studies in which populations were known to be in decline (Rettie and Messier 1998; McLoughlin et al. 2003; EC 2008).

Table 5. Counts of caribou and estimates of recruitment in the winters of 2009, 2011, and 2012 in the Swan Range.

		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]
2009	Winter Distribution	56	63	74	11	29	188	233	0.401	96.46	11.40	5.39
2011	Winter Distribution	4	0	3	6	245	7	258	1.000[4]	n/a[5]	n/a[5]	46.15
2011	Targeted Recruitment	243	28	103	51	215	374	640	0.786	294.00	17.35	n/a[6]
2012	Targeted Recruitment	97			16		97	123	0.786	76.24	20.99	n/a[6]

[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 collared adult females and therefore represents a less biased survey for calculating percentage of calves in the population
[4]Value of 1.000 based on one group of animals; confidence in this value is low.
[5]Due to bias created by targeting collared adult female caribou during recruitment surveys, % calves not applicable from recruitment survey data
[6]Sample size too small to calculate

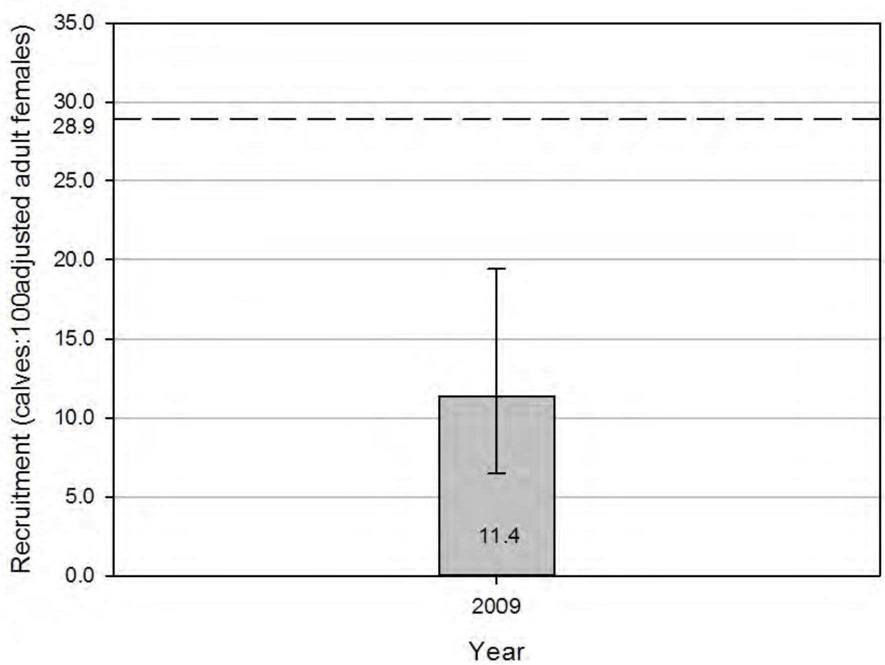

Figure 27. Swan Range recruitment estimates (calves per 100 AF_{adj}) with associated 95% confidence intervals from the 2009 winter distribution survey. Dashed line indicates recruitment level expected for a stable to increasing population (EC 2008).

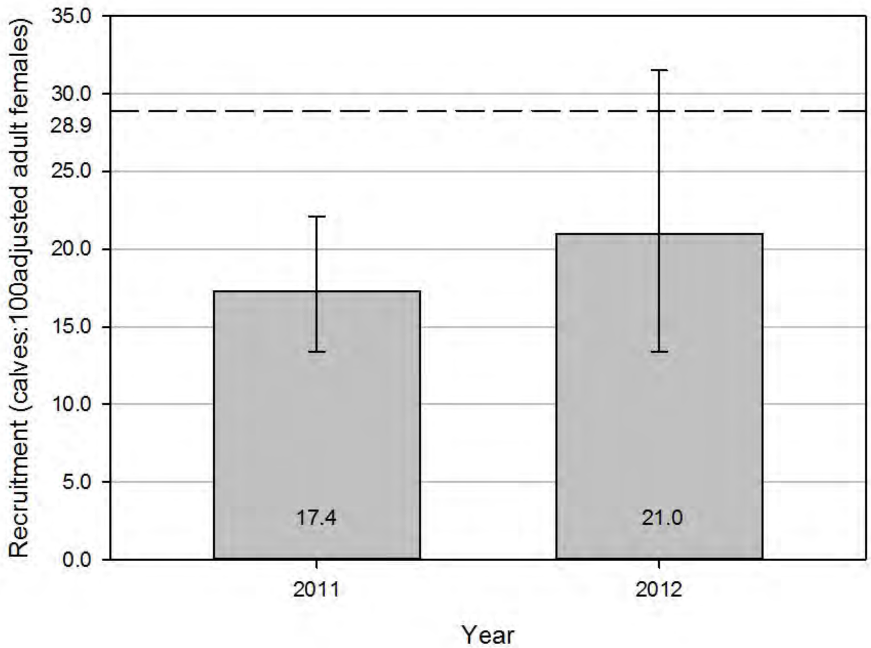

Figure 28. Swan Range recruitment estimates (calves per 100 AF_{adj}) with associated 95% confidence intervals from the targeted recruitment surveys in 2011 and 2012. Dashed line indicates recruitment level expected for a stable to increasing population (EC 2008).

Annual survival was not estimated for the Swan Range as only one collared caribou was assigned to this range. No lambda estimate was determined. The recruitment values of 17.4 and 21.0 suggest that the population is likely declining.

5.1.2.2 Spirit Range

Aerial surveys that contributed to the population state analysis for the Spirit Range Integrated Range Assessment were flown each winter between 2009 and 2012.

In 2009, a total of 296 caribou were observed during winter distribution flights after removing recounts. The following winter (2010), a total of 230 animals were observed during winter distribution flights and targeted recruitment flights. In the winters of 2011 and 2012, 109 and 197 caribou were observed during targeted recruitment flights, respectively (Table 8).

The minimum animal count (MAC) in the Spirit Range is 373 caribou, based on observations from the winter distribution survey results from 2009 and 2010. Estimates for the two survey years were combined for complete range coverage according to the hexagon grid with minimal overlap or spatial gaps between survey areas.

The number of calves varied somewhat from year-to-year with the greatest numbers counted in 2009 (26) and 2010 (28). Only 11 and 19 calves were observed during the 2011 and 2012 flights, respectively.

In 2009, the sex ratio of known adult females to known adult males observed during the winter distribution survey was 0.610. Using the sex ratio to determine the number of adjusted adult females resulted in recruitment of 41.05 calves per 100 adjusted AF_{adj} and 19.55% calves, which was the highest documented values; it was lowest in 2012 at 12.51 calves per 100 AF_{adj} (Table 7; Figure 29 & Figure 30). Although the 2009 estimate was high, all subsequent years were well below the identified threshold of 28.9 calves per 100 AF_{adj} and consistent with studies in which populations were known to be in decline (Rettie and Messier 1998; McLoughlin et al. 2003; EC 2008).

Table 6. Counts of caribou and estimates of recruitment in the winters of 2009, 2010, 2011, and 2012 in the Spirit Range.

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]
2009	Winter Distribution	53	23	31	26	163	107	296	0.610	63.33	41.05	19.55
2010	Winter Distribution	39	11	8	5	14	58	77	0.610[4]	31.79	15.73	7.94
2010	Targeted Recruitment	130			23		130	153	0.853	110.89	20.74	n/a[5]
2011	Targeted Recruitment	36	8	24	11	30	68	109	0.853	54.71	20.11	n/a[5]
2012	Targeted Recruitment	178			19		178	197	0.853	151.83	12.51	n/a[5]

[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 collared adult females and therefore represents a less biased survey for calculating percentage of calves in the population
[4]Based on only two groups of caribou so 2009 sex ratio was used here.
[5]Due to bias created by targeting collared adult female caribou during recruitment surveys, % calves not applicable from recruitment survey data

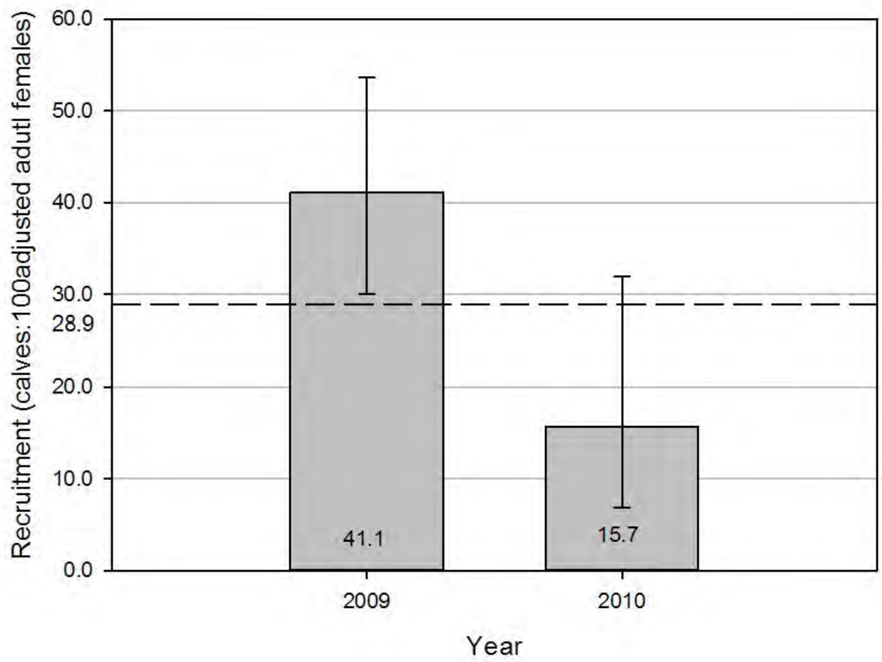

Figure 29. Spirit Range recruitment estimates (calves per 100 AF_{adj}) with associated 95% confidence intervals from the 2009 and 2010 winter distribution surveys. Dashed line indicates recruitment level expected for a stable to increasing population (EC 2008).

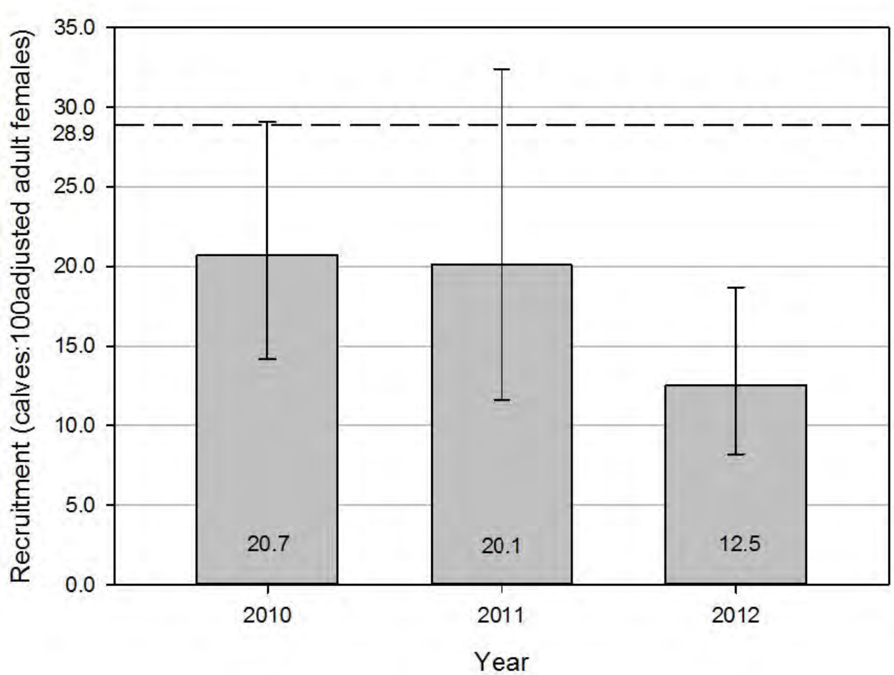

Figure 30. Spirit Range recruitment estimates (calves per 100 AF_{adj}) with associated 95% confidence intervals from the 2010-2012 targeted recruitment surveys. Dashed line indicates recruitment level expected for a stable to increasing population (EC 2008).

Annual survival was estimated for all collared adult females that spent the majority of their time (>50%) within the Spirit Range during the biological year (April 1st-March 31st). The survival rate for adult females ranged from 0.75-1.0 with a geometric mean of 0.88 (Table **7**8 and Figure 31), which is comparable to the assumed average adult female survival of 0.85 (EC 2008). Using these estimates of survival and the 2009-2012 recruitment estimates we calculated a mean annual population growth rate (λ) of 0.95 (range 0.93-1.06), suggesting that the short-term population trend is likely declining.

Table 7. Annual survival rates (*S*) and population growth rates (λ) of collared adult female caribou (*n*) and number of mortalities (*d*) during 2008-2011 biological years (April 1st-March 31st), in the Spirit Range.

Biological year	*n*	*d*	Exposure days	Daily survival rate	*S*	Upper 95% CI	Lower 95% CI	λ
2008					0.88			1.06
2009	21	2	7330	0.9997	0.91	1.00	0.79	1.00
2010	19	5	6216	0.9992	0.75	0.96	0.58	0.82
2011	14	0	4810	1.0000	1.00[1]	1.00	1.00	0.93
Geometric mean survival rate (2009-11)[2]					**0.88**	**Geometric mean λ (2008-11)**		**0.95**

[1]It was assumed that a survival rate of 1.0 was not biologically reasonable to estimate a population growth rate (λ) in 2011; therefore the geometric mean survival rate (2009-2011) was used.

[2]The geometric mean survival rate from 2009- 2011 was used to estimate population growth rate (λ) for the 2008 and 2011 biological years.

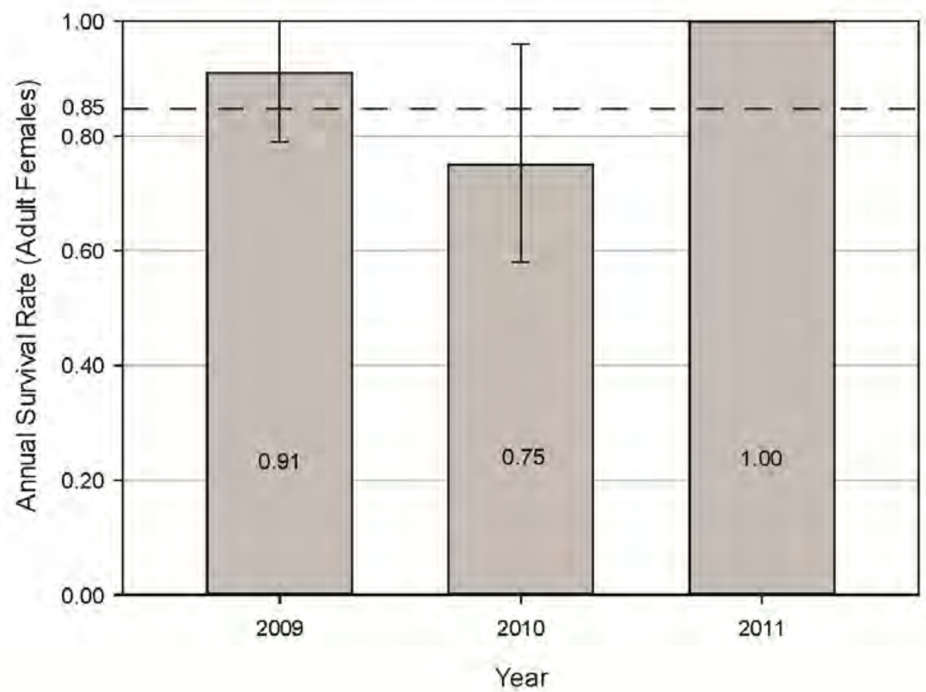

Figure 31. Annual survival rate and 95% confidence intervals of collared adult female caribou that spent the majority of the biological year (April 1st-March 31st) within the Spirit Range. Dashed line represents the 85% survival rate (EC 2008).

5.1.2.3 Kinloch Range

Aerial surveys that contributed to the population state analysis for the Kinloch Range Integrated Range Assessment were flown each winter between 2010 and 2013.

In 2010, a total of 27 caribou were observed during winter distribution flights in the Kinloch Range after removing possible recounts. In winters 2011, 2012 and 2013, 247, 332 and 173 caribou were observed during targeted recruitment flights, respectively (Table 8).

The minimum animal count (MAC) in the Kinloch Range is 113 caribou, based on the combined observations from the Northern Boreal Initiative surveys (see section 3.3) from 2008 and 2009, and the winter 2010.

The number of calves varied somewhat from year-to-year with the greatest number counted in 2012 (33 calves). Two calves were observed during the winter distribution survey in 2010, although the survey only covered a very small portion of the Kinloch Range, while 14 and 21 calves were observed in the 2011 and 2013 targeted recruitment flights, respectively.

Recruitment estimates were not calculated for the winter distribution estimates. Between 2011 and 2013, recruitment ranged from 7.59-20.62 calves per 100 AF_{adj} (Table 89; Figure 32). All estimates are well below the identified threshold of 28.9 calves per 100 AF_{adj} and consistent with studies in which populations were known to be in decline (Rettie and Messier 1998; McLoughlin et al. 2003; EC 2008).

Table 8. Counts of caribou and estimates of recruitment in the winters from 2008-2013 in the Kinloch Range.

		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]
2008	NBI Winter Distribution[4]				3	72		75	n/a[4]	n/a[4]	n/a[4]	n/a[4]
2009	NBI Winter Distribution[4]	9		1	1		10	11	n/a[4]	n/a[4]	n/a[4]	n/a[4]
2010	Winter Distribution	11	3	2	2	9	16	27	0.000	n/a	n/a	11.11
2011	Targeted Recruitment	65	6	122	14	40	193	247	0.960	184.40	7.59	n/a[5]
2012	Targeted Recruitment	299			33		299	332	0.788	235.61	14.01	n/a[5]
2013	Targeted Recruitment	29	44	79	21	0	152	173	0.788	101.85	20.62	n/a[5]

[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 collared adult females and therefore represents a less biased survey for calculating percentage of calves in the population
[4]2008 and 2009 survey from the Northern Boreal Initiative project, data used for MAC but not recruitment.
[5]Due to bias created by targeting collared adult female caribou during recruitment surveys, % calves not applicable from recruitment survey data

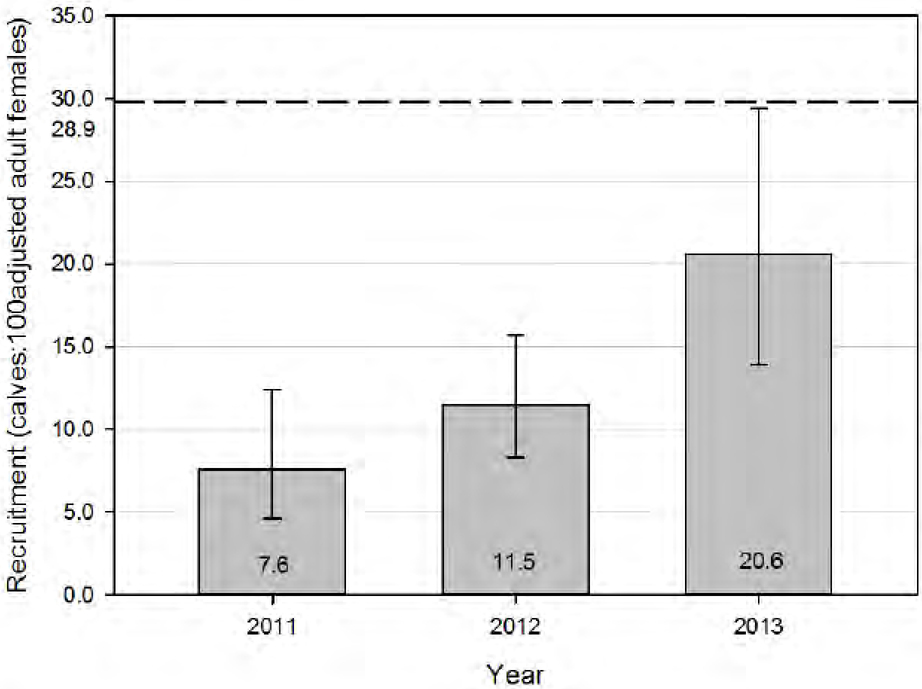

Figure 32. Kinloch Range recruitment estimates (calves per 100 AF_{adj}) with associated 95% confidence intervals from the 2011-2013 targeted recruitment surveys. Dashed line indicates recruitment level expected for a stable to increasing population (EC 2008).

Annual survival was estimated for all collared adult females that spent the majority of their time within the Kinloch Range during the biological year (April 1st-March 31st). The survival rate for adult females was between 0.85-0.98 with a geometric mean of 0.89 (Table 90 and Figure 33). These estimates are comparable or better than the assumed mean annual adult female survival of 0.85 (EC 2008). Using these estimates of survival and the 2011-2013 recruitment estimates we calculated a mean annual population growth rate (λ) of 0.95 (range 0.91-1.01), suggesting that the short-term population trend is likely declining.

Table 9. Annual survival rates (*S*) and population growth rates (λ) of collared adult female caribou (*n*) and number of mortalities (*d*) during 2010-2012 biological years (April 1st-March 31st), in the Kinloch Range.

Biological year	*n*	*d*	Exposure days	Daily survival rate	*S*	Upper 95% CI	Lower 95% CI	λ
2010	43	1	14801	0.9999	0.98	1.00	0.93	1.01
2011	46	6	14116	0.9996	0.86	0.97	0.76	0.92
2012	43	6	13347	0.9996	0.85	0.97	0.74	0.94
Geometric mean survival rate (2010-12)					**0.89**	**Geometric mean λ (2010-12)**		**0.95**

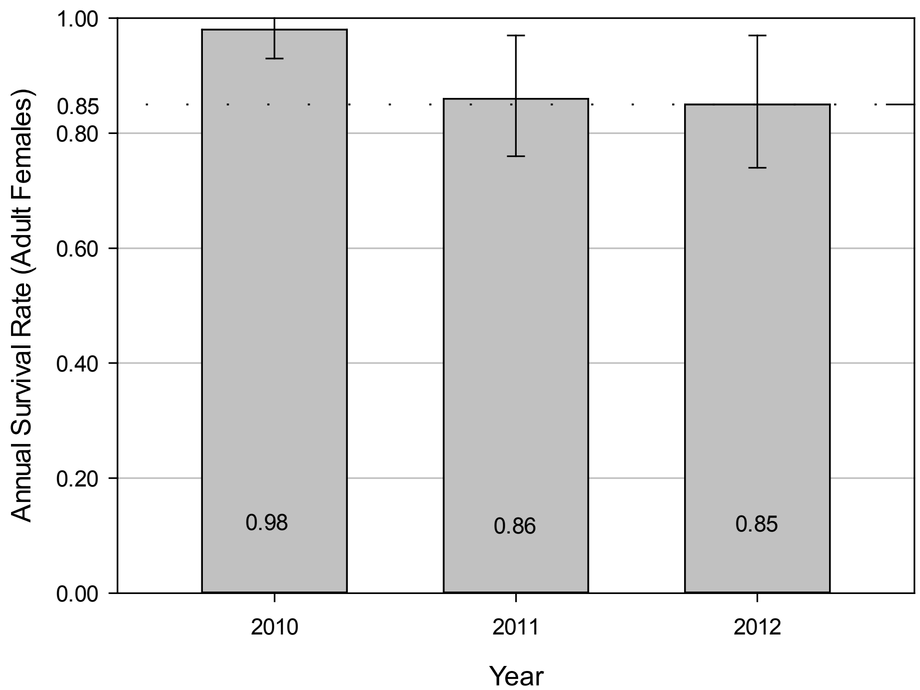

Figure 33. Annual survival rate and 95% confidence intervals of collared adult female caribou that spent the majority of the biological year (April 1st-March 31st) within the Kinloch Range. Dashed line represents the 85% survival rate (EC 2008).

