Keeyask Infrastructure Project

Terrestrial and Aquatic Monitoring Plan

Mammals Monitoring

Annual Report 2013-2014

KEEYASK

Hydropower Limited Partnership

December 2014

KEEYASK INFRASTRUCTURE PROJECT

TERRESTRIAL AND AQUATIC MONITORING PLAN

Mammals Monitoring: Annual Report 2013 - 2014

Report for

MANITOBA CONSERVATION AND WATER STEWARDSHIP

Prepared on Behalf of the

Keeyask Hydropower Limited Partnership

By

Wildlife Resource Consulting Services MB Inc.

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EXECUTIVE SUMMARY

The Keeyask Hydropower Limited Partnership is constructing the Keeyask Infrastructure Project (the Project or KIP). The Project is located approximately 40 km southwest of Gillam, extending between Provincial Road (PR) 280 and Gull Rapids on the Nelson River. The Project includes a start-up camp and associated infrastructure, a 25 km all-weather access road and the first phase of a main camp.

As part of the KIP licensing conditions (Environment Act Licence No. 2952R), the Keeyask Hydropower Limited Partnership is conducting terrestrial effects monitoring during the KIP construction. Mammals monitoring for the KIP is required during construction activities and, in particular, for summer-resident caribou present in the area. Effects monitoring required that baseline data be collected prior to project development. Baseline surveys were conducted in 2011 prior to construction. In 2012 and 2013, spring, summer and fall surveys were conducted during construction of the KIP. Black bear and gray wolf den surveys were also conducted prior to road and camp clearing activities to prevent these species from being affected during the denning period.

The caribou monitoring component includes both Local and Regional Study Areas. Caribou calving complexes and islands within these areas were selected using habitat data, and were first field sampled in 2011. Four complexes containing 12 habitat islands were added to the design in 2012 and were resampled in 2013. Samples were distributed in Project Effects, Reference and Road Reference Areas throughout a total of 48 peatland complexes containing 342 habitat islands. Once selected, sign tracking transects with thread lines of varying lengths were used to detect caribou and moose occurrences in three seasonal site visits. A total of 48 Reconyx™ PM35C31 trail cameras were deployed on heavy use game trails and/or located near the edges of potential caribou calving islands for a five-month period. Trail camera results were used to corroborate the results from the tracking studies. Other types of monitoring transects consisting of 11 paired 5-km transects that were established adjacent to the future access road. These lines were used further to investigate the relationship between moose, black bear, gray wolf and caribou.

In summer 2013, construction activities were temporarily suspended due to a large forest fire which occurred in proximity of the Project. Although transects were sampled in April 2013, many transects in July and September/October were not sampled because of the extensive forest fires that began in early June 2013. Due to the forest fires, limited data were also collected by trail cameras between April and July 2013. At least 31 trail cameras were destroyed by fire; however 39 of 48 cameras had all or part of the photographs recovered.

In total, sign from 15 species were recorded during surveys completed in the spring, summer and fall 2013. Mammal species signs included American marten, beaver, black bear, caribou, ermine, fisher, gray wolf, lynx, mink, moose, red fox, river otter and wolverine; snowshoe hare sign was not recorded in 2013. Moose and caribou sign were observed the most frequently as the surveys were designed to detect large mammal activity. With the exception of black bear and gray wolf, occurrences of other species are largely considered incidental.

Mammal sign surveys indicated that adult caribou use of complexes and islands declined over all study areas sampled from 2011 to 2012, but generally increased in 2013, regardless of construction activities. The reversal of caribou activities measured during the construction period was not expected because sensory disturbances, including noise and movements of machinery and people, were anticipated to increase loss of effective habitat. However, results were influenced heavily by the movement of migratory Pen Islands caribou into the region, many of which moved adjacent to active construction areas, and secondly, by large scale forest fires that occurred during summer and fall, 2013 in the KIP area. Calving and rearing complexes that were not directly affected by fire may have experienced increased caribou activity due to animals were being displaced from nearby areas affected by forest fires, or this result may be an artifact of low sample size during summer and fall site visits. Future sampling efforts will be required to determine the short-term and long-term suitability of caribou calving complexes and islands affected by fire versus those unaffected by fire.

The monitoring of caribou activity levels in proximity to the access road, start-up camp and main camp areas was problematic because all calving complexes and islands located within 3 km of the access road were affected by the 2013 forest fire. Based on the limited number of unburned complexes and islands sampled in 2013, there appeared to be an increased level of use by adult

caribou over 2012 levels. Calving activity levels were similar to those observed at comparable distance classes sampled in 2012. Overall, and most likely as a result of forest fires that burned during the calving period, calving potential in the KIP area may have been limited due to the decreased availability of calving complexes.

The sampling of complexes and islands in proximity to PR 280 indicated increased levels of adult caribou activity in 2013. Caribou calving and rearing activity appeared to take place on fewer complexes in proximity to PR 280 compared to previous years, but activities occurred on a larger number of islands. This could indicate that at a broader scale, although caribou calved on a limited set of complexes, the overall number of islands used increased. Although it is unclear precisely how many complexes were affected by fire, and where alternative calving habitats remained suitable in 2013 during the fires, the increased level of island use at complexes near the highway likely corresponds with the reduction of habitat quality elsewhere. At a population level, this would have resulted in caribou calving occurring at higher densities over a limited area, which is not expected to be the preferred calving behaviour of sedentary caribou which commonly use a spacing away approach to avoid predators. It may suggest that at times of stress, remaining suitable habitat, or less suitable alternate habitats are used, despite achieving higher density and increased predation risk.

The monitoring of moose and other terrestrial mammals was limited because of the forest fires that reduced sampling effort adjacent to the access road. Based on existing data, the number of species observed over the first visit in April 2013, prior to the forest fires, was comparable to those levels observed in 2011 and 2012. Future monitoring will continue to investigate the distribution and activities of mammal species in proximity to the access road to determine the short-term and long-term suitability of wildlife habitat affected by fire versus those unaffected by fire.

In late January 2013, Manitoba Hydro personnel, First Nations community members and Manitoba Conservation and Water Stewardship biologists observed many caribou migrating into the Keeyask Generation Project Study Area (Zone 5). Similar reports of large caribou numbers emerged from the KIP study area in late January. An aerial reconnaissance survey was used to investigate the abundance and distribution of migratory caribou near KIP access road

construction. During the survey conducted on January 31, 7,787 caribou were recorded. The unusually high numbers of caribou observed during the reconnaissance survey north of the Nelson River triggered additional monitoring. A systematic fixed-wing aerial survey was designed and conducted from February 5 to 8, 2013, with the goal of estimating caribou density and abundance in the broader geographic region. Strip transects were used to sample and count animals. Estimates of both caribou density and abundance were based on the results of distance sampling line transect methods and quantitative analysis in the program DISTANCE v.6.0, and were used to derive a population estimate.

In total, 4,169 caribou were observed during the survey. On the distance sampling line transects, 3,486 caribou grouped in 262 clusters were observed. Population modelling results indicated a density of 1.66 caribou/km^2 and generated a population estimate of 13,985 (± 18.17%, 95% CI) caribou in the eastern half of Study Zone 5. Based on physical appearance, radio-collar information on Pen Islands and Cape Churchill caribou in the area, and anecdotal reports from community members, observed caribou were identified as coastal caribou originating from the Pen Islands herd. Herd membership was further verified through genetic testing of caribou faecal pellet samples collected concurrently with the February aerial survey.

In addition to the population estimate, 36 sites were identified where caribou crossed the Nelson River and Stephens Lake. Seventeen sites were located on the Nelson River between Birthday Rapids and Gull Rapids, 14 sites were on Stephens Lake between Gull Rapids and Gillam and five sites crossed the north arm of Stephens Lake.

Black bear den surveys were completed in October 2013 in selected areas of the KIP Local Study Area. Surveys were completed through systematic surveys of areas where clearing activities were scheduled in order to ensure no active dens were disturbed. No dens were detected during surveys.

ACKNOWLEDGEMENTS

Chief(s) and Council(s) of the Tataskweyak Cree First Nation (TCN), Fox Lake Cree Nation (FLCN), War Lake First Nation (WLCN) and York Factory First Nation (YFCN) are gratefully acknowledged for their support of this program. We would also like to thank Victor Spence and Clayton Flett of TCN for arranging logistic support.

We would like to thank Manitoba Hydro, in particular Sherrie Mason, for providing her guidance and for the opportunity and resources to conduct this study.

Also thanked are North/South Consultants Inc., who are gratefully acknowledged for providing guidance, logistical support, and other resources that made this study feasible. Special thanks are also extended to ECOSTEM Ltd., including Dr. James Ehnes who are gratefully acknowledged for providing technical and other support throughout the study.

STUDY TEAM

The study team consisted of personnel from Wildlife Resource Consulting Services MB Inc (WRCS) as well as field assistants from the KCN's. WRCS personnel who have worked on this field project include Nicholas LaPorte, Peter Hettinga, Timothy Kroeker, Joseph Guay, Scott MacKenzie, Morgan Scharf, Krista Kenyon, Cole Moszynski, and Gordon MacDonald.

The following members are thanked for their local expertise and assistance in conducting winter and summer mammal field studies during 2013: TCN - Kelvin Kitchekeesik, Leonard Kirkness, Clayton Flett, Kenneth Ouskin, Kenneth Keeper, and Clayton Spence, Josh Spence, Courtney Spence; WLFN - Gary Spence, Dalton Kennedy, and Corey Beardy; FLCN - Richard Henderson and Terry Neepin; YLFN - Darcy Wastesicoot and Vincent Ouskin.

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1.0 INTRODUCTION

The Keeyask Hydropower Limited Partnership is constructing the Keeyask Infrastructure Project (the Project or KIP). The Project is located approximately 40 km southwest of Gillam, extending between Provincial Road (PR) 280 and Gull Rapids on the Nelson River. The Project includes a start-up camp and associated infrastructure, a 25 km all-weather access road and the first phase of a main camp.

The mammals monitoring addresses caribou and other large mammals and is described in detail in the *Keeyask Infrastructure Project Terrestrial and Aquatic Monitoring Plan* (TAMP). Monitoring is undertaken in order to ascertain whether KIP development activities could affect caribou and other large mammals as predicted in the KIP Environmental Assessment (EA) Report (KHLP 2009). This annual monitoring report presents the data and preliminary results of mammals monitoring studies conducted during the reporting period of April 1, 2013 to March 31, 2014, and also includes caribou aerial surveys conducted in January and February 2013. Wildlife observations are reported in the *Keeyask Infrastructure Project Environmental Protection Plan Annual Report 2013 -2014*.

Construction of the KIP was ongoing during the 2013 - 2014 reporting period. Construction activities within this period included: clearing trees, stripping, grubbing, stockpiling materials, burning slash, crushing, installation of main camp buildings, and installation of the raw water lines.

Caribou (*Rangifer tarandus*) is an important species in the region, having cultural, ecological and economic value. As such, direct and indirect Project effects, including the access road and other infrastructure components, must be considered. While some studies propose that single linear corridors have a negligible effect on caribou movement (Curatolo and Murphy 1986), potential consequences of road construction include, but are not limited to, physical habitat loss, loss of effective habitat due to noise and other disturbances and partial disruption of caribou movements due to barriers created by the road. Potential caribou mortality due to increased predation resulting from the development of linear corridors, increased harvest opportunity due to new access (James and Stuart-Smith 2000) and vehicle-wildlife collisions is also a concern. These

effects will be monitored in the mammals monitoring program. The program was primarily designed for caribou effects monitoring, and in particular, for the summer resident caribou population; however, other large mammal species and habitats were monitored opportunistically.

As described in the TAMP, mammal monitoring studies were developed to determine and document whether unexpected effects from the construction of the Project are occurring on large mammals and if so, make recommendations to mitigate these unanticipated effects. These mammal monitoring studies were also developed using an adaptive approach to support recommendations for changes to mitigation and protection measures where unexpected difficulties arise. Caribou calving monitoring focuses primarily on Project effects at the local level. Moose (*Alces alces*) and other terrestrial mammal monitoring were designed to consider other regionally significant mammal species such as moose, gray wolf, black bear and caribou in the sampling program. It is expected that depending on the species, the potential degree of effects will range from small to large (e.g., from fire), while the spatial extent of effects would likely be limited to the Local Study Area, unless there is a large fire.

In studying the potential for summer resident caribou to be affected by clearing and construction activities, it was necessary to examine habitat areas potentially important to caribou and monitor caribou use of these areas over time. Of importance in demonstrating the use of habitat areas by caribou includes the measurement of caribou activity in sampled areas as well as monitoring instances of caribou calving and calf-rearing. Caribou calving and calf-rearing is thought to only occur in acceptable habitat areas which have minimal levels of anthropogenic disturbance and reduced mammalian predator species presence. In the Keeyask Regional Study Area, peatland complexes are habitat areas potentially used as calving and calf-rearing habitat areas. Peatland complexes are areas which can be generally defined as muskegs or wetland areas interspersed with raised islands of mature black spruce forest. The presence of these 'habitat islands' provide a means for caribou to become spatially isolated during calving and calf-rearing season which allows for the avoidance of predator species which often play a determining factor in calf survival rates and population growth over the longer term.

Large numbers of migratory caribou were observed in the Gillam area in mid-January, 2013 by the authors during a moose survey of the Fox Lake Resource Management Area. Numerous First

Nations members also reported caribou occurrences in the same area around this time. In late January, 2013, Manitoba Hydro personnel began observing caribou migrating near and crossing the KIP access road, which was under construction at the time. Large numbers of caribou were reported by WRCS staff and confirmed by Manitoba Conservation and Water Stewardship (V. Trim, Pers. Comm.) during a reconnaissance survey to be in the order of several thousand animals. Many observed animals were located near the proposed Keeyask Generating Station (GS) site. Due to the unusually high numbers of caribou in this area in January 2013, an investigation into caribou abundance and distribution was undertaken as part of the mammals monitoring studies.

Clearing of construction areas within the KIP Footprint was planned for the winter of 2014 (early 2014). Prior to clearing of these areas, Manitoba Hydro requested that site surveys be conducted to locate and report any black bear (*Ursus americanus*) dens in the areas to be cleared. These den surveys are included in the mammals monitoring for this reporting period.

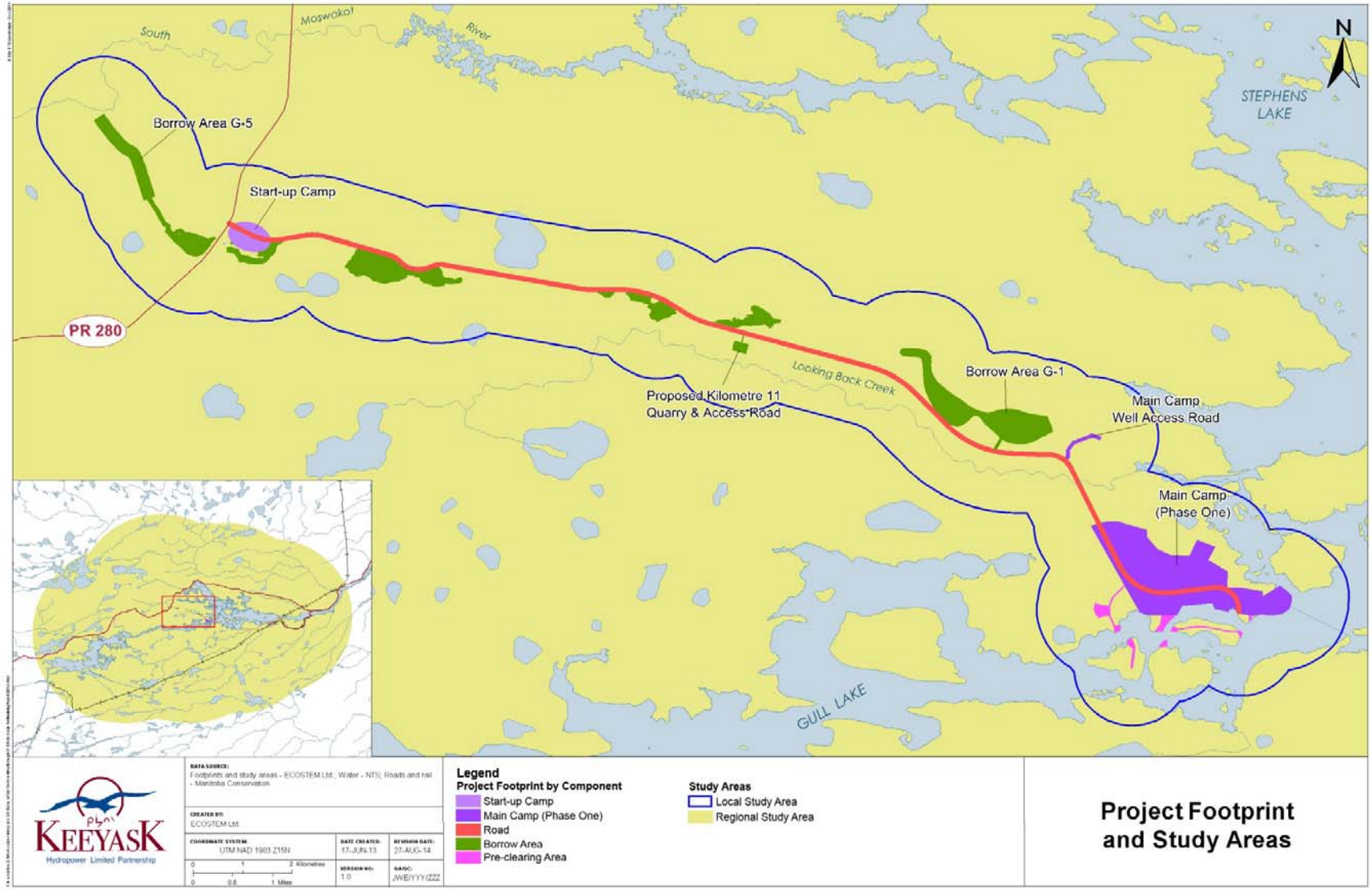
2.0 METHODS

A number of monitoring programs were developed to monitor caribou, moose and other large mammals prior to and during construction activities for the Project. Monitoring activities were carried out in the Regional and Local Study Areas (Map 2-1). Monitoring programs include summer resident caribou (hereinafter known as caribou) calving island monitoring, which included both mammal sign surveys and trail camera traps and aerial surveys for caribou. In conducting caribou calving island monitoring, other mammal species including moose, black bear and gray wolf occurrences were also noted as they can potentially affect caribou use of habitat islands. Den surveys were also completed prior to the start of Project clearing and construction activities that were planned for winter 2014.

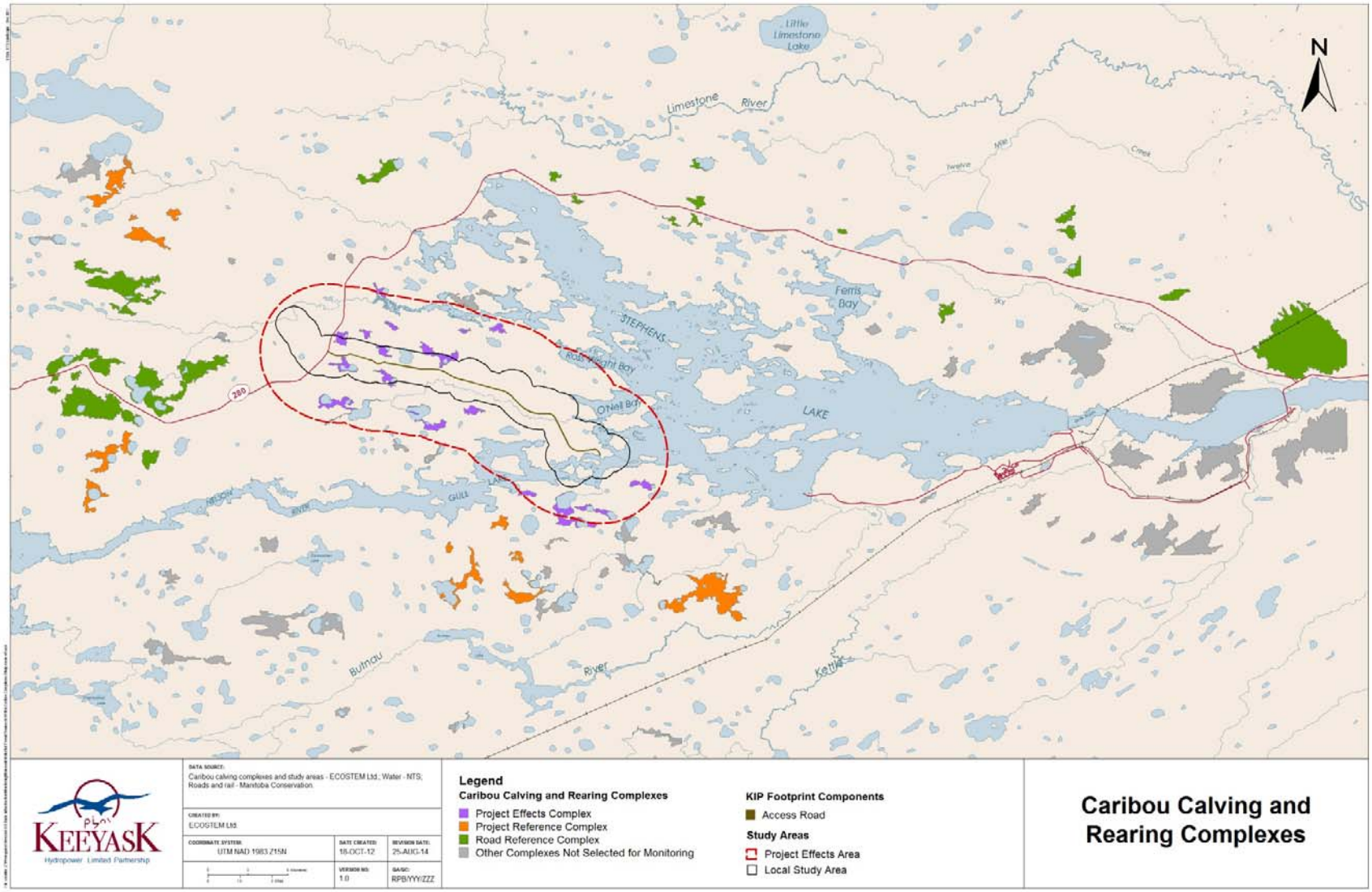
2.1 CARIBOU CALVING ISLAND MONITORING

Caribou calving and calf rearing islands were selected using habitat data from the KIP Environmental Assessment (KHLP 2009), orthophotos, maps and other data obtained from caribou island studies conducted between 2001 and 2010 (Map 2-2). In the Keeyask region, caribou calving and rearing habitats consist of relatively undisturbed islands in lakes or raised black spruce surrounded by expansive wetlands or treeless areas (peatland complexes). The objectives of monitoring the peatland complexes and potential caribou calving and calf-rearing islands included:

- determining whether there is caribou calving activity on islands in bogs and/or lakes near the road, start-up camp, main camp and borrow areas;
- determining whether there are Project effects on caribou and/or caribou behaviour by quantifying distribution, relative abundance, and assessing the loss of effective habitat on caribou calving and calf-rearing complexes and islands resulting from construction of the KIP;
- providing baseline data and information for future use on this and other projects; and,
- identifying unexpected impacts and effects of the Project.



Map 2-1. Keeyask Infrastructure Project Regional Study Area, Local Study Area and Project Footprint.



Map 2-2. Caribou calving islands identified in the Keeyask Infrastructure Project Regional Study Area.

To evaluate Project related effects and other effects on caribou during Project construction and operation, different transect types including Project Effects Areas (EA), Reference Areas (CA) and Road Reference Areas (RC) were considered (Map 2-2). The sampling of these transect types took place through use of mammal sign surveys where trail camera monitoring was also done to examine species presence based on identified EA transects.

2.1.1 Mammal Sign Surveys

A total of 252 transects, ranging from 50 m to 18 km in length, were surveyed on a total of 48 complexes and 342 islands in 2013. Changes to the sample design included the addition of four complexes and 12 islands in 2012. Also, as recommended by Manitoba Conservation and Water Stewardship, an earlier installation date for hip-chain thread on caribou calving islands occurred in April 2012 and 2013 (in contrast with later thread installation in May of 2011). Cameras were installed along a selected portion of these lines (see Section 2.1.2). General methods for sign and thread monitoring activities follow Schemnitz (1980) and Elzinga *et al.* (2001). Each transect, regardless of length, was made up of 50 m segments and oriented along an island so as to best detect caribou movements. During the initial placement of hip-chain thread, all animal sign visible up to 1 m on either side of the thread was recorded, including tracks, trails, droppings, shelters, browse or feeding sites, and visual observations. The specific locations of all sign, including signs of caribou activity, were recorded using GPS units.

During subsequent site visits, which occurred in July and September/October, 2013, caribou distribution and activity were monitored by assessing thread breaks along each transect. The specific locations of all breaks were recorded with GPS. Sign such as tracks and droppings confirmed the species responsible for each thread break. All thread breaks were repaired so that species activity could be properly evaluated on subsequent site visits. The timing of sampling events for the placement of hip-chain thread and subsequent site visits are as indicated in Appendix A.

The number of calving and rearing islands being used by caribou in the Local and Regional Study areas during spring, summer and fall are described with presence/absence data and by thread-break activity counts. Caribou calving and rearing activities in sampled areas were identified through the presence of caribou calf sign on sampled complexes and islands.

The evaluation of caribou (and other species) activity within the sampled Reference Area and Project Effects Area was done to evaluate potential Project-related effects on caribou following clearing and construction activities associated with the access road and other infrastructure (Map 2-2). For analysis purposes, six distance classes were considered in assessing the extent to which the potential effects of clearing and construction could affect caribou activity: 0 to 1 km, 1 to 2 km, 2 to 3 km, 3 to 4 km, 4 to 5 km and >5 km away from the access road. In jointly considering the number of peatland complexes in the sampled Reference and Project Effects Areas, 15 were located 0 to 5 km from the access road and 18 were located 5 km or more from the location of the access road. In considering complexes sampled 5 km or more from the access road, four more were sampled in 2012 and 2013 in comparison to the number of complexes sampled in 2011.

Road Reference transects were established on peatland complexes and habitat islands adjacent to PR 280 and PR 290 to identify levels of caribou activity in proximity to this landscape feature (Map 2-2). In this way, sampled caribou activity levels on Road Reference transects will be used to corroborate the predictions of how the access road may affect adjacent caribou calving islands under future conditions. For analysis purposes, six distance classes were considered in assessing the extent to which PR 280 and PR 290 have affected caribou activity: 0 to 1 km, 1 to 2 km, 2 to 3 km, 3 to 4 km, 4 to 5 km and >5 km away. Of sampled Road Reference Area peatland complexes, 14 were located approximately 0 m to 5 km from PR 280 and 3 were located 5 km or more from PR 280.

It should be noted that many mammal sign transects were affected by forest fires in 2013 and therefore were not surveyed a second or third time (see Appendix A for visit dates). Project Effects Area transects were the most severely affected by the 2013 forest fires, with the destruction of 16 transects (EA001-EA015 and EA024A) resulting from the summer forest fires (Appendix A). Two Project Effects Area transects (EA018 and EA023B) were surveyed a second time in July 2013 but had burned since the second visit and was not surveyed a third time. One Project Effects Area transect (EA024B) was not surveyed in July because of nearby fires (Appendix A) but was surveyed in autumn (Appendix A). Reference Area transects were also affected by forest fires with five transects (CA002, CA009, CA009, CA010, and CA011) burning in the fires (Appendix A). Due to the fires, five Road Reference transects (RC008,

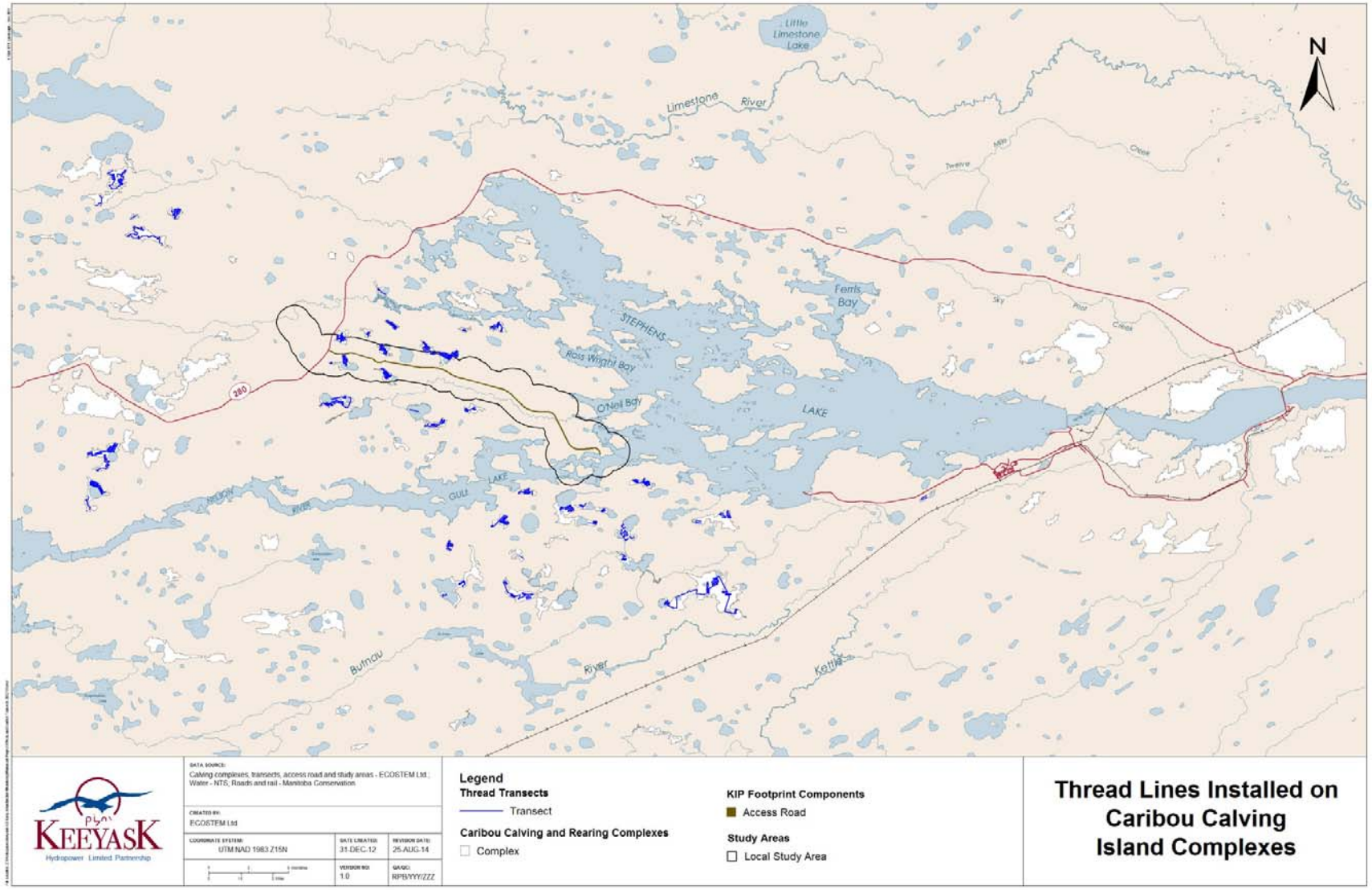
RC009, RC022, RC033, and RC041) were not visited a second and third time and 28 Road Reference Area transects (RC007, RC027, RC028, RC030, RC031, RC034, RC038, RC040, RC050, RC052, RC057, RC060-RC062, RC065, RC070-RC76, RC081, RC082, RC098, RC103, RC151, RC155, and RC181) were not visited a third time (Appendix A).

Caribou calving island mammal tracking data was also analysed separately for the second and third visits across all years. This was necessary for two reasons. First, an earlier installation date for hip-chain thread on caribou calving islands, as recommended by Manitoba Conservation and Water Stewardship, occurred in April 2012 and 2013 in contrast with thread installation in May 2011. This difference in thread lay timing may have introduced sampling bias into mammal sign counts. As transects surveyed in April surveys generally have more snow cover than surveys in May, mammal sign detectability is not equal between surveys conducted with snow cover and surveys conducted on bare ground. Mammal sign left in snow may be easier to detect than signs left on bare ground, however fresh snowfall may also obscure some mammal sign and decrease its detectability. In addition, there are likely to be more caribou, particularly calves, present in calving and rearing areas during May sampling activities in comparison to April as this latter time corresponds more closely to the timing of caribou calving activities.

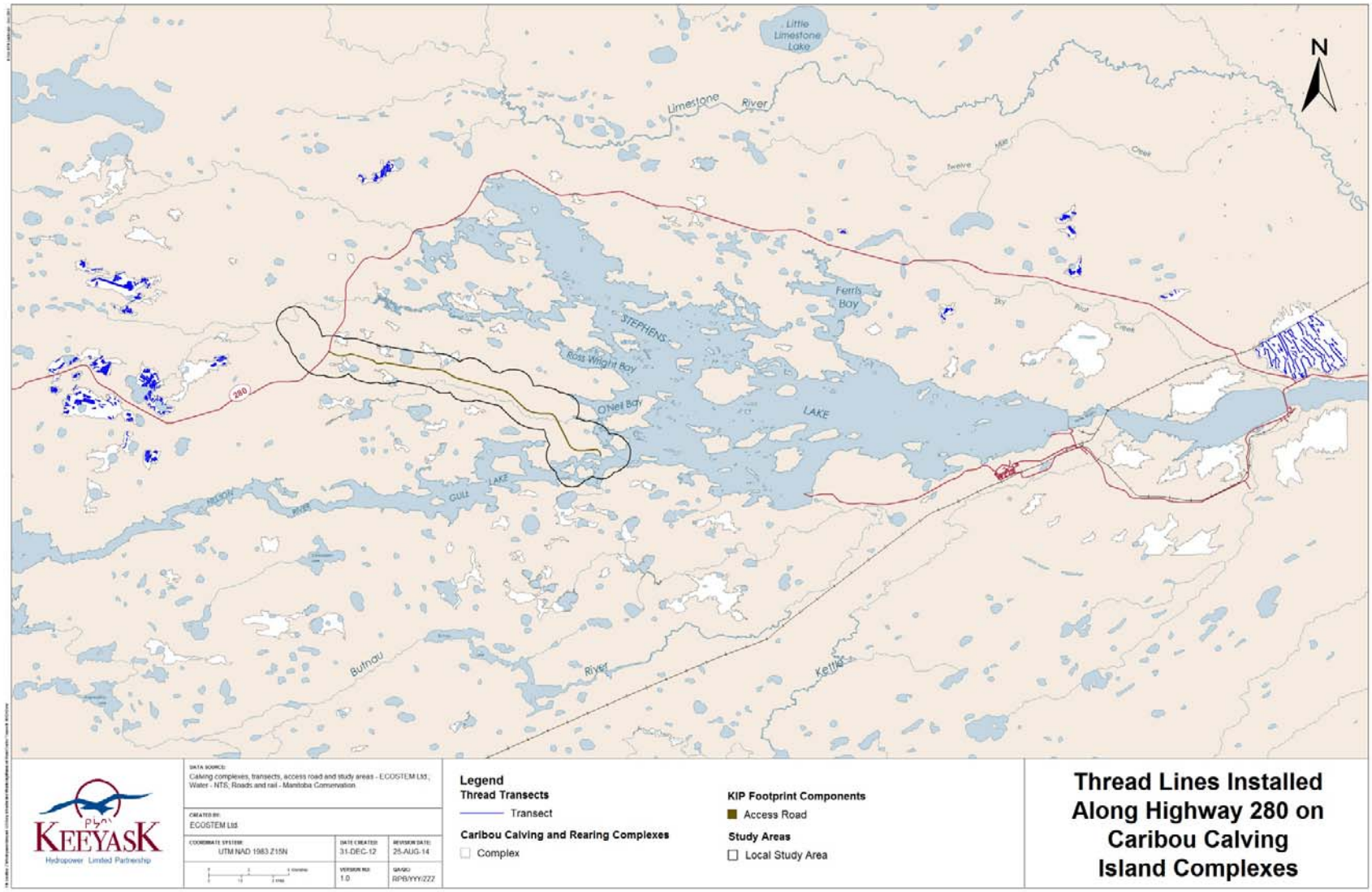
The large migratory movements of the Pen Islands caribou herd which migrated through the KIP area in January and February 2013 (see Section 3.4.1) left much sign that was recorded during the first visit (April) of 2013. Consequently, the total numbers of mammal sign data collected in 2013 were skewed due to the considerable amount of caribou sign observed during the first visit, making it difficult to differentiate between sign related to caribou use of complexes and islands for summer calving and rearing activity. By separately examining mammal sign results from the second visit over all three study years as well as the third visit across all three study years, questions about caribou in the KIP area are more easily addressed, thus improving the assessment of Project-related effects.

The results of the second and third visits are focused upon caribou, their primary predators - gray wolf and black bear, and alternate prey species (i.e., moose). Total numbers of sign recorded for these species during the first visit are detailed in Section 3.1.2 to demonstrate how the large number of Pen Islands caribou present in the KIP area in late winter skewed the sampling of

caribou sign over all three visits toward the first visit, and made interpretation of the monitoring data, in relation to assessing the use of calving and rearing areas, somewhat problematic.



Map 2-3. Locations of Reference and Project Effects Area transects on potential caribou calving complexes.



