5.0 RESULTS AND DISCUSSION

5.1 Boreal Woodland Caribou

The monitoring program involves three boreal woodland caribou ranges (P-Bog, N-Reed, Wabowden) intersected by the Bipole III Transmission Project and one reference population (Charron Lake) (Figure 4-1-1). Population status assessment was initiated in Year 1 (2014/15) of the monitoring program using Non-invasive Genetic Sampling (NGS) and Capture-Mark-Recapture (CMR) population estimation methods; NGS/CMR was repeated in Year 3 (2016/17), to assess population size and to inform population models to calculate λ.

Annual aerial survey methods were used to assess winter calf recruitment and population structure. Locations from GPS satellite collars were used for range scale and fine scale assessment of winter core use areas, habitat use patterns, movement and mortality rates / sources (for collared adult female caribou).

5.1.1 Satellite Telemetry

5.1.1.1 Range Use

Distributions of annual and seasonal range areas for each monitored population have not shifted since the monitoring program was initiated and largely show similar patterns of distribution from year to year. The average home range and seasonal range use size for caribou varied across ranges in the as illustrated by the high variation around the average sizes for each range type (Table 5-1-1). The average annual and season ranges for caribou in Charron Lake caribou are significantly larger than those for any other ranges ($P<0.05$). Annual and seasonal range sizes between N-Reed, Wabowden and P-Bog caribou are not significantly different in most years.

Annual 90% kernel home ranges (Figures 5-1-1 to 5-1-4) and 70% overwintering ranges (Figures 5-1-5 to 5-1-8) for individual collared caribou overlap considerably in all four ranges. The 70% kernel calving ranges for individual collared have some level of overlap but are more spread out that than observed during the winter (Figures 5-1-9 to 5-1-12). In 2017, the seasonal range use null models created for the site fidelity analysis corroborated this pattern, revealing that from May to September, collared cows are more spread out from each other than during the winter months as depicted in the higher null expectations for this period.

5.1.1.2 Site Fidelity

Significant philopatry is the tendency of individuals to stay in, or return to, their core use areas. It is present when null models are outside the 95% confidence intervals for empirical means per month (Figures 5-1-13 to 5-1-20).

Collared female caribou displayed varying degrees of site fidelity within each range contingent on season and scale. The larger scale population null demonstrates an annual cycle in the empirical locations across all ranges. Distances between successive year activity centers are smaller during the calving period than other times of the year in all populations, where the majority of collared females within each range show strong fidelity to areas used from May to August, often using activity centers within 1 to 10 km of the previous year (Figures 5-1-9 to 5-1-20). At the population scale, caribou returned to the same calving areas within their larger population range from year to year.

In contrast, during the winter, a broader variation in space use is observed, with some collared females demonstrating weak fidelity, using areas up to 100 km apart from the previous year while others returning to within 10 km of the previous year (Figures 5-1-5 to 5-1-8 and 5-1-13 to 5-1-20). In spite of the greater variation observed during the winter, significant philopatry was still observed at the population scale for both Charron Lake and Wabowden ranges indicating that animals returned to the same areas within their overall population range from year to year for overwintering; behaviour was consistent whereby strong fidelity was displayed annually during both pre-construction and construction time periods. Fidelity in the P-Bog and N-Reed ranges was demonstrated during the calving period but then weakened during the fall and winter period. In the P-Bog range, fidelity to fall and winter ranges was present in the pre-construction phase but was weaker during the construction phase. In the N-Reed range, fidelity to winter ranges was not present during either the pre-construction or construction phase.

The smaller-scale seasonal null model implies that fidelity to monthly winter range areas was absent for Wabowden and N-Reed ranges during both the pre-construction and construction phases (Figures 5-1-14 and Figure 5-1-16), suggesting that within monthly winter range areas, caribou alter the location of their centers of activity from year to year. Conversely caribou within the P-Bog and Charron Lake ranges demonstrated fidelity to wintering areas in the pre-construction phase and a lack of fidelity in the construction phase (Figures 5-1-18 and 5-1-20). However, for all ranges, after May, females displayed attraction to sites occupied the previous year and local areas of concentrated use within monthly ranges tend to remain comparable from year to year (Figures 5-1-13 to 5-1-20).

