Keeyask Generation Project

Terrestrial Effects Monitoring Plan

Caribou Sensory Disturbance Monitoring Report

TEMP-2019-15

KEEYASK

Manitoba Sustainable Development Client File 5550.00
Manitoba Environment Act Licence No. 3107

2018 -2019

KEEYASK GENERATION PROJECT

TERRESTRIAL EFFECTS MONITORING PLAN

REPORT #TEMP-2019-15

CARIBOU SENSORY DISTURBANCE MONITORING

Prepared for

Manitoba Hydro

By

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June 2019

This report should be cited as follows:

Wildlife Resource Consulting Services MB Inc. 2019. Keeyask Generation Project Terrestrial Effects Monitoring Plan Report #TEMP-2019-15: Caribou Sensory Disturbance Monitoring. A report prepared for Manitoba Hydro by Wildlife Resource Consulting Services MB Inc., June 2019.

SUMMARY

Background

Construction of the Keeyask Generation Project (the Project) at Gull Rapids began in July 2014. The Keeyask Hydropower Limited Partnership (KHLP) was required to prepare a plan to monitor the effects of construction and operation of the generating station on the terrestrial environment. Monitoring results will help the KHLP, government regulators, members of local First Nation communities, and the general public understand how construction and operation of the generating station will affect the environment, and whether more needs to be done to reduce harmful effects.

The ranges of three migratory caribou herds extend into the Keeyask region: the Qamanirjuaq herd (Barren-ground caribou) and the Southern Hudson Bay (formerly called Pen Islands) and Cape Churchill herds (both Eastern Migratory caribou; formerly called forest-tundra or coastal caribou). Groups from these herds occasionally overwinter in the Keeyask region and leave in spring to calve.

A small group of caribou occupies the Keeyask region in spring and summer (referred to as summer resident caribou) and is known to calve on the islands in Gull and Stephens lakes and in peatland complexes (raised treed patches surrounded by low, wet areas, which essentially act as islands). Summer resident caribou move within and likely beyond the Keeyask region in the winter months, but the extent of their core range is unknown. These caribou remain in the Keeyask region to calve, but it is unclear whether the same individuals calve in the area in consecutive years.

Predicted Project effects on summer resident caribou in the Keeyask region include the loss of physical habitat from clearing and development and the effective loss of habitat due to sensory disturbance (e.g., noise and light from construction activities). Caribou may temporarily avoid or less frequently use otherwise suitable habitat near construction sites due to the sounds, odours, and sights caused by construction activities. A lesser effect may also occur near Project infrastructure and roads during the operation phase. Caribou movement patterns in and through the Keeyask region could also be affected by the Project.

Why is the study being done?

Caribou calving on islands in lakes and in mainland habitat near the Project may be affected by the loss of effective habitat due to noise and light disturbance. The goal of this study is to monitor the effect of these disturbances on caribou distribution and relative abundance near the Project during construction and operation. At the same time, monitoring of other large mammals may provide an indication of the effects of potential changes in the distribution of alternative prey (moose) and predators (black bear and gray wolf) on the caribou population.

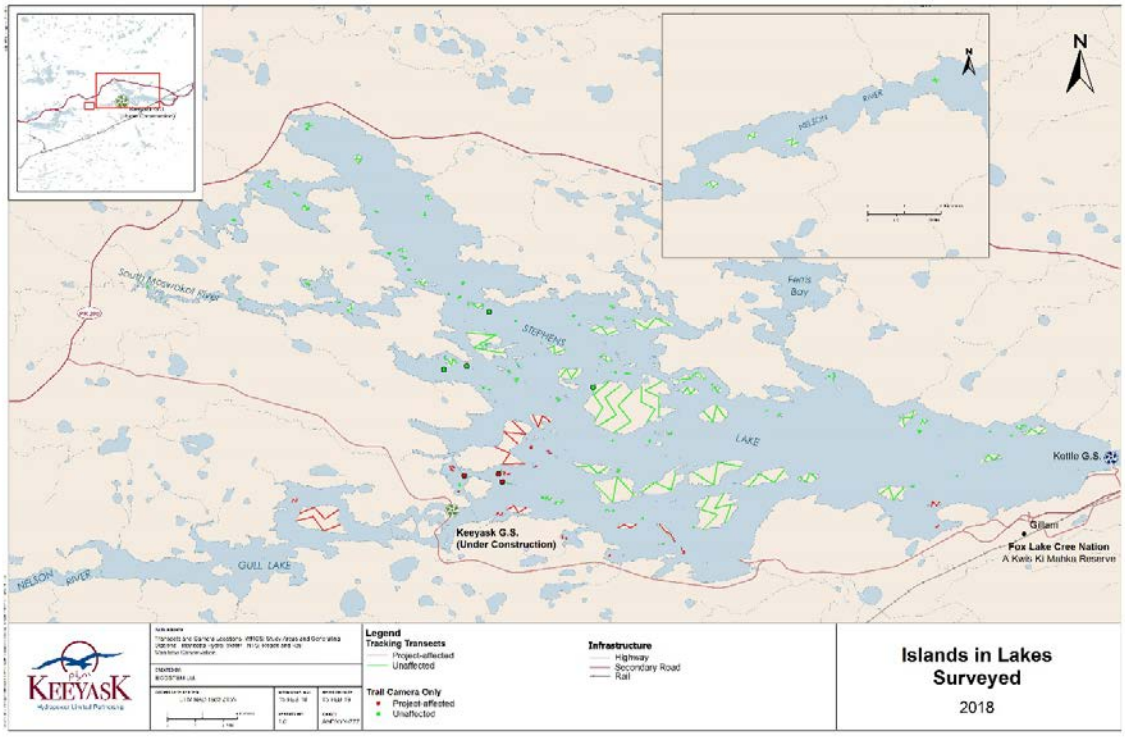
What was done?

Ground tracking transects and trail cameras were used to gather information on caribou (and other large mammal) use of islands in lakes, mainland habitat, and habitat near the north and south access roads. Islands in lakes and mainland areas were surveyed as these habitats are known to be used by caribou during the calving and calf-rearing period, when caribou are sensitive to disturbance. Habitat along the north and south access roads was surveyed to determine the effects of construction traffic disturbance on caribou and other large mammals.

Most ground tracking transects were visited three times in 2018, timed to coincide with periods in the caribou calving and calf-rearing season. The initial visit was in April, prior to cow arrival, to ensure animals were not disturbed during calving. The second visit was in July, to coincide with the early calf-rearing period. The third visit was in September, during the mid to late calf-rearing period. During each visit, signs (e.g., tracks and droppings) of caribou and other large mammals were recorded.

A trail camera was placed on most ground tracking transects on islands in lakes and within each mainland habitat surveyed during the initial visit. Trail cameras were placed where caribou activity was most likely to be detected (i.e., heavily used game trails, large openings). Photographs were reviewed following camera removal, and the species, number, and sex (where possible) of photographed animals was noted.

The timing of ice breakup on Gull and Stephens lakes was also monitored using trail cameras deployed along the shorelines, to see how it corresponds with the use of the islands in the lakes by caribou.



What was found?

Caribou occupied 54% of the islands in lakes surveyed in 2018, 9% of which were also occupied by calves. During the pre-construction period (2010 to 2014), the percentage of islands on which caribou and their calves were detected declined. The trend continued in 2015 and then reversed in 2017, when caribou and calves were detected on a greater percentage of islands than in 2015. The declining trend resumed in 2018. As predicted in the EIS, many Project-affected islands were unoccupied by caribou in 2018. However, there was also less caribou activity on unaffected islands than in previous survey years.

The percentage of ice cover on Stephens Lake remained consistent from April until mid- to late May and then decreased rapidly. Ice breakup was on May 27 and Stephens Lake was free of ice by June 3. Ice breakup was May 22 on Gull Lake, with no ice remaining on June 2.

Caribou on an Island in Stephens Lake in 2018

Caribou occupied 66% of all surveyed mainland habitat areas, 19% of which were also occupied by calves. Caribou activity was found in the smallest percentage of Project-affected mainland habitats. Caribou occupied more unburned than burned habitats. Signs of calves were only found in one burned mainland habitat.

On access road transects the density of caribou signs was greater beyond 2 km from the access roads than within 2 km. No calf signs were found within 2 km of the access roads and there was also very little calf activity further from the roads.

What does it mean?

While the spring and summer distribution of caribou in Gull and Stephens lakes can vary from year to year, the potentially unoccupied islands near the Project site may indicate avoidance of habitat by some individuals due to construction-related sensory disturbances. However, some Project-affected islands continued to be occupied by caribou. As caribou can eventually get used to human disturbance, some animals may be less affected by ongoing construction activity than others. While caribou activity was found on fewer Project-affected islands in 2018 than in 2017, caribou activity on unaffected islands also declined, suggesting that caribou were not re-locating to undisturbed islands in Stephens Lake as may be expected. An overall decrease in the amount of caribou activity in the Keeyask region may have been observed.

Caribou activity was found in fewer Project-affected mainland habitats than in unaffected habitats and in more unburned than burned habitats. Caribou tend to avoid forest that is less than 50 years old but may pass through regenerating forest to get from one patch of more suitable habitat to another. Caribou may also use recently burned habitat in summer, when they eat young, green vegetation. Unlike in 2017, there appeared to be less calving activity in mainland habitat than on islands in lakes. The near absence of calf activity in burned mainland habitat suggests that cows avoid recently burned areas when calving.

It is unclear why there appeared to be more caribou activity near the access roads than further away in 2015 and 2017 but not in 2018. Results in 2018 conformed to EIS predictions, as some, but not all, caribou were generally expected to avoid areas within 2 km of the access roads. As caribou can tolerate some human disturbance, some individuals may be less affected by traffic noise than others, and the extent of the noise effect may have been greater in the spring and summer of 2018 than in previous years. Potential differences in habitat quality closer to and farther from the road, possibly related to fire or other factors, could also have influenced caribou distribution.

What will be done next?

Trail camera surveys conducted in from 2015 to 2018 will be repeated in 2019 and ground tracking and trail camera surveys will be conducted in 2020. Information from this caribou monitoring study will be provided to the Keeyask Caribou Coordination Committee (KCCC) to support the Partnership's monitoring activities and collaborate, if requested, on the development of broader common research goals and perspectives with Manitoba Hydro, Manitoba Sustainable Development, and local stakeholders.

A multi-year monitoring synthesis report will provide an integrated evaluation of Project effects on caribou distribution and abundance, the availability of suitable habitat, and habitat effectiveness using results from this monitoring study as well as relevant information from other caribou monitoring programs for the Project.

STUDY TEAM

We would like to thank Sherrie Mason and Rachel Boone of Manitoba Hydro and Ron Bretecher of North/South Consultants Inc. for logistical assistance in the field. We would also like to thank James Ehnes of ECOSTEM Ltd. for GIS support and mapping. Biologists and other personnel who designed, participated in, and drafted the survey results included:

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1.0 INTRODUCTION

Construction of the Keeyask Generation Project (the Project), a 695-megawatt hydroelectric generating station (GS) and associated facilities, began in July 2014. The Project is located at Gull Rapids on the lower Nelson River in northern Manitoba where Gull Lake flows into Stephens Lake, 35 km upstream of the existing Kettle GS.

The *Keeyask Generation Project Response to EIS Guidelines* (the EIS), completed in June 2012, provides a summary of predicted effects and planned mitigation for the Project. Technical supporting information for the terrestrial environment, including a description of the environmental setting, effects and mitigation, and a summary of proposed monitoring and follow-up programs is provided in the *Keeyask Generation Project Environmental Impact Statement Terrestrial Supporting Volume* (TE SV). *The Terrestrial Effects Monitoring Plan* (TEMP) was developed as part of the licensing process for the Project. Monitoring activities for various components of the terrestrial environment were described, including the focus of this report, the use of calving and calf-rearing habitat in the Keeyask region by caribou (*Rangifer tarandus*) during the construction and operation phases.

As described in the EIS, the ranges of three migratory caribou herds extend into the Keeyask region: barren-ground caribou from the Qamanirjuaq herd and forest-tundra woodland caribou from the Pen Islands and Cape Churchill coastal caribou herds. Small groups from the Qamanirjuaq herd of barren-ground caribou will occasionally migrate from Nunavut into the Keeyask region in winter, although large numbers (10,000) have been recorded infrequently (Keeyask Hydropower Limited Partnership [KHLP] 2012). Caribou from the Cape Churchill and Pen Islands herds migrate from northern Manitoba and northern Ontario into parts of the Keeyask region in winter and return to the Hudson Bay coast in spring to calve. Larger groups of Pen Islands caribou, numbering in the hundreds, have been observed in the Keeyask region on occasion, but there are generally fewer than about 50 individuals in a typical winter (KHLP 2012).

Forest-tundra caribou have most recently been referred to as the Eastern Migratory population, and the Pen Islands herd is now called the Southern Hudson Bay subpopulation (Committee on the Status of Endangered Wildlife in Canada [COSEWIC] 2017). In April 2017, the Eastern Migratory population, which includes the Southern Hudson Bay and Cape Churchill subpopulations, was designated as Endangered by COSEWIC, mainly due to the decline in two subpopulations in Quebec and Labrador (COSEWIC 2017). The Barren-ground caribou population was designated as Threatened by COSEWIC in 2016, as many of its subpopulations are in decline, including the Qamanirjuaq (COSEWIC 2016). Neither population is currently protected under the federal *Species at Risk Act* or *The Endangered Species and Ecosystems Act* of Manitoba.

A small group of caribou occupies the Keeyask region in spring and summer (herein referred to as summer resident caribou). This group is known to calve on the islands in Gull and Stephens lakes and in peatland complexes comprised of treed islands – raised areas of mainland habitat

– surrounded by expansive, treeless wetlands. These islands in lakes and in peatland complexes (collectively referred to as calving habitat hereafter) are provided a physical barrier by the surrounding habitat and offer some protection from predators such as gray wolf (*Canis lupus)* and black bear (*Ursus americanus*). Summer resident caribou move within and likely beyond the Keeyask region, but their herd association and the extent of their core range are uncertain. While these caribou remain in the Keeyask region to calve, it is unclear whether the same individuals calve in the area in consecutive years. Genetic analysis of fecal samples collected in the region during construction monitoring showed that at least one female occupied islands in Stephens Lake over two consecutive summers (Wildlife Resource Consulting Services MB Inc. [WRCS] 2018a); however, it is unknown if she calved.

The Project may affect the distribution of caribou and their use of calving habitat due to habitat loss and alteration, sensory disturbance, and changes in the predator community. Predicted Project effects on caribou included the loss or alteration of winter and calving habitat and a reduction in habitat intactness (i.e., the degree to which habitat remains unaltered by fire and human disturbances) in the Keeyask region.

In addition to the loss of physical habitat, a Project-related loss of effective habitat due to sensory disturbance was anticipated. Caribou are particularly vulnerable to sensory disturbance during the calving period. Reproduction could be reduced if calving habitat, which composes a relatively small proportion of the Keeyask region, becomes limited. Noise generated by construction activity, blasting, and vehicle traffic may result in caribou temporarily avoiding otherwise suitable habitat near these disturbances. This loss of effective habitat for summer resident caribou is predicted to occur within 4 km of the Project construction site and within 2 km of the north and south access roads (KHLP 2012). Because caribou tend to calve solitarily and in low densities on the landscape, the presence of undisturbed calving habitat is critical for successful reproduction (Leclerc et al. 2014).

Habitat alteration may also affect the vulnerability of caribou cows and calves to gray wolves and black bears. Habitat alteration, including land clearing for trails and roads, may change or facilitate predator movements and can increase predation risk (James and Stuart-Smith 2000). Habitat alteration may also result in increased populations of alternative prey such as moose (*Alces alces*), which could increase the predator population, potentially affecting caribou mortality and reproduction (James et al. 2004; Peters et al. 2012).

As part of the TEMP, ground tracking transect and trail camera surveys were conducted to monitor changes in the distribution and relative abundance of caribou near the Project due to sensory disturbance or to changes in the predator community. The distribution and relative abundance of moose, black bear, and gray wolf were also documented to estimate the amount of alternative prey and predator activity in the region. The timing of ice breakup on Gull and Stephens lakes was monitored using trail cameras because of its potential to affect the use of islands in lakes by calving caribou.

2.0 METHODS

2.1 SURVEY METHODS

2.1.1 GROUND TRACKING TRANSECTS AND TRAIL CAMERAS

Ground tracking transect and trail camera surveys were conducted to gather information on the use of islands in lakes, peatland complexes, and habitat near the north and south access roads by caribou and three other large mammal species. Ground tracking surveys for construction phase monitoring began in 2015 and continued in 2017 and 2018. Trail camera surveys were conducted annually from 2015 to 2018. Moose were included in the surveys as they are a potential attractant for wolves, which could opportunistically prey on caribou. Black bears and gray wolves were included as they are common predators of adult caribou and calves and can influence their use of habitat. Islands in lakes and peatland complexes were surveyed as these habitats are known to support caribou during the sensitive calving and calf-rearing period. Habitat along the north and south access roads was also surveyed to determine the effects of traffic disturbance on caribou and other large mammals.

Most transects on islands in lakes, in peatland complexes, and near the access roads were visited three times in 2018; four island in lake transects and one peatland complex transect were visited once or twice. Each visit was timed to coincide with caribou calving and calf-rearing periods. The initial visit was in April, prior to cow arrival, to ensure that animals were not disturbed during calving. The second visit was in July, to coincide with the late calving and early calf-rearing period. The third visit was in September, to coincide with the mid to late calf-rearing period (Table 1).