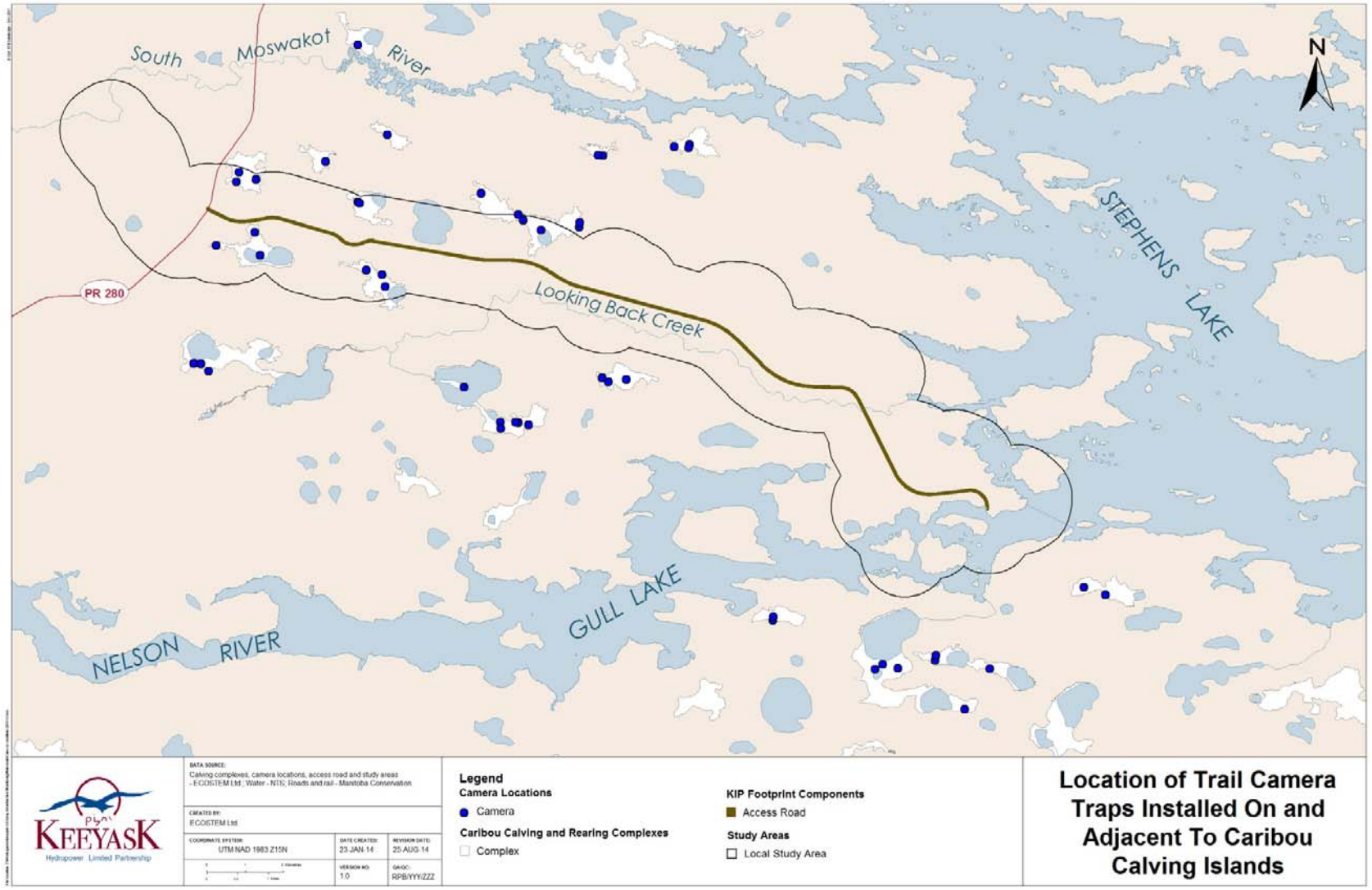
Map 2-4. Locations of Road Reference transects on potential caribou calving complexes.

2.1.2 Trail Camera Monitoring

A total of 48 Reconyx™ PM35C31 trail cameras were deployed on heavy use game trails and/or near the edges of potential caribou calving islands to document mammal activity in the Local and Regional Study Areas (Map 2-5). The cameras were to be left in place to monitor species activity for a five-month period (mid-April to mid-September). Islands were selected within a complex where optimal island habitat characteristics and juxtaposition requirements between camera locations appeared to be suitable for caribou calving activities. Refer to Appendix B for trail camera set-up and removal dates. Widespread forest fires in the area in summer 2013 led to the removal of all the Project's cameras in July to prevent extensive data and equipment losses. By the time the Project's cameras were removed, three cameras were damaged by fires and had ceased capturing images in June; a further nine cameras were so badly damaged that no images could be recovered (Appendix B). In total, 31 trail cameras were destroyed by fire. Other cameras were returned to the manufacturer and refurbished with new lenses, sensors or other electronic components which had been damaged by heat and smoke.

Trail cameras were used to gather additional data on the timing of caribou movements and occurrences in and around the calving complexes in the Local and Regional study areas. Trail cameras were installed in Project Effects Areas to corroborate activity, age and sex classifications, and to document the movements of individuals among islands and calving complexes.

Cameras were set to high sensitivity and programmed to take a series of five rapid-fire photographs once triggered, and continue taking photographs one second after the first series as long as movement was still detected. The setup for each trail camera varied slightly but efforts were made to affix each camera approximately 1.5 to 2 m high on a large stable tree. Brush and other vegetation that was likely to trigger the camera were removed from the immediate area of the camera line-of-sight.



Map 2-5. Locations of trail camera traps installed on and adjacent to potential caribou calving islands.

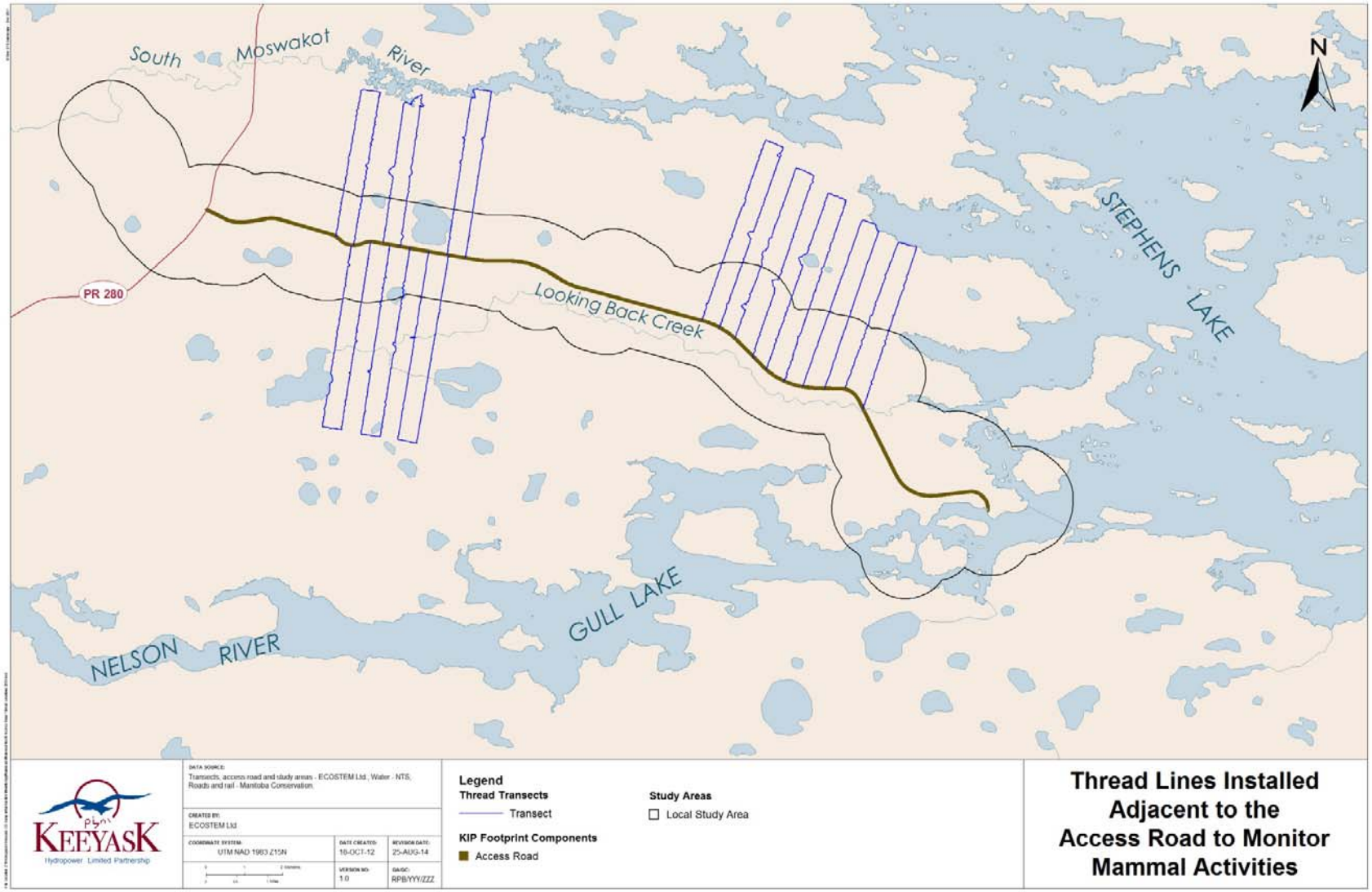
2.2 MOOSE AND OTHER TERRESTRIAL MAMMAL MONITORING

Monitoring for moose and other large mammals, including caribou, black bear and gray wolf was completed along the north and south sides of the access road (NNR and SNR transects respectively) in order to:

- determine whether there are Project effects on terrestrial mammal behaviours by quantifying distribution, abundance, and measuring the loss of effective habitat resulting from construction of the road and infrastructure areas during the construction phase;
- collect data that could attribute differences in caribou activity; and
- provide baseline data and information for future use on this and other projects.

A total of eight northern lines and three southern lines, ranging from 9 to 11 km in length for a total length of 107 km were installed in April using biodegradable hip-chain thread (Map 2-6). Trail cameras were not installed along these lines. General methods for sign and thread monitoring activities follow Schemnitz (1980) and Elzinga *et al.* (2001). A series of paired transects up to 5 km in length and oriented perpendicular to the KIP Footprint were established in the vicinity of the road, start-up camp, main camp and borrow areas by stringing hip chain thread through all habitat types. All animal sign visible up to 1 m on either side of the thread was recorded during the first site visit. Sign included tracks, trails, droppings, shelters, browse or feeding sites, and visual observations. The specific locations of all sign and in particular, moose, caribou, black bear, and gray wolf were recorded with portable GPS units.

Transects were established in April 2013 but were not visited a second time in July due to safety concerns due to forest fires, nor a third time because transect threads and the habitat they traversed had burned in the fires and could not be meaningfully re-established to fit the study design (Appendix C).



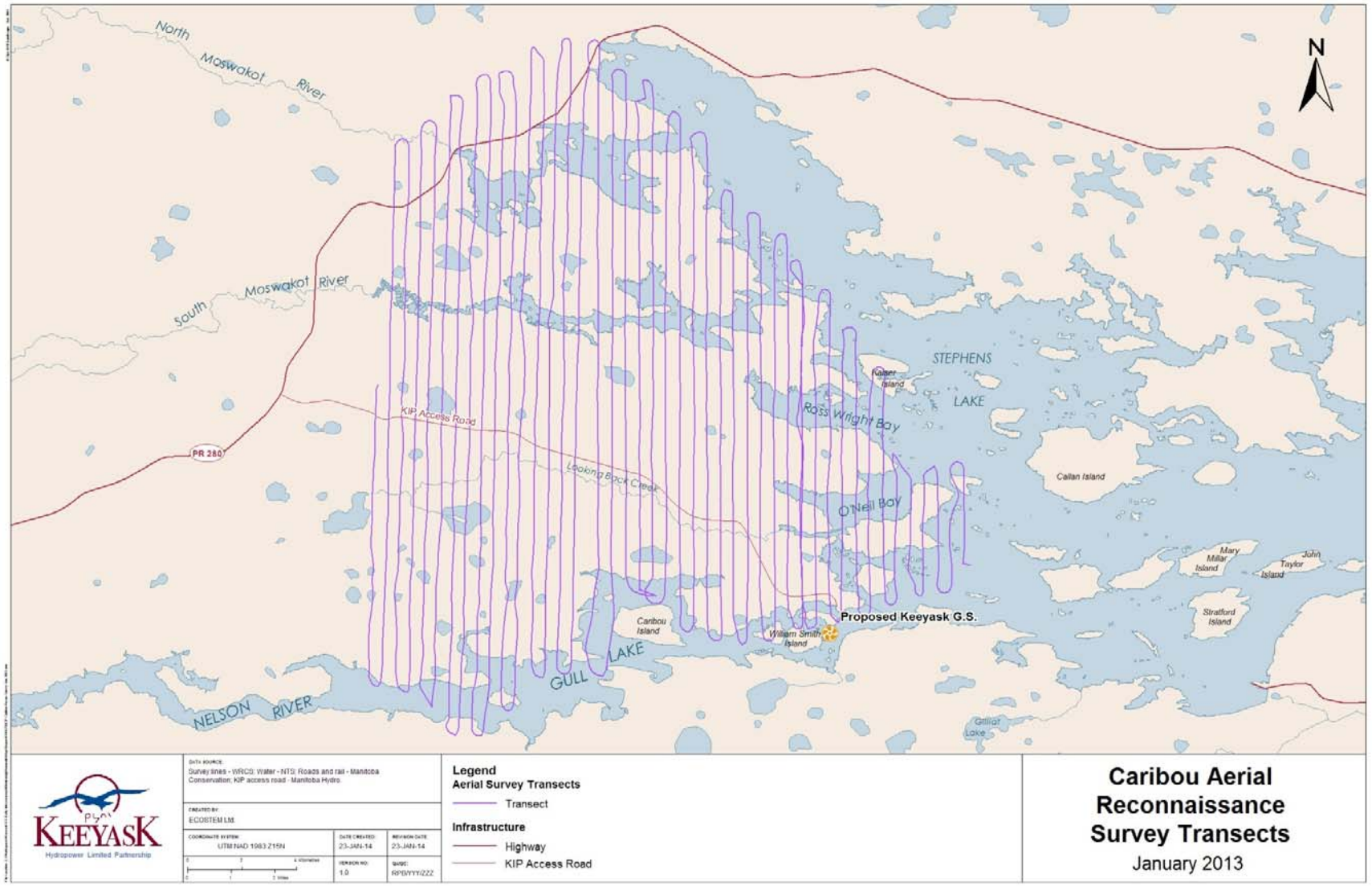
Map 2-6. Mammal tracking lines installed adjacent to the access road in 2013.

2.3 CARIBOU AERIAL RECONAISSANCE SURVEY

In late January, 2013, Manitoba Hydro personnel began observing caribou in the vicinity of the KIP start-up camp and crossing the access road. To investigate the abundance and distribution of the unprecedented number of caribou in the KIP area, and to assess whether there were sufficient numbers of caribou to warrant a more comprehensive survey to estimate the population over a much larger area (see Section 2.4), an aerial reconnaissance survey was conducted by WRCS on January 31, 2013, in the KIP area north of the Nelson River (Map 2-8). Additionally the reconnaissance survey also sought to identify locations where caribou may be crossing the Nelson River between Gull Rapids and Birthday Rapids.

The survey was conducted during high visibility weather and complete snow coverage with a Bell 206 Jet Ranger helicopter. A systematic survey was established over the area of interest near the access road. North-south transects were prepared every 500 m, and the survey crew flew transects following a Global Positioning System (GPS, Garmin GPSMAP 60 CSx) at 70-100 m agl (above ground level) and at speeds of 80-140 km/h, depending on topography and forest cover density. In addition, to document potential river crossing locations, a general survey line was flown in a west to east direction along the Nelson River between Birthday Rapids and Gull Rapids.

Surveys were conducted by one crew comprised of three experienced observers. The front left observer was responsible for detecting caribou clusters near the transect line through the front window of the aircraft, while the rear observers were responsible for sighting caribou on either side. The pilots also assisted with spotting wildlife near the transect line. The front left observer recorded cluster locations with an independent GPS and recorded field notes. Distance to cluster was not estimated during the survey. Animal care and safety was a high priority, and to minimize disturbance, wildlife were never approached or circled by the aircraft. Caribou density and abundance in the KIP area was not estimated and only total number of caribou observed and average caribou cluster size are reported.



Map 2-7. Caribou aerial reconnaissance survey transects on January 31, 2013.

2.4 CARIBOU AERIAL SURVEY

2.4.1 Design and Field Methods

Based on the information collected during the January 31 reconnaissance survey, and other anecdotal data compiled from observation reports, a detailed survey design was required to estimate the local and regional caribou population. Abundance estimates are essential for the management of wildlife and for developing a robust understanding of conservation and population dynamics. Wildlife managers require survey techniques that: (1) allow completion of surveys in a cost and time effective manner; (2) provide a reasonably accurate estimate of a herd's population size; and (3) provide indicators to assess confidence in the estimate (Guenzel 1994). Consequently, different techniques have been developed to estimate the size of ungulate populations.

There are a number of methods available (reviewed in Heard 1985), with mark-recapture and distance sampling being the most widely employed (Williams *et al.* 2002). Line transect distance sampling and related techniques have been successfully used to survey many species of wildlife (Thomas *et al.* 2010) and have been applied to caribou populations as early as the 1950s (Banfield *et al.* 1955) and more recently by the Nunavut government (Jenkins *et al.* 2011). Distance sampling uses the perpendicular distances from the observer to clusters of objects (caribou) to obtain a measure of detection probability as a function of distance (Buckland *et al.* 2001). Larger clusters are easier to detect than smaller clusters and observers are more likely to detect animals that are closer to the observer than those farther away are (Guenzel 1997). As such, distance-sampling techniques correct for effects of cluster size and distance on detectability. The gregarious nature of caribou, particularly in winter, and their use of shorelines and frozen lakes for travel (Banfield 1954; Miller 2003), makes caribou a suitable species for the use of distance sampling.

In order to generate reliable population estimates through distance sampling techniques, there are three key assumptions to be met (Buckland *et al.* 2001):

1. All objects (caribou clusters) are detected with certainty on the transect line (g(0));
2. Objects do not move; and

3. Measurements are exact.

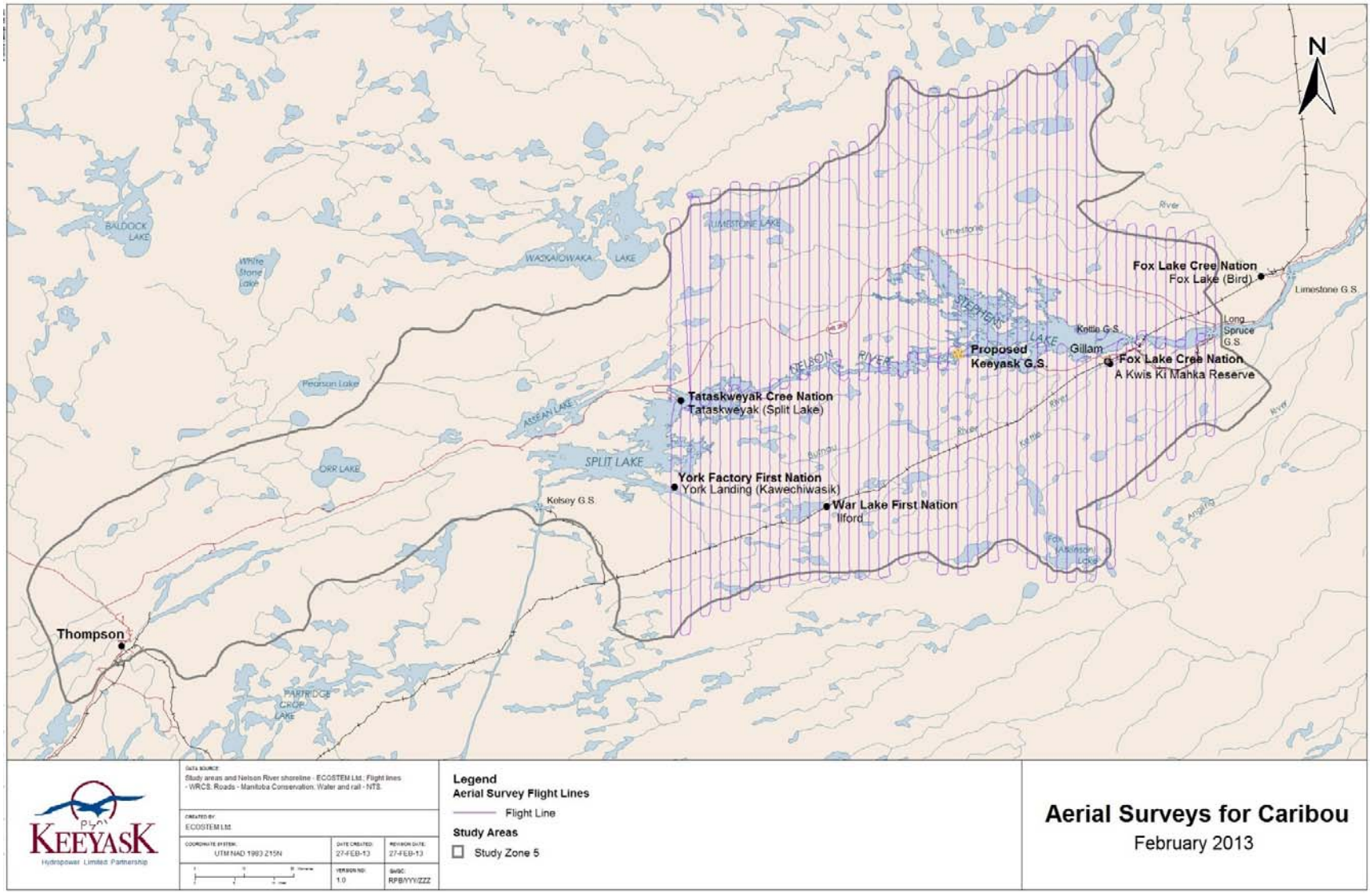
However, these assumptions can be relaxed (Buckland *et al.* 2001, Thomas *et al.* 2010). Although there are other minor assumptions to be met (Buckland *et al.* 2001), they are seldom of great practical significance (Thomas *et al.* 2010). It is assumed that object locations are independent of the position of the transect lines, which is ensured by having an adequate sample of lines, and by randomizing their locations (Buckland *et al.* 2001, Thomas *et al.* 2010). It is also assumed that detections are independent events, though distance sampling methods are very robust to failures of this assumption (Thomas *et al.* 2010). By defining the cluster, and not individual animals, as the object of interest, violations of the independent detections assumption are of minor importance (Buckland *et al.* 2001).

Distance sampling is more cost and time efficient in larger study areas with sparsely distributed animal populations (Buckland *et al.* 2001, Nielson *et al.* 2006). As such, the design selected and used here was to estimate the relative density, and thus abundance, of caribou in the eastern half of the Keeyask Generation Project Study Area (Zone 5) in northern Manitoba.

Surveys for caribou in the Project area (Map 2-8) were conducted over a four-day period from February 5 to 8, 2013. Caribou were dispersed over a large geographical area. A complete census is not possible and abundance and density estimates are based on distance sampling methods. Standard aerial survey techniques and distance sampling methods were followed (Buckland *et al.* 2001). Surveys were conducted during high visibility weather and complete snow coverage with two BN2A Britten Norman Islander twin propeller fixed-wing aircraft. Systematic north-south transects were established every 2 km, and transects flown following a Global Positioning System (GPS, Garmin GPSMAP 60 CSx) at 80 m AGL (range 70-100 m AGL) and 80-140 km/h, depending on topography and forest cover density. One crew sampled the north side of the Nelson River, while the second crew simultaneously sampled the south side of the Nelson River. Both crews worked from east to west. Transect lengths took an average of 13.3 minutes (SD = 4.15 min, min = 5 min, max = 23 min) to survey. The average length of time to ferry between transects was 2.5 minutes (SD = 1.1 min, min = 1 min, max = 9 min). The average length of time to and from the study area and the Gillam Airport (refuelling, aircraft maintenance) was 70 minutes (SD = 28.5 min, min = 34 min, max = 94 min). The average length of time to survey a

transect, ferry to the next transect, and survey the following transect was 28.6 minutes (SD = 8.03, min = 14, max = 46 min).

Two crews comprised of three experienced observers per crew conducted surveys. The unit of observation was clusters of caribou, where a cluster refers to an individual or group of caribou that were closely spatially aggregated (i.e., <50 m apart) to ensure independence (Buckland *et al.* 2001). The front right observer was responsible for detecting caribou clusters near the transect line through the front window of the aircraft, while the rear observers were responsible for sighting caribou clusters on either side. The pilots also assisted with spotting wildlife near the transect line. The front right observer recorded cluster locations with an independent GPS and recorded cluster size estimates and perpendicular distance from the aircraft to the centre of clusters. Exact distance measurements were not taken, but were grouped by 50 m distance intervals out to a maximum distance of 450 m. Animal care and safety was a high priority, and to minimize disturbance, the aircraft never circled wildlife. We recorded observations that were detected upon leaving transects (i.e., while ferrying) as off-transect, and excluded such observations from the final analysis.



Map 2-8. Caribou aerial survey area and distance sampling transects in February 2013.

2.4.2 Data Analysis

Distance sampling data were analysed in the program DISTANCE v. 6.0 (Thomas *et al.* 2010) to model the line transect data and estimate density and abundance of caribou in the Project area. Exploratory analyses were conducted to determine an appropriate truncation distance of at least 5% of extreme right tail observations (Buckland *et al.* 2001) to avoid extra adjustment terms to fit a long tail to the detection function, to discard outliers, and to improve model fit of the detection functions (Buckland *et al.* 2001).

As larger clusters of caribou may be easier to detect than smaller groups further from the transect line (Drummer and McDonald, 1987), a size bias leading to overestimation of density is potentially introduced (Buckland *et al.* 2001). To obtain an unbiased estimate of the expected cluster size, a size bias regression estimator was employed in the program DISTANCE by regressing the log of caribou cluster size against the probability of detection at distance x. This method estimates expected cluster size on the transect line, where size bias should be negligible (Buckland *et al.* 2001). Expected cluster size was used to estimate the caribou population density rather than the mean cluster size, which positively biases the estimator (Buckland *et al.* 2001). Density of caribou was estimated by the program DISTANCE as:

$$D = n*g(0)/2L$$

where L is the sum of all transect lengths, n denotes the number of detected caribou clusters and g(0) is the probability density function of observed perpendicular distances evaluated at zero distance. The probability density function is a function of three model components: the estimated detection probability, the encounter rate and cluster size (Buckland *et al.* 2001).

To model the detection function, combinations of three key functions and three adjustment terms were considered following recommendations of Buckland *et al.* (1997 and 2001). A priori candidate models were a half-normal key function with the option of cosine or hermite adjustment terms, a uniform key function with the option of cosine or polynomial adjustments, and a hazard-rate key function with cosine adjustments. The best model was determined using Akaike's Information Criterion (AIC), where the model with the lowest AIC value is considered the most parsimonious (Akaike 1974; Anderson *et al.* 1998). Goodness-of-fit tests ($\chi 2$ GOF) and

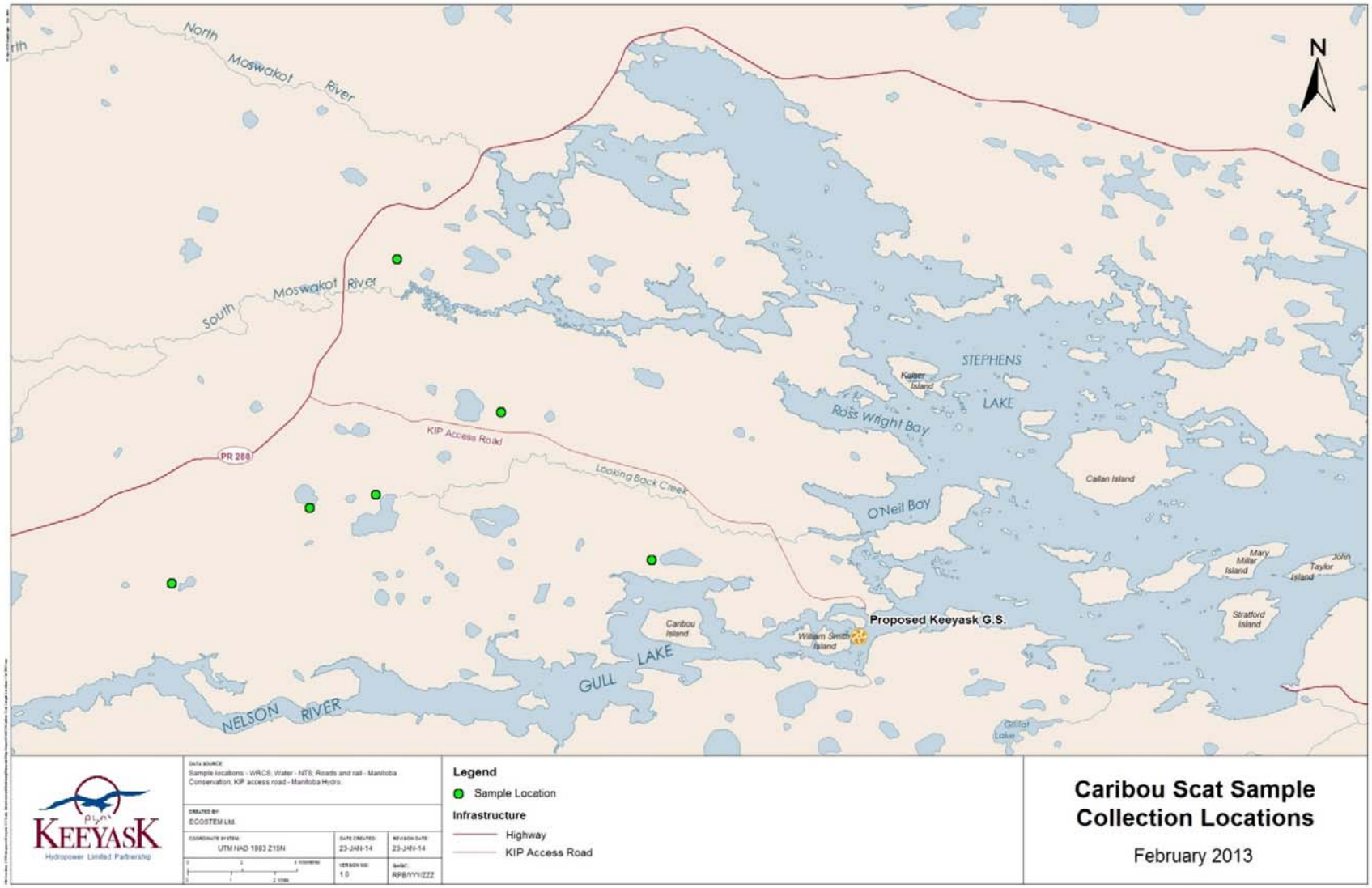
qq-plots (especially at distance 0) results were examined to detect assumption violations (Buckland *et al.* 2001). Estimates for all models were produced with the objective of obtaining a coefficient of variation (CV) less than 20% (Otis *et al.* 1978). Robson and Regier (1964) recommend an accuracy of ±25% for management studies that estimate the size of animal populations. In addition, variance was estimated using a weighted average of several plausible models (Buckland *et al.* 2001, Burnham and Anderson 2002) in a non-parametric bootstrap method that estimated variance from 1,000 bootstrap iterations, which requires fewer assumptions than parametric methods (Buckland *et al.* 2001).

2.4.3 Caribou Ice Crossings

A reconnaissance survey was flown opportunistically in a west to east direction on January 31, 2013 covering the Nelson River between Birthday Rapids and Gull Rapids to detect caribou river crossing locations. Between February 5 - 8, 2013, caribou trails detected on the Nelson River and Stephens Lake were also recorded to identify caribou crossing locations during distance sampling transect surveys. Photographic examples of caribou crossing the Nelson River are presented in Appendix D. Trails crossing open areas of the Nelson River and Stephens Lake were difficult to detect due to caribou tracks becoming obscured by drifting snow. Points of convergence in near-shore areas were recorded as potential crossing points.

2.5 CARIBOU SCAT SAMPLING

To improve confidence in determining the dominant origins of the unprecedented number of caribou reported in the Keeyask area, caribou scat was collected throughout the KIP study area (Map 2-8) for genetic analysis. A total of 74 samples were collected on February 9, 2013, and sent to Trent University for genetic analysis. Genetic analysis methods and results are detailed in Appendix E.

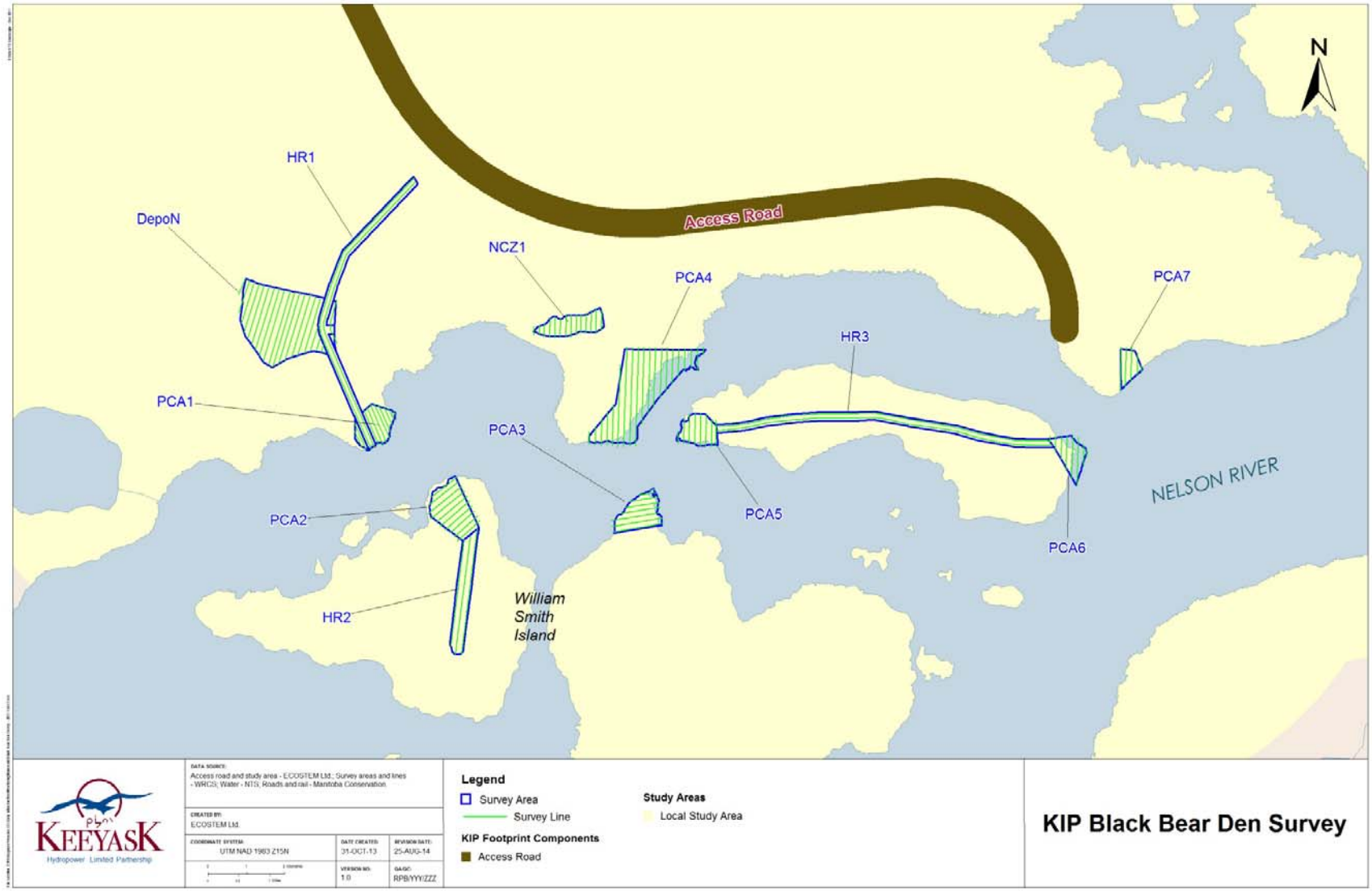


Map 2-9. Locations of caribou scat sampled on February 9, 2013 in the Keeyask Study Area.

2.6 BEAR DEN SURVEYS

Shapefiles of the areas selected for winter clearing were provided by the Keeyask Hydropower Limited Partnership (Map 2-10). The total length of the planned search area for black bear dens was 25.6 km. The intended total survey area was approximately 41.9 ha. A search pattern was created in a Geographic Information system (GIS) using mostly east/west and north/south running transects along each of the areas. Transects were spaced 20 m apart; however, spacing varied depending on site search conditions, ranging from 5 m to 20 m. Planned transects were superimposed over the survey area and converted to route files (Map 2-10). Route files were uploaded to handheld Garmin GPS 60Cs and 60Csx receivers used for field work.