5.1.2.4 Ozhiski Range

Aerial surveys that contributed to the population state analysis for the Ozhiski Range Integrated Range Assessment were flown each winter between 2010 and 2013.

A total of 5, 133 and 57 caribou were observed during 2009, 2010 and 2011, respectively, during the NBI, winter distribution, and targeted recruitment flights in the Ozhiski Range, after removing recounts (Table 10). Thirty-two and 12 caribou were observed in the winters of 2012 and 2013, respectively, during targeted recruitment flights (Table 10). Five caribou were also observed during the 2009 winter distribution survey.

The minimum animal count (MAC) in the Ozhiski Range is 148 caribou, based on observations from the 2009-2011 winter distribution surveys. Estimates for the surveys were combined for more complete range coverage with minimal overlap or spatial gaps between survey areas.

The greatest number of calves was observed in the 2010 winter distribution survey (11 calves). Otherwise, the number of calves ranged from 1-3 among the other survey years.

Recruitment was 28.69 calves per 100 AF_{adj} with 10.78% calves based on the 2010 winter distribution survey whereas recruitment was 17.86 calves per 100 AF_{adj} based on the targeted recruitment survey during the same year. Between 2011 and 2013, recruitment ranged from 7.00-60.00 calves per 100 AF_{adj} (Table 10; Figure 34 and Figure 35). Only the 2010 and 2013 (small sample size) winter distribution recruitment estimates are comparable or greater than the identified threshold of 28.9 calves per 100 AF_{adj} and consistent with studies in which populations were known to be in decline (Rettie and Messier 1998; McLoughlin et al. 2003; EC 2008), although the 2013 estimate of 60 calves per 100 AF_{adj} was based on a comparatively small sample size.

Table 10. Counts of caribou and estimates of recruitment in the winters of 2009-2013 in the Ozhiski Range.

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]**
2009[4]	NBI Winter Distribution	3		1	1		4	5	n/a[4]	n/a[4]	n/a[4]	n/a[4]
2010	Winter Distribution	57	20	14	11	15	91	117	0.427	38.34	28.69	10.78
2010	Targeted Recruitment	14			2		14	16	0.800	11.20	17.86	n/a[6]
2011	Winter Distribution	3	9	13	1	0	25	26	0.427[5]	14.28	7.00	3.85
2011	Targeted Recruitment	7	6	15	3	0	28	31	0.800	20.60	14.56	n/a[6]
2012	Targeted Recruitment	30			2		30	32	0.800	24.00	8.33	n/a[6]
2013	Targeted Recruitment	1	4	4	3	0	9	12	1.000	5.00	60.00	n/a[6]

[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 collared adult females and therefore represents a less biased survey for calculating percentage of calves in the population
[4]From 2009 survey from the Northern Boreal Initiative project, data used to calculate MAC but not recruitment
[5]Based on three observations; therefore used the 2010 sex ratio for 2011.
[6]Due to bias created by targeting collared adult female caribou during recruitment surveys, % calves not applicable from recruitment survey data

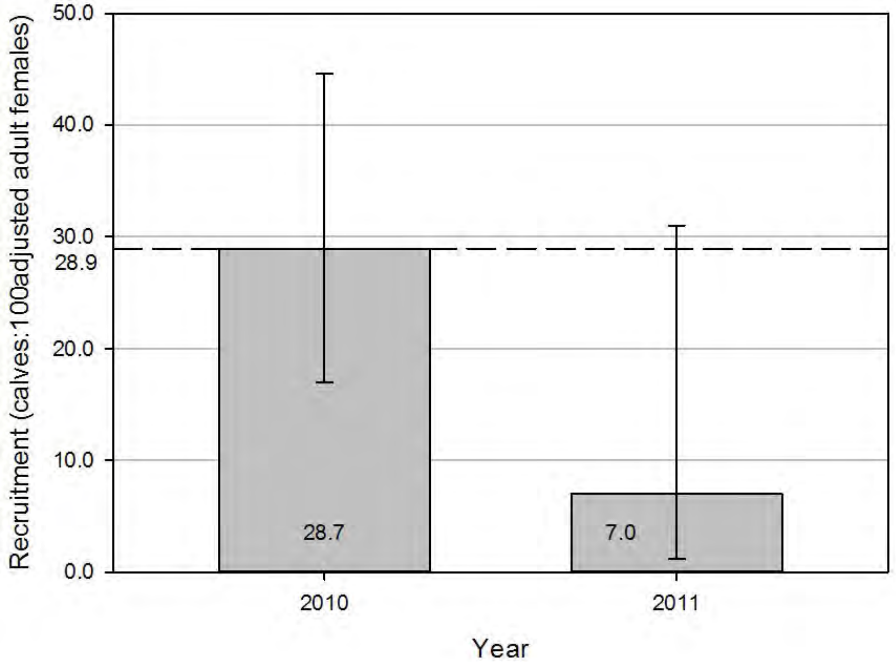

Figure 34. Ozhiski Range recruitment estimates (calves per 100 AF_{adj}) with associated 95% confidence intervals from the 2010 and 2011 winter distribution surveys. Dashed line indicates recruitment level expected for a stable to increasing population (EC 2008).

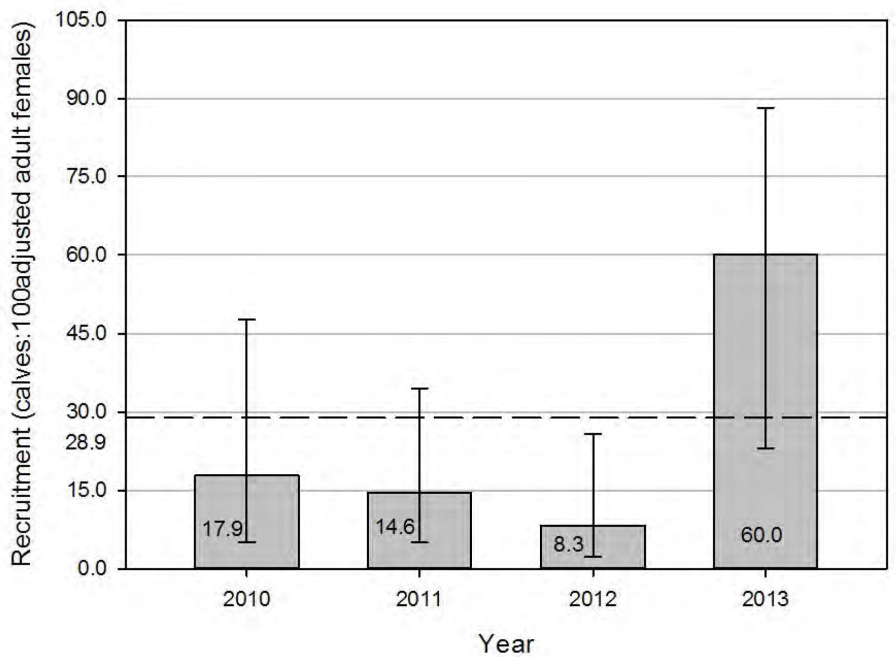

Figure 35. Ozhiski Range recruitment estimates (calves per 100 AF_{adj}) with associated 95% confidence intervals from the 2010-2013 targeted recruitment surveys. Dashed line indicates recruitment level expected for a stable to increasing population (EC 2008).

Annual survival was not estimated for the Ozhiski Range as only three collared caribou were assigned to this range. No lambda estimate was determined. Varying recruitment estimates as another trend indicator suggests that the population may be stable or declining.

5.1.2.5 Missisa Range

Aerial surveys that contributed to the population state analysis for the Missisa Range Integrated Range Assessment were flown each winter between 2009 and 2013.

In 2009, a total of 164 caribou were observed during winter distribution flights in the Missisa Range, after removing recounts. The following winter (2010), 577 caribou were observed during distribution flights and targeted recruitment flights. In winters of 2011, 2012 and 2013, 328, 447, and 11 caribou were observed during the targeted recruitment flights, respectively (Table 12).

The minimum animal count (MAC) in the Missisa Range is 745 caribou, based on observations from the winter distribution survey results from 2009 to 2011. Estimates for the three survey years were combined for complete range coverage according to the hexagon grid with minor overlap and spatial gaps between survey areas or flightlines. 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 Missisa Range. The number of calves varied somewhat from year-to-year with the greatest numbers counted in 2011 (30); all other surveys yielded 18 calves or less.

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. Between 2009 and 2013, sex ratios ranged between 0.549 and 0.889. Using the sex ratios to determine the number of adjusted adult females resulted in recruitment of between 0-22.21 calves per 100 AF_{adj} (Table 12; Figure 36 and Figure 37), although the estimate in 2013 (0 calves per 100 AF_{adj}) was based on a small sample size. All estimates were well below the identified threshold of 28.9 calves per 100 AF_{adj} and consistent with studies in which populations were known to be in decline (Rettie and Messier 1998; McLoughlin et al. 2003; EC 2008).

Table 11. Counts of caribou and estimates of recruitment in the winters from 2009 to 2013 in the Missisa Range.

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]
2009	Winter Distribution	12	36	57	6	53	105	164	0.591	64.09	9.36	5.41
2010	Winter Distribution	56	42	101	17	119	199	335	0.698	140.09	12.14	7.87
2010	Targeted Recruitment	225			17		225	242	0.844	190.00	8.95	n/a[6]
2011	Winter Distribution	42	45	112	30	17	199	246	0.549	135.06	22.21	13.10
2011	Targeted Recruitment	25	5	33	12	7	63	82	0.844	54.10	22.18	n/a[6]
2012	Targeted Recruitment	129			18		129	447	0.844	108.88	16.53	n/a[6]
2013	Targeted Recruitment	2	1	8	0	0	11	11	0.889	9.78	0.00	n/a[6]

[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 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

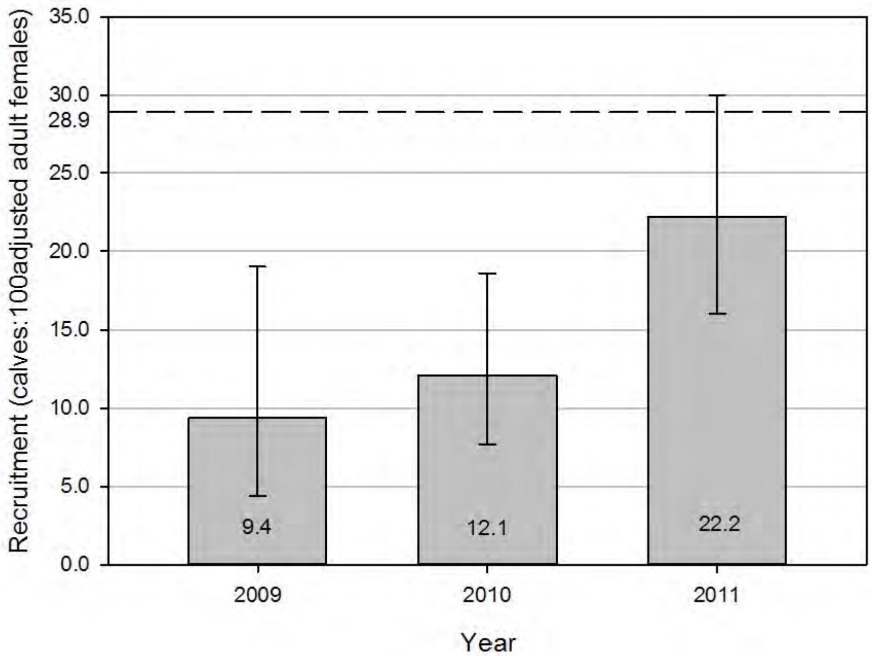

Figure 36. Missisa Range recruitment estimates (calves per 100 AF_{adj}) with associated 95% confidence intervals from the 2009-2011 winter distribution surveys. Dashed line indicates recruitment levels expected for a stable to increasing population (EC 2008).

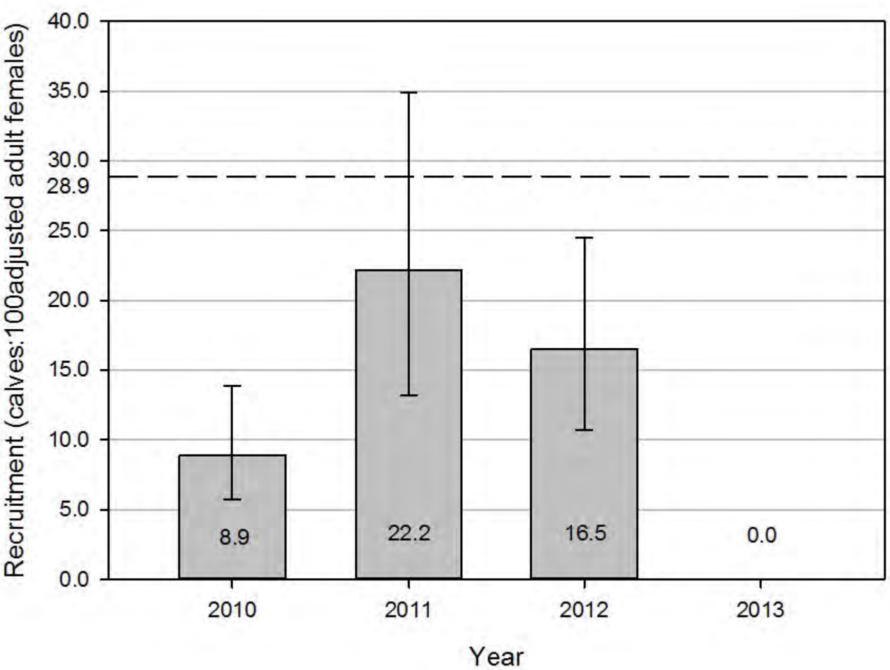

Figure 37. Missisa Range recruitment estimates (calves per 100 AF_{adj}) with associated 95% confidence intervals from the 2010-2013 targeted recruitment surveys. Dashed line indicates recruitment levels expected for a stable to increasing population (EC 2008).

Annual survival was estimated for all collared adult females that spent the majority of their time within the Missisa Range during the biological year (April 1st-March 31st). The survival rate for adult females was between 0.69-0.87 with a geometric mean of 0.80 (Table 123 and Figure 38). These estimates are below the assumed average adult female survival of 85% (EC 2008). Using these estimates of survival and the 2009-2012 recruitment estimates, a mean annual population growth rate (λ) of 0.86 (range 0.73-0.97) was calculated, suggesting that the short-term population trend is likely declining.

Table 12. Annual survival rates (*S*) and population growth rates (λ) of collared adult female caribou (*n*) and number of mortalities (*d*) during 2008-2011 biological years (April 1st – March 31st), in the Missisa Range.

Biological year	*n*	*d*	Exposure days	Daily survival rate	*S*	Upper 95% CI	Lower 95% CI	λ
2008					0.80[1]			0.84
2009	*22*	*7*	6902	0.9990	0.69	0.91	0.52	0.73
2010	15	2	5384	0.9996	0.87	1.00	0.72	0.97
2011	14	2	4324	0.9995	0.84	1.00	0.67	0.91
Geometric mean survival rate (2009-11)					**0.80**	**Geometric mean λ (2008-2011)**		**0.86**

[1] The geometric mean survival rate from 2009-2011 was used to estimate population growth rate (λ) for the 2008 biological year.

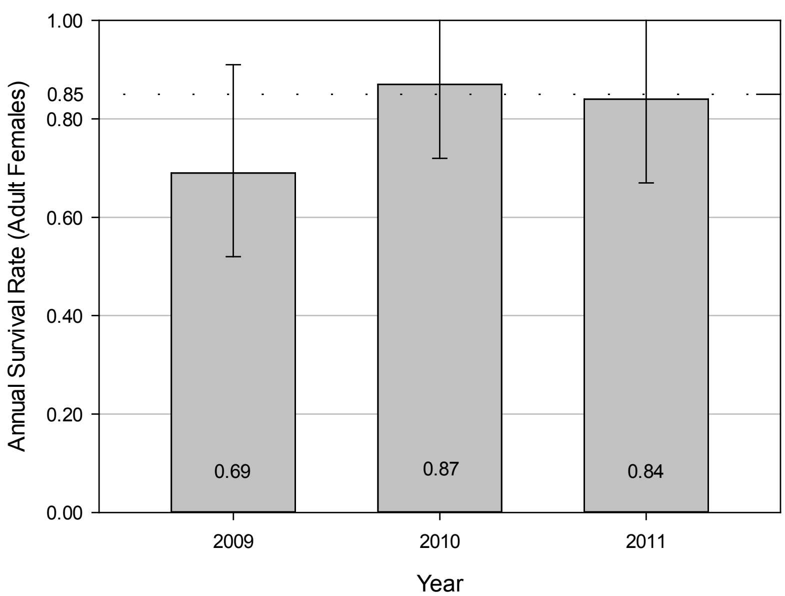

Figure 38. Annual survival rate and 95% confidence intervals of collared adult female caribou which spent the majority of the biological year (April 1st-March 31st) within the Missisa Range. Dashed line represents the 85% survival rate (EC 2008).

5.1.2.6 James Bay Range

Aerial surveys that contributed to the population state analysis for the James Bay Range Integrated Range Assessment were flown each winter between 2010 and 2013.

In 2010, a total of 210 caribou were observed during winter distribution and targeted recruitment flights in the James Bay Range, after removing recounts. The following winter (2011), 39 caribou were observed during distribution and targeted recruitment flights. In the winters of 2012 and 2013, 96, and 57 caribou were observed during the targeted recruitment flights, respectively (Table 7).

The minimum animal count (MAC) in the James Bay Range is 177 caribou, based on observations from the winter distribution survey results from 2010 and 2011. Estimates for the two survey years were combined for complete range coverage according to the hexagon grid with minimal overlap or spatial gaps between survey areas.

The number of calves varied somewhat from year-to-year with the greatest numbers counted in 2012 (25); all other surveys yielded 12 calves or less.

Between 2010 and 2013, sex ratios ranged between 0.699-1.00. Using the sex ratios to determine the number of adjusted adult females resulted in recruitment of between 9.54-45.91 calves per 100 adjusted females (AF_{adj}) (Table 134; Figure 39 and Figure 40). All but one (2012) estimate were below the identified threshold of 28.9 calves per 100 AF_{adj} and consistent with studies in which populations were known to be in decline (Rettie and Messier 1998; McLoughlin et al. 2003; EC 2008).

Table 13. Counts of caribou and estimates of recruitment in the winters from 2010-2013 in the James Bay Range.

		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	23	39	71	12	21	133	166	0.699	87.08	13.78	8.28
2010	Targeted Recruitment	41			3		41	44	0.767	31.45	9.54	n/a[5]
2011	Winter Distribution	1	0	1	1	8	2	11	1.000[4]	n/a	n/a	33.33
2011	Targeted Recruitment	0	3	20	5	0	23	28	1.000	20.00	25.00	n/a[5]
2012	Targeted Recruitment	71			25		71	96	0.767	54.46	45.91	n/a[5]
2013	Targeted Recruitment	3	12	36	6	0	51	57	0.767	38.30	15.67	n/a[5]

[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 collared adult females and therefore represents a less biased survey for calculating percentage of calves in the population
[4]Value of 1.000 based on one group of animals; confidence in this value is low
[5]Due to bias created by targeting collared adult female caribou during recruitment surveys, % calves not applicable from recruitment survey data

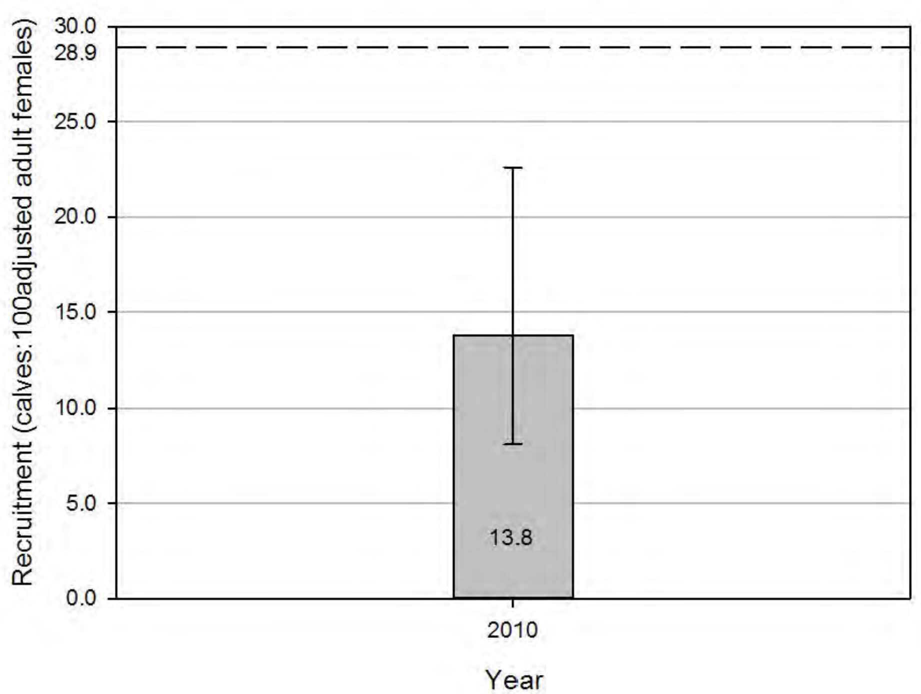

Figure 39. James Bay recruitment estimates (calves per 100 AF_{adj}) with associated 95% confidence intervals from the 2010 winter distribution survey. Dashed line indicates recruitment level expected for a stable to increasing population (EC 2008).

