Keeyask Generation Project

Terrestrial Effects Monitoring Plan

Caribou Winter Abundance Estimate Report

TEMP-2019-16

KEEYASK

Manitoba Sustainable Development Client File 5550.00
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KEEYASK GENERATION PROJECT

TERRESTRIAL EFFECTS MONITORING PLAN

REPORT #TEMP-2018-16

2019 CARIBOU WINTER ABUNDANCE ESTIMATE

Prepared for

Manitoba Hydro

By

Wildlife Resource Consulting Services MB Inc.

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SUMMARY

Background

Construction of the Keeyask Generation Project (the Project) at Gull Rapids began in July 2014. As a part of licensing requirements for the Project, 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.

This survey was designed as part of the Keeyask Terrestrial Effects Monitoring Plan (TEMP). The objective of this survey was to evaluate how the Project may be affecting patterns and trends in caribou distribution, abundance, and population characteristics in Study Zone 5 (the Keeyask region).

Three migratory caribou herds occasionally occupy the Keeyask region in winter: barren-ground caribou (*Rangifer tarandus groenlandicus*) from the Qamanirjuaq herd; and two coastal caribou (*R. t. caribou*) herds, the Hudson Bay Coastal Lowland herd (formally known as the Pen Islands herd) and the Cape Churchill herd, which are forest-tundra migratory woodland caribou ecotypes. A fourth group of caribou may be present in the Keeyask region year-round and are referred to as summer residents. This report describes the results of aerial surveys conducted for migratory caribou in the winter of 2019.

Why is the study being done?

Caribou are widely distributed and occasionally abundant in the Keeyask region. Caribou monitoring is being done because the species is important in the Keeyask region, having ecological, cultural, and economic value. There is a potential for some small adverse Project effects on caribou populations, with a moderate degree of uncertainty concerning the effects predictions, as described in the Project's Environmental Impact Statement (EIS).

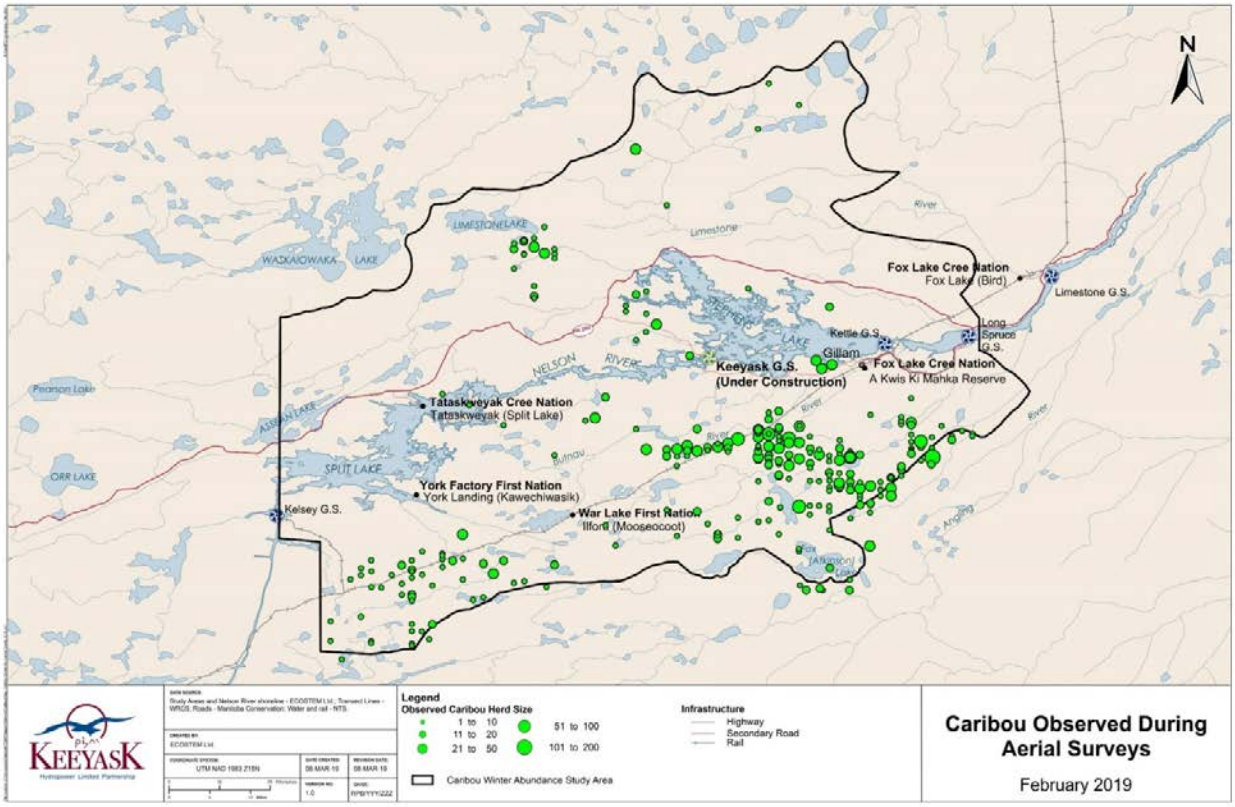
What was done?

Aerial surveys were conducted in late February 2019, to estimate the abundance of caribou in the eastern half of the Keeyask region. Surveys were initiated shortly after local community members and Project site workers began reporting the arrival of migratory caribou into the Keeyask region. Two fixed-wing aircraft were used to conduct the survey. On each airplane, a crew of three observers and a pilot flew regularly-spaced survey lines over the survey area, recording all caribou observed. Line transect distance sampling techniques, and the computer program DISTANCE were used to estimate the total number of caribou in the survey area.

What was found?

A total of 3,684 caribou in 280 clusters were observed during the survey. Using the computer program DISTANCE, caribou density in the survey area was estimated to be 0.63 animals/km^2, or a total of 6,665 caribou. Most caribou were seen in the southern portion of the survey area, mainly between Gillam and Atkinson (Fox) Lake, and south of York Landing. Track densities were high throughout the survey area, except for the northeast portion, indicating extensive use of the Keeyask region. Caribou appeared to cross the Nelson River between Clark Lake and Gull Rapids, but no crossing sites were seen on Stephens Lake.

Caribou observed during the aerial survey in February 2019



What does it mean?

Similar to reports by local resource users and Manitoba Sustainable Development of large caribou numbers in 2017/18, relatively high numbers of caribou were also present in the Keeyask region during winter 2018/19. Prior to this, large numbers of caribou had not been seen in the Keeyask area during the winter since early 2013, when 13,984 caribou were estimated to be in the area. This shows that caribou use of the Keeyask region is variable and difficult to predict. The influence Project construction activity had in the lack of crossings on Stephens Lake is difficult to determine as caribou movements may vary year to year, and be affected by many factors. It has been well established that caribou may avoid construction activities and roads, such as the South Access Road. However, numerous observations of caribou and tracks were made in and near the construction site, suggesting minimal influence.

What will be done next?

An aerial survey during the winter of 2019/20 may be conducted if large numbers of caribou are reported to be present in the survey area. Following the sixth year of operation, the results of all caribou population monitoring to date will be reviewed and used to determine the need for further monitoring.

STUDY TEAM

We would like to thank Wings Over Kississing, 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 Gord MacDonald, Michelle Ewacha, and Brian Fournier of Manitoba Hydro for conducting the reconnaissance survey, and Dr. James Ehnes of ECOSTEM Ltd., for study design, GIS support and cartography.