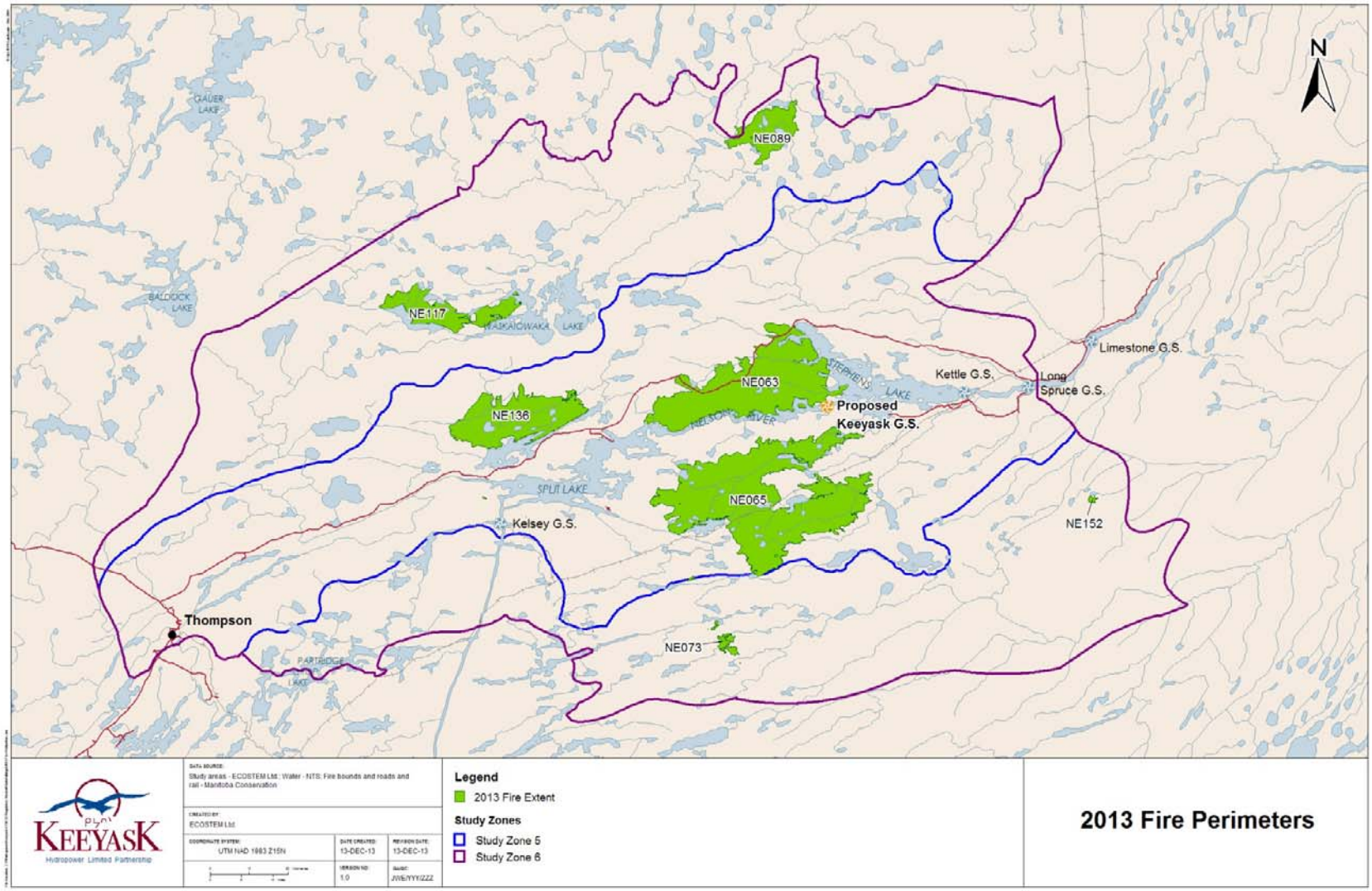
Seven technicians participated in the survey that took place over a 2-day period, from October 26-27, 2013. The survey was completed between 8:00 a.m. and 4:00 p.m. Weather conditions on both survey days were overcast, with light snow, light wind <10 km/h, and temperatures ranging from -1° to -13°C. Average snow depth was estimated at 5 cm in the search areas. An intensive ground search was conducted to detect black bear dens within the survey areas.



Map 2-10. Bear den survey areas searched in October 2013.

2.7 2013 FIRES

Several fires occurred in the KIP study area and broader Keeyask region beginning in early June 2013 (Map 2-11). In total, Manitoba Conservation recorded 38 fires as depicted on the map in Zone 6 during 2013, encompassing 219,256 ha. The 2013 fire boundaries are fire perimeters which include burned areas, most waterbodies, and areas skipped over by the fire. After removing waterbodies and fire skips, an estimated 151,714 ha burned during 2013 (ECOSTEM Ltd., Unpubl. Data).



Map 2-11. 2013 Fire Perimeter Boundaries.

3.0 RESULTS

3.1 CARIBOU CALVING ISLANDS

A total of 5,582 caribou (*Rangifer tarandus*) sign and 2,255 moose sign (*Alces alces*) were identified in 2013 during the tracking surveys completed to monitor caribou activity on sampled peatland complexes and habitat islands (Table 1). Total caribou sign in 2013 was 58% greater than the total caribou sign recorded in 2011 and 545% greater than the total caribou sign recorded in 2012. Moose sign in 2013 was 26% less than the total moose sign recorded in 2011 and 86% greater than the total moose sign recorded in 2012. Incidental sign included 604 American marten (*Martes americana*), one beaver (*Castor canadensis*), 42 black bear, 12 ermine (*Mustela erminea*), 12 fisher (*Martes pennanti*), 28 gray wolf, 7 lynx (*Lynx canadensis*), 65 mink (*Neovison vison*), 63 red fox (*Vulpes vulpes*), 59 river otter (*Lontra canadensis*), one snowshoe hare (*Lepus americanus)* and 7 wolverine (*Gulo gulo*) (Table 1). Moose and caribou sign were the most sampled type of sign in the 2011- 2013 sampling years.

3.1.1 Caribou Sign Surveys All Visits

Reference Areas

A total of 12 Reference Area transects were installed in the KIP Regional Study area in 2013. The surveyed length of these transects over three visits totalled 185.9 km and traversed 12 complexes and 80 calving islands (Table 2). A total of 1,449 caribou sign were detected on Reference Area transects, or 7.79 signs/km (Table 2). Caribou sign on Reference Area transects was recorded on 12 complexes (100%) and on 78 (98%) of the islands (Table 2). Caribou sign observed on Reference Area transects in complexes included 12 complexes with adult sign (100%), and two complexes with calf sign (17%) (Table 3). Caribou sign observed on islands included 69 islands (86%) with adult sign and 10 islands (13%) with calf sign (Table 3). The percentage of complexes with adult caribou sign in Reference Areas decreased from 100% in 2011, 92% in 2012 and returned to 100% of complexes in 2013 (Table 3; Figure 1). The percentage of complexes with caribou calf sign decreased from 83% in 2011 to 58% in 2012 and decreased further to 17% in 2013 (Table 3; Figure 1). The percentage of islands with adult caribou sign decreased from 76% in 2011 to 63% in 2012 and increased to 86% in 2013 (Table

3; Figure 2). The percentage of islands with caribou calf sign decreased from 20% in 2011 to 11% in 2012 and increased to 13% in 2013 (Table 3; Figure 2).

Other wildlife species detected on Reference Area transects included moose, black bear and gray wolf (Table 4). A total of 559 moose sign were observed on Reference Area complexes with 236 moose signs observed on islands (Table 5). For moose sign observed on complexes and islands, 12 complexes (100%) and 48 islands (60%) contained adult sign while eight complexes (67%) and 17 islands (21%) contained calf sign (Table 5). Although total moose sign observed on Reference Area transects decreased from 865 signs in 2011 to 568 in 2012 and decreased slightly further to 559 in 2013 (Table 4), the percentage of complexes in Reference Areas with adult moose has consistently stayed at 100% over the three years of this study. Alternately, the percentage of complexes in Reference Areas with moose calves increased from 58% in 2011 to 83% in 2012 and then decreased to 67% in 2013 (Table 5; Figure 3). The percentage of islands with adult moose sign was stable at 76% in 2011 and 2012 and decreased to 60% in 2013 (Table 5; Figure 4). The percentage of islands with moose calf sign remained stable at 20% in 2011 and 2012 and increased slightly to 21% in 2013 (Table 5; Figure 4).

Nine black bear sign and three gray wolf sign were also recorded on sampled calving islands transects in Reference Areas in 2013 (Table 4). The number of black bear signs in Reference Areas decreased from 20 in 2011 to 11 in 2012 and nine in 2013 (Table 4). The number of gray wolf signs in Reference Areas calving islands decreased from 9 in 2011 to 2 in 2012 and increased to 3 in 2013 (Table 4).

Project Effects Areas

A total of 21 Project Effects Area transects were sampled in the KIP Local Study Area in 2013. The total length of these transects over three visits covered 124.3 km, 21 complexes and 72 islands (Table 2). Monitoring on the Project Effects Area transects resulted in the detection of 1,117 caribou sign, or 9.01 sign/km (Table 2). Caribou sign observed on Project Effects Area complexes included 20 complexes with adult sign (95%) and 4 complexes with calf sign (19%) (Table 3). Caribou sign observed on islands included 56 islands (78%) with adult sign and six islands (8%) with calf sign (Table 3). The percentage of complexes in Project Effects Areas with adult caribou sign decreased from 94% in 2011 to 62% in 2012 and increased to 95% in 2013,

whereas the percentage of complexes with caribou calf sign decreased from 53% in 2011 to 38% in 2012 and further, to 19%, in 2013 (Table 3; Figure 1). The percentage of islands in Project Effects Areas with adult caribou sign decreased from 70% in 2011 to 49% in 2012 and increased to 78% in 2013 (Table 3; Figure 2). The percentage of islands in Project Effects Areas with caribou calf sign decreased from 17% in 2011 to 10% in 2012 and to 8% in 2013 (Table 3; Figure 2).

Other wildlife species detected on Project Effects Area transects included moose, black bear and gray wolf (Table 4). A total of 386 moose sign were observed on sampled Project Effects Area complexes (Table 4), with 262 sign being observed on sampled islands (Table 5). Of the incidental moose sign observed on complexes and islands, 16 (76%) and 27 (38%) of the complexes and islands contained adult sign, respectively, and five (24%) and nine (13%) of the complexes and islands, respectively, contained calf sign (Table 5). Total moose sign observed in Project Effects Areas decreased by 41% from 2011 to 2013 (Table 4). The percentage of complexes in Project Effects Areas that adult moose sign were observed remained consistent at 100% in 2011 and 2012 but decreased to 76% in 2013, whereas moose calf presence increased from 47% of complexes in 2011 to 81% in 2012 and decreased to 24% in 2013 (Table 5; Figure 3). For habitat islands, the percentage of islands with adult moose sign increased from 70% in 2011 to 76% in 2012 and decreased to 38% from in 2013. Alternately, the percentage of islands with moose calf sign increased from 17% in 2011 to 33% in 2012 and decreased to 13% in 2013 (Table 5; Figure 4). Two black bear signs and seven wolf sign were also identified on Project Effects Area transects (Table 4), which is higher than numbers detected in 2011 but lower than the number of detections in 2012 for both species (Table 4).

When Reference Area and Project Effects Area transects are combined and distance of sampled areas to the access road is considered, 89% of sampled complexes greater than five km away had signs of adult caribou and 28% had calf sign (Table 6). For complexes less than 5 km from the access road, the percentage of sampled complexes with adult sign was consistently 100% (Table 6), with the portion of complexes with calf sign ranging from 0% (0 to 1 km, 1 to 2 km, 2 to 3 km, and 4 to 5 km) to 25% (3 to 4 km) (Table 6). For islands located greater than 5 km from the access road, 82% of sampled complexes had adult caribou sign and 12% had calf sign. For islands less than 5 km from the access road, the percent of complexes with adult sign, based on

distance class, ranged from 61% (4 to 5 km) to 93% (distance of 3 to 4 km) with the portion of calf sign ranging from 0% (0 to 1 km, 1 to 2 km, and 2 to 3 km) to 11% (4 to 5 km) (Table 6).

Road Reference Areas

Two hundred and eleven Road Reference transects were sampled in the KIP Regional Study Area in 2013. The total length of these transects, over three visits, covered 515.6 km, 17 complexes and 190 islands (Table 2). Several Road Reference transects were not surveyed over multiple visits due to safety concerns related to the 2013 forest fires (see Appendix A for visit dates). A total of 3,016 caribou signs were identified, resulting in 5.84 signs/km (Table 2). Caribou sign observed on Road Reference Area complexes included 16 complexes (94%) with adult sign and 10 complexes (59%) with calf sign (Table 3). Caribou sign observed on sampled habitat islands included 164 islands (86%) with adult sign and 43 islands (23%) with calf sign (Table 3). The percentage of complexes in Road Reference Areas with adult caribou sign decreased from 94% in 2011 to 65% in 2012 and returned to 94% in 2013, whereas the percentage of complexes with caribou calf remained consistent at 47% in 2011 and 2012 but increased to 59% in 2013 (Table 3; Figure 1). The percentage of islands in Road Reference Areas with adult caribou sign decreased from 65% in 2011 to 39% in 2012 and increased 86% in 2013, whereas the percentage of complexes with caribou calf sign was fairly constant at 11% in 2011 and 12% in 2012, but increased to 23% in 2013 (Table 3; Figure 2).

Other wildlife species detected on Road Reference Area transects included moose, black bear and gray wolf (Table 4). A total of 1,310 moose sign were observed on Road Reference Area complexes with 1,089 moose sign observed on islands (Table 5). Of the moose sign observed, 16 (94%) and 160 (84%) of the complexes and islands respectively contained adult moose sign whereas 14 (82%) and 61 (32%) of the complexes and islands respectively contained calf sign (Table 5). Total moose sign observed in Road Reference Areas decreased from 1,510 in 2011 to 1,146 in 2012 and increased to 1,310 in 2013 (Table 4). The percentage of complexes in Road Reference Areas with adult moose sign remained stable at 100% in 2011 and 2012 but declined to 94% in 2013. Alternately, the percentage of complexes with moose calf sign increased from 41% in 2011 to 65% in 2012 and further increased to 82% in 2013 (Table 5; Figure 3). The percentage of islands in Road Reference Areas with adult moose sign increased from 65% in

2011 to 75% in 2012 and increased further to 84% in 2013, whereas the percentage of islands with moose calf sign increased from 11% in 2011 to 21% in 2012 and increased further to 32% in 2013 (Table 3; Figure 4). Black bear and gray wolf sign were also identified in Road Reference Areas with 31 and 18 observations respectively (Table 4). Black bear sign observations on Road Reference transects increased from 16 in 2011 to 37 in 2012, and decreased to 31 in 2013 (Table 4). Gray wolf sign observations increased from 9 in 2011 to 11 in 2012 and increased further to 18 in 2013 (Table 4).

The number of sampled complexes located greater than 5 km from PR 280 with adult caribou sign was three (100%) and the number with calf sign was also three (100%) (Table 7). The number of sampled complexes less than 5 km from PR 280 with adult caribou sign ranged from 75% (3 to 4 km) to 100% (0 to 1 km, 1 to 2 km, and 4 to 5 km) with caribou calf sign ranging from 25% (3 to 4 km) to 100% (4 to 5 km). It should be noted that no complexes were sampled in the 2 to 3 km range due to the method used in assigning distance classes. The number of islands greater than 5 km from PR 280 with adult caribou sign was 19 (90%) and eight (38%) for calf sign (Table 7). For islands less than 5 km from PR 280, the number of islands with adult sign ranged from 62% (0 to 1 km) to 100% (4 to 5 km) and for calf sign ranged from 5% (0 to 1 km) to 28% (1 to 2 km) (Table 7).

3.1.2 Visit 1

Reference Areas

In Reference Areas, a total of 879 caribou sign were observed during the first visit in 2013 (Table 8). The total number of caribou sign observed during the first visit in Reference Areas represents 61% of all caribou sign observed across all three visits in 2013; whereas 27% of all caribou sign in Reference Areas in 2011, and 3% of all caribou sign in Reference Areas in 2012, were observed during the first visit (Table 8).

A total of 48 moose sign were observed during the first visit in 2013 (Table 8). The total number of moose sign observed during the first visit in Reference Areas represents 9% of all moose sign observed across all three visits in 2013; whereas 27% of all moose sign in Reference Areas in

2011, and 11% of all moose sign in Reference Areas in 2012, were observed during the first visit (Table 8).

Predators observed during the first visit included black bear and gray wolf. A total of one black bear sign was observed during the first visit in 2013 (Table 8). The total number of black bear sign observed during the first visit in Reference Areas represents 11% of all black bear sign observed across all three visits in 2013; whereas 15% of all black bear sign in Reference Areas in 2011, and 0% of all black bear sign in Reference Areas in 2012, were observed during the first visit (Table 8). No gray wolf sign was observed during the first visit in 2013 (Table 8). The total number of gray wolf sign observed during the first visit in Reference Areas represents 0% of all gray wolf sign observed across all three visits in 2013; whereas 22% of all gray wolf sign in Reference Areas in 2011, and 50% of all gray wolf sign in Reference Areas in 2012, were observed during the first visit (Table 8).

Project Effects Areas

In Project Effects Areas, a total of 919 caribou sign were observed during the first visit in 2013 (Table 8). The total number of caribou sign observed during the first visit in Project Effects Areas represents 82% of all caribou sign observed across all three visits in 2013; whereas 23% of all caribou sign in 2011, and 0% of all caribou sign in 2012, were observed during the first visit (Table 8).

A total of 62 moose sign were observed during the first visit in 2013 (Table 8). The total number of moose sign observed during the first visit in Project Effects Areas represents 16% of all moose sign observed across all three visits in 2013; whereas 34% of all moose sign in Project Effects Areas in 2011, and 12% of all moose sign in Project Effects Areas in 2012, were observed during the first visit (Table 8).

A total of one black bear sign was observed during the first visit in 2013 (Table 8). The total number of black bear sign observed during the first visit in Project Effects Areas represents 11% of all black bear sign observed across all three visits in 2013; whereas 100% of all black bear sign in Project Effects Areas in 2011, and 0% of all black bear sign in Project Effects Areas in 2012, were observed during the first visit (Table 8). No gray wolf sign were observed during the

first visit in 2013 (Table 8). The total number of gray wolf sign observed during the first visit in Project Effects Areas represents 0% of all gray wolf sign observed across all three visits in 2013; whereas 0% of all gray wolf sign in Project Effects Areas in 2011, and 84% of all gray wolf sign in Project Effects Areas in 2012, were observed during the first visit (Table 8).

Road Reference Areas

In Road Reference Areas, a total of 1,422 caribou sign were observed during the first visit in 2013 (Table 8). The total number of caribou sign observed during the first visit in Road Reference Areas represents 47% of all caribou sign observed across all three visits in 2013; whereas 61% of all caribou sign in 2011, and 2% of all caribou sign in 2012, were observed during the first visit (Table 8).

A total of 192 moose sign were observed during the first visit in 2013 (Table 8). The total number of moose sign observed during the first visit in Road Reference Areas represents 15% of all moose sign observed across all three visits in 2013; whereas 41% of all moose sign in Road Reference Areas in 2011, and 10% of all moose sign in Road Reference Areas in 2012, were observed during the first visit (Table 8).

No black bear sign were observed during the first visit in 2013 (Table 8). The total number of black bear sign observed during the first visit in Road Reference Areas represents 0% of all black bear sign observed across all three visits in 2011, 2012, and 2013 (Table 8). Two gray wolf sign were observed during the first visit to Road Reference Areas in 2013 (Table 8). The total number of gray wolf sign observed during the first visit in Road Reference Areas represents 11% of all gray wolf sign observed across all three visits in 2013; whereas 78% of all gray wolf sign in Road Reference Areas in 2011, and 45% of all gray wolf sign in Road Reference Areas in 2012, were observed during the first visit (Table 8).

3.1.3 Visit 2

Reference Areas

A total of 11 Reference Area transects were surveyed during the second visit in the KIP Regional Study area in 2013. The length of these transects totalled 56.8 km and traversed 10 complexes

and 56 calving islands (Table 9). A total of 399 caribou sign were detected on Reference Area transects, or 7.02 signs/km (Table 9). Caribou sign on Reference Area transects was recorded on nine complexes (90%) and on 38 (68%) of the islands (Table 9). Caribou sign observed on Reference Area transects in complexes included 9 complexes with adult sign (90%), and two complexes with calf sign (20%) (Table 10). Caribou sign observed on islands included 39 islands (68%) with adult sign and eight islands (14%) with calf sign (Table 10). The percentage of complexes with adult caribou sign in Reference Areas decreased from 100% in 2011 to 75% in 2012 and increased to 90% of complexes in 2013 (Table 10; Figure 5). The percentage of complexes with caribou calf sign increased from 42% in 2011 to 58% in 2012 and decreased to 20% in 2013 (Table 10; Figure 5). The percentage of islands with adult caribou sign decreased from 58% in 2011 to 36% in 2012 and increased to 68% in 2013 (Table 10; Figure 2). The percentage of islands with caribou calf sign decreased from 15% in 2011 to 8% in 2012 and increased to 14% in 2013 (Table 10; Figure 6).

Other wildlife species detected on Reference Area transects during the second visit in 2013 included moose, black bear and gray wolf (Table 11). A total of 303 moose sign were observed on Reference Area complexes with 96 moose signs observed on islands (Table 12). For moose sign observed on complexes and islands, 10 complexes (100%) and 30 islands (54%) contained adult sign while six complexes (60%) and 13 islands (23%) contained calf sign (Table 12). Although total moose sign observed on Reference Area transects during second visits decreased from 444 signs in 2011 to 216 in 2012 and increased to 303 in 2013 (Table 11), the percentage of complexes in Reference Areas with adult moose during the second visit was consistent at 92% in 2011 and 2012 and increased to 100% in 2013, whereas the percentage of complexes in Reference Areas with moose calves remained at 50% in 2011 and 2012 and increased to 60% in 2013 (Table 12; Figure 7). The percentage of islands with adult moose sign decreased from 63% in 2011 to 46% in 2012 and increased to 54% in 2013 (Table 12; Figure 7). The percentage of islands with moose calf sign decreased from 16% in 2011 to 10% in 2012 and increased to 23% in 2013 (Table 12; Figure 8).

Seven black bear sign and three gray wolf sign were also recorded on sampled calving islands transects in Reference Areas in 2013 (Table 11). The number of black bear signs in Reference Areas increased by one in each year from five signs in 2011 to seven signs in 2013 (Table 4).

The number of gray wolf signs in Reference Areas calving islands decreased from two to zero from 2011 to 2012 and increased to three signs in 2013 (Table 4).

Project Effects Areas

A total of nine Project Effects Area transects were sampled during the second visit in the KIP Local Study Area in 2013. The total length of these transects during the second visit covered 24.3 km, seven complexes and 23 islands (Table 9). Monitoring on the Project Effects Area transects resulted in the detection of 96 caribou sign, or 3.95 signs/km (Table 8). Caribou sign observed on Project Effects Area complexes during the second visit included five complexes with adult sign (71%) and three complexes with calf sign (43%) (Table 10). Caribou sign observed on islands included 14 islands (61%) with adult sign and four islands (17%) with calf sign (Table 10). The percentage of complexes in Project Effects Areas with adult caribou sign during the second visit decreased from 94% in 2011 to 50% in 2012 and increased to 71% in 2013, whereas the percentage of complexes with caribou calf sign increased from 18% in 2011 to 38% in 2012 and increased further to 43% in 2013 (Table 10; Figure 5). The percentage of islands in Project Effects Areas with adult caribou sign decreased from 61 % in 2011 to 29% in 2012 and returned to 61% in 2013 (Table 10; Figure 6). The percentage of islands in Project Effects Areas with caribou calf sign decreased from 15% in 2011 to 5% in 2012 and increased to 17% in 2013 (Table 10; Figure 6).

Other wildlife species detected on Project Effects Area transects during the second visit included moose, black bear and gray wolf (Table 11). A total of 180 moose sign were observed on sampled Project Effects Area complexes (Table 11), with 103 sign being observed on sampled islands (Table 12). Of the moose sign observed on complexes and islands, 6 (86%) and 19 (83%) of the complexes and islands contained adult sign, respectively, and four (57%) and five (22%) of the complexes and islands, respectively, contained calf sign (Table 12). Total moose sign observed in Project Effects Areas decreased from 217 signs in 2011 to 159 in 2012 and 180 in 2013 (Table 11). The percentage of complexes in Project Effects Areas that adult moose sign were observed on during the second visit decreased from 94% in 2011 to 90% in 2012 and decreased to 86% in 2013, whereas the number of complexes with calf sign observed increased from 35% in 2011 to 50% in 2012 and, further, to 57% in 2013 (Table 12; Figure 7). For habitat

islands, the percentage of islands with adult moose sign decreased from 58% in 2011 to 48% in 2012, and increased to 83% in 2013, whereas the percentage of islands with moose calf sign decreased from 19% in 2011 to 15% in 2012 and increased to 22% in 2013 (Table 12; Table 5; Figure 8).

One black bear sign and two gray wolf sign were also identified on Project Effects Area transects (Table 11), which for black bear is higher than numbers detected in 2011 but lower than the number of detections in 2012, and also an increase in the number of gray wolf sign from none observed in 2011 and 2012 (Table 11).

When Reference Area and Project Effects Area transects are combined and distance of sampled areas to the access road is considered, 80% of sampled complexes greater than five km away had signs of adult caribou and 33% had calf sign (Table 13). For complexes less than 5 km from the access road, the percentage of sampled complexes with adult or calf sign was 100% at all distance classes (Table 13); however, no complexes less than 3 km from the access road were sampled due to forest fires. For islands located greater than 5 km from the access road, 69% of sampled complexes had adult caribou sign and 16% had calf sign. For islands less than 5 km from the access road, the percent of complexes with adult sign, based on distance class, ranged from 0% (3 to 4 km) to 63% (distance of 4 to 5 km) with the portion of calf sign ranging from 0% (3 to 4 km) to 13% (4 to 5 km), though islands less than 3 km from the access road were not surveyed due to forest fires (Table 13).

Road Reference Areas

One hundred and ninety three Road Reference transects were sampled during the second visit in the KIP Regional Study Area in 2013. The total length of these transects sampled during the second visit covered 165.4 km, 17 complexes and 173 islands (Table 9). Several Road Reference transects were not surveyed over multiple visits due to safety concerns related to the 2013 forest fires (see Appendix A for visit dates). A total of 1,092 caribou signs were identified, resulting in 6.60 signs/km (Table 8). Caribou sign observed on Road Reference Area complexes included 14 complexes (82%) with adult sign and eight complexes (47%) with calf sign (Table 10). Caribou sign observed on sampled habitat islands included 126 islands (73%) with adult sign and 31 islands (18%) with calf sign (Table 10). The percentage of complexes in Road Reference Areas

with adult caribou sign decreased from 71% in 2011 to 67% in 2012 and increased to 82% in 2013, whereas the percentage of complexes with caribou calf sign increased from 24% in 2011 to 53% in 2012 and decreased slightly to 47% in 2013 (Table 10; Figure 5). The percentage of islands in Road Reference Areas with adult caribou sign decreased from 39% in 2011 to 33% in 2012 and increased dramatically to 73% in 2013. The percentage of complexes with caribou calf sign increased throughout the sample years from 3% of islands in 2011 to 13% in 2012 and 18% in 2013 (Table 10; Figure 6).

Other wildlife species detected during the second visit to Road Reference Area transects included moose, black bear and gray wolf (Table 11). A total of 662 moose sign were observed on Road Reference Area complexes with 555 moose sign observed on islands (Table 12). Of the moose sign observed, 14 (82%) and 106 (61%) of the complexes and islands respectively contained adult moose sign while 10 (59%) and 41 (24%) of the complexes and islands respectively contained calf sign (Table 12). Total moose sign observed in Road Reference Areas decreased from 530 signs in 2011 to 509 in 2012, and increased to 662 in 2013 (Table 11). The percentage of complexes in Road Reference Areas with adult moose sign remained stable at 100% across 2011, 2012, but decreased to 82% of complexes in 2013, whereas the percentage of complexes with moose calf sign increased from 41% in 2011 to 60% in 2012 and decreased slightly to 59% in 2013 (Table 12; Figure 3). The percentage of islands in Road Reference Areas with adult moose sign increased from 57% in 2011 to 65% in 2012 and decreased to 61% in 2013, whereas the percentage of islands with moose calf sign increased from 9% in 2011 to 17% in 2012 and increased further to 24% in 2013 (Table 12; Figure 8).

Black bear and gray wolf sign were also identified in Road Reference Areas with 28 and 3 observations respectively (Table 11). Black bear sign observations on Road Reference transects increased from 3 in 2011 to 24 in 2012, and increased further in 2013 to 28 (Table 4). Gray wolf sign observations increased remained stable at four signs in 2011 and 2012 and decreased to three signs in 2013 (Table 4).

The number of sampled Road Reference complexes located greater than 5 km from PR 280 with adult caribou sign was three (100%) and the number with calf sign was two (67%) (Table 14). The number of sampled complexes less than 5 km from PR 280 with adult caribou sign ranged

from 67% (0 to 1 km) to 100% (4 to 5 km) with caribou calf sign ranging from 0% (4 to 5 km) to 33% (0 to 1 km). It should be noted that no complexes were sampled in the 2 to 3 km range due to the method used in assigning distance classes to sampled complexes. The number of islands greater than 5 km from PR 280 with adult caribou sign was 13 (62%) and eight (38%) for calf sign (Table 14). For islands less than 5 km from PR 280, the number of islands with adult sign ranged from 63% (0 to 1 km) to 100% (4 to 5 km) and for calf sign ranged from 3% (0 to 1 km) to 24% (1 to 2 km) (Table 14).

3.1.4 Visit 3

Reference Areas

A total of 10 Reference Area transects were surveyed during the third visit in the KIP Regional Study area in 2013. This amount was reduced from the 16 available Reference Area transects due to fire. The surveyed length of these transects during the third visit totalled 48.7 km and traversed nine complexes and 49 calving islands (Table 15). A total of 171 caribou sign were detected on Reference Area transects, or 3.51 signs/km (Table 15). Caribou sign on Reference Area transects was recorded on eight complexes (89%) and on 18 (37%) of the islands (Table 15). Caribou sign observed on Reference Area transects in complexes included eight complexes with adult sign (89%), and zero complexes with calf sign (Table 16). Caribou sign observed on islands included 18 islands (37%) with adult sign and zero islands with calf sign (Table 16). The percentage of complexes with adult caribou sign in Reference Areas decreased from 92% of complexes in 2011 to 83% of complexes in 2012 and increased to 89% of complexes in 2013 (Table 16; Figure 1). The percentage of complexes with caribou calf sign decreased from 33% in 2011 to 25% in 2012 and further decreased to 0% in 2013 (Table 16; Figure 9). The percentage of islands with adult caribou sign decreased from 54% in 2011 to 43% in 2012 and decreased to 37% in 2013 (Table 16; Figure 10). The percentage of islands with caribou calf sign decreased from 6% in 2011 to 3% in 2012 and to 0% in 2013 (Table 16; Figure 10).

Other wildlife species detected on Reference Area transects during the third visit included moose and black bear (Table 17). A total of 208 moose sign were observed on Reference Area complexes with 111 moose signs observed on islands (Table 18). For moose sign observed on complexes and islands, 10 complexes (91%) and 33 islands (67%) contained adult sign while

four complexes (36%) and 3 islands (6%) contained calf sign (Table 18). As total moose sign observed on Reference Area transects during the third visit increased from 149 signs in 2011 to 287 in 2012 and decreased to 208 in 2013 (Table 17), the percentage of complexes in Reference Areas with adult moose sign increased from 83% in 2011 to 100% of complexes in 2012 with a slight decline to 91% in 2013, whereas the percentage of complexes in Reference Areas with moose calves remained stable at 42% in 2011 and 2012 and decreased to 36% in 2013 (Table 18; Figure 4). The percentage of islands with adult moose sign increased from 37% in 2011 to 58% in 2012 and increased further to 67% in 2013 (Table 18; Figure 4). The percentage of islands with moose calf sign increased from 4% in 2011 to 10% in 2012 and decreased to 6% in 2013 (Table 18; Figure 4).

One black bear sign was also recorded during the third visit on sampled calving islands transects in Reference Areas in 2013 (Table 17). The number of black bear signs in Reference Areas during the third visit decreased every year from 12 in 2011 to 2 in 2012 and one in 2013 (Table 17). The number of gray wolf signs in Reference Areas calving islands decreased from four in 2011 to one in 2012 and zero in 2013 (Table 17).

Project Effects Areas

A total of eight Project Effects Area transects were sampled during the third visit in the KIP Local Study Area in 2013. This amount was reduced from the 24 available transects, for which a large portion had burned and were not conducive to sampling at this time. The total length of these transects during the third visit covered 22.1 km, seven complexes and 21 islands (Table 15). Monitoring of the Project Effects Area transects resulted in the detection of 102 caribou sign, or 4.62 signs/km (Table 15). Caribou sign observed on Project Effects Area complexes included seven complexes with adult sign (100%) and two complexes with calf sign (29%) (Table 16). Caribou sign observed on islands included 13 islands (62%) with adult sign and two islands (10%) with calf sign (Table 16). The percentage of complexes in Project Effects Areas with adult caribou sign decreased from 65% on complexes in 2011 to 62% in 2012 and increased to 100% in 2013, based on those complexes which were successfully sampled at this time (Table 16; Figure 9). The percentage of islands in Project Effects Areas with adult caribou sign remained relatively stable at 40% use in 2011 to 39% use in 2012, while increasing to 62% in

2013 (Table 16; Figure 10). The percentage of islands in Project Effects Areas with caribou calf sign increased from 3% in 2011 to 8% in 2012 and 10% in 2013 (Table 16; Figure 10).

Other wildlife species detected on Project Effects Area transects included moose, black bear and gray wolf (Table 17). A total of 144 moose sign were observed on sampled Project Effects Area complexes (Table 17), with 116 sign being observed on sampled islands (Table 18). Of the incidental moose sign observed on complexes and islands, 7 (100%) and 20 (95%) of the complexes and islands contained adult sign, respectively, and four (57%) and six (29%) of the complexes and islands, respectively, contained calf sign (Table 18). Total moose sign observed in Project Effects Areas increased from 205 signs in 2011 to 279 in 2012 and decreased to 144 in 2013 (Table 17). The percentage of complexes in Project Effects Areas that adult moose sign were observed on increased from 94% in 2011 to 100% in 2012 and 2013, whereas the percentage on complexes that moose calf sign was observed increased substantially from 12% in 2011 to 48% in 2012 and increased further to 57% in 2013 (Table 18; Figure 11). For habitat islands, the percentage of islands with adult moose sign increased slightly from 60% in 2011 to 63% in 2012 and increased more substantially to 95% in 2013, whereas the percentage of islands with moose calf sign increased from 3% in 2011 to 21% in 2012 and increased to 29% in 2013 (Table 18; Figure 4).

One black bear sign and two gray wolf sign were also identified on Project Effects Area transects (Table 17). Black bear sign increased from zero sign in 2011 to six in 2012 and decreased to one sign observed in 2013 (Table 17). Gray wolf signs decreased from four signs in 2011 to three in 2012 and two in 2013 (Table 17).

When Reference Area and Project Effects Area transects are combined and distance of sampled areas to the access road is considered, 93% of sampled complexes greater than five km away had signs of adult caribou and 7% had calf sign (Table 19). For sampled complexes less than 5 km from the access road, both (100%) had sign of adult caribou as present but where no complexes less than 3 km from the access road were sampled (Table 19). For islands located greater than 5 km from the access road, 39% of sampled complexes had adult caribou sign and 0% had calf sign. For islands less than 5 km from the access road, the percent of complexes with adult sign,

based on distance class, ranged from 71% (4 to 5 km) to 100% (3 to 4 km) with the portion of calf sign ranging from 14% (4 to 5 km) to 50% (3 to 4 km) (Table 19).

Road Reference Areas

One hundred and seventy one Road Reference transects were sampled during the third visit in the KIP Regional Study Area in 2013 as compared to 211 transect lines sampled in previous years. Several Road Reference transects were not surveyed during the third visit due to safety concerns related to the 2013 forest fires (see Appendix A for visit dates).

The total length of these transects during the third visit covered 152.8 km, 17 complexes and 153 islands (Table 15). A total of 428 caribou signs were identified, resulting in 2.80 signs/km (Table 15). Caribou sign observed on Road Reference Area complexes included 14 complexes (82%) with adult sign and eight complexes (47%) with calf sign (Table 16). Caribou sign observed on sampled habitat islands included 103 islands (67%) with adult sign and 10 islands (7%) with calf sign (Table 16). The percentage of complexes in Road Reference Areas with adult caribou sign decreased from 76% in 2011 to 67% in 2012 and increased to 82% in 2013, whereas the percentage of complexes with caribou calf sign increased from 24% in 2011 to 27% in 2012 and to 47% in 2013 (Table 16; Figure 9). The percentage of islands in Road Reference Areas with adult caribou sign decreased from 39% in 2011 to 30% in 2012 and increased to 67% in 2013, whereas the percentage of complexes with caribou calf sign was fairly constant at 6% in 2011, 4% in 2012 and 7% in 2013 (Table 16; Figure 10).

Other wildlife species detected on Road Reference Area transects during the third visit included moose, black bear and gray wolf (Table 17). A total of 456 moose sign were observed on Road Reference Area complexes with 371 moose sign observed on islands (Table 18). Of the moose sign observed, 16 (94%) and 96 (63%) of the complexes and islands respectively contained adult moose sign while 10 (59%) and 15 (10%) of the complexes and islands respectively contained calf sign (Table 18). Total moose sign observed in Road Reference Areas increased from 367 signs in 2011 to 517 in 2012, and decreased to 456 in 2013 (Table 17). The percentage of complexes in Road Reference Areas with adult moose sign remained stable at 100% in 2011 and 2012 and dropped slightly, to 94%, in 2013. Alternately, the percentage of complexes with moose calf sign increased from 24% in 2011 to 40% in 2012 and increased further to 59% in

2013 (Table 18; Figure 11). The percentage of islands in Road Reference Areas with adult moose sign increased from 47% in 2011 to 63% in 2012 and in 2013 also. The percentage of islands with moose calf sign increased from 5% in 2011 to 11% in 2012 and decreased slightly to 10% in 2013 (Table 18; Figure **12**).

Black bear and gray wolf sign were also identified in Road Reference Areas during the third visit with three and 13 observations, respectively (Table 17). Black bear sign observations on Road Reference transects decreased from 13 in 2011 to 11 in 2012 to three in 2013 (Table 17). Gray wolf sign observations increased from zero in 2011 to one in 2011 and three in 2013 (Table 17).