This analysis at the seasonal scale also revealed that although during the winter, collared caribou may not return to the same local sites from year to year, they are closer in proximity to each other than distances between animals observed during warmer months where females tended to spread out from each other. This pattern is reflected in the null model expectations which are derived using distances between collared caribou. The null expectation was generated by calculating distances between all possible pairs of caribou locations within each month within each range. Larger distances between caribou in each month will generate larger null expectations for that month. Null expectations from May to September are increased by 15 km compared to that observed for the winter.

Overall results suggest that winter range use is scale dependent for some caribou, where females are philopatric to general wintering areas within a larger population range but not necessarily to precise locations within these areas. Conversely, patterns observed after May persist across scales indicating consistent site fidelity from calving to breeding periods irrespective of the extent of observations, suggesting that female caribou are attracted to specific locations for the calving and post-calving period from year to year.

Fidelity to wintering areas in the P-Bog range became weaker during the construction phase for both the population and seasonal scales. Looking at the distribution of wintering areas from 2015, 2016 and 2017 reveals that caribou have not shifted their distribution on the landscape away the Project, however these results indicate that their centers of activity within these wintering areas shifted from one year to the next. This pattern was also observed at the seasonal scale for Charron Lake, the reference range that does not interact with the Project. However as only two comparisons from 2015/2016 to the 2016/2017 winter are currently available for the construction phase additional data needs to accumulate before the long term pattern for levels of fidelity during the construction phase can be ascertained and will continue to be assessed in future months.

For caribou, minimization of predation risk to females and calves is regarded as the underlying drive for space use patterns (Ferguson et al. 1988, Bergerud 1996). Assuming the scale invariant site fidelity by female caribou for the calving and post–calving period is a strategy to minimize predation risk, these results support the previous studies that report the consistent and limiting effects of predation on the more sedentary forest-forest ecotype populations (Seip 1992, Bergerud 1996, Rettie & Messier 1998, Schaefer et al. 1999 and Schaefer et al. 2000). This also supported by the increased spacing out of female caribou from each other at the more local seasonal scale. Calving in isolation from other caribou is a predator avoidance strategy as detection becomes harder (Bergerud 1996, Leclerc et al. 2012). Caribou in Wabowden and Charron Lake demonstrated fidelity to wintering areas within the larger population range, suggesting they may move to areas that have lower predation risk on the landscape and limited aerial survey results to date suggest little overlap with wolf in these areas. However, at a smaller scale, fidelity is absent during the winter and caribou may be decoupling themselves from this predation risk (Schaefer et al. 2000) and preferring sites with better forage access or more optimal snow cover. In P-Bog and N-Reed range, fidelity during the winter has been weaker and caribou may alter site use as a predation avoidance strategy to create unpredictable occupancy patterns. Patterns of site fidelity during construction and post construction will continue to be refined as data accumulates.

There were no differences in behaviour observed in the pre-construction phase in the Charron Lake population compared to P-Bog and Wabowden range during any portion of the year, however, N-Reed demonstrated a lack of fidelity at the population and seasonal scales to wintering areas. Currently in the construction phase, fidelity to calving areas in all ranges continues to be strong, however a lack of fidelity to wintering areas in some months has been observed for P-Bog, N-Reed and Charron Lake. As only two comparisons from 2015/2016 to the 2016/2017 winter are currently available for the construction phase additional data needs to accumulate before the long term pattern for levels of fidelity during the construction phase can be ascertained and will continue to be assessed in future months.