Table 1: Start and End Dates of Survey Visits to Tracking Transects, 2018

Transect Type	Visit 1			Visit 2			Visit 3		
	Start Date	End Date	No. Days	Start Date	End Date	No. Days	Start Date	End Date	No. Days
Island in lakes	Apr. 3	Apr. 14	12	Jul. 8	Jul. 29	22	Sep. 5	Sep. 17	13
Peatland complex	Apr. 3	May 5	33	Jul. 11	Jul. 30	20	Sep. 5	Sep. 16	12
Access road	Apr. 3	May 5	33	Jul. 7	Jul. 29	23	Sep. 5	Sep. 16	12

During the initial visit, biodegradable thread was strung approximately 75 cm above ground level and anchored to trees or shrubs roughly every 20 m (Searing 1981; Demarchi and Searing 1997). Thread was used to ensure that surveying consistently occurred along the same line and

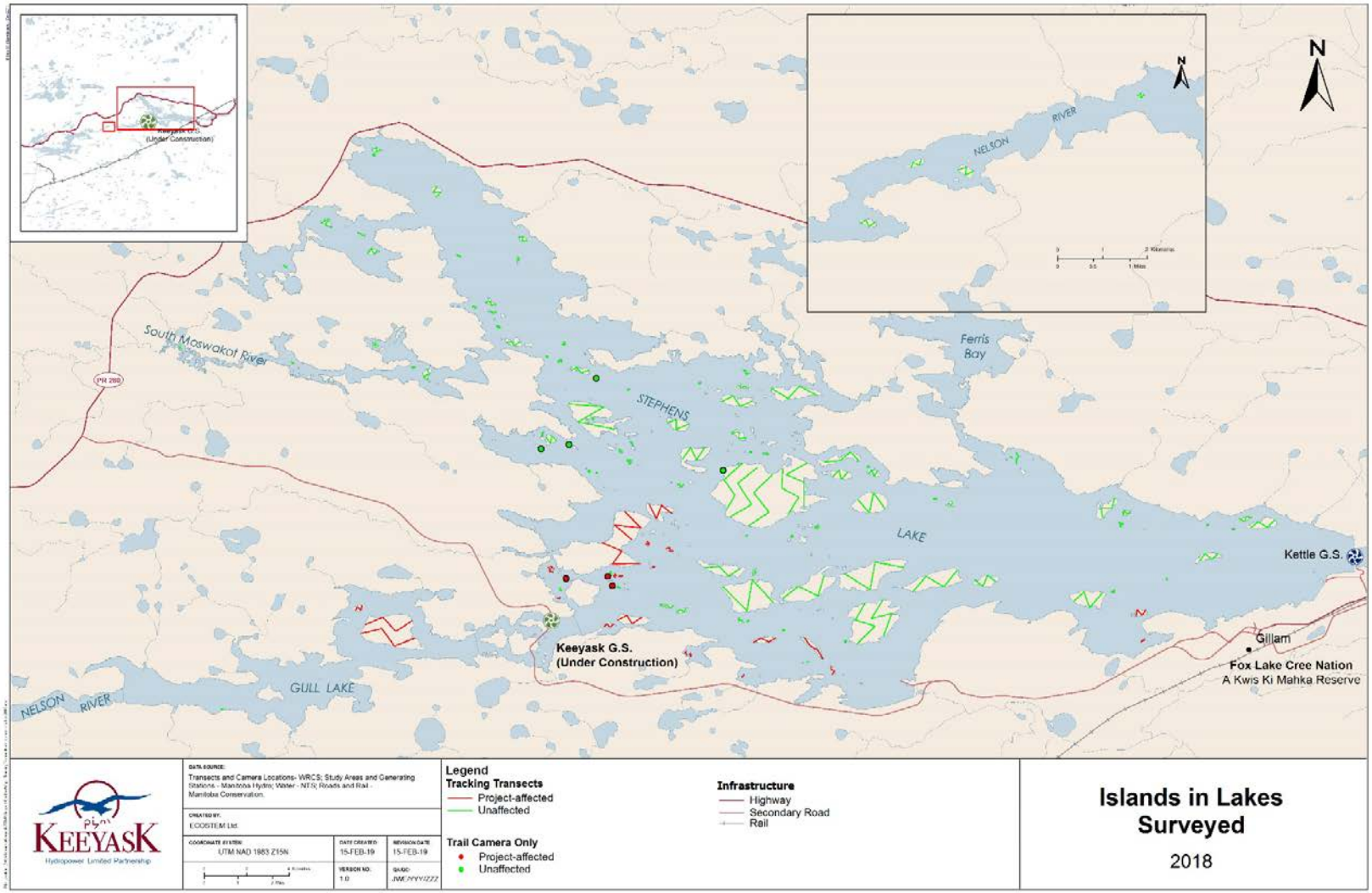
to increase sign detectability. Breaks in the thread helped identify animal movements. All signs visible up to 1 m on either side of the transect were recorded, including tracks, trails, droppings, beds, browse or feeding sites, and visual observations. The specific locations of sign were recorded using hand-held Global Positioning System (GPS) units.

During the second and third visits, large mammal activity was identified at breaks in the thread along each transect, where possible. Thread breaks observed during the second visit were repaired to allow for re-evaluation on the third visit. The locations of all thread breaks were recorded with a GPS unit. Signs such as tracks and scat were used to identify the species responsible for each thread break, where possible.

2.1.1.1 ISLANDS IN LAKES

For the tracking transect study, islands greater than 5 ha in size in Gull and Stephens lakes and upstream in the Nelson River with more than 5% tree cover were selected ("islands in lakes"). These islands were classified by their distance to Project-related disturbance, where those within 2 km of borrow areas or Project infrastructure or within 4 km of the generating station construction site were "Project-affected" and those beyond were "unaffected" (KHLP 2015). A total of 122 transects were surveyed on 113 islands in Stephens and Gull lakes in 2018, all of which were surveyed in previous years (Appendix 1, Table A-1). Twenty-four transects totalling 25.5 km in length were surveyed on 22 Project-affected islands and 98 transects totalling 104.4 km in length were surveyed on 91 unaffected islands. Transect length was proportional to island size. One transect was typically established on each island. However, six of the largest islands (>300 ha) were divided into 150-ha units, with one transect surveyed in each (Map 1). In general, "Z"-shaped transects were established across islands to maximize the detection of mammal signs (e.g., tracks and droppings).

A Reconyx™ PM35C31 trail camera was placed on all but four island transects during the initial visit. All were at the same locations as in 2015, 2016 and/or 2017, the previous trail camera monitoring years for caribou (Appendix 1, Table A-2). Eight cameras were placed at locations independent of transects. In all, 126 cameras were deployed on 115 islands, each where caribou activity would likely be detected (i.e., heavily used game trails, large openings). Batteries and memory cards were exchanged during the second visit to tracking transects, and the cameras were removed during the third visit. Photographs were reviewed following removal of memory cards, and the species, number, and sex of photographed animals was determined, where possible.



Map 1: Islands in Lakes Surveyed in 2018

2.1.1.2 PEATLAND COMPLEXES

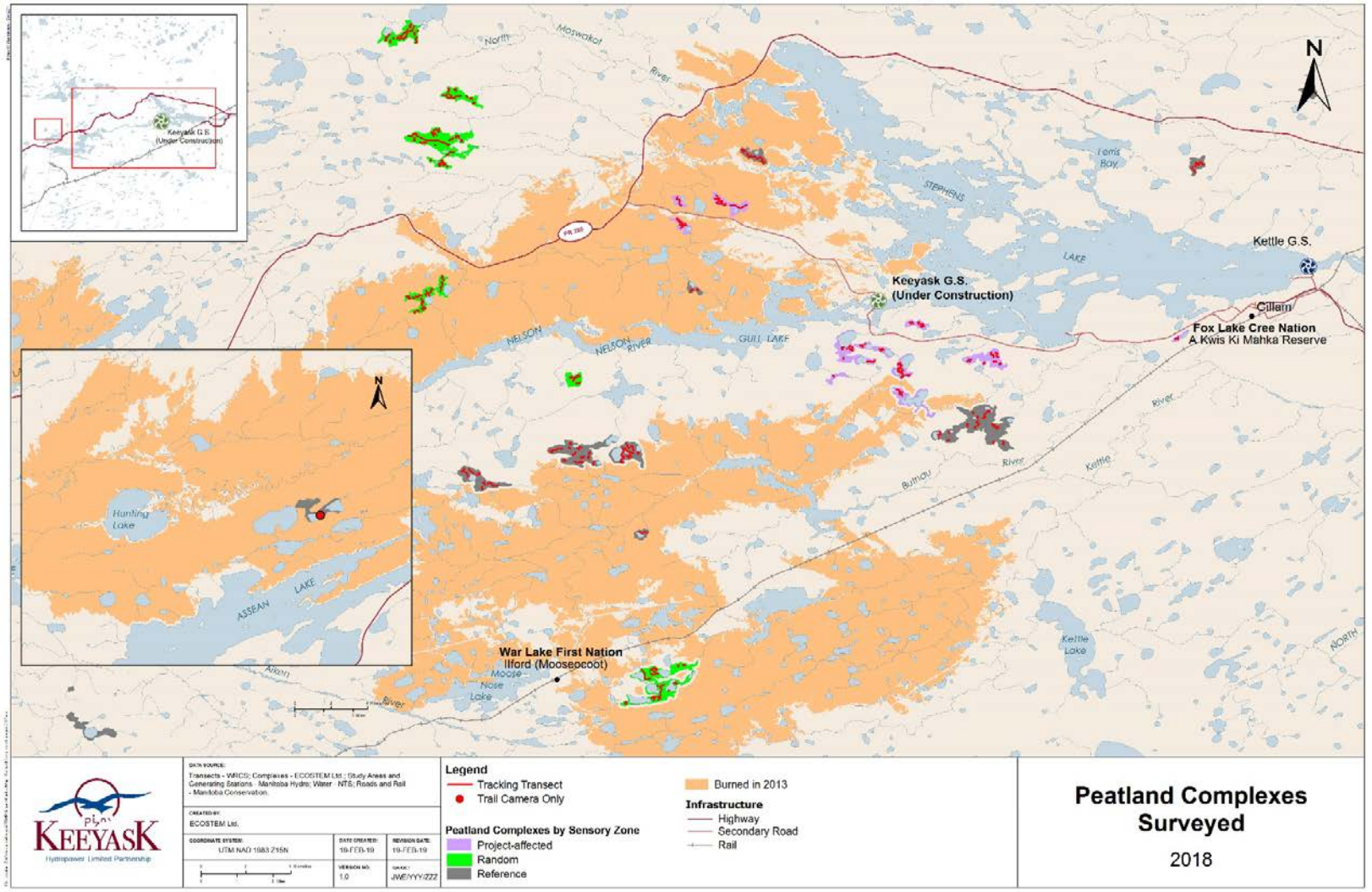
Peatland complex tracking transects were established on raised mainland habitat "islands" within a wet bog matrix. Peatland complexes were selected and categorized based on their distance to a disturbance source. Project-affected peatland complexes were within 4 km of the Project construction site or within 2 km of the north or south access roads, and where disturbance was generated only from these features. For each Project-affected peatland complex, a reference peatland complex similar in size and with similar habitat characteristics but not affected by sensory disturbance (i.e., more than 4 km from the Project construction site and more than 2 km from the access roads) was selected. Random peatland complexes were selected randomly from undisturbed areas to act as a reference for natural variability. The state of Project-affected, reference, and random peatland complexes relative to the forest fires in 2013 (burned or unburned) was also identified.

Like the islands in lakes, tracking transects in peatland complexes were "Z" shaped and varied in length depending on habitat island size. One hundred and eighty-eight transects were surveyed in 31 peatland complexes, totalling 112.2 km in length (Table 2, Map 2). The number of transects in each peatland complex ranged from 1 to 20, and the total length of transects in complexes ranged from 137 m to 2.9 km. All transects had been surveyed in 2015 and 2017 (Appendix 1, Table A-3).

A Reconyx™ PM35C31 trail camera was placed on one transect within each peatland complex during the initial visit, all at locations surveyed in previous years (Appendix 1, Table A-4). A single trail camera was placed in a peatland complex that was not surveyed by tracking transect (Map 2). In all, 32 trail cameras were deployed where caribou activity would likely be detected (i.e., heavily used game trails, large openings). Batteries and memory cards were exchanged during the second visit to tracking transects, and the cameras were removed during the third visit. Photographs were reviewed following removal of memory cards, and the species, number, and sex of photographed animals was determined, where possible.

Table 2: Peatland Complex Transects Surveyed in 2018

Complex Type	Number of Complexes	Number of Transects	Length of Transects (km)
Project-affected, burned in 2013	3	15	8.7
Project-affected, not burned in 2013	8	27	16.9
Reference, burned in 2013	3	9	6.0
Reference, not burned in 2013	8	53	30.0
Random, burned in 2013	4	20	11.8
Random, not burned in 2013	5	64	38.8
Total	31	188	112.2



Map 2: Peatland Complexes Surveyed in 2018

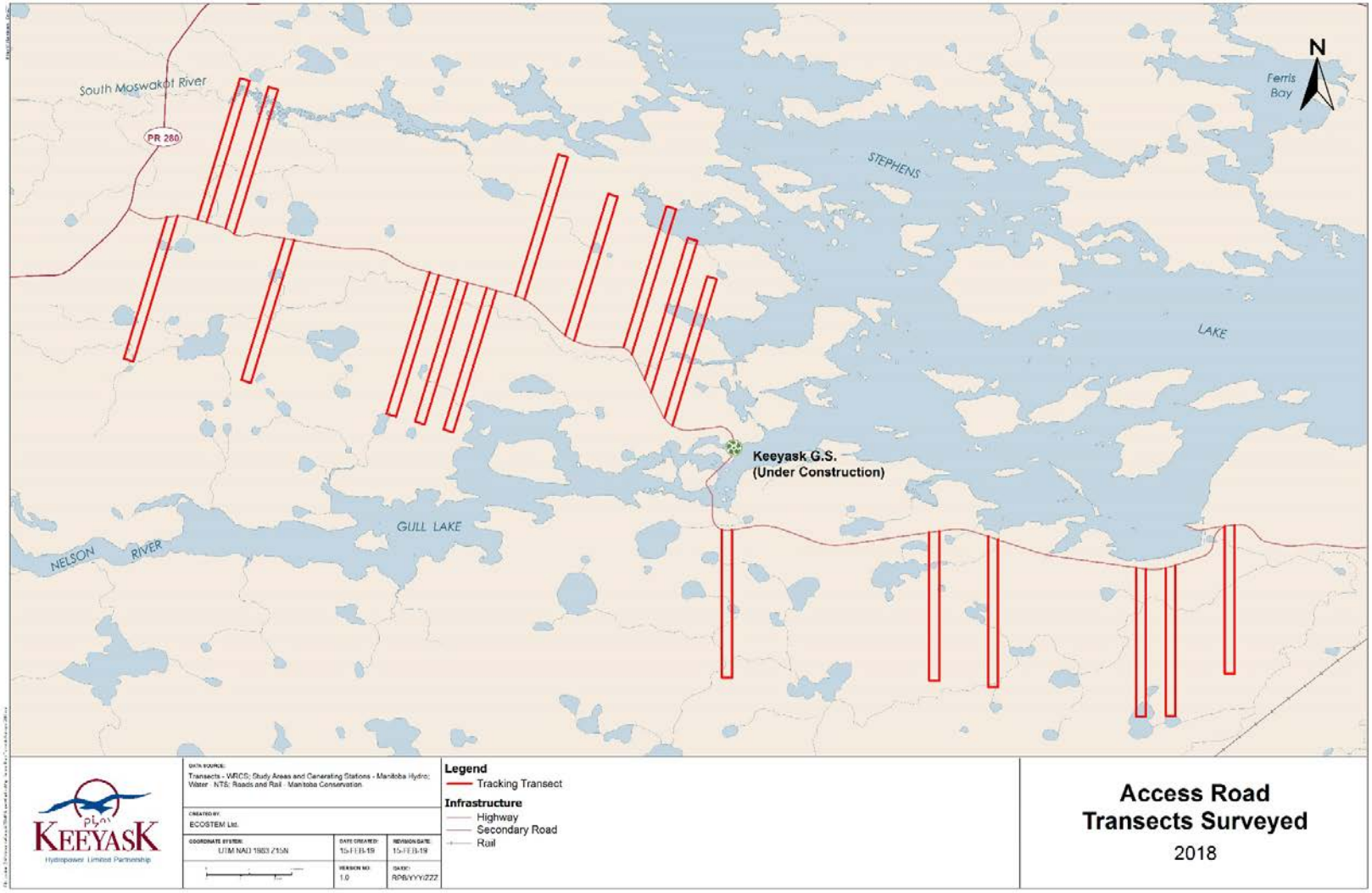
2.1.1.3 ACCESS ROAD TRANSECTS

Access road tracking transects were placed at random locations along the north and south access roads. These “U” shaped transects were perpendicular to the north and south access roads. Transects were developed to be 10.3 km long, consisting of two 5-km long portions separated by 333 m. Actual transect lengths varied due to terrain and obstacles such as water bodies or construction zones (Table 3).

Eighteen access road transects were surveyed, all of which were also surveyed in 2015 and 2017. Seven transects totalling 75.3 km in length were north of the north access road, five totalling 60.1 km were south of the north access road, and six totalling 66.5 km were south of the south access road (Map 3). Of the 201.9 km surveyed, 72 km were within 2 km of an access road, where effects of sensory disturbance on caribou were anticipated, and 129.9 km were beyond 2 km, where no sensory disturbance effects were expected.