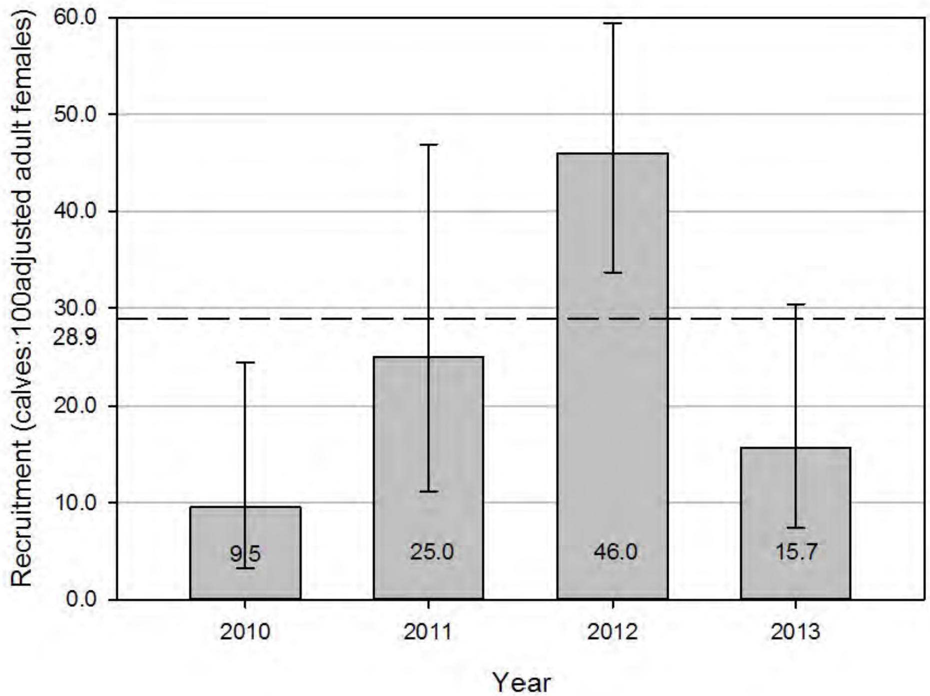

Figure 40. James Bay Range recruitment estimates (calves per 100 AF_{adj}) with associated 95% confidence intervals from 2010-2013 targeted recruitment surveys. Dashed line indicates recruitment level expected for a stable to increasing population (EC 2008).

Annual survival was estimated for all collared adult females that spent the majority of their time within the James Bay Range during the biological year (April 1st-March 31st). The survival rate for adult females was between 0.78-1.00 with a geometric mean of 0.84 (Table 145 and Figure 41). These estimates are comparable with the assumed average adult female survival of 85% (EC 2008). Using these estimates of survival and the 2009-2012 recruitment estimates, we calculated a mean annual population growth rate (λ) of 0.91 (range 0.83-0.95), suggesting that the short-term population trend is likely declining.

Table 14. Annual survival rates (*S*) and population growth rates (λ) of collared adult female caribou (*n*) and number of mortalities (*d*) during 2009-2012 biological years (April 1st – March 31st), in the James Bay Range.

Biological year	*n*	*d*	Exposure days	Daily survival rate	*S*	Upper 95% CI	Lower 95% CI	λ
2009	9	2	2881	0.9993	0.78	1.10	0.55	0.83
2010	7	0	5384	1.0000	1.00[1]	1.00	1.00	0.95
2011	9	3	4324	0.9993	0.78	1.03	0.58	0.95
2012					0.84			0.91
Geometric mean survival rate (2009-11)[2]					**0.84**	**Geometric mean λ (2009-12)**		**0.91**

[1]It was assumed that a survival rate of 1.0 was not biologically reasonable to estimate a population growth rate (λ) in 2010; therefore the geometric mean survival rate (2009-2011) was used.
[2]The geometric mean survival rate from 2009-2011 was used to estimate population growth rate (λ) for the 2010 and 2012 biological year.

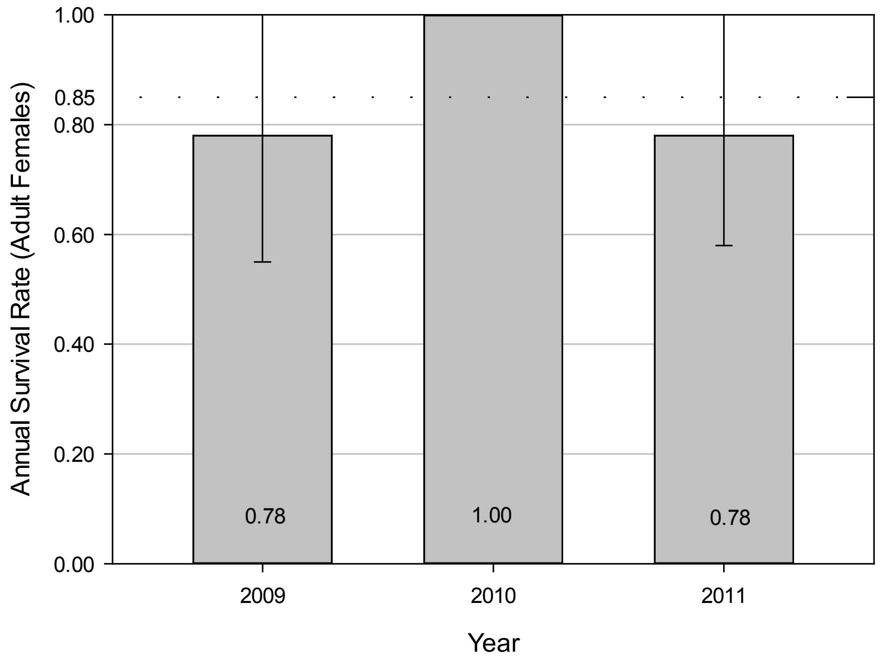

Figure 41. Annual survival rate and 95% confidence intervals of collared adult female caribou which spent the majority of the biological year (April 1st-March 31st) within the James Bay Range. Dashed line represents the 85% survival rate (EC 2008)

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5.2 Habitat state: disturbance and habitat

5.2.1 Disturbance assessment

The disturbance analysis is intended to reflect the loss or conversion 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 forest age was available, young forest was defined as being less than 36 years of age (MNRF 2014a). However, the annual mean temperature in the Far North Ranges is 1-3 C° cooler than the southern ranges, thereby reducing the mean growing season length by 10-20 days (McKenney et al. 2010; Watson and MacIver 1995). Consequently, the age at which forest stands are expected to transition, through the process of succession, from young to mature forest may be later than the 36 years described within the Protocol (MNRF 2014a). As a result, a sensitivity analysis was conducted

in which the definition of young forest was defined as being less than 50 years of age (section 5.2.2.5). 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.
The area in the Far North of Ontario does not have FRI coverage, so various LIO (2014) data sources such as cuts and burns associated with the provincial land cover layers were considered as young forest 36 (and 50) years of age or less.

Anthropogenic disturbance types included infrastructure, industrial and resource extraction activities, and physical recreational features (MNRF 2014a) such as:

i. Infrastructure
    - airports sites
    - rail lines
    - 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.

5.2.2 Disturbance analysis results

The physical disturbance from various sources within the Far North Ranges (Figure 42 to Figure 46) contributes to the cumulative disturbance footprint (Figure 47, Figure 48, and Figure 49). Sections 5.2.2.1-5.2.2.5 describes the disturbance contributions of other industry, linear features, mineral development, tourism, and natural disturbances.

5.2.2.1 Other industry disturbance

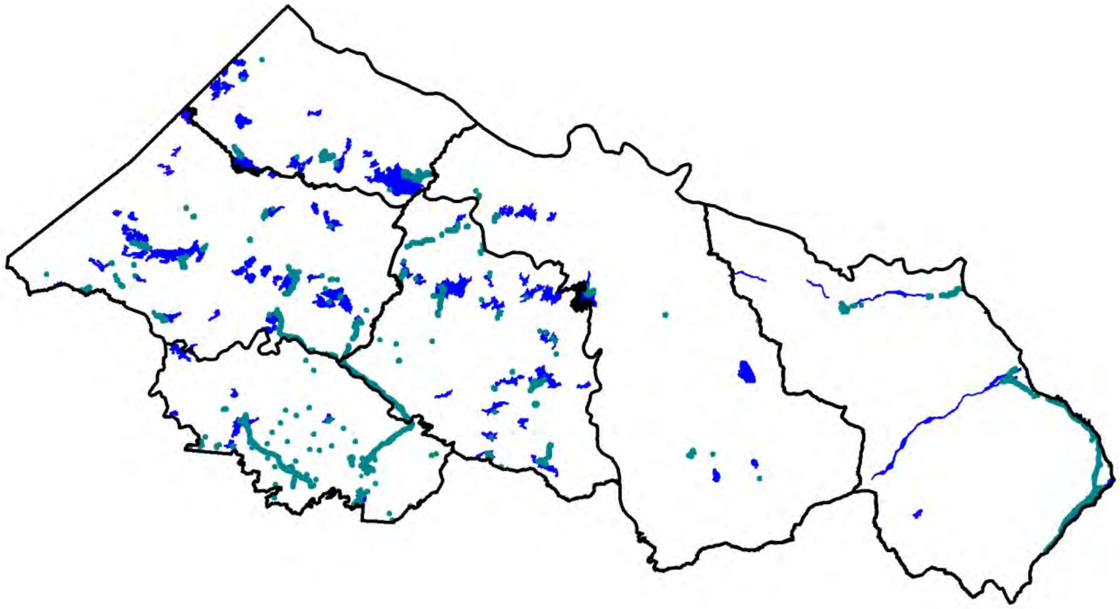


Figure 42. Other industry features (■) including 500 metre buffers in the Far North Ranges.

Table 15. Other industry disturbance statistics for the Far North Ranges.

Swan Range

Other industry features	**Count (n)**	**Area (ha)**	**Buffer area (ha)**
Airports	8	33	969
Buildings	865	n/a[2]	3,736
Dams	0	n/a[2]	0
Forest processing facilities	0	n/a[2]	0
Infrastructure (2012 Provincial Satellite Derived Disturbance Mapping)	n/a[1]	n/a[2]	15,959
Infrastructure (PLC 2010)	n/a[1]	n/a[2]	9,119
Towers	0	n/a[2]	0
Trap cabin	0	n/a[2]	0
Utility Sites	0	n/a[2]	0
Waste disposal sites	0	n/a[2]	0

Water power generating stations	0	n/a[2]	0
Work camps	0	n/a[2]	0

Spirit Range

Other industry features	Count (n)	Area (ha)	Buffer area (ha)
Airports	24	67	2,343
Buildings	1,440	n/a[2]	6,031
Dams	1	n/a[2]	79
Forest processing facilities	0	n/a[2]	0
Infrastructure (2012 Provincial Satellite Derived Disturbance Mapping)	n/a[1]	n/a[2]	30,441
Infrastructure (PLC 2010)	n/a[1]	n/a[2]	22,051
Towers	3	n/a[2]	277
Trap cabin	24	n/a[2]	2,014
Utility Sites	0	n/a[2]	0
Waste disposal sites	1	n/a[2]	79
Water power generating stations	1	n/a[2]	79
Work camps	0	n/a[2]	0

Kinloch Range

Other industry features	Count (n)	Area (ha)	Buffer area (ha)
Airports	35	1,279	2,361
Buildings	553	n/a[2]	7,606
Dams	1	n/a[2]	79
Forest processing facilities	0	n/a[2]	0
Infrastructure (2012 Provincial Satellite Derived Disturbance Mapping)	n/a[1]	n/a[2]	31,445
Infrastructure (PLC 2010)	n/a[1]	n/a[2]	41,286
Towers	5	n/a[2]	393

Trap cabin	3	n/a[2]	159
Utility sites	0	n/a[2]	0
Waste disposal sites	0	n/a[2]	0
Water power generating stations	0	n/a[2]	0
Work camps	0	n/a[2]	0
Ozhiski Range			
Other industry features	**Count (n)**	**Area (ha)**	**Buffer area (ha)**
Airports	24	171	2,267
Buildings	971	n/a[2]	3,755
Dams	0	n/a[2]	0
Forest processing facilities	0	n/a[2]	0
Infrastructure (2012 Provincial Satellite Derived Disturbance Mapping)	n/a[1]	n/a[2]	23,109
Infrastructure (PLC 2010)	n/a[1]	n/a[2]	28,325
Towers	2	n/a[2]	232
Trap cabin	87	n/a[2]	7,069
Utility sites	0	n/a[2]	0
Waste disposal sites	0	n/a[2]	0
Water power generating stations	0	n/a[2]	0
Work camps	21	n/a[2]	1,760
Missisa Range			
Other industry features	**Count (n)**	**Area (ha)**	**Buffer area (ha)**
Airports	12	29	797
Buildings	568	n/a[2]	1,387
Dams	0	n/a[2]	0
Forest processing facilities	0	n/a[2]	0
Infrastructure (2012 Provincial Satellite Derived Disturbance	n/a[1]	n/a[2]	5,499

Mapping)			
Infrastructure (PLC 2010)	n/a[1]	n/a[2]	1,970
Towers	0	n/a[2]	0
Trap cabin	56	n/a[2]	4,874
Utility sites	0	n/a[2]	0
Waste disposal sites	0	n/a[2]	0
Water power generating stations	0	n/a[2]	0
Work camps	4	n/a[2]	569

James Bay Range

Other industry features	**Count (n)**	**Area (ha)**	**Buffer area (ha)**
Airports	26	89	2,908
Buildings	2,937	n/a[2]	4,203
Dams	0	n/a[2]	0
Forest processing facilities	0	n/a[2]	0
Infrastructure (2012 Provincial Satellite Derived Disturbance Mapping)	n/a[1]	n/a[2]	32,380
Infrastructure (PLC 2010)	n/a[1]	n/a[2]	14,820
Towers	8	n/a[2]	645
Trap cabin	0	n/a[2]	0
Utility sites	4	n/a[2]	314
Waste disposal sites	0	n/a[2]	0
Water power generating stations	0	n/a[2]	0
Work camps	0	n/a[2]	0

[1]Derived from raster; count not available.
[2] Features are represented by point data types; area not available.

5.2.2.2 Linear features disturbance

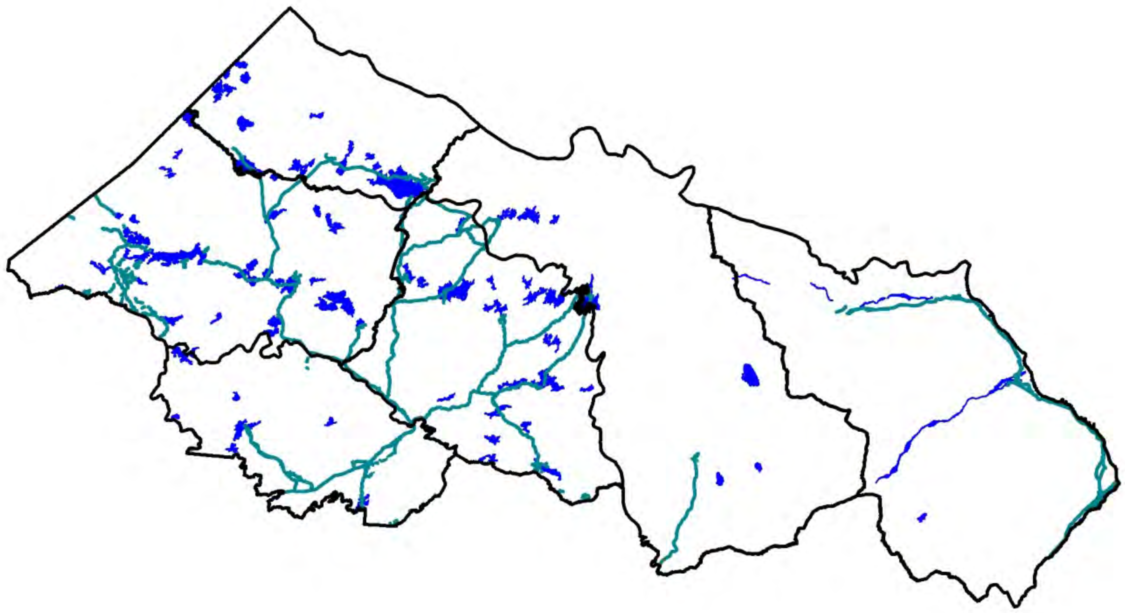


Figure 43. Linear features (■) including 500 metre buffers in the Far North Ranges.

Table 16. Linear features disturbance statistics for the Far North Ranges.

Swan Range

Linear feature	Count (n)	Area (ha)	Buffer area (ha)
Roads	n/a[1]	n/a[2]	24,778
Trails	n/a[1]	n/a[2]	0
Rail lines	n/a[1]	n/a[2]	0
Utility lines	n/a[1]	n/a[2]	80

Spirit Range

Linear feature	Count (n)	Area (ha)	Buffer area (ha)
Roads	n/a[1]	n/a[2]	76,948
Trails	n/a[1]	n/a[2]	19,206
Rail lines	n/a[1]	n/a[2]	0
Utility lines	n/a[1]	n/a[2]	5,434

Kinloch Range			
Linear feature	**Count (n)**	**Area (ha)**	**Buffer area (ha)**
Roads	n/a[1]	n/a[2]	39,163
Trails	n/a[1]	n/a[2]	1,995
Rail lines	n/a[1]	n/a[2]	0
Utility lines	n/a[1]	n/a[2]	27,835
Ozhiski Range			
Linear feature	**Count (n)**	**Area (ha)**	**Buffer area (ha)**
Roads	n/a[1]	n/a[2]	119,937
Trails	n/a[1]	n/a[2]	169
Rail lines	n/a[1]	n/a[2]	0
Utility lines	n/a[1]	n/a[2]	8,772
Missisa Range			
Linear feature	**Count (n)**	**Area (ha)**	**Buffer area (ha)**
Roads	n/a[1]	n/a[2]	22,886
Trails	n/a[1]	n/a[2]	0
Rail lines	n/a[1]	n/a[2]	0
Utility lines	n/a[1]	n/a[2]	0
James Bay Range			
Linear feature	**Count (n)**	**Area (ha)**	**Buffer area (ha)**
Roads	n/a[1]	n/a[2]	44,810
Trails	n/a[1]	n/a[2]	2,605
Rail lines	n/a[1]	n/a[2]	7,423
Utility lines	n/a[1]	n/a[2]	46,525

[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

5.2.2.3 Mineral development disturbance

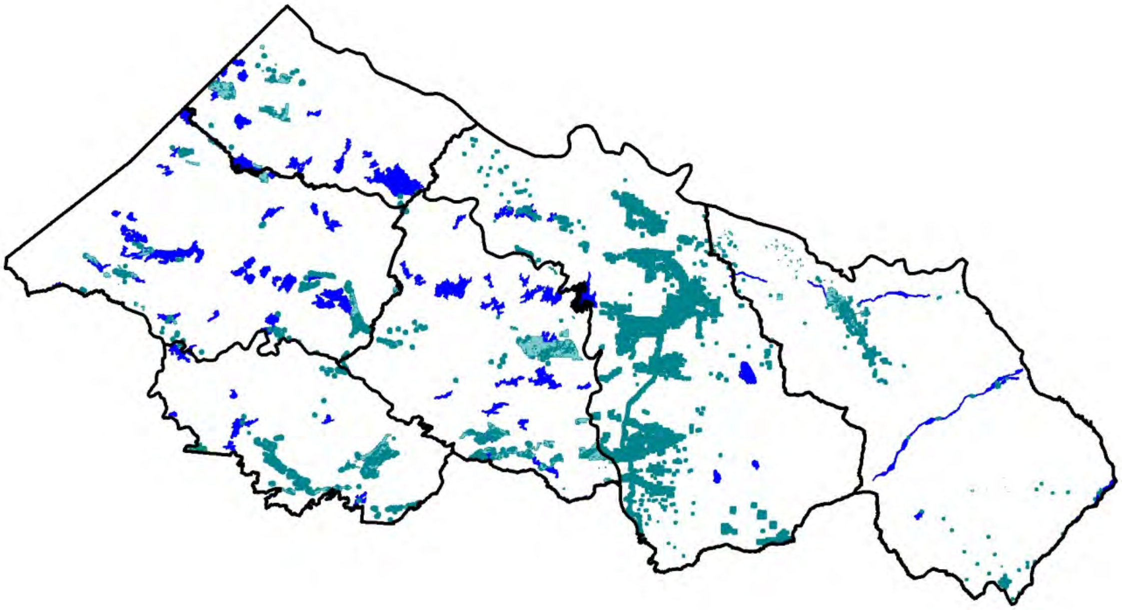


Figure 44. Mining and mineral exploration features (■) including 500 metre buffer in the Far North Ranges.

Table 17. Mining feature disturbance statistics for the Far North Ranges.