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1.0 INTRODUCTION

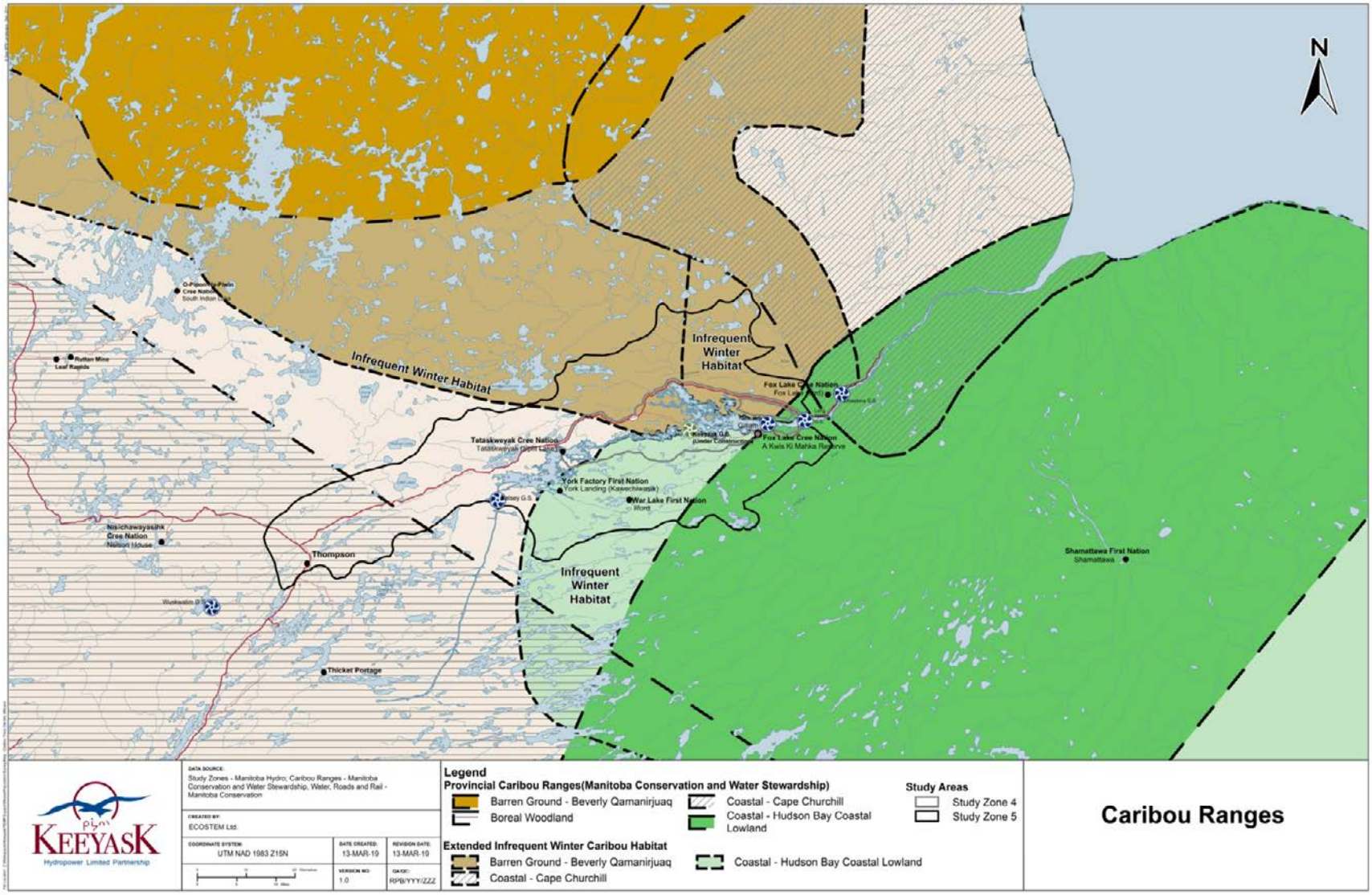
Construction of the Keeyask Generation Project (the Project), a 695-megawatt hydroelectric generating station (GS) and associated facilities, began in July 2014. The Project is located at Gull Rapids on the lower Nelson River in northern Manitoba where Gull Lake flows into Stephens Lake, 35 km upstream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

The *Keeyask Generation Project: Response to EIS Guidelines* (EIS) (KHLP 2012a), 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 Environment Supporting Volume* (TESV) (KHLP 2012b). The *Keeyask Generation Project 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, winter caribou abundance, for the construction and operation phases of the Project.

The goal of this study is to characterize the variability in caribou abundance in the winter and to evaluate how the Project may be affecting movement patterns. The objectives of this study are to:

- Estimate the variability in the number of caribou in Study Zone 5 during the winter; and,
- Evaluate whether winter habitat use, and/or river crossings, in the context of highly variable winter distribution patterns, are affected by the Project.

Four groupings of caribou are found in the Keeyask region: barren-ground caribou (*Rangifer tarandus groenlandicus*); two herds of coastal caribou (*R. t. caribou*), a forest-tundra migratory woodland caribou ecotype; and, summer resident caribou (summer residents), a type of woodland caribou whose exact range and herd association is uncertain. This study focuses on coastal caribou from the from the Hudson Bay Coastal Lowland (formally called the Pen Islands) herd, as the majority of caribou observed in the study region are from this group.



Map 1: Caribou Ranges in the Lower Nelson River Area

Coastal caribou from the Cape Churchill and Hudson Bay Coastal Lowland occur within the Keeyask region in the winter and leave in spring to calve near the Hudson Bay coast (Map 1). These caribou are designated as part of the Eastern Migratory population, which were assessed as “endangered” by the Committee on the Status of Endangered Species in Canada (COSEWIC) in 2017 due to population declines (COSEWIC 2017).

During winter, the Hudson Bay Coastal Lowland caribou herd migrates from the Hudson’s Bay coast in Ontario into the interior of Manitoba (COSEWIC 2017). Within Manitoba the herd may migrate through Shamattawa to the Atkinson Lake area (WLCN 2002) and as far west as the Nelson River at York Landing and as far south as Oxford House (Map 1). Animals from the Hudson Bay Coastal Lowland herd were first reported in the Keeyask region in the 1990’s (Thompson 1994; Thompson and Abraham 1994; Abraham and Thompson 1998; Abraham *et al.* 2012). In the mid-1990’s, the Hudson Bay Coastal Lowland herd was estimated at 10,800 individuals (Abraham and Thompson 1998; Abraham *et al.* 2012). The most recent minimum population estimate is 16,638 individuals, but population trends are difficult to determine for the herd as there is a lack of strong historical population estimates (COSEWIC 2017). Population trends are also confounded by the shift of habitat use away from the coastline to more inland areas, which likely caused an apparent population decline as these areas were not thoroughly surveyed (COSEWIC 2017).

Migration of the Hudson Bay Coastal Lowland caribou herd into the Keeyask region is annually variable. In the winter of 2011/12, less than 30 caribou were observed in the Keeyask region during field studies. In February 2013, an estimated 13,985 (±18.17%) were present in the Keeyask region (LaPorte *et al.* 2013), but in 2016, only 81 caribou were observed during an aerial survey (WRCS 2016). In 2018, large numbers of caribou were noted in the region during an aerial moose survey (KWMS and WRCS 2018) and upwards of 2,000 animals were observed by local First Nation resource users on Split Lake (Local resource user pers. comm.).

The Cape Churchill coastal caribou herd, which may also migrate into the Keeyask region in winter, is estimated to have a minimum of 2,937 individuals (COSEWIC 2017). This population is believed to be stable, as population estimates from 1998 (3,013) and 2007 (2,937) were similar (COSEWIC 2017). Although a large migration into the Keeyask region was observed in winter 2010 (Manitoba Hydro 2011), these events appear to be uncommon.

While the Nelson River serves as a physical boundary for both Hudson Bay Coastal Lowland and Cape Churchill caribou in the Keeyask region, river crossing locations have been reported for the Nelson River and Stephens Lake (FLCN 2012). Genetic studies indicated that coastal caribou genotypes were found both north and south of the Nelson River between 2004 and 2006. Recent radio-collaring data from a program being led by Manitoba Sustainable Development indicate that most of the Cape Churchill herd's activity is north of the Nelson River and they do not typically cross the Nelson River to the south; while the majority of the Hudson Bay Coastal Lowland herd's activity is south of the Nelson River (Manitoba Sustainable Development unpubl. data; Manitoba Hydro 2011).

Barren-ground caribou from the Qamanirjuaq herd and summer resident caribou may also be found in the Keeyask region during winter. Barren-ground caribou were assessed as "threatened" by COSEWIC (COSEWIC 2016) and the status of summer caribou is unknown due to their unidentified range or herd association. Barren-ground caribou migrate from Nunavut in autumn to overwinter in Manitoba's northern forests and then leave in spring to calve. On occasion, a small fraction of the herd may reach Study Zone 5 (Map 1). Summer resident caribou are present in the Keeyask region year-round. No recent population estimates exists for this group of caribou, but there may be an estimated 20-50 individuals in the Keeyask region (KHLP 2012b).