5.1.1.3 Zone of Influence

Wabowden Range

The habitat model for Wabowden was developed in 2016 (Amec Foster Wheeler 2017) and used in this current analysis. Significant predictors of habitat selection included treed wetland, shrub wetland, herb wetland, dense coniferous stands, open coniferous stands, shrub stands and water (Amec Foster Wheeler 2017). Other potential predictors such as mixedwood or deciduous stands were not significant or were removed because they were unstable variables or rare (<5%) on the landscape. Generally, the probability of caribou occurrence in any season significantly increased with the availability of wetland communities and open coniferous stands and decreased in association with dense coniferous stands, shrubs and water (Amec Foster Wheeler 2017).

Results suggest that there was a short ZOI of approximately 1 to 2 m for the pre-existing linear corridor present during the pre-construction phase, as well for the widened corridor created through Project construction across all seasons (Figures 5-1-21 to 5-1-26). Analysis of the most recent data collected in 2016 and 2017 has not revealed an increase in avoidance for any season suggesting that caribou did not alter their response to construction. Although Manitoba Hydro avoids construction during the calving period, the spring is known to be a very sensitive time for caribou. It was hypothesized that stronger avoidance of the Project may occur in the spring (compared to other seasons) during both the pre-construction and construction phases. This lack of change in response level during the calving period may reflect the effectiveness of this timing window mitigation strategy and will continue to be monitored as more data accumulate.

Results suggest that caribou in the Wabowden range were already exhibiting avoidance of 1 to 2 km to the existing linear corridor that was in place prior to the implementation of the Project. This response appears to be not have been significantly altered during the construction phase, likely due to some level of habituation to this feature. There is mixed evidence suggesting a habituation effect for ungulates (Stankowich 2008), some studies reporting weak effects (Cote et al. 2013) or lack of behavioral habituation (Bleich et al. 1994, Frid 2003). Johnson & Russell (2014) identified a large ZOI of 38 km of the Porcupine Herd around human disturbance footprint using a long term, 27year data set and assessed levels of habituation. Boulanger et al. (2012) found temporal variation in the avoidance response of caribou but no obvious habituation effect. However, reindeer have been found to habituate to power lines shortly after their construction when the lines are not accompanied by other human activity such as vehicular traffic (Reimers et al. 2000).

As caribou were already avoiding this linear corridor prior to the installation of the Project there is currently no evidence that their distribution has shifted significantly as a result of construction. As was the case in past years, caribou locations were fewer near the Project than areas farther away peaking in abundance at distances 10 to 15 km from the Project. As sample sizes are low within 0 to 2 km of the Project, the level of confidence with which the ZOI can be drawn at 1 km versus 2 km is uncertain. Therefore, very small changes (<1 km) in ZOI may have occurred, however, there are not enough locations to detect these shifts.

P-Bog Range

The habitat model for P-Bog range was developed in 2016 (Amec Foster Wheeler 2017) and used for this current report. Significant predictors of habitat selection included treed wetland, shrub wetland, herb wetland, dense coniferous stands, open coniferous stands, shrub stands and water (Amec Foster Wheeler 2017). Generally, in this range, the probability of caribou occurrence in any season significantly increased with the availability of treed wetlands and decreased in association with dense coniferous stands and water (Amec Foster Wheeler 2017). Caribou occurrence also increased with the availability of herb wetlands in the spring and summer and decreased with this same variable in the fall and winter (Amec Foster Wheeler 2017).

Results suggest that there has been a short ZOI of approximately 1 to 2 km during the construction phase (Figures 5-1-27 to 5-1-32). There is evidence suggesting that avoidance may have increased to during the summer and fall as the log-likelihood plots illustrate the potential for larger ZOI during these seasons (Figures 5-1-31 and 5-1-32). However as per Boulanger et al. (2012) methods, model fit demonstrates no strong pattern indicating that model currently does a poor job of fitting the data for these seasons. This pattern will continue to be assessed as more data accumulates and we will be reassessed in 2018. At this time, results indicate a potential for an increase in ZOI during this period that will continue to be assessed.

As was the case for the Wabowden range, caribou locations in the P-Bog range were fewer near the Project than areas farther away peaking in abundance at distances 10 to 15 km away. As sample sizes are low within 0 to 2 km of the Project, the level of confidence with which the ZOI can be drawn at 1 km versus 2 km is uncertain but will continue to be assessed as data accumulates through the remainder of the construction period and into the operations phase.