Swan Range

Mining feature	Count (n)	Area (ha)	Buffer area (ha)
Active mining claims	259	61,703	n/a[1]
Aggregate sites – category 14	0	n/a[2]	0
Aggregate sites – authorized	0	0	0
Aggregate sites – un-rehabilitated	1	n/a[2]	78
Drill holes	98	n/a[2]	3,045
Mining locations	0	0	0
Petroleum well	0	n/a[2]	0
Pits and quarries	0	0	0

Spirit Range			
Mining feature	**Count (n)**	**Area (ha)**	**Buffer area (ha)**
Active mining claims	730	56,547	n/a[1]
Aggregate sites – category 14	0	n/a[2]	0
Aggregate sites – authorized	3	18	375
Aggregate sites – un-rehabilitated	8	n/a[2]	699
Drill holes	2,960	n/a[2]	19,112
Mining locations	0	0	0
Petroleum well	0	n/a[2]	0
Pits and quarries	23	296	2,130

Kinloch Range			
Mining feature	**Count (n)**	**Area (ha)**	**Buffer area (ha)**
Active mining claims	467	85,063	n/a[1]
Aggregate sites – category 14	0	n/a[2]	0
Aggregate sites – authorized	12	41	667
Aggregate sites – un-rehabilitated	8	n/a[2]	628
Drill holes	2,618	n/a[2]	43,2061
Mining locations	0	0	0
Petroleum well	0	n/a[2]	0
Pits and quarries	9	8	858

Ozhiski Range			
Mining feature	**Count (n)**	**Area (ha)**	**Buffer area (ha)**
Active mining claims	857	178,564	n/a[1]
Aggregate sites – category 14	0	n/a[2]	0
Aggregate sites – authorized	0	0	0
Aggregate sites – un-rehabilitated	1	n/a[2]	9
Drill holes	1,019	n/a[2]	22,368

Mining locations	0	0	0
Petroleum cell	0	n/a[2]	0
Pits and quarries	5	98	576

Missisa Range

Mining feature	Count (n)	Area (ha)	Buffer area (ha)
Active mining claims	2,926	647,638	n/a[1]
Aggregate sites – category 14	0	n/a[2]	0
Aggregate sites – authorized	0	0	0
Aggregate sites – un-rehabilitated	0	n/a[2]	0
Drill holes	1,142	n/a[2]	49,444
Mining locations	0	0	0
Petroleum cell	5	n/a[2]	696
Pits and quarries	2	7	244

James Bay Range

Mining feature	Count (n)	Area (ha)	Buffer area (ha)
Active mining claims	241	43,791	n/a[1]
Aggregate sites – category 14	0	n/a[2]	0
Aggregate sites – authorized	11	198	1,888
Aggregate sites – un-rehabilitated	0	n/a[2]	0
Drill holes	789	n/a[2]	23,929
Mining locations	1	347	585
Petroleum well	48	n/a[2]	3,697
Pits and quarries	8	172	725

[1]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 a disturbance.
[2]n/a available - features are represented by point data types; area not available

5.2.2.4 Tourism infrastructure disturbance

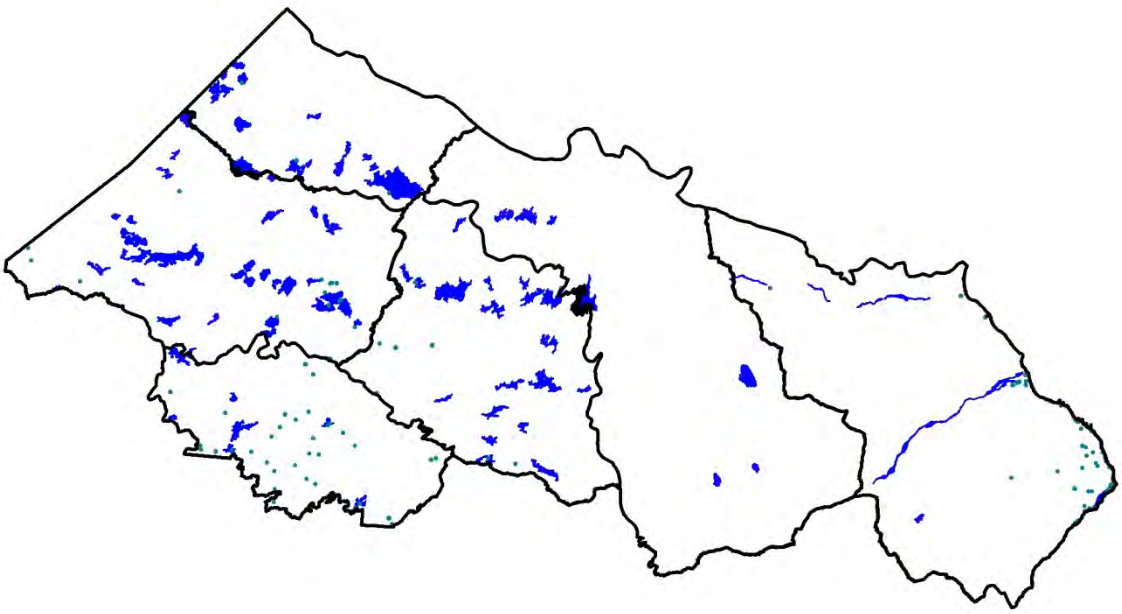


Figure 45. Tourism infrastructure features (■) including 500 metre buffers in the Far North Ranges.

Table 18. Tourism infrastructure disturbance statistics for the Far North Ranges.

Swan Range			
Tourism feature	**Count (n)**	**Area (ha)**	**Buffer area (ha)**
Cottage and residential sites	0	0	0
Commercial campgrounds	0	0	0
Main base lodges (remote/non-remote)	0	0	0
Recreational camps	0	0	0
Outpost camp	4	13	388
Spirit Range			
Tourism feature	**Count (n)**	**Area (ha)**	**Buffer area (ha)**
Cottage and residential sites	7	7	660
Commercial campgrounds	1	<1	71
Main base lodges (remote/non-remote)	2	<1	160
Recreational camps	1	<1	79
Outpost camp	26	5	2,101

Kinloch Range			
Tourism feature	**Count (n)**	**Area (ha)**	**Buffer area (ha)**
Cottage and residential sites	21	46	1,549
Commercial campgrounds	0[1]	0[1]	13
Main base lodges (remote/non-remote)	3	<1	251
Recreational camps	0	0	0
Outpost camp	39	54	3,505
Ozhiski Range			
Tourism feature	**Count (n)**	**Area (ha)**	**Buffer area (ha)**
Cottage and residential sites	36	50	1,513
Commercial campgrounds	0	0	0
Main base lodges (remote/non-remote)	2	14	251
Recreational camps	1	<1	81
Outpost camp	26	52	2,226
Missisa Range			
Tourism feature	**Count (n)**	**Area (ha)**	**Buffer area (ha)**
Cottage and residential sites	0	0	0
Commercial campgrounds	0	0	0
Main base lodges (remote/non-remote)	0	0	0
Recreational camps	0	0	0
Outpost Camp	11	<1	869
James Bay Range			
Tourism feature	**Count (n)**	**Area (ha)**	**Buffer area (ha)**
Cottage and residential sites	6	3	578
Commercial campgrounds[1]	0	0	0
Main base lodges (remote/non-remote)	0	0	0
Recreational camps	115	14	6,577
Outpost camp	6	5	502

[1]Commercial campgrounds are not within Kinloch Range; however one is close enough to the range boundary that part of the zone of influence falls within the range

5.2.2.5 Natural disturbance

Similar to the anthropogenic disturbances, there were several cases where the same natural disturbance existed in two or more of these datasets. In these cases the most up-to-date source that contained the finest resolution for the last 20 years was used. After 20 years the LIO Fire Disturbance Polygon dataset was used to capture burns.

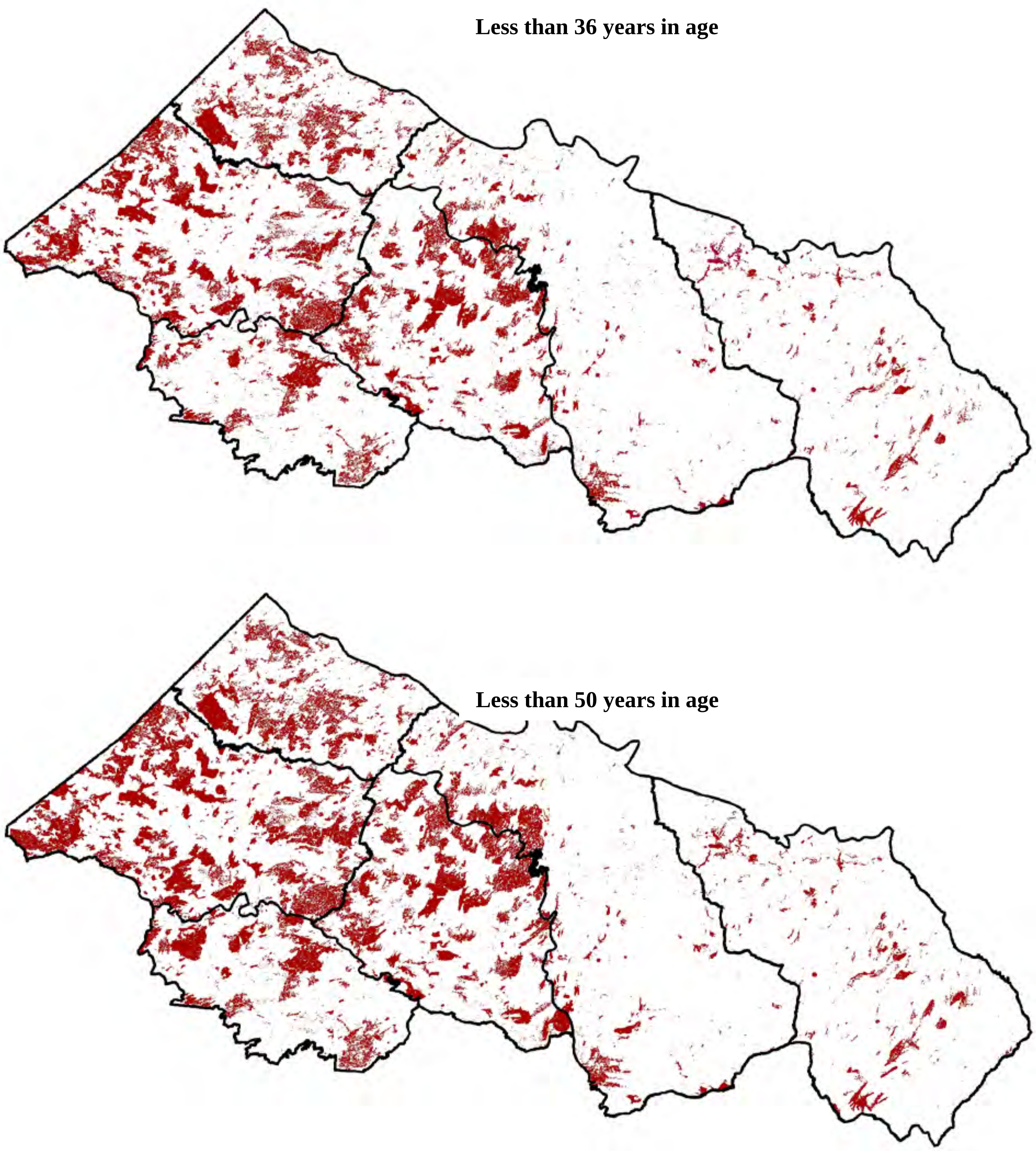


Figure 46. Natural disturbance features (forest <36 years and <50 years) (■) in the Far North Ranges from fire, blowdown, snow, and insect damage.

Table 19. Natural disturbance statistics of the Far North Ranges.

Swan Range		
Natural feature	**< 36 Years area (ha)**	**< 50 Years area (ha)**
Fire (2012 Provincial Satellite Derived Disturbance Mapping)	414,820	426,230
Weather (2012 Provincial Satellite Derived Disturbance Mapping)	180	180
Unknown causes (2012 Provincial Satellite Derived Disturbance Mapping)	1,609	1,609
Fire (PLC 2010)	32,775	45,722
Fire (LIO)	67,582	100,064
Spirit Range		
Natural feature	**< 36 Years area (ha)**	**< 50 Years area (ha)**
Fire (2012 Provincial Satellite Derived Disturbance Mapping)	671,993	767,830
Weather (2012 Provincial Satellite Derived Disturbance Mapping)	6,472	6,472
Unknown causes (2012 Provincial Satellite Derived Disturbance Mapping)	1,114	1,114
Fire (PLC 2010)	204,966	165,184
Fire (LIO)	316,107	534,205
Kinloch Range		
Natural feature	**< 36 Years area (ha)**	**< 50 Years area (ha)**
Fire (2012 Provincial Satellite Derived Disturbance Mapping)	202,239	236,410
Weather (2012 Provincial Satellite Derived Disturbance Mapping)	5,290	11,629
Unknown causes (2012 Provincial Satellite Derived Disturbance Mapping)	472	526
Fire (PLC 2010)	91,363	87,253
Fire (LIO)	89,273	157,503
Ozhiski Range		
Natural feature	**< 36 Years area (ha)**	**< 50 Years area (ha)**
Fire (2012 Provincial Satellite Derived	485,584	516,621

Disturbance Mapping)		
Weather (2012 Provincial Satellite Derived Disturbance Mapping)	9,861	9,917
Unknown causes (2012 Provincial Satellite Derived Disturbance Mapping)	816	859
Fire (PLC 2010)	48,351	42,601
Fire (LIO)	262,099	421,741
Missisa Range		
Natural feature	**< 36 Years area (ha)**	**< 50 Years area (ha)**
Fire (2012 Provincial Satellite Derived Disturbance Mapping)	225,949	237,650
Weather (2012 Provincial Satellite Derived Disturbance Mapping)	3,843	3,904
Unknown causes (2012 Provincial Satellite Derived Disturbance Mapping)	2,817	2,817
Fire (PLC 2010)	10,404	9,663
Fire (LIO)	114,986	220,098
James Bay Range		
Natural feature	**< 36 Years area (ha)**	**< 50 Years area (ha)**
Fire (2012 Provincial Satellite Derived Disturbance Mapping)	173,165	176,714
Weather (2012 Provincial Satellite Derived Disturbance Mapping)	0	0
Unknown causes (2012 Provincial Satellite Derived Disturbance Mapping)	1,799	1,799
Fire (PLC 2010)	3,715	3,299
Fire (LIO)	87,308	105,869

5.2.3 Disturbance analysis summaries

Table 20 includes landscape statistics which assist with the interpretation of disturbance statistics and maps (Figure 47, Figure 48, and Figure 49). Water accounts between 5.9 % (James Bay Range) to 16.4% (Swan Range) of the area within the Far North Ranges (Table 20). The amount of area, inferred as functional habitat loss identified from the disturbance analysis (based on forests <36 years) ranges from 6.6% (James Bay Range) to 28.6% (Spirit Range). With the exception of the Missisa Range, the amount of natural disturbance exceeds anthropogenic disturbance.

Table 20. Disturbance summaries of 36 year and 50 year landscape statistics for the Far North Ranges.

Swan Range

Range component	Area (ha)	% of range		
Total range area	2,513,578	100.0		
Water	413,305	16.4		
Non-water	2,100,273	83.6		
	36 year disturbance		**50 year disturbance**	
	Area (ha)	**% of range**	**Area (ha)**	**% of range**
Total disturbance within range	591,118	23.5	649,237	25.8
Natural	511,173	20.3	565,765	22.5
Anthropogenic[1]	79,945	3.2	83,472	3.2
Not disturbed within range	1,922,460	76.5	1,864,341	25.8

Spirit Range

Range component	Area (ha)	% of range		
Total range area	4,666,255	100.0		
Water	556,365	11.9		
Non-water	4,109,890	88.1		
	36 year disturbance		**50 year disturbance**	
	Area (ha)	**% of range**	**Area (ha)**	**% of range**
Total disturbance within range	1,335,332	28.6	1,615,971	34.6
Natural	1,172,783	25.1	1,438,535	30.8
Anthropogenic[1]	162,549	3.5	177,436	3.8
Not disturbed within range	3,330,923	71.4	3,050,284	65.4

Kinloch Range

Range component	Area (ha)	% of range		
Total range area	2,672,476	100.0		
Water	286,805	10.7		
Non-water	2,385,671	89.3		
	36 year disturbance		**50 year disturbance**	
	Area (ha)	**% of range**	**Area (ha)**	**% of range**
Total disturbance within range	522,787	19.6	637,051	23.8
Natural	376,864	14.1	477,604	17.9
Anthropogenic[1]	145,923	5.5	159,447	6.0
Not disturbed within range	2,149,689	80.4	2,035,425	76.2

Ozhiski Range

Range component	Area (ha)	% of range
Total range area	3,871,021	100.0
Water	507,598	13.1

Non-water	3,363,423	86.9

	36 year disturbance		50 year disturbance	
	Area (ha)	% of range	Area (ha)	% of range
Total disturbance within range	1,068,148	27.6	1,243,057	32.1
Natural	772,886	20.0	947,535	24.5
Anthropogenic[1]	295,262	7.6	295,522	7.6
Not disturbed within range	2,802,873	72.4	2,627,965	67.9

Missisa Range

Range component	Area (ha)	% of range
Total range area	6,966,862	100.0
Water	466,914	6.7
Non-water	6,499,947	92.3

	36 year disturbance		50 year disturbance	
	Area (ha)	% of range	Area (ha)	% of range
Total disturbance within range	1,001,661	14.4	1,108,687	15.9
Natural	345,535	5.0	461,179	6.6
Anthropogenic[1]	656,126	9.4	647,508	9.3
Not disturbed within range	5,965,201	85.6	5,858,174	84.1

James Bay Range

Range component	Area (ha)	% of range
Total range area	6,035,852	100.0
Water	354,095	5.9
Non-water	5,681,757	94.1

	36 year disturbance		50 year disturbance	
	Area (ha)	% of range	Area (ha)	% of range
Total disturbance within range	401,007	6.6	422,157	7.0
Natural	262,022	4.3	283,110	4.7
Anthropogenic[1]	138,985	2.3	139,047	2.3
Not disturbed within range	5,634,845	93.4	5,613,695	93.0

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

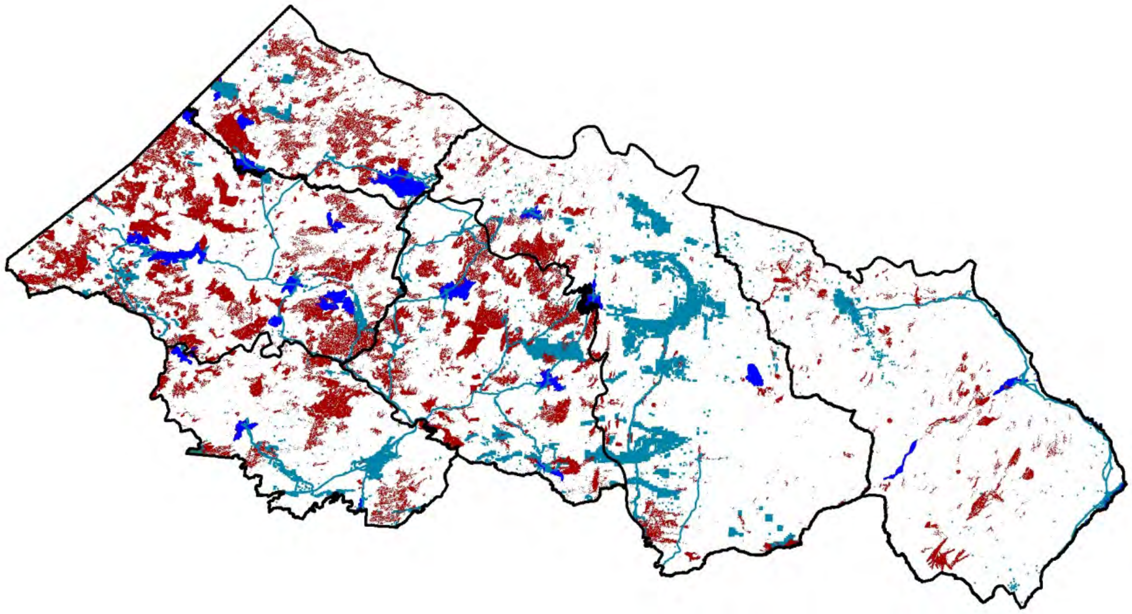


Figure 47. Anthropogenic[1] (■) and natural (■) disturbances (i.e. forest <36 years) in the Far North Ranges using the Fire Disturbance Polygon data set from Land Information Ontario (LIO) for burns between 20-35 years.
1Anthropogenic disturbances include a 500 m buffer. When anthropogenic disturbances overlap with natural disturbances it is counted as anthropogenic.

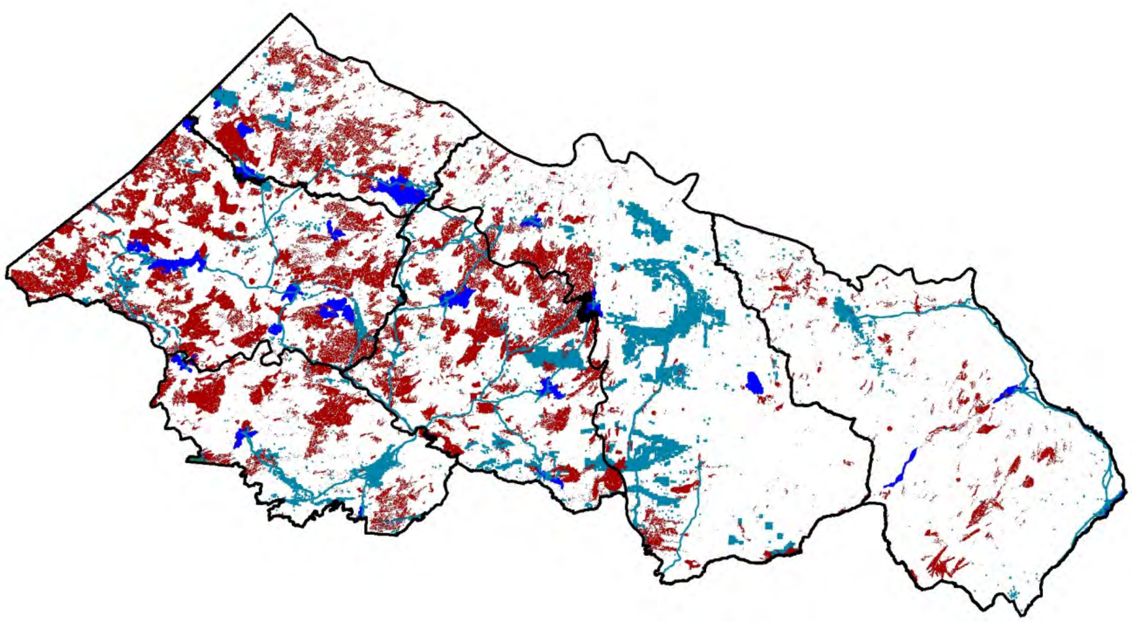


Figure 48. Anthropogenic[1] (■) and natural (■) disturbances (i.e. forest <50 years) in the Far North Ranges using the Fire Disturbance Polygon data set from Land Information Ontario (LIO) for burns between 20-50 years.
1Anthropogenic disturbances include a 500 m buffer. When anthropogenic disturbances overlap with natural disturbances it is counted as anthropogenic.

The pattern of disturbance across the Far North Ranges reflected in 100 km^2 hexagons is depicted in Figure 49.

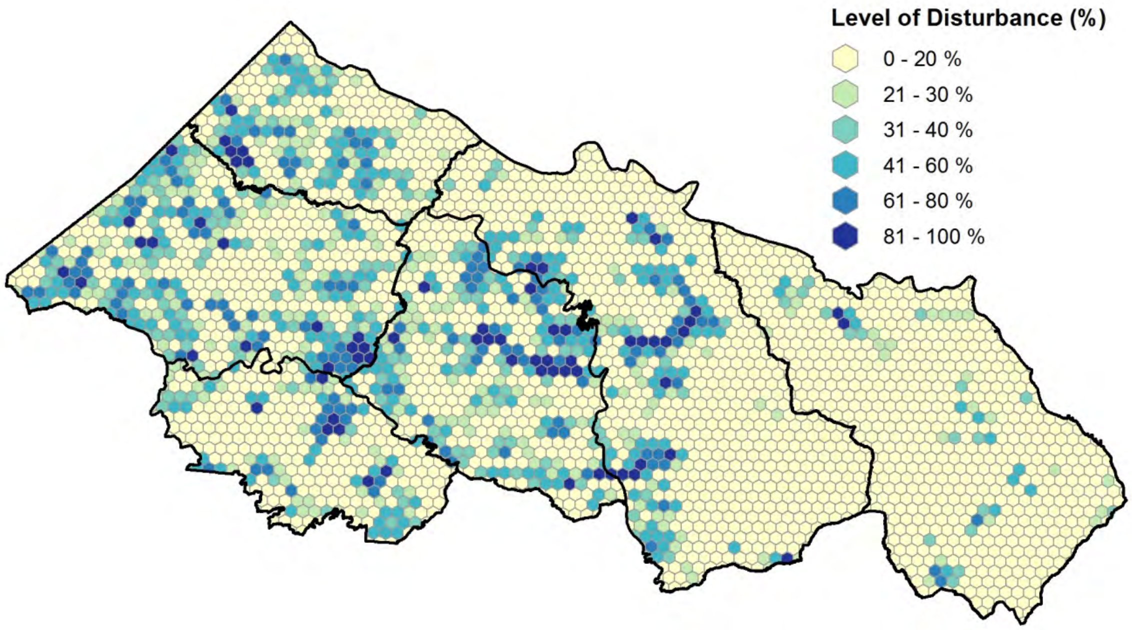
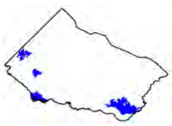
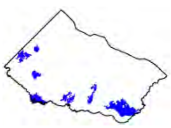
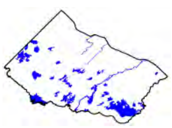
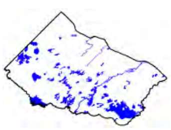
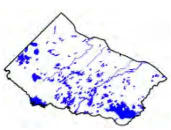
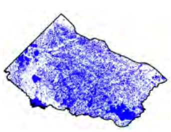


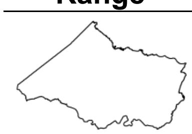
Figure 49. The concentration of natural and anthropogenic disturbances (< 36 years) within 100 km^2 hexagon grid cells used for the probability of occupancy survey (Section 3.3) distributed across the Far North Ranges.