The goal of this study is to determine the relative density of caribou in the Keeyask region during winter and examine any potential effects of Project construction on movement patterns and habitat use. This report describes the results of caribou monitoring conducted during the winter of 2019, the fifth year of Project construction.

2.0 METHODS

2.1 AERIAL SURVEY

The timing of caribou winter abundance surveys varies annually and is based on local reports of caribou movements in and near Study Zone 5. Regular contact was coordinated with local First Nations resource users, Manitoba Hydro staff, and locally based aircraft pilots to monitor for caribou presence in the Keeyask region. This information was used to inform the Keeyask Hydropower Limited Partnership (KHLP) on when aerial surveys for caribou were warranted.

On February 3, 2019 a herd of 40-50 caribou were observed crossing the access road to the Ellis Esker (a Project borrow area) by Manitoba Hydro site environmental staff (Brian Fournier pers. comm.; Appendix 1) Additional anecdotal observations of caribou in the survey area prompted an aerial reconnaissance survey to evaluate the extent of caribou presence in the survey area. This survey was designed by the authors and conducted by three Manitoba Hydro Keeyask site environmental staff. The methods and results used for this reconnaissance survey can be found in Appendix 1. Results from this survey prompted the larger planned survey described in this document.

In 2019, caribou surveys in the eastern portion of Study Zone 5 (caribou winter abundance survey area) were conducted over five days, from February 15 to 19. Within the survey area, systematic north-south transects were established every 2 km (Map 2). This area had been surveyed for caribou in this manner in 2001, 2013, and 2016 and are referred to as the "established transects". In addition to this survey area, at the request of partner First Nations and consistent with methods outlined in the TEMP, survey transects were added to the western portion of the survey area, to examine the area south of Split Lake. These lines are referred to as "extended transects" (Map 2). Several transects were also surveyed to the north of Split Lake to provide a reconnaissance of this area and referred to as "reconnaissance transects" (Map 2). Data from all these transects were used in the final analysis.

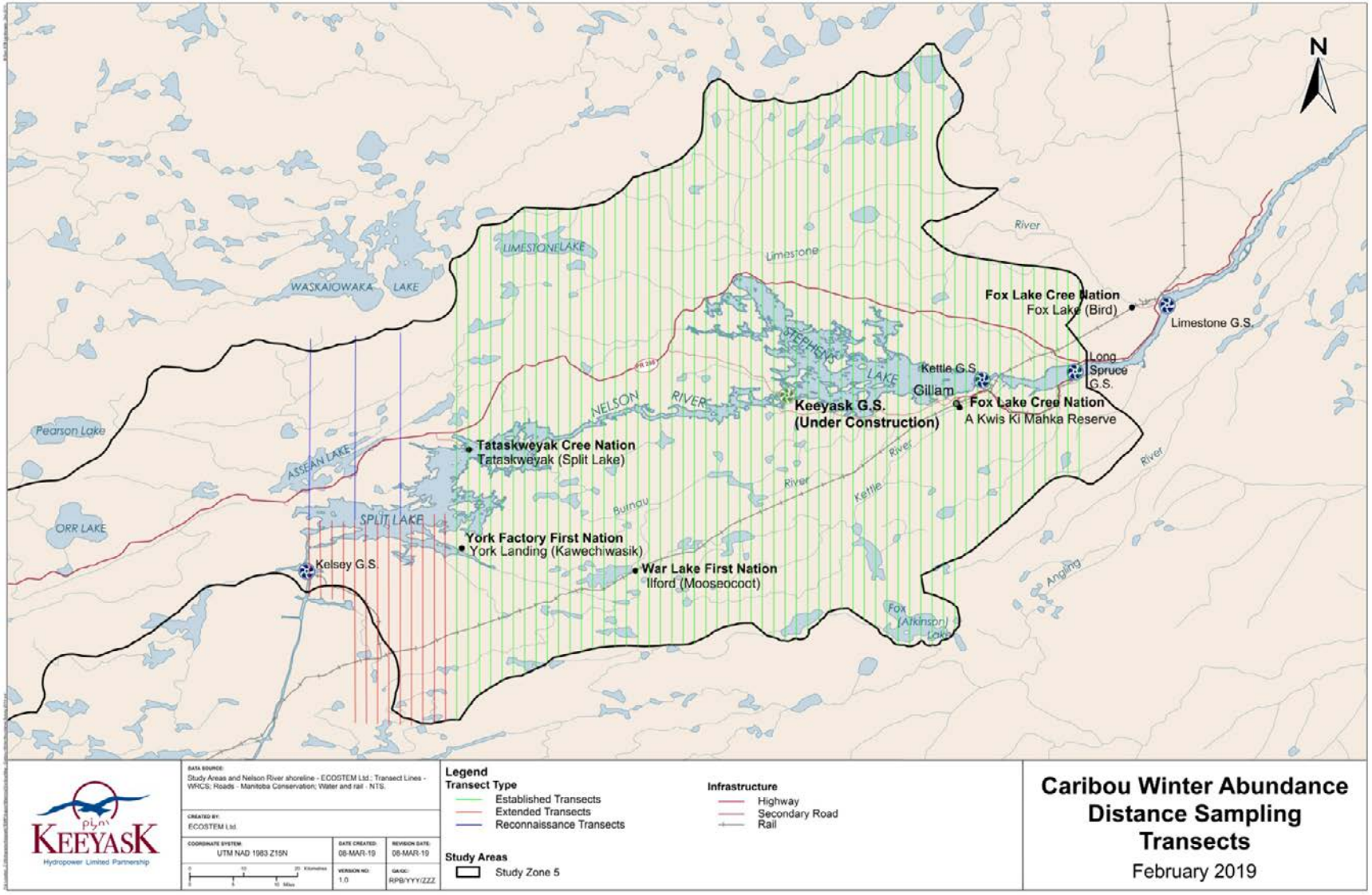
As a complete census of all animals is not possible, abundance and density estimates are based on distance sampling methods. Standard aerial survey techniques and distance sampling methods (Buckland *et al.* 2001) were followed. Surveys were conducted during high visibility weather and complete snow coverage with a de Havilland Canada DHC-2 Beaver and a de Havilland Canada DHC-3 Otter airplane. Transects were flown at approximately 100 m AGL and at a speed of 140 km/h, depending on topography and forest cover density.

Surveys were conducted by two crews comprised of three observers and the pilot per airplane. The front right observer was responsible for spotting caribou clusters on and near the transect line through the front window of the aircraft, while the rear observers were responsible for spotting caribou on either side. The pilots also assisted with spotting caribou near the transect line. A Global Positioning System (GPS) Receiver (Garmin GPSMAP 60 CSx) was used to

collect caribou location data. 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 of observations (Buckland *et al.* 2001). The front right observer recorded cluster locations and recorded cluster size and perpendicular distance from the aircraft. Exact distance measurements were not taken but were grouped by 50 m distance intervals from 0 to 500 m and included a group for observations made >500 m away. Animal care and safety was a high priority and to minimize disturbance, wildlife were never circled by the aircraft. Incidental observations that were detected while ferrying between transects were also recorded, but these observations were excluded from the final analysis.

An attempt was made by the front-right observer to identify the number of calves and adults in smaller clusters (2-20 individuals). Photos taken during the survey were also examined to determine the number of calves and adults in caribou clusters. These data were used to assess productivity. It should be noted that these data were collected opportunistically, and the methods used were not ideal for estimating productivity. Therefore, results should be interpreted with caution.

Other notable observations, including hunters, moose, grey wolves, and kill/predation sites (from hunters and wolves) were recorded incidentally.



Map 2: Caribou Winter Abundance Distance Sampling Transects Surveyed February 2019

2.2 DATA ANALYSES – ABUNDANCE ESTIMATE

Distance sampling data were analysed in the program DISTANCE v. 7.2 (Thomas *et al.* 2010) to model the line transect data and estimate density and abundance of caribou in the survey area. As larger clusters of caribou are easier to detect than smaller groups further from the transect line (Drummer and McDonald, 1987), there is potential that cluster size bias may cause an overestimation of density (Buckland *et al.* 2001). To counter this, a size bias regression estimator was used in the program DISTANCE that regresses 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 is commonly 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 in 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).