The number of sampled complexes located greater than 5 km from PR 280 with adult caribou sign was three (100%) and the number with calf sign was also three (100%) (Table 20). The number of sampled complexes less than 5 km from PR 280 with adult caribou sign ranged from 50% (3 to 4 km) to 100% (0 to 1 km and 4 to 5 km) with caribou calf sign ranging from 0% (3 to 4 km and 4 to 5 km) to 67% (0 to1 km). It should be noted that no complexes were sampled in the 2 to 3 km range due to the method used in assigning distance classes. The number of islands greater than 5 km from PR 280 with adult caribou sign was 18 (95%) and two (11%) for calf sign (Table 20). For islands less than 5 km from PR 280, the number of islands with adult sign ranged from 54% (0 to 1 km) to 73% (3 to 4 km) and for calf sign ranged from 5% (0 to 1 km) to 10% (4 to 5 km) (Table 20).

3.1.5 Trail Camera Monitoring

Because nine cameras were irreversibly damaged by forest fires, only 39 of 48 cameras installed to monitor wildlife contained photographic data. Seven mammal species (caribou, moose, gray wolf, black bear, red fox, American marten, and snowshoe hare) were identified at 39 cameras installed immediately adjacent to potential caribou calving islands (Table 21).

Caribou were identified at two of the 39 camera locations. Of the caribou observed, 3 photos of males and 13 photos of females were identified on multiple dates and on multiple cameras (Table 21). Additionally, the three male caribou photos were of one individual during a single event at a single location (EA018_1) (Photo 3-1) and the 13 female caribou photos were also of one individual during a single event on a single day at a single location (EA020_1) (Photo 3-2). Of

39 cameras monitored, the number of cameras that detected caribou declined from 9 to 4 to 2 cameras from 2011, 2012, and 2013, respectively (Table 21).

Moose were observed on 11 of 39 cameras. Of the moose observed, 496 photos of males and 361 photos of females were identified on multiple dates and at multiple cameras (Table 21). Of photographed moose, three adult males (Photo 3-3) were identified on multiple dates at a three locations. A cow and calf were captured on two dates at two locations (Photo 3-4). Other moose captured by trail cameras include six adult moose of unknown sex on multiple dates at six locations and two females on a single day at a single location. The number of cameras that detected moose declined from 17 to 16 to 11 cameras in 2011, 2012, and 2013, respectively (Table 21).

Trail cameras also recorded the presence of black bear at three cameras placed throughout the study area. Of the black bears observed, 49 photos of adults of unknown sex and nine photos of juveniles were identified on multiple dates and at multiple cameras (Table 21). Of photographed black bears, three adults (Photo 3-5) were identified separately on three dates at three locations. One juvenile black bear was captured on one day at one location. Of 39 cameras monitored, the number of cameras that detected black bear declined from seven and eight in 2011 and 2012, respectively, to three in 2013 (Table 21).

Additionally, one gray wolf was captured by a single trail camera during a single event (Photo 3-6). Individual American marten were captured by trail cameras on three dates at three locations. Individual red fox were captured by trail cameras on two dates at two locations. Of 39 cameras monitored, the number of cameras that detected gray wolf changed from four and zero in 2011 and 2012, respectively, to 1 camera in 2013 (Table 21).

An assortment of fire photos were captured by trail cameras and are presented in Photo 3-7; Photo 3-8; Photo 3-9; and Photo 3-10.

Photo 3-1. Bull caribou captured on trail camera EA018b, June 18, 2013.

Photo 3-2. Caribou captured on trail camera EA020_1, May 31, 2013.

Photo 3-3. Bull moose captured on trail camera EA015_1, June 4, 2013.

Photo 3-4. Moose cow and calf captured on trail camera EA08_3, August 14, 2013.

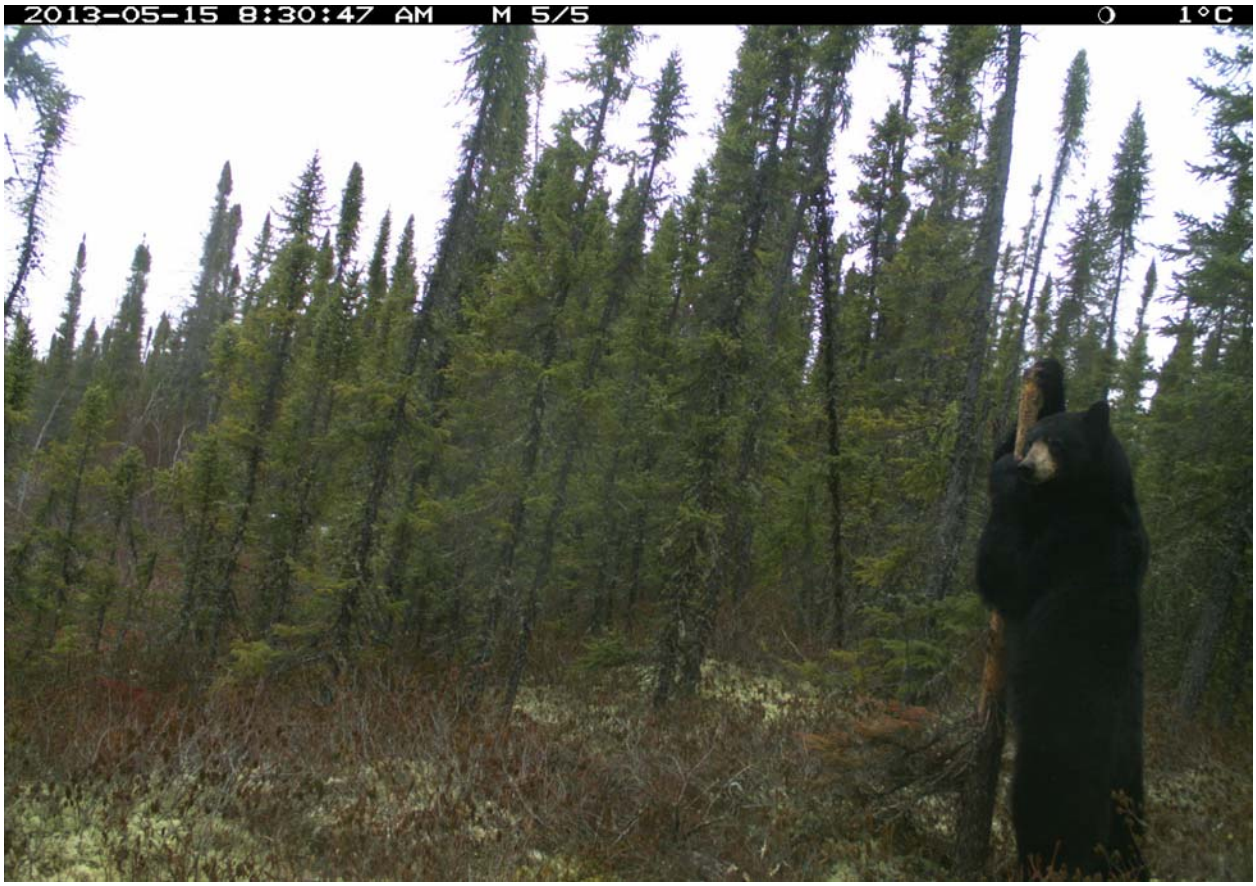


Photo 3-5. Black bear captured on trail camera EA002, May 15, 2013.

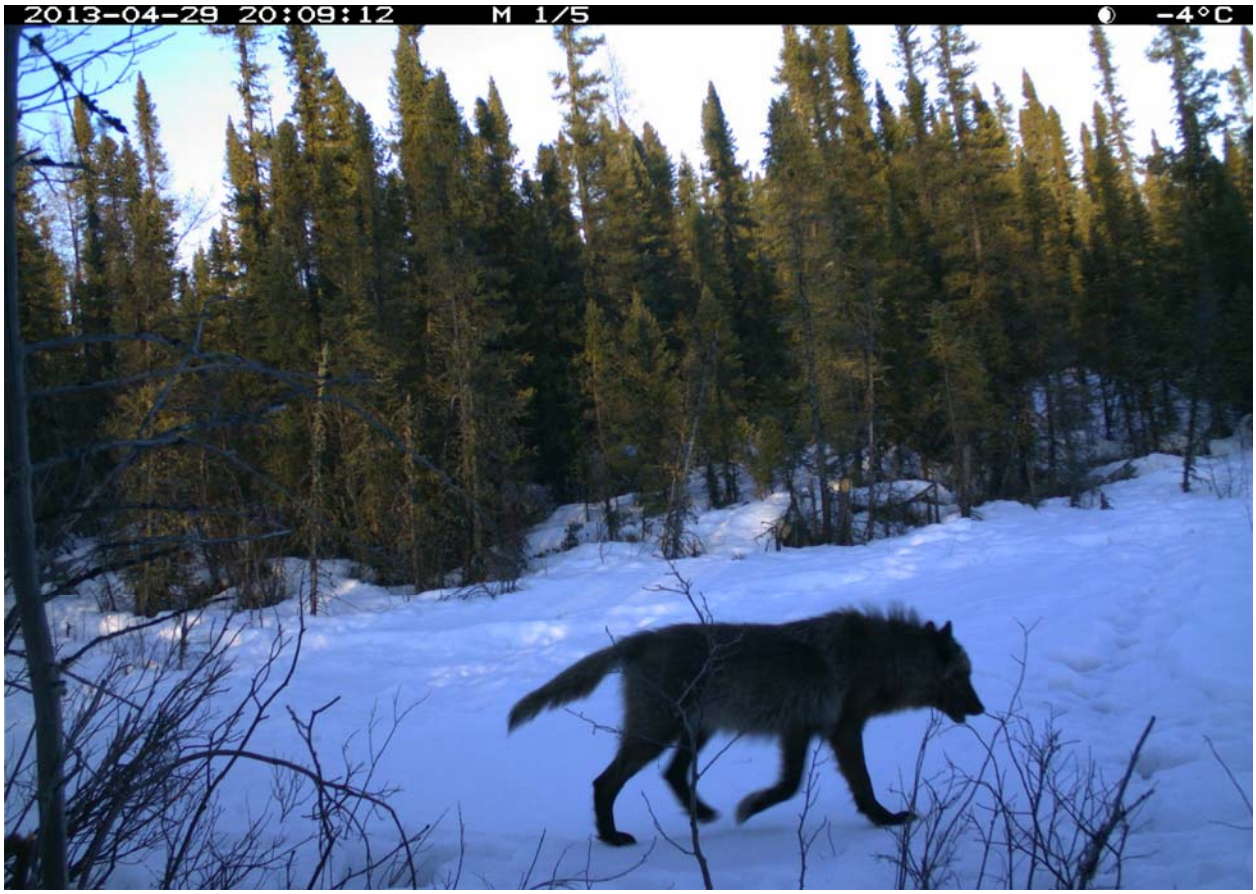


Photo 3-6. Gray wolf captured on trail camera EA008_3, April 29, 2013.

Photo 3-7. Fire photo captured on trail camera EA020, June 25, 2013.

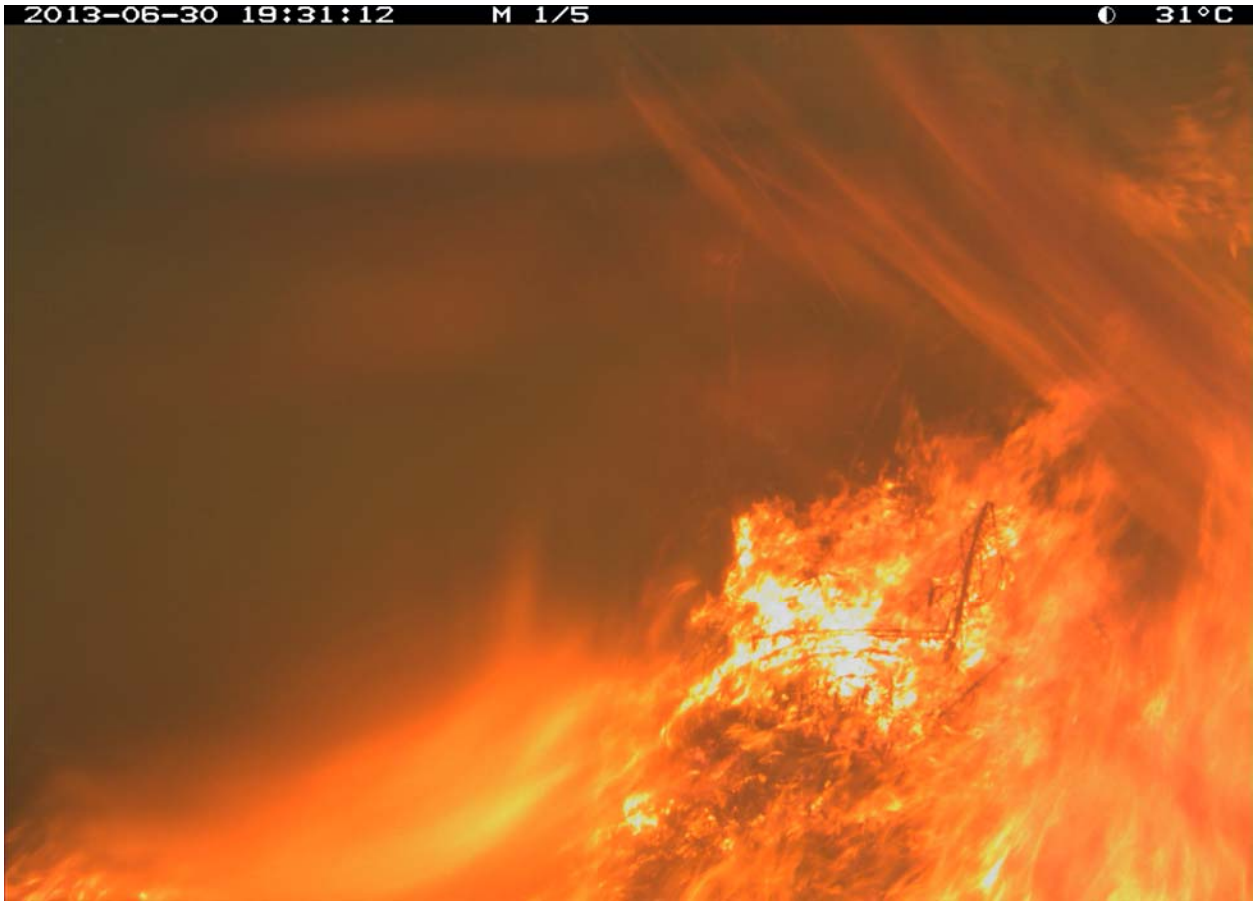


Photo 3-8. Fire photo captured on trail camera EA003, June 30, 2013.

Photo 3-9. Fire photo captured on trail camera EA005, June 14, 2013.

Photo 3-10. Fire photo captured on trail camera EA007, June 26, 2013.

3.2 MOOSE AND OTHER TERRESTRIAL MAMMALS

The sampling of moose and other mammal species in proximity to the access road occurred based on tracking transects situated on the north side of the access road (eight transects) as well as on the south side of the access road (three transects). While the sampling design for 2013 was originally based on the sampling of each transect over three visits, forest fires which occurred in July 2013 limited the sampling of these transects to only the first visit. In order to more accurately compare trends in sampled sign across sampling years, the review of sampling information was further broken down based on sampling visit to provide another means of comparison between years.

3.2.1 Moose and Other Mammal Sign Surveys All Visits

Access Road (North Side)

Eleven mammal species were identified along eight north side access road monitoring transects (Table 22). In 2013, a total of 145 moose sign and 385 caribou sign were observed during monitoring activities, resulting in 1.67 sign/km and 4.43 sign/km, respectively (Table 23). Of the moose sign identified, one was determined to be left by a cow, 54 were determined to be left by adults, five were left by moose calves, and the remaining 85 sign remained unidentified for the purposes of aging and sexing of animals (Table 22). Of the caribou sign identified, 156 were determined to be from adults of an unknown sex and 229 were from unknown individuals (Table 22). Caribou sign declined substantially from 2011 to 2012 and increased in 2013 to within 14% less than the number of sign observed in 2011. From 2011 through to 2013, moose sign declined substantially (87%) from 1,052 to 145 signs. Black bear were also identified during monitoring activities with three sign observed; a substantial decrease from the 14 signs in 2011 and the 13 signs in 2012 (Table 24). Gray wolf observations decreased by 43% from 28 to 16 signs from 2011 to 2012 and only one gray wolf sign was observed in 2013.

Access Road (South Side)

Nine mammal species were detected on transects south of the access road (Table 22). A total of eight moose sign and 396 caribou sign were identified, for sign frequencies of 0.26 sign/km and 12.65 sign/km, respectively (Table 23). Of the moose sign identified, five were determined to be adult moose sign (Table 22). Of the caribou sign observed, 192 were signs of adults and 204 were from caribou of undetermined age (Table 22). From 2011 to 2013, moose decreased by 97%, whereas caribou increased by 12%; however, from 2011 to 2012 caribou sign decreased by 87%. Signs from black bear and gray wolf declined to the extent that they were not observed in 2013 on the transects south of the access road (Table 24).

3.2.2 Visit 1

Access Road (North Side)

The sampling of mammal species on transects on the north side of the access road indicated the presence of ten species during visit 1 (Table 25). This was the same number of species observed during the first visit in 2012 and two less species than were observed in 2011. For the first visit, there was a total of 145 moose sign observed, with the aging and sexing information for sampled animals being the same as described above (all three visits combined). This quantity of moose sign amounts to 1.67 sign/km (Table 26). Compared to previous years, the quantity of moose sign/km in 2013 is approximately 32% of those levels observed during the first visit of 2011, but 167% higher than those levels observed in 2012. For caribou, 385 sign were recorded which amounts to an average number of caribou sign per km of 4.43 sign per km (Table 25, Table 26). These quantities are 515% higher than those levels observed over the first visit in 2011. As no caribou sign was sampled over the first visit in 2012, comparison between 2012 and 2013 cannot be applied in this manner. The number of sampled black bear and gray wolf sign was three and one, respectively (Table 27). Comparatively, this amount of black bear sign is one more sign than was recorded in the first visit of these transects in 2011 and 2012. Sampled wolf sign during the first visit of 2013 was 5% of 2011 and 9% of 2012 quantities.

Access Road (South Side)

A total of nine mammal species were observed on the south side transects sampled during the first visit (Table 25). This is compared with six species observed in both 2011 and 2012. A total of 8 moose sign were observed which amounts to 0.22 moose sign/km (Table 26). This amounts to 11% of those levels observed in 2011 and 41% of those levels observed in 2012, over the first visit. For caribou, 396 sign were recorded over 37 km of transects, or 10.70 caribou sign/km (Table 26). These quantities are 515% higher than those levels observed over the first visit in 2011. As no caribou sign was sampled over the first visit in 2012, there is no comparison between 2012 and 2013. The number of sampled black bear and gray wolf sign in 2013 was three and one, respectively (Table 27). Comparatively, this amount of black bear sign is one more sign than was recorded in the first visit in 2011 and 2012. Sampled wolf sign during 2013 was 5% of 2011 and 9% of 2012 quantities, showing a substantial decrease in the sampling of this species over this time.

3.2.3 Visit 2

The sampling of species sign on transects during the second visit could only be compared based on the 2011 and 2012 sampling years, due to large forest fires in 2013 which made these transects unavailable during the second and third visits in 2013.

Access Road (North Side)

For transects north of the access road, sign from four mammal species were recorded in 2011 (Table 28). For these transects, in 2011, 380 moose sign were sampled in comparison to 283 moose sign sampled in 2012 (a 26% decrease; Table 29), a change from 4.37 to 3.25 sign/km. In 2011, 178 caribou were recorded, with six calf sign (2.05 sign/km). Alternately in 2012, 42 caribou sign were recorded, including two calf sign (0.48 sign/km) (Table 29). Six black bear and nine gray wolf sign was recording in 2011 compared to eight and two for 2012, respectively (Table 30).

Access Road (South Side)

Sampling of mammal species over the second visit in 2011 and 2012 indicated the presence of three mammal species in each of these periods (Table 28). Ninety-seven moose sign were observed in 2011 compared to 110 in 2012. For moose, calculated sign density was 2.62 sign/km and 2.97 sign/km in 2011 and 2012, respectively (Table 29). For caribou, 35 caribou sign were record in 2012 with seven calf sign recorded (0.95 sign/km) and 147 sign recorded in 2011 with no calf sign (3.97 sign/km; Table 28 and Table 29). In 2011, one gray wolf sign and no black bear sign were recorded (Table 30). In 2012 no predator sign were recorded.

3.2.4 Visit 3

The sampling of species sign on transects during the third visit could only be compared based on the 2011 and 2012 sampling years. This is due to large forest fires in 2013 which made these transects unavailable during the second and third visits in 2013.

Access Road (North Side)

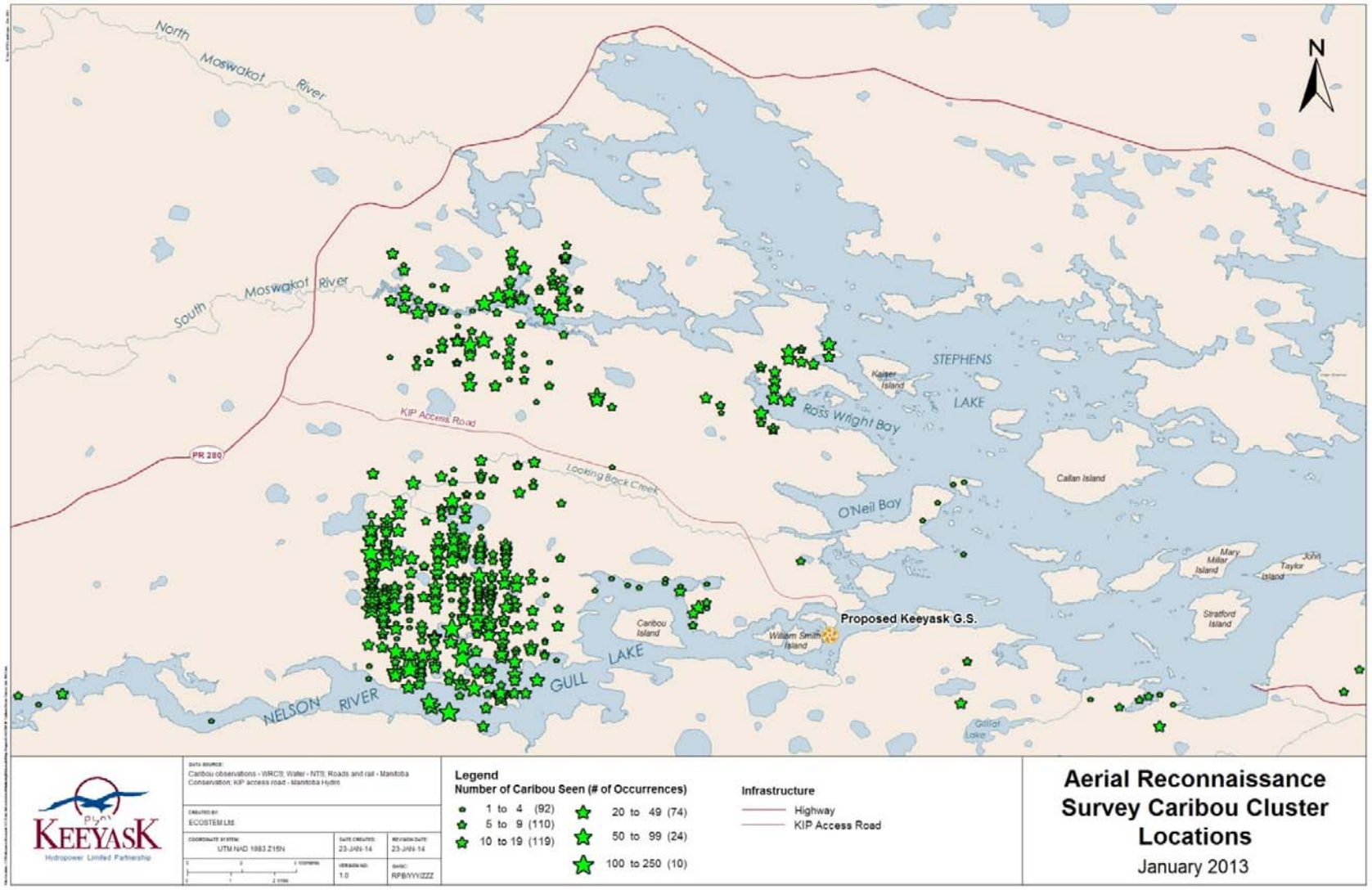
Sampled mammal species on the north side of the access road, in 2011, included black bear, caribou and moose. In 2012 gray wolf sign was also observed (Table 31). Sampled moose sign over the third visit indicated 285 moose sign recorded in 2012 (3.45 sign/km) compared to 300 in 2011 (3.30 sign/km) (Table 32). The sampling of caribou over this visit indicated 192 sign in 2011 (2.21 sign/km) and 12 sign in 2012 (0.14 sign/km) (Table 32). Sampled predator species in 2011 included six black bear sign, and in 2012 included three black bear and three gray wolf sign (Table 33).

Access Road (South Side)

On the south side of the access road, four mammal species were recorded in 2011 and three were recorded in 2012 (Table 31). Sampled moose sign decreased from 119 sign in 2011 (3.22 sign/km) to 62 sign in 2012 (1.68 sign/km) (Table 32). Sampled caribou sign included 88 sign in 2011 (2.38 sign/km) and 11 sign in 2012 (0.30 sign/km). Sampled predator species was limited to one gray wolf in 2011 and one black bear in 2012 (Table 33).

3.3 CARIBOU AERIAL RECONNAISANCE SURVEY

Fixty-six transects were flown in 2013, covering 376 km^2 in the KIP area (Map 3-1), for a total transect length of 764 km. During the survey, 7,787 caribou in 429 clusters were observed. The distribution of caribou in the KIP area on January 31, 2013 was not uniform (Map 3-1). Mean cluster size was 18.4 (SD = 24.2), ranging from one to 189 caribou. The spacing of the clusters appeared to avoid the immediate construction area on the access road. Most caribou were found at distances greater than one km (perpendicular distance) from the access road. A few crossing locations were noted near the access road in a north-south direction. The large number of caribou observed during the reconnaissance survey warranted a more comprehensive systematic caribou aerial survey over a much larger geographic area (see Sections 2.4 and 3.4).



Map 3-1. Locations of caribou observed during the January 31, 2013 aerial reconnaissance survey.

3.4 CARIBOU AERIAL SURVEY

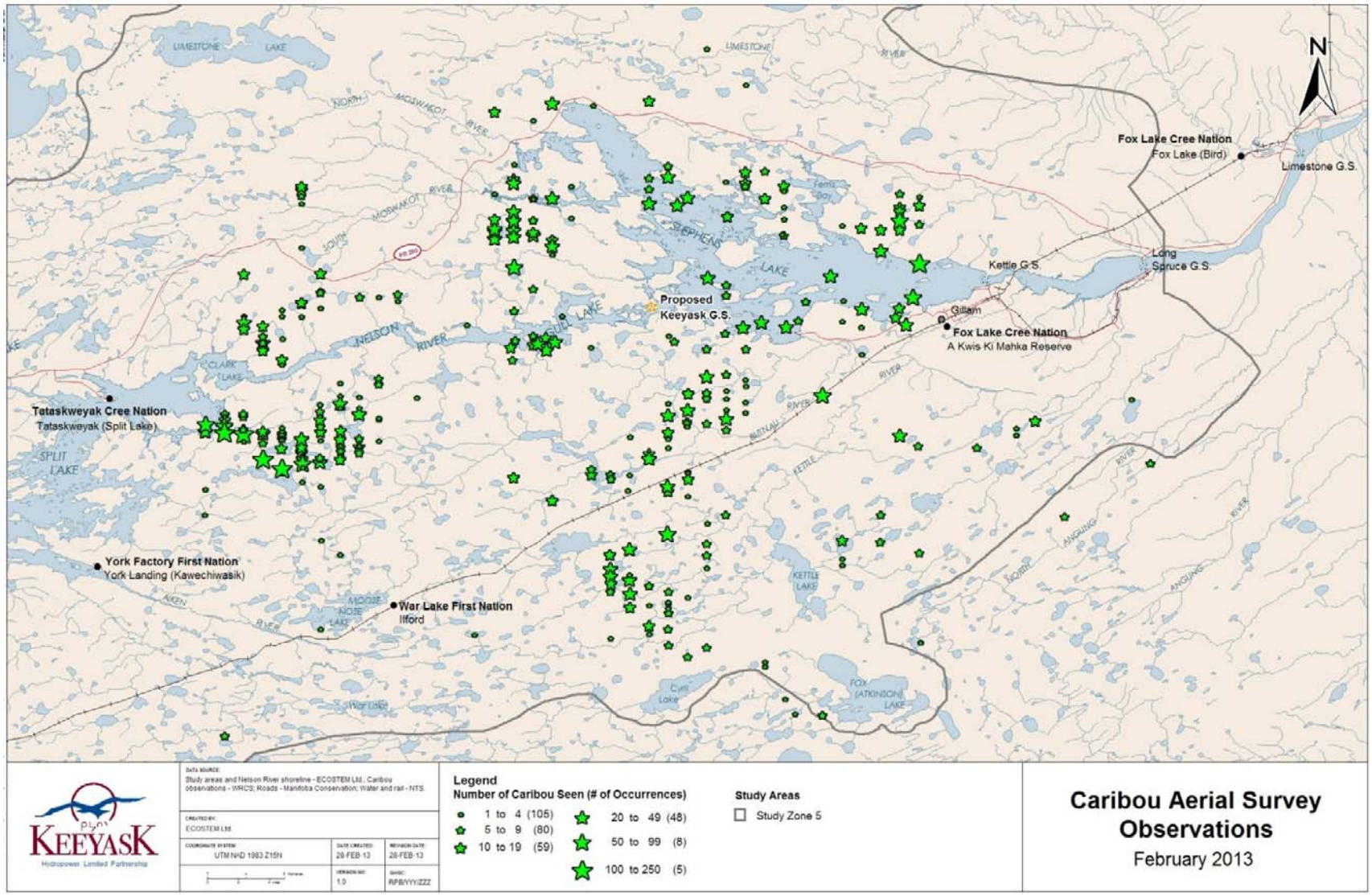
3.4.1 Density and Population Size

Fifty-six transects were flown, covering an area of 8,400 km^2 in the eastern half of the Keeyask Generation Project's Study Zone 5 (Map 2-8), with a total transect length of 12,844 km. In total, 4,169 caribou in 305 clusters were observed during the survey, although many clusters were observed off-transect. On the distance sampling line transects, 3,486 caribou in 262 clusters were observed. The distribution of caribou in the Keeyask area from February 5 to 8, 2013, was not uniform (Map 3-2). Mean cluster size was 13.56 and ranged from one to 250 caribou. We selected a truncation distance of >450 m which removed 26 (9.9%) data points, leaving 3,200 caribou in 236 clusters (Table 34) - that provided a sufficiently large sample size and a good fit to the data for most detection function models.

Based on the lowest AIC values, model fit close to the transect line, and low %CV, a half-normal model with a cosine adjustment term was selected as the best detection function (Table 35, Figure 13). We observed high model selection uncertainty (ΔAIC <2; Anderson *et al.* 1998) between the best model and other top two detection functions. The half normal with cosine adjustments and the hazard key with cosine adjustments showed good fit with p-values from $\chi 2$ GOF tests between 0.893 and 0.952 and yielded the same detection probability of 0.50, similar density estimates (1.66 and 1.68 caribou/km^2), and overlapping CI's (Table 35).

The averaged model, obtained by generating 1,000 bootstrap iterations, showed good fit with a $\chi 2$ GOF test p-value of 0.952, and a detection probability of 0.50. The bootstrap caribou density of 1.73 caribou/km^2 was near parametric estimates, although with a much greater %CV (Table 35).

The best supported distance-sampling model (half normal with a cosine adjustment key) indicated that the density of caribou in the Keeyask area (Study Zone 5) from February 5 to 8, 2013, was approximately 1.66 caribou/km^2. Thus, the surveyed area of 8,400 km^2 hosted 13,984 (± 18.17%, 95% CI) caribou from February 5 to 8, 2013 (Table 35).



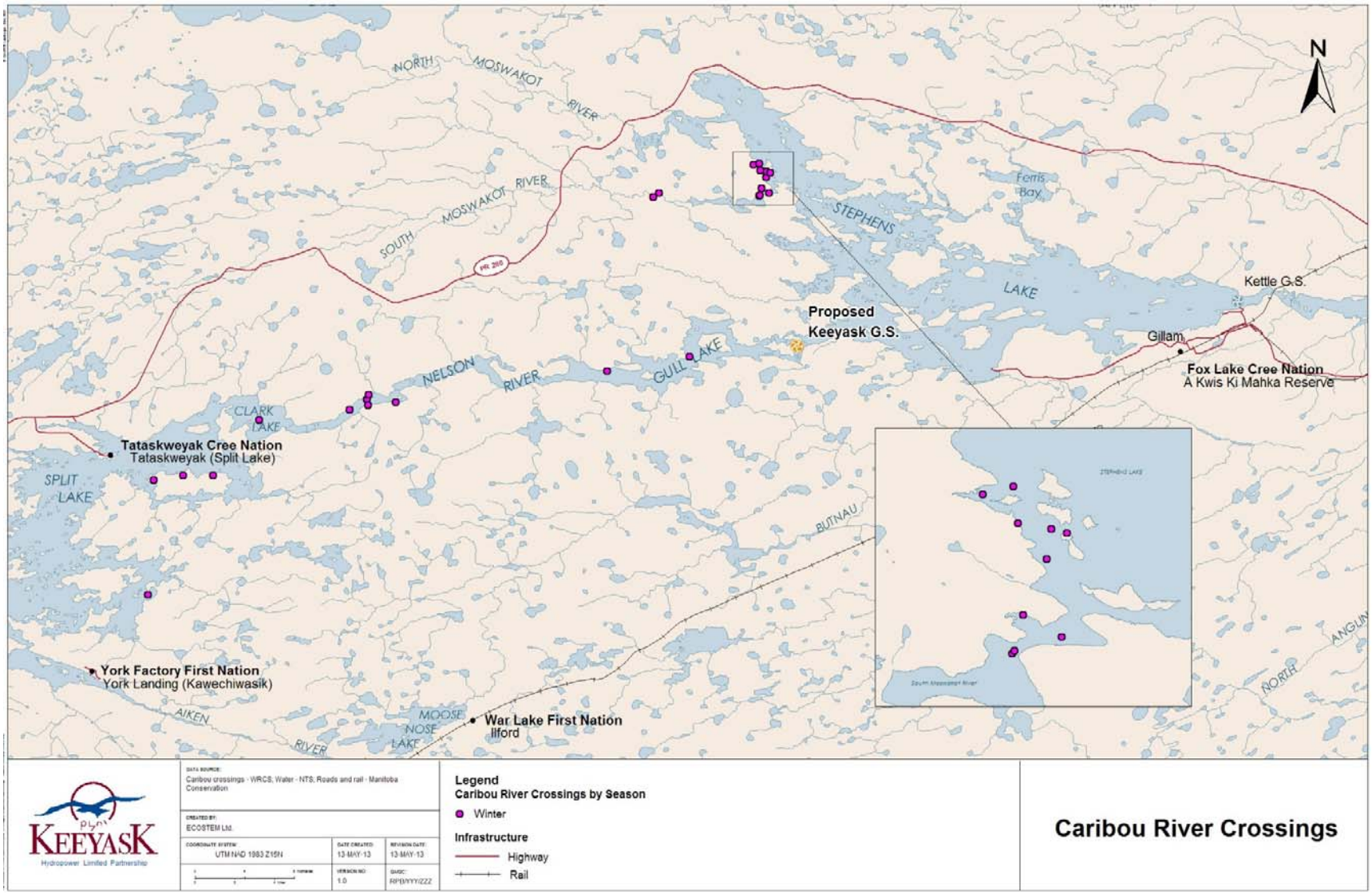
Map 3-2. Locations of caribou observed during aerial surveys in February, 2013.