Most regional studies have revealed that caribou reduce their use of areas within 1 to 10 km of a development (Murphy & Curatolo, 1987, Wolfe et al. 2000, Nellmann et al. 2001, Mahoney & Schaefer 2002, Cameron et al. 2005, Joly et al. 2006, Weir et al. 2007, Vistnes & Nellmann 2008, Polfus et al. 2011). Boulanger et al. (2012) detected a ZOI of 14 km, however, the study was focused on a large open pit mine which from a noise and disturbance perspective is much different than a transmission line. Johnson et al. (2005) also found a large area of avoidance near mines and communities with the avoidance response varying seasonally. Caribou have varying disturbance threshold responses to linear disturbances, ranging from ≤250 m from seismic lines and trails (James & Stewart-Smith 2000, Dyer et al. 2001, Hebblewhite et al. 2010) to ≥500 m for well-traveled roads and highways (Environment Canada 2012, Haskell et al. 2006, Hebblewhite et al. 2010, Cameron et al. 2005). Studies of caribou and hydroelectric projects suggest diminished habitat use within 3 km following construction (Mahoney & Schaefer 2002) and up to 5 km if the power line is associated with roads (Nellemann et al. 2003, Vistnes & Nellemann 2008).

Woodland caribou are affected by cumulative disturbance within a range (Environment Canada 2012) and behavioral responses to the Project could be affected by other disturbances within the range. In 2015, AIC analysis revealed that models which included both the distance to other linear features such as highways and distance to the existing linear corridor fit the data better than when they were included separately (Amec Foster Wheeler 2016). These responses could be explored and quantified through a more complex RSF model that was not focused on defining the ZOI around the Project in future analysis.

5.1.1.4 Crossing Analysis

After the completion of the ZOI analysis, caribou behavior was further assessed on a more local scale by evaluating the extent to which the Project acted as a barrier to local movements. This crossing analysis differs from the ZOI analysis in that it evaluates individual local movement responses of individual caribou to the Project whereas the ZOI analysis quantifies the overall avoidance response by all collared caribou within a given range. The crossing analysis specifically assesses the extent to which the Project acts as a barrier to individual local movements by caribou whereas the ZOI analysis examines overall distribution of caribou on the landscape relative to the installation of the Project.

Both linear and mixed models were run for the crossing analysis in both the Wabowden and P-Bog ranges to control for individual level responses. Mixed models control for individual level effects without having to compare mean numbers of crossings. As both models provided comparable results we only report the results for the linear model.

In the Wabowden range, there was no significant increase in the level of avoidance from the pre-construction to construction phase (df = 1, 76; $p = 0.22$) indicating that widening of the ROW through the installation of the Project did not significantly alter caribou crossing behavior after the initiation of construction (Amec Foster Wheeler 2017). In 2016, collared caribou were found to cross the ROW less frequently than expectations generated through random movement trajectories suggesting that they are avoiding crossing the ROW (df = 77, $p < 0.0001$); caribou continued to avoid crossing the ROW in 2017 (df = 18, $p < 0.009$).

In the P-Bog range, there was no significant increase in the level of avoidance from the pre-construction to construction phase in the first two years of construction (Amec Foster Wheeler 2017). However, caribou did start avoiding crossing the ROW in 2017 (df = 18, p = <0.03) which indicates a potential lag effect in avoidance behavior.

5.1.1.5 Effectiveness of the Vegetation Mitigation Strategies

In 2016 and 2017 individuals continued to cross the Project in the P- Bog range at mitigated areas more frequently than expected (Figure 5-1-33). This was confirmed by examining the movements of individuals (Figure 5-1-34). Previous results (Amec Foster Wheeler 2017) also suggest individuals have not altered their movement patterns in this range as a response to the construction and also that mitigated areas were put in place where caribou would naturally cross the ROW.