Following recommendations of Buckland *et al.* (1997 and 2001), detection functions were modelled using combinations of three key functions and three adjustment terms. *A priori* candidate models were developed using 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 selected based on Akaike's Information Criterion (AIC), where the model with the lowest AIC value was considered the most parsimonious (*i.e.,* the simplest model with the least assumptions and variables but with the greatest explanatory power) (Anderson *et al.* 1998). Goodness-of-fit tests (χ^2 GOF) and qq-plots (especially at distance 0), were used 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; White *et al.* 1982). Robson and Regier (1964) recommend an accuracy of ±25% for management studies that estimate the size of animal populations.

2.3 ICE CROSSING SITES AND TRACK DENSITIES

Locations of caribou trails detected on the Nelson River and Stephens Lake during distance sampling surveys were recorded to identify locations where caribou crossed large frozen waterbodies (*i.e.,* Nelson River, Stephens Lake, Split Lake, Clark Lake).

Caribou track densities were estimated for each survey transect to help describe caribou movement patterns in the survey area. Track densities were described as none, low, medium, or high (Photo 1-Photo 3).

Photo 1: Representative Pattern of Low Density Caribou Tracks

Photo 2: Representative Pattern of Medium Density Caribou Tracks

Photo 3: Representative Pattern of High Density Caribou Tracks

3.0 RESULTS

3.1 ABUNDANCE ESTIMATE

A total of 3,684 caribou in 280 clusters were observed during the survey. Some of these observations were made away from the distance sampling transects or observed at a distance greater than 500 m. A total of 3,022 caribou in 248 clusters were observed on the distance sampling transects and used in the abundance estimate analysis (Table 1). To produce a better model fit, observations were grouped into five intervals: 0-100 m, 101-200 m, 201-300 m, 301-400 m, and 401-500 m.

Based on the lowest AIC values, model fit close to the transect line, and low percent coefficient of variation, a half-normal model with a cosine adjustment term was selected as the best detection function (Table 2; Figure 1). Within the 10,530 km^2 survey area, the model estimated caribou density to be 0.63 animals/km^2, or a total of 6,665 caribou in the survey area.

The distribution of caribou in the survey area was not uniform. Most observations were made in the southern portion of the survey area, mainly between Gillam and Atkinson (Fox) Lake, and south of York Landing (Map 3). There were also numerous observations made near Limestone Lake (Map 3) which coincided with local information indicating the most northerly routes of caribou occurred just north of Limestone Lake in 2019 (Robert Spence pers. comm.).

Calf to adult ratios were determined using observations from 16 different caribou clusters. A total of 36 calves and 157 adults were counted from these observations, providing an estimate of 23 calves per 100 adults or 13% of the total number of caribou observed (when calves were distinguished).

Incidental wildlife observations made during the survey included 89 moose, five grey wolves, and two wolf predation sites. One potential hunting group of three individuals was observed on the north side of Stephens Lake.

Table 1: Number of Caribou Clusters and Individuals Observed on Distance Sampling Transects in Each Distance Interval

Distance Interval	No. of Clusters	No. of Individuals
0-100	74	882
101-200	53	727
201-300	39	659
301-400	40	378
401-500	42	376
Total	248	3,022

Table 2: Ranked Distance Sampling Models and Results

Model Key	Adjustment Term	AIC	ΔAIC	X^2 GOF P-value	P	D	%CV	N	LCI	UCI
Half Normal	Cosine	785.98	0.00	1.00	58.5	0.63	13.09	6,665	5,159	8,610
Uniform	Cosine	786.33	0.34	0.84	53.9	0.61	12.42	6,424	5,038	8,191
Hazard Rate	Cosine	788.03	2.05	0.81	64.2	0.62	14.09	6,551	4,973	8,629
Uniform	Simple Polynomial	788.51	2.52	0.28	45.3	0.55	11.39	5,826	4,660	7,282
Half Normal	Hermite Polynomial	791.95	5.97	0.05	37.7	0.49	10.68	5,155	4,182	6,354

P: Estimated average detection probability
D: Estimated caribou density (caribou/km^2)
%CV: Coefficient of variation at the 95% confidence intervals
N: Number of caribou estimated in survey area
LCI: Lower confidence interval of number of caribou estimated
UCI: Upper confidence interval of number of caribou estimated

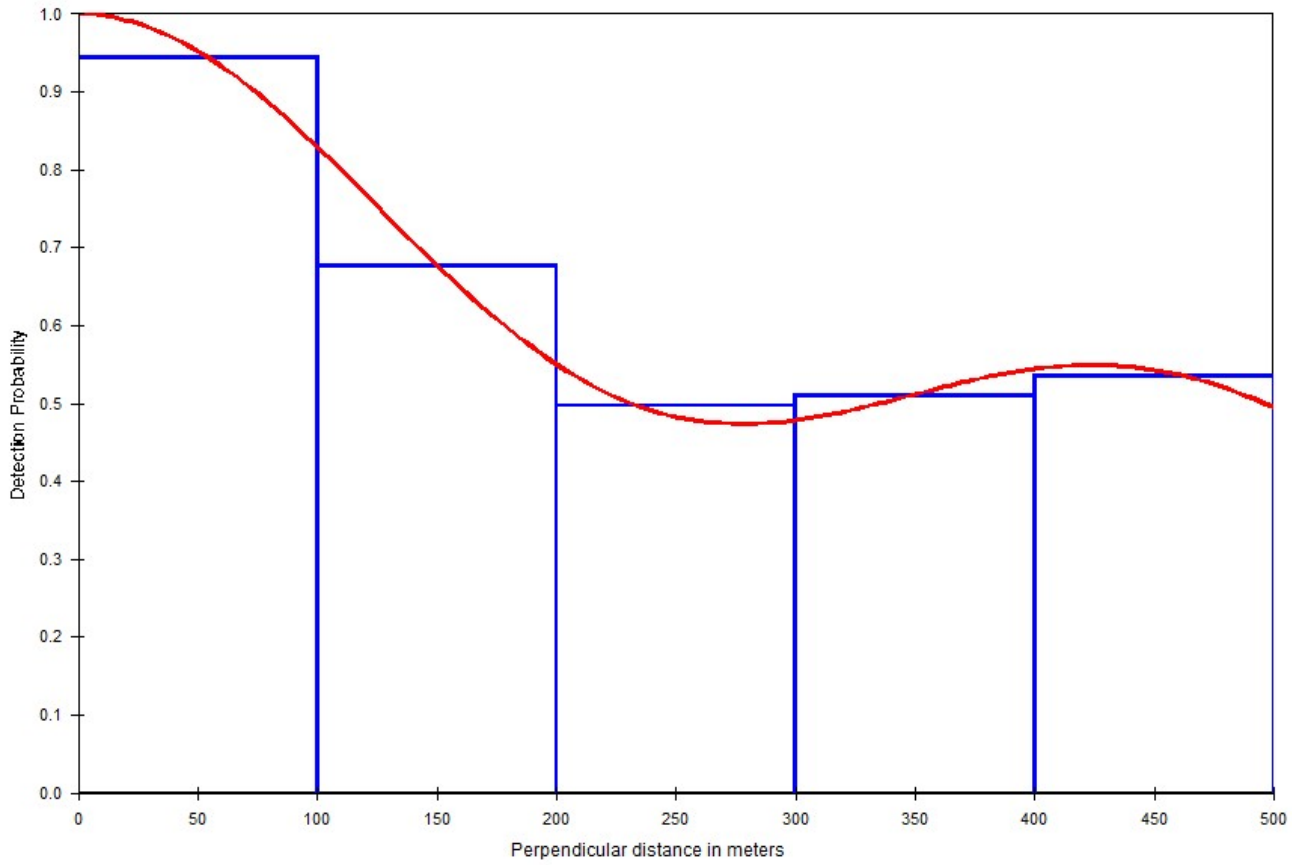
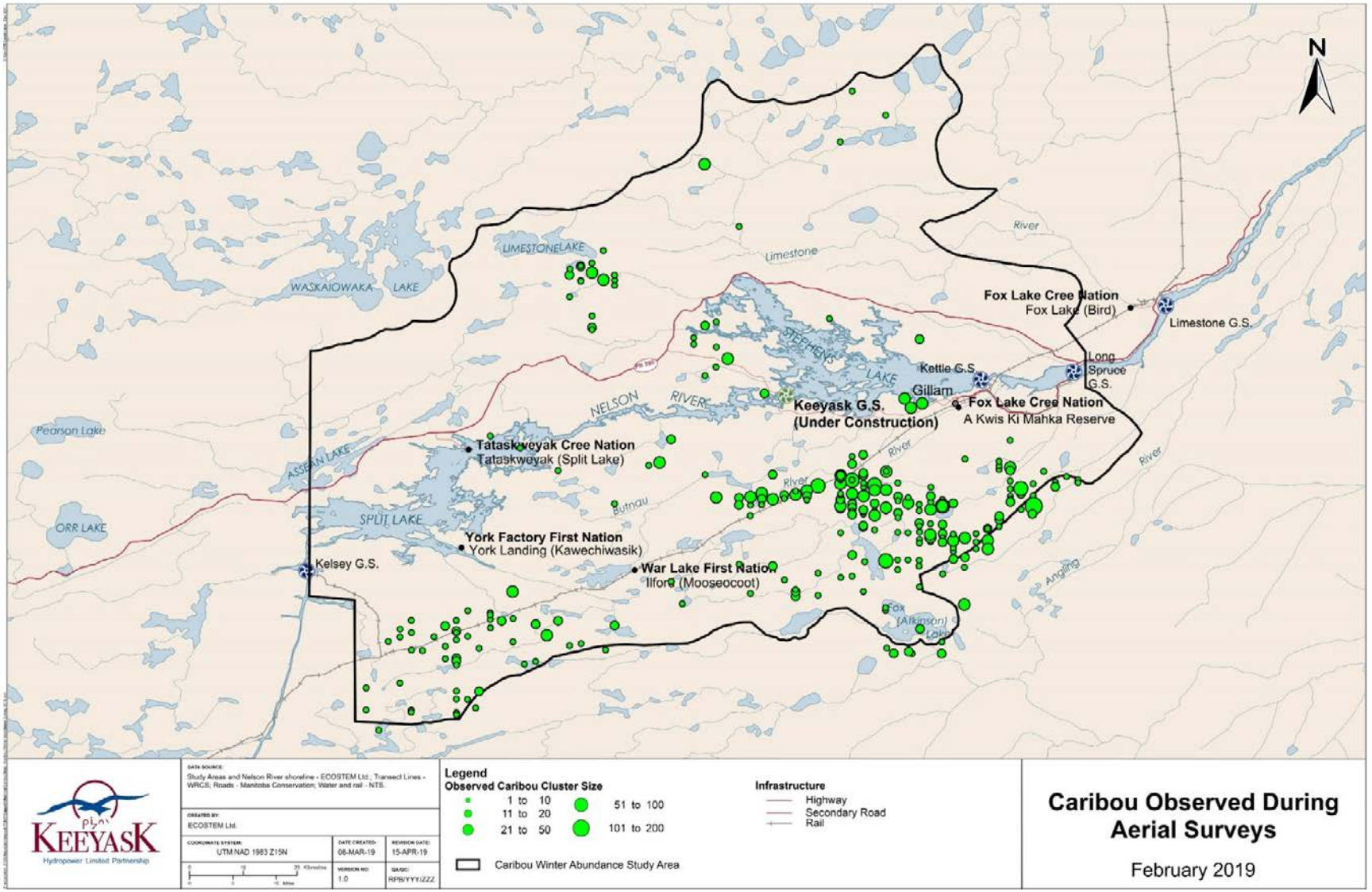