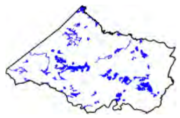
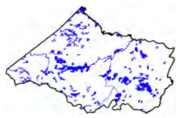
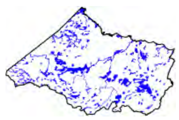
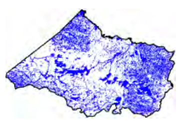
5.2.4 Disturbance considerations related to water

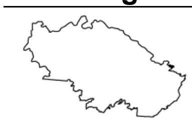
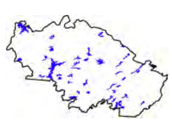
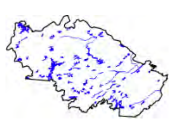
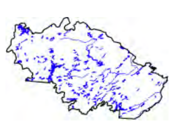
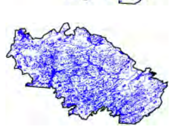
Large waterbodies within the Far North Ranges may contribute to refuge value of the landscape and likely contribute to calving and nursery habitat. However, the footprint of natural or anthropogenic disturbances do not directly apply to the range area occupied by water. Therefore, the intensity and extent of disturbances and the associated functional habitat loss is likely underestimated when represented as a proportion of the total range area (includes area from both land and waterbodies). A sensitivity analysis was conducted in which waterbodies of different size classes were removed (Table 22) 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.

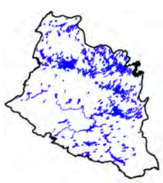
Table 21. Disturbance sensitivity analysis on the Far North Ranges for both < 36 and < 50 years. The percent disturbance is estimated by removing waterbodies of differing sizes from the denominator (i.e. lakes >10,000 ha, lakes > 5,000 ha, lakes > 1,000 ha, lakes > 500 ha, lakes > 250 ha, and all water).

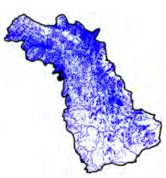
			Disturbance (%)					
			< 36 Years			< 50 Years		
Swan Range	Waterbody	Water ha (%)	Natural	Anthropogenic	All	Natural	Anthropogenic	All
	Range extent	0 (0.0)	20.3	3.2	23.5	22.5	3.3	25.8
	> 10,000 ha removed	111,459 (4.4)	21.3	3.3	24.6	23.6	3.5	27.0
	> 5,000 ha removed	139,061 (6.6)	21.5	3.4	24.9	23.8	3.5	27.3
	> 1,000 ha removed	190,467 (7.6)	22.0	3.4	25.4	24.4	3.6	27.9
	> 500 ha removed	209,989 (8.4)	22.2	3.5	25.7	24.6	3.6	28.2
	> 250 ha removed	233,297 (9.3)	22.4	3.5	25.9	24.8	3.7	28.5
	All water removed	412,305 (16.4)	24.3	3.8	28.1	26.9	4.0	30.9

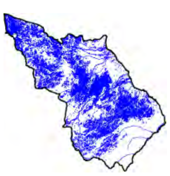
			Disturbance (%)					
			< 36 Years			< 50 Years		
Spirit Range	Waterbody	Water ha (%)	Natural	Anthropogenic	All	Natural	Anthropogenic	All
	Range extent	0 (0.0)	25.1	3.5	28.6	30.8	3.8	34.6
	> 10,000 ha removed	108,049 (2.3)	25.7	3.6	29.3	31.6	3.9	35.5

	> 5,000 ha removed	195,455 (4.8)	26.2	3.6	29.9	32.2	4.0	36.1
	> 1,000 ha removed	284,030 (6.1)	26.8	3.7	30.5	32.8	4.0	36.9
	> 500 ha removed	330,815 (7.1)	27.1	3.7	30.8	33.2	4.1	37.3
	> 250 ha removed	375,446 (8.0)	27.3	3.8	31.1	33.5	4.1	37.7
	All water removed	556,365 (11.9)	28.5	4.0	32.5	35.0	4.3	39.3

			Disturbance (%)					
			< 36 Years			< 50 Years		
Kinloch Range	**Waterbody**	**Water ha (%)**	**Natural**	**Anthro pogenic**	**All**	**Natural**	**Anthro pogenic**	**All**
	Range extent	0 (0.0)	14.1	5.5	19.6	17.9	6.0	23.8
	> 10,000 ha removed	23,285 (0.9)	14.2	5.5	19.7	18.0	6.0	24.0
	> 5,000 ha removed	23,285 (0.9)	14.2	5.5	19.7	18.0	6.0	24.0
	> 1,000 ha removed	85,258 (3.2)	14.6	5.6	20.2	18.5	6.2	24.6
	> 500 ha removed	120,755 (4.5)	14.1	5.5	19.6	17.9	6.0	23.8
	> 250 ha removed	150,235 (5.6)	14.8	5.7	20.5	18.7	6.2	25.0
	All water removed	286,805 (10.7)	15.8	6.1	21.9	20.0	6.7	26.7

			Disturbance (%)					
			< 36 Years			< 50 Years		
Ozhiski Range	Waterbody	Water ha (%)	Natural	Anthro pogenic	All	Natural	Anthro pogenic	All
	Range extent	0 (0.0)	20.0	7.6	27.6	24.5	7.6	32.1
	> 10,000 ha removed	58,602 (1.5)	20.3	7.7	28.0	24.9	7.8	32.6
	> 5,000 ha removed	120,106 (3.6)	20.6	7.9	28.5	25.3	7.9	33.1
	> 1,000 ha removed	198,361 (5.1)	21.0	8.0	29.1	25.8	8.0	33.8
	> 500 ha removed	239,466 (6.2)	21.3	8.1	29.4	26.1	8.1	34.2
	> 250 ha removed	291,627 (7.5)	21.6	8.2	29.8	26.5	8.3	34.7
	All water removed	507,598 (13.1)	23.0	8.8	31.8	28.2	8.8	37.0

			Disturbance (%)					
			< 36 Years			< 50 Years		
Missisa Range	Waterbody	Water ha (%)	Natural	Anthro pogenic	All	Natural	Anthro pogenic	All
	Range extent	0 (0.0)	5.0	9.4	14.4	6.6	9.3	15.9
	> 10,000 ha removed	55,309 (0.8)	5.0	9.5	14.5	6.7	9.4	16.0
	> 5,000 ha removed	68,156 (1.0)	5.0	9.5	14.5	6.7	9.4	16.1
	> 1,000 ha removed	124,440 (1.8)	5.0	9.6	14.6	6.7	9.5	16.2
	> 500 ha removed	151,314 (2.2)	5.1	9.6	14.7	6.8	9.5	16.3
	> 250 ha removed	193,686 (2.8)	5.1	9.7	14.8	6.8	9.6	16.4
	All water removed	466,914 (6.7)	5.3	10.1	15.4	7.1	10.0	17.1

			Disturbance (%)					
			< 36 Years			< 50 Years		
James Bay Range	**Waterbody**	**Water ha (%)**	**Natural**	**Anthro pogenic**	**All**	**Natural**	**Anthro pogenic**	**All**
	Range extent	**0 (0.0)**	4.3	2.3	6.6	4.7	2.3	7.0
	> 10,000 ha removed	**28,682 (0.5)**	4.4	2.3	6.7	4.7	2.3	7.0
	> 5,000 ha removed	**28,682 (0.5)**	4.4	2.3	6.7	4.7	2.3	7.0
	> 1,000 ha removed	**51,140 (0.8)**	4.4	2.3	6.7	4.7	2.3	7.1
	> 500 ha removed	**64,651 (1.1)**	4.4	2.3	6.7	4.7	2.3	7.1
	> 250 ha removed	**77,352 (1.3)**	4.4	2.3	6.7	4.8	2.3	7.1
	All water removed	**354,095 (5.9)**	4.6	2.4	7.1	5.0	2.4	7.4

5.2.5 Habitat state: habitat assessment

The habitat assessment, as outlined in the Protocol (MNRF 2014a), compared the current amount and arrangement of habitat against that projected by the Simulated Range of Natural Variation (SRNV). Both the amount and arrangement SRNV was compared against current amounts and arrangement as inferred from the Forest Resource Inventory (FRI). The relative difference is a measure of how close or how far away the range condition is to the natural levels of habitat. This comparison informs the interpretation of the probability of persistence.

In the Far North of Ontario, where FRI information is not available, neither reliable estimates of current amount of habitat nor the projected SRNV are achievable with existing information. Therefore the PLC 2010 was used as a surrogate for caribou habitat. Also, specific habitat models do not yet exist to translate the amount and arrangement of these landscape components into relative caribou habitat values. In the Far North of Ontario there is little knowledge about the relationship between these land cover classes and the forest or peatland ecosystem conditions captured by them, especially in the Swan, Spirit, Ozhiski and James Bay Ranges. However, the Protocol (MNRF 2014a) describes a boreal and claybelt habitat model.

The habitat analysis for the Far North Ranges reflects the relative availability of land cover classes identified as being significant within the boreal and claybelt habitat models with no implication that the stated relationship holds true in the Far North of Ontario. The amount of each land cover class is expressed as a proportion of the total classified land area. Consequently, the habitat assessment reports on the amount of each land cover class using the PLC 2010 updated with recent disturbances. This analysis represents the most basic measure of the amount of various habitat components at a broad landscape level. Over time this provides the opportunity to conduct comparative evaluations against future landscape conditions.

5.2.6 Habitat assessment results

5.2.6.1 Caribou habitat amount

The amount of each land cover class from the PLC 2010 data set is, at a broad scale, a direct measure of the amount of landscape components available to provide for the life requirements for caribou (Figure 50 and Table 23).

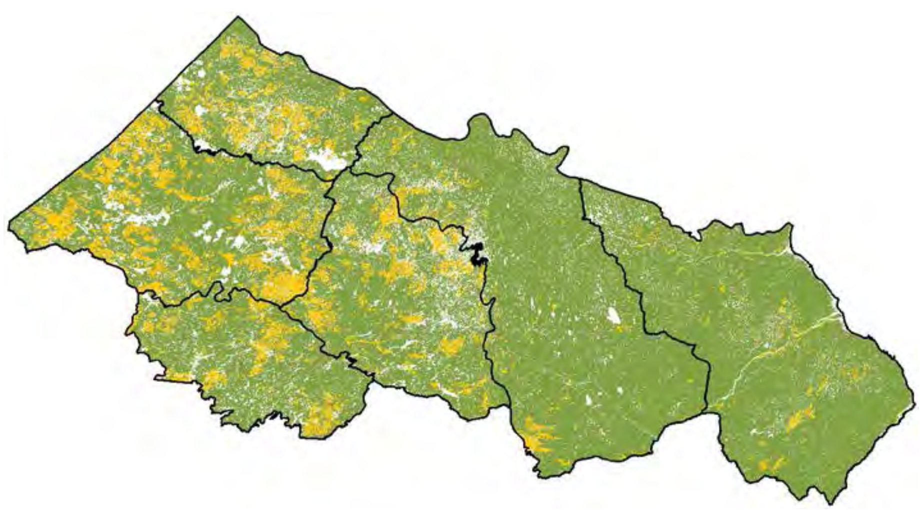


Figure 50. Provincial Land Cover 2010 (2010) classes assigned to winter, refuge, or suitable habitat (■), and young forest (■) based on the conventional boreal and claybelt habitat models in the Far North Ranges.

Table 22. Provincial Land Cover 2010 classification statistics within each range highlighting the classes defined by the conventional boreal and claybelt models as contributing to either winter, refuge, or suitable habitat (■), and young forest (■).

	Swan		Spirit		Kinloch		Ozhiski		Missisa		James Bay	
Range area (ha)	2,513,578		4,666,255		2,672,476		3,871,021		6,966,862		6,035,852	
Land Cover Classification[1]	**ha (,000)**	**%**	**ha (,000)**	**%**	**ha (,000)**	**%**	**ha (,000)**	**%**	**ha (,000)**	**%**	**ha (,000)**	**%**
Clear open water	421	16.8	427	9.2	318	11.9	585	15.1	608	8.7	448	7.4
Turbid water	54	2.2	131	2.8	3	0.1	2	0.1	19	0.3	10	0.2
Intertidal mudflat	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.0
Intertidal marsh	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	9	0.2
Supertidal marsh	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	14	0.2
Freshwater marsh	0	0.0	2	0.0	0	0.0	0	0.0	0	0.0	10	0.2
Heath	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Thicket swamp	28	1.1	64	1.4	30	1.1	27	0.7	57	0.8	42	0.7
Coniferous swamp	130	5.2	264	5.7	196	7.4	563	14.5	1,102	15.8	464	7.7
Treed peatland	0	0.0	4	0.1	81	3.0	28	0.7	0	0.0	0	0.0
Open fen	80	3.2	91	1.9	19	0.7	22	0.6	397	5.7	612	10.1
Treed fen	276	11.0	412	8.8	70	2.6	205	5.3	1,260	18.1	2,246	37.2
Open bog	104	4.1	198	4.2	134	5.0	118	3.0	1,029	14.8	1,104	18.3
Treed bog	440	17.5	261	5.6	293	11.0	180	4.6	1,415	20.3	725	12.0
Sparse treed	337	13.4	516	11.1	78	2.9	120	3.1	136	1.9	12	0.2
Deciduous treed	51	2.0	121	2.6	38	1.4	106	2.7	40	0.6	22	0.4
Mixed treed	50	2.0	221	4.7	82	3.1	265	6.8	90	1.3	22	0.4
Coniferous treed	135	5.4	918	19.7	985	36.9	1,120	28.9	581	8.3	133	2.2
Disturbance (non and sparse woody)	38	1.5	488	10.5	768	6.3	138	3.6	81	1.2	88	1.5
Disturbance (treed / shrub)	368	14.6	525	11.3	170	6.4	384	9.9	150	2.2	66	1.1
Sand/gravel/mine tailings	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	0.1
Bedrock	0	0.0	17	0.4	2	0.1	3	0.1	1	0.0	0	0.0
Community/ infrastructure	1	0.0	1	0.0	2	0.1	2	0.0	0	0.0	1	0.0
Agriculture	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Deciduous swamp	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Cloud/shadow	0	0.0	3	0.1	1	0.0	3	0.1	1	0.0	0	0.0
other	0	0.0	3	0.1	2	0.1	0	0.0	0	0.0	0	0.0

[1]The PLC 2010 data was updated with recent disturbances using Fire Disturbance Polygons available from Land Information Ontario (LIO)

Although it is widely understood that water is an important component of landscapes containing caribou, water was not regarded as habitat in this analysis. Additionally, disturbed and developed landscape features (as defined by land cover classifications) are not considered to be advantageous for caribou and are therefore not considered habitat. The remaining landscape can be broadly classified as wetlands (bog, fen, swamp, marsh, peatland), or terrestrial features (treed, non-treed).

In the Swan Range, water represents 19% of the total range area and 16% is considered to be disturbed or developed. Of the remaining 65% of the range, 36% is bog and fen (treed or open), 6% is swamp (coniferous or thicket), and 23% is treed (sparse, mixed, deciduous or coniferous).

In the Spirit Range, water represents 12% of the total range area and 22% is considered to be disturbed or developed. Of the remaining 66% of the range, 21% is bog and fen (treed or open), 7% is swamp (coniferous or thicket), 38% is treed (sparse, mixed, deciduous or coniferous), and 0.4% is non-treed (bedrock).

In the Kinloch Range, water represents 12% of the total range area and 13% is considered to be disturbed or developed. Of the remaining 75% of the range, 19% is bog and fen (treed or open), 8% is swamp (coniferous or thicket), 3% is peatland (treed), and 44% is treed (sparse, mixed, deciduous or coniferous).

In the Ozhiski Range, water represents 15% of the total range area and 14% is considered to be disturbed or developed. Of the remaining 71% of the range, 14% is bog and fen (treed or open), 15% is swamp (coniferous or thicket), 1% is peatland (treed), and 42% is treed (sparse, mixed, deciduous or coniferous).

In the Missisa Range, water represents 9% of the total range area and 3% is considered to be disturbed or developed. Of the remaining 88% of the range, 59% is bog and fen (treed or open), 17% is swamp (coniferous or thicket), and 12% is treed (sparse, mixed, deciduous or coniferous).

In the James Bay Range, water represents 8% of the total range area and 3% is considered to be disturbed or developed. Of the remaining 89% of the range, 78% is bog and fen (treed or open), 8% is swamp (coniferous or thicket), and 3% is treed (sparse, mixed, deciduous or coniferous).

6.0 Interpretation of Lines of Evidence

6.1 Swan Range

6.1.1 Interpretation of population state

The minimum animal count for caribou (MAC) occupying the Swan Range during the 2009 and 2011 winter distribution survey was 491 caribou. During the winter distribution surveys, observations of caribou activity were recorded throughout the range but were sparse in areas south of Swan Lake, the south western portion of Severn River Provincial Park and surrounding areas, and north of Two River Lake. It is believed that the 491 caribou observed within the Swan Range is low relative to the true number of caribou occupying the range during the winter. Approximately 9% of the range was covered during the winter distribution survey efforts and the range was not surveyed in its entirety during one survey year. Surveys of this nature are expected to detect only a portion of the caribou present with detectability significantly limited by the presence of dense tree cover. In addition, the 2011 targeted recruitment survey observed 640 caribou. As a result it was concluded that the range is occupied during the winter by at least 640 caribou (both the forest-dwelling and forest-tundra ecotypes) and likely substantially more.

The degree of immigration and emigration across the Swan Range boundaries is unknown, although collaring data has shown significant movement northward into the Hudson Bay lowland, as well as east into the Missisa Range, and into Manitoba. There is also some documented movement from the Spirit and Ozhiski Ranges to the south. Forest-tundra caribou are also known to be move into the northern portion of the range during the winter, and many are likely included in the MAC.

A recruitment rate of 28.9 calves per 100 adult females is generally considered adequate to maintain the population if the adult survival rate is 85% or greater. The recruitment rate during 2012 was greatest at 20.99 calves per 100 AF_{adj}, all other estimates of recruitment from the 2009 (11.40) and 2011(17.35) surveys were less than what is considered adequate. These data indicate the current number of calves is likely inadequate to maintain the population. Estimating survival and population trend was not feasible because of the lack of collared females within the range. Additional estimates of recruitment and survival from the collared caribou in future years will be important to establish and refine our estimate of population trend (MNRF 2014a).

6.1.2 Interpretation of habitat state

The distribution of disturbance within the Swan Range is primarily in the south, west, and central portions of the range, there is little disturbance in the northeastern portion. The vast majority of this disturbance is of natural causes because of the aggressive fire regime. Human activity within the range is primarily limited to settlements, roads, and some mining activity.

The disturbance footprint encompasses 23.5% (all waterbodies included) of the Swan Range. As a result, it is likely that the range supports stable to increasing population growth with an estimated probability of 0.78. However, the influence of waterbodies in the disturbance analysis should be considered when evaluating the level of disturbance within the range. The water sensitivity analysis demonstrated that the disturbance estimate for the Swan Range may be as great as 28.1% (all waterbodies excluded). At such a level, it is still likely that the range could sustain caribou. It is possible that landscapes rich in large waterbodies with islands may help compensate for moderate levels of landscape disturbance by providing valuable caribou habitat because the surrounding body of water may provide additional refuge.

Collectively, there are a number of anthropogenic disturbance types not addressed in the above analyses including outfitter activities, access points, campsites and shore lunch activities, trapping, and other recreational activities. These disturbances 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 may be considerable at a local scale.

At this time, it is assumed that habitat availability attributed to forest composition and structure is similar to that available in a natural forest. However, the specific contributions of land cover classes to the provision of refuge, winter or mature conifer forest habitat is largely unknown. Generally we assume that the land cover classes that represent older conifer forest and peatland conditions are more desirable than other land cover classes. This analysis provides a valuable benchmark of those land cover classes against which future assessments may be compared. In the Swan Range, the latitude, calcareous soils and high levels of disturbance may warrant a specific habitat model to be developed for future assessments.

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

6.2 Spirit Range

6.2.1 Interpretation of population state

The minimum animal count for caribou (MAC) occupying the Spirit Range during the 2009 and 2010 winter distribution survey was 373 caribou. During these surveys, the majority of the observations of caribou activity were recorded in the central and eastern part of the range. We believe that the 373 caribou observed within the Spirit Range is low relative to the true number of caribou occupying the range. Approximately 9% of the range was covered during the winter distribution survey efforts and the range was not surveyed in its entirety during one survey year. Surveys of this nature are expected to detect only a portion of the caribou present with detectability significantly limited by the presence of dense tree cover. It was concluded that the range was occupied by at least 373 caribou and possibly substantially more.

The degree of immigration and emigration across the Spirit Range boundaries is unknown, although it is likely that caribou traverse into surrounding ranges and into Manitoba.

A recruitment rate of 28.9 calves per 100 adult females is generally considered adequate to maintain the population if the adult survival rate is 85% or greater (EC 2008). The recruitment rate during 2009 was greatest at 41.05 calves per 100 AF_{adj}. However, all other estimates of recruitment from the 2010-2012 surveys were less than what is considered adequate and ranged from 12.51-20.7 calves per 100 AF_{adj}. These data indicate that the current number of calves is likely inadequate to maintain the population. Annual adult female survival within the Spirit Range during the 2008-2011 biological years (which correspond to 2009-2012 survey years) ranged between 0.75-1.00 with a geometric mean survival rate of 0.88 – that is comparable to the accepted average adult survival rate of 85% (EC 2008). Based on the relatively low estimates of recruitment but average estimates of survival, the estimated population trend (λ) was 0.95, suggesting the population is likely in short-term decline. Additional estimates of recruitment and survival from the collared caribou in future years will be important to refine our estimate of population trend (MNRF 2014a).