3.4.2 Caribou Ice Crossings

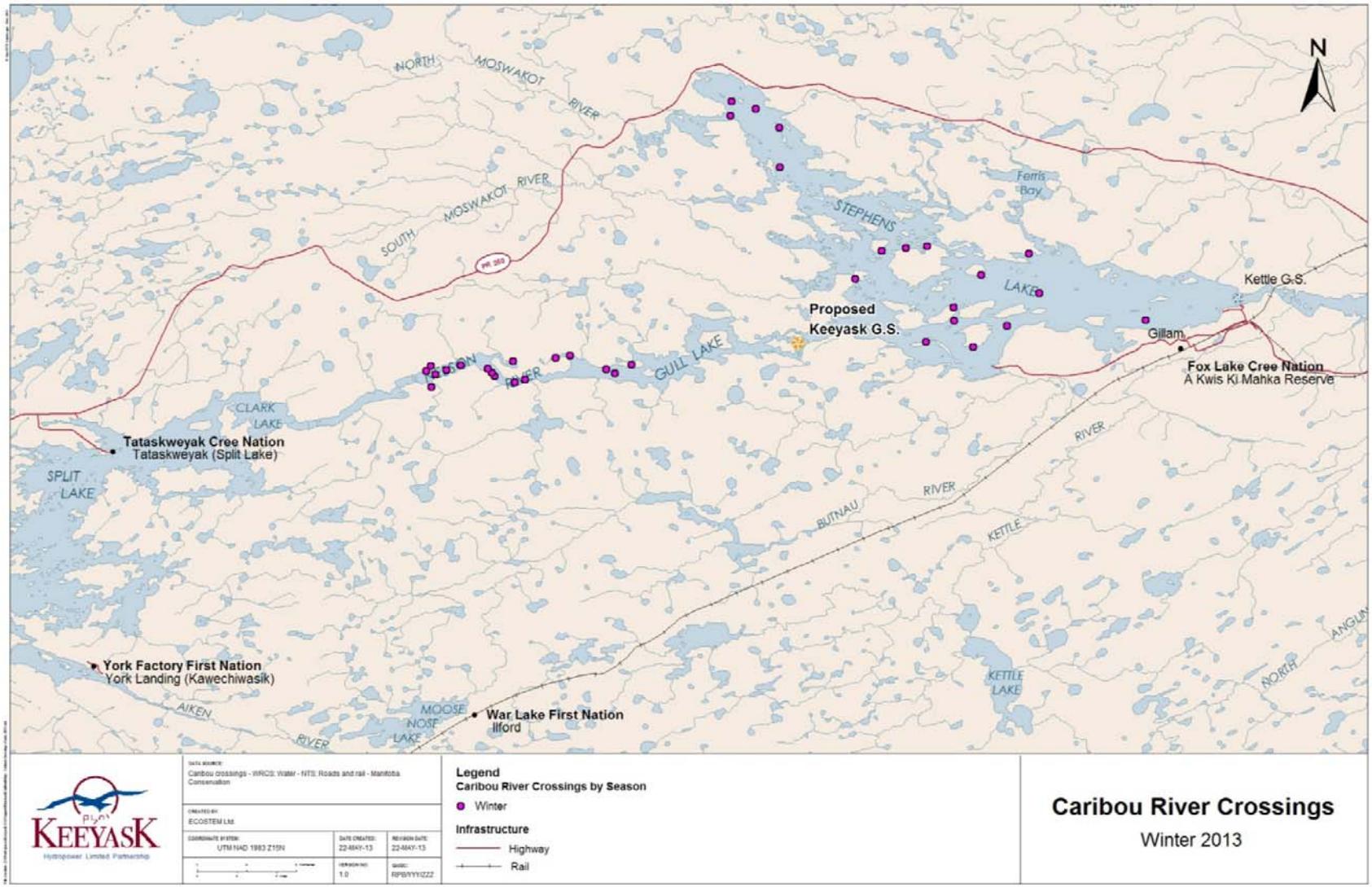
Several locations where caribou crossed ice over the Nelson River and Stephens Lake were identified on January 31, 2013 during the reconnaissance survey, and while surveying distance sampling transects from February 5 to 8, 2013. During the reconnaissance survey on January 31, 2013, 10 caribou crossing sites were recorded between Birthday Rapids and Gull Lake (Map 3-4; Photos D-1 and D-2). Seven additional sites between Birthday Rapids and Gull Lake were recorded during line transect distance sampling (Map 3-4, Photos 1 and 2). On Stephens Lake, five crossing sites were recorded on the north arm of the lake and 14 were recorded between Gull Rapids and 3 km west of Gillam (Map 3-4, Photos D-3 and D-4). No caribou trails were detected from open water areas to terrestrial habitats near Birthday Rapids or Gull Rapids.

3.5 CARIBOU SCAT SAMPLING

Laboratory analysis of 764 caribou scat samples collected in the KIP area in February 2013 indicates that the animals responsible for the sampled scat originated from the Pen Islands caribou herd. The laboratory report is available in Appendix E.



Map 3-3. Known caribou ice crossing locations in the Keeyask area in 2013 (WRCS unpubl. data).



Map 3-4. Caribou ice crossing locations observed on Jan 31 and Feb 5-8, 2013.

3.6 DEN SURVEYS

3.6.1 Black Bear Den Survey

No black bear dens or bear activity (e.g., tracks, scat, digging) were found at any of the sites during the October survey.

The 25.6 km of survey lines were searched in areas selected for haul roads, quarries, deposit sites and planned cleared areas near the access road. Search areas varied in vegetation cover. Search areas PCA1, PCA2, PCA3, PCA4, PCA5, PCA6, HR1, HR2, HR3 and DepoN (Map 3-4) were located in peatland habitat and consisted mostly of small (2 to 6 m tall) black spruce and tamarack. Burned peatland and upland habitat with regenerating jack pine (approximately 2 to 3 m tall) was also present in NCZ1, in addition to spruce and tamarack. The majority of search area PCA7 was forested with 5 m tall black spruce and jack pine. Six of 12 search sites were also located on islands in the Nelson River, including PCA2, PCA3, PCA5, PCA6, HR2 and HR3.

Incidental wildlife activity documented at one or more sites included caribou, moose, American marten, red fox, spruce grouse (*Falcipennis canadensis*), sharp-tailed grouse (*Tympanuchus phasianellus*), and snowshoe hare.

4.0 INCIDENTAL WILDLIFE REPORTS

4.1 GRAY WOLF

A gray wolf was observed in the KIP camp in October 2013. While staying at the KIP camp, WRCS staff observed a gray wolf running between contractor accommodation trailers in the evening of October 25, 2013. A second gray wolf was observed on October 27 along the tree line between the KIP start-up camp and the security gate. Concerns about gray wolves entering the KIP start-up camp initiated a safety awareness campaign.

4.2 CARIBOU

As reported in Section 3.3, a large number of caribou were observed in the KIP study area in early 2013. Concerns were raised by Manitoba Hydro and contractors regarding the potential for caribou movements through the access road area, and how to minimize caribou disturbances and potential accidents. As a result, Manitoba Hydro initiated an education and safety awareness campaign. Additional mitigation and adaptive management measures that were adopted at this time to avoid the disruption of caribou movements included safety briefings about caribou occurrences, signage, and the potential use of flagmen for traffic control purposes, if required.

Photo 4-1. Construction vehicles stopped for caribou movements across the access road, January 26, 2013.

On March 24, 2013 a caribou (left circle) was observed being chased by a gray wolf (right circle) through an active construction area (Photo 4-2). A short video of the chase was captured by Manitoba Hydro personnel. The caribou ran through a narrow opening between two large rock trucks and it was observed running towards the distant forest. Neither animal appeared to react to the construction activity during the pursuit in the video.

Photo 4-2. Caribou pursued by a gray wolf in an active construction area, March 24 2013.

On January 13, 2014, a caribou was sighted beside the access road, about 15 km from PR 280 (S. Mason, Pers. Comm.). Track evidence observed by the Site Environmental Officer indicated that the caribou crossed the access road.

4.3 MOOSE

In 2013, there was one reported moose collision. The collision occurred at Kilometre 11 on the access road at approximately 5:45 pm on November 18. While travelling back to the start-up camp, a construction contractor struck a cow moose with a half-ton pick-up truck. The driver was not injured by the accident. The truck sustained damage to the windshield and left side of the truck (Photo D-5). The collision was reported as a glancing strike as opposed to a direct collision. The moose moved off the road and into the forest (S. Mason, Pers. Comm.). The collision was reported to Manitoba Conservation and Water Stewardship. Natural Resource Officers came to the site to investigate. Attempts to track the animal indicated that the moose was travelling with a calf. From the track evidence evaluated, the cow did not appear to be

substantially injured because it did not lie down and movements appeared unhindered and regular.

4.4 ARCTIC FOX

In 2013, there were two reports of arctic fox (*Vulpes lagopus*) near the Project. On approximately November 26, the KIP Site Environmental Officer reported an arctic fox on PR 280, a half hour before the turn off to Split Lake (S. Mason, Pers. Comm.). The second sighting was of an arctic fox observed frequenting the start-up camp site in mid-December (Photo D-6). This arctic fox initially appeared to be in good health and did not exhibit any signs of disease. However, between December 12 and 18, a dead arctic fox was found in the KIP start-up camp. It was thought to be the individual sighted earlier. The cause of death was not determined. The fox tested negative for the rabies virus, and it was given to a local trapline holder. No additional reports of arctic fox were reported.

4.5 WOLVERINE

One wolverine observation was reported in 2013. The KIP Site Environmental Officer reported a wolverine observation in Work Area A (S. Mason, Pers. Comm.). The sighting could not be confirmed by the Site Environmental Officer, as blowing snow obscured any wolverine sign that may have been detectable.

5.0 DISCUSSION

A number of natural and anthropogenic variables have the potential to influence wildlife populations. In the consideration of caribou use of the KIP area, calving and rearing activities declined during the first year of KIP construction, as predicted. Conversely, it was demonstrated that the migratory Pen Island herd did not appear to be dissuaded from migrating near, and in some cases, through an active construction area during the winter. The large influx of caribou and the large-scale forest fires in summer 2013 confounded the results of monitoring efforts, and were most likely responsible for affecting species activity measures and distribution in the KIP study area. The effect of fire and habitat change is expected to last well into the future. Further monitoring of wildlife species will be required to evaluate how KIP construction will affect wildlife species in the context of ecosystem drivers such as fire.

5.1 CARIBOU SIGN SURVEYS AND TRAIL CAMERA MONITORING

As part of the *KIP Terrestrial and Aquatic Monitoring Plan*, caribou and other mammal species were monitored in the KIP Study Area in 2011, 2012, and 2013. Monitoring occurred through systematic surveys of caribou calving and rearing complexes, both close to and removed from construction activities, to compare for differences in species use over time. Sampling was conducted prior to construction of the access road and associated infrastructure in 2011, and also during construction in 2012 and 2013. This design allowed for a basis of comparison between years for distinguishing potential Project-related effects from other factors, and to compare these monitoring results with other studies based on scientific literature.

While the sampling of caribou activity demonstrated a substantial increase in the number of caribou sign recorded in 2013, compared to 2011 and 2012 levels, these increased levels are highly likely associated with the movements of migratory Pen Islands caribou herd having moved through the KIP area in winter/spring and are not reflective of changes in the use of calving complexes and islands. This is important to consider, as changes in the use of calving complexes and islands was the main variable being measured for identifying how caribou activity may change as a result of KIP construction. Due to the potential for incidences of migratory caribou being recorded on complexes near the KIP site, and values not based solely on

explicit complex use by caribou for calving and rearing, yearly monitoring information was examined further on a by-visit basis using the second and third sampling periods.

In addition to the influx of caribou sign recorded during the first visit of the 2013 field season, due to migratory movements in the previous months, large forest-fires in the summer of 2013 resulted in a many transects being removed from analysis. Two large fires burned throughout the summer, covering a combined area of approximately 151,714 ha in Study Zone 6 (Ecostem Ltd. unpubl. data). Sample sites most seriously affected by these forest fires were located in the Project Effects Area (EA) complexes and islands nearest to the KIP infrastructure. Available (i.e., unburned) sample sites in 2013 declined to 33% of those originally available in 2011 and 2012. Forest fires disrupted all complexes and islands located within 3 km of the access road during the second and third visits. The 2013 forest fires affected the monitoring results in a number of ways, including:

1) Altering caribou calving complex and island use during the second and third visits of the 2013 sampling year;
2) Making it more difficult to compare the sampling of sign during the second and third visits across the 2011-2013 sampling years;
3) Acting as a confounding variable, making it difficult to assess the effects of KIP construction from more highly influential factors that drive habitat use.

The number of Reference Area (CA) and Road Reference (RC) transects affected by the 2013 fires was comparatively low. For CA transects the number of available complexes and islands for the second visit dropped to 83 and 70%, and for the third visit to 75 and 61%, respectively. Alternately, the number of RC complexes available for sampling remained the same for the second and third visit (100%) but the number of islands available for sampling dropped to 91 and 81%, respectively.

The sampling of complexes and islands in 2013 indicated that, compared to 2012 - the year KIP construction began, there was increased levels of complex and island use by adult caribou. This is only based on the sampling of sign during the second and third visits and where the number of available transects was reduced based on forest fires. As it was those complexes and islands within close proximity to the access road (≤ 3 km) which were removed from sampling during

the second and third visit, calculated rates of complex and island use by adult caribou activity may be overestimated.

Measured levels of caribou calf activity on sampled complexes and islands during the second visit indicated the potential continued value of these areas as caribou calving and rearing areas. Based on the percentage of complexes and islands with caribou calf sign during the second visit of the 2011-2013 sampling years, there has been stable to gradually increasing use of these areas. This was evident in the consideration of all three transect types, with the exception of a marked decline in calf activity for sampled Reference Area complexes in 2013. The number of CA islands with caribou calf activity has remained relatively stable however. This may be indicative of calving activity being reduced on certain complexes but where those islands available in alternate complexes are instead being used.

In comparing levels of caribou calf activity over the third visit from 2011-2013, complex use increased for sampled RC transects, declined for CA transects and remained stable to slightly increasing for sampled EA transects. Measured caribou calf activity levels for sampled islands during the third visit indicated stable use of islands for RC transects, stable to slightly increasing use of islands associated with EA transects and declining use of islands associated with CA transects. For sampled CA transects in 2013 it should be noted that no calf sign was recorded over the third visit. This may have been a result of these areas being avoided due to the large forest fires in the area which prompted caribou adults and their calves to move to alternate areas.

As the number of available EA transects in 2013, and to a lesser extent CA and RC transects, became unavailable for sampling during the second and third visits in 2013, trends in adult and calf activity levels for these times is based on limited data. Alternately, the percentage use of complexes and islands in 2011 and 2012 by caribou is based on a larger number of sampled complexes and islands and is therefore a better representative dataset for detailing caribou calving activities. Despite observed trends based on the second and third visits, indicating the potential for increasing caribou calving activities on EA transects, it is expected that caribou calving activities would normally decrease in areas affected by construction activities. Mahoney and Schaefer (2002) found for example, that migratory caribou avoided areas where active construction is occurring. Caribou also avoided roads for the purposes of calving and rearing

activities Dyer *et al.* (2001) and Leclerc *et al.* (2012). Linear features are commonly avoided by caribou (James and Stuart-Smith 2000; Dyer *et al.* 2001, 2002; Beauchesne *et al.*, 2014). The apparent increase in calf activity on sampled EA transects may be due to the limited number of EA transects sampled during this time, as the EA transects which remained available for sampling over the second and third visits occurred at distances > 3 km of the access road. Alternatively or in part, caribou activities may have increased near the access road in 2013, because construction activities also ceased during the fire period for the majority of June and up to July15.

Distance of sensory disturbance effects can be highly variable. Some studies have demonstrated caribou avoidance of linear features occurring at distances ranging from 100 – 250 m (Dyer *et al.* 2001) to 500 m (Environment Canada 2012) to less than 2 km during road construction for the Wuskwatim Generation Project (Ambrose *et al.* 2011). Mahoney and Schaefer (2002) indicated a distance of 3 km to be where the effects of sensory disturbance associated with the construction of a hydro-electric generating station no longer significantly altered migratory woodland caribou behaviours. Overall, measuring the avoidance of linear features to the nearest km may not always be the most appropriate distance scale if the range of effects is limited to the smallest distances. Detecting effects at finer distance scales in the Keeyask Local Study Area is not feasible because caribou complexes and islands are limited in number and geographic distribution.

The reduced 2013 rates of caribou calf and adult use of complexes and islands along sampled CA transects may be due to large forest fires making these areas less suitable for caribou. Similarly to the expectation that sensory disturbances can result in the loss of effective habitat for caribou, large forest fires may reduce the effectiveness of habitat areas without serving to directly physically alter them. A number of CA transects, while not removed from sampling due to forest fires, occurred within close proximity to where the fires had occurred. This included two transects within < 1 km of fires (CA001 and CA003) and another three transects < 5 km of fires (CA005, CA006 and CA007). Together, these transects accounted for five complexes and 22 islands which were likely of reduced quality for caribou calving and rearing activities relative to previous years. Future monitoring will be required to determine if these complexes and islands remain to be of reduced suitability for caribou, or if they are used again in the future.

Due to large migratory caribou movements in the KIP study area and the removal of the EA transects located < 3 km of the access road, interpretation of distance class information in proximity to the access road, has limited applicability. In addition, for the second and third visits in 2013, the number of complexes and islands in the 3 to 4 km and 4 to 5 km distance classes is far reduced compared to those available in 2011 and 2012. This limits the applicability of previously identified distance classes for use in assessing the potential impacts of KIP construction on caribou calving and rearing activity. Future sampling of complexes and islands burnt in 2013 will need to be understood in the context that these areas may no longer be suitable for caribou calving and rearing, or as suitable caribou habitat (Environment Canada 2012) and that monitoring results will no longer be directly comparable to those of 2011 and 2012.

It should be noted that other potential calving and rearing areas, aside from complexes and islands sampled as part of the KIP monitoring, are present in the KIP Regional Study Area. Other sample locations in the region include islands on lakes (e.g., Stephens Lake, Gull Lake). Based on a review of island use for caribou calving and calf-rearing, seasonal variation in use is to be expected over the long-term. Between-years variation in the use of calving and calf-rearing areas adds a degree of complexity to understanding what the average level of seasonal caribou use is for these areas.

In considering sampled occurrences of moose, adult moose were detected on 88% of complexes and 54% of islands. Although moose presence on complexes and islands was approximately equal in 2011 and 2012, moose presence in 2013 demonstrated a decrease in activity on Project Effects Area transects, while remaining relatively stable across all three years in the Reference Areas. Project clearing and construction activities may have played a role in affecting the distribution and occurrence of this species. However, it is uncertain whether construction, fire or a combination of both predominantly influenced the distribution and occurrence of this species locally. Because construction activity was halted during the fire for the majority of June and from July 3-15, the reason for this suspected occurrence and distribution is most likely fire-related.

Trail cameras deployed on potential calving islands and areas adjacent to islands did not corroborate an increase in the distribution frequency of caribou, where detections by location

declined from 9 camera sites in 2011, to 4 camera sites in 2012, and to 2 cameras in 2013. It should be noted however, that the cameras deployed in 2013 were removed in July (due to the forest fires), and the time deployed on site was not comparable to 2011 or 2012. The total number of cow observations increased on a per camera basis and may suggest increased site use at fewer locations by cows. The decrease in the number of bull observations may suggest decreased site use at fewer locations. Finally, fewer photos of black bear were recorded on the trail cameras in 2013 as compared to 2011 and 2012, potentially indicating decreased black bear activity in the area. Because very few gray wolves were detected by cameras in all study years, small changes in the number of cameras that captured images of gray wolves should not be interpreted to indicate change in the local gray wolf population. Increased caribou sign in the KIP Local Study Area may be supported by distributional shifts in predator activity or by decreased predator activity such as by black bears in the Local Study Area, as measured by trail cameras.

5.2 MOOSE AND OTHER TERRESTRIAL MAMMALS

The sampling of mammal species in proximity to the access road in 2013 indicated a similar number of species as was observed during the 2011 and 2012. However, as these transects were not sampled over the second and third visits, the number of sign for each of these species, as expected, is less for 2013 than for each of the two previous years. One notable exception to this was the quantity of caribou sign sampled in 2013 in comparison with the quantity of caribou sign sampled in 2012, for both the NNR and SNR transect types, and in 2011, for sampled SNR transects. This was due to the large influx of migratory caribou into the study area in winter 2013; leading to an increased availability of caribou sign during the first visit. This is particularly evident based on comparisons of caribou sign recorded over the first visit in 2013, which showed an approximate 400% increase from quantities of sign observed in 2011 - the pre-construction phase of the KIP.

The occurrence of large forest fires resulted in absence of sampling information for the second and third visits in 2013. However it is expected that had sampling of these transects continued under normal circumstances, sampled caribou levels would have been comparable to 2011 and 2012 levels. In addition, sampling that took over the first visit in 2013 is not representative of the

same ecological circumstances that were in place during the first visit in 2011 and 2012 and is not easily applied for understanding the ecological implications of KIP construction on mammal species. However, it should be noted that the large migratory caribou herd that moved through the KIP area during construction did not seem to be largely affected by construction activities (Section 5.3).

A comparison of species sign across the first visit includes an evaluation of a number of species which are not ordinarily sampled over the second and third visits. Tracking during the first sampling visit is often facilitated through snow conditions and increased species sign availability during this time. Accordingly, the first visit allows for relative increases in species activity to be noted, such as the increases in accumulated American marten sign from 2011 to 2013, or decreases in the sampling of snowshoe hare, which would otherwise go unnoted.

Species information recorded during the second and third visits focused exclusively on moose, caribou, black bear and gray wolf. A comparison of sampling results during the second visit, corresponding to a July/August sampling period, indicated a slight reduction in moose activity relative to the onset of KIP construction. Over the third visit, that pattern was repeated in transects north of the access road; however moose activity appeared to be substantially reduced on transects south of the access road. Although localized decreases on some transects were apparent, overall moose activity did not appear substantially altered.

Based on a review of monitoring information from the second visit, there were substantial decreases in the sampling of caribou from 2011 to 2012, which is also consistent with sampling conducted during the third visit. This trend is confirmed by numerous publications that show evidence of caribou avoiding construction effects related to anthropogenic projects (Dyer *et al.* 2001; Mahoney and Schaefer 2002; Beauchesne *et al.* 2014). Anthropogenic linear features, such as roadways and seismic lines, are often used as movement corridors for predator species, such as gray wolves and black bears which use these features to hunt species including caribou (James and Stuart-Smith, 2000; Latham *et al.* 2012; Tigner *et al.* 2014). Accordingly, woodland caribou tend to avoid anthropogenic linear features as a means of avoiding predation (James and Stuart-Smith, 2000). It has also been demonstrated that caribou select calving sites in areas with reduced road densities, possibly as a means of avoiding predator species (Leclerc *et al.* 2012). In

addition, caribou are expected to expand their home range as a means of adjusting to anthropogenic disturbance and habitat loss (Beauchesne *et al.* 2014), although this flexibility is based on alternate undisturbed boreal forest habitat areas being available.

Sampled predator levels from 2011 to 2012 indicated variable levels of change occurring, with most predator species observed on transects north of the access road. As only small quantities of predator sign are recorded, even small increases in the sampling of sign can drastically affect calculated activity levels. As large mammalian predators tend to inhabit large home range areas, the lower levels of predator activity, relative to moose and caribou, is expected. Based on a comparison of 2011 to 2012 sampling levels, there does not appear to be increased use of the KIP study area by predator species.

5.3 CARIBOU RECONNAISSANCE AERIAL SURVEY

During the January 31, 2013 aerial reconnaissance survey, 7,787 caribou in 429 clusters were observed in the KIP Regional Study Area. Group sizes ranged from one to 189 caribou, with an average group size of about 18 animals per cluster. Based on the physical appearance of caribou detected during the aerial survey, including size, colour and antler shape, all of the caribou detected were assumed to be from the Pen Islands herd. Additional data were required to corroborate this assertion because a mixture of caribou including the Cape Churchill herd and Qamanirjuaq herd (Beverly and Qamanirjuaq Caribou Management Board 2002, 2011 and 2012; Campbell 2005) could not be ruled out.

The spacing of the groups appeared to avoid the immediate construction area on the access road. Most caribou were found at distances greater than one km (perpendicular distance) from the access road. A few crossing locations were noted near the access road in a north-south direction. Some loss of effective habitat and the avoidance of roads, linear features and hydro-electric generation facilities under construction by migratory caribou is documented is well documented (James and Stuart-Smith 2000; Dyer *et al.* 2001, 2002; Mahoney and Schaefer 2002, Ambrose *et al.* 2011; Beauchesne *et al.*, 2014).

Ten caribou ice crossing locations were recorded over continuous ice conditions between Birthday Rapids and Gull Lake during the reconnaissance survey. Discontinuous ice, open water and ice jams that continued approximately one km east of Birthday Rapids may have impeded

caribou movements across the Nelson River, as no tracks crossing the river in this geographic area were observed.

Because thousands of widely scattered caribou were observed throughout the Keeyask area during the January 31, 2014 aerial reconnaissance survey, a more comprehensive aerial survey was warranted. Caribou density and abundance were not estimated as distance to cluster was not estimated during the reconnaissance survey. The more comprehensive aerial survey for caribou was conducted from February 5 to 8, 2014.

5.4 CARIBOU AERIAL SURVEYS

The systematic aerial survey for caribou in early February, 2013 provided a population estimate of 13,985 (± 18.17%, 95% CI) caribou in the Keeyask area, as well as indicators to assess confidence in estimated population size. It is worth noting however, that the effect of caribou moving away from the observers might have negatively biased our estimates, though this effect was probably minimal (Buckland *et al.* 2001).

Based on the physical appearance of caribou detected during the aerial survey, including size, colour and antler shape, all of the caribou detected were assumed to be from the Pen Islands herd, though some individuals, especially those north of PR 280, may have been from other herds (i.e., Cape Churchill herd, Qamanirjuaq herd). Other corroborative evidence tends to support this assertion. Up to seven radio-collared Pen Islands caribou were located in Study Zone 5 at the time of the survey (V. Trim, Pers. Comm.). Based on radio-collaring of individuals in the Cape Churchill herd at this time, representative animals from this group were in their traditional range and outside of the survey area (V. Trim, Pers. Comm.); as such, the presence of Cape Churchill coastal caribou was unlikely. Based on the lack of track evidence observed in the northern fringe of the survey area, it is unlikely that Qamanirjuaq animals were present. DNA analysis of 74 caribou faecal samples collected in the Keeyask area on Feb 9, 2013 confirmed that the dominant origins of the caribou reported in the study area at this time was the Pen Islands herd.

Although the survey does not assume that all of the caribou in the Pen Islands herd were in the surveyed area, the abundance estimate surpasses the minimum population size of 10,800 estimated for the Pen Islands herd in 1994 (Thompson and Abraham 1994; Abraham and

Thompson 1998; Abraham *et al.* 2012) by approximately 30%. Although the current estimate is only accurate within 18.17% (95% CI), this estimate is close to the population estimate of approximately 16,600 Pen Islands caribou made by provincial wildlife managers in 2012 (G. Racey, Pers. Comm.), although the differences are not statistically comparable as the provincial estimate does not include confidence limits for the unpublished data. Caribou numbers estimated during this survey would likely have included minor additions from individuals referred to as summer resident caribou.

The assumptions of distance sampling (Buckland *et al.* 2001) were reasonably met. Because the estimated detection probability at g(0) was 1.0, the assumption that all animals on or near the transect line were detected was met. The assumption that caribou did not move in response to the observer was relaxed; caribou were observed moving away from the aircraft during the survey, however transect lines were spaced sufficiently apart (2 km) so that animals that did move were not likely to be counted again on subsequent transect lines (Guenzel 1994). A negative bias in density estimates is expected in distance sampling if animals move away from the observer prior to being detected (Buckland *et al.* 2001). By having the observers look well ahead and by taking perpendicular measurements to caribou clusters from the original position of the clusters, detections occurred beyond the likely range of the effect of the observer, thus keeping negative bias in the density estimate to a minimum (Buckland *et al.* 2001). Furthermore, an examination of our distance data histogram did not detect evasive movements by caribou (Buckland *et al.* 2001). By grouping perpendicular distances into intervals, the assumption that distance measurements were exact was relaxed. However, line transect distance sampling models remain robust when observations are assigned to distance intervals (Buckland *et al.* 2001).

All distance-sampling models gave results with large, overlapping confidence intervals. The relatively low amount of variability between model estimates indicated good survey design and data collection (Buckland *et al.* 2001). Although three models demonstrated greater accuracy in abundance estimates (small %CVs), these models were rejected due to higher AIC values, and poor model fit. Although there was high model selection uncertainty (ΔAIC <2; Anderson *et al.* 1998) between the two top models, better model fit and lower %CV indicated that the half-normal model with a cosine adjustment term was the best model with the least bias associated with density and abundance estimates. Additionally, estimates from the averaged model were

rejected based on a very high %CV that was above the ±25% recommended for management studies (Robson and Regier 1964).

Abundance may be over-estimated if animals move ahead of the observer and are double-counted (Buckland *et al.* 2001). During the survey, some clusters of caribou responded to the observers with evasive movements away from the aircraft. However, evasive movements appeared to end quickly once the aircraft was moving away from them. Double-counting may have occurred while surveying the longest transects, however, it is unlikely that this occurred on shorter lines as these caribou would have to be moving at consistently high speeds, often through dense forested areas and deep snow conditions, in order to be counted twice. Furthermore, the distribution and abundance of cratering sites throughout the survey area indicate that caribou were not moving rapidly, but rather that these animals were searching periodically for food resources and could have remained in certain areas for extended periods of time. Caribou may have also been double-counted from one day to the next, although, this is unlikely as the survey was conducted in an overall east to west direction and caribou were predominately moving in a north-easterly to easterly direction. If some double-counting occurred during the survey, this would have over-estimated density and therefore, the abundance estimates. As repeated double-counting was probably not common, this bias is likely to be small (Buckland *et al.* 2001). Although speculative, small positive bias from double-counting and small negative bias from caribou moving away from the observer (Buckland *et al.* 2001) may have somewhat cancelled each other out, although this cannot be quantified.

Although the large caribou migration into the Keeyask area is atypical, it is not particularly surprising considering the general irruptive, dynamic, and unpredictable movement patterns of migratory caribou (Banfield 1955; Miller 2003). Pen Islands caribou use substantially different areas from year to year. For example, in 1987/1988, the Pen Islands herd spanned the Manitoba/Ontario border throughout the autumn and winter; in 1988-89, they congregated in Manitoba during the fall, shifted into Ontario in November, and returned to Manitoba in December through late winter; in 1989-90, they moved from Manitoba to Ontario in December though late winter (Abraham and Thompson 1998). Abraham and Thompson (1998) concluded that Pen Islands caribou showed a complex movement and habitat use pattern that varied among months and years. Furthermore, a survey of the KIP area in 2011, using the same techniques

employed in 2013, resulted in zero caribou observations (Keeyask Hydropower Limited Partnership 2012a).

Aerial surveys such as these are important for monitoring the potential effects of caribou abundance, distribution and habitat use relative to the construction and operation of roads and future generating stations. Secondly, monitoring activities that detect change is an important tool that can be used to apply short-term and long-term adaptive management measures. Finally, the presence of large numbers of migratory caribou in winter may also play role for calving habitat use during subsequent summers, and in part, could explain some of the large summer resident variability between years. For example, Manitoba Hydro (2011 and 2012) reported large numbers of caribou in the Conawapa area during the winter of 2010-11 as compared to winter 2009-10. High caribou use of peatland complexes and islands use was subsequently reported in summer 2011 (Keeyask Hydropower Limited Partnership 2013). Although local declines of caribou calving activities in summer 2012 may be construction related, overall regional declines also coincided with an absence of Pen Islands caribou in the area during the 2011-12 winter (Keeyask Hydropower Limited Partnership 2012b). If Pen Islands caribou abundance in winter can influence summer resident caribou use of the area in the following summer, then regional occurrences should predictably increase in spring and possibly summer 2013, based on a large influx of animals. Long-term monitoring, broader regional monitoring and radio-collaring would be required to corroborate this hypothesis.

During distance sampling transect surveys, seven ice crossings between Birthday Rapids and Gull Rapids, 14 ice crossings on Stephens Lake between Gull Rapids and Gillam, and five ice crossings on the north arm of Stephens Lake were detected in addition to the KIP reconnaissance survey. Ice conditions at the time likely affected caribou movements across frozen water bodies. Miller and Gunn (1986) observed some barren-ground caribou sniffing the edge of thin ice and returning into the forest after attempting to cross thin ice on lakes in the Northwest Territories. Fox Lake Cree Nation (FLCN) elders indicated that caribou drowning events in the Nelson River and Stephens Lake were related to unsafe ice conditions in hydroelectric reservoirs and changes in water level (FLCN 2010). Furthermore, one FLCN Member indicated that when thousands of barren ground caribou crossed PR 280 and moved towards Stephens Lake, they could not cross the lake as it was not safe to cross (FLCN 2010). Thus, ice conditions, especially near Birthday

and Gull Rapids, likely contributed to the distribution of caribou ice crossing sites on the Nelson River and Stephens Lake. Finally, movements across Stephens Lake occurred at distances greater than 3 km west of the edge of the town of Gillam. Based on the distribution of the caribou observed at ice crossing sites, sensory disturbances from the town (i.e., noise, vibrations, smells, lights or other factors) may have contributed to caribou crossing Stephens Lake at certain locations and avoiding the community.

5.5 DEN SURVEYS

As stated in the *KIP Terrestrial and Aquatic Monitoring Plan*, two important large mammal species (black bear and gray wolf) require dens for the birthing and rearing of young, and in the case of black bears, for torpor during the winter months. Dens are considered important and possibly critical to the life requisites for black bear and because of this, black bear den searches were completed in Project footprint areas scheduled for planned winter clearing in 2014.

Of the areas selected for haul roads, quarries, deposit sites and planned clearing areas near the access road and the 12 areas searched for bear activity, two (PCA7 and NCZ1) were located in upland habitat areas. These site types appeared to be suitable for potential black bear denning. Additionally, PCA7 contained larger and more established trees. Although it is possible that black bears could potentially den in these areas, all of these sites were located in close proximity to established construction activities and an active access road. With nearby construction activities, the possibility of a bear denning amongst these disturbances was low. The 10 areas that were located mostly in lowland topography were dominated by black spruce and tamarack on peatland. Because six of 10 sites were also located on islands in the Nelson River, the overall suitability of these sites as potential black bear denning habitat was considered very low.

Based on the overall findings, it was determined to be highly unlikely that black bears were denning in the surveyed areas.

6.0 CONCLUSION

The third year of studies identified in the *Keeyask Infrastructure Project Terrestrial and Aquatic Monitoring Plan* was completed in 2013. Based on 2013 monitoring activities, it is unclear if there was a change in the use of complexes and islands by caribou for calving and rearing activities based on clearing and construction activities alone. This is largely due to the fact that sampled complexes and islands in the Reference Areas, Project Effects Areas, and Road Reference transects also demonstrated a pronounced increase in caribou activity in 2013. Increased caribou sign on study areas in 2013 indicates regional and/or seasonal fluctuations in caribou activity, and is further complicated by the summer forest fires that occurred in the KIP area; therefore, additional data and analyses are required.

The identification of trends in calving and rearing activity in the KIP study area, as affected through construction of the access road, is limited based on the occurrence of forest fires which limited the number of complexes and islands available for sampling in 2013. In particular, the removal of complexes and islands within 3 km of where the access road is located limits the ability to compare the 2013 sampling year with the 2011 and 2012 sampling years, in which an increased number of complexes and islands were sampled.

It remains to be determined if the summer 2013 forest fires will have a lasting impact on habitat use in the KIP study area, particularly as it relates to caribou activity on calving and rearing complexes. It is expected that most species displaced by the 2013 forest fires will select alternate habitat areas, some of which may be located along sampled transects located elsewhere in the study area. This could include sampled Road Reference lines which are widely dispersed throughout the region. Future sampling of the KIP study area will also reveal the extent to which calving complexes and islands burnt, as these areas are wetter in nature and less susceptible to complete destruction as compared to dryer areas located at increased elevations.

The caribou aerial survey demonstrated a cost and time effective survey technique that provided a reasonably accurate population estimate of caribou in the Keeyask area in early February, 2013. Genetic analysis of caribou faecal samples collected in the Keeyask area further

corroborated professional judgement that the dominant origin of the caribou reported in the study area was the Pen Islands caribou herd.

No black bear dens were found in search areas covering the access road, borrow areas, start-up camp and the main camp site in 2013. With increased construction activities occurring along the access road, it is increasingly unlikely that black bear denning will take place in the Local Study Area. Suitable alternate black bear denning habitat is available elsewhere in the region, and because black bears are adaptable, animals are expected to move to these habitats during the construction period.

7.0 RECOMMENDATIONS

As this is the third year of monitoring during the construction phase of the Keeyask Infrastructure Project, which was designed to detect changes in caribou activity in the Local and Region Study Areas over time, it is recommended that monitoring efforts continue as outlined in the *KIP Terrestrial and Aquatic Monitoring Plan*.

Forest fires in summer 2013 will have a lasting impact on habitat use in the KIP study area, particularly as it relates to caribou activity on calving and rearing complexes. It is expected that most species displaced by the 2013 forest fires will select alternate habitat areas, some of which may be located along sampled transects located elsewhere in the study area. As it will be important to distinguish between the potential effects of burns versus ongoing KIP construction activities, ground monitoring efforts should continue. Of particular importance for future monitoring efforts is to identify which calving and rearing complexes burned and how severely caribou habitat was affected in the local and regional study areas.

It is recommended that den surveys continue as a means of avoiding potential Project-related effects on gray wolf and black bear for those areas yet to be cleared. It should be noted that the optimal time for black bear den searches is in late autumn, and as such, pre-clearing bear den surveys should coincide with this time period.

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TABLES

Table 1. Total sign observations per species, and sign composition on caribou calving island transects in 2011, 2012, and 2013 over all three visits.

	Number of Sign Identified in 2011						Number of Sign Identified in 2012						Number of sign identified in 2013					
Species	**M**	**F**	**UA**	**J**	**U**	**Total**	**M**	**F**	**UA**	**J**	**U**	**Total**	**M**	**F**	**UA**	**J**	**U**	**Total**
American marten	0	0	1	0	13	14	0	0	36	0	34	70	0	0	231	0	373	604
Beaver	0	0	1	0	1	2	0	0	0	0	1	1	0	0	0	0	1	1
Black bear	0	0	35	1	1	37	8	4	43	4	66	125	7	0	33	1	1	42
Caribou	70	168	2,074	132	1,085	3,529	70	142	250	99	306	867	13	18	3,229	109	2,213	5,582
Ermine	0	0	0	0	0	0	0	0	0	0	1	1	0	0	3	0	9	12
Fisher	0	0	1	0	4	5	0	0	2	0	0	2	0	0	2	0	10	12
Gray wolf	0	0	12	1	9	22	0	0	25	0	7	32	0	0	25	0	3	28
Lynx	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	1	4	7
Mink	0	0	1	0	3	4	0	0	3	0	2	5	0	0	32	0	33	65
Moose	261	423	1,495	141	713	3,033	117	120	576	214	183	1,210	77	56	1,785	204	133	2,255
Muskrat	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Red fox	0	0	4	0	3	7	0	0	40	0	19	59	0	0	46	0	17	63
Red squirrel	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
River otter	0	0	4	0	8	12	0	0	3	0	0	3	0	0	38	0	21	59
Snowshoe hare	0	0	0	0	46	46	0	0	3	0	3	6	0	0	1	0	0	1
Wolverine	0	0	8	0	0	8	0	0	10	0	0	10	0	0	3	0	4	7

Note: M = Male, F = Female, UA = Unknown adult, J = Juvenile, U = Unknown.