Figure 1: Estimated Detection Probability of Caribou Clusters Observed in February 2019. Note: The model used was a half-normal key with a cosine adjustment term



Map 3: Locations of Caribou Clusters Observed During Aerial Surveys in February 2019

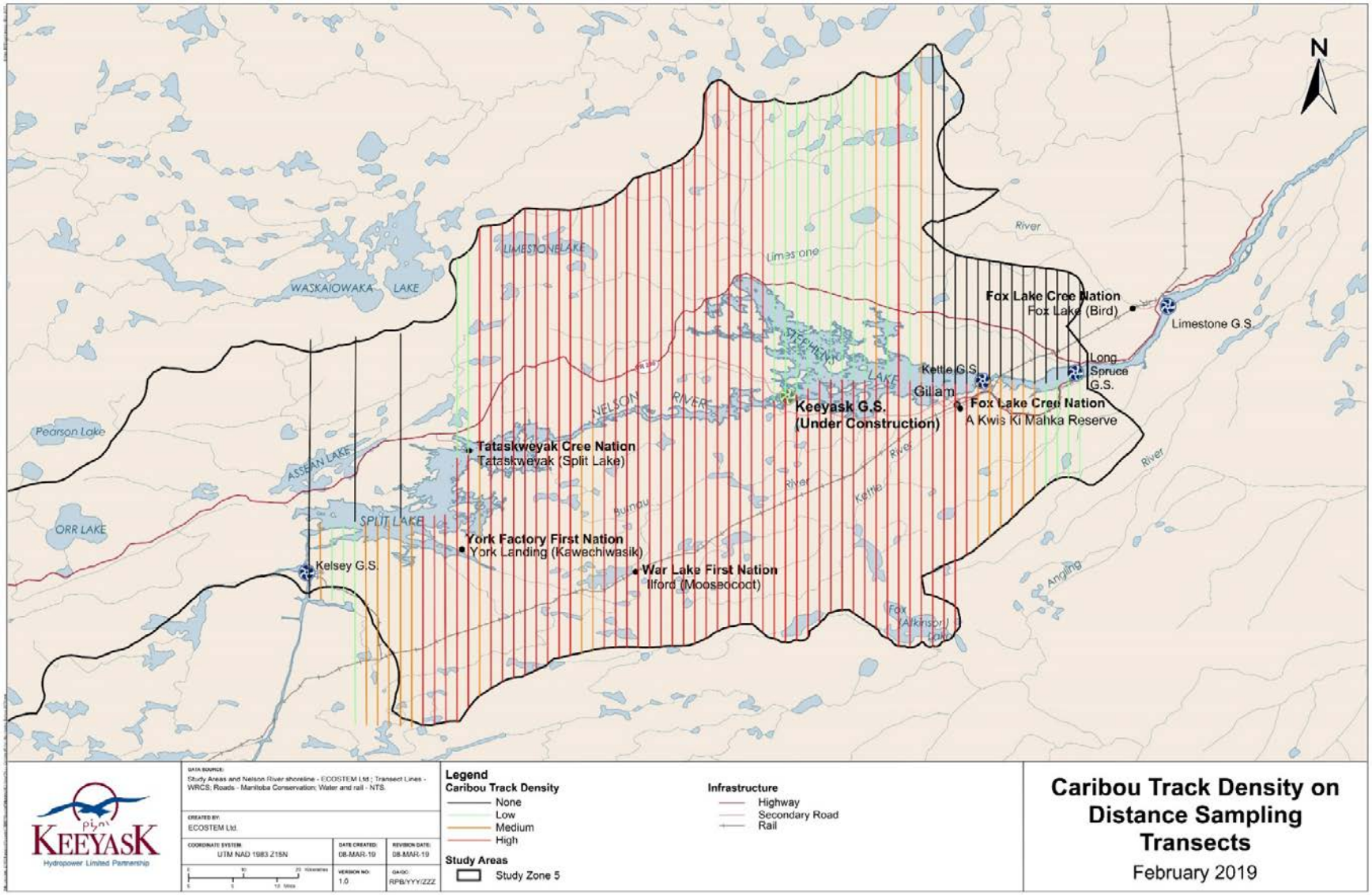
3.2 ICE CROSSING SITES AND TRACK DENSITIES

Ten crossing sites were observed on large waterbodies in the survey area. River crossings appeared to be limited to the Nelson River, between Gull Rapids and Clark Lake (Map 4; Photo 4). No crossings were noted on Stephens Lake or Split Lake.

Caribou track densities were high on a majority (57%) of distance sampling transects surveyed (Map 5). Caribou track densities were lower in the northeast portion of the survey area and none were observed in the northwestern portion of the reconnaissance area (Map 5).