6.2.2 Interpretation of habitat state

Disturbance within the Spirit Range is relatively evenly distributed. The vast majority of this disturbance is of natural causes due to the aggressive fire regime. Human activity within the range is primarily limited to settlements, roads, and some mining activity.

Overall, the disturbance footprint encompasses 28.6% (all waterbodies included) of the Spirit Range. As a result, it is likely that the range supports stable to increasing population growth with an estimated probability of 0.7. However, the influence of waterbodies in the disturbance analysis should be considered when evaluating the level of disturbance within the range. The water sensitivity analysis demonstrated that the disturbance estimate for the Spirit Range may be as great as 32.5% (all waterbodies excluded). At such a level it is still likely that the range could sustain caribou. It is possible that landscapes rich in large waterbodies with islands may help compensate for moderate levels of landscape disturbance by providing valuable caribou habitat because the surrounding body of water may provide additional refuge.

Collectively, there are a number of anthropogenic disturbance types not addressed in the above analyses including outfitter activities, access points, campsites and shore lunch activities, trapping, and other recreational activities. These disturbances 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 may be considerable at a local scale.

At this time, it is assumed that habitat availability attributed to forest composition and structure is similar to that available in a natural forest. However, the specific contributions of land cover classes to the provision of refuge, winter or mature conifer forest habitat is largely unknown. Generally we assume that the land cover classes that represent older conifer forest and peatland conditions are more desirable than other land cover classes. This analysis provides a valuable benchmark of those land cover classes against which future assessments may be compared. In the Spirit Range, the latitude, calcareous soils and high levels of disturbance may warrant a specific habitat model to be developed for future assessments.

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

6.3 Kinloch Range

6.3.1 Interpretation of population state

The minimum animal count for caribou (MAC) occupying the Kinloch Range during the 2008-2010 surveys was 113 caribou. Caribou were observed throughout the range but were less prevalent in the northwest portion of the range around MacDowell Lake and Hwy 599. We believe that the 113 caribou observed within the Kinloch Range is low relative to the true number of caribou occupying the range. Approximately 22% of the range was covered during the winter distribution survey efforts and the range was not surveyed in its entirety in one survey year. Surveys of this nature are expected to detect only a portion of the caribou present with detectability significantly limited by the presence of dense tree cover. In addition, the targeted recruitment survey in 2012 observed 332 caribou, therefore it was concluded that the range is occupied by at least 332 caribou and possibly substantially more.

The degree of immigration and emigration across the Kinloch Range boundaries is unknown, although collaring observations demonstrate movement of varying magnitudes with all surrounding ranges.

A recruitment rate of 28.9 calves per 100 adult females is generally considered adequate to maintain the population if the adult survival rate is 85% or greater. The recruitment rate during 2013 was greatest at 20.62 calves per 100 AF_{adj}, whereas estimates of recruitment from the 2011 (7.59) and 2012 (11.50) surveys were less than what is considered adequate. These data indicate that the current number of calves is likely inadequate to maintain the population. Annual adult female survival within the Kinloch Range during the 2010-2012 biological years (which correspond to 2011-2013 survey years) ranged between 0.85-0.98 with a geometric mean survival rate of 0.89 – which is better than the accepted average adult survival rate of 0.85 (EC 2008). Based on the relatively low estimates of recruitment but above average estimates of survival, the estimated population trend (λ) was 0.95, suggesting the population is likely in short-term decline. Additional estimates of recruitment and survival from the collared caribou in future years will be important to refine our estimate of population trend (MNRF 2014a).

6.3.2 Interpretation of habitat state

Disturbance within the Kinloch Range is relatively evenly distributed, and the majority is from natural causes, particularly wildfires. Anthropogenic disturbances within the range are primarily limited to settlements, roads, utility lines, and some mining activity, particularly along Hwy 599 and winter road corridors to Cat Lake and Slate Falls.

The level of disturbance on the Kinloch Range is 19.6% (all waterbodies included). As a result, it is likely that the range supports a stable to increasing population growth with an estimated probability of 0.75. However, the influence of waterbodies in the disturbance analysis should be considered when evaluating the level of disturbance within the range. The water sensitivity analysis demonstrated that the disturbance estimate for the Kinloch Range may be as great as 21.9% (all waterbodies excluded). At such a level it is still likely that the range could sustain caribou. It is possible that landscapes rich in large waterbodies with islands may help compensate for moderate levels of landscape disturbance by providing valuable caribou habitat because the surrounding body of water may provide additional refuge.

Collectively, there are a number of anthropogenic disturbance types not addressed in the above analyses including outfitter activities, access points, campsites and shore lunch activities, trapping, and other recreational activities. These disturbances 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 may be considerable at a local scale.

At this time, it is assumed that habitat availability attributed to forest composition and structure is similar to that available in a natural forest. However, the specific contributions of land cover classes to the provision of refuge, winter or mature conifer forest habitat is largely unknown. Generally we assume that the landcover classes that represent older conifer forest and peatland conditions are more desirable than other landcover classes. This analysis provides a valuable benchmark of those land cover classes against which future assessments may be compared. In the Kinloch Range, it is assumed that the boreal habitat model as described by MNRF (2014a) and applied to the land cover dataset likely applies, but a more refined analysis using FRI data is warranted, once that dataset becomes available.

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

6.4 Ozhiski Range

6.4.1 Interpretation of population state

The minimum animal count for caribou (MAC) occupying the Ozhiski Range during the 2009-2011 winter distribution survey was 148 caribou. During the winter distribution surveys, the majority of the observations of caribou activity were recorded in the central and eastern part of the range. We believe that the 148 caribou observed within the Ozhiski Range is low relative to the true number of caribou occupying the range. Approximately 8% of the range was covered during the winter distribution survey efforts and the range was not surveyed in its entirety in one survey year. Surveys of this nature are expected to detect only a portion of the caribou present with detectability significantly limited by the presence of dense tree cover. It was concluded that the range is occupied by at least 148 caribou and possibly substantially more.

The degree of immigration and emigration across the Ozhiski Range boundaries is unknown. Collaring data is sparse within the Ozhiski Range; however, the available data demonstrates some movement from surrounding ranges into and out of the Ozhiski Range.

A recruitment rate of 28.9 calves per 100 adult females is generally considered adequate to maintain the population if the adult survival rate is 85% or greater. The recruitment rate during

2013 was greatest at 60.00 calves per 100 AF_{adj} (although this estimate was based on a small sample size of 12 caribou) and the next greatest estimate was 28.69 in 2009, all other estimates of recruitment between 2010-2012 ranged from 8.33-17.86 calves per 100 AF_{adj} and were less than what is considered adequate. These varying estimates suggest that the population may be stable or declining. These data indicate the current number of calves may be inadequate to maintain the population; however more information could help to refine this. Annual survival and trend could not be determined due to a lack of data from recruitment survey work. Additional estimates of recruitment and survival from the collared caribou in future years will be important to establish our estimate of population trend (MNRF 2014a).

6.4.2 Interpretation of habitat state

Disturbance within the Ozhiski Range is relatively evenly distributed. The majority of this disturbance is of natural causes where the fire regime is very aggressive. Human activity within the range is primarily limited to settlements, roads, and some mining activity.

The level of disturbance on the Ozhiski Range is 27.6% (all waterbodies included). As a result it is likely that the range supports a stable to increasing population growth with an estimated probability of 0.7. However, the influence of waterbodies in the disturbance analysis should be considered when evaluating the level of disturbance within the range. The water sensitivity analysis demonstrated that the disturbance estimate for the Ozhiski Range may be as great as 31.8% (all waterbodies excluded). At such a level, it is still likely that the range could sustain caribou. It is possible that landscapes rich in large waterbodies with islands may help compensate for moderate levels of landscape disturbance by providing valuable caribou habitat because the surrounding body of water may provide additional refuge.

Collectively, there are a number of anthropogenic disturbance types not addressed in the above analyses including outfitter activities, access points, campsites and shore lunch activities, trapping, and other recreational activities. These disturbances 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 may be considerable at a local scale.

At this time, it is assumed that habitat availability attributed to forest composition and structure is similar to that available in a natural forest. However, the specific contributions of land cover classes to the provision of refuge, winter or mature conifer forest habitat is largely unknown. Generally we assume that the land cover classes that represent older conifer forest and peatland conditions are more desirable than other land cover classes. This analysis provides a valuable benchmark of those land cover classes against which future assessments may be compared. In the Ozhiski Range, the latitude, calcareous soils and high levels of disturbance may warrant a specific habitat model to be developed for future assessments.

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

6.5 Missisa Range

6.5.1 Interpretation of population state

The minimum animal count for caribou (MAC) occupying the Missisa Range during the 2009-2011 winter distribution surveys was 745 caribou. During the winter distribution surveys, caribou activity was well distributed across the entire range. We believe that the 745 caribou observed within the Missisa Range is low relative to the true number of caribou occupying the range. Approximately 8% of the range was covered during the winter distribution survey efforts and the range was not surveyed in its entirety in one survey year. Surveys of this nature are expected to detect only a portion of the caribou present with detectability significantly limited by the presence of dense tree cover. It was concluded that this range is occupied by at least 745 caribou during the winter and possibly substantially more.

The degree of immigration and emigration across the Missisa Range boundaries is unknown, but collaring data demonstrates much movement between the Swan Range, James Bay Range, as well as northward into the Northern Taiga Ecoregion. Forest-tundra caribou are also known to be move into the northern portion of the range during the winter, and many are likely included in the MAC. Collaring movement into the Ozhiski, Nipigon, and Pagwachuan Ranges has been documented to a lesser degree.

A recruitment rate of 28.9 calves per 100 adult females is generally considered adequate to maintain the population if the adult survival rate is 85% or greater. The recruitment rate during 2011 was greatest at 22.21 calves per 100 AF_{adj}. However, all other estimates of recruitment from the 2009-2013 surveys were less than what is considered adequate and ranged from 8.95-22.18 calves per 100 AF_{adj}. These data indicate that the current number of calves is likely inadequate to maintain the population. Annual adult female survival within the Missisa Range during the 2008-2011 biological years (which correspond to 2009-2012 survey years) ranged between 0.69-0.87 with a geometric mean survival rate of 0.80 – which is less than the accepted average adult survival rate of 0.85 (EC 2008). Based on the relatively low estimates of recruitment and low estimates of survival, the estimated population trend (λ) was 0.86, suggesting the population is likely in short-term decline.

6.5.2 Interpretation of habitat state

Disturbance within the Missisa Range is primarily in the western, central, and northern portions of the range. Anthropogenic activity represents the majority of disturbance within the range. Human activity within the range is primarily limited to settlements, roads, and mineral exploration associated with the Ring of Fire area. Natural disturbances are less prevalent in this range where the fire regime is primarily slow, particularly within the central and eastern portions of the range.

The level of disturbance on the Missisa Range is 15.9% (all waterbodies included). As a result it is likely that the range supports a stable to increasing population growth with an estimated probability of 0.86. However, the influence of waterbodies in the disturbance analysis should be considered when evaluating the level of disturbance within the range. The water sensitivity analysis demonstrated that the disturbance estimate for the Missisa Range may be as great as 17.1% (all waterbodies excluded). At such a level it is still likely that the range could sustain caribou.

Collectively, there are a number of anthropogenic disturbance types not addressed in the above analyses including outfitter activities, access points, campsites and shore lunch activities, trapping, and other recreational activities. These disturbances 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 may be considerable at a local scale.

At this time, it is assumed that habitat availability attributed to forest composition and structure is similar to that available in a natural forest. However, the specific contributions of land cover classes to the provision of refuge, winter or mature conifer forest habitat is largely unknown. Generally we assume that the land cover classes that represent older conifer forest and peatland conditions are more desirable than other land cover classes. This analysis provides a valuable benchmark of those land cover classes against which future assessments may be compared. Future assessments for the Missisa Range might include specific habitat models that account for the latitude, extensive areas of peatlands, and complex hydrology.

6.6 James Bay Range

6.6.1 Interpretation of population state

The minimum animal count for caribou (MAC) occupying the James Bay Range during the 2010 and 2011 winter distribution survey was 177 caribou. During the winter distribution surveys, caribou activity was well distributed across the entire range. We believe that the 177 caribou observed within the James Bay Range is low relative to the true number of caribou occupying the range. Approximately 8% of the range was covered during the winter distribution survey efforts and the range was not surveyed in its entirety in one survey year. Surveys of this nature are expected to detect only a portion of the caribou present with detectability significantly limited by the presence of dense tree cover. It was concluded that this range is occupied by at least 177 caribou during the winter and possibly substantially more.

The degree of immigration and emigration across the James Bay Range boundaries is unknown; however collar data demonstrates movement between all surrounding ranges as well as the Northern Taiga Ecoregion to the northwest. Forest-tundra caribou are also known to be move into the northern portion of the range during the winter, and many are likely included in the MAC.

A recruitment rate of 28.9 calves per 100 adult females is generally considered adequate to maintain the population if the adult survival rate is 85% or greater. The recruitment rate was greatest during 2012with 45.91 calves per 100 AF_{adj}. However, all other estimates of recruitment from the 2010-2013 surveys were less than what is considered adequate and ranged from 9.54-25.00 calves per 100 AF_{adj}. These data indicate the current number of calves is likely inadequate to maintain the population. Annual adult female survival within the James

Bay Range during the 2009-2012 biological years (which correspond to 2010-2013 survey years) ranged between 0.78-1.00 with a geometric mean survival rate of 0.84 – which is comparable to the accepted average adult survival rate of 0.85 (EC 2008). Based on the relatively low estimates of recruitment but average estimates of survival, the estimated population trend (λ) was 0.91, suggesting the population is likely in short-term decline.

6.6.2 Interpretation of habitat state

Disturbance within the James Bay Range is primarily in the northern, coastal, and some southcentral portions of the range. The majority of this disturbance is of natural causes despite the fire regime being low-to-moderate. Human activity within the range is primarily limited to settlements, roads, and some mining activity.

The level of disturbance on the James Bay Range is 6.6% (all waterbodies included). As a result it is likely that the range supports a stable to increasing population growth with an estimated probability of 0.9. However, the influence of waterbodies in the disturbance analysis should be considered when evaluating the level of disturbance within the range. The water sensitivity analysis demonstrated that the disturbance estimate for the James Bay Range may be as great as 7.1% (all waterbodies excluded). At such a level it is still likely that the range could sustain caribou.

Collectively, there are a number of anthropogenic disturbance types not addressed in the above analyses including outfitter activities, access points, campsites and shore lunch activities, trapping, and other recreational activities. These disturbances 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 may be considerable at a local scale.

At this time, it is assumed that habitat availability attributed to forest composition and structure is similar to that available in a natural forest. However, the specific contributions of land cover classes to the provision of refuge, winter or mature conifer forest habitat is largely unknown. Generally we assume that the land cover classes that represent older conifer forest and peatland conditions are more desirable than other land cover classes. This analysis provides a valuable benchmark of those land cover classes against which future assessments may be compared. Future assessments for the James Bay Range might include specific habitat models that account for the latitude, extensive areas of peatlands, and complex hydrology.

7.0 Integrated Risk Assessment

7.1 Swan Range

7.1.1 Population size

The minimum number of caribou on the Swan Range based on the MAC is 491 (Figure 51) and likely exceeds 500. The Swan Range is part of the Continuous Distribution in Ontario and some immigration and emigration likely occurs between neighbouring ranges, the Northern

Taiga Ecoregion to the north, and Manitoba to the west. By using the minimum animal count of 491, 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) are 0.95-0.99 and 0.85-0.9 respectively (Figure 51) (MNRF 2014a; EC 2011).

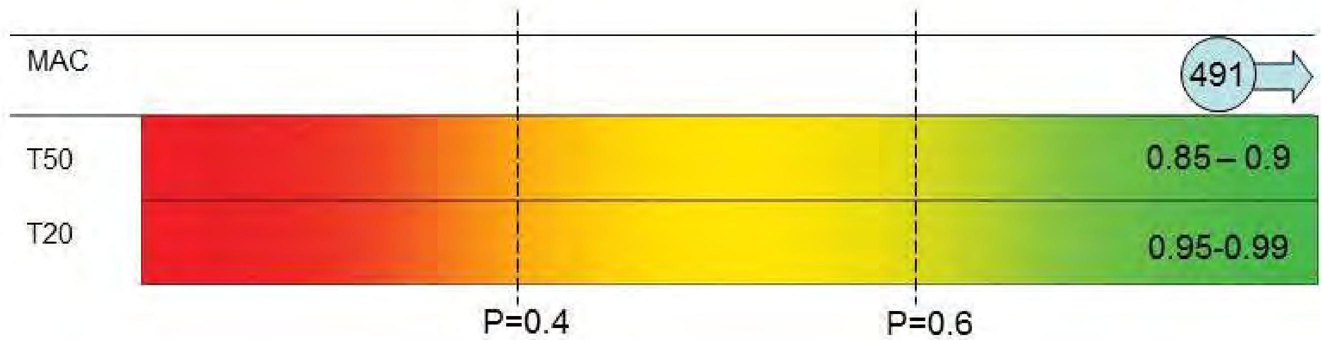


Figure 51. Minimum animal count (MAC) in the Swan Range from the 2009 and 2011 winter distribution surveys, as compared to probability of persistence in 20 years (T20) and 50 years (T50).

7.1.2 Population trend

No estimate of trend was calculated due to a lack of collaring data. However, low recruitment as another indicator would suggest that the population is likely declining (Figure 52).

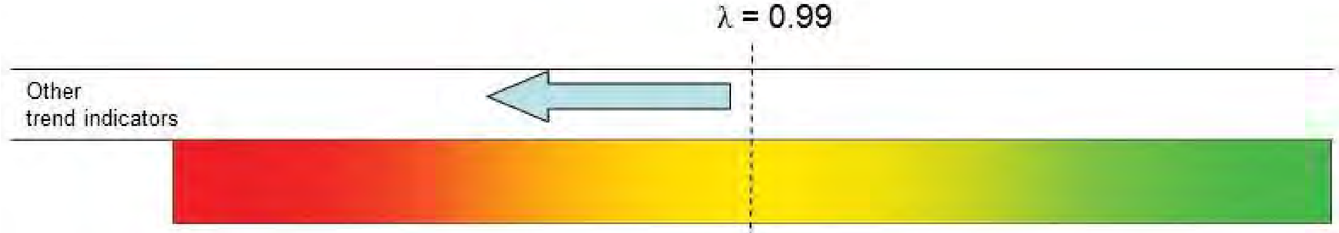


Figure 52. Estimated population trend for the Swan Range is based on recruitment values.

7.1.3 Disturbance analysis

The amount of disturbance (younger than 36 years) on the Swan Range is 23.5%. Calculated values of disturbance ranged from 23.5-28.1%, depending on the treatment of water. When considering the accuracy of fine-scale data used in the disturbance assessment, we believe the calculated value of 23.5% provides a realistic depiction of the amount of disturbance in the Swan Range. This level of disturbance suggests that it is likely that the Swan Range is capable of sustaining the caribou population. The likelihood of stable or increasing population growth is approximately 0.78 (Figure 53).

As per the sensitivity analysis, disturbance (younger than 50 years) was determined to be 25.8% (Figure 54). This level of disturbance also suggests that it is likely that the Swan Range is capable of sustaining the caribou population. The likelihood of stable or increasing population growth is approximately 0.75.

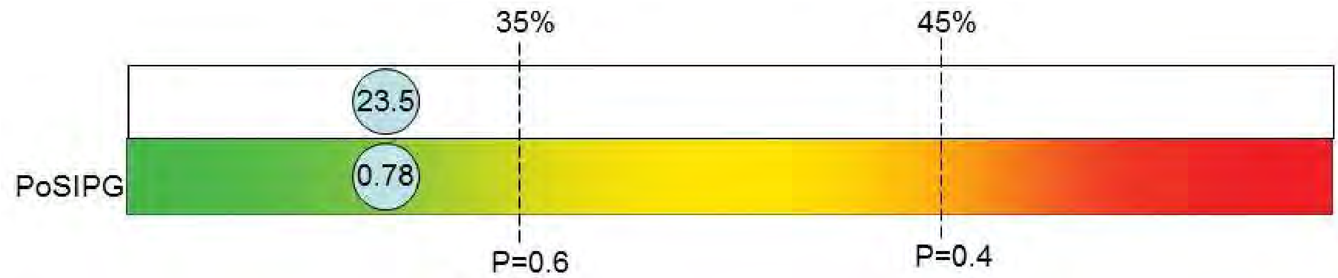


Figure 53. Disturbance estimates (younger than 36 years) as a percentage of area within the Swan Range as it relates to the probability of a stable or increasing population growth (PoSIPG.

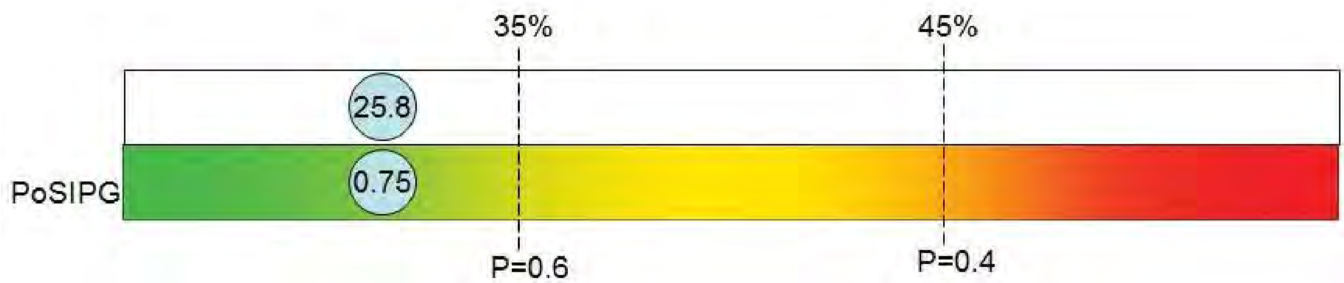


Figure 54. Disturbance estimates (younger than 50 years) as a percentage of area within the Swan Range as it relates to the probability of a stable or increasing population growth (PoSIPG)

7.1.4 Integrated risk assessment process

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

Step 1: No estimate of lambda exists. Likelihood of stable or increasing population growth exceeds 0.4; the estimate of population size is greater than 80 caribou.

Step 2: Lambda (λ) is not available.

Step 5: Likelihood of stable or increasing population growth based on the level of landscape disturbance is greater than 0.6; no lambda (λ) was available; the range is not maintained by population management actions.

Step 4: Probability of persistence is greater than 0.6 (T=50).

Based on this analysis, risk to caribou is low in the Swan Range.

7.1.5 Range condition

Risk is estimated to be low in the Swan Range. Although observed recruitment rates were low, the Assessment Team determined that range condition is likely sufficient to sustain caribou.

7.2 Spirit Range

7.2.1 Population size

The minimum number of caribou on the Spirit Range based on the MAC is 373 (Figure 55) and likely exceeds 400. The Spirit Range is part of the Continuous Distribution in Ontario and some immigration and emigration likely occurs between neighbouring ranges and Manitoba. By using the minimum animal count of 373, 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) are approximately 0.95 and 0.95-0.99 respectively (Figure 55) (MNRF 2014a; EC 2011).