Table 2. Distribution of tracking transects and number of caribou sign observations across three monitoring types in 2011, 2012, and 2013 over all three visits.

Year	Transect Type	Number of Complexes	Number of Complexes with Caribou Sign	% of Complexes with Caribou Sign	Number of Islands	Number of Islands with Caribou Sign	% of Islands with Caribou Sign	Number of Transects	Total Transect Length (km)	Total number of Caribou Sign	Number of Caribou Sign per km Surveyed
2011	Reference Area	12	12	100%	80	65	81%	16	261	768	2.94
	Project Effects Area	17	17	100%	60	48	80%	21	243	689	2.84
	Road Reference Area	17	17	100%	190	153	81%	209	618	2,072	3.35
	TOTAL	*46*	*46*	*100%*	*330*	*266*	*81%*	*246*	*1,122*	*3,529*	*3.15*
2012	Reference Area	12	11	92%	80	50	63%	16	261	260	1.00
	Project Effects Area	21	17	81%	72	37	51%	25	271	176	0.65
	Road Reference Area	17	14	82%	190	88	46%	211	554	431	0.78
	TOTAL	*50*	*42*	*84%*	*342*	*175*	*51%*	*252*	*1,086*	*867*	*0.80*
2013	Reference Area	12	12	100%	80	78	98%	16	186	1,449	7.79
	Project Effects Area	21	20	95%	72	70	97%	25	124	1,117	9.01
	Road Reference Area	17	16	94%	190	179	93%	211	516	3,016	5.84
	TOTAL	*50*	*48*	*96%*	*342*	*327*	*96%*	*252*	*826*	*5,582*	*6.76*

Table 3. Number of adult and juvenile sign on virtual complexes and virtual islands for caribou calving island monitoring 2011, 2012, and 2013 over all three visits.

Year	Transect Type	Number of Complexes with Adult Caribou Sign	Number of Complexes with Caribou Calf Sign	% of Complexes with Adult Caribou Sign	% of Complexes with Caribou Calf Sign	Number of Islands With Adult Caribou Sign	Number of Islands with Caribou Calf Sign	% of Islands with Adult Caribou Sign	% of Islands with Caribou Calf Sign
2011	Reference Area	12	10	100%	83%	61	16	76%	20%
	Project Effects Area	16	9	94%	53%	42	10	70%	17%
	Road Reference Area	16	8	94%	47%	124	21	65%	11%
	TOTAL	*44*	*27*	*98%*	*59%*	*227*	*47*	*69%*	*14%*
2012	Reference Area	10	7	83%	58%	50	9	63%	11%
	Project Effects Area	13	8	62%	38%	35	7	49%	10%
	Road Reference Area	11	8	65%	47%	80	24	39%	12%
	TOTAL	*34*	*23*	*68%*	*46%*	*165*	*40*	*48%*	*12%*
2013	Reference Area	12	2	100%	17%	69	10	86%	13%
	Project Effects Area	20	4	95%	19%	56	6	78%	8%
	Road Reference Area	16	10	94%	59%	164	43	86%	23%
	TOTAL	*48*	*16*	*96%*	*32%*	*275*	*60*	*80%*	*17%*

Table 4. Total numbers of caribou, moose, black bear and gray wolf sign on caribou calving island transects in 2011, 2012, and 2013 over all three visits.

Year	Transect Type	Caribou	Moose	Black bear	Gray wolf
2011	Reference Area	768	865	20	9
	Project Effects Area	689	658	1	4
	Road Reference	2,072	1,510	16	9
	Total	*3,529*	*3,033*	*37*	*22*
2012	Reference Area	260	568	11	2
	Project Effects Area	176	496	17	19
	Road Reference	431	1,146	37	11
	Total	*867*	*2,210*	*65*	*32*
2013	Reference Area	1,449	559	9	3
	Project Effects Area	1,117	386	2	7
	Road Reference	3,016	1,310	31	18
	Total	*5,582*	*2,225*	*42*	*28*

Table 5. Distribution of moose sign observations across three monitoring areas in complexes and calving islands in 2011, 2012, and 2013.

Year	Habitat Type	Area Type	Surveyed *n*	Total Sign Observed	Adult *n*	Adult %	Calf *n*	Calf %
2011	Peatland Complex	Reference Area	12	768	12	100%	7	58%
		Project Effects Area	17	689	17	100%	8	47%
		Road Reference Area	17	2,072	17	100%	7	41%
		Total	*46*	*3,529*	*46*	100%	*22*	*48%*
	Habitat Island	Reference Area	80	354	61	76%	16	20%
		Project Effects Area	60	395	42	70%	10	17%
		Road Reference Area	190	1,714	124	65%	21	11%
		Total	*330*	*2,523*	*227*	*69%*	*47*	*14%*
2012	Peatland Complex	Reference Area	12	568	12	100%	10	83%
		Project Effects Area	21	496	21	100%	17	81%
		Road Reference Area	17	1,146	17	100%	11	65%
		Total	*50*	*2,210*	*50*	*100%*	*38*	*76%*
	Habitat Island	Reference Area	80	303	61	76%	16	20%
		Project Effects Area	72	313	55	76%	24	33%
		Road Reference Area	190	1,026	142	75%	40	21%
		Total	*342*	*1,642*	*258*	*67%*	*80*	*23%*
2013	Peatland Complex	Reference Area	12	386	12	100%	8	67%
		Project Effects Area	21	124	16	76%	5	24%
		Road Reference Area	17	1,310	16	94%	14	82%
		Total	*50*	*668*	*44*	88%	*27*	54%
	Habitat Island	Reference Area	80	236	48	60%	17	21%
		Project Effects Area	72	262	27	38%	9	13%
		Road Reference Area	190	1,089	160	84%	61	32%
		Total	*342*	*1,587*	*235*	*69%*	*87*	*25%*

Table 6. Number of peatland complexes and habitat islands where caribou adult and calf sign were observed based on distance classes associated with the distance of Project Effects Area and Reference Area transects from the Access Road.

Year	Distance From Road	Peatland Complexes							Habitat Islands						
		Total	Caribou		Adult Caribou		Calf Caribou		Total	Caribou		Adult Caribou		Calf Caribou	
		#	#	%	#	%	#	%	#	#	%	#	%	#	%
2011	0 to 1 km	4	4	100%	3	75%	3	75%	10	6	60%	5	50%	1	10%
	1 to 2 km	3	3	100%	3	100%	2	67%	12	9	75%	6	50%	3	25%
	2 to 3 km	1	1	100%	1	100%	0	0%	3	3	100%	3	100%	0	0%
	3 to 4 km	4	4	100%	4	100%	1	25%	14	13	93%	12	86%	1	7%
	4 to 5 km	3	3	100%	3	100%	0	0%	18	14	78%	13	72%	4	22%
	5+ km	14	14	100%	14	100%	8	57%	83	68	82%	64	77%	17	20%
	TOTAL	29	29	100%	28	97%	14	48%	140	113	81%	103	74%	26	19%
2012	0 to 1 km	4	1	25%	1	25%	1	25%	10	1	10%	1	10%	0	0%
	1 to 2 km	3	2	67%	2	67%	1	33%	12	4	33%	3	25%	2	17%
	2 to 3 km	1	0	0%	0	0%	0	0%	3	2	67%	2	67%	0	0%
	3 to 4 km	4	3	75%	3	75%	1	25%	14	9	64%	9	64%	2	14%
	4 to 5 km	3	2	67%	2	67%	1	33%	18	12	67%	11	61%	2	11%
	5+ km	18	13	72%	13	72%	4	22%	95	59	62%	59	62%	10	11%
	TOTAL	33	21	64%	21	64%	8	24%	152	87	57%	85	56%	16	11%
2013	0 to 1 km	4	4	100%	4	100%	0	0%	10	9	90%	9	90%	0	0%
	1 to 2 km	3	3	100%	3	100%	0	0%	12	10	83%	10	83%	0	0%
	2 to 3 km	1	1	100%	1	100%	0	0%	3	2	67%	2	67%	0	0%
	3 to 4 km	4	4	100%	4	100%	1	25%	14	13	93%	13	93%	1	7%
	4 to 5 km	3	3	100%	3	100%	0	0%	18	11	61%	11	61%	2	11%
	5+ km	18	16	89%	16	89%	5	28%	95	78	82%	78	82%	11	12%
	TOTAL	33	31	94%	31	94%	6	18%	152	123	81%	123	81%	14	9%

Table 7. Number of peatland complexes and habitat islands where caribou adult and calf sign were observed based on distance classes associated with the distance of Road Reference transects from PR 280.

Year	Distance From PR 280	Peatland Complexes							Habitat Islands						
		Total	Caribou		Adult Caribou		Calf Caribou		Total	Caribou		Adult Caribou		Calf Caribou	
		#	#	%	#	%	#	%	#	#	%	#	%	#	%
2011	0 to 1 km	3	3	100%	3	100%	1	33%	41	33	80%	25	61%	2	5%
	1 to 2 km	6	6	100%	5	83%	4	67%	63	48	76%	38	60%	4	6%
	2 to 3* km	0	0	NA	0	NA	0	NA	42	31	74%	29	69%	8	19%
	3 to 4 km	4	3	75%	2	50%	0	0%	13	13	100%	10	77%	2	15%
	4 to 5 km	1	1	100%	1	100%	1	100%	10	10	100%	7	70%	3	30%
	5+ km	3	3	100%	2	67%	0	0%	21	18	86%	15	71%	2	10%
	TOTAL	17	16	94%	0	0%	6	35%	190	153	81%	124	65%	21	11%
2012	0 to 1 km	3	2	67%	2	67%	1	33%	42	23	55%	18	43%	8	19%
	1 to 2 km	6	5	83%	5	83%	2	33%	64	28	44%	28	44%	4	6%
	2 to 3* km	0	0	NA	0	NA	0	NA	42	17	40%	15	36%	5	12%
	3 to 4 km	4	0	0%	0	0%	0	0%	13	5	38%	4	31%	2	15%
	4 to 5 km	1	0	0%	0	0%	0	0%	10	4	40%	4	40%	2	20%
	5+ km	3	3	100%	3	100%	1	33%	21	11	52%	11	52%	3	14%
	TOTAL	17	10	59%	10	59%	4	24%	192	88	46%	80	42%	24	13%
2013	0 to 1 km	3	3	100%	3	100%	2	67%	42	32	76%	26	62%	2	5%
	1 to 2 km	6	6	100%	6	100%	4	67%	64	60	94%	56	88%	18	28%
	2 to 3* km	0	0	NA	0	NA	0	NA	42	34	81%	30	71%	6	14%
	3 to 4 km	4	3	75%	3	75%	1	25%	13	11	85%	10	77%	2	15%
	4 to 5 km	1	1	100%	1	100%	0	0%	10	10	100%	10	100%	2	20%
	5+ km	3	3	100%	3	100%	3	100%	21	19	90%	19	90%	8	38%
	TOTAL	17	16	94%	16	94%	10	59%	192	166	86%	151	79%	38	20%

*Centroid of complex was located outside this distance; however this distance does contain islands.

Table 8. Total numbers of caribou, moose, black bear and gray wolf sign on caribou calving island transects in 2011, 2012, and 2013 during the first visit.

Year	Transect Type	Caribou			Moose			Black bear			Gray wolf		
		1st Visit	All Visits	%	1st Visit	All Visits	%	1st Visit	All Visits	%	1st Visit	All Visits	%
2011	Reference Area	208	768	27%	233	865	27%	3	20	15%	2	9	22%
	Project Effects Area	158	689	23%	226	658	34%	1	1	100%	0	4	0%
	Road Reference Area	1,273	2,072	61%	613	1,510	41%	0	16	0%	7	9	78%
	Total	*1,639*	*3,529*	*46%*	*1,072*	*3,033*	*35%*	*4*	*37*	*11%*	*9*	*22*	*41%*
2012	Reference Area	7	260	3%	63	568	11%	0	11	0%	1	2	50%
	Project Effects Area	0	176	0%	59	496	12%	0	17	0%	16	19	84%
	Road Reference Area	7	431	2%	120	1,146	10%	0	37	0%	5	11	45%
	Total	*14*	*867*	*2%*	*242*	*2,210*	*11%*	*0*	*65*	*0%*	*22*	*32*	*69%*
2013	Reference Area	879	1,449	61%	48	559	9%	1	9	11%	0	3	0%
	Project Effects Area	919	1,117	82%	62	386	16%	1	2	50%	3	7	43%
	Road Reference Area	1,422	3,016	47%	192	1,310	15%	0	31	0%	2	18	11%
	Total	*3,220*	*5,582*	*58%*	*302*	*2,225*	*14%*	*2*	*42*	*5%*	*5*	*28*	*18%*

Table 9. Distribution of tracking transects and number of caribou sign observations across three monitoring types in 2011, 2012, and 2013 during the second visit.

Year	Transect Type	Number of Complexes	Number of Complexes with Caribou Sign	% of Complexes with Caribou Sign	Number of Islands	Number of Islands with Caribou Sign	% of Islands with Caribou Sign	Number of Transects	Total Transect Length (km)	Total number of Caribou Sign	Number of Caribou Sign per km Surveyed
2011	Reference Area	12	12	100%	80	46	58%	16	77.3	167	2.16
	Project Effects Area	17	16	94%	59	36	61%	21	68.6	162	2.36
	Road Reference Area	17	12	71%	190	75	39%	209	191.1	367	1.92
	TOTAL	*46*	*40*	*87%*	*329*	*157*	*48%*	*246*	*336.9*	*696*	*2.07*
2012	Reference Area	12	9	75%	80	32	40%	16	76.7	116	1.51
	Project Effects Area	20	10	50%	66	19	29%	24	75.5	87	1.15
	Road Reference Area	15	10	67%	163	53	33%	178	172.1	230	1.34
	TOTAL	*47*	*29*	*62%*	*309*	*104*	34%	*218*	*324.3*	*433*	*1.34*
2013	Reference Area	10	9	90%	56	38	68%	11	56.8	399	7.02
	Project Effects Area	7	5	71%	23	14	61%	9	24.3	96	3.95
	Road Reference Area	17	14	82%	173	127	73%	193	165.4	1,092	6.60
	TOTAL	*34*	*28*	82%	*252*	*179*	71%	*213*	*246.5*	*1,587*	*6.44*

Table 10. Number of adult and juvenile sign on virtual complexes and virtual islands for caribou calving island monitoring 2011, 2012, and 2013 during the second visit.

Year	Transect Type	Number of Complexes with Adult Caribou Sign	Number of Complexes with Caribou Calf Sign	% of Complexes with Adult Caribou Sign	% of Complexes with Caribou Calf Sign	Number of Islands With Adult Caribou Sign	Number of Islands with Caribou Calf Sign	% of Islands with Adult Caribou Sign	% of Islands with Caribou Calf Sign
2011	Reference Area	12	9	100%	42%	46	12	58%	15%
	Project Effects Area	16	8	94%	18%	36	9	61%	15%
	Road Reference Area	12	5	71%	24%	75	5	39%	3%
	TOTAL	*40*	*22*	87%	26%	*157*	*26*	48%	8%
2012	Reference Area	9	5	75%	58%	32	6	40%	8%
	Project Effects Area	10	3	50%	38%	19	3	29%	5%
	Road Reference Area	10	8	67%	53%	53	21	33%	13%
	TOTAL	*29*	*21*	62%	48%	*104*	*30*	34%	10%
2013	Reference Area	9	2	90%	20%	38	8	68%	14%
	Project Effects Area	5	3	71%	43%	14	4	61%	17%
	Road Reference Area	14	8	82%	47%	126	31	73%	18%
	TOTAL	*28*	*13*	82%	38%	*178*	*43*	71%	17%

Table 11. Total numbers of caribou, moose, black bear and gray wolf sign on caribou calving island transects in 2011, 2012, and 2013 during the second visit.

Year	Transect Type	Caribou	Moose	Black bear	Gray wolf
2011	Reference Area	167	444	5	2
	Project Effects Area	162	217	0	0
	Road Reference Area	367	530	3	4
	Total	*696*	*1,170*	*8*	*6*
2012	Reference Area	116	216	6	0
	Project Effects Area	87	159	6	0
	Road Reference Area	230	509	24	4
	Total	*433*	*884*	*36*	*4*
2013	Reference Area	399	303	7	3
	Project Effects Area	96	180	1	2
	Road Reference Area	1,092	662	28	3
	Total	*1,587*	*1,145*	*36*	*8*

Table 12. Distribution of moose sign observations across three monitoring areas in complexes and calving islands in 2011, 2012, and 2013 during the second visit.

Year	Habitat Type	Area Type	Surveyed *n*	Total Sign Observed	Adult *n*	Adult %	Calf *n*	Calf %
2011	Peatland Complex	Reference Area	12	444	11	92%	6	50%
		Project Effects Area	17	217	16	94%	6	35%
		Road Reference Area	17	509	17	100%	7	41%
		Total	*46*	*1170*	*44*	*96%*	*19*	*41%*
	Habitat Island	Reference Area	80	212	50	63%	13	16%
		Project Effects Area	59	113	34	58%	11	19%
		Road Reference Area	190	397	108	57%	17	9%
		Total	*329*	*722*	*192*	*58%*	*41*	*12%*
2012	Peatland Complex	Reference Area	12	216	11	92%	6	50%
		Project Effects Area	20	159	18	90%	10	50%
		Road Reference Area	15	509	15	100%	9	60%
		Total	*47*	*884*	*44*	94%	*25*	*53%*
	Habitat Island	Reference Area	80	108	37	46%	8	10%
		Project Effects Area	66	94	32	48%	10	15%
		Road Reference Area	163	448	106	65%	28	17%
		Total	*309*	*650*	*175*	57%	*46*	*15%*
2013	Peatland Complex	Reference Area	10	303	10	100%	6	60%
		Project Effects Area	7	180	6	86%	4	57%
		Road Reference Area	17	662	14	82%	10	59%
		Total	*34*	*1145*	*30*	*88%*	*20*	*59%*
	Habitat Island	Reference Area	56	96	30	54%	13	23%
		Project Effects Area	23	103	19	83%	5	22%
		Road Reference Area	173	555	106	61%	41	24%
		Total	*252*	*754*	*155*	*62%*	*59*	*23%*

Table 13. Number of peatland complexes and habitat islands where caribou adult and calf sign were observed based on distance classes associated with the distance of Project Effects Area and Reference Area transects from the Access Road during the second visit.

Year	Distance From Road	Peatland Complexes							Habitat Islands						
		Total	Caribou		Adult Caribou		Calf Caribou		Total	Caribou		Adult Caribou		Calf Caribou	
		#	#	%	#	%	#	%	#	#	%	#	%	#	%
2011	0 to 1 km	4	3	75%	3	75%	3	75%	10	4	40%	4	40%	1	10%
	1 to 2 km	3	3	100%	3	100%	2	67%	12	6	50%	6	50%	3	25%
	2 to 3 km	1	1	100%	1	100%	0	0%	3	3	100%	3	100%	0	0%
	3 to 4 km	4	4	100%	4	100%	1	25%	13	10	77%	10	77%	1	8%
	4 to 5 km	3	3	100%	3	100%	1	33%	18	11	61%	11	61%	3	17%
	5+ km	14	14	100%	14	100%	10	71%	83	48	58%	48	58%	13	16%
	TOTAL	29	28	97%	28	97%	17	59%	139	82	59%	82	59%	19	14%
2012	0 to 1 km	4	1	25%	1	25%	0	0%	10	1	10%	1	10%	0	0%
	1 to 2 km	3	1	33%	1	33%	1	33%	12	0	0%	0	0%	0	0%
	2 to 3 km	1	0	0%	0	0%	0	0%	3	0	0%	0	0%	0	0%
	3 to 4 km	4	2	50%	2	50%	2	50%	14	4	29%	4	29%	2	14%
	4 to 5 km	2	1	50%	1	50%	0	0%	12	8	67%	8	67%	1	8%
	5+ km	18	14	78%	14	78%	5	28%	95	38	40%	38	40%	6	6%
	TOTAL	32	19	59%	19	59%	8	25%	146	51	35%	51	35%	9	6%
2013	0 to 1 km	0	0	NA	0	NA	0	NA	0	0	NA	0	NA	0	NA
	1 to 2 km	0	0	NA	0	NA	0	NA	0	0	NA	0	NA	0	NA
	2 to 3 km	0	0	NA	0	NA	0	NA	0	0	NA	0	NA	0	NA
	3 to 4 km	1	1	100%	1	100%	0	0%	3	0	0%	0	0%	0	0%
	4 to 5 km	1	1	100%	1	100%	0	0%	8	5	63%	5	63%	1	13%
	5+ km	15	12	80%	12	80%	5	33%	68	47	69%	47	69%	11	16%
	TOTAL	17	14	82%	14	82%	5	29%	79	52	66%	52	66%	12	15%

Table 14. Number of peatland complexes and habitat islands where caribou adult and calf sign were observed based on distance classes associated with the distance of Road Reference transects from PR 280 during the second visit.

Year	Distance From PR 280	Peatland Complexes							Habitat Islands						
		Total	Caribou		Adult Caribou		Calf Caribou		Total	Caribou		Adult Caribou		Calf Caribou	
		#	#	%	#	%	#	%	#	#	%	#	%	#	%
2011	0 to 1 km	3	3	100%	3	100%	1	33%	41	16	39%	16	39%	0	0%
	1 to 2 km	6	3	50%	3	50%	2	33%	63	21	33%	21	33%	1	2%
	2 to 3* km	0	0	NA	0	NA	0	NA	42	19	45%	19	45%	2	5%
	3 to 4 km	4	2	50%	2	50%	0	0%	13	8	62%	8	62%	0	0%
	4 to 5 km	1	1	100%	1	100%	0	0%	10	4	40%	4	40%	1	10%
	5+ km	3	3	100%	3	100%	2	67%	21	7	33%	7	33%	1	5%
	TOTAL	17	12	71%	12	71%	5	29%	190	75	39%	75	39%	5	3%
2012	0 to 1 km	3	2	67%	2	67%	2	67%	36	18	50%	12	33%	8	22%
	1 to 2 km	6	4	67%	4	67%	4	67%	58	19	33%	19	33%	4	7%
	2 to 3* km	0	0	NA	0	NA	0	NA	34	10	29%	8	24%	4	12%
	3 to 4 km	3	1	33%	1	33%	0	0%	11	3	27%	3	27%	0	0%
	4 to 5 km	0	0	NA	0	NA	0	NA	6	4	67%	3	50%	2	33%
	5+ km	3	3	100%	3	100%	2	67%	18	8	44%	8	44%	3	17%
	TOTAL	15	10	67%	10	67%	8	53%	163	62	38%	53	33%	21	13%
2013	0 to 1 km	3	2	67%	2	67%	1	33%	30	19	63%	19	63%	1	3%
	1 to 2 km	6	5	83%	5	83%	1	17%	63	48	76%	48	76%	15	24%
	2 to 3* km	0	0	NA	0	NA	0	NA	37	28	76%	27	73%	5	14%
	3 to 4 km	4	3	75%	3	75%	1	25%	12	9	75%	9	75%	1	8%
	4 to 5 km	1	1	100%	1	100%	0	0%	10	10	100%	10	100%	1	10%
	5+ km	3	3	100%	3	100%	2	67%	21	13	62%	13	62%	8	38%
	TOTAL	17	14	82%	14	82%	5	29%	173	127	73%	126	73%	31	18%

*Centroid of complex was located outside this distance; however this distance does contain islands.

Table 15. Distribution of tracking transects and number of caribou sign observations across three monitoring types in 2011, 2012, and 2013 during the third visit.

Year	Transect Type	Number of Complexes	Number of Complexes with Caribou Sign	% of Complexes with Caribou Sign	Number of Islands	Number of Islands with Caribou Sign	% of Islands with Caribou Sign	Number of Transects	Total Transect Length (km)	Total number of Caribou Sign	Number of Caribou Sign per km Surveyed
2011	Reference Area	12	11	92%	78	42	54%	16	77.3	229	2.96
	Project Effects Area	17	11	65%	60	24	40%	21	68.6	182	2.65
	Road Reference	17	13	76%	189	74	39%	209	190.9	318	1.67
	TOTAL	*46*	*35*	*76%*	*327*	*140*	*43%*	*246*	*336.8*	*729*	*2.16*
2012	Reference Area	12	10	83%	80	36	45%	16	76.7	136	1.77
	Project Effects Area	21	14	67%	66	28	42%	24	75.5	89	1.18
	Road Reference	15	10	67%	163	50	31%	178	172.1	194	1.13
	TOTAL	*48*	*34*	*71%*	*309*	*114*	*37%*	*218*	*324.3*	*419*	*1.29*
2013	Reference Area	9	8	89%	49	18	37%	10	48.7	171	3.51
	Project Effects Area	7	7	100%	21	13	62%	8	22.1	102	4.62
	Road Reference	17	14	82%	153	103	67%	171	152.8	428	2.80
	TOTAL	*33*	*30*	*91%*	*223*	*135*	*61%*	*189*	*223.6*	*701*	*3.14*

Table 16. Number of adult and juvenile sign on virtual complexes and virtual islands for caribou calving island monitoring 2011, 2012, and 2013 during the third visit.

Year	Transect Type	Number of Complexes with Adult Caribou Sign	Number of Complexes with Caribou Calf Sign	% of Complexes with Adult Caribou Sign	% of Complexes with Caribou Calf Sign	Number of Islands With Adult Caribou Sign	Number of Islands with Caribou Calf Sign	% of Islands with Adult Caribou Sign	% of Islands with Caribou Calf Sign
2011	Reference Area	10	4	92%	33%	42	5	54%	6%
	Project Effects Area	11	2	65%	12%	24	2	40%	3%
	Road Reference	13	4	76%	24%	74	11	39%	6%
	TOTAL	*35*	*10*	*76%*	*22%*	*140*	*18*	*43%*	*6%*
2012	Reference Area	10	3	83%	25%	34	2	43%	3%
	Project Effects Area	13	6	62%	29%	26	5	39%	8%
	Road Reference	10	4	67%	27%	49	7	30%	4%
	TOTAL	*33*	*13*	69%	*27%*	*109*	*14*	35%	*5%*
2013	Reference Area	8	0	89%	0%	18	0	37%	0%
	Project Effects Area	7	2	100%	29%	13	2	62%	10%
	Road Reference	14	8	82%	47%	103	10	67%	7%
	TOTAL	*29*	*10*	*88%*	*30%*	*134*	*12*	*60%*	*5%*

Table 17. Total numbers of caribou, moose, black bear and gray wolf sign on caribou calving island transects in 2011, 2012, and 2013 during the third visit.

Year	Transect Type	Caribou	Moose	Black bear	Gray wolf
2011	Reference Area	229	149	12	4
	Project Effects Area	182	205	0	4
	Road Reference	318	367	13	0
	Total	*729*	*721*	*25*	*8*
2012	Reference Area	136	287	2	1
	Project Effects Area	89	279	6	3
	Road Reference	194	517	11	1
	Total	*419*	*1,083*	*19*	*4*
2013	Reference Area	171	208	1	0
	Project Effects Area	102	144	1	2
	Road Reference	428	456	3	13
	Total	*701*	*808*	*5*	*15*

Table 18. Distribution of moose sign observations across three monitoring areas in complexes and calving islands in 2011, 2012, and 2013 during the third visit.

Year	Habitat Type	Area Type	Surveyed *n*	Total Sign Observed	Adult *n*	Adult %	Calf *n*	Calf %
2011	Peatland Complex	Reference Area	12	149	10	83%	5	42%
		Project Effects Area	17	205	16	94%	2	12%
		Road Reference Area	17	367	17	100%	4	24%
		Total	*46*	*721*	*43*	*93%*	*11*	*24%*
	Habitat Island	Reference Area	78	68	29	37%	3	4%
		Project Effects Area	60	109	36	60%	2	3%
		Road Reference Area	189	289	89	47%	9	5%
		Total	*327*	*466*	*154*	*47%*	*14*	*4%*
2012	Peatland Complex	Reference Area	12	287	12	100%	5	42%
		Project Effects Area	21	279	21	100%	10	48%
		Road Reference Area	15	517	15	100%	6	40%
		Total	*48*	*1,083*	*48*	100%	*21*	*44%*
	Habitat Island	Reference Area	80	166	46	58%	8	10%
		Project Effects Area	71	191	45	63%	15	21%
		Road Reference Area	161	484	101	63%	17	11%
		Total	*312*	*841*	*192*	*62%*	*40*	*13%*
2013	Peatland Complex	Reference Area	11	208	10	91%	4	36%
		Project Effects Area	7	144	7	100%	4	57%
		Road Reference Area	17	456	16	94%	10	59%
		Total	*35*	*808*	*33*	*94%*	*18*	*51%*
	Habitat Island	Reference Area	49	111	33	67%	3	6%
		Project Effects Area	21	116	20	95%	6	29%
		Road Reference Area	153	371	96	63%	15	10%
		Total	*223*	*598*	*149*	*67%*	*24*	*11%*

Table 19. Number of peatland complexes and habitat islands where caribou adult and calf sign were observed based on distance classes associated with the distance of Project Effects Area and Reference Area transects from the Access Road during the third visit.

Year	Distance From Road	Peatland Complexes							Habitat Islands						
		Total	Caribou		Adult Caribou		Calf Caribou		Total	Caribou		Adult Caribou		Calf Caribou	
		#	#	%	#	%	#	%	#	#	%	#	%	#	%
2011	0 to 1 km	4	1	25%	1	25%	0	0%	10	1	10%	1	10%	0	0%
	1 to 2 km	3	0	0%	0	0%	0	0%	12	0	0%	0	0%	0	0%
	2 to 3 km	1	1	100%	1	100%	0	0%	3	2	67%	3	100%	0	0%
	3 to 4 km	4	4	100%	4	100%	1	25%	14	9	64%	9	64%	0	0%
	4 to 5 km	3	3	100%	3	100%	1	33%	18	5	28%	5	28%	1	6%
	5+ km	14	13	93%	9	64%	6	43%	81	49	60%	34	42%	6	7%
	TOTAL	29	22	76%	18	62%	8	28%	138	66	48%	52	38%	7	5%
2012	0 to 1 km	4	1	25%	1	25%	1	25%	10	0	0%	0	0%	0	0%
	1 to 2 km	3	1	33%	0	0%	0	0%	12	4	33%	1	8%	2	17%
	2 to 3 km	1	0	0%	0	0%	0	0%	3	2	67%	1	33%	0	0%
	3 to 4 km	4	1	25%	0	0%	0	0%	13	6	46%	1	8%	1	8%
	4 to 5 km	3	2	67%	2	67%	1	33%	18	8	44%	5	28%	1	6%
	5+ km	18	10	56%	5	28%	2	11%	95	42	44%	14	15%	3	3%
	TOTAL	33	15	45%	8	24%	4	12%	151	62	41%	22	15%	7	5%
2013	0 to 1 km	0	0	NA	0	NA	0	NA	0	0	NA	0	NA	0	NA
	1 to 2 km	0	0	NA	0	NA	0	NA	0	0	NA	0	NA	0	NA
	2 to 3 km	0	0	NA	0	NA	0	NA	0	0	NA	0	NA	0	NA
	3 to 4 km	1	1	100%	1	100%	1	100%	2	2	100%	2	100%	1	50%
	4 to 5 km	1	1	100%	1	100%	0	0%	7	5	71%	5	71%	1	14%
	5+ km	14	13	93%	13	93%	1	7%	61	24	39%	24	39%	0	0%
	TOTAL	16	15	94%	15	94%	2	13%	70	31	44%	31	44%	2	3%

Table 20. Number of peatland complexes and habitat islands where caribou adult and calf sign were observed based on distance classes associated with the distance of Road Reference transects from PR 280 during the third visit.

Year	Distance From PR 280	Peatland Complexes							Habitat Islands						
		Total	Caribou		Adult Caribou		Calf Caribou		Total	Caribou		Adult Caribou		Calf Caribou	
		#	#	%	#	%	#	%	#	#	%	#	%	#	%
2011	0 to 1 km	3	2	67%	2	67%	1	33%	41	15	37%	15	37%	1	2%
	1 to 2 km	6	5	83%	5	83%	2	33%	63	19	30%	19	30%	2	3%
	2 to 3* km	0	0	NA	0	NA	0	NA	42	18	43%	18	43%	5	12%
	3 to 4 km	4	3	75%	3	75%	0	0%	13	6	46%	6	46%	1	8%
	4 to 5 km	1	1	100%	1	100%	1	100%	10	5	50%	5	50%	1	10%
	5+ km	3	2	67%	2	67%	0	0%	20	11	55%	11	55%	1	5%
	TOTAL	17	13	76%	13	76%	4	24%	189	74	39%	74	39%	11	6%
2012	0 to 1 km	3	2	67%	1	33%	1	33%	36	10	28%	3	8%	1	3%
	1 to 2 km	6	3	50%	2	33%	0	0%	59	14	24%	2	3%	0	0%
	2 to 3* km	0	0	NA	0	NA	0	NA	32	12	38%	3	9%	2	6%
	3 to 4 km	3	0	0%	0	0%	0	0%	10	4	40%	3	30%	2	20%
	4 to 5 km	0	0	NA	0	NA	0	NA	6	2	33%	1	17%	1	17%
	5+ km	3	1	33%	1	33%	0	0%	18	8	44%	4	22%	1	6%
	TOTAL	15	6	40%	4	27%	1	7%	161	50	31%	16	10%	7	4%
2013	0 to 1 km	3	3	100%	3	100%	2	67%	26	14	54%	14	54%	1	4%
	1 to 2 km	6	5	83%	5	83%	3	50%	59	39	66%	39	66%	3	5%
	2 to 3* km	0	0	NA	0	NA	0	NA	28	17	61%	17	61%	2	7%
	3 to 4 km	4	2	50%	2	50%	0	0%	11	8	73%	8	73%	1	9%
	4 to 5 km	1	1	100%	1	100%	0	0%	10	7	70%	7	70%	1	10%
	5+ km	3	3	100%	3	100%	3	100%	19	18	95%	18	95%	2	11%
	TOTAL	17	14	82%	14	82%	8	47%	153	103	67%	103	67%	10	7%

*Centroid of complex was located outside this distance; however this distance does contain islands.

Table 21. Species list of mammals identified and number of trail camera detections in 2011, 2012, and 2013.

Common Name	2011						2012						2013					
	C	M	F	J	U	T	C	M	F	J	U	T	C	M	F	J	U	T
American marten	1	0	0	0	0	0	0	0	0	0	0	0	3	5	0	0	16	21
Black bear	7	0	0	0	0	0	8	0	0	0	106	106	3	0	0	9	49	58
Caribou	9	12	5	0	0	17	4	149	9	0	1	159	2	3	13	0	0	16
Gray Wolf	4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	2
Lynx	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Moose	17	14	17	3	0	34	16	160	387	0	241	788	11	496	361	47	31	935
Red Fox	1	0	0	0	0	0	2	0	0	0	8	8	2	0	0	0	6	6
River otter	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Snowshoe hare	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	26	26

Note: C = Number of cameras with species detected; M = Male; F = Female; J = Juvenile; U = Unknown adult; T = Total.

Table 22. Total number of sign observations per species, and sign composition for KIP mammal monitoring in 2011, 2012, and 2013 – all visits.

Species	Transect Type	Number of Sign 2011						Number of Sign 2012						Number of Sign 2013					
		M	F	UA	J	U	T	M	F	UA	J	U	T	M	F	UA	J	U	T
American marten	NNR	0	0	0	0	9	9	0	0	11	3	28	42	0	0	56	0	94	150
	SNR	0	0	0	0	1	1	0	0	3	0	13	16	0	0	44	0	42	86
Beaver	NNR	0	0	0	0	7	7	0	0	0	0	0	0	0	0	0	0	0	0
	SNR	0	0	0	0	6	6	0	0	1	0	0	1	0	0	0	0	0	0
Black bear	NNR	0	0	9	0	5	14	0	0	6	1	6	13	0	0	0	0	3	3
	SNR	0	0	0	0	3	3	0	0	1	0	0	1	0	0	0	0	0	0
Caribou	NNR	0	3	98	11	333	445	0	11	20	5	18	54	0	0	156	0	229	385
	SNR	0	7	83	4	259	353	0	25	6	7	8	46	0	0	192	0	204	396
Fisher	NNR	0	0	0	0	3	3	0	0	0	0	2	2	0	0	2	0	1	3
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
Gray wolf	NNR	0	0	6	0	22	28	0	0	10	1	5	16	0	0	1	0	0	1
	SNR	0	0	0	0	6	6	0	0	0	0	1	1	0	0	0	0	0	0
Lynx	NNR	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Mink	NNR	0	0	0	0	1	1	0	0	2	0	13	15	0	0	11	0	12	23
	SNR	0	0	0	0	0	0	0	0	0	0	2	2	0	0	5	0	8	13
Moose	NNR	90	76	286	78	610	1140	38	153	178	61	225	656	0	1	54	5	85	145
	SNR	22	17	54	5	215	313	22	45	64	22	39	192	0	0	5	0	3	8
Red squirrel	NNR	0	0	0	0	10	10	0	0	3	0	0	3	0	0	0	0	0	0
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red fox	NNR	0	0	0	0	0	0	0	0	10	0	8	18	0	0	9	0	1	10
	SNR	0	0	0	0	0	0	0	0	6	0	2	8	0	0	13	0	3	16
River otter	NNR	0	0	0	0	8	8	0	0	4	0	0	4	0	0	4	0	4	8
	SNR	0	0	0	0	0	0	0	0	3	0	2	8	0	0	10	0	4	14
Ermine	NNR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
Snowshoe hare	NNR	0	0	0	0	38	38	0	0	1	0	0	1	0	0	1	0	0	1
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*M = Male; F = Female; UA = Unknown Adult; J = Juvenile; U = Unknown; T = Total.