Photo 4: Caribou Crossing Site on the Nelson River in February 2019

Map 4: Caribou Ice Crossing Locations in February 2019



Map 5: Caribou Track Densities Observed on Distance Sampling Transects in February 2019

4.0 DISCUSSION

Results of the 2019 survey support the understanding that the Hudson Bay Coastal Lowland (formally Pen Islands) herd's movements into Manitoba and the survey area are inconsistent. The number of caribou observed in the survey area in winter has been highly variable during Project construction monitoring. For the last two years (2018 and 2019) the number of caribou in the study area during the winter has been relatively high. No caribou surveys were conducted in 2018, to avoid disturbing resource users, but numerous caribou and high densities of caribou tracks were observed during a moose survey in the area and upwards of 2,000 animals were reported on Split Lake by a local resource user. In 2019, the estimated number of caribou (6,665) in the survey area was lower than the number estimated in 2013 (13,984) and greater than the number observed in 2016 (81) (Laporte *et al.* 2013; WRCS 2016). The variability of use of the study area by caribou in the winter is likely a result of complex habitat use patterns, including differences in snow fall, timing of waterbody freeze up, or habitat alterations from recent forest fires (Abraham and Thompson 1998), human disturbances and cumulative effects (Mahoney and Schaefer 2002; Dyer *et al.* 2008; Polfus *et al.* 2011).

River crossing by caribou appeared to be limited to the Nelson River in 2019. However, local resource users reported large numbers of caribou crossing Split Lake and some onto Assean Lake near the beginning of February. As the planned survey occurred approximately one week after these observations, it is likely the tracks were obliterated by wind and snow, and these animals had moved elsewhere in the region.

Based on the locations of river crossings and the relatively low number of caribou tracks observed in the northeastern portion of the survey area, it appears that caribou did not cross Stephens Lake in large numbers. This differs from the observations made in 2013, when numerous crossings and animals were observed on Stephens Lake (Laporte *et al.* 2013). The reason for this difference is unclear. Migratory caribou's movements are likely affected by numerous factors (Abraham and Thompson 1998) making movement patterns difficult to predict. It is possible that the construction activity and presence of the South Access Road limited caribou crossing from south to north across Stephens Lake as it has been demonstrated that construction activities and the presence of linear features can affect caribou movements (Mahoney and Schaefer 2002; Dyer *et al.* 2008; Polfus *et al.* 2011). The potential level of influence that may have occurred is difficult to determine, but it should be noted that during the aerial reconnaissance survey and planned survey, clusters of animals and tracks were observed in and around the active construction area. During one instance, when caribou were observed on the Project construction site, construction staff stopped traffic on a haul road to allow caribou to cross undisturbed and workers in the area were reminded to use caution (Brian Fournier pers. comm.).

Another factor that may affect caribou movements in the survey area includes harvesting pressure. To date, no quantitative information exists on the caribou harvest in the survey area. Although an effort was made to count hunters during the 2019 survey, the survey itself was

designed to avoid peak harvest times and areas with hunters (e.g., direction was given from Manitoba Sustainable Development (MSD) to avoid surveying Split Lake on the weekend) as best possible. Only a single group of hunters was observed during the survey. Approximately 200 harvested caribou were identified on MSD patrols from late January through February in the Keeyask study region between Split Lake, Ilford and Gillam, but that estimate is likely a bit low. Hunters from various communities in northern Manitoba were harvesting in the area, as well as a few communities from northern Saskatchewan (*Vicki Trim, pers. comm.*). The extent to which harvesting pressure has affected caribou movements in the study is unknown and is likely variable and dependent on the number of harvesters present, accessibility to hunting areas, and local movements and numbers of caribou.

Abraham *et al.* (2012) observed the percentage of calves in the herd ranging from 8.8-23.1% in 2008 and 2009, which were similar to what was observed during this survey (13%). The threshold to maintain a sustainable population is recommended to be 12-13% of calves in the herd in late winter (Bergerud 1996), which suggests the herd is sustainable. However, it should be noted that these data were collected incidentally and not under ideal conditions and may not accurately represent the status of the whole population.

5.0 SUMMARY AND CONCLUSIONS

A relatively large number of caribou were present in the survey area in 2019. Caribou observations were concentrated south of the Nelson River, mainly between Gillam and Atkinson (Fox) Lake. Track densities in the survey area suggested that caribou used a large portion of the survey area but did not cross Stephens Lake nor use the area directly north of Stephens Lake. The influence Project construction activity and the presence of the South Access Road had in the lack of crossings on Stephens Lake is difficult to determine as caribou movements may be affected by complex habitat use patterns. It has been well established that caribou may avoid construction activities and roads, such as the South Access Road. However, numerous observations of caribou and tracks were made in and near other areas of the active construction site, suggesting minimal influence.

6.0 LITERATURE CITED

Abraham, K. F. and J. E. Thompson. 1998. Defining the Pen Islands caribou herd of southern Hudson Bay. Rangifer Special Issue 10: 33-40.

Abraham, K. F., B. A. Pond, S. M. Tully, V. Trim, D. Hedman, C. Chenier and G. D. Racey. 2012. Recent changes in summer distribution of and numbers of migratory caribou on the southern Hudson Bay coast. Rangifer Special Issue 20: 269-276.

Anderson, D. R., K. P. Burnham and G. C. White. 1998. Comparison of Akaike information criterion and consistent Akaike information criterion for model selection and statistical inference from capture-recapture studies. Journal of Applied Statistics 25: 263-282.

Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet?, Rangifer Special Issue 9: 95–116.

Buckland, S. T., K. P. Burnham and N. H. Augustin. 1997. Model selection: an integral part of inference. Biometrica 53: 603–618.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to Distance Sampling. Oxford University Press, London. 432 pp.

COSEWIC. 2016. COSEWIC assessment and status report on the Caribou Rangifer tarandus, Barren-ground population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xiii + 123 pp. (http://www.registrelep-sararegistry.gc.ca/default.asp?lang=en&n=24F7211B-1).

COSEWIC. 2017. COSEWIC assessment and status report on the Caribou *Rangifer tarandus*, Eastern Migratory population and Torngat Mountains population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xvii + 68 pp. (http://www.registrelepsararegistry.gc.ca/default.asp?lang=en&n=24F7211B-1).

Drummer, T. D. and L. L. McDonald. 1987. Size bias in line transect sampling. Biometrics 43: 13-21.

Dyer, S.J., J.P. O'Neill, S.M. Wasel, and S. Boutin. 2001. Avoidance of industrial development by woodland caribou. The Journal of Wildlife Management 65(3): 531-542.

FLCN (Fox Lake Cree Nation). 2012. Environment Evaluation Report. Fox Lake Cree Nation, Manitoba. 111 pp.

KHLP (Keeyask Hydropower Limited Partnership). 2012a. Keeyask Generation Station Project Environmental Impact Statement: Response to EIS Guidelines. Prepared by Keeyask Hydropower Partnership Limited, Winnipeg, Manitoba. June 2012. 1208 pp.

KHLP. 2012b. Keeyask Generation Station Project Environmental Impact Statement: Terrestrial Environment Supporting Volume. Prepared by Keeyask Hydropower Partnership Limited, Winnipeg, Manitoba. June 2012. 1342 pp.

KWMS and WRCS (Knudsen Wildlife Management Systems and Wildlife Resource Consulting Services MB Inc). 2018. Keeyask Generation Project Terrestrial Effects Monitoring Plan Report #TEMP-2018-20: Moose Population Estimate 2018. A report prepared for Manitoba Hydro by Knudsen Wildlife Management Systems and Wildlife Resource Consulting Services MB Inc., June 2018.

LaPorte, N., R. Berger and P. N. Hettinga. 2013. Keeyask Caribou Aerial Survey Winter 2013. Report Prepared for Manitoba Hydro by Wildlife Resource Consulting Services MB Inc. Winnipeg, Manitoba. 28 pp.

Mahoney, S.P and J.A. Schaefer. 2002. Hydroelectric development and the disruption of migration in caribou. Biological Conservation 107: 147-153.

Manitoba Hydro. 2011. Bipole III Transmission Project. Caribou Technical Report. Prepared for Manitoba Hydro by Joro Consultants Inc. November 2011. 205 pp.