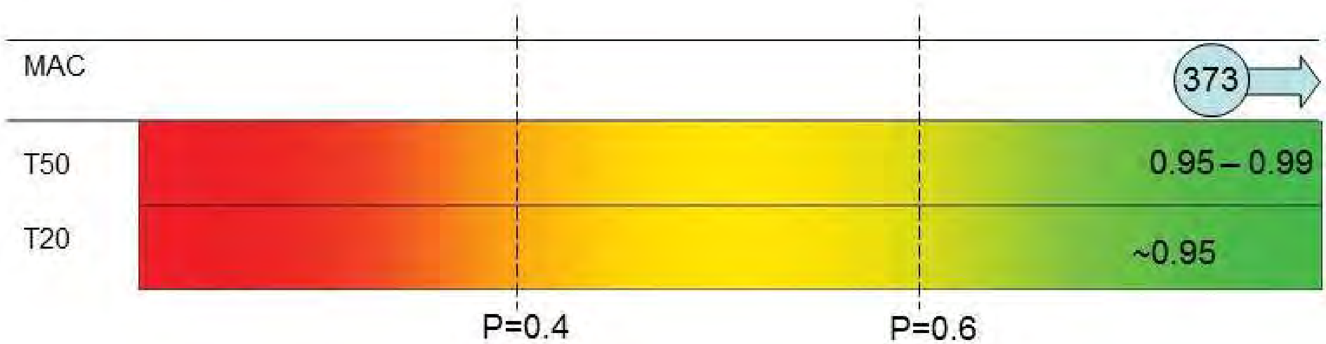


Figure 55. Minimum animal count (MAC) in the Spirit Range from the 2009 and 2010 winter distribution surveys, as compared to probability of persistence in 20 years (T20) and 50 years (T50).

7.2.2 Population trend

Estimates of short-term trend suggest a declining population (λ = 0.95) in the Spirit Range (Figure 56).

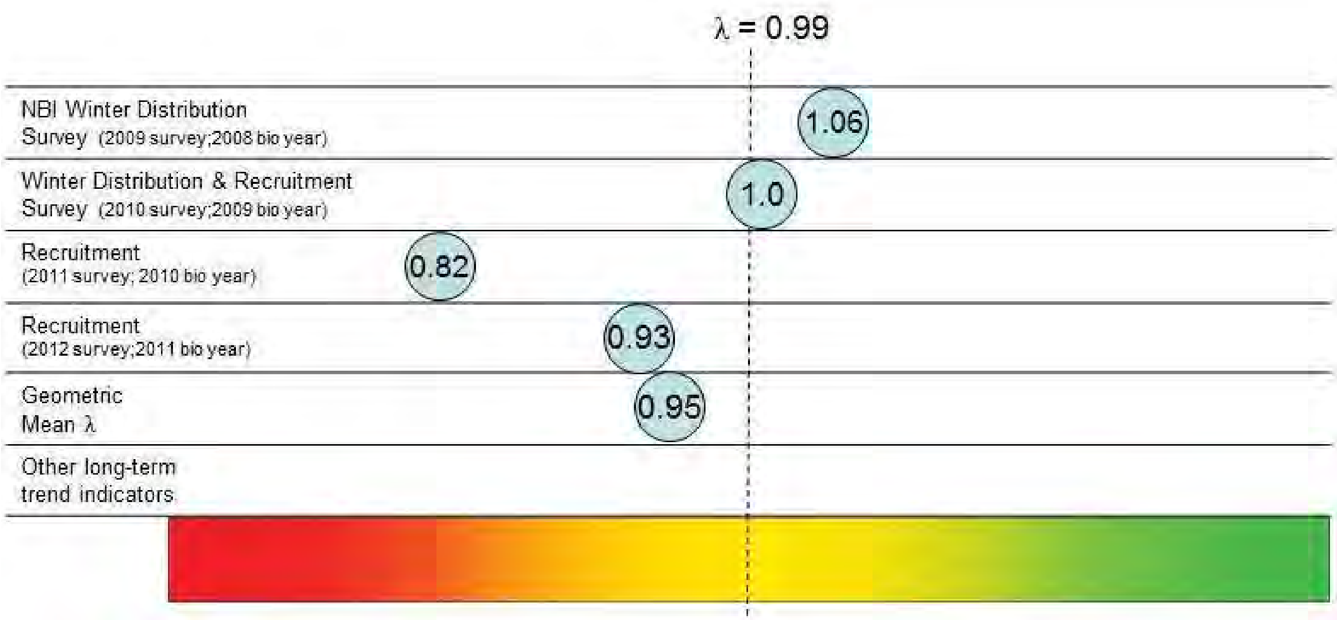


Figure 56. Estimated population trend (λ) for the Spirit Range according to the source of data (i.e. survey) and the corresponding year, as well as the short-term trend (geometric mean) and long-term trend (not available) as determined from other trend indicators.

7.2.3 Disturbance analysis

The amount of disturbance (younger than 36 years) on the Spirit Range is 28.6%. Calculated values of disturbance ranged from 28.6-32.5%, depending on the treatment of water. When considering the accuracy of fine-scale data used in the disturbance assessment, we believe the calculated value of 28.6% provides a realistic depiction of the amount of disturbance in the Spirit Range. This level of disturbance suggests that it is likely that the Spirit Range is capable of sustaining the caribou population. The likelihood of stable or increasing population growth is approximately 0.7 (Figure 57).

As per the sensitivity analysis, disturbance (younger than 50 years) was determined to be 34.6% (Figure 58). At this level, the range is at the threshold between being capable of sustaining the caribou population and being uncertain whether it can with the likelihood of stable of increasing population growth approximately 0.6.

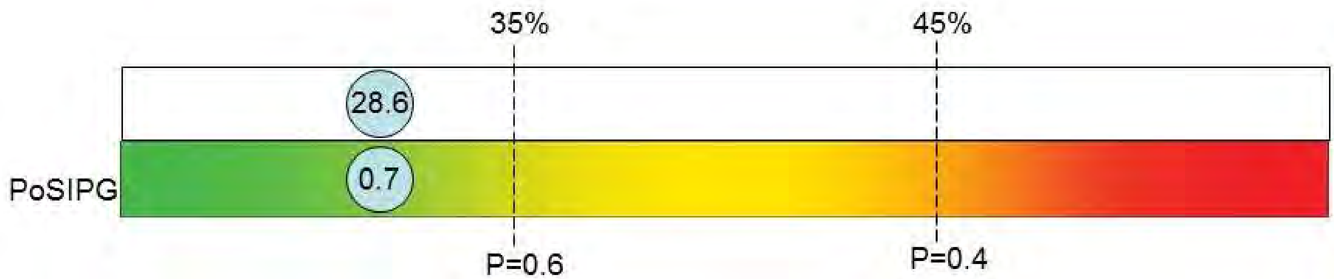


Figure 57. Disturbance estimates (younger than 36 years) as a percentage of area within the Spirit Range as it relates to the probability of a stable and increasing population growth (PoSIPG).

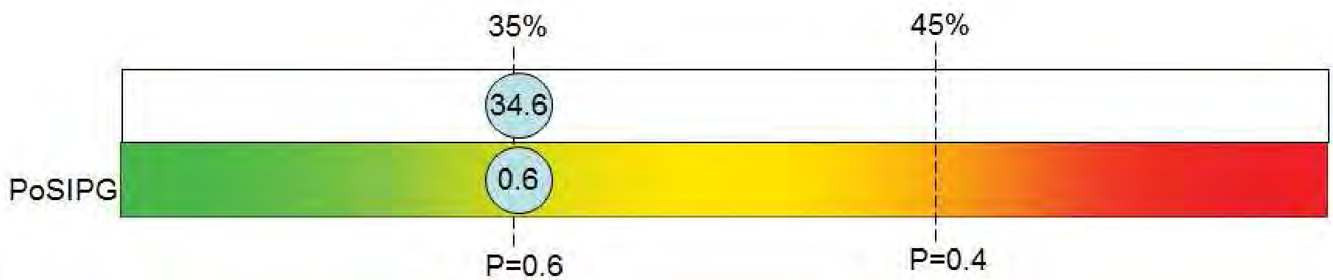


Figure 58. Disturbance estimates (younger than 50 years) as a percentage of area within the Spirit Range as it relates to the probability of a population growth (PoSIPG)**.**

7.2.4 Integrated risk assessment process

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

Step 1: Lambda (λ) is less than 0.99; likelihood of stable or increasing population growth is greater than 0.4; the estimate of population size is greater than 80 caribou.

Step 2: Lambda (λ) 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 greater than 0.6; lambda (λ) is considered reliable; the range is not maintained by population management actions.

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

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

7.2.5 Range condition

Risk is estimated to be intermediate in the Spirit Range. The Assessment Team determined that it is uncertain if the range condition is sufficient to sustain caribou.

7.3 Kinloch Range

7.3.1 Population size

The minimum number of caribou on the Kinloch Range based on the MAC is 113 (Figure 59) and likely exceeds 350. The Kinloch Range is part of Continuous Distribution in Ontario and some immigration and emigration likely occurs between neighbouring ranges. By using the minimum animal count of 113, 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) are approximately 0.9-0.95 and 0.75-0.85 respectively (Figure 59) (MNRF 2014a; EC 2011).

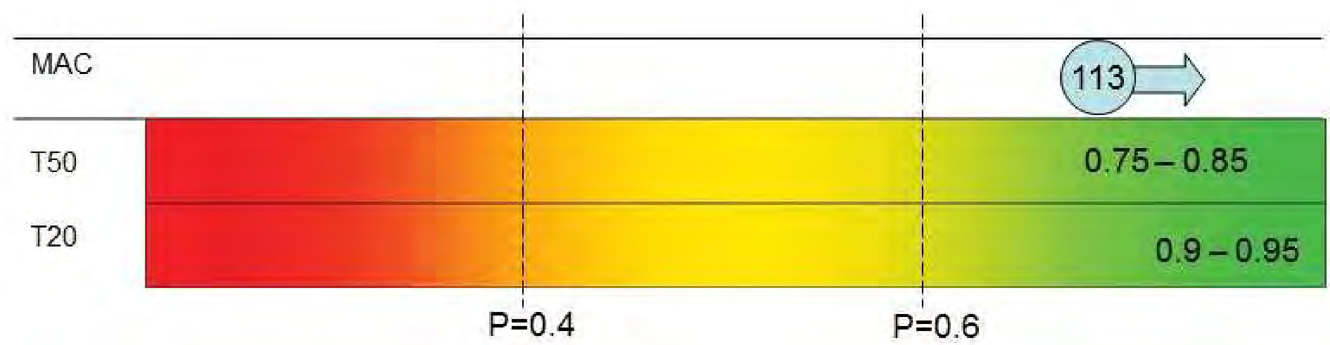


Figure 59. Minimum animal count (MAC) in the Kinloch Range from the 2008-2010 winter distribution surveys as compared to probability of persistence in 20 years (T20) and 50 years (T50).

7.3.2 Population trend

Estimates of short-term trend suggest a declining population (geometric mean $\lambda = 0.95$) in the Kinloch Range (Figure 60). The declining trend is the result of low recruitment, as survival estimates were at or above the national average.

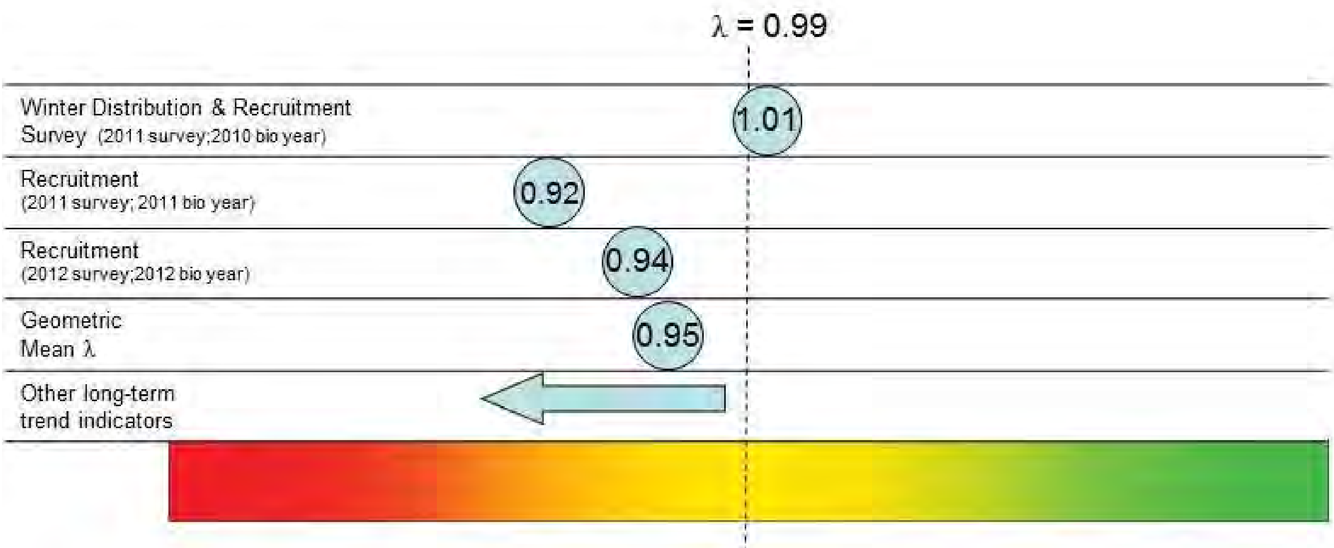


Figure 60. Estimated population trend (λ) for the Kinloch Range according to the source of data (i.e. survey) and the corresponding year, as well as the short term trend (geometric mean) and long-term trend (not available) as determined from other trend indicators.

7.3.3 Disturbance analysis

The amount of disturbance (younger than 36 years) on the Kinloch Range is 19.6%. Calculated values of disturbance ranged from 19.6-21.9%, depending on the treatment of water. When considering the accuracy of fine-scale data used in the disturbance assessment, we believe the calculated value of 19.6% provides a realistic depiction of the amount of disturbance in the Kinloch Range. This level of disturbance suggests that it is likely that the Kinloch Range is capable of sustaining the caribou population. The likelihood of stable or increasing population growth is approximately 0.8 (Figure 61).

As per the sensitivity analysis, disturbance (younger than 50 years) was determined to be 23.8% (Figure 62). This level of disturbance also suggests that it is likely that the Kinloch Range is capable of sustaining the caribou population. The likelihood of stable or increasing population growth is approximately 0.75.

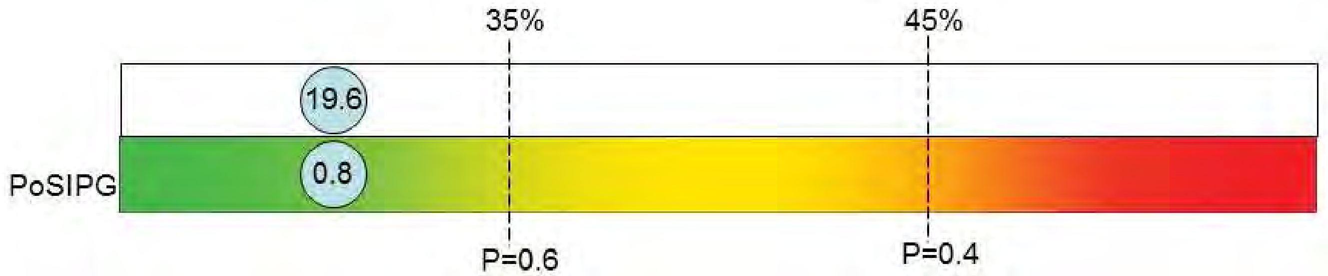


Figure 61. Disturbance estimates younger than 36 years as a percentage of area within the Kinloch Range as it relates to the probability of a stable or increasing population growth (PoSIPG).

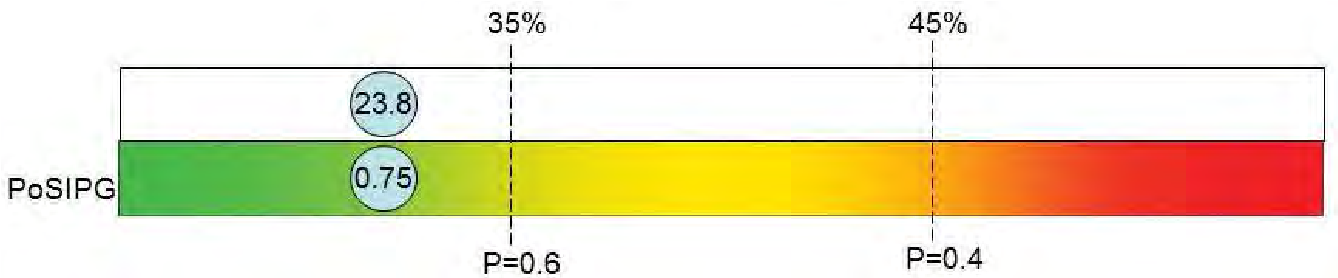


Figure 62. Disturbance estimates younger than 50 years as a percentage of area within the Kinloch Range as it relates to the probability of a stable or increasing population growth (PoSIPG).

7.3.4 Integrated risk assessment process

The 6 steps of the risk assessment process (MNRF 2014a) lead to a conclusion on degree of risk.

Step 1: Lambda (λ) is less than 0.99; and likelihood of stable or increasing population growth is greater than 0.4; and the estimate of population size is greater than 80 caribou.

Step 2: Lambda (λ) is available and is less than 0.99.

Step 5: Likelihood of stable or increasing population growth based on the level of landscape disturbance is greater than 0.6; lambda (λ) is considered reliable; the range is not maintained by population management actions.

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

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

7.3.5 Range condition

Risk is estimated to be intermediate in the Kinloch Range. The Assessment Team determined that it is uncertain if the range condition is sufficient to sustain caribou.

7.4 Ozhiski Range

7.4.1 Population size

The minimum number of caribou on the Ozhiski Range based on the MAC is 148 (Figure 63) and likely exceeds 150. The Ozhiski Range is part of Continuous Distribution in Ontario and some immigration and emigration likely occurs between neighbouring ranges. By using the minimum animal count of 148, 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) are approximately 0.9-0.95 and 0.7-0.75 respectively (Figure 63) (MNRF 2014a; EC 2011).

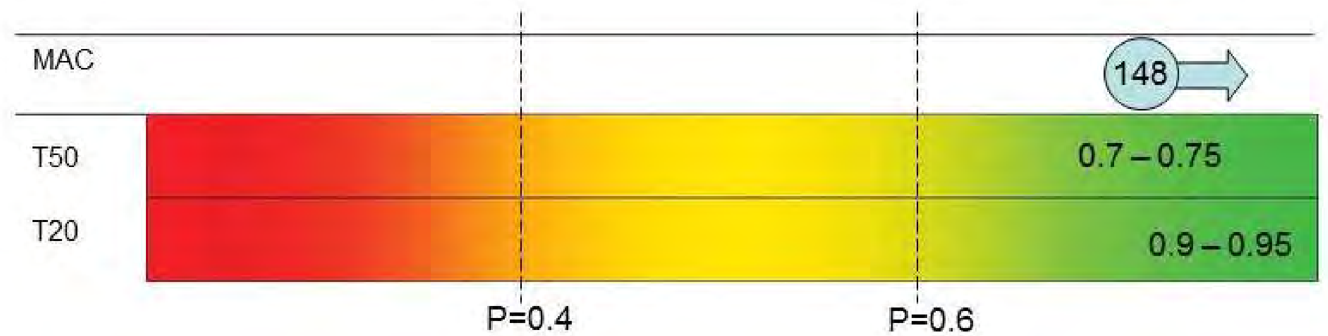


Figure 63. Minimum animal count (MAC) in the Ozhiski Range from the 2010 and 2011 winter distribution surveys, as compared to probability of persistence in 20 years (T20) and 50 years (T50).

7.4.2 Population trend

No estimate of trend was calculated due to a lack of collaring data. However, varying recruitment estimates as another trend indicator suggests that the population may be stable or declining (Figure 64).

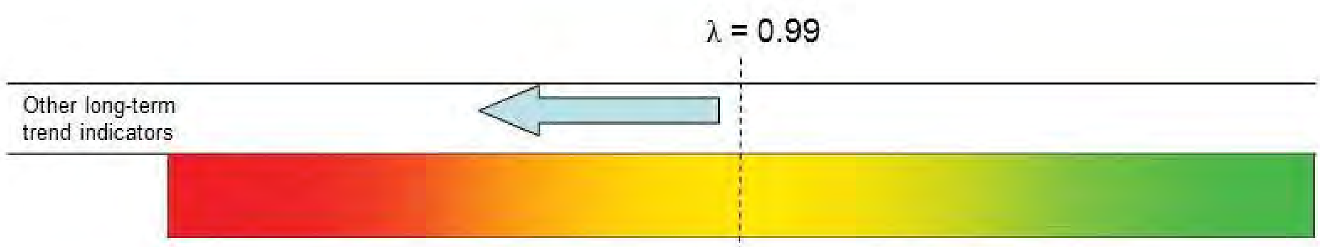


Figure 64. The estimate of population trend of the Ozhiski Range is based on recruitment values from 2010 to 2013.

7.4.3 Disturbance analysis

The amount of disturbance (younger than 36 years) on the Ozhiski Range is 27.6%. Calculated values of disturbance ranged from 27.6-31.8%, depending on the treatment of water. When considering the accuracy of fine-scale data used in the disturbance assessment, we believe the calculated value of 27.6% provides a realistic depiction of the amount of disturbance in the Ozhiski Range. This level of disturbance suggests that it is likely that the Ozhiski Range is capable of sustaining the caribou population. The likelihood of stable or increasing population growth is approximately 0.7 (Figure 65).

As per the sensitivity analysis, disturbance (younger than 50 years) was determined to be 32.1% (Figure 66). This level of disturbance also suggests that it is likely that the Ozhiski Range is capable of sustaining the caribou population. The likelihood of stable or increasing population growth is approximately 0.65.

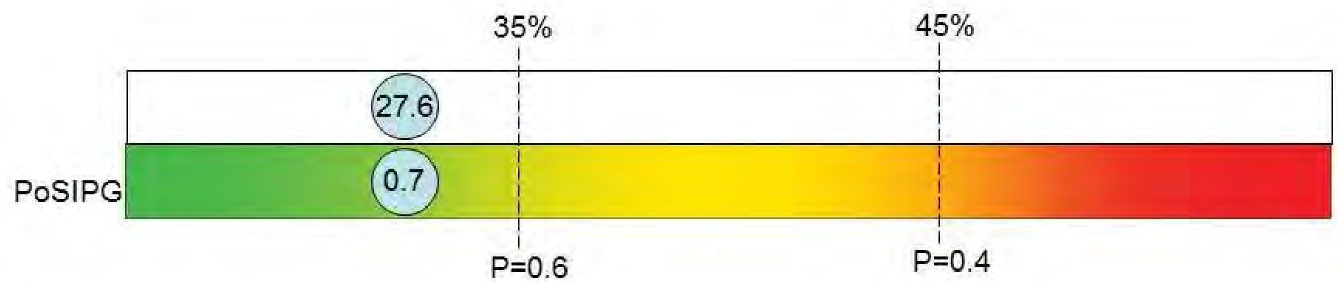


Figure 65. Disturbance estimates (younger than 36 years) as a percentage of area within the Ozhiski Range as it relates to the probability of a stable or increasing population growth (PoSIPG).