Table 3: Access Road Transects Surveyed in 2018

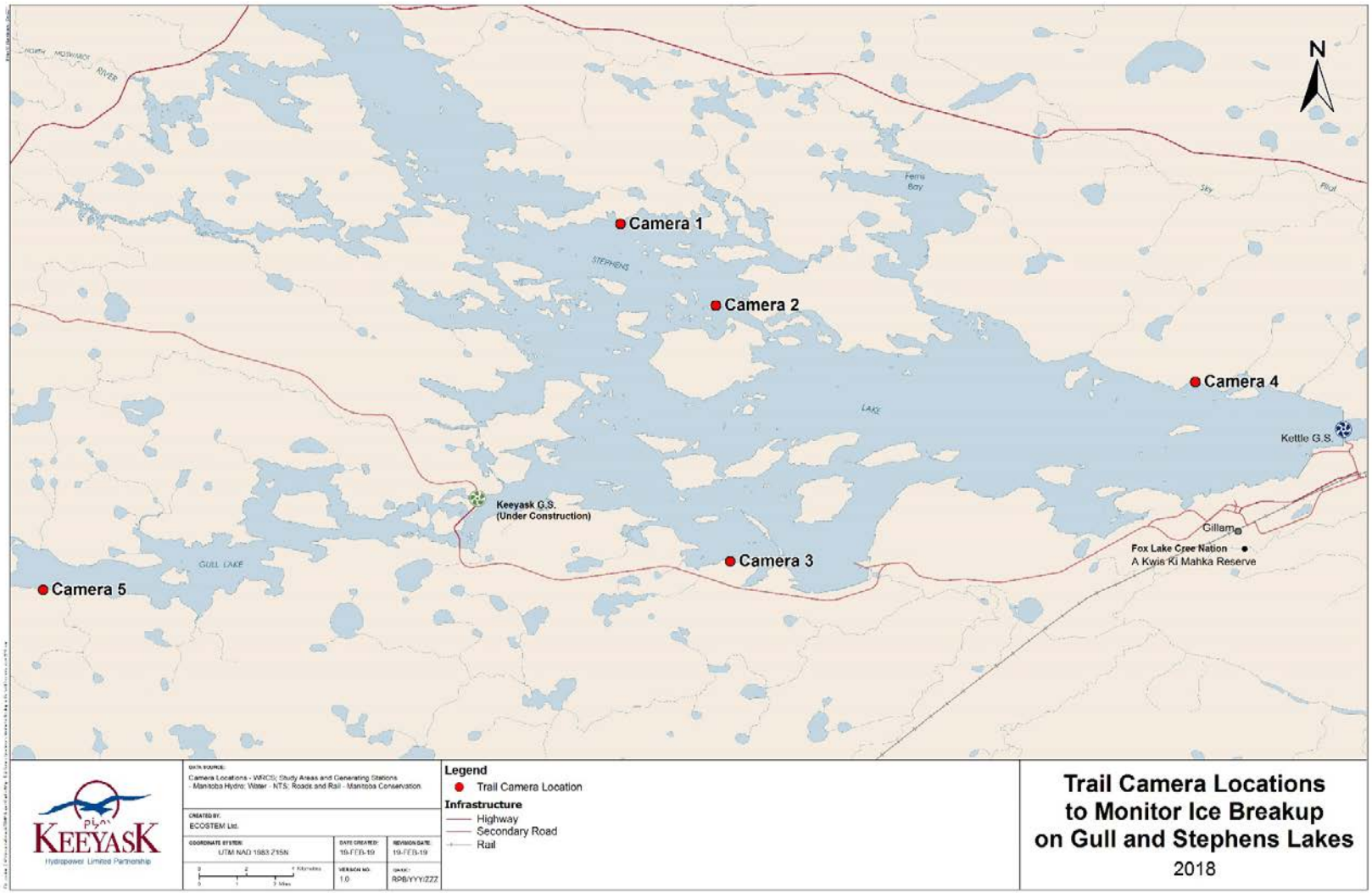
North Access Road		South Access Road	
Transect	**Length (km)**	**Transect**	**Length (km)**
N23	11.4	S1	12.1
N24	8.9	S10	12.3
N34	13.0	S15	9.8
N36	11.9	S16	11.0
N38	9.2	S18	10.1
N39	11.3	S8	11.2
N40	9.6		
S42	12.9		
S46	11.8		
S51	11.4		
S52	11.8		
S53	12.2		



Map 3: Access Road Tracking Transects Surveyed in 2018

2.1.2 TIMING OF ICE BREAKUP

Four trail cameras were placed on the shores of Stephens Lake and one was placed on the shore of Gull Lake between April 5 and 14, 2018 to monitor the timing of ice breakup (Map 4). The trail cameras, which were set to take a picture of the lake every four hours during daylight hours, were removed between July 8 and 16, 2018. Ice coverage was estimated at 25% increments in each photograph from each camera. Ice breakup was defined as the date when all cameras indicated less than 25% ice coverage in view.



Map 4: Trail Camera Locations to Monitor Ice Breakup on Gull and Stephens Lakes, 2018

2.2 DATA ANALYSIS

Ground tracking transect and trail camera data were summarized separately and then combined for a broader indication of large mammal distribution on islands in lakes and in peatland complexes in the study area. Only tracking data from the second and third visits were included in the combined data because signs observed during the first visit were of varying ages (dependent on time since last snowfall) and because the first visit was prior to the caribou calving season.

Using the combined tracking transect and trail camera data, the presence and general distribution of caribou, caribou calves, moose, and moose calves were examined for each island and peatland complex. A total of 117 islands in lakes and 32 peatland complexes were surveyed. Large mammals were considered present on an island or in a peatland complex where their sign was observed on one or more tracking transects and/or where they were photographed by at least one trail camera. Combined tracking transect and trail camera data were also used to identify islands in lakes and peatland complexes occupied by caribou and by moose and/or predators during the survey period, as the presence of moose, black bears, or gray wolves on islands or in peatland complexes occupied by caribou can provide an indication of the influence of predators and alternative prey (moose) on the selection of calving and calf-rearing habitat by caribou.

For access road tracking transects, sign density (signs/km) was calculated using the distance surveyed during the initial visit in April to describe large mammal activity. The activity of caribou and other large mammals within 2 km of the north and south access roads and subject to sensory disturbance (Project-affected) was compared with activity in areas further away and not subject to sensory disturbance (unaffected; KHLP 2015).

3.0 RESULTS

3.1 GROUND TRACKING TRANSECTS AND TRAIL CAMERAS

3.1.1 ISLANDS IN LAKES

Caribou signs were observed on 61 of the 113 islands on which ground tracking transects were surveyed (Table 4; Appendix 1, Table A-5). Caribou calf signs were recorded on one island where no adult signs were found. Moose were marginally more widely distributed. Signs of all large mammal species were observed on the most islands during the second visit and on the fewest islands during the first visit. As the first visit was prior to the caribou and moose calving season, no signs of calves were observed until later visits. Black bear and gray wolf signs were observed on fewer islands than either caribou or moose. A wolverine (*Gulo gulo*) sign was also observed on one island during the first visit.

Table 4: Number of Islands in Lakes on Which Large Mammal Signs Were Observed, 2018

Species	Visit 1 (Apr. 3 to 14)	Visit 2 (Jul. 8 to 29)	Visit 3 (Sep. 5 to 17)	Visits 2 and 3 Combined	All Visits Combined
Caribou	2	50	36	61	61
Caribou calf	0	3	1	3	3
Moose	9	50	52	69	69
Moose calf	0	15	5	19	19
Black bear	0	3	5	8	8
Gray wolf	1	0	7	7	8

Caribou were photographed on 23 islands. The first caribou calf was photographed on May 21, 2018 (see Photo 1 for a caribou and calf). In previous survey years caribou calves were first photographed May 25, 2015; June 19, 2016; and June 6, 2017. Two cows and two calves were photographed together on the same island on June 3 (Appendix 2). Moose were photographed on 36 islands. The first moose calf (see Photo 2 for a moose cow and calf) was photographed on June 12, 2018. In previous survey years moose calves were first photographed June 3, 2015; May 29, 2016; and May 31, 2017. The number of islands occupied by caribou and moose appeared to peak in August and July, respectively, and then declined in August and September (Table 5). Few or no predators (black bear and gray wolf) were captured on trail cameras. No caribou were photographed on the same islands as black bears or gray wolves. No gray wolves were photographed on the same islands as moose, but there was some overlap in use of islands by moose and black bears (Table 6; see Photo 3 for a black bear). The two species were typically photographed weeks or months apart, with nine days as the shortest interval.

Table 5: Number of Islands in Lakes Occupied by Large Mammals Monthly from Trail Camera Data, 2018

Species	April	May	June	July	August	September	All
Caribou	0	5	9	10	12	5	23
Caribou calf	0	1	3	3	2	1	7
Moose	3	3	15	22	9	0	36
Moose calf	0	0	6	8	1	0	13
Black bear	1	1	0	1	2	0	5
Gray wolf	0	0	0	0	0	0	0

Table 6: Nearest Dates on Which Caribou or Moose and Predators Were Photographed on the Same Islands in Lakes, 2018

Island	Moose	Black Bear
KI122003	Aug. 1	Aug. 9
KI124047	Aug. 7	Jul. 22
KI124092	May 28	Apr. 26
KI124103	May 9	Aug. 14

Photo 1: Caribou Cow and Calf on an Island in Stephens Lake June 14, 2018

Photo 2: Moose Cow and Calf on and Island in Stephens Lake June 26, 2018

Photo 3: Black Bear on an Island in Stephens Lake July 22, 2018

When results from tracking transect visits 2 and 3 and trail camera surveys were combined, large mammal activity was detected on 93 of the 117 islands surveyed. Caribou and moose occupied 49 of the same islands, 10 of which were also occupied by black bear and/or gray wolf (Map 5). Thirteen islands were occupied by only caribou and 26 islands were occupied only by moose.

Caribou activity was widely distributed on the islands in Stephens Lake and upstream of the GS site (Map 6). Caribou occupied 54% of the islands surveyed in 2018 (Table 7). Caribou occupied a smaller percentage of Project-affected islands than unaffected islands and no calves were detected on Project-affected islands. Moose were the most widely distributed large mammal and were observed on a greater percentage of Project-affected islands than unaffected islands. Moose calves were observed on a smaller percentage of Project-affected than unaffected islands (Map 7). Black bear and gray wolf activity was observed on few islands relative to caribou and moose (Table 7; Map 8).

Table 7: Project-affected and Unaffected Islands Occupied by Large Mammals from Combined Tracking Transect[1] and Trail Camera Data, 2018

Species	Project-affected Islands		Unaffected Islands		All Islands	
	Number Occupied	Percentage Occupied	Number Occupied	Percentage Occupied	Number Occupied	Percentage Occupied
Caribou	10	40	53	58	63	54
Caribou calf	0	0	10	11	10	9
Moose	19	76	61	66	80	63
Moose calf	5	20	24	26	29	25
Black bear	4	16	7	8	11	9
Gray wolf	2	8	5	5	7	6

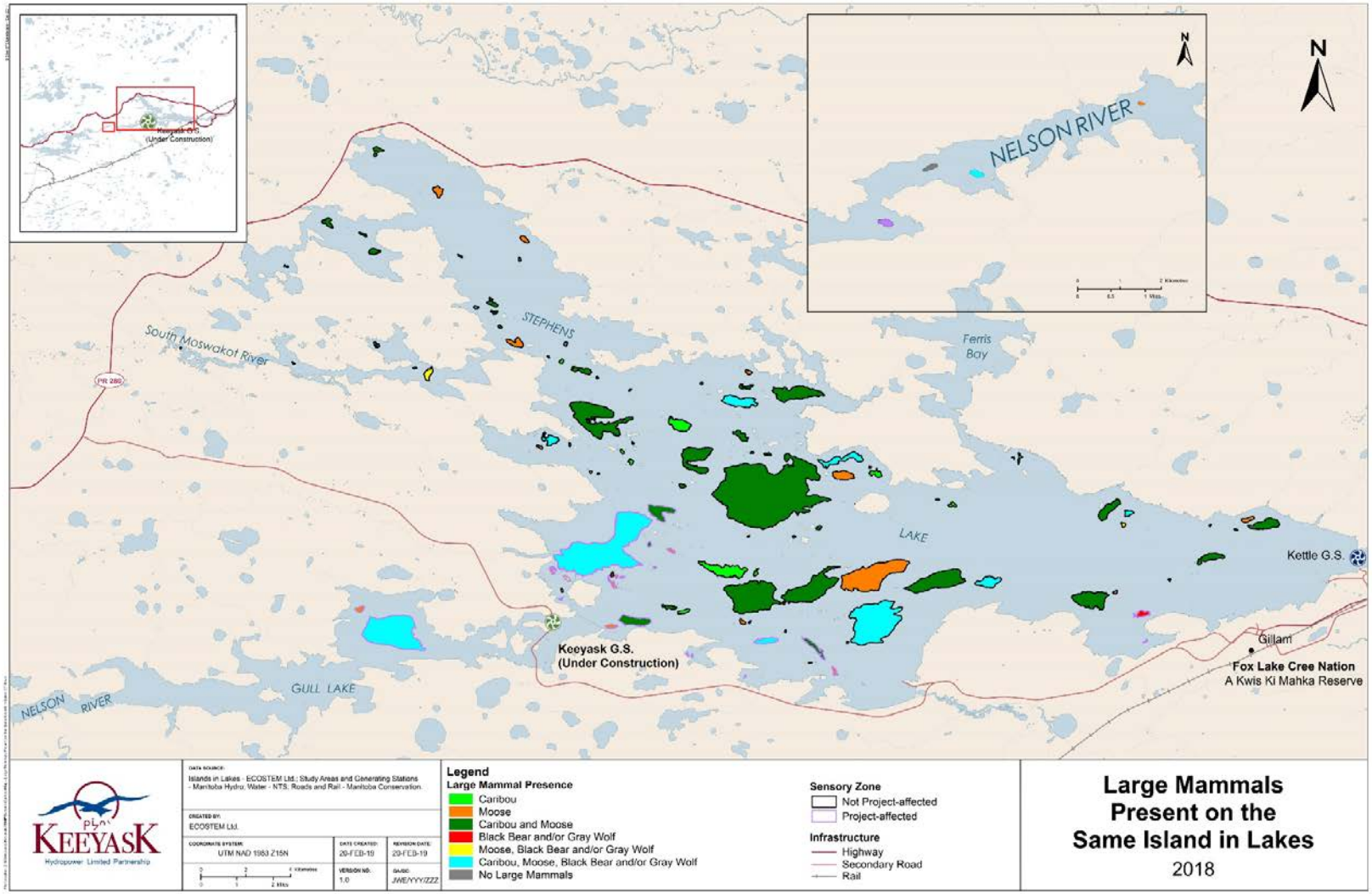
1. Visits 2 and 3 only.

While the percentage of Project-affected islands on which caribou were detected more than doubled (28% to 65%) from 2015 to 2017, it decreased 38% from 2017 to 2018 (65% to 40%; Table 8). The percentage of unaffected islands on which caribou were detected, which had increased slightly from 2015 to 2017, also decreased from 2017 to 2018, but by a smaller margin. Caribou calves were detected on a greater percentage of Project-affected and unaffected islands in 2017 than in 2015 but were absent from Project-affected islands in 2018. Caribou calves were detected on 56% fewer unaffected islands in 2018 than in 2017. The percentage of Project-affected islands on which moose were observed was similar in 2015, 2017, and 2018. The percentage of unaffected islands on which moose were observed declined from 2015 to 2017 and again in 2018. Moose calves were detected on 49% fewer Project-affected islands and on 18% more unaffected islands in 2018 than in 2017.

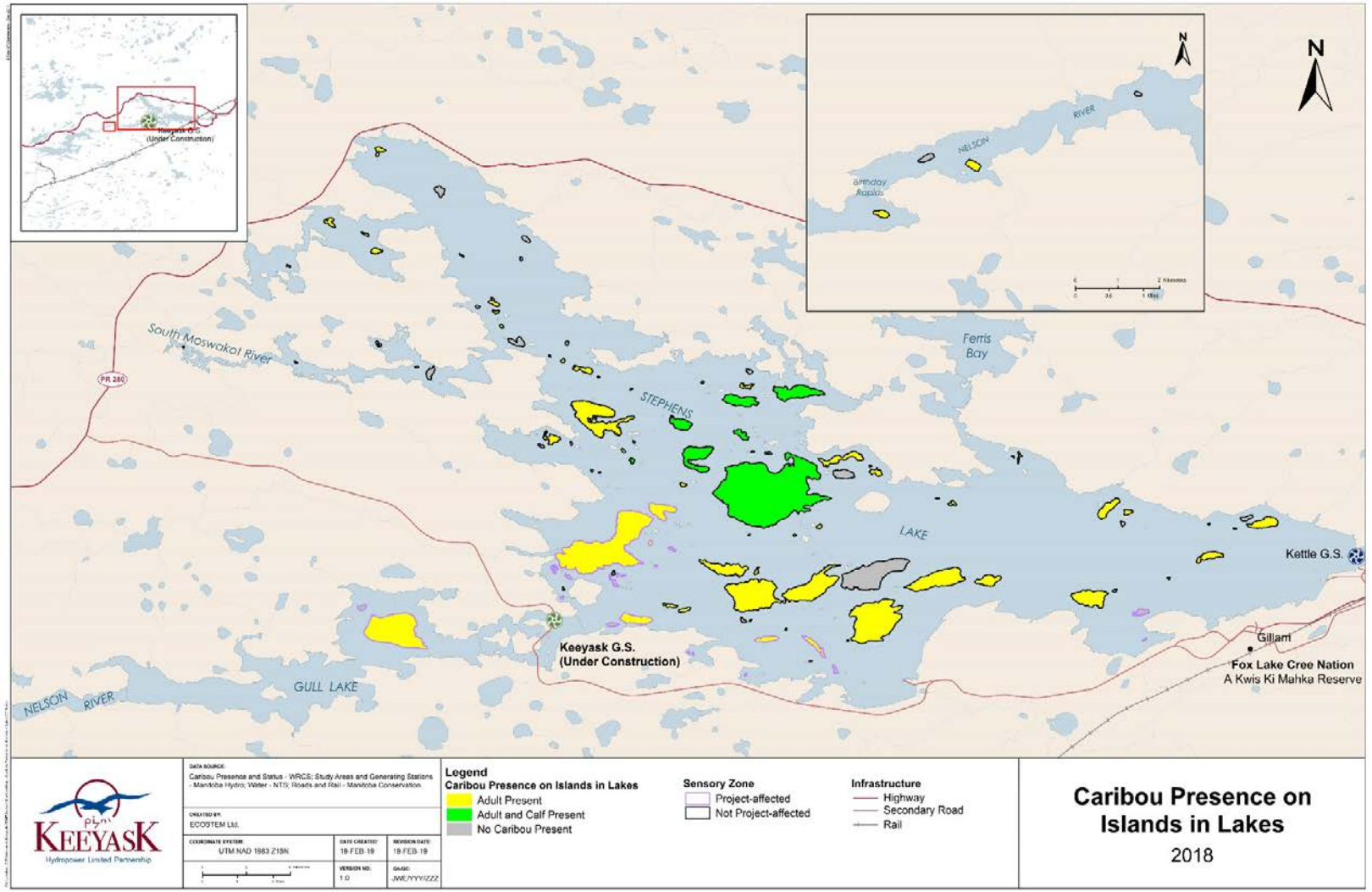
Table 8: Percentage of Project-affected and Unaffected Islands in Lakes on Which Caribou and Moose Presence Was Detected during Ground Tracking[1] and/or Trail Camera Surveys, 2015, 2017, and 2018

Species	Project-affected Islands				Unaffected Islands			
	2015	2017	2018	Percent Change 2017–2018	2015	2017	2018	Percent Change 2017–2018
Caribou	28	65	40	-38	67	70	58	-17
Caribou calf	7	8	0	-100	19	25	11	-56
Moose	79	77	76	-1	91	72	66	-8
Moose calf	31	39	20	-49	41	22	26	18