Table 23. Moose and caribou sign composition recorded on KIP access road mammal monitoring transects in 2011, 2012, and 2013 – all visits.

Year	Transect Type	Number of Transects	Number of Visits	Total Surveyed Length (km)	Number of Moose Sign	Number of Moose Sign per km Surveyed	Number of Caribou Sign	Number of Caribou Sign per km Surveyed
2011	NAR North Side (NNR)	8	3	261.0	1,140	4.37	445	1.71
	NAR South Side (SNR)	3	3	111.0	313	2.82	353	3.18
2012	NAR North Side (NNR)	8	3	261.0	656	2.51	54	0.21
	NAR South Side (SNR)	3	3	111.0	192	1.73	46	0.41
2013	NAR North Side (NNR)	8	1	87.0	145	1.67	385	4.43
	NAR South Side (SNR)	3	1	37.0	8	0.22	396	10.70

Table 24. Total numbers of moose, caribou, black bear and gray wolf sign on mammal monitoring transects in 2011, 2012, and 2013 – all visits.

Year	Transect Type	Moose	Caribou	Black bear	Gray wolf
2011	NAR North Side (NNR)	1,140	445	14	28
	NAR South Side (SNR)	313	353	3	6
2012	NAR North Side (NNR)	656	54	13	16
	NAR South Side (SNR)	192	46	1	1
2013	NAR North Side (NNR)	145	385	3	1
	NAR South Side (SNR)	8	396	0	0

Table 25. Total number of sign observations per species, and sign composition for KIP mammal monitoring in 2011, 2012, and 2013 – visit 1.

Species	Transect Type	Number of Sign Identified in 2011						Number of Sign Identified in 2012						Number of Sign Identified in 2013					
		M	F	UA	J	U	T	M	F	UA	J	U	T	M	F	UA	J	U	T
American marten	NNR	0	0	0	0	9	9	0	0	11	3	28	42	0	0	56	0	94	150
	SNR	0	0	0	0	1	1	0	0	3	0	13	16	0	0	44	0	42	86
Beaver	NNR	0	0	0	0	7	7	0	0	0	0	0	0	0	0	0	0	0	0
	SNR	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0
Black bear	NNR	0	0	0	0	2	2	0	0	1	0	1	2	0	0	0	0	3	3
	SNR	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Caribou	NNR	0	0	0	0	75	75	0	0	0	0	0	0	0	0	156	0	229	385
	SNR	0	0	62	0	56	118	0	0	0	0	0	0	0	0	192	0	204	396
Fisher	NNR	0	0	0	0	3	3	0	0	0	0	2	2	0	0	2	0	1	3
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
Gray wolf	NNR	0	0	0	0	19	19	0	0	5	1	5	11	0	0	0	0	1	1
	SNR	0	0	0	0	4	4	0	0	0	0	1	1	0	0	0	0	0	0
Lynx	NNR	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Mink	NNR	0	0	0	0	1	1	0	0	2	0	13	15	0	0	11	0	12	23
	SNR	0	0	0	0	0	0	0	0	0	0	2	2	0	0	5	0	8	13
Moose	NNR	2	0	126	19	313	460	0	4	45	8	29	86	0	1	54	5	85	145
	SNR	0	1	21	1	74	97	0	2	12	1	5	20	0	0	5	0	3	8
Red squirrel	NNR	0	0	0	0	10	10	0	0	3	0	0	3	0	0	0	0	0	0
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red fox	NNR	0	0	0	0	0	0	0	0	10	0	8	18	0	0	9	0	1	10
	SNR	0	0	0	0	0	0	0	0	6	0	2	8	0	0	13	0	3	16
River otter	NNR	0	0	0	0	8	8	0	0	4	0	0	4	0	0	4	0	4	8
	SNR	0	0	0	0	0	0	0	0	3	0	0	3	0	0	10	0	4	14
Ermine	NNR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
Snowshoe hare	NNR	0	0	0	0	38	38	0	0	1	0	0	1	0	0	1	0	0	1
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*M = Male; F = Female; UA = Unknown Adult; J = Juvenile; U = Unknown; T = Total. - = no data due to fire

Table 26. Moose and caribou sign composition recorded on KIP access road mammal monitoring transects in 2011, 2012, and 2013 – visit 1.

Year	Transect Type	Number of Transects	Number of Visits	Total Surveyed Length (km)	Number of Moose Sign	Number of Moose Sign per km Surveyed	Number of Caribou Sign	Number of Caribou Sign per km Surveyed
2011	NAR North Side (NNR)	8	1	87.0	460	5.29	75	0.86
	NAR South Side (SNR)	3	1	37.0	97	2.62	118	3.19
2012	NAR North Side (NNR)	8	1	87.0	86	0.99	0	0.00
	NAR South Side (SNR)	3	1	37.0	20	0.54	0	0.00
2013	NAR North Side (NNR)	8	1	87.0	145	1.67	385	4.43
	NAR South Side (SNR)	3	1	37.0	8	0.22	396	10.70

Table 27. Total numbers of moose, caribou, black bear and gray wolf sign on mammal monitoring transects in 2011, 2012, and 2013 – visit 1.

Year	Transect Type	Moose	Caribou	Black bear	Gray wolf
2011	NAR North Side (NNR)	460	75	2	19
	NAR South Side (SNR)	97	118	3	4
2012	NAR North Side (NNR)	86	0	2	11
	NAR South Side (SNR)	20	0	0	1
2013	NAR North Side (NNR)	145	385	3	1
	NAR South Side (SNR)	8	396	0	0

Table 28. Total number of sign observations per species, and sign composition for KIP mammal monitoring in 2011, 2012, and 2013 – visit 2.

Species	Transect Type	Number of Sign Identified in 2011						Number of Sign Identified in 2012						Number of Sign Identified in 2013					
		M	F	UA	J	U	T	M	F	UA	J	U	T	M	F	UA	J	U	T
American marten	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
Beaver	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	1	1	0	0	0	0	1	1	-	-	-	-	-	-
Black bear	NNR	0	0	4	0	2	6	0	0	4	1	3	8	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
Caribou	NNR	0	2	24	6	146	178	0	9	19	2	12	42	-	-	-	-	-	-
	SNR	0	6	3	0	138	147	0	16	5	7	7	35	-	-	-	-	-	-
Fisher	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
Gray wolf	NNR	0	0	6	0	3	9	0	0	2	0	0	2	-	-	-	-	-	-
	SNR	0	0	0	0	1	1	0	0	0	0	0	0	-	-	-	-	-	-
Lynx	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
Mink	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
Moose	NNR	60	66	69	33	152	380	25	58	79	27	94	283	-	-	-	-	-	-
	SNR	11	15	0	3	68	97	19	32	28	15	16	110	-	-	-	-	-	-
Red squirrel	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
Red fox	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
River otter	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
Ermine	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
Snowshoe hare	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-

*M = Male; F = Female; UA = Unknown Adult; J = Juvenile; U = Unknown; T = Total. - = no data due to fire

Table 29. Moose and caribou sign composition recorded on KIP access road mammal monitoring transects in 2011, 2012, and 2013 – visit 2.

Year	Transect Type	Number of Transects	Number of Visits	Total Surveyed Length (km)	Number of Moose Sign	Number of Moose Sign per km Surveyed	Number of Caribou Sign	Number of Caribou Sign per km Surveyed
2011	NAR North Side (NNR)	8	1	87.0	380	4.37	178	2.05
	NAR South Side (SNR)	3	1	37.0	97	2.62	147	3.97
2012	NAR North Side (NNR)	8	1	87.0	283	3.25	42	0.48
	NAR South Side (SNR)	3	1	37.0	110	2.97	35	0.95
2013	NAR North Side (NNR)	0	0	0	-	-	-	-
	NAR South Side (SNR)	0	0	0	-	-	-	-

Table 30. Total numbers of moose, caribou, black bear and gray wolf sign on mammal monitoring transects in 2011, 2012, and 2013 – visit 2.

Year	Transect Type	Moose	Caribou	Black bear	Gray wolf
2011	NAR North Side (NNR)	380	178	6	9
	NAR South Side (SNR)	97	147	0	1
2012	NAR North Side (NNR)	283	42	8	2
	NAR South Side (SNR)	110	35	0	0
2013	NAR North Side (NNR)	-	-	-	-
	NAR South Side (SNR)	-	-	-	-

Table 31. Total number of sign observations per species, and sign composition for KIP mammal monitoring in 2011, 2012, and 2013 – visit 3.

Species	Transect Type	Number of Sign Identified in 2011						Number of Sign Identified in 2012						Number of Sign Identified in 2013					
		M	F	UA	J	U	T	M	F	UA	J	U	T	M	F	UA	J	U	T
American marten	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
Beaver	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
Black bear	NNR	0	0	5	0	1	6	0	0	1	0	2	3	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	1	0	0	1	-	-	-	-	-	-
Caribou	NNR	0	1	74	5	112	192	0	2	1	2	4	9	-	-	-	-	-	-
	SNR	0	1	22	1	65	88	0	9	1	0	1	11	-	-	-	-	-	-
Fisher	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
Gray wolf	NNR	0	0	0	0	0	0	0	0	1	0	0	1	-	-	-	-	-	-
	SNR	0	0	0	0	1	1	0	0	0	0	0	0	-	-	-	-	-	-
Lynx	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
Mink	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
Moose	NNR	28	10	91	26	145	300	13	89	54	26	103	285	-	-	-	-	-	-
	SNR	11	1	33	1	73	119	3	11	24	6	18	62	-	-	-	-	-	-
Red squirrel	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
Red fox	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
River otter	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
Ermine	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
Snowshoe hare	NNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
	SNR	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-

*M = Male; F = Female; UA = Unknown Adult; J = Juvenile; U = Unknown; T = Total. - = no data due to fire

Table 32. Moose and caribou sign composition recorded on KIP access road mammal monitoring transects in 2011, 2012, and 2013 – visit 3.

Year	Transect Type	Number of Transects	Number of Visits	Total Surveyed Length (km)	Number of Moose Sign	Number of Moose Sign per km Surveyed	Number of Caribou Sign	Number of Caribou Sign per km Surveyed
2011	NAR North Side (NNR)	8	1	87.0	300	3.45	192	2.21
	NAR South Side (SNR)	3	1	37.0	119	3.22	88	2.38
2012	NAR North Side (NNR)	8	1	87.0	287	3.30	12	0.14
	NAR South Side (SNR)	3	1	37.0	62	1.68	11	0.30
2013	NAR North Side (NNR)	0	0	0	-	-	-	-
	NAR South Side (SNR)	0	0	0	-	-	-	-

Table 33. Total numbers of moose, caribou, black bear and gray wolf sign on mammal monitoring transects in 2011, 2012, and 2013 – visit 3.

Year	Transect Type	Moose	Caribou	Black bear	Gray wolf
2011	NAR North Side (NNR)	300	192	6	0
	NAR South Side (SNR)	119	88	0	1
2012	NAR North Side (NNR)	287	12	3	3
	NAR South Side (SNR)	62	11	1	0
2013	NAR North Side (NNR)	-	-	-	-
	NAR South Side (SNR)	-	-	-	-

Table 34. Number of caribou clusters and individuals detected on distance sampling line transects in each distance interval.

Distance Interval (m)	**Number of Caribou Clusters**	**Number of Caribou**
0-50	52	1,134
51-100	57	693
101-150	22	253
151-200	37	402
201-250	9	65
251-300	30	360
301-350	5	33
351-450	24	260
Total	*236*	*3,200*

Table 35. Ranked fitted detection function models used in the program DISTANCE v.6.0 to estimate caribou density From February 5 to 8, 2013, in the Keeyask Generating Station area. Ranking is based on the difference in Akaike's Information Criterion (ΔAIC).

Model Key	Adjustment Term	AIC	ΔAIC	χ^2 GOF P-value	P	D	%CV	N	LCI	UCI
Half Normal	Cosine	728.07	0.00	0.952	0.50	1.66	18.17	13,984	9,810	19,933
Hazard rate	Cosine	728.20	0.13	0.893	0.50	1.68	20.97	14,131	9,400	21,243
Uniform	Cosine	729.50	1.43	0461	0.54	1.52	17.59	12,798	9,078	18,043
Uniform	Simple polynomial	730.25	2.18	0.596	0.52	1.57	18.02	13,221	9,301	18,792
Half Normal	Hermite polynomial	732.10	4.03	0.107	0.61	1.32	16.80	11,107	7,997	15,426
Averaged model		*728.07*	*0.00*	*0.952*	*0.50*	*1.73*	*27.60*	*14,536*	*8,876*	*24,019*

Note: χ^2 GOF is the p-value of the χ^2 goodness of fit test, P is the estimated average detection probability, D is the estimated caribou density (caribou/km^2) for the study area and CV is its coefficient of variation at 95% confidence intervals, N is the total abundance estimate, and LCI and UCI are lower and upper confidence limits, respectively.

FIGURES

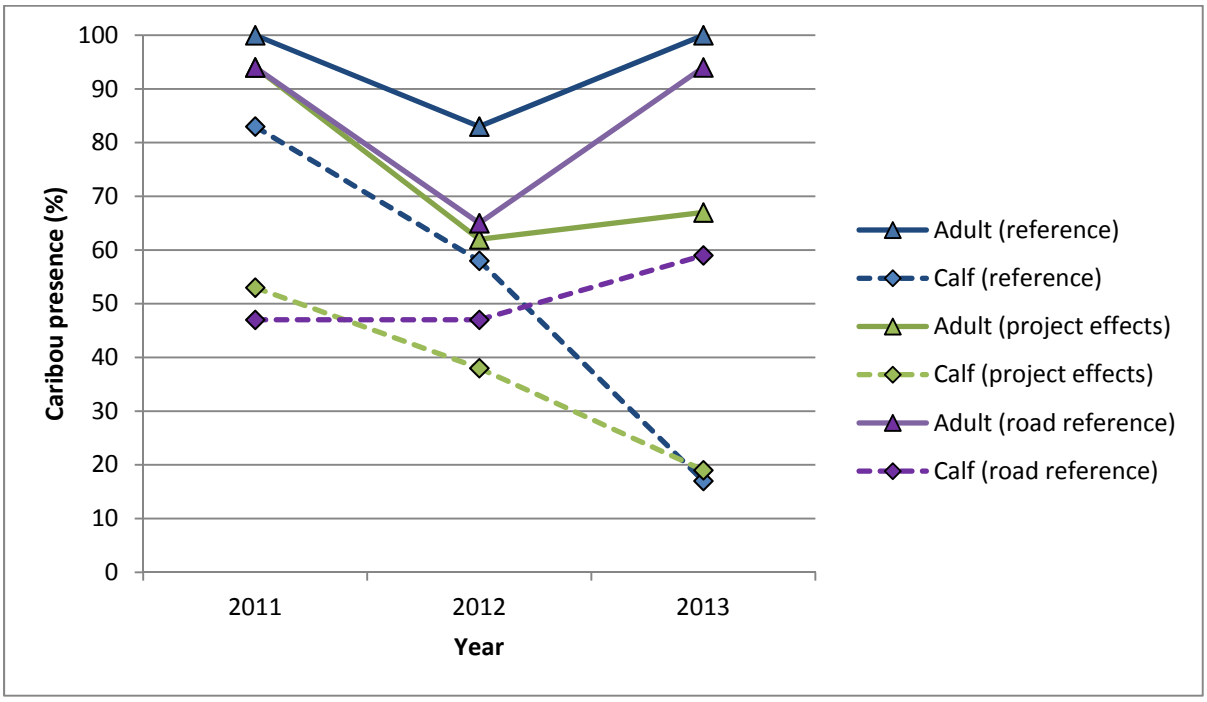

Figure 1. Percentage of surveyed peatland complexes with adult and calf caribou sign in Reference, Project Effects, and Road Reference Areas across all three visits in 2011, 2012, and 2013.

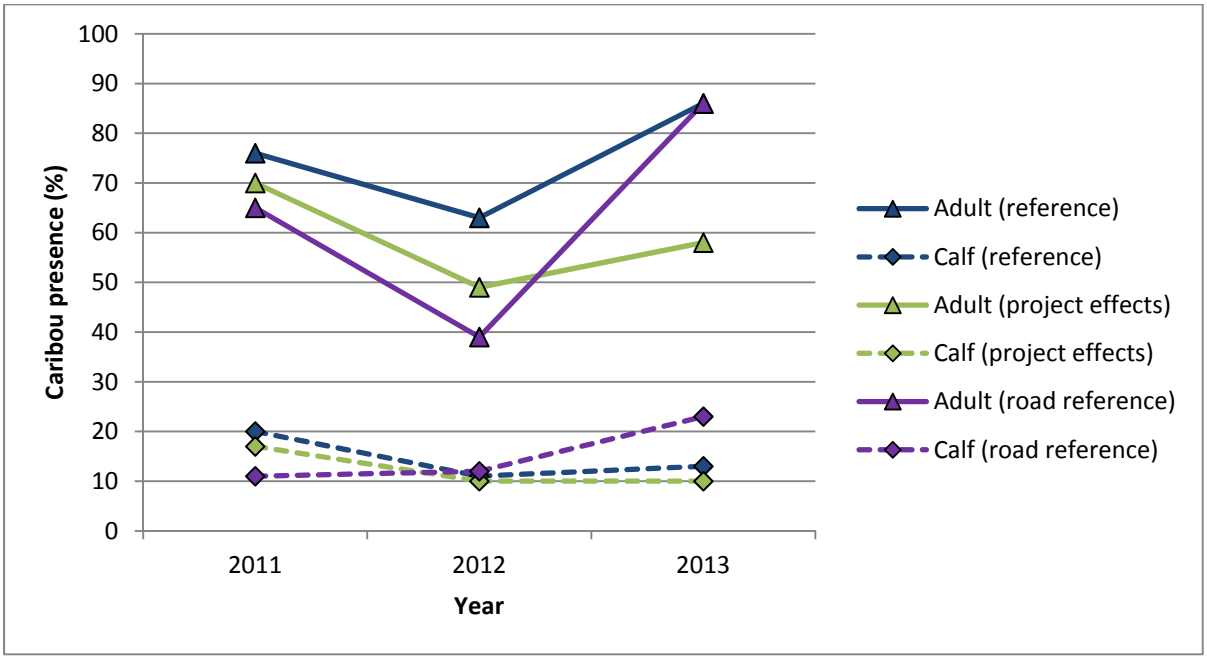

Figure 2. Percentage of surveyed habitat islands with adult and calf caribou sign in Reference, Project Effects, and Road Reference Areas across all three visits in 2011, 2012, and 2013.

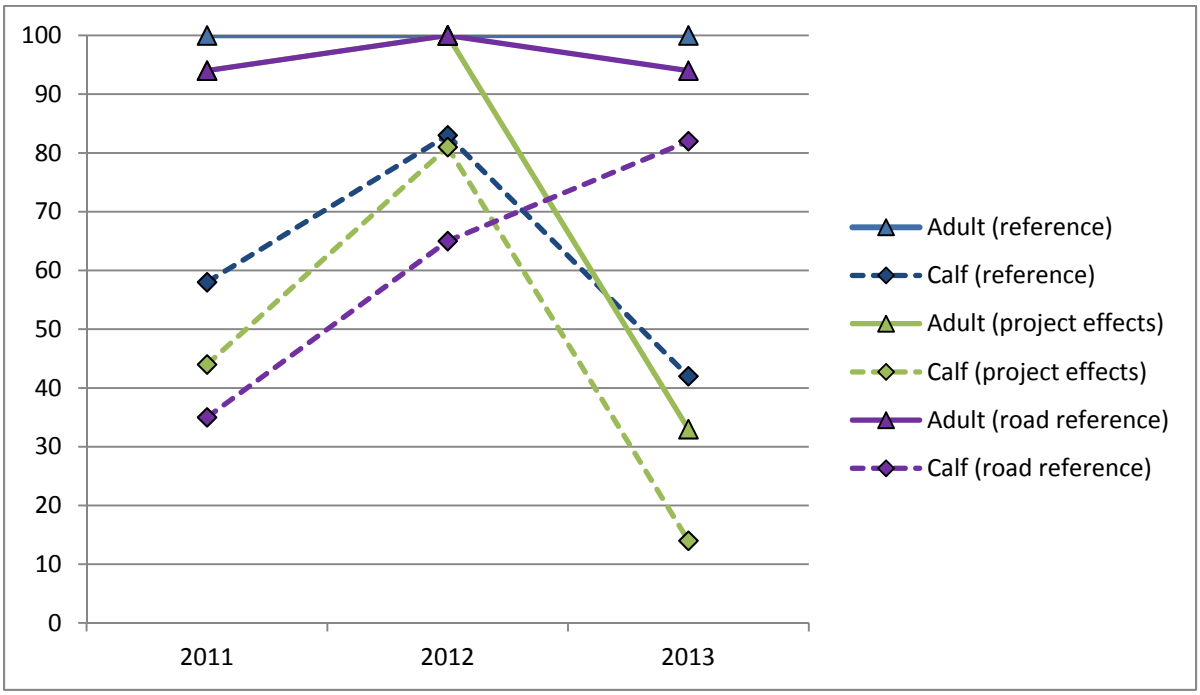

Figure 3. Percentage of surveyed peatland complexes with adult and calf moose sign in Reference, Project Effects, and Road Reference Areas across all three visits in 2011, 2012, and 2013.

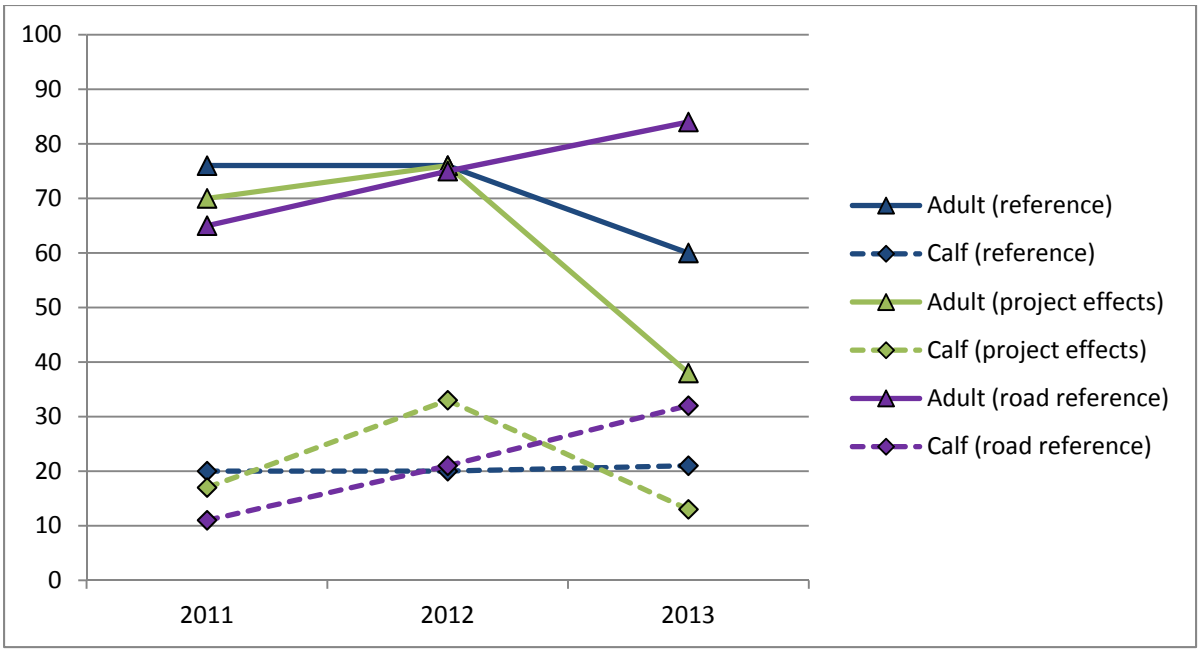

Figure 4. Percentage of surveyed habitat islands with adult and calf moose sign in Reference, Project Effects, and Road Reference Areas across all three visits in 2011, 2012, and 2013.

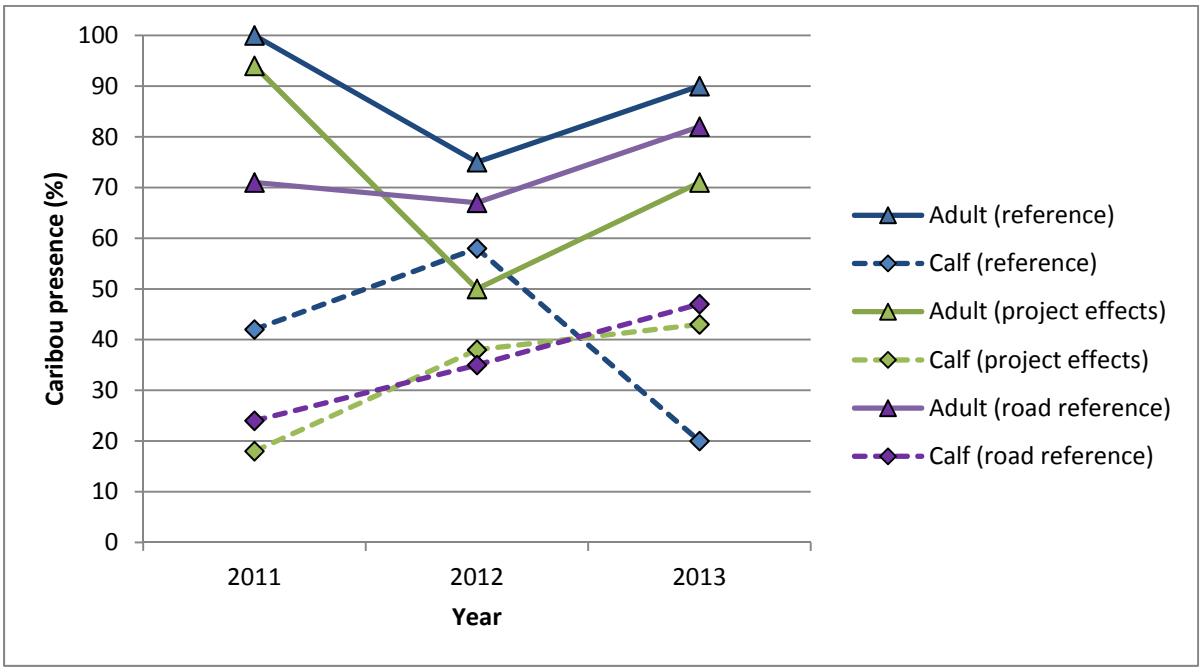

Figure 5. Percentage of surveyed peatland complexes with adult and calf caribou sign in Reference, Project Effects, and Road Reference Areas during the second visit in 2011, 2012, and 2013.

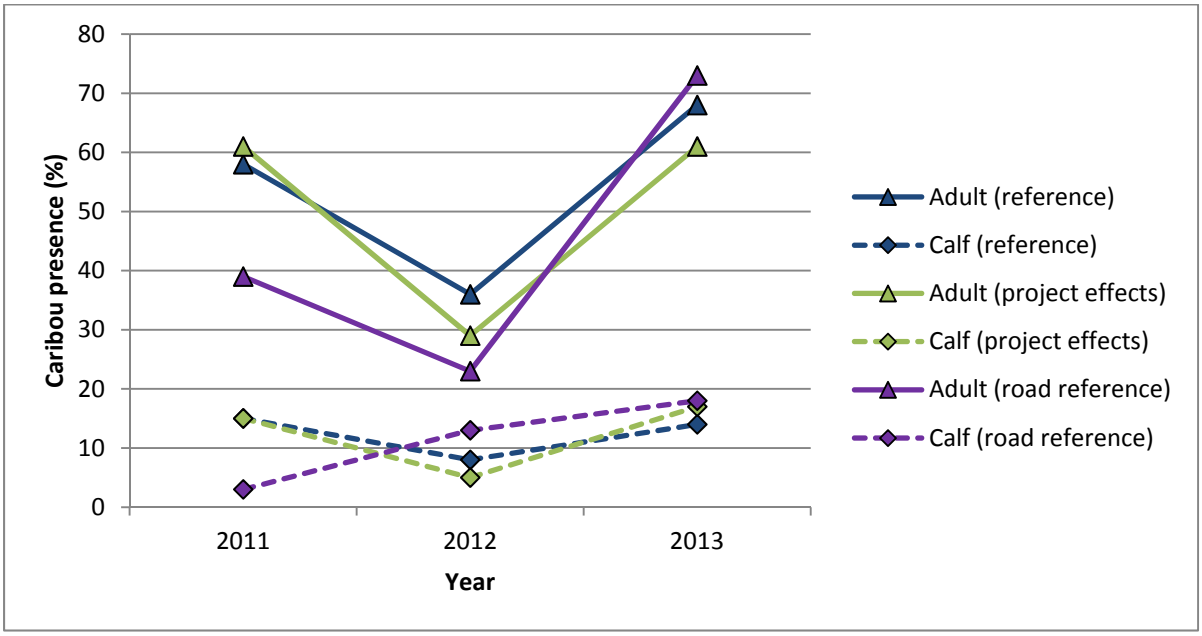

Figure 6. Percentage of surveyed habitat islands with adult and calf caribou sign in Reference, Project Effects, and Road Reference Areas during the second visit in 2011, 2012, and 2013.

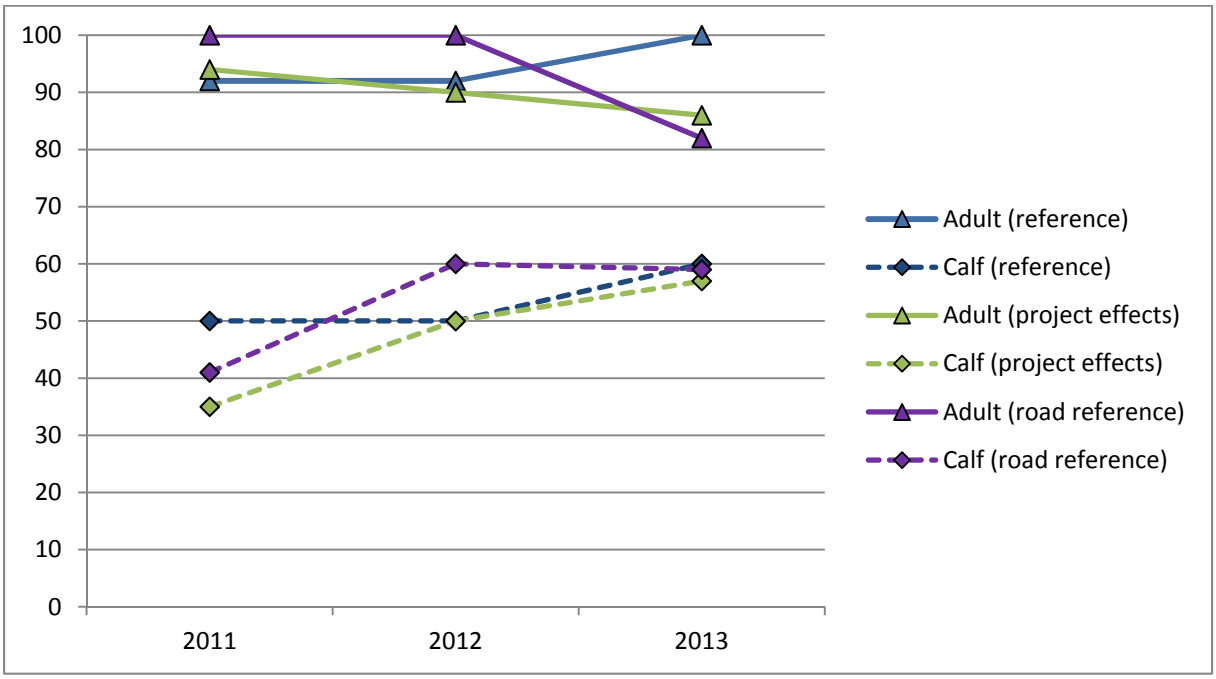

Figure 7. Percentage of surveyed peatland complexes with adult and calf moose sign in Reference, Project Effects, and Road Reference Areas during the second visit in 2011, 2012, and 2013.

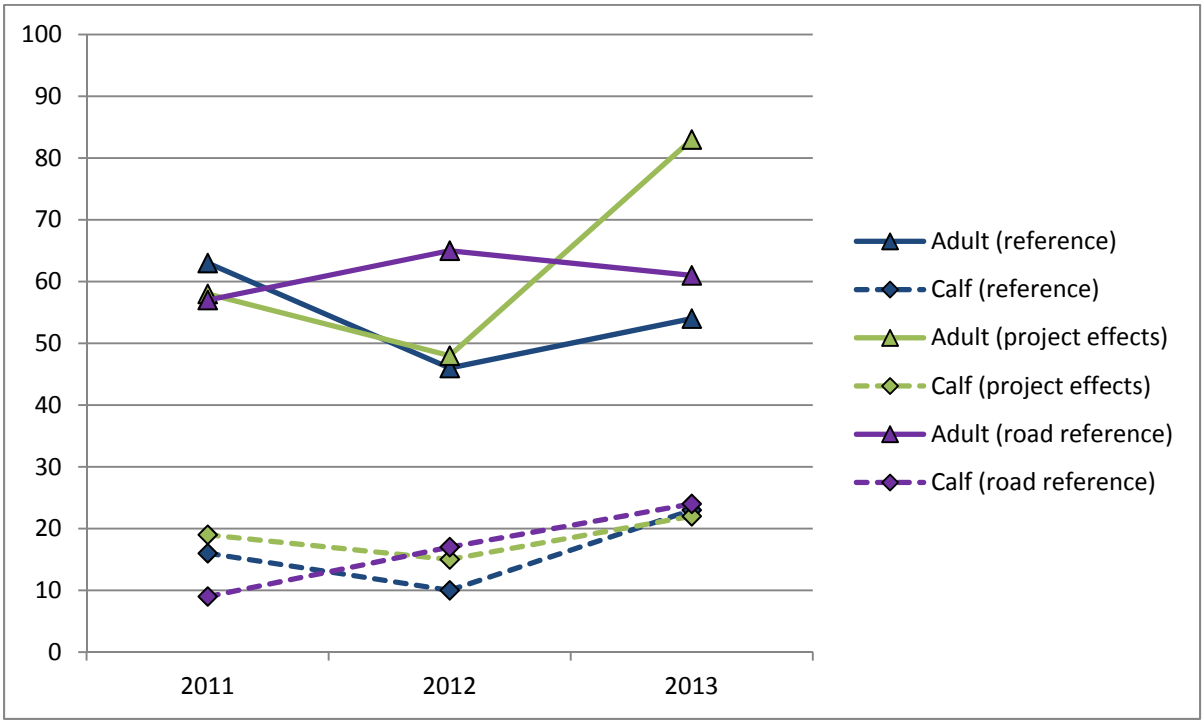

Figure 8. Percentage of surveyed habitat islands with adult and calf moose sign in Reference, Project Effects, and Road Reference Areas during the second visit in 2011, 2012, and 2013.

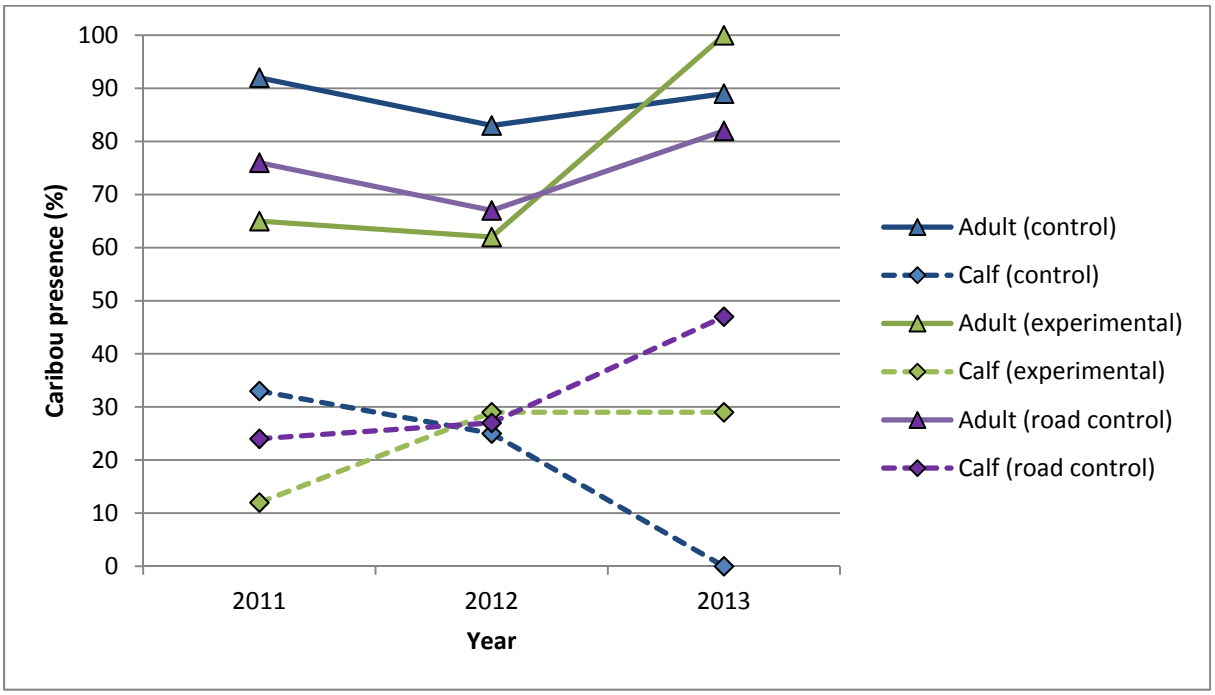

Figure 9. Percentage of surveyed peatland complexes with adult and calf caribou sign in Reference, Project Effects, and Road Reference Areas during the third visit in 2011, 2012, and 2013.