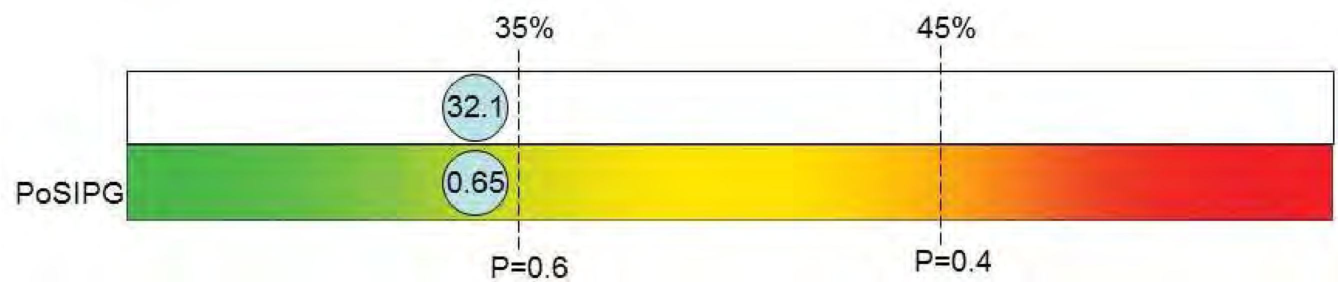


Figure 66. Disturbance estimates (younger than 50 years) as a percentage of area within the Ozhiski Range as it relates to the probability of a stable or increasing population growth (PoSIPG).

7.4.4 Integrated risk assessment process

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

Step 1: No estimate of lambda (λ) exists; likelihood of stable or increasing population growth is greater than 0.4; and the estimate of population size is greater than 80 caribou.

Step 2: Lambda (λ) is not available.

Step 5: Likelihood of stable or increasing population growth based on the level of landscape disturbance is greater than 0.6; no lambda (λ) was available; the range is not maintained by population management actions.

Step 4: Probability of persistence is greater than 0.6 (T=50).

Based on this analysis, risk to caribou in the Ozhiski Range is low.

7.4.5 Range condition

Risk is estimated to be low in the Ozhiski Range. The Assessment Team determined that range condition is likely sufficient to sustain caribou.

7.5 Missisa Range

7.5.1 Population size

The minimum number of caribou on the Missisa Range based on the MAC is 745 (Figure 67) and likely exceeds 750. The Missisa Range is part of Continuous Distribution in Ontario and some immigration and emigration likely occurs between neighbouring ranges and the Northern Taiga Ecoregion to the north. By using the minimum animal count of 745, 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) are approximately 0.98-1.0 and 0.95-1.0 respectively (Figure 67) (MNRF 2014a; EC 2011).

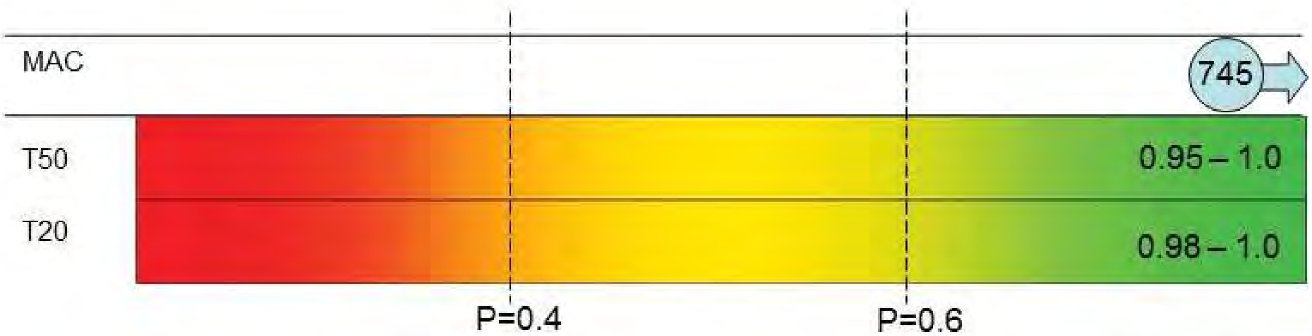


Figure 67. Minimum animal count (MAC) in the Missisa Range from the 2009-2011 winter distribution surveys, as compared to probability of persistence in 20 years (T20) and 50 years (T50).

7.5.2 Population trend

Estimates of short-term trend suggest a declining population (geometric mean λ = 0.86) in the Missisa Range (Figure 68).

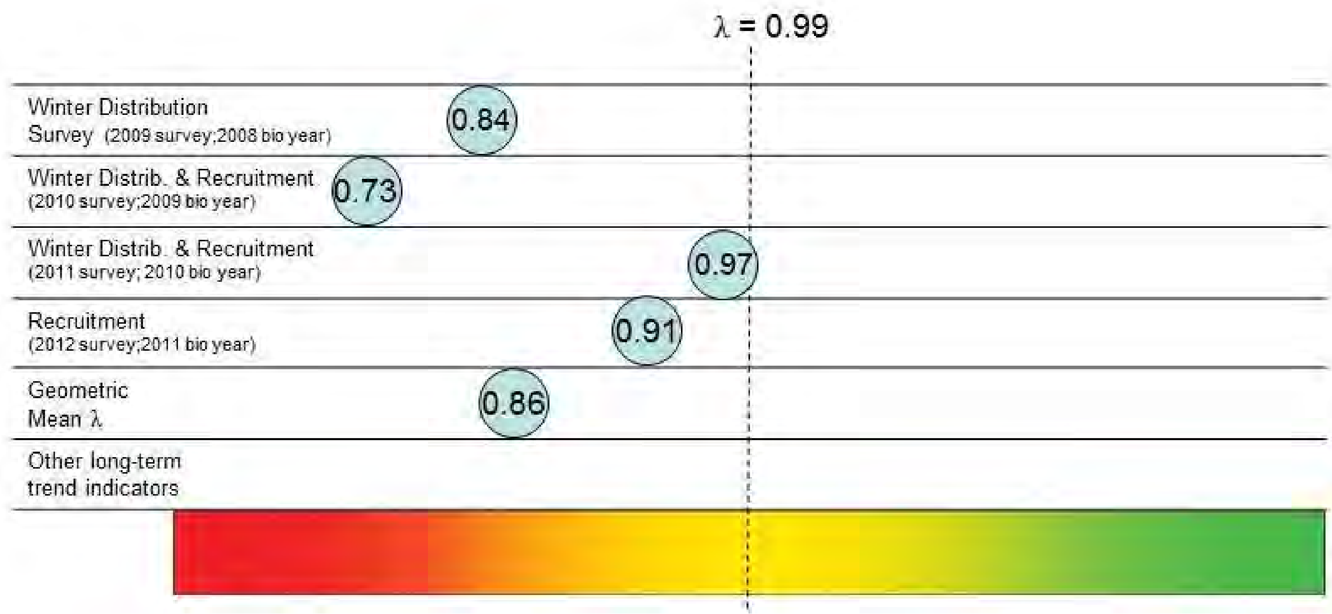


Figure 68. Estimated population trend (λ) for the Missisa Range according to the source of data (i.e. survey) and the corresponding year, as well as the short term trend (geometric mean) and long-term trend (not available) as determined from other trend indicators.

7.5.3 Disturbance analysis

The amount of disturbance (younger than 36 years) on the Missisa Range is 14.4%. Calculated values of disturbance ranged from 14.4-15.4%, depending on the treatment of water. When considering the accuracy of fine-scale data used in the disturbance assessment, we believe the calculated value of 14.4% provides a realistic depiction of the amount of disturbance in the Missisa Range. This level of disturbance suggests that it is likely that the Missisa Range is capable of sustaining the caribou population. The likelihood of stable or increasing population growth is approximately 0.86 (Figure 69).

As per the sensitivity analysis, disturbance (younger than 50 years) was determined to be 15.9% (Figure 70). This level of disturbance also suggests that it is likely that the Missisa Range is capable of sustaining the caribou population. The likelihood of stable or increasing population growth is approximately 0.85.

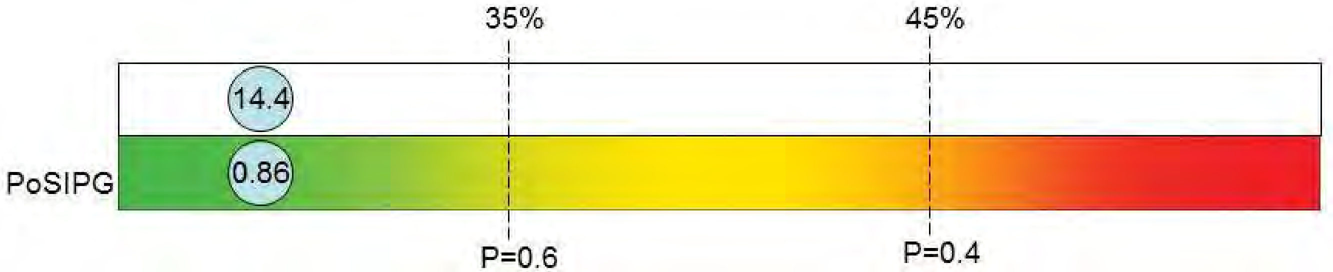


Figure 69. Disturbance estimates (younger than 36 years) as a percentage of area within the Missisa Range as it relates to the probability of a stable or increasing population growth (PoSIPG).

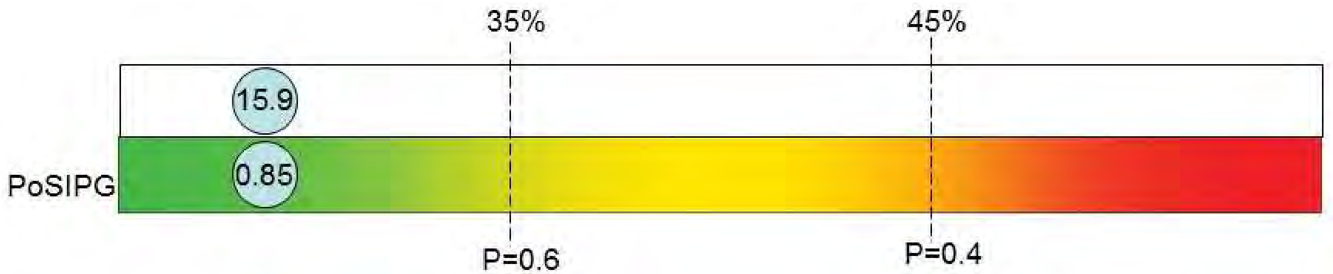


Figure 70. Disturbance estimates (younger than 50 years) as a percentage of area within the Missisa Range as it relates to the probability of a stable or increasing population growth (PoSIPG).

7.5.4 Integrated risk assessment process

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

Step 1: Lambda (λ) is less than 0.99; and likelihood of stable or increasing population growth is greater than 0.4; and the estimate of population size is greater than 80 caribou.

Step 2: Lambda (λ) is available and is less than 0.99.

Step 5: Likelihood of stable or increasing population growth based on the level of landscape disturbance is greater than 0.6; lambda (λ) is considered reliable; the range is not maintained by population management actions.

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

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

7.5.5 Range condition

Risk is estimated to be intermediate in the Missisa Range. The Assessment Team determined that it is uncertain if the range condition is sufficient to sustain caribou.

7.6 James Bay Range

7.6.1 Population size

The minimum number of caribou on the James Bay Range based on the MAC is 177 (Figure 71) and likely exceeds 200. The James Bay Range is part of Continuous Distribution in Ontario and some immigration and emigration likely occurs between neighbouring ranges and the Northern Taiga Ecoregion to the north. By using the minimum animal count of 177, 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) are approximately 0.9-0.95 and 0.7-0.75, respectively (Figure 71) (MNRF 2014a; EC 2011).

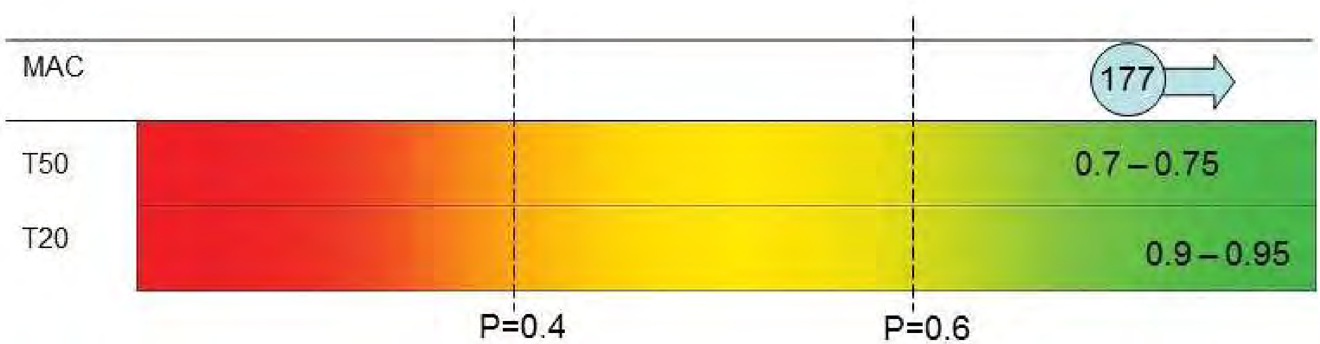


Figure 71. Minimum animal count (MAC) in the James Bay Range from the 2010 and 2011 winter distribution surveys, as compared to probability of persistence in 20 years (T20) and 50 years (T50).

7.6.2 Population trend

Estimates of short-term trend suggest a declining population (geometric mean λ = 0.91) in the James Bay Range (Figure 72). The declining trend is the result of low survival rates in 2009 and 2011.

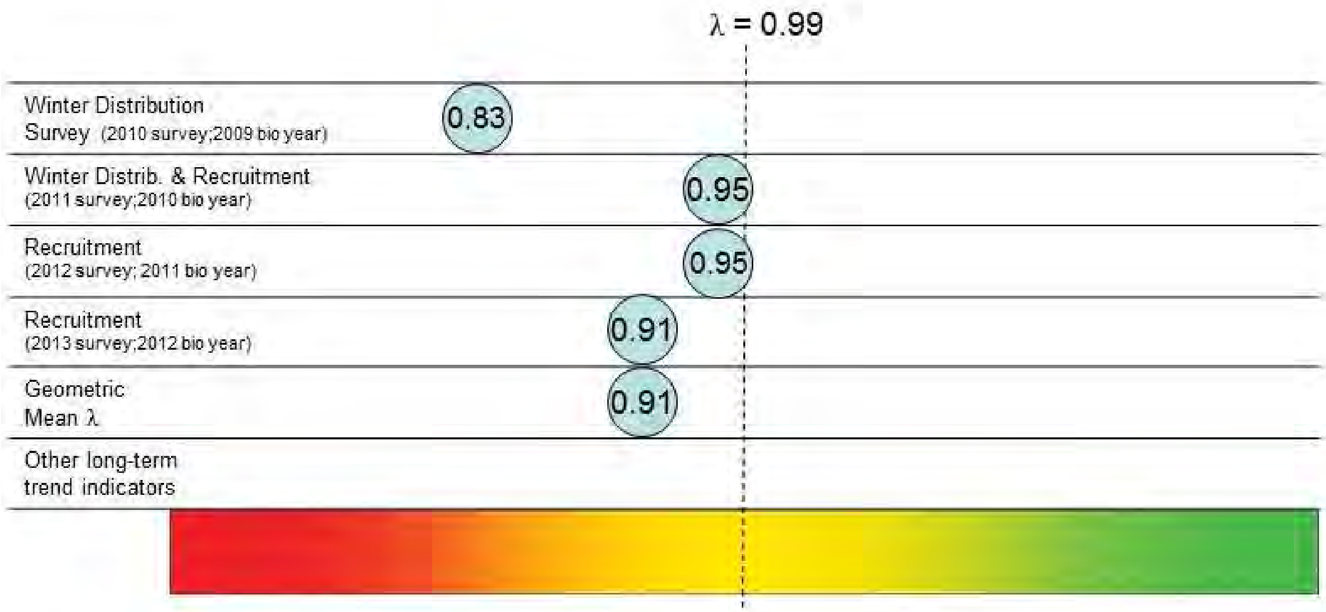


Figure 72. Estimated population trend (λ) for the James Bay Range according to the source of data (i.e. survey) and the corresponding year, as well as the short term trend (geometric mean) and long-term trend (not available) as determined from other trend indicators.

7.6.3 Disturbance analysis

The amount of disturbance (younger than 36 years) on the James Bay Range is 606%. Calculated values of disturbance ranged from 6.6-7.1%, depending on the treatment of water. When considering the accuracy of fine-scale data used in the disturbance assessment, we believe the calculated value of 6.6% provides a realistic depiction of the amount of disturbance in the James Bay Range. This level of disturbance suggests that it is likely that the James Bay Range is capable of sustaining the caribou population. The likelihood of stable or increasing population growth is approximately 0.9 (Figure 73).

As per the sensitivity analysis, disturbance (younger than 50 years) was determined to be 7.0%. This level of disturbance also suggests that it is likely that the James Bay Range is capable of sustaining the caribou population. The likelihood of stable or increasing population growth is approximately 0.9 (Figure 74).

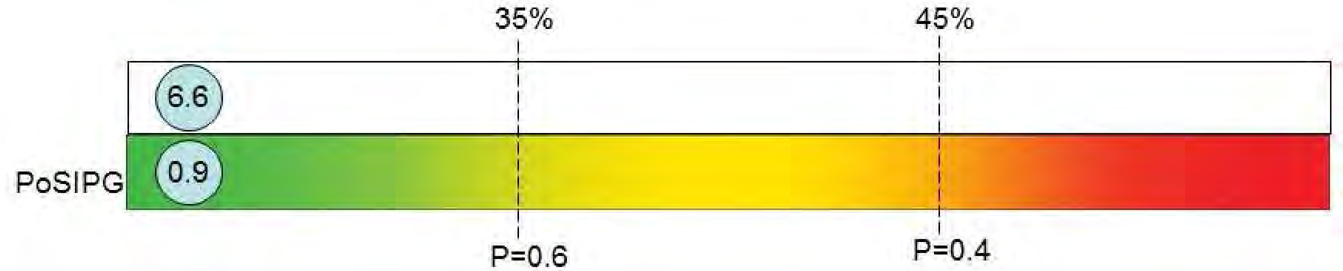


Figure 73. Disturbance estimates (younger than 36 years) as a percentage of area within the James Bay Range as it relates to the probability of a stable or increasing population growth (PoSIPG).

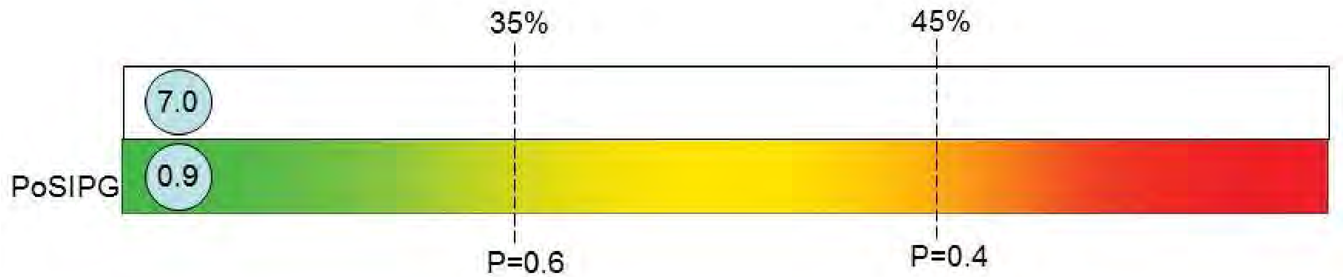


Figure 74. Disturbance estimates (younger than 50 years) as a percentage of area within the James Bay Range as it relates to the probability of a stable or increasing population growth (PoSIPG).

7.6.4 Integrated risk assessment process

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

Step 1: Lambda (λ) is less than 0.99; and likelihood of stable or increasing population growth is greater than 0.4; and the estimate of population size is greater than 80 caribou.

Step 2: Lambda (λ) is available and is less than 0.99.

Step 5: Likelihood of stable or increasing population growth based on the level of landscape disturbance is greater than 0.6; lambda (λ) is considered reliable; the range is not maintained by population management actions.

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

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

7.6.5 Range condition

Risk was estimated to be intermediate in the James Bay Range. The Assessment Team determined that it is uncertain of the range condition is sufficient to sustain caribou.

8.0 Involvement of First Nation Communities

Much of the population state for the Integrated Range Assessments of the Far North Ranges was derived the Far North Caribou project (Berglund et al. 2014). Field work and survey activities were conducted out of remote First Nation communities including:

- Far North Winter Distribution Surveys – Kitchenuhmaykoosib Inninuwug, Keewaywin, Sachigo, Attawapiskat, Marten Falls, Webequie
- Far North Collaring – Attawapiskat, Kitcheuhmaykoosib Inninuwug, Eabametoong and Keewaywin

A number of community members also participated in field work including:

- Waylon Achneepineskum, John Ashpanaquestcum, Derek Innese, Amos Jacob, Bill Jacob, Barlow Kakagamic, Perry Mamakeesik, Paul Mattinas, Calvin Myles, Gerald Myles, Junior Myles, Wallace Moskotaywenene, Jack Rickard, Nita Quequich, Jacob Wynne.

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). In that report, the area represented by the Swan, Spirit, Ozhiski, Kinloch, Missisa, and James Bay Ranges was summarized as 'Far North'. A conclusion, based on disturbance analysis alone, was that the population was self-sustaining.

This Integrated Range Assessment Report for the ranges in the Far North of Ontario documents the assessment results for the six ranges that included best available information on disturbance, population size, and population trend. Differences between the Far North of Ontario Integrated Range Assessments documented in this report and the results of the EC assessment can be attributed to the following:

1. The amount of disturbance identified within the six ranges in the Far North of Ontario includes additional disturbances associated with mining claims, linear features, and blowdown events which were not addressed by EC. MNRF used a finer-grained depiction fire disturbance than used by EC. MNRF determined varied estimates of disturbance associated with stated assumptions relating to the inclusion or exclusion of waterbodies of various sizes in the disturbance calculations.
2. Current recruitment and adult survival estimates derived from winter distribution surveys and collared caribou resulted in lambda calculations that suggest a declining trend over the short-term.

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