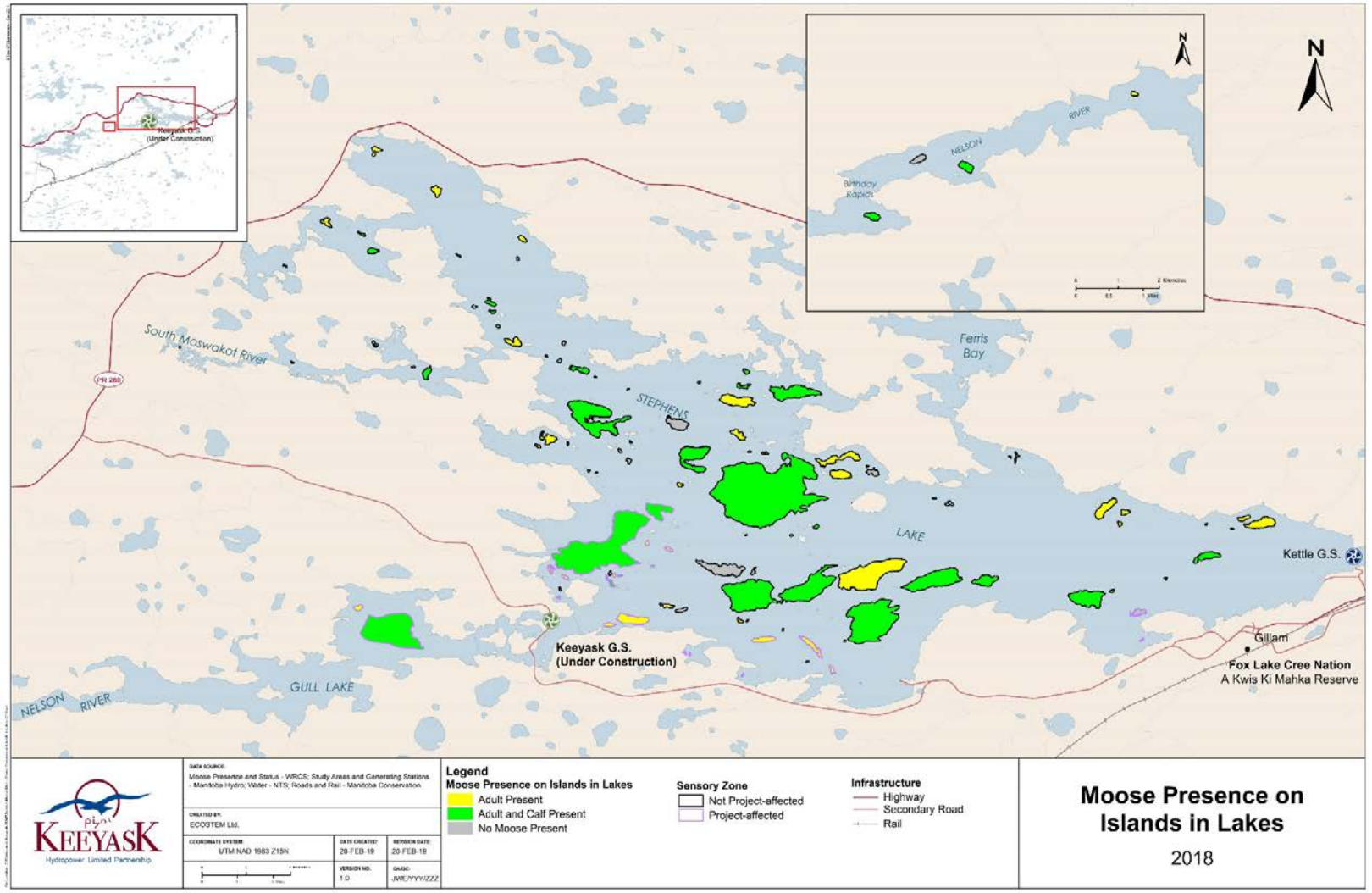
1. Visits 2 and 3 only.



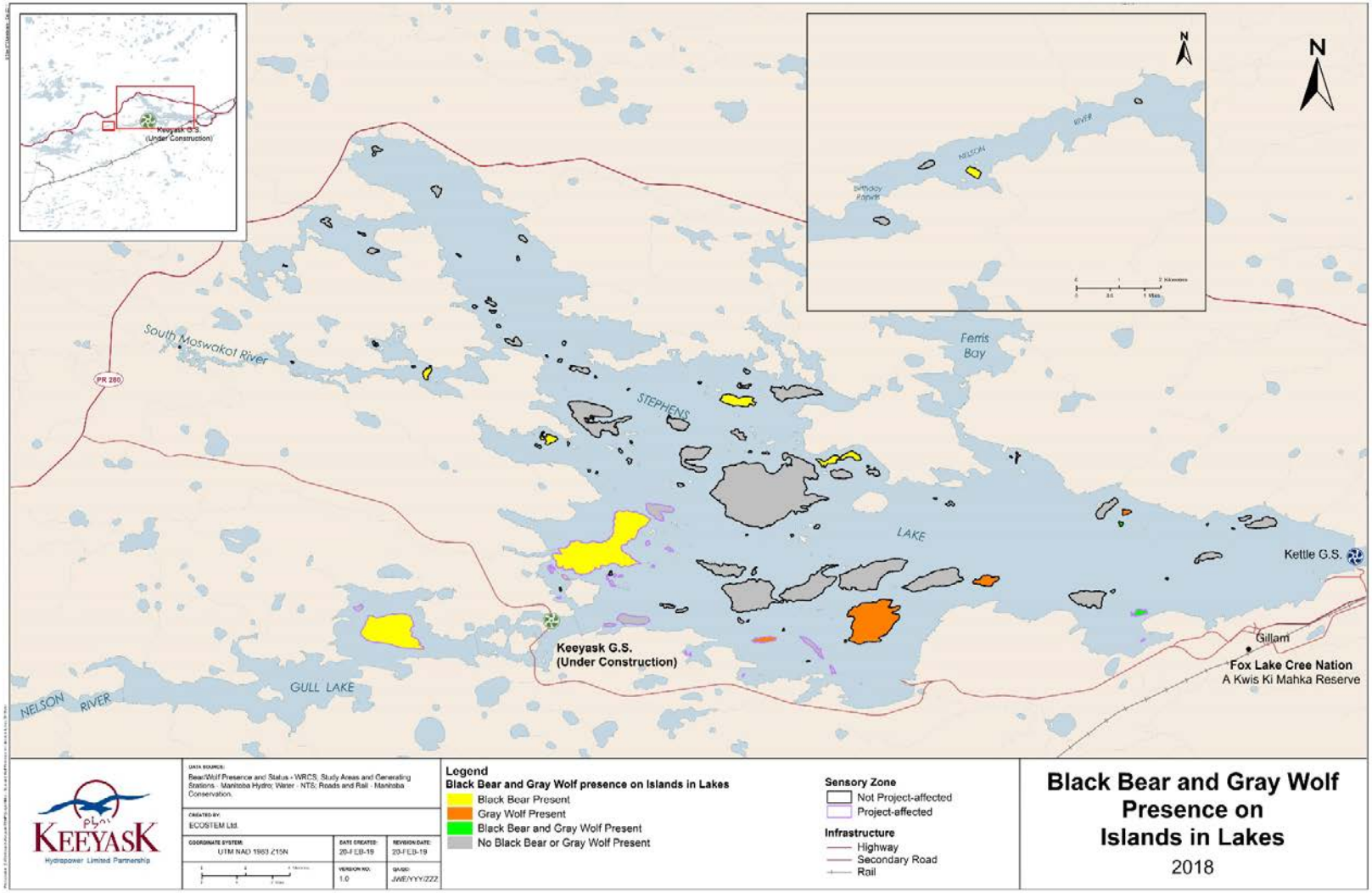
Map 5: Large Mammals Present on the Same Island in Lakes, 2018



Map 6: Caribou Presence on Islands in Lakes, 2018

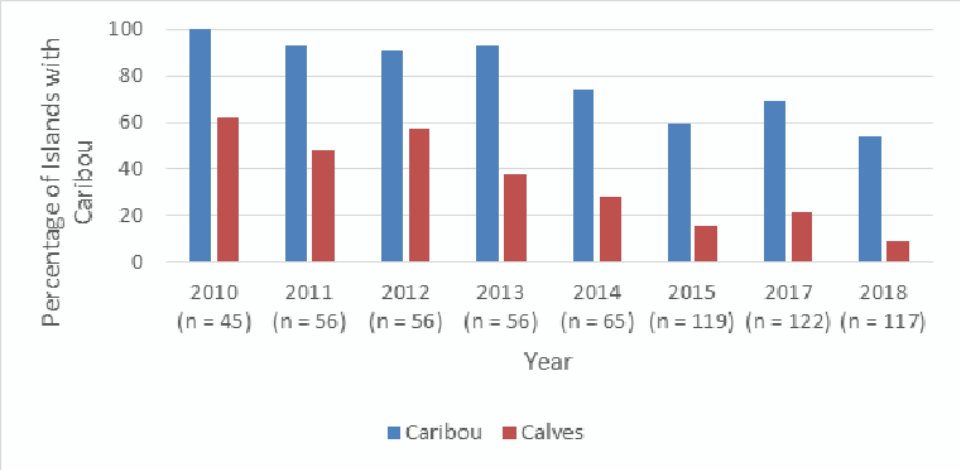


Map 7: Moose Presence on Islands in Lakes, 2018



Map 8: Black Bear and Gray Wolf Presence on Islands in Lakes, 2018

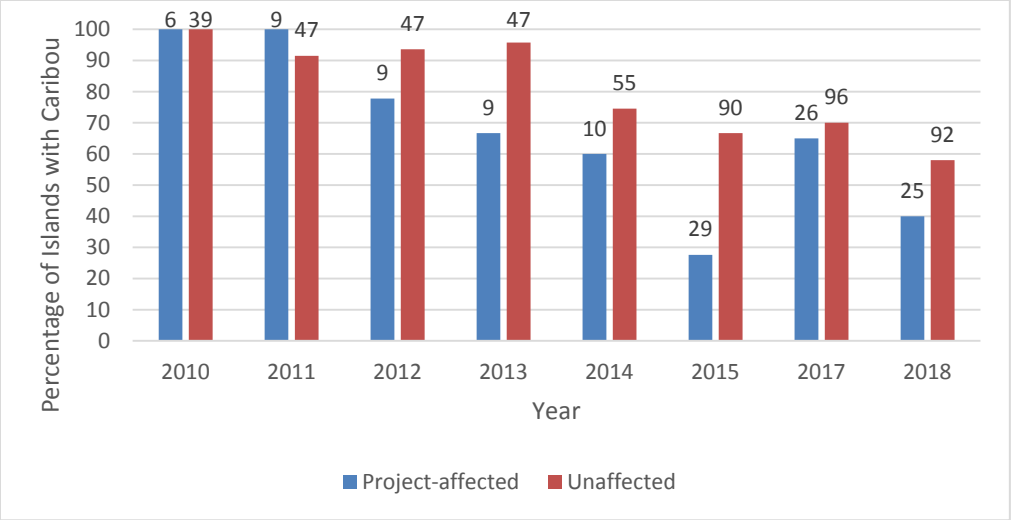
The percentage of islands in lakes on which caribou and calves were observed (from combined trail camera data and data from ground tracking visits 2 and 3 to ground tracking transects) declined from the pre-construction (2010–2014) to construction (2015-2018) periods (Figure 1). The percentage of surveyed islands in lakes on which they were detected ranged from 100% in 2010 to 74% in 2014 for caribou and from 62% in 2010 to 28% in 2014 for calves (KHLP 2012; WRCS unpubl. data). The declining trend continued during construction in 2015, when caribou were detected on 60% of islands and calves on 16% (WRCS 2016). The percentage of islands on which caribou and calf activity was observed increased to 69% for caribou and 21% for calves in 2017 (WRCS 2018b), then declined again in 2018, to 54% for caribou and 9% for calves, an overall decrease from 2015.



NOTE: “n” indicates the number of islands surveyed each study year.

Figure 1: Percentage of Islands in Lakes on Which Caribou Activity Was Observed from Combined Trail Camera and Tracking Transect Data, before (2010–2014) and during (2015–2018) Construction

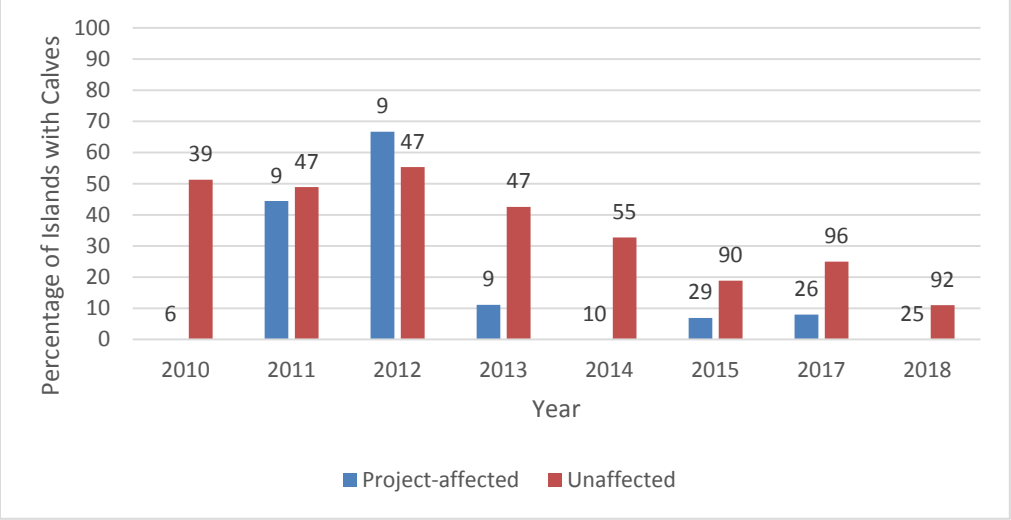
During the 2010–2014 pre-construction period, 6 to 10 Project-affected and 39 to 55 unaffected islands were surveyed, most of which were also surveyed from 2015 to 2018. The percentage of Project-affected islands on which caribou activity was detected declined steadily before construction began, from 100% in 2010 and 2011 to 60% in 2014 (Figure 2). During construction, caribou activity continued to decline on Project-affected islands in 2015 and then increased in 2017. On unaffected islands, caribou activity was similar to or greater than activity on Project-affected islands during the pre-construction and construction periods. A decline in caribou activity from the pre-construction to construction periods was also observed on unaffected islands but was less pronounced than the decline on Project-affected islands. Before construction, caribou activity was detected on 93 to 100% of unaffected islands from 2010 to 2013, and on a somewhat smaller percentage (75%) in 2014. During construction, caribou activity was observed on 58 to 70% of unaffected islands.



NOTE: Data labels indicate the number of Project-affected and unaffected islands surveyed each study year.

Figure 2: Percentage of Project-affected and Unaffected Islands on Which Caribou Activity Was Observed from Combined Trail Camera and Tracking Transect Data, before (2010–2014) and during (2015–2018) Construction

Caribou calves were detected on a greater percentage of unaffected than Project-affected islands in all years before and during construction except for 2012 (Figure 3). No calves were observed on Project-affected islands in 2010, 2014, or 2018. The percentage of Project-affected and unaffected islands on which calves were detected declined from the pre-construction to construction periods.



NOTE: Data labels indicate the number of Project-affected and unaffected islands surveyed each study year.

Figure 3: Percentage of Project-affected and Unaffected Islands on Which Caribou Calf Activity Was Observed from Combined Trail Camera and Tracking Transect Data, before (2010–2014) and during (2015–2018) Construction

3.1.2 PEATLAND COMPLEXES

Caribou signs were observed in 21 of the 31 peatland complexes in which ground tracking transects were surveyed (Appendix 1, Table A-6). Moose were more widely distributed (Table 9). Gray wolf and black bear signs were observed in fewer complexes than either caribou or moose.

Table 9: Number of Peatland Complexes Occupied by Large Mammals from Tracking Transect Data, 2018

Species	Visit 1 (Apr. 4 to 17)	Visit 2 (Jul. 7 to 27)	Visit 3 (Sep. 6 to 19)	Visits 2 and 3 Combined	All Visits Combined
Caribou	6	15	12	19	21
Caribou calf	0	2	1	3	3
Moose	24	28	26	29	29
Moose calf	3	10	5	12	13
Black bear	0	3	7	9	9
Gray wolf	2	1	4	5	7

Large mammals were photographed in 16 of the 32 peatland complexes in which trail cameras were placed. Caribou, moose (Photo 4) and black bears were each photographed in six peatland complexes (Table 10). Caribou calves were photographed in three peatland complexes, including one with a radio-collared cow (Photo 5). Two calves were photographed on June 30 and one on July 4, 2018. No moose calves were observed. A wolverine was photographed in a peatland complex in spring (Photo 6). Caribou were photographed in one complex with black bear, 13 days apart (Table 11). Moose were photographed in one complex with black bear and in another with gray wolf (Photo 7). The detection of moose and predators in the same complex was separated by at least 39 days.