Otis, D. L., K. P. Burnham, G. C. White and D. R. Anderson. 1978. Statistical inference from capture data on closed animal populations. Wildlife Monographs 162: 3-135.

Polfus, J.L., Hebblewhite M., Heinemeyer K. 2011. Identifying indirect habitat loss and avoidance of human infrastructure by northern mountain woodland caribou. Biological Conservation 144: 2637-2646.

Robson, D. S. and H. A. Reiger. 1964. Sample size in Petersen mark-recapture experiments. Transactions of the American Fisheries Society 93: 215-226.

Thomas, L., S. T. Buckland, E. A. Rexstad, J. L. Laake, S. Strindberg, S. L. Hedley, J. R. B. Bishop, F. F. C. Marques and K. P. Burnham. 2010. Distance software: design and analysis of distance sampling surveys for estimating population size. Journal of Applied Ecology 47: 5-14.

Thompson, R. C. 1994. Ground-breaking co-management in the Split Lake Resource Management Area of Manitoba, Canada. Rangifer 9: 259-262.

Thompson, J. E. and K. F. Abraham. 1994. Range, seasonal distribution and population dynamics of the Pen Islands caribou herd of southern Hudson Bay. Final report. Ontario Ministry of Natural Resources, Moosonee, Ontario. 144 pp.

White, G. C., D. R. Anderson, K. P. Burnham and D. L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. Los Alamos, Los Alamos National Laboratory, U.S.A. 235 pp.

WLCN (War Lake Cree Nation). 2002. War Lake OWL Process: Keeyask Project, July 2002. War Lake First Nation, Manitoba. 35 pp.

WRCS (Wildlife Resource Consulting Services MB Inc.). 2016 Caribou Winter Abundance Estimates. Terrestrial Effects Monitoring Plan Report #TEMP-2016-06. A report prepared for Manitoba Hydro by Wildlife Resource Consulting Services MB Inc., June 2016. 24 pp.

6.1 PERSONAL COMMUNICATIONS

Brian Fournier, Manitoba Hydro, Email communication with Rachel Boone, Manitoba Hydro. February 2019.

Local resource user, Conversation with Robert Berger, Wildlife Resource Consulting Services MB Inc., 2018.

Megan Anger, Manitoba Hydro, Email communication with Rachel Boone, Manitoba Hydro. February 2019.

Robert Spence, Tataskweyak Cree Nation, Email communication with Rachel Boone, Manitoba Hydro. March 2019.

Vicki Trim, Manitoba Sustainable Development, Email communication with Rachel Boone, Manitoba Hydro. June 2019.

APPENDIX 1:
ADDITIONAL CARIBOU OBSERVATIONS

Incidental Caribou Observations on Ellis Esker Access Road

On February 3, 2019, Manitoba Hydro staff noted “a herd of 40-50 caribou were spotted crossing the ice road to the Ellis Esker this morning at around 09:45. The BBE Earthworks Foreman in the area did an all call and stopped all haul traffic on the ice road to allow for the herd to move through.” (Megan Anger pers. comm.).

“It appeared as though the herd continued south, parallel to the road; they did not cross at any other junction the rest of the day. As the haul was allowed to resume, the contractor did a good job to keep drivers mindful, and traffic cautious throughout the day, and indicated that the information will be reiterated to nightshift.” (Brian Fournier pers. comm.).

Figure A-1: Location of Caribou Herd Crossing on the Ellis Esker Access Road

Photo A-1: Caribou Observed Crossing the Ellis Esker Access Road

Photo A-2: Caribou Observed Crossing the Ellis Esker Access Road

Caribou Reconnaissance Survey Report

A caribou helicopter survey was conducted on February 10th, 2019. The survey was completed between 10:00 AM and 3:00 PM with fueling stops at Gillam and Kelsey Generating Station. Conditions were sunny at -17 °C with westward winds gusting around 20 km/h.

Total distance of the helicopter survey was about 440 km, plus the north and south dykes. Flight speed was maintained at approximately 120 km/h and about 200 m above ground level. The pilot adhered to the planned route and did not circle caribou. A slight detour was made at Split Lake to avoid disturbance to hunters.

One Manitoba Hydro Environmental Inspector (Gord Macdonald) directed the pilot and recorded data, while two environmental inspectors (Michelle Ewacha and Brian Fournier) observed and counted caribou out to about 200 m on both sides of the helicopter. Gord Macdonald and the pilot also assisted in observing and counting caribou. In addition to counting caribou, Environmental Inspectors observed the ground for caribou tracks and noted whether tracks were old or fresh, and whether track occurrence was low (<10 caribou), medium (10-50 caribou), or high (>50 caribou).

Approximately 2,032 caribou were observed on the survey. Most caribou were observed between Gillam and the Kelsey Generating Station (Fig. A-1). Caribou tracks were prominent throughout the survey route with many old tracks observed on the southern portion of the survey and fresh tracks on the northern portion of the survey (Fig. A- 2). Images of tracks and caribou were taken for reference (Fig. A-3 to 7).