5.1.1.6 Summary of ZOI versus Crossing Analysis Results

Wabowden Range - the crossing analysis continues to reveal that in the Wabowden range, there was no significant increase in the level of avoidance to the Project from the pre-construction to construction phase by collared caribou. Caribou continued to avoid crossing the ROW in 2017. This is comparable to the results of the ZOI analysis which revealed that the ZOI around the Project did not increase as a result of Project construction (i.e., widening of the corridor). Although not tested directly, these results may be a result of habituation by local caribou to this linear corridor. The crossing analysis also revealed that collared caribou crossed the Project less frequently than randomly generated crossings suggesting that caribou are avoiding crossing the Project even though there may be a level of habituation to the linear corridor.

Therefore, caribou do avoid the Project by a buffer of 1 to 2 km throughout the year, irrespective of Project phase. The Project is also a semi-permeable barrier to movement, it does not completely prevent local movement on the landscape, however, it does reduce the frequency. Caribou who choose to cross the Project, do not cross as frequently as would be expected by random. Some caribou still do cross the ROW and this behavior has not been not altered by construction. Should the information become available, future reports will assess the extent to which vegetation mitigation applications in this range have been effective in mitigating impacts to local caribou movements.

P-Bog Range - the crossing analysis reveals that in 2017 caribou started to avoid crossing the ROW. This is a change from results reported last year (Amec Foster Wheeler 2017) that quantified the response to the initiation of construction demonstrating no avoidance of the ROW and suggests that there may be a lag effect in how caribou adjusted to the Project. The ROW is semi-permeable barrier to movement on the landscape as some caribou still choose to move cross the ROW. This may be the result of the mitigation provided by installation of vegetation mitigation areas to encourage use.

The crossing analysis results for the P-Bog range do not contradict the ZOI results which indicated an overall avoidance buffer of approximately 1 to 2 km by caribou to the Project. Overall collared caribou did not occur frequently within 1 km of the Project during construction. Individual caribou who decided to cross the Project, were doing so less frequently than what would be expected randomly. This indicates that the Project has not been a complete barrier to local movement which may be the result of effective installation of vegetation mitigation areas. In 2016 and 2017 individuals continued to cross the Project at mitigated areas at a higher proportion of the time than areas without vegetation mitigation and at frequencies higher than expected at random.

5.1.2 Population Demography

5.1.2.1 Structure and Calf Recruitment

Calf mortality is greatest during the first six months after birth, with survival increasing to adult levels after six months (Gustine et al. 2006, Pinard et al. 2012, Traylor-Holzer 2015). Estimation of calf recruitment provides valuable insight into population state and provides a measure of calves produced and surviving to a point where they are considered recruited into the yearling/adult caribou population. Assuming annual adult survival is >85%, populations are likely growing if the proportion of calves (% Calves) in winter is >15%, stable if 12 to 15%, or in decline if <10% (Bergerud 1974, Stuart-Smith et al. 1997, Dzus 2001, Arsenault 2003). A population viability analysis conducted by Environment Canada (2008, 2011) suggests calf recruitment rates >28.9 calves/100 cows indicates a stable to increasing population (assuming annual adult female survival is ≥85%). If calf recruitment drops below this threshold and/or annual female survival rates are <85%, the population is likely declining.

Calf recruitment estimates (Table 5-1-4) were obtained from aerial surveys conducted January 17 to February 5, 2017. **Annual adult female survival** was estimated from telemetry data for each boreal woodland caribou range using the Kaplan-Meier method of survival analysis (Pollock et al. 1989) with a staggered entry design to account for multiple collar deployments. The telemetry data were right-censored with time-at-risk based on the number of months since the animal was live-captured. Kaplan-Meier plots for each boreal woodland caribou are presented in Figure 5-1-35 and were used to determine the annual adult female survival rates reported in Table 5-1-4. Annual adult female survival rates for collared caribou in Year 3 were all above 85%, which is conducive to population stability or growth when the proportion of calves in the population is >12% or when the calf recruitment rate (calves/100 cows) is >28.9.