Table 10: Number of Peatland Complexes Occupied Monthly by Large Mammals from Trail Camera Data, 2018

Species	April	May	June	July	August	September	All
Caribou	0	3	2	2	1	0	6
Caribou calf	0	0	2	1	0	0	3
Moose	2	2	1	3	0	0	6
Moose calf	0	0	0	0	0	0	0
Black bear	0	3	0	1	2	0	6
Gray wolf	0	1	0	0	0	0	1

Table 11: Nearest Dates on Which Caribou or Moose and Predators Were Photographed in the Same Peatland Complex, 2018

Complex	Caribou	Moose	Black Bear	Gray Wolf
KV063000	-	Jun. 9	-	May 1
KV097000	May 17	-	May 30	-
KV098000	-	Jul. 25	May 11	-

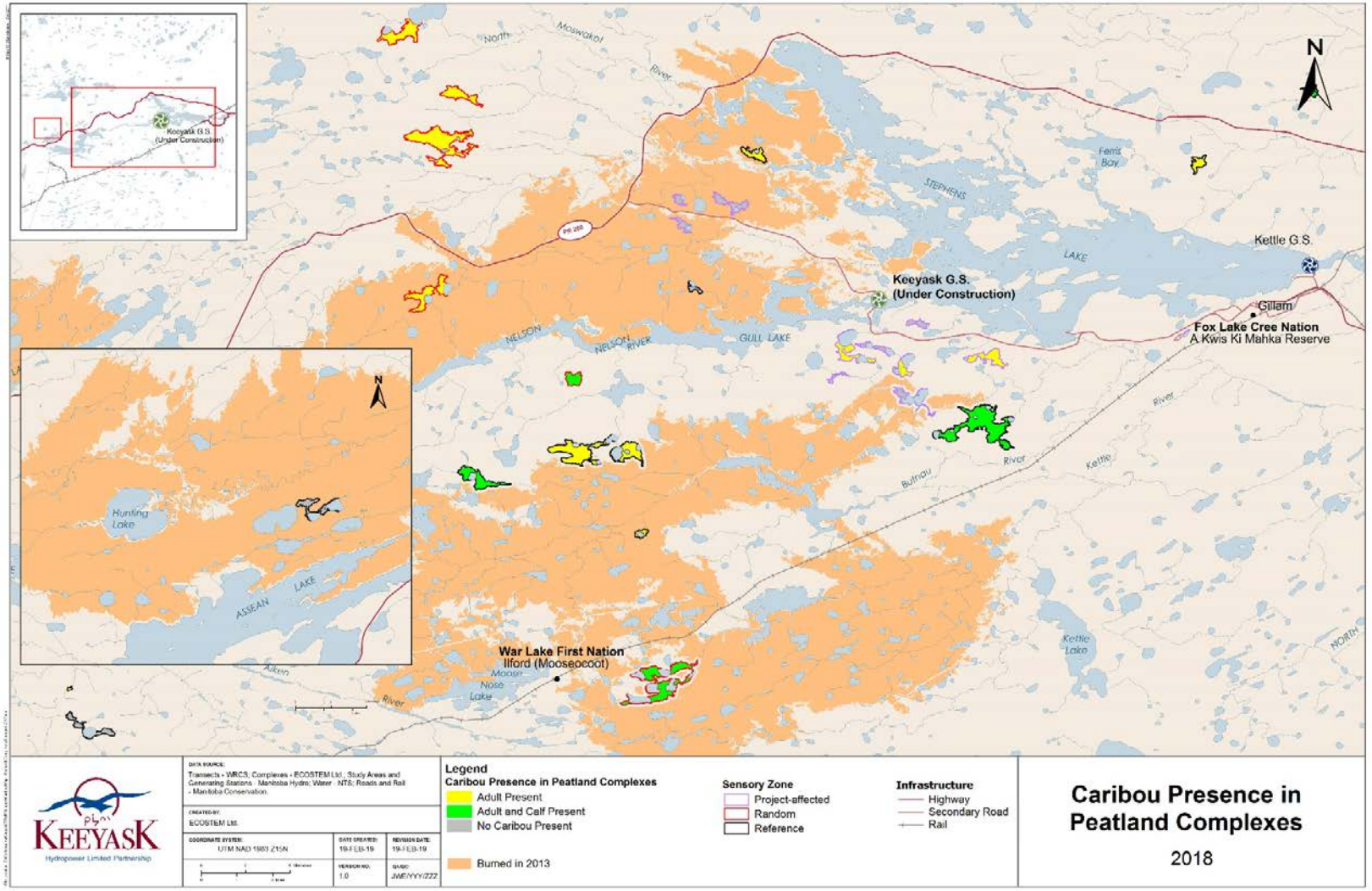
Photo 4: Bull Moose in a Peatland Complex July 2, 2018

Photo 5: Radio-collared Caribou Cow with Calf in a Peatland Complex June 30, 2018

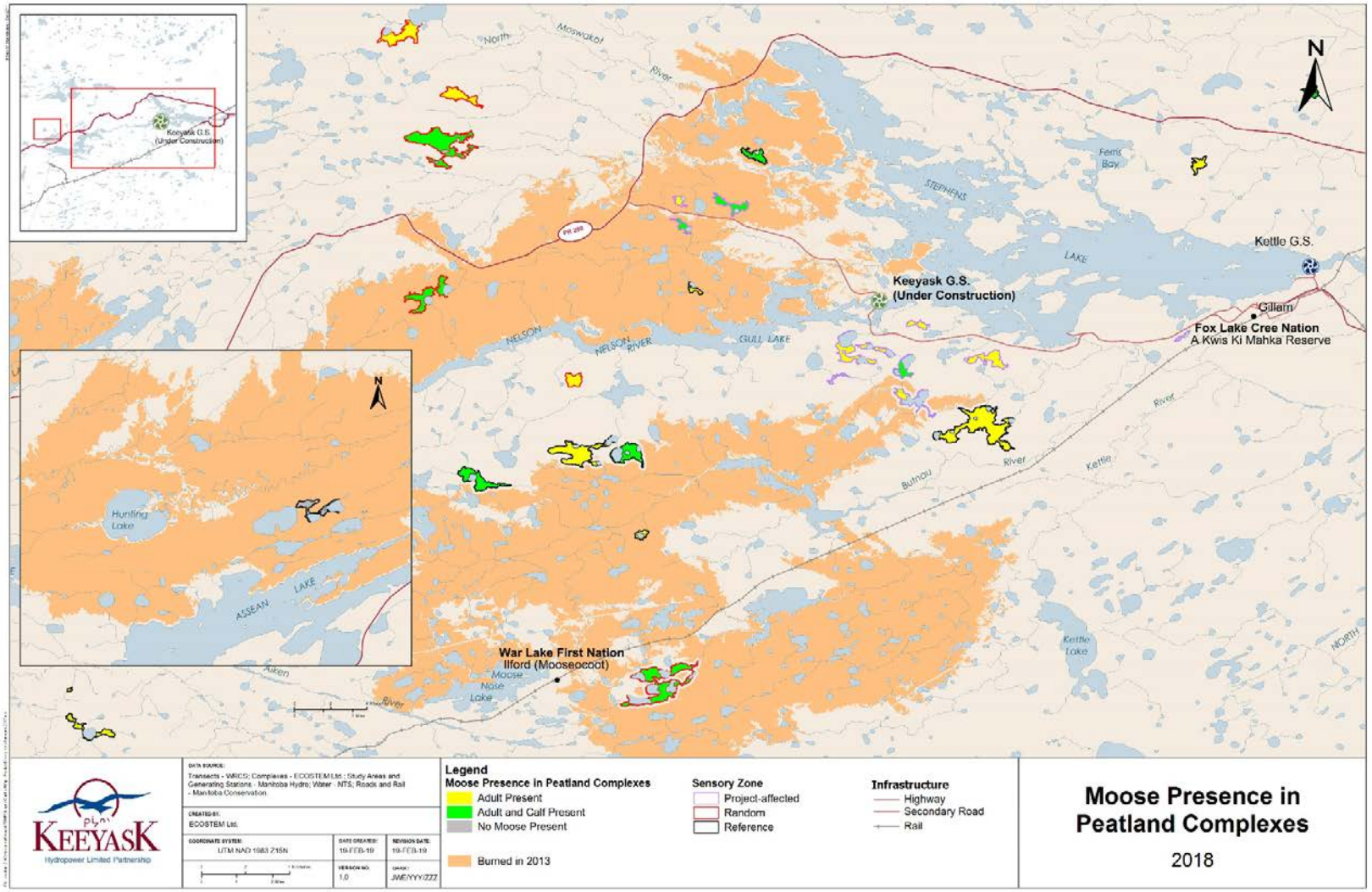
Photo 6: Wolverine in a Peatland Complex May 1, 2018

Photo 7: Gray Wolf in a Peatland Complex May 1, 2018

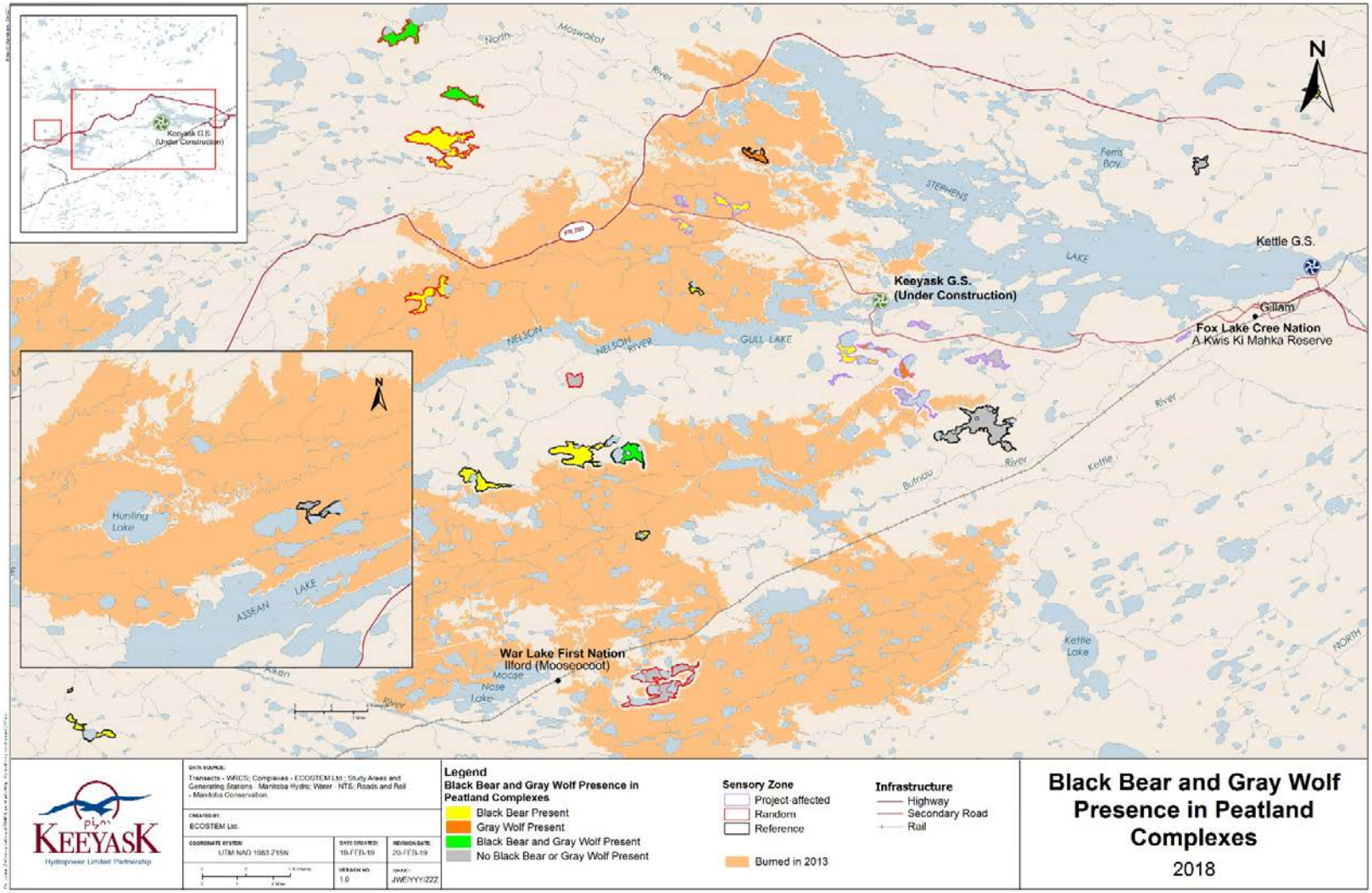
When results from tracking transect (visits 2 and 3) and trail camera surveys were combined, large mammal activity was detected in 30 of the 32 peatland complexes surveyed. Caribou activity was widely distributed in peatland complexes (Map 9). All but one of the 21 complexes occupied by caribou were also occupied by moose, which were detected in a total of 29 complexes (Map 10). Gray wolves or black bears (Map 11) were detected in 12 of the complexes occupied by caribou (Map 12).



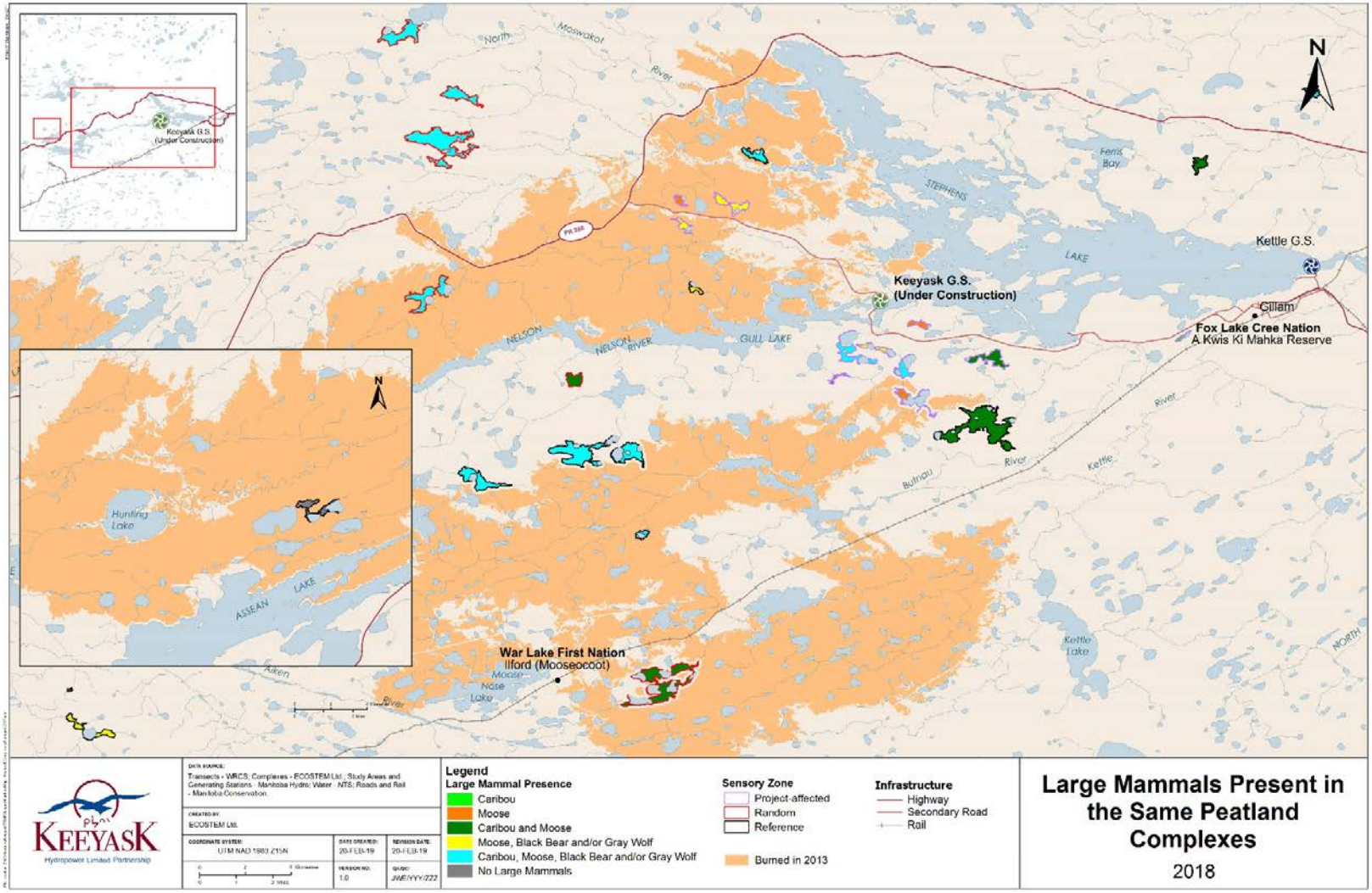
Map 9: Caribou Presence in Peatland Complexes, 2018



Map 10: Moose Presence in Peatland Complexes, 2018



Map 11: Black Bear and Gray Wolf Presence in Peatland Complexes, 2018



Map 12: Large Mammals Present in the Same Peatland Complexes, 2018

When tracking transect and trail camera data were combined, caribou were detected in the greatest percentage of random complexes and the smallest percentage of Project-affected complexes (Table 12). Caribou were detected in a greater percentage of unburned than burned Project-affected, reference, and random complexes. Overall, there was a 51% difference in the total number of burned and unburned peatland complexes occupied by caribou, where they were detected in 45% and 76% of complexes, respectively. Caribou calves were detected in the greatest percentage of random complexes and in the smallest percentage of Project-affected complexes, where none were observed.

Table 12: Peatland Complexes Occupied by Caribou by Disturbance Source and Forest Fire Influence from Combined Tracking Transect[1] and Trail Camera Data, 2018

Complex Type	Burned in 2013	Caribou		Caribou Calf	
		Number Occupied	Percentage Occupied	Number Occupied	Percentage Occupied
Project-affected	Yes	0	0	0	0
	No	4	50	0	0
	Total	*4*	*36*	*0*	*0*
Reference	Yes	2	50	0	0
	No	7	88	3	38
	Total	*9*	*75*	*3*	*27*
Random	Yes	3	75	1	25
	No	5	100	2	40
	Total	*8*	*89*	*3*	*33*
All		21	66	6	19

1. Visits 2 and 3 only.

Moose were detected in 92% of reference complexes, and in a somewhat smaller percentage of Project-affected and random complexes (Table 13). Overall, moose were detected in 91% of burned complexes and in 90% of unburned complexes, a difference of 1%. Moose calves were observed in the greatest percentage of random complexes and in the smallest percentage of Project-affected complexes.

Table 13: Peatland Complexes Occupied by Moose by Disturbance Source and Forest Fire Influence from Combined Tracking Transect[1] and Trail Camera Data, 2018

Complex Type	Burned in 2013	Moose		Moose Calf	
		Number Occupied	Percentage Occupied	Number Occupied	Percentage Occupied
Project-affected	Yes	3	100	2	67
	No	6	75	1	13
	Total	*9*	*82*	*3*	*27*
Reference	Yes	3	75	1	25
	No	8	100	3	38
	Total	*11*	*92*	*4*	*33*
Random	Yes	3	75	2	50
	No	5	100	2	40
	Total	*8*	*89*	*4*	*44*
All		29	91	11	34

1. Visits 2 and 3 only.

Black bears were detected in the greatest percentage of reference peatland complexes and in relatively few Project-affected complexes (Table 14). Overall, black bears were detected in 45% of burned complexes and in 43% of unburned complexes. Gray wolves were observed in the greatest percentage of random complexes and in a similar percentage of Project-affected and reference complexes. Overall, gray wolves were detected in 9% of burned complexes and in 24% of unburned complexes.

Table 14: Peatland Complexes Occupied by Black Bear and Gray Wolf by Disturbance Source and Forest Fire Influence from Combined Tracking Transect[1] and Trail Camera Data, 2018

Complex Type	Burned in 2013	Black Bear		Gray Wolf	
		Number Occupied	Percentage Occupied	Number Occupied	Percentage Occupied
Project-affected	Yes	2	67	0	0
	No	1	13	2	25
	Total	*3*	*27*	*2*	*18*
Reference	Yes	2	50	1	25
	No	5	63	1	13
	Total	*7*	*58*	*2*	*17*
Random	Yes	1	25	0	0
	No	3	60	2	40
	Total	*4*	*44*	*2*	*22*
All		14	44	6	19

1. Visits 2 and 3 only.

When tracking transect and trail camera data were combined, caribou were detected in 51% fewer (73% to 36%) and moose in 10% fewer (91% to 82%) Project-affected peatland

complexes in 2018 than in 2017. Caribou were detected in all burned Project-affected complexes that were surveyed in 2017 and in none in 2018, a 100% decline (Table 15). A smaller decrease was observed in unburned complexes over the same period. There was no change in caribou calf detection in burned Project-affected complexes from 2015 to 2018 because none were observed in any survey year. Calves were detected in 13% of unburned complexes in 2015 and 2017 and in none in 2018. As moose were detected in all burned complexes from 2015 to 2018, there was no change in their distribution. Moose detections in unburned Project-affected complexes decreased 15% from 2017 to 2018 after declining 12% from 2015 to 2017. The percentage of burned Project-affected complexes in which moose calves were observed decreased from 2015 to 2017 but there was no change from 2017 to 2018. Moose calves were detected in 79% fewer unburned complexes in 2018 than in 2017. Overall, caribou and moose detections declined or remained the same in burned and unburned Project-affected peatland complexes.

Table 15: Percentage of Project-affected Peatland Complexes in Which Caribou and Moose Presence Was Detected during Ground Tracking[1] and/or Trail Camera Surveys, 2015, 2017, and 2018

Species	Burned				Unburned			
	2015	2017	2018	Percent Change 2017–2018	2015	2017	2018	Percent Change 2017–2018
Caribou	33	100	0	-100	75	63	50	-21
Caribou calf	0	0	0	–	13	13	0	-100
Moose	100	100	100	0	100	88	75	-15
Moose calf	100	67	67	0	38	63	13	-79

1. Visits 2 and 3 only.

When tracking transect and trail camera data were combined, caribou were detected in 10% fewer reference peatland complexes in 2018 than in 2017. Moose were observed in 92% of complexes both years. Caribou were detected in 34% more burned and in 12% fewer unburned reference peatland complexes in 2018 than in 2017 (Table 16). There was no change in the percentage of burned or unburned complexes in which caribou calves were detected from 2015 to 2018. The percentage of burned reference transects in which moose were detected increased 33% from 2017 to 2018. The percentage of burned reference complexes in which moose calves were observed declined by one third from 2015 to 2017 and again from 2017 to 2018. Moose calves were detected in 49% fewer unburned complexes in 2018 than in 2017. Overall, caribou were more widely distributed in burned reference peatland complexes in 2018 than in previous survey years and the distribution of moose was similar in all reference peatland complexes from 2015 to 2018.

Table 16: Percentage of Reference Peatland Complexes in Which Caribou and Moose Presence Was Detected during Ground Tracking[1] and/or Trail Camera Surveys, 2015, 2017, and 2018

Species	Burned				Unburned			
	2015	2017	2018	Percent Change 2017–2018	2015	2017	2018	Percent Change 2017–2018
Caribou	50	50	67	+34	100	100	88	-12
Caribou calf	0	0	0	–	38	38	38	0
Moose	100	75	100	+33	100	100	100	0
Moose Calf	75	50	33	-34	50	75	38	-49

1. Visits 2 and 3 only.

When tracking transect and trail camera data were combined, caribou were detected in 33% more and moose in 11% fewer random peatland complexes in 2018 than in 2017. Caribou were detected in three times more burned complexes in 2018 than in 2017 and were observed in all unburned complexes from 2015 to 2018 (Table 17). In 2018, caribou calves were observed in burned complexes for the first time in the three-year survey period. There was no change in the percentage of unburned complexes in which calves were detected from 2017 to 2018. Moose were detected in all random complexes in 2015 and 2017, but in fewer burned and unburned complexes in 2018, with the largest decline in unburned complexes. While moose calves were detected in fewer burned complexes in 2018 than in 2015 and 2017, they were detected in 25% more unburned complexes in 2018 than in 2017. Overall, caribou were widely distributed in burned and unburned random peatland complexes in 2018, and moose also widely distributed in random peatland complexes in 2018 but less so than in previous survey years.

Table 17: Percentage of Random Peatland Complexes in Which Caribou and Moose Presence Was Detected During Ground Tracking[1] and/or Trail Camera Surveys, 2015, 2017, and 2018

Species	Burned				Unburned			
	2015	2017	2018	Percent Change 2017–2018	2015	2017	2018	Percent Change 2017–2018
Caribou	75	25	75	+200	100	100	100	0
Caribou calf	0	0	25	–	60	40	40	0
Moose	100	100	75	-25	100	100	40	-60
Moose Calf	75	75	40	-47	80	40	50	+25

1. Visits 2 and 3 only.

3.1.3 ACCESS ROAD TRANSECTS

Caribou signs were observed on 16 of the 18 access road transects surveyed in 2018 (Appendix 1, Table A-7). No caribou activity was observed during the first visit (Table 18). Caribou calf signs were observed on one transect during each of the second and third visits. Moose signs were detected on all access road transects during all visits and moose calf signs were observed on 14 transects over three visits. Predator signs were somewhat less widely distributed than caribou and moose signs. A wolverine track was observed on one transect along the south access road.

Table 18: Number of Access Road Tracking Transects on Which Large Mammals Were Detected, 2018

Species	Visit 1 (Apr. 3 to May 5)	Visit 2 (Jul. 7 to 29)	Visit 3 (Sep.5 to 16)	Visits 2 and 3 Combined	All Visits Combined
Caribou	0	11	9	16	16
Caribou calf	0	1	1	1	2
Moose	18	18	18	18	18
Moose calf	4	9	6	13	14
Black bear	2	9	5	10	12
Gray wolf	4	6	7	13	14

The density of caribou signs was greatest during the second visit to access road transects (Table 19). A total of two calf signs were observed over all three visits; sign density was low. Moose sign density was considerably greater than that of all other large mammal species over all visits.

Table 19: Mammal Sign Density along Access Road Transects, 2018

Species	Visit 1		Visit 2		Visit 3		Visits 2 and 3	
	Number of Signs	Signs per km	Number of Signs	Signs per km	Number of Signs	Signs per km	Number of Signs	Signs per km
Caribou	0	0	32	0.16	22	0.11	54	0.13
Caribou calf	0	0	1	<0.01	1	<0.01	2	<0.01
Moose	538	2.66	549	2.72	524	2.60	1,073	2.66
Moose calf	6	0.03	14	0.07	8	0.04	22	0.05
Black bear	3	0.01	24	0.12	8	0.04	32	0.08
Gray wolf	16	0.08	9	0.04	20	0.10	29	0.07

The density of caribou and caribou calf signs was greater further than 2 km from the access roads than within 2 km during the second and third visits (Table 20). The density of moose and moose calf signs was generally greater within 2 km of the access roads than further away, with a bigger difference for adult moose.

Table 20: Mammal Sign Density within 2 km and More Than 2 km from Access Roads, 2018

Species	Visit 1 (signs per km)		Visit 2 (signs per km)		Visit 3 (signs per km)		Visits 2 and 3 (signs per km)	
	≤ 2 km	> 2 km	≤ 2 km	> 2 km	≤ 2 km	> 2 km	≤ 2 km	> 2 km
Caribou	0	0	0.08	0.20	0.08	0.12	0.08	0.16
Caribou calf	0	0	0	0.01	0	0.01	0	0.01
Moose	4.19	1.80	3.14	2.49	3.19	1.99	3.17	2.24
Moose calf	0.03	0.03	0.08	0.06	0.07	0.02	0.08	0.04
Black bear	0.03	0.01	0.19	0.08	0.06	0.02	0.13	0.05
Gray wolf	0.07	0.08	0.03	0.05	0.08	0.10	0.06	0.08

3.1.4 INCIDENTAL OBSERVATIONS

In 2018, mammal and bird species incidentally detected on islands, in peatland complexes, and on access road transects while tracking and from trail camera photos included: American marten, American robin, bald eagle, beaver, boreal chickadee, Canada goose, common grackle, common raven, gray jay, fisher, lynx, mink, mallard, mink, northern flicker, red fox, red squirrel, river otter, sandhill crane, short-eared owl, snowshoe hare, spruce grouse, sharp-tailed grouse, and willow ptarmigan.

3.2 TIMING OF ICE BREAKUP

Four cameras were placed at Stephens Lake and one camera (#5) was placed at Gull Lake to monitor the timing of ice breakup. On Stephens Lake, the percentage of ice cover remained consistent from installation in April until mid- to late May, and then decreased rapidly (Table 21). Ice breakup was on May 27 and Stephens Lake was free of ice by June 3 (Photo 8 to Photo 12). Ice breakup was May 22 on Gull Lake, with no ice remaining on June 2.

In previous survey years ice breakup on Stephens Lake was observed by June 2, 2015; May 20, 2016; and June 2, 2017. Stephens Lake was free of ice by June 3, 2015; May 22, 2016; and June 3, 2017 (Table 22).

Table 21: Timing of Ice Breakup on Stephens and Gull Lakes, 2018

Percent Ice Cover	Stephens Lake				Gull Lake
	Camera 1	Camera 2	Camera 3	Camera 4	Camera 5
100	Apr. 10	Apr. 9	Apr. 7	Apr. 11	Apr. 14
75	May 24	May 20	May 21	May 20	May 11
50	May 25	May 24	May 22	May 24	May 17
25	May 27	May 25	May 23	May 25	May 22
0	May 30	May 29	May 28	Jun. 3	Jun. 2

Table 22: Timing of Ice Breakup on Stephens Lake, 2015, 2016, and 2017

Percent Ice Cover	2015 Cameras 1–4	2016 Cameras 1–4	2017 Cameras 2–4
100	May 9–12	Apr. 27–29	Apr. 11–16
75	May 20–27	May 8–17	May 20–31
50	May 23–Jun. 1	May 10–19	May 27–Jun.1
25	May 25–June 2	May 14–20	May 27–Jun. 2
0	May 26–Jun. 3	May 18–22	May 28–Jun. 3

Photo 8: Ice Cover at 100% on Stephens Lake April 11, 2018

Photo 9: Ice Cover at 75% on Stephens Lake May 20, 2018

Photo 10: Ice Cover at 50% on Stephens Lake May 24, 2018

Photo 11: Ice Cover at 25% on Stephens Lake May 25, 2018

Photo 12: Ice Cover at 0% on Stephens Lake June 3, 2018

4.0 DISCUSSION

As predicted in the EIS, several Project-affected islands were unoccupied by caribou in 2018. Two of the largest islands at the Project construction site have been cleared and developed and are no longer suitable for caribou habitat; as such, they were not surveyed in 2018. Two additional islands in Gull Lake have been partially cleared; caribou signs were observed on the largest (Caribou Island). Of the 63 islands in lakes occupied by caribou, only 16% were Project-affected. No caribou calves were observed on Project-affected islands, a 100% decline from 2017. The apparent absence of caribou activity on most Project-affected islands could indicate that caribou were generally avoiding construction-related sensory disturbance. However, there was adult caribou activity on several Project-affected islands. As caribou can habituate to human disturbance, some individuals may be less affected by ongoing construction activity than others (Haskell et al. 2006), or the extent of the disturbance effect (i.e., 4 km from the GS site) may be less than predicted in the EIS. It should be noted that these field studies can document animals' presence in an area but cannot confirm their absence; as such, it cannot be known for certain that there were no caribou on some of the islands.

There was less caribou activity on Project-affected islands in lakes during construction than during the pre-construction period, as predicted in the EIS. However, there was also a decline in caribou activity on unaffected islands, suggesting that caribou were not re-locating to the undisturbed islands in Stephens Lake as may be expected. There may have been an overall decrease in the amount of caribou and calf activity in the Keeyask region from 2010 to 2018. Additional construction phase monitoring and a multi-year analysis of results may identify trends in the occupancy of Project-affected and unaffected islands in lakes by caribou.

The specific timing of caribou calving in the area is uncertain but likely occurs from May 1 to June 30, based on data collected on calving caribou in Stephens Lake from 2010 to 2014 and from studies on boreal woodland caribou at roughly the same latitude (Rettie and Messier 2001; Ferguson and Elkie 2004). Caribou cows may avoid islands if there is ice on the lakes during the calving period. In 2018, ice breakup on Stephens Lake was in early June, in the middle of the general calving period and two weeks later than the first caribou calf was photographed (June 6).

Moose were somewhat more widely distributed on islands in lakes than caribou in 2018. Fewer than half of the islands occupied by caribou were also occupied by moose. Predators were more likely to occupy islands on which only moose were found than those on which only caribou were found. The abundance and distribution of moose signs in the Keeyask region suggests that enough habitat is available to sustain a moose population, which is likely an adequate source of primary prey for gray wolves.

There was little caribou activity and no sign of calves in Project-affected peatland complexes, possibly indicating avoidance of construction-related sensory disturbances during the calving period. Caribou occupied 51% more unburned than burned complexes. Caribou tend to avoid forest that is less than 50 years old (Schaefer and Pruitt 1991) but may pass through

regenerating forest to get from one patch of more suitable habitat to another. Caribou may also use recently burned (within five years) habitat in summer, when they eat regenerating herbs and deciduous browse (Schaefer and Pruitt 1991). The percentage of Project-affected peatland complexes in which caribou activity was observed declined by half from 2017 to 2018. A small decrease in caribou activity was also observed in reference complexes, while activity increased by one third in random complexes. The general decline in caribou activity in peatland complexes in addition to islands in lakes may suggest that fewer caribou occupied the Keeyask region in 2018. However, caribou activity unexpectedly increased in Project-affected habitats in 2017, and comparisons to a potentially anomalous year should be interpreted with caution.

A radio-collared caribou cow was photographed with a calf in peatland complexes in both 2018 and 2017; it is unknown if it was the same individual. Review of the radio-collar data (from a Manitoba Sustainable Development-led Pen Islands caribou collaring program) would identify the cow or cows that are known to have calved in the Keeyask region, either confirming that the same individual calved in the same general area in consecutive years or that more than one individual calves in the peatland complexes south of the Nelson River. Two cows, each with a calf, were photographed together on an island in Stephens Lake in early June 2018. It is unusual for caribou that typically calve in isolation to congregate during the calving period, even in small groups.

Moose and moose calves occupied more peatland complexes than caribou. Calves were detected in burned and unburned complexes, possibly indicating that moose select a wider range of habitats for calving than caribou.

On access road transects, the density of caribou signs was lower within 2 km of the access roads than beyond 2 km, as predicted in the EIS. In 2015 and 2017, the reverse was generally observed - there was more caribou activity closer to the roads than farther away (WRCS 2016, 2018b). The density of caribou calf signs was also smaller within 2 km of the access roads, as signs were only observed further away. As caribou can habituate to human disturbance, some individuals may be less affected by traffic noise than others, or the extent of the disturbance effect (i.e., 2 km from the access roads) may be less than predicted in the EIS. There was more moose activity within 2 km of the access roads than further away, but fewer calf signs were observed nearer the roads. Moose are as widely distributed in the Keeyask region as caribou. However, substantially more moose signs were found nearer the access roads than caribou signs, suggesting that moose may be more tolerant of sensory disturbances or may habituate more readily to human disturbance than caribou. Additional construction phase monitoring and a multi-year analysis of results may identify trends in caribou activity closer to or farther from disturbance on the access roads.

5.0 SUMMARY AND CONCLUSIONS

In 2018, caribou were present on half of the islands in lakes and in approximately two thirds of the peatland complexes surveyed in the Keeyask region. Caribou did not avoid all islands or peatland complexes within 4 km of the Project construction site, or all areas within 2 km of the access roads. As predicted in the EIS, sensory disturbance from construction and traffic may have caused some individuals to avoid areas nearer the Project construction site or access roads, but some areas within the predicted disturbance zones were occupied by caribou and calves. These caribou may have habituated to the construction disturbance, or the zone of disturbance may be smaller than predicted in the EIS. Trail camera surveys conducted in from 2015 to 2018 will be repeated in 2019 and ground tracking and trail camera surveys will be conducted in 2020. Additional construction phase monitoring and a multi-year analysis of results may identify trends in caribou activity nearer or farther from disturbance at the Project construction site and near the access roads.

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APPENDIX 1:
TABLES

Table A-1: Transects Surveyed on Islands in Lakes, 2015, 2017, and 2018

Island	Transect	Number of Times Surveyed 2018	Number of Times Surveyed 2017	Number of Times Surveyed 2015
KI122001	KI122001	3	3	3
KI122003	KI122003	3	3	3
KI122005	KI122005	3	3	3
KI122006	KI122006	3	3	3
KI123005	KI123005	0	2	3
KI123008	KI123008	0	2	3
KI123010	KI123010	3	3	3
KI123012	KI123012	3	3	3
	KI123012_001	3	3	3
KI124003	KI124003	3	3	3
KI124004	KI124004	2	2	3
KI124005	KI124005	3	3	3
KI124007	KI124007	3	3	3
KI124009	KI124009	3	3	3
KI124010	KI124010	3	3	3
KI124013	KI124013	2	3	3
KI124015	KI124015	3	3	3
KI124016	KI124016	3	3	3
KI124017	KI124017	3	3	3
KI124018	KI124018	3	3	3
KI124019	KI124019	3	3	3
KI124020	KI124020	3	3	3
KI124022	KI124022	3	3	3
KI124024	KI124024	3	3	3
KI124026	KI124026	3	3	3
KI124029	KI124029	3	3	3
KI124030	KI124030	3	3	3
KI124035	KI124035	3	3	3
KI124037	KI124037	3	3	3
KI124038	KI124038	3	3	3
KI124040	KI124040	3	3	3
KI124041	KI124041	3	3	3
KI124042	KI124042	3	3	3
KI124043	KI124043	3	3	3
KI124044	KI124044	3	3	3
KI124045	KI124045	3	3	3
KI124046	KI124046	3	3	3
KI124047	KI124047	3	3	3

Island	Transect	Number of Times Surveyed 2018	Number of Times Surveyed 2017	Number of Times Surveyed 2015
KI124050	KI124050	3	3	3
KI124052	KI124052	3	3	3
KI124053	KI124053	3	3	3
KI124055	KI124055	3	3	3
KI124056	KI124056	3	3	3
KI124057	KI124057	3	3	3
KI124058	KI124058	3	3	3
KI124060	KI124060	3	3	3
KI124063	KI124063	3	3	3
KI124065	KI124065	3	3	3
KI124066	KI124066	3	3	3
	KI124066_001	3	3	3
KI124069	KI124069	3	3	3
KI124070	KI124070	3	3	3
KI124072	KI124072	3	3	3
KI124075	KI124075	3	3	3
KI124079	KI124079	3	3	3
KI124080	KI124080	3	3	3
KI124082	KI124082	3	3	3
KI124083	KI124083	2	3	3
KI124086	KI124086	3	3	3
KI124088	KI124088	3	3	3
KI124089	KI124089	3	3	3
KI124090	KI124090	3	3	3
KI124091	KI124091	3	3	3
KI124092	KI124092	3	3	3
	KI124092_001	3	3	3
KI124094	KI124094	2	3	3
KI124096	KI124096	3	3	3
KI124097	KI124097	3	3	3
KI124100	KI124100	3	2	0
KI124102	KI124102	3	3	3
KI124103	KI124103	0	0	3
KI124105	KI124105	3	3	3
KI124111	KI124111	0	0	3
KI124115	KI124115	3	3	3
KI124117	KI124117	3	3	3
KI124120	KI124120	3	3	3
KI124124	KI124124	3	3	3

Island	Transect	Number of Times Surveyed 2018	Number of Times Surveyed 2017	Number of Times Surveyed 2015
KI124125	KI124125	3	3	3
KI124128	KI124128	3	3	3
KI124129	KI124129	3	3	3
KI124133	KI124133	3	3	3
KI124136	KI124136	3	3	3
KI124141	KI124141	3	3	3
KI124145	KI124145	3	3	3
KI124146	KI124146	0	0	3
KI124147	KI124147	3	3	3
KI124150	KI124150	3	3	0
KI124151	KI124151	3	3	3
KI124152	KI124152	0	0	3
KI124153	KI124153	3	3	3
KI124155	KI124155	3	3	3
KI124156	KI124156	3	3	3
KI124158	KI124158	3	3	3
KI124162	KI124162	3	3	3
KI124163	KI124163	3	3	0
KI124164	KI124164	3	3	3
KI124165	KI124165	3	3	3
KI124166	KI124166	3	3	3
KI124167	KI124167	3	3	3
KI124170	KI124170	3	3	3
KI124173	KI124173	3	3	3
KI124176	KI124176	3	3	3
KI124178	KI124178	3	3	3
KI124180	KI124180	3	3	3
	KI124180_001	3	3	3
KI124181	KI124181	2	3	3
KI124182	KI124182	3	3	3
KI124186	KI124186	3	3	3
	KI124186_001	3	3	3
	KI124186_002	3	3	3
	KI124186_003	3	3	3
	KI124186_004	3	3	3
KI124192	KI124192	3	3	3
KI124193	KI124193	3	3	3
KI124194	KI124194	3	3	3
KI124196	KI124196	3	3	3

Island	Transect	Number of Times Surveyed 2018	Number of Times Surveyed 2017	Number of Times Surveyed 2015
KI124197	KI124197	3	3	3
KI124202	KI124202	3	3	3
KI124205	KI124205	3	3	3
	KI124205_001	3	3	3
KI124206	KI124206	3	3	3
KI124209	KI124209	3	3	3
KI124210	KI124210	3	3	3
KI124212	KI124212	3	3	3
KI124214	KI124214	3	3	3
KI124217	KI124217	3	3	3
KI124227	KI124227	3	3	3
KI126011	KI126011	0	0	3
KI126016	KI126016	0	1	3
KI126017	KI126017	0	0	3
KI126020	KI126020	3	1	3

Table A-2: Trail Cameras on Islands in Lakes, 2015 to 2018

Island	Number of Cameras 2018	Number of Cameras 2017	Number of Cameras 2016	Number of Cameras 2015
KI122001	1	1	1	1
KI122003	1	1	1	1
KI122005	1	1	1	1
KI122006	1	1	1	1
KI123005	0	0	1	1
KI123008	0	0	1	1
KI123010	1	1	1	1
KI123012	2	2	2	2
KI124003	1	1	1	1
KI124004	1	0	1	1
KI124005	1	1	1	1
KI124007	1	1	1	1
KI124009	1	1	1	1
KI124010	1	1	1	1
KI124013	1	1	1	1
KI124015	1	1	1	1
KI124016	1	1	1	1
KI124017	1	1	1	1
KI124018	1	1	1	1
KI124019	1	1	1	1
KI124020	1	1	1	1
KI124022	1	1	1	1
KI124024	1	1	1	1
KI124026	1	1	1	1
KI124029	1	1	1	1
KI124030	1	1	1	1
KI124035	1	1	1	1
KI124037	1	1	1	1
KI124038	1	1	1	1
KI124040	1	1	1	1
KI124041	1	1	1	1
KI124042	1	1	1	1
KI124043	1	1	1	1
KI124044	1	1	1	1
KI124045	1	1	1	1

Island	Number of Cameras 2018	Number of Cameras 2017	Number of Cameras 2016	Number of Cameras 2015
KI124046	1	1	1	1
KI124047	1	1	1	1
KI124050	1	1	1	1
KI124051	0	0	1	0
KI124052	1	1	1	1
KI124053	1	1	1	1
KI124055	1	1	1	1
KI124056	1	1	1	1
KI124057	1	1	1	1
KI124058	1	1	1	1
KI124060	1	1	1	1
KI124063	1	1	1	1
KI124065	1	1	1	1
KI124066	2	2	2	2
KI124069	1	1	1	1
KI124070	1	1	1	1
KI124072	1	1	1	1
KI124075	1	1	1	1
KI124077	1	0	1	0
KI124079	1	1	1	1
KI124080	1	1	1	0
KI124082	1	1	1	1
KI124083	1	1	0	1
KI124086	1	1	1	1
KI124088	1	1	1	1
KI124089	1	1	1	1
KI124090	1	1	1	1
KI124091	1	1	1	1
KI124092	2	2	2	2
KI124094	1	1	1	1
KI124096	1	1	1	1
KI124097	1	1	1	1
KI124102	1	1	1	1
KI124103	1	0	1	1
KI124105	1	1	1	1
KI124111	0	1	1	1

Island	Number of Cameras 2018	Number of Cameras 2017	Number of Cameras 2016	Number of Cameras 2015
KI124113	1	0	1	0
KI124115	1	1	2	1
KI124117	1	1	1	1
KI124120	1	1	1	1
KI124124	1	1	1	1
KI124125	1	1	1	1
KI124128	1	1	1	1
KI124129	1	1	1	1
KI124131	1	0	1	0
KI124133	1	1	1	1
KI124136	1	1	1	1
KI124141	1	1	1	1
KI124145	1	1	1	1
KI124146	1	0	1	1
KI124147	1	1	1	1
KI124150	0	1	0	0
KI124151	1	1	1	1
KI124152	1	0	1	1
KI124153	1	1	1	1
KI124155	1	1	1	1
KI124156	1	1	1	1
KI124158	1	1	1	1
KI124162	1	1	1	1
KI124164	1	1	1	1
KI124165	1	0	1	1
KI124166	1	1	1	1
KI124167	1	1	1	1
KI124170	1	1	1	1
KI124173	1	1	1	1
KI124176	1	1	1	1
KI124178	1	1	1	1
KI124180	3	2	3	2
KI124181	1	1	0	0
KI124182	1	1	1	1
KI124186	6	5	6	4
KI124192	1	1	1	1

Island	Number of Cameras 2018	Number of Cameras 2017	Number of Cameras 2016	Number of Cameras 2015
KI124193	1	1	1	1
KI124194	1	1	1	1
KI124196	1	1	1	1
KI124197	1	1	1	1
KI124202	1	1	1	1
KI124205	2	2	2	1
KI124206	1	1	1	1
KI124209	1	1	1	1
KI124210	1	1	1	1
KI124212	1	1	1	1
KI124214	1	1	1	1
KI124217	1	1	1	1
KI124227	1	1	0	1
KI126016	0	0	1	1
KI126017	0	0	0	1
KI126020	0	0	1	1

Table A-3: Transects Surveyed in Peatland Complexes, 2015, 2017, and 2018

Complex	Transect	Number of Times Surveyed 2018	Number of Times Surveyed 2017	Number of Times Surveyed 2015
KV022000	KV022001	3	3	3
	KV022002	3	3	3
	KV022003	3	3	3
	KV022004	3	3	3
	KV022005	3	3	3
	KV022006	3	3	3
	KV022007	3	3	3
	KV022008	3	3	3
	KV022009	3	3	3
	KV022010	3	3	3
	KV022011	3	3	3
	KV022012	3	3	3
	KV022013	3	3	3
	KV022014	3	3	3
	KV022015	3	3	3
KV023000	KV023001	3	3	3
	KV023002	3	3	3
KV036000	KV036001	3	3	3
	KV036002	3	3	3
	KV036003	3	3	3
	KV036004	3	3	3
	KV036005	3	3	3
	KV036006	3	3	3
	KV036007	3	3	3
	KV036008	3	3	3
	KV036009	3	3	3
	KV036010	3	3	3
	KV036011	3	3	3
	KV036012	3	3	3
	KV036013	3	3	3
	KV036014	3	3	3
	KV036015	3	3	3
	KV036016	3	3	3
	KV036017	3	3	3
KV037000	KV037001	3	3	3
	KV037002	3	3	3
	KV037003	3	3	3
	KV037004	3	3	3

Complex	Transect	Number of Times Surveyed 2018	Number of Times Surveyed 2017	Number of Times Surveyed 2015
KV038000	KV038001	3	3	3
	KV038002	3	3	3
	KV038003	3	3	3
	KV038004	3	3	3
	KV038005	3	3	3
	KV038006	3	3	3
	KV038007	3	3	3
	KV038008	3	3	3
	KV038009	3	3	3
	KV038010	3	3	3
	KV038011	3	3	3
	KV038012	3	3	3
	KV038013	3	3	3
	KV038014	3	3	3
	KV038015	3	3	3
	KV038016	3	3	3
	KV038017	3	3	3
	KV038018	3	3	3
	KV038019	3	3	3
	KV038020	3	3	3
KV039000	KV039001	3	3	3
KV044000	KV044001	3	3	3
	KV044002	3	3	3
	KV044003	3	3	3
	KV044004	3	3	3
	KV044005	3	3	3
	KV044006	3	3	3
	KV044007	3	3	3
	KV044008	3	3	3
	KV044009	3	3	3
	KV044010	3	3	3
KV047000	KV047001	3	3	3
	KV047002	3	3	3
	KV047003	3	3	3
	KV047004	3	3	3
	KV047005	3	3	3
	KV047006	3	3	3
KV050000	KV050001	3	2	3
	KV050002	3	3	3

Complex	Transect	Number of Times Surveyed 2018	Number of Times Surveyed 2017	Number of Times Surveyed 2015
KV050000	KV050003	3	3	3
	KV050004	3	3	3
	KV050005	3	3	3
	KV050006	3	3	3
	KV050007	3	3	3
	KV050008	3	3	3
KV058000	KV058001	3	3	3
	KV058002	3	3	3
	KV058003	3	3	3
	KV058004	3	3	3
	KV058005	3	3	3
	KV058006	3	3	3
	KV058007	3	3	3
	KV058008	3	3	3
	KV058009	3	3	3
	KV058010	3	3	3
	KV058011	3	3	3
	KV058012	3	3	3
	KV058013	3	3	3
	KV058014	3	3	3
KV061000	KV061001	3	3	3
	KV061002	3	3	3
	KV061003	3	3	3
KV062000	KV062001	3	3	3
	KV062002	3	3	3
KV063000	KV063001	3	3	3
	KV063002	3	3	3
	KV063003	3	3	3
	KV063004	3	3	3
	KV063005	3	3	3
	KV063006	3	3	3
KV066000	KV066001	3	3	3
	KV066002	3	3	3
	KV066003	2	3	3
KV069000	KV069001	3	3	3
	KV069002	3	3	3
	KV069003	3	3	3
	KV069004	3	3	3
	KV069005	3	3	3

Complex	Transect	Number of Times Surveyed 2018	Number of Times Surveyed 2017	Number of Times Surveyed 2015
KV071000	KV071001	3	3	3
KV094000	KV094001	3	3	3
	KV094002	3	3	3
	KV094003	3	3	3
	KV094004	3	3	3
	KV094005	3	3	3
	KV094006	3	3	3
	KV094007	3	3	3
KV097000	KV097001	3	3	3
	KV097002	3	3	3
	KV097003	3	3	3
	KV097004	3	3	3
	KV097005	3	3	3
	KV097006	3	3	3
	KV097007	3	3	3
	KV097008	3	3	3
	KV097009	3	3	3
	KV097010	3	3	3
	KV097011	3	3	3
	KV097012	3	3	3
	KV097013	3	3	3
KV098000	KV098001	3	3	3
	KV098002	3	3	3
KV101000	KV101001	3	3	3
	KV101002	3	3	3
	KV101003	3	3	3
	KV101004	3	3	3
	KV101005	3	3	3
KV102000	KV102001	3	3	3
	KV102002	3	3	3
KV103000	KV103001	3	3	3
	KV103002	3	3	3
	KV103003	3	3	3
	KV103004	3	3	3
	KV103005	3	3	3
	KV103006	3	3	3
KV107000	KV107001	3	3	3
	KV107002	3	3	3
	KV107003	3	3	3

Complex	Transect	Number of Times Surveyed 2018	Number of Times Surveyed 2017	Number of Times Surveyed 2015
KV107000	KV107004	3	3	3
	KV107005	3	3	3
	KV107006	3	3	3
	KV107007	3	3	3
	KV107008	3	3	3
	KV107009	3	3	3
KV113000	KV113001	3	3	3
	KV113002	3	3	3
	KV113003	3	3	3
	KV113004	3	3	3
	KV113005	3	3	3
	KV113006	3	3	3
	KV113007	3	3	3
	KV113008	3	3	3
	KV113009	3	3	3
	KV113010	3	3	3
	KV113011	3	3	3
	KV113012	3	3	3
	KV113013	3	3	3
	KV113014	3	3	3
KV116000	KV116001	3	3	3
KV119000	KV119001	3	3	3
	KV119002	3	3	3
	KV119003	3	3	3
	KV119004	3	3	3
	KV119005	3	3	3
	KV119006	3	3	3
KV120000	KV120001	3	3	3
	KV120002	3	3	3
KV121000	KV121001	3	3	3
KV122000	KV122001	0	3	3
KV123000	KV123001	3	3	3
KV124000	KV124001	3	3	3

Table A-4: Trail Cameras in Peatland Complexes, 2015 to 2018

Complex	Transect	Number of Cameras 2018	Number of Cameras 2017	Number of Cameras 2016	Number of Cameras 2015
KV005000	KV005814	0	0	1	0
KV006600	KV006602	0	0	1	0
KV022000	KV022002	1	1	1	1
KV023000	KV023001	1	1	1	1
KV036000	KV036006	1	1	1	1
KV037000	KV037003	1	1	1	1
KV038000	KV038008	1	1	1	1
KV039000	KV039001	1	1	1	1
KV044000	KV044001	1	1	1	1
KV047000	KV047001	1	1	1	1
KV050000	KV050006	1	1	1	1
KV58000	KV058014	1	1	1	1
KV061000	KV061003	1	1	1	1
KV062000	KV062001	1	1	1	1
KV063000	KV063005	1	1	1	1
KV066000	KV066002	1	1	1	1
KV069000	KV069005	1	1	1	1
KV071000	KV071001	1	1	1	1
KV094000	KV094002	1	1	1	1
KV097000	KV097002	1	1	1	1
KV098000	KV098001	1	1	1	1
KV101000	KV101005	1	1	1	1
KV102000	KV102002	1	1	1	1
KV103000	KV103001	1	1	1	1
KV107000	KV107007	1	1	1	1
KV113000	KV113005	1	1	1	1
KV116000	KV116001	1	1	1	1
KV119000	KV119005	1	1	1	1
KV120000	KV120001	1	1	1	1
KV121000	KV121001	1	1	1	1
KV122000	KV122001	1	1	1	1
KV123000	KV123001	1	0	1	1
KV124000	KV124001	1	1	1	1
KV597000	–	1	0	1	1

Table A-5: Number of Large Mammal Signs Detected during Three Visits to Tracking Transects on Islands in Lakes, 2018

Species	Transect	Visit 1	Visit 2	Visit 3	Total
Caribou	KI122003	1	4	0	5
	KI122006	0	2	0	2
	KI123012	0	2	0	2
	KI123012_001	0	1	5	6
	KI124003	0	0	1	1
	KI124010	0	9	0	9
	KI124015	0	0	3	3
	KI124017	0	0	1	1
	KI124022	0	3	0	3
	KI124024	0	15	0	15
	KI124026	0	2	0	2
	KI124029	0	8	0	8
	KI124030	0	1	2	3
	KI124035	0	12	3	15
	KI124037	0	5	4	9
	KI124038	0	1	8	9
	KI124040	0	3	3	6
	KI124041	0	1	0	1
	KI124042	0	1	0	1
	KI124045	0	2	0	2
	KI124046	0	13	2	15
	KI124055	0	0	9	9
	KI124056	0	2	0	2
	KI124057	0	0	1	1
	KI124058	0	0	17	17
	KI124060	0	2	0	2
	KI124063	0	1	0	1
	KI124066	0	19	0	19
	KI124066_001	0	1	5	6
	KI124082	0	1	0	1
	KI124089	0	1	23	24
	KI124091	0	6	1	7
	KI124092	0	1	0	1
	KI124096	0	3	3	6
	KI124102	0	2	0	2
	KI124115	0	4	3	7
	KI124117	0	3	0	3
	KI124120	0	10	0	10

Species	Transect	Visit 1	Visit 2	Visit 3	Total
Caribou	KI124128	0	0	7	7
	KI124129	0	0	1	1
	KI124136	0	5	0	5
	KI124145	0	1	0	1
	KI124147	0	7	11	18
	KI124162	0	1	5	6
	KI124164	0	6	0	6
	KI124166	0	3	0	3
	KI124170	0	2	2	4
	KI124173	0	33	8	41
	KI124176	0	4	0	4
	KI124180	0	2	55	57
	KI124180_001	0	7	0	7
	KI124181	0	0	3	3
	KI124182	0	2	11	13
	KI124186	0	0	9	9
	KI124186_001	0	0	11	11
	KI124186_002	0	1	20	21
	KI124186_003	0	2	12	14
	KI124186_004	0	1	0	1
	KI124192	1	5	0	6
	KI124193	0	8	34	42
	KI124194	0	0	1	1
	KI124196	0	5	19	24
	KI124205_001	0	1	0	1
	KI124206	0	0	4	4
	KI124210	0	12	10	22
	KI124212	0	18	17	35
	KI124214	0	7	2	9
	KI124217	0	1	5	6
	Total	2	275	341	618
Caribou calf	KI124045	0	2	0	2
	KI124212	0	0	17	17
	Total	0	2	17	19
Moose	KI122003	0	14	4	18
	KI122006	0	4	5	9
	KI123010	0	0	1	1
	KI123012	0	17	3	20
	KI123012_001	0	9	0	9
	KI124003	0	4	6	10

Species	Transect	Visit 1	Visit 2	Visit 3	Total
Moose	KI124005	0	0	4	4
	KI124010	0	2	6	8
	KI124017	0	0	3	3
	KI124018	0	0	3	3
	KI124019	0	0	3	3
	KI124020	0	0	1	1
	KI124022	0	0	1	1
	KI124024	0	0	1	1
	KI124026	0	0	1	1
	KI124029	0	1	7	8
	KI124035	0	2	0	2
	KI124037	0	22	12	34
	KI124038	0	10	1	11
	KI124040	0	19	1	20
	KI124041	0	1	0	1
	KI124042	0	1	0	1
	KI124044	0	2	5	7
	KI124046	0	36	1	37
	KI124047	0	12	9	21
	KI124050	0	1	0	1
	KI124056	0	20	1	21
	KI124057	0	14	0	14
	KI124060	0	7	1	8
	KI124065	0	5	2	7
	KI124066	0	35	6	41
	KI124066_001	1	12	20	33
	KI124069	0	0	1	1
	KI124072	1	27	0	28
	KI124075	0	1	0	1
	KI124079	3	0	1	4
	KI124080	0	1	0	1
	KI124082	0	8	5	13
	KI124083	0	0	2	2
	KI124088	0	1	0	1
	KI124089	1	1	0	2
	KI124091	0	3	0	3
	KI124092	1	16	40	57
	KI124092_001	0	38	47	85
	KI124100	0	0	1	1
	KI124115	0	114	18	132

Species	Transect	Visit 1	Visit 2	Visit 3	Total
Moose	KI124117	2	10	5	17
	KI124120	0	0	1	1
	KI124124	0	0	1	1
	KI124128	1	58	0	59
	KI124129	0	2	0	2
	KI124136	0	0	1	1
	KI124141	0	1	0	1
	KI124145	0	2	3	5
	KI124150	0	2	4	6
	KI124151	0	0	1	1
	KI124155	0	6	3	9
	KI124158	0	3	1	4
	KI124164	0	6	11	17
	KI124165	0	3	1	4
	KI124167	0	2	0	2
	KI124170	0	4	4	8
	KI124173	0	0	2	2
	KI124180	1	29	0	30
	KI124180_001	0	1	16	17
	KI124181	0	0	3	3
	KI124182	0	18	15	33
	KI124186	28	6	5	39
	KI124186_001	38	20	5	63
	KI124186_002	22	0	14	36
	KI124186_003	0	2	1	3
	KI124186_004	0	10	3	13
	KI124192	0	3	1	4
	KI124193	0	13	12	25
	KI124205_001	0	2	0	2
	KI124209	0	1	0	1
	KI124212	0	2	7	9
	Total	99	666	343	1,108
Moose calf	KI124010	0	1	0	1
	KI124024	0	0	1	1
	KI124029	0	0	1	1
	KI124037	0	3	0	3
	KI124038	0	1	0	1
	KI124046	0	5	0	5
	KI124047	0	0	1	1
	KI124056	0	1	0	1

Species	Transect	Visit 1	Visit 2	Visit 3	Total
Moose calf	KI124066	0	1	0	1
	KI124092	0	1	0	1
	KI124092_001	0	0	1	1
	KI124115	0	1	0	1
	KI124117	0	1	0	1
	KI124128	0	2	0	2
	KI124158	0	1	0	1
	KI124170	0	1	0	1
	KI124180	0	4	0	4
	KI124186_001	0	1	0	1
	KI124186_004	0	1	0	1
	KI124193	0	0	1	1
	KI124212	0	1	0	1
	Total	0	26	5	31
Black bear	KI123012	0	1	0	1
	KI124016	0	0	1	1
	KI124018	0	0	1	1
	KI124047	0	2	0	2
	KI124082	0	1	0	1
	KI124089	0	0	1	1
	KI124124	0	0	1	1
	KI124182	0	0	1	1
	Total	0	4	5	9
Gray wolf	KI124013	2	0	0	2
	KI124016	0	0	1	1
	KI124017	0	0	2	2
	KI124018	0	0	2	2
	KI124029	0	0	10	10
	KI124037	0	0	15	15
	KI124066_001	0	0	10	10
	KI124145	0	0	8	8
	Total	2	0	48	50

Table A-6: Number of Large Mammal Signs Detected during Three Visits to Tracking Transects in Peatland Complexes, 2018

Species	Complex	Transect	Visit 1	Visit 2	Visit 3	Total
Caribou	KV022000	KV022003	0	1	2	3
		KV022009	0	1	2	3
		KV022011	0	1	0	1
	KV023000	KV023001	1	0	0	1
	KV036000	KV036005	0	5	0	5
		KV036007	0	0	1	1
		KV036010	0	0	1	1
		KV036013	0	0	2	2
		KV036015	0	3	0	3
	KV037000	KV037003	0	2	0	2
	KV038000	KV038003	2	0	0	2
		KV038015	0	2	0	2
		KV038016	0	2	0	2
		KV038017	1	0	0	1
		KV038018	0	2	0	2
	KV039000	KV039001	0	0	3	3
	KV044000	KV044001	0	0	1	1
	KV047000	KV047004	0	0	2	2
		KV047005	0	0	4	4
	KV050000	KV050001	0	0	3	3
		KV050002	0	1	1	2
		KV050003	0	0	13	13
		KV050004	0	0	7	7
		KV050005	0	0	6	6
		KV050006	0	0	9	9
		KV050007	0	0	5	5
		KV050008	0	2	0	2
	KV058000	KV058001	0	1	2	3
		KV058002	0	0	8	8
		KV058006	0	0	1	1
		KV058007	0	3	0	3
		KV058008	36	1	0	37
		KV058009	0	5	5	10
		KV058013	0	4	0	4
	KV063000	KV063002	0	1	4	5
		KV063004	0	1	1	2
	KV069000	KV069003	0	0	1	1
	KV097000	KV097002	5	0	0	5

Species	Complex	Transect	Visit 1	Visit 2	Visit 3	Total
Caribou	KV097000	KV097007	10	4	0	14
		KV097008	1	0	0	1
		KV097012	7	0	0	7
		KV097013	0	5	0	5
	KV101000	KV101001	9	0	0	9
		KV101004	3	0	0	3
	KV107000	KV107001	0	1	2	3
		KV107003	0	0	1	1
		KV107004	9	0	2	11
		KV107005	0	1	0	1
		KV107007	0	1	0	1
		KV107009	0	0	1	1
	KV113000	KV113001	0	0	1	1
		KV113002	0	2	0	2
		KV113005	0	0	1	1
		KV113006	0	0	2	2
		KV113011	0	4	0	4
	KV116000	KV116001	0	1	0	1
	KV119000	KV119005	0	2	0	2
	KV120000	KV120002	0	5	1	6
	KV122000	KV122001	0	2	0	2
	KV124000	KV124001	0	1	0	1
	Total		84	67	95	246
Caribou calf	KV050000	KV050006	0	0	9	9
Moose	KV022000	KV022003	0	3	0	3
		KV022009	0	1	0	1
		KV022010	0	2	1	3
		KV022012	3	0	2	5
		KV022015	0	1	0	1
	KV023000	KV023001	1	3	0	4
		KV023002	0	0	2	2
	KV036000	KV036001	0	4	2	6
		KV036002	0	4	0	4
		KV036003	0	0	1	1
		KV036005	0	6	3	9
		KV036006	0	1	1	2
		KV036007	0	4	0	4
		KV036009	0	13	6	19
		KV036010	0	2	0	2
		KV036011	0	6	8	14

Species	Complex	Transect	Visit 1	Visit 2	Visit 3	Total
Moose	KV036000	KV036012	0	14	1	15
		KV036013	0	4	0	4
		KV036014	1	1	2	4
		KV036015	0	11	0	11
		KV036016	2	5	3	10
		KV036017	0	5	0	5
	KV037000	KV037001	0	0	1	1
		KV037003	0	4	0	4
		KV037004	3	1	0	4
	KV038000	KV038001	0	0	2	2
		KV038002	3	8	8	19
		KV038004	0	1	0	1
		KV038005	3	0	1	4
		KV038006	0	0	4	4
		KV038008	0	0	1	1
		KV038010	1	0	0	1
		KV038011	0	1	2	3
		KV038012	0	2	0	2
		KV038013	1	0	0	1
		KV038015	4	0	0	4
		KV038016	0	0	2	2
		KV038017	5	0	0	5
		KV038018	7	0	2	9
		KV038019	4	1	3	8
		KV038020	0	1	0	1
	KV044000	KV044001	0	0	3	3
		KV044002	6	1	0	7
		KV044003	0	1	0	1
		KV044004	0	0	1	1
		KV044006	1	0	8	9
		KV044007	0	2	3	5
		KV044008	0	0	2	2
		KV044009	0	0	1	1
		KV044010	0	0	2	2
	KV047000	KV047001	4	0	0	4
		KV047002	2	0	1	3
		KV047004	2	1	0	3
		KV047005	3	0	0	3
		KV047006	9	0	0	9

Species	Complex	Transect	Visit 1	Visit 2	Visit 3	Total
Moose	KV050000	KV050001	0	4	0	4
		KV050003	1	3	0	4
		KV050004	0	1	0	1
		KV050006	1	4	0	5
		KV050007	2	1	0	3
		KV050008	1	1	1	3
	KV058000	KV058001	0	0	1	1
		KV058004	0	1	0	1
		KV058005	2	5	0	7
		KV058007	2	0	0	2
		KV058009	0	2	0	2
		KV058010	0	4	1	5
		KV058012	2	3	0	5
		KV058013	1	0	0	1
		KV058014	0	1	0	1
	KV061000	KV061001	0	0	1	1
		KV061002	2	0	0	2
		KV061003	1	2	7	10
	KV062000	KV062001	0	4	8	12
		KV062002	0	3	8	11
	KV063000	KV063001	0	12	6	18
		KV063002	0	1	0	1
		KV063003	0	8	5	13
		KV063004	0	3	0	3
		KV063005	0	6	2	8
		KV063006	0	4	1	5
	KV066000	KV066001	5	1	3	9
	KV069000	KV069001	0	0	1	1
		KV069002	6	2	2	10
		KV069003	11	4	3	18
		KV069004	0	3	0	3
		KV069005	7	1	0	8
	KV094000	KV094002	2	4	1	7
		KV094003	0	0	1	1
		KV094004	0	2	0	2
		KV094005	0	0	2	2
		KV094006	0	3	0	3
		KV094007	0	0	2	2
	KV097000	KV097001	3	0	0	3
		KV097002	8	6	0	14

Species	Complex	Transect	Visit 1	Visit 2	Visit 3	Total
Moose	KV097000	KV097003	2	0	0	2
		KV097006	2	2	0	4
		KV097007	1	0	0	1
		KV097008	4	6	1	11
		KV097009	5	1	0	6
		KV097010	1	1	0	2
		KV097011	1	1	2	4
		KV097012	0	0	1	1
		KV097013	0	1	0	1
	KV098000	KV098001	0	5	0	5
		KV098002	0	2	0	2
	KV101000	KV101001	1	1	0	2
		KV101003	3	0	1	4
		KV101004	1	0	1	2
		KV101005	1	1	0	2
	KV102000	KV102001	0	0	1	1
		KV102002	0	1	0	1
	KV103000	KV103001	2	0	0	2
		KV103002	2	17	1	20
		KV103003	1	1	0	2
		KV103005	0	1	0	1
		KV103006	0	6	0	6
	KV107000	KV107001	1	1	3	5
		KV107002	0	2	1	3
		KV107003	1	1	1	3
		KV107004	1	2	0	3
		KV107005	11	2	8	21
		KV107006	3	1	0	4
		KV107007	3	3	1	7
		KV107008	2	1	0	3
		KV107009	2	5	1	8
	KV113000	KV113001	6	2	0	8
		KV113002	0	12	2	14
		KV113003	0	6	5	11
		KV113004	0	2	5	7
		KV113005	1	5	3	9
		KV113006	0	7	4	11
		KV113007	0	2	2	4
		KV113009	1	1	0	2
		KV113010	0	0	2	2

Species	Complex	Transect	Visit 1	Visit 2	Visit 3	Total
Moose	KV113000	KV113011	4	0	0	4
		KV113013	0	0	1	1
		KV113014	0	0	2	2
	KV116000	KV116001	0	0	5	5
	KV119000	KV119001	0	4	1	5
		KV119002	0	7	5	12
		KV119003	0	21	10	31
		KV119004	0	6	2	8
		KV119005	1	1	6	8
		KV119006	0	3	0	3
	KV120000	KV120001	14	17	0	31
		KV120002	12	2	0	14
	KV121000	KV121001	9	5	0	14
	KV122000	KV122001	3	6	5	14
	KV123000	KV123001	5	24	23	52
	KV124000	KV124001	1	12	4	17
	Total		230	423	245	898
Moose calf	KV023000	KV023001	0	3	0	3
	KV036000	KV036011	0	6	0	6
	KV037000	KV037004	3	0	0	3
	KV038000	KV038001	0	0	2	2
	KV050000	KV050001	0	4	0	4
	KV063000	KV063003	0	8	0	8
	KV069000	KV069003	0	0	3	3
		KV069004	0	3	0	3
	KV094000	KV094002	0	4	0	4
	KV103000	KV103001	2	0	0	2
		KV103006	0	6	0	6
	KV107000	KV107001	0	0	3	3
		KV107005	11	0	0	11
	KV113000	KV113002	0	12	0	12
		KV113003	0	0	5	5
		KV113005	0	0	3	3
	KV119000	KV119003	0	21	10	31
	KV124000	KV124001	0	12	0	12
	Total		16	79	26	121
Black bear	KV022000	KV022011	0	0	1	1
	KV023000	KV023002	0	0	1	1
	KV036000	KV036013	0	0	1	1
	KV038000	KV038010	0	0	1	1

Species	Complex	Transect	Visit 1	Visit 2	Visit 3	Total
Black bear	KV044000	KV044009	0	1	0	1
	KV050000	KV050002	0	1	0	1
	KV069000	KV069003	0	0	1	1
	KV094000	KV094002	0	1	1	2
	KV107000	KV107007	0	0	1	1
	Total		0	3	7	10
Gray wolf	KV022000	KV022001	0	2	0	2
	KV044000	KV044001	0	0	6	6
		KV044006	0	0	7	7
		KV044007	0	0	2	2
		KV044010	0	0	2	2
	KV050000	KV050003	3	0	0	3
	KV058000	KV058009	1	0	0	1
	KV066000	KV066001	0	0	1	1
	KV107000	KV107005	0	0	1	1
	KV119000	KV119002	0	0	1	1
	Total		4	2	20	26

Table A-7: Number of Large Mammal Signs Detected during Three Visits to Access Road Tracking Transects, 2018

Species	Access Road	Transect	Visit 1	Visit 2	Visit 3	Total
Caribou	North	N-23	0	0	1	1
		N-24	0	3	0	3
		N-34	0	0	1	1
		N-36	0	3	0	3
		N-39	0	2	5	7
		N-40	0	0	6	6
		S-42	0	3	0	3
		S-46	0	2	2	4
		S-51	0	1	0	1
		S-52	0	0	1	1
		S-53	0	1	0	1
	South	S-10	0	2	0	2
		S-15	0	5	1	6
		S-16	0	4	0	4
		S-18	0	0	1	1
		S-8	0	6	5	11
	Total		0	32	22	54
Caribou calf	South	S-15	0	1	0	1
		S-8	0	0	1	1
		Total	0	1	1	2
Moose	North	N-23	21	37	32	90
		N-24	42	37	20	99
		N-34	12	22	47	81
		N-36	54	71	17	142
		N-38	22	50	30	102
		N-39	66	17	97	180
		N-40	5	26	41	72
		S-42	9	5	31	45
		S-46	92	80	41	213
		S-51	19	13	11	43
		S-52	10	14	16	40
		S-53	13	54	22	89
	South	S-1	5	29	14	48
		S-10	43	7	17	67
		S-15	26	29	24	79
		S-16	17	25	11	53
		S-18	16	8	36	60
		S-8	66	25	17	108

Species	Access Road	Transect	Visit 1	Visit 2	Visit 3	Total
Moose	Total		538	549	524	1,611
Moose calf	North	N-23	0	1	1	2
		N-24	0	2	0	2
		N-34	0	0	2	2
		N-36	3	2	0	5
		N-39	0	0	1	1
		N-40	0	0	1	1
		S-42	1	1	0	2
		S-46	1	1	0	2
		S-53	0	1	0	1
	South	S-1	0	0	2	2
		S-15	0	1	0	1
		S-16	1	0	0	1
		S-18	0	2	1	3
		S-8	0	3	0	3
	Total		6	14	8	28
Black bear	North	N-34	0	2	0	2
		N-38	0	1	1	2
		N-39	0	0	1	1
		S-42	0	1	0	1
		S-46	1	0	0	1
		S-52	2	0	0	2
		S-53	0	5	0	5
	South	S-10	0	1	0	1
		S-15	0	9	0	9
		S-16	0	2	3	5
		S-18	0	1	2	3
		S-8	0	2	1	3
	Total		0	24	8	35
Gray wolf	North	N-24	0	0	1	1
		N-34	0	0	1	1
		N-38	0	1	0	1
		N-39	0	0	13	13
		N-40	0	1	0	1
		S-42	0	1	0	1
		S-51	7	0	0	7
		S-52	6	0	1	7
		S-53	1	4	0	5

Species	Access Road	Transect	Visit 1	Visit 2	Visit 3	Total
Gray wolf	South	S-1	0	1	0	1
		S-15	2	1	0	3
		S-16	0	0	1	1
		S-18	0	0	1	1
		S-8	0	0	2	2
	Total		16	9	20	45

APPENDIX 2:
PHOTO SEQUENCE OF TWO CARIBOU COWS AND CALVES ON AN ISLAND IN STEPHENS LAKE


2018-06-03 14:55:04 M 5/5 3°C
PC800 PROFESSIONAL
RECONYX


2018-06-03 14:56:19 M 1/5 3°C
PC800 PROFESSIONAL
RECONYX


2018-06-03 14:56:20 M 2/5 3°C
PC800 PROFESSIONAL
RECONYX


2018-06-03 14:56:21 M 3/5 3°C
PC800 PROFESSIONAL
RECONYX


2018-06-03 14:56:21 M 4/5 3°C
PC800 PROFESSIONAL
RECONYX


2018-06-03 14:56:22 M 5/5 3°C
PC800 PROFESSIONAL
RECONYX


2018-06-03 16:41:38 M 2/5 3°C
PC800 PROFESSIONAL
RECONYX