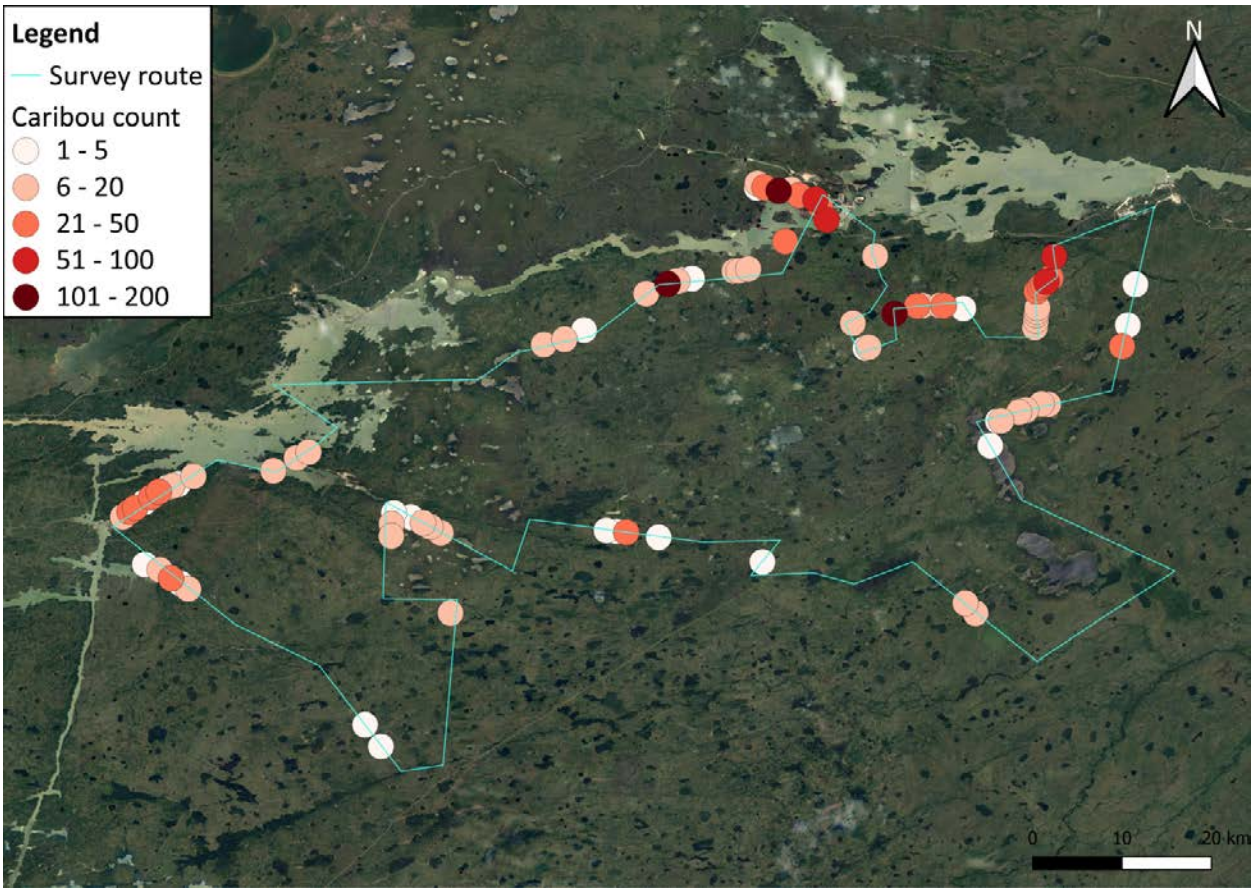


Figure A-2: Caribou Counts Along Reconnaissance Survey Route, 2019

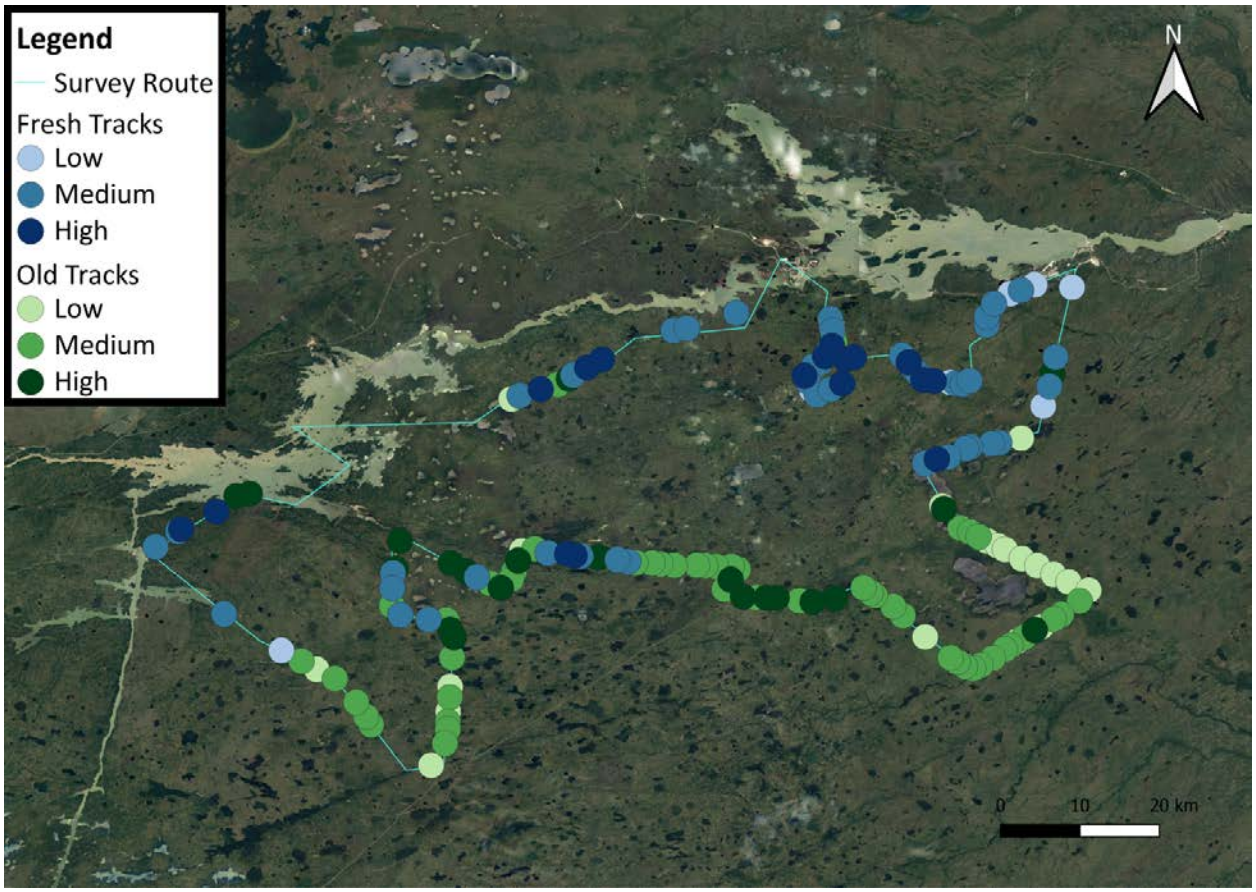


Figure A-3: Caribou Tracks Along Recconnaissance Survey Route, 2019. Tracks were observed as old or fresh, and low (<10 caribou), medium (10-50 caribou), or high (>50 caribou)

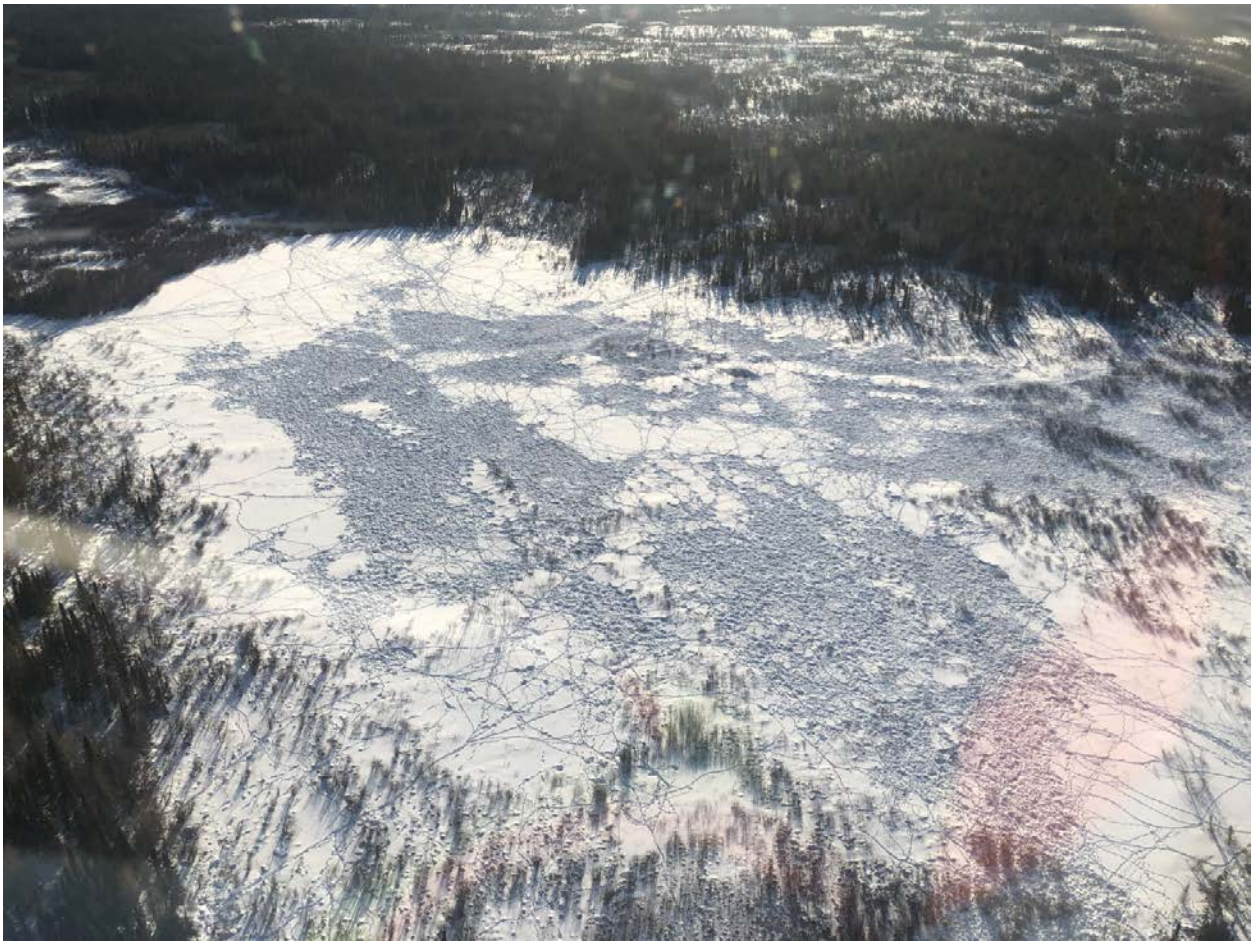


Figure A-4: High Caribou Track Counts (>50 caribou)

Figure A-5: Medium Caribou Track Counts (10-50 caribou)

Figure A-6: Low Caribou Track Counts (<10 caribou)

Figure A-7: Caribou Observed on Recconnaisance Survey, 2019