- The demographic indicator metrics of winter calf recruitment (% calves and calves/100 cows) and Kaplan-Meier adult female survival (Table 5-1-4) for Year 1 through Year 3 of monitoring are consistent with stable populations in the P-Bog, Wabowden, and Charron Lake ranges, and a stable (possibly increasing) population trend in the N-Reed range.

Adult female survival rates over the past 3 years (Table 5-1-4) of monitoring indicate slightly lower rates for Wabowden and N-Reed populations compared to P-Bog and Charron Lake (reference population in a relatively undisturbed range).

5.1.2.2 Abundance and Trend

NGS/CMR methods were used to obtain initial population estimates using closed population model estimators for each monitored woodland caribou range (P-Bog, N-Reed, Wabowden and Charron Lk) in Year 1 (2014/15). Sampling was repeated in Year 3 (2016/17) to assess population state (abundance, trend (λ), and sex ratio). No phylogenetics or kinship/pedigree analyses are planned for this monitoring study. No population genetic structure/health assessments are planned to assess inbreeding, genetic diversity, genetic variation or genetic drift for any of the monitored populations. Results of the sampling effort are presented in Table 5-1-5.

Preliminary population abundance trend models were developed for the 2009 to 2017 interval for each monitored woodland caribou local population (Figure 5-1-36). A third degree polynomial was used to fit a long-term population trend line to the abundance estimates for each moose management unit (Kuzyk 2016). The polynomial was used because it is more sensitive to fluctuations in population size than a linear or log-linear trend line (Kuzyk 2016). The objective of model fitting was to examine population trend within the 2009-2017 period of assessment. Results of the genotyping and preliminary trend modelling indicate each local population is stable and occurring at natural levels of abundance:

- P-Bog local population was initially stable, averaging about 190 individuals (0.0329 caribou/km²), with a recent significant increase in abundance to 230 individuals during the construction phase of the Project.
- Wabowden local population has remained stable, averaging about 166 individuals (0.0405 caribou/km²) through the assessment period, but CMR results indicate significant increase during the construction phase.
- N-Reed local population has remained stable (possibly increasing over the 9-year modelling period), averaging about 330 individuals (0.0505 caribou/km²).
- Charron lake local population has remained stable, averaging about 1,200 individuals (0.0755 caribou/km²), which is larger than previous provincial guesstimates of population size, but within a natural level of abundance for woodland caribou.
- Application of open-population model estimation will be investigated in a future monitoring report; additional population estimates in future years of monitoring are required to improve the modelled abundance trend assessment and to assess for lag effects of the Project footprint on population state.

Genetic population structure analyses indicate the Charron Lake population has a large proportion of the eastern migratory haplotype lineage mixed with smaller proportions of barren-ground and western and southern Manitoba haplotype lineages (Klütch et al*.* 2012, Manseau et al*.* 2014).

Estimates of population trend (lambda; λ) for each monitored boreal woodland caribou range were possible after analysis of pellet samples collected in Year 3 (2016/17) of the monitoring program. Population trend models for the 2009 to 2017 period were used to calculate mean λ estimates for each local population ($\lambda < 1.0$ indicates population decline; $\lambda = 1.0$ indicates stability; $\lambda > 1.0$ indicates population growth).

- Lambda (λ) estimates for the 2009-2017 modelled interval indicate stable local populations for P-Bog ($\lambda = 1.00$), Wabowden ($\lambda = 0.99$), Charron Lake ($\lambda = 1.00$), and a stable to slightly increasing population for N-Reed ($\lambda = 1.03$).

5.2 Forest-Tundra and Barren-ground Caribou

The Bipole III construction phase is expected to be completed in 2018. Therefore, no further Bipole III construction monitoring of Forest-Tundra or Barren-ground caribou will be required after 2018 per project commitment.

5.2.1 Forest-Tundra Caribou

The **Pen Islands** caribou population was estimated to total 10,800 in 1994 (Abraham & Thompson 1998). The population summers along the Hudson Bay coast of Ontario and Manitoba and overwinters inland near the boundary of the Hudson Plain and Boreal Shield ecozones (Biodivcanada.ca 2016). The population in recent years is thought to be decreasing with the population range shifting eastward. Satellite telemetry data (January 2010 to March 2017) indicates there are movements as far west as the Nelson River proximate to the southeast edge of Split Lake and York Factory First Nation in Manitoba (Figure 4-2-1). Typically, <300 caribou from this population occur in the general Project area, although large winter migrations are known to have occurred in 2001, 2005 and February 2013 (LaPorte et al. 2013, WRCS 2016).

The **Cape Churchill** caribou population is considered to be stable with a minimum population size estimate of about 3,000 caribou (Abraham et al. 2012, Biodivcanada 2016). This population resides on Coastal Hudson Bay Lowland ecoregion west of Hudson Bay between the Churchill and Nelson Rivers (Trim 2015), and will seasonally migrate southward occasionally as far as the Bipole III Project in proximity to the N1 construction segment northeast of Stephens Lake (Figure 5-2-1). Satellite telemetry data (2010 to January 2015) indicates most of their activity occurs north of the Nelson River (Figure 5-2-1). Typically, <50 caribou from this population overwinter in the general Project area in most winters (WRCS 2016).

Pen Islands and Cape Churchill caribou are a forest-tundra ecotype, also referred to as coastal caribou (Trim 2015). A collaborative study of these populations was initiated in February 2010 involving MB Gov, MB Hydro and the Fox Lake, Split Lake and York Factory Resource Management Boards. The study has a telemetry, aerial population demographic, and genetic analysis components to assess population spatial structure (including range extent), movement dynamics relative to landscape disturbance, mortality sources, changes in population demographics and population genetic relatedness. Calf recruitment results for the study are presented in Table 5-2-1.

The following summarizes forest-tundra (Pen Islands and Cape Churchill populations) and barren-ground (Qamanirjuaq population) caribou recent occurrence in the Project area:

1. **Pre-disturbance** - A large migration of forest-tundra woodland caribou (Pen Islands population) occurred in the Bipole III Project area in winter of 2012/13 (LaPorte et al. 2013).

2. **Year 1 (2014/15)** - No forest-tundra woodland caribou or barren-ground (Qamanirjuaq population) caribou occurrences were noted in proximity of the Project during winter clearing/construction activities in 2014/2015 (MB Gov, V. Trim, personal communication, February 22, 2016).

3. **Year 2 (2015/16)** – Caribou believed to be from the Cape Churchill population were harvested along Highway 280 between Gillam and Bird (Fox Lake Cree Nation) in January 2016 (MB Hydro, T. Barker, personal communication, October 11, 2016).

4. **Year 3 (2016/17)** – No Pen Islands or Cape Churchill caribou were present along the Bipole III ROW during winter construction; GPS collared Pen Islands caribou all remained south of the Nelson River and Cape Churchill caribou remained north of the ROW into at least late February 2017 (MB Gov, V. Trim, personal communication, August 14, 2017). There were no calf recruitment surveys conducted for either population during Year 3. The telemetry study is nearing completion; no additional telemetry collars will be deployed and no calf recruitment surveys are planned for this or future years in relation to the current telemetry study (MB Gov, V. Trim, personal communication, August 14, 2017).

5.2.2 Barren-ground Caribou

The **Qamanirjuaq** caribou population has declined from 349,000 ± (SE)44,900 (2008 estimate) to 264,000 ±(95%CI) 44,084 (2014 estimate), accompanied by a downward trend in cow:calf ratios indicative of reduced annual calf recruitment (Biodivcanada 2016, Campbell et al. 2010, Campbell et al. 2015). A survey of this population was conducted in 2017 by Government of Nunavut, but the results of the survey were not available to present in this report. This population annually migrates from Nunavut in fall to overwinter in northern Manitoba, and then return to Nunavut in spring to calve. Periodically a small component of the population (usually consisting primarily of bulls) may overwinter as far south as the northern extent of the Bipole III Project area (proximate to N1 construction segment). The last