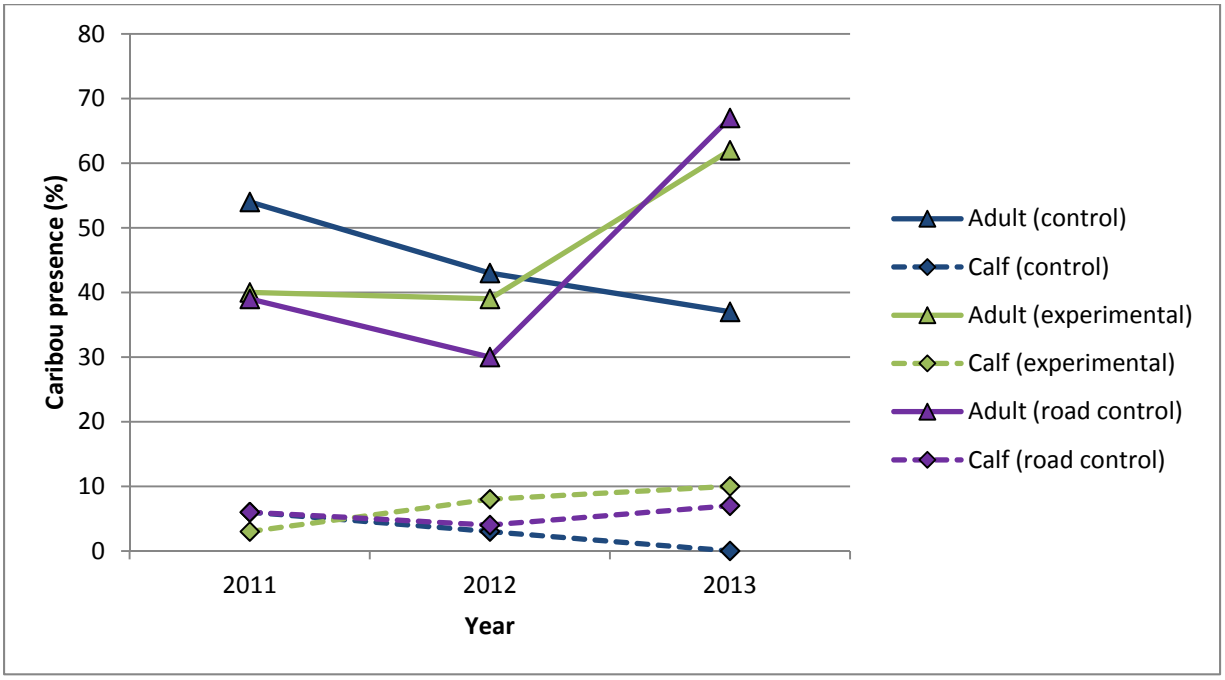

Figure 10. Percentage of surveyed habitat islands with adult and calf caribou sign in Reference, Project Effects, and Road Reference Areas during the third visit in 2011, 2012, and 2013.

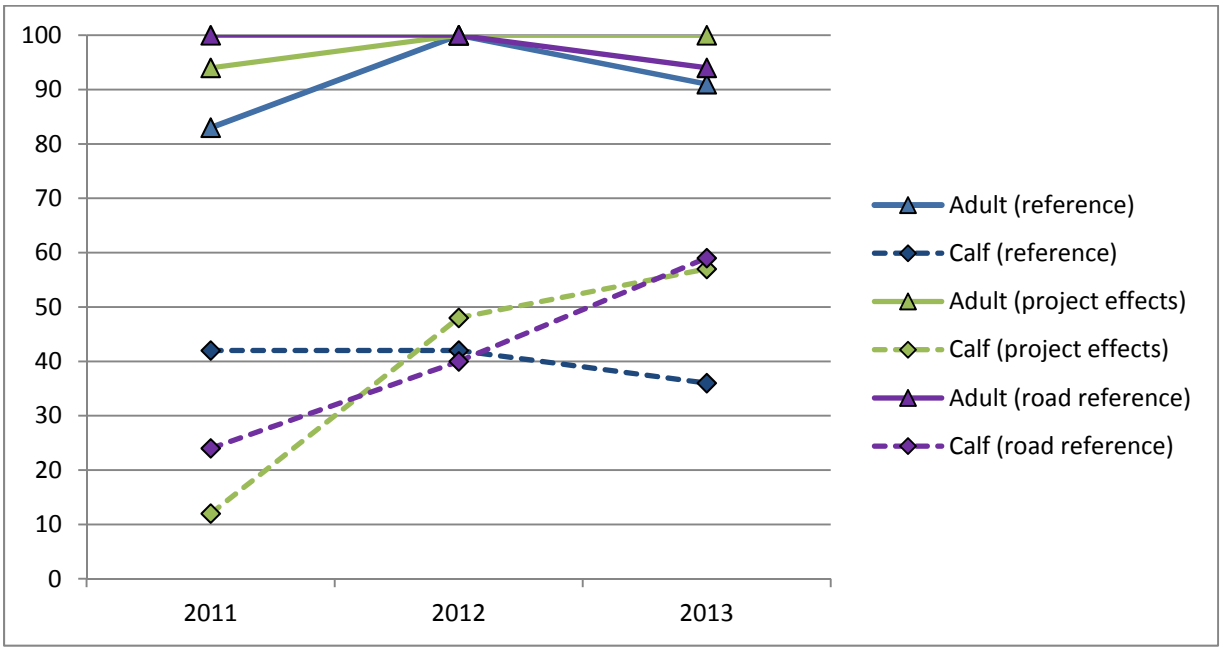

Figure 11. Percentage of surveyed peatland complexes with adult and calf moose sign in Reference, Project Effects, and Road Reference Areas during the third visit in 2011, 2012, and 2013.

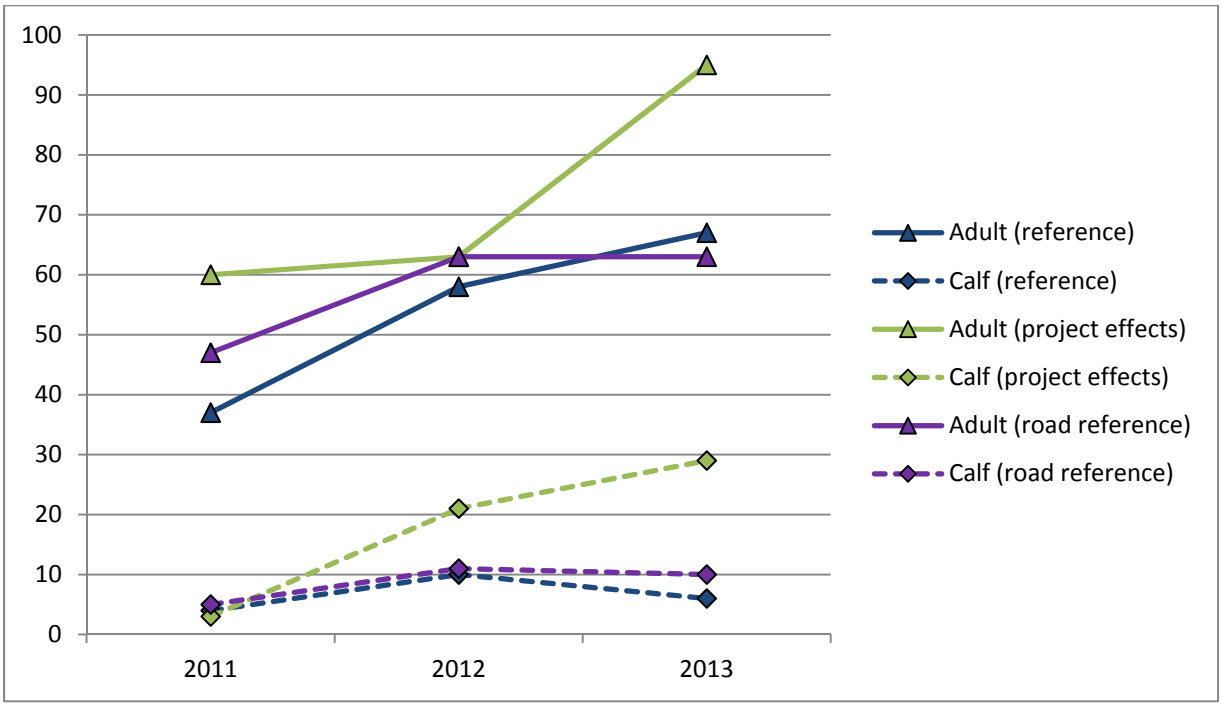

Figure 12. Percentage of surveyed habitat islands with adult and calf moose sign in Reference, Project Effects, and Road Reference Areas during the third visit in 2011, 2012, and 2013.

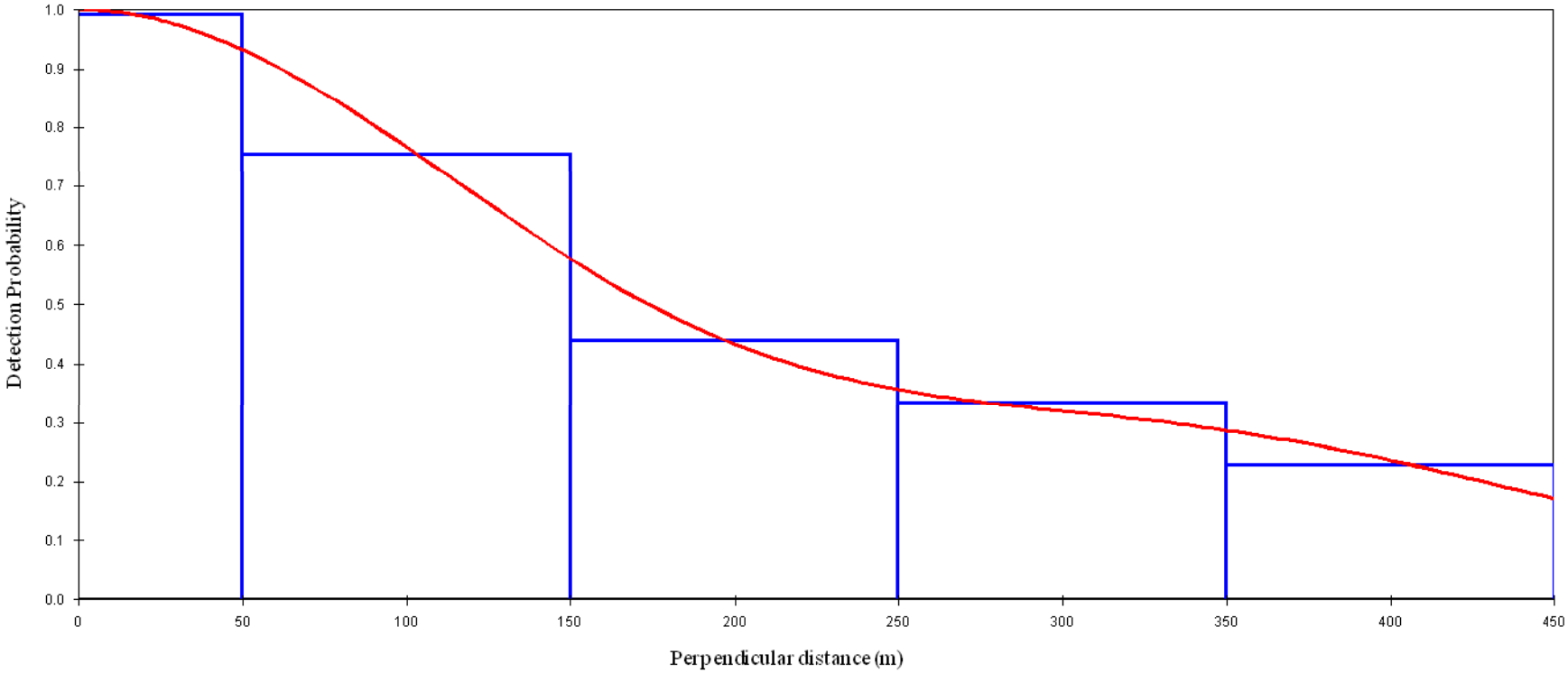

Figure 13. Estimated detection probability of caribou clusters in the Keeyask Generating Station area, modeled in the program DISTANCE v. 6.0. The model is a half-normal key with a cosine adjustment term.

APPENDIX A - TRANSECT ESTABLISHMENT AND RESAMPLE DATES IN 2013 FOR PROJECT EFFECTS, REFERENCE AND ROAD REFERENCE AREA LINES BY TRANSECT

Note: NA depicts sites that were not revisited due to fire

Transect	Visit		
	1	**2**	**3**
CA001	18/04/2013	12/07/2013	04/09/2013
		23/07/2013	
		24/07/2013	
CA002	19/04/2013	NA	NA
CA003	19/04/2013	12/07/2013	06/09/2013
CA004	18/04/2013	12/07/2013	06/09/2013
		24/07/2013	
CA005	19/04/2013	12/07/2013	06/09/2013
CA006a	18/04/2013	24/07/2013	06/09/2013
CA006b	18/04/2013	24/07/2013	06/09/2013
CA007	19/04/2013	24/07/2013	06/09/2013
CA008	13/04/2013	NA	NA
CA009	15/04/2013	NA	NA
CA010a	15/04/2013	NA	NA
CA010b	15/04/2013	NA	NA
CA011	15/04/2013	NA	NA
CA012	11/04/2013	12/07/2013	05/09/2013
CA013	16/04/2013	12/07/2013	05/09/2013
			07/09/2013
CA014	11/04/2013	18/07/2013	05/09/2013
CA015	12/04/2013	18/07/2013	05/09/2013
		19/07/2013	
CA016	12/04/2013	18/07/2013	07/09/2013
EA001	17/04/2013	NA	NA
EA002	17/04/2013	NA	NA
EA003	17/04/2013	NA	NA
EA004	03/04/2013	17/04/2013	NA
EA005	17/04/2013	NA	NA
EA006	17/04/2013	NA	NA
EA007	17/04/2013	NA	NA
EA008	17/04/2013	NA	NA
EA009a	17/04/2013	NA	NA
EA009b	17/04/2013	NA	NA
EA010	20/04/2013	NA	NA
EA011	20/04/2013	NA	NA

Transect	Visit		
	1	**2**	**3**
EA012	17/04/2013	NA	NA
EA013	20/04/2013	NA	NA
EA014	17/04/2013	NA	NA
EA015	20/04/2013	NA	NA
EA016a	19/04/2013	24/07/2013	04/09/2013
EA016b	19/04/2013	24/07/2013	04/09/2013
EA017	19/04/2013	24/07/2013	04/09/2013
EA018	19/04/2013	23/07/2013	NA
EA019	19/04/2013	23/07/2013	04/09/2013
EA020	19/04/2013	24/07/2013	04/09/2013
EA021a	19/04/2013	25/07/2013	06/09/2013
EA021b	19/04/2013	25/07/2013	06/09/2013
EA022	19/04/2013	24/07/2013	04/09/2013
EA023a	10/04/2013	23/07/2013	04/09/2013
EA023b	10/04/2013	23/07/2013	NA
EA023c	10/04/2013	23/07/2013	04/09/2013
EA024a	10/04/2013	NA	NA
EA024b	10/04/2013	NA	04/09/2013
EA025a	10/04/2013	23/07/2013	04/09/2013
EA025b	10/04/2013	23/07/2013	04/09/2013
EA025c	10/04/2013	23/07/2013	04/09/2013
EA025d	10/04/2013	23/07/2013	06/09/2013
EA025e	19/04/2013	23/07/2013	04/09/2013
EA025f	10/04/2013	23/07/2013	04/09/2013
NNR001	04/04/2013	NA	NA
NNR002	05/04/2013	NA	NA
NNR003	06/04/2013	NA	NA
NNR004	06/04/2013	NA	NA
NNR005	07/04/2013	NA	NA
NNR006	07/04/2013	NA	NA
NNR007	08/04/2013	NA	NA
NNR008	08/04/2013	NA	NA
SNR001	09/04/2013	NA	NA
SNR002	09/04/2013	NA	NA
SNR003	10/04/2013	NA	NA

Transect	Visit		
	1	**2**	**3**
RC001	14/04/2013	27/07/2013	09/09/2013
RC002	14/04/2013	19/07/2013	08/09/2013
RC003	14/04/2013	NA	NA
RC004	14/04/2013	28/07/2013	10/09/2013
RC005	15/04/2013	NA	NA
RC006	15/04/2013	28/07/2013	08/09/2013
RC007	15/04/2013	27/07/2013	NA
RC008	13/04/2013	NA	NA
RC009	15/04/2013	NA	NA
RC010	15/04/2013	27/07/2013	08/09/2013
RC011	23/04/2013	27/07/2013	09/09/2013
		28/07/2013	
RC012	14/04/2013	27/07/2013	09/09/2013
RC013	14/04/2013	27/07/2013	09/09/2013
RC014	14/04/2013	27/07/2013	09/09/2013
RC015	14/04/2013	27/07/2013	09/09/2013
RC016	16/04/2013	27/07/2013	09/09/2013
RC017	14/04/2013	27/07/2013	09/09/2013
RC018	16/04/2013	27/07/2013	09/09/2013
RC019	16/04/2013	27/07/2013	09/09/2013
RC020	16/04/2013	27/07/2013	09/09/2013
RC021	14/04/2013	27/07/2013	09/09/2013
RC022	16/04/2013	NA	NA
RC023	15/04/2013	27/07/2013	09/09/2013
RC024	16/04/2013	27/07/2013	09/09/2013
RC025	16/04/2013	27/07/2013	09/09/2013
RC026	16/04/2013	27/07/2013	09/09/2013
RC027	23/04/2013	28/07/2013	NA
RC028	23/04/2013	28/07/2013	NA
RC029	15/04/2013	27/07/2013	08/09/2013
RC030	23/04/2013	28/07/2013	NA
RC031	23/04/2013	28/07/2013	NA
RC032	15/04/2013	27/07/2013	08/09/2013
RC033	23/04/2013	NA	NA
RC034	23/04/2013	28/07/2013	NA

Transect	Visit		
	1	**2**	**3**
RC035	23/04/2013	28/07/2013	08/09/2013
RC036	23/04/2013	28/07/2013	08/09/2013
RC037	14/04/2013	27/07/2013	09/09/2013
RC038	14/04/2013	27/07/2013	09/09/2013
RC039	23/04/2013	27/07/2013	09/09/2013
RC040	23/04/2013	27/07/2013	NA
RC041	23/04/2013	NA	NA
RC042	23/04/2013	25/07/2013	10/09/2013
RC043	23/04/2013	17/07/2013	15/09/2013
RC044	23/04/2013	25/07/2013	10/09/2013
RC045	23/04/2013	27/07/2013	15/09/2013
RC046	23/04/2013	27/07/2013	15/09/2013
RC047	23/04/2013	25/07/2013	15/09/2013
RC048	15/04/2013	28/07/2013	NA
RC049	23/04/2013	17/07/2013	15/09/2013
		28/07/2013	
RC050	23/04/2013	28/07/2013	NA
RC051	23/04/2013	25/07/2013	10/09/2013
RC052	23/04/2013	25/07/2013	NA
RC053	23/04/2013	17/07/2013	10/09/2013
RC054	23/04/2013	25/07/2013	10/09/2013
RC055	23/04/2013	17/07/2013	10/09/2013
RC056	14/04/2013	25/07/2013	10/09/2013
RC057	13/04/2013	27/07/2013	NA
RC058	12/04/2013	25/07/2013	10/09/2013
RC059	13/04/2013	25/07/2013	08/09/2013
RC060	13/04/2013	27/07/2013	NA
RC061	23/04/2013	25/07/2013	NA
RC062	13/04/2013	28/07/2013	NA
RC063	13/04/2013	25/07/2013	08/09/2013
RC064	23/04/2013	25/07/2013	08/09/2013
RC065	13/04/2013	27/07/2013	NA
RC066	23/04/2013	25/07/2013	08/09/2013
RC067	13/04/2013	25/07/2013	08/09/2013
RC068	13/04/2013	25/07/2013	08/09/2013

Transect	Visit		
	1	**2**	**3**
RC069	23/04/2013	25/07/2013	10/09/2013
RC070	14/04/2013	27/07/2013	NA
RC071	14/04/2013	27/07/2013	NA
RC072	14/04/2013	27/07/2013	NA
RC073	14/04/2013	27/07/2013	NA
RC074	15/04/2013	27/07/2013	NA
RC075	15/04/2013	27/07/2013	NA
RC076	15/04/2013	27/07/2013	NA
RC077	13/04/2013	25/07/2013	08/09/2013
RC078	14/04/2013	19/07/2013	08/09/2013
RC079	14/04/2013	19/07/2013	08/09/2013
RC080	11/04/2013	19/07/2013	08/09/2013
RC081	11/04/2013	19/07/2013	NA
RC082	11/04/2013	19/07/2013	NA
RC083	12/04/2013	19/07/2013	07/09/2013
RC084	12/04/2013	19/07/2013	07/09/2013
RC085	11/04/2013	19/07/2013	07/09/2013
RC086	11/04/2013	19/07/2013	07/09/2013
RC087	11/04/2013	19/07/2013	07/09/2013
RC088	11/04/2013	19/07/2013	07/09/2013
RC089	11/04/2013	19/07/2013	07/09/2013
RC090	11/04/2013	19/07/2013	07/09/2013
RC091	11/04/2013	20/07/2013	07/09/2013
RC092	11/04/2013	20/07/2013	07/09/2013
RC093	12/04/2013	20/07/2013	07/09/2013
RC094	16/04/2013	19/07/2013	05/09/2013
RC095	12/04/2013	20/07/2013	07/09/2013
RC096	11/04/2013	22/07/2013	07/09/2013
RC097	12/04/2013	20/07/2013	07/09/2013
RC098	12/04/2013	22/07/2013	NA
RC099	11/04/2013	25/07/2013	05/09/2013
RC100	11/04/2013	25/07/2013	05/09/2013
RC101	12/04/2013	25/07/2013	05/09/2013
RC102	11/04/2013	22/07/2013	05/09/2013
RC103	19/04/2013	22/07/2013	NA

Transect	Visit		
	1	**2**	**3**
RC104	19/04/2013	18/07/2013	10/09/2013
		19/07/2013	
RC105	19/04/2013	19/07/2013	10/09/2013
RC118	20/04/2013	21/07/2013	11/09/2013
RC119	22/04/2013	21/07/2013	11/09/2013
RC120	22/04/2013	21/07/2013	11/09/2013
RC121	22/04/2013	21/07/2013	11/09/2013
RC122	20/04/2013	21/07/2013	11/09/2013
RC123	20/04/2013	11/07/2013	11/09/2013
RC124	20/04/2013	11/07/2013	11/09/2013
RC125	20/04/2013	11/07/2013	11/09/2013
RC126	20/04/2013	11/07/2013	11/09/2013
RC127	20/04/2013	11/07/2013	11/09/2013
RC128	20/04/2013	11/07/2013	11/09/2013
RC129	22/04/2013	11/07/2013	11/09/2013
RC130	22/04/2013	11/07/2013	11/09/2013
RC131	22/04/2013	11/07/2013	11/09/2013
RC132	20/04/2013	11/07/2013	11/09/2013
RC133	20/04/2013	11/07/2013	11/09/2013
RC134	20/04/2013	11/07/2013	11/09/2013
RC135	20/04/2013	11/07/2013	11/09/2013
RC136	20/04/2013	11/07/2013	11/09/2013
RC137	21/04/2013	04/07/2013	12/09/2013
RC138	22/04/2013	17/07/2013	14/09/2013
RC139	22/04/2013	16/07/2013	14/09/2013
RC140	21/04/2013	13/07/2013	11/09/2013
RC141	22/04/2013	16/07/2013	14/09/2013
RC142	21/04/2013	13/07/2013	08/09/2013
RC143	21/04/2013	13/07/2013	08/09/2013
RC144	22/04/2013	17/07/2013	14/09/2013
RC145	21/04/2013	13/07/2013	08/09/2013
RC146	21/04/2013	16/07/2013	08/09/2013
RC147	22/04/2013	16/07/2013	13/09/2013
RC148	22/04/2013	17/07/2013	14/09/2013
RC149	22/04/2013	16/07/2013	08/09/2013

Transect	Visit		
	1	**2**	**3**
RC150	21/04/2013	16/07/2013	08/09/2013
RC151	22/04/2013	28/07/2013	NA
RC152	21/04/2013	13/07/2013	08/09/2013
RC153	22/04/2013	16/07/2013	14/09/2013
RC154	22/04/2013	16/07/2013	13/09/2013
RC155	22/04/2013	28/07/2013	NA
RC156	22/04/2013	13/07/2013	08/09/2013
		16/07/2013	
RC157	21/04/2013	16/07/2013	08/09/2013
RC158	22/04/2013	16/07/2013	13/09/2013
RC159	21/04/2013	13/07/2013	08/09/2013
RC160	22/04/2013	16/07/2013	13/09/2013
RC161	21/04/2013	16/07/2013	08/09/2013
RC162	22/04/2013	16/07/2013	14/09/2013
RC163	21/04/2013	13/07/2013	08/09/2013
RC164	21/04/2013	13/07/2013	13/09/2013
RC165	21/04/2013	16/07/2013	13/09/2013
RC166	21/04/2013	16/07/2013	12/09/2013
RC167	21/04/2013	13/07/2013	08/09/2013
RC168	21/04/2013	13/07/2013	08/09/2013
		17/07/2013	
RC169	21/04/2013	16/07/2013	12/09/2013
	22/04/2013		
RC170	22/04/2013	16/07/2013	13/09/2013
RC171	21/04/2013	13/07/2013	13/09/2013
RC172	22/04/2013	16/07/2013	14/09/2013
RC173	22/04/2013	13/07/2013	13/09/2013
RC174	22/04/2013	13/07/2013	08/09/2013
RC175	21/04/2013	13/07/2013	13/09/2013
RC176	22/04/2013	13/07/2013	12/09/2013
RC177	22/04/2013	16/07/2013	14/09/2013
RC178	22/04/2013	13/07/2013	08/09/2013
RC179	22/04/2013	16/07/2013	13/09/2013
RC180	22/04/2013	04/07/2013	12/09/2013
RC181	22/04/2013	28/07/2013	NA

Transect	Visit		
	1	**2**	**3**
RC182	22/04/2013	16/07/2013	14/09/2013
RC183	22/04/2013	13/07/2013	13/09/2013
RC184	22/04/2013	16/07/2013	12/09/2013
RC185	22/04/2013	16/07/2013	14/09/2013
RC186	22/04/2013	13/07/2013	13/09/2013
RC187	21/04/2013	04/07/2013	12/09/2013
RC188	22/04/2013	04/07/2013	12/09/2013
RC189	22/04/2013	16/07/2013	14/09/2013
RC190	22/04/2013	16/07/2013	14/09/2013
RC191	22/04/2013	16/07/2013	14/09/2013
RC192	21/04/2013	16/07/2013	14/09/2013
RC193	21/04/2013	13/07/2013	13/09/2013
RC194	22/04/2013	16/07/2013	12/09/2013
RC195	22/04/2013	16/07/2013	14/09/2013
RC196	22/04/2013	04/07/2013	12/09/2013
RC197	21/04/2013	04/07/2013	12/09/2013
RC198	22/04/2013	16/07/2013	14/09/2013
RC199	22/04/2013	13/07/2013	13/09/2013
RC200	21/04/2013	13/07/2013	13/09/2013
RC201	21/04/2013	16/07/2013	13/09/2013
RC202	22/04/2013	04/07/2013	12/09/2013
RC203	21/04/2013	16/07/2013	13/09/2013
RC204	22/04/2013	13/07/2013	13/09/2013
RC205	21/04/2013	03/07/2013	14/09/2013
RC206	22/04/2013	16/07/2013	14/09/2013
RC207	21/04/2013	04/07/2013	13/09/2013
RC208	21/04/2013	04/07/2013	13/09/2013
RC209	21/04/2013	04/07/2013	13/09/2013
RC210	21/04/2013	04/07/2013	14/09/2013
RC211	21/04/2013	04/07/2013	14/09/2013
RC212	21/04/2013	16/07/2013	13/09/2013
RC213	21/04/2013	04/07/2013	14/09/2013
RC214	21/04/2013	04/07/2013	13/09/2013
RC215	22/04/2013	16/07/2013	14/09/2013
RC216	21/04/2013	13/07/2013	13/09/2013

	Visit		
Transect	**1**	**2**	**3**
RC217	22/04/2013	16/07/2013	14/09/2013
RC218	21/04/2013	16/07/2013	13/09/2013
RC219	21/04/2013	04/07/2013	14/09/2013
RC220	21/04/2013	16/07/2013	13/09/2013
RC221	22/04/2013	16/07/2013	14/09/2013
RC222	22/04/2013	17/07/2013	14/09/2013
RC223	21/04/2013	13/07/2013	08/09/2013

APPENDIX B - TRAIL CAMERA LOCATION, SET-UP AND REMOVAL DATES IN 2013 BY CAMERA

Name	Install Date	Removal Date	Location	Name	Install Date	Removal Date	Location
EA001_1*	16-Apr-13	*NA*	15 V 348117 6257275	EA011_2	16-Apr-13	15-Jul-13	15 V 351490 6249727
EA002_1	16-Apr-13	04-Jul-13	15 V 346498 6256572	EA011_3*	16-Apr-13	*NA*	15 V 351086 6249723
EA003_1†	16-Apr-13	30-Jun-13	15 V 347340 6259626	EA011_4	16-Apr-13	11-Jul-13	15 V 351104 6249557
EA004_1*	16-Apr-13	*NA*	15 V 344780 6254104	EA011_5	16-Apr-13	11-Jul-13	15 V 351837 6249652
EA004_2	16-Apr-13	10-Jul-13	15 V 344631 6254705	EA012_1*	17-Apr-13	*NA*	15 V 350137 6250636
EA005_2	16-Apr-13	15-Jul-13	15 V 344670 6256098	EA013_1	16-Apr-13	15-Jul-13	15 V 353930 6250783
EA005_3	16-Apr-13	15-Jul-13	15 V 344225 6256286	EA013_2	16-Apr-13	15-Jul-13	15 V 353761 6250890
EA005_1	16-Apr-13	15-Jul-13	15 V 344155 6256034	EA013_3	16-Apr-13	16-Jul-13	15 V 354407 6250839
EA006_1*	16-Apr-13	*NA*	15 V 343628 6254365	EA014_2	16-Apr-13	01-Jul-13	15 V 353664 6256733
EA007_3	17-Apr-13	15-Jul-13	15 V 347395 6255476	EA014_1	16-Apr-13	01-Jul-13	15 V 353784 6256715
EA007_1	17-Apr-13	15-Jul-13	15 V 347348 6255503	EA015_1	16-Apr-13	16-Jul-13	15 V 355664 6256955
EA008_2	17-Apr-13	16-Jul-13	15 V 348058 6253275	EA015_2*	16-Apr-13	*NA*	15 V 356068 6257012
EA008_3	17-Apr-13	16-Jul-13	15 V 347985 6253600	EA015_3*	16-Apr-13	*NA*	15 V 356040 6256926
EA008_1	16-Apr-13	04-Jul-13	15 V 347565 6253720	EA016_1	17-Apr-13	16-Jul-13	15 V 366994 6245191
EA009_3	16-Apr-13	04-Jul-13	15 V 343219 6251252	EA016_2	17-Apr-13	16-Jul-13	15 V 366437 6245386
EA009_2†	16-Apr-13	09-Jun-13	15 V 343420 6251066	EA017_1	17-Apr-13	15-Jul-13	15 V 363951 6243243
EA009_1*	16-Apr-13	*NA*	15 V 343029 6251262	EA018_2	17-Apr-13	16-Jul-13	15 V 362543 6243591
EA010_3	16-Apr-13	16-Jul-13	15 V 353166 6254848	EA018_1	17-Apr-13	16-Jul-13	15 V 362518 6243470
EA010_2†	16-Apr-13	30-Jun-13	15 V 351691 6255018	EA019_1	17-Apr-13	16-Jul-13	15 V 363300 6242183
EA010_4	16-Apr-13	16-Jul-13	15 V 353181 6254962	EA020_2	17-Apr-13	16-Jul-13	15 V 360937 6243232
EA010_5	16-Apr-13	16-Jul-13	15 V 352168 6254769	EA020_3	17-Apr-13	16-Jul-13	15 V 361544 6243252
EA010_6	16-Apr-13	04-Jul-13	15 V 350590 6255726	EA020_1	17-Apr-13	16-Jul-13	15 V 361140 6243358
EA010_1	16-Apr-13	15-Jul-13	15 V 351567 6255176	EA021_1	16-Apr-13	15-Jul-13	15 V 358251 6244512
EA011_1*	16-Apr-13	*NA*	15 V 351568 6249708	EA021_2	16-Apr-13	15-Jul-13	15 V 358265 6244612

*Data lost due to damage by forest fires.
†Camera damaged in June but data recovered.

APPENDIX C - ACCESS ROAD TRANSECT ESTABLISHMENT DATES IN 2013 BY TRANSECT

Transect	Visit*	Date
NNR001	1	04-Apr-13
NNR002	1	05-Apr-13
NNR003	1	06-Apr-13
NNR004	1	06-Apr-13
NNR005	1	07-Apr-13
NNR006	1	07-Apr-13
NNR007	1	08-Apr-13
NNR008	1	08-Apr-13
SNR001	1	09-Apr-13
SNR002	1	09-Apr-13
SNR003	1	10-Apr-13

*Forest fires precluded second and third visits to access road transects in July and September, 2013.

APPENDIX D – PHOTOGRAPHS

Photo D-1. Caribou crossing the Nelson River and moving east along the north shore of the Nelson River.

Photo D-2. Caribou crossing the Nelson River. Birthday Rapids and downstream ice jams are visible to the west in the background.

Photo D-3. Caribou crossing Stephens Lake 7 km south of PR 280.

Photo D-4. Caribou crossing the Nelson River 4 km west of Gillam. Kettle Generating Station and the town of Gillam are visible to the southeast in the background.

Photo D-5. Truck damage after a moose collision at Kilometre 11 of the access road on November 18, 2013.

Photo D-6. Arctic fox observed in the KIP start-up camp in mid-December, 2013.

APPENDIX E – CARIBOU SCAT GENETIC ANALYSIS

Manitoba Hydro Report_2013-09-19:

Cornelya Klütsch[1], Micheline Manseau[2,3], Paul J. Wilson[1]

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Background

A batch of fecal pellets was collected in and around Gillam, Manitoba in February 2013 and submitted by Wildlife Resource Consulting Services MB Inc. for Manitoba Hydro to Trent University for genetic analysis. The objective of the genetic analysis was to determine the type and population of caribou sampled at the time.

Material and Methods

A Manitoba data set was compiled including previously analysed samples (e.g., Ball *et al*. 2010) from the southern part of the province as well as the newly submitted batches from Northern Manitoba. All samples were analysed with 10 microsatellite loci. Microsatellites are genetic markers that consist of tandem repeats of 1–6 nucleotides (e.g., CACACA) found at high frequencies in the nuclear genomes of most taxa (e.g., Selkoe & Toonen 2006). The main advantage of these genetic markers is a high mutation rate that results in a high resolution. Therefore, these markers are widely used in population genetic studies and forensics where often closely related individuals are studied. All samples were independently scored by two scorers to ensure high quality of allele scores and samples that failed or showed ambiguous scores were re-amplified for filling-in gaps and conformation, respectively. A few individuals were discarded from the analysis, because too few microsatellite loci amplified. This might have been caused by inhibitors and/or degraded DNA preventing reliable amplification. Subsequently, the software program STRUCTURE (Pritchard *et al*. 2000; Falush *et al*. 2003) was used to determine the most likely number of population clusters (K). The STRUCTURE algorithm attempts to identify the number of groups (K) of individuals in the dataset that minimizes linkage disequilibrium and deviations from Hardy-Weinberg equilibrium. As a result, population structure might be detected in a given data set as well as an estimate for membership coefficient (q) for each individual.

Results

In total, four genetic clusters were identified by STRUCTURE that are represented with four different colours in Fig. 1.

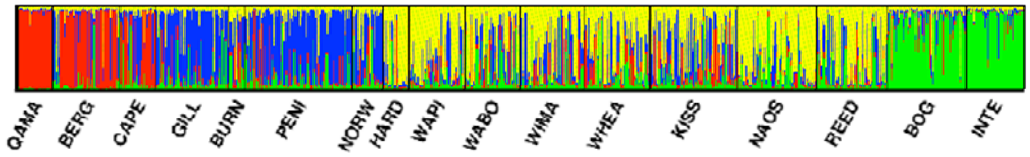

Figure 1. Four genetic clusters detected by STRUCTURE. Sampling collections shown:

- Red cluster = Qamanirjuaq (QAMA), some of the old samples from R. Berger (BERG), and some of the Cape Churchill (CAPE) samples
- Blue cluster = Gillam (GILL), Burntwood Lake (BURN), Pen Island (PENI), Norway House (NORW), some of the old samples from R. Berger, and some of the Cape Churchill samples
- Yellow cluster = Harding Lake (HARD), Wapisu (WAPI), Wabowden (WABO), Wimapedi (WIMA), Wheadon (WHEA), Kississing (KISS), Naosap (NAOS), Reed (REED); and,
- Green cluster = The Bog (BOG) and North Interlake (INTE).

Based on these results, the samples collected in Gillam (2013) clustered with the Pen Island reference collection provided by Manitoba Conservation. The Pen Island animals are classified as Eastern Migratory caribou (DU4, COSEWIC 2011).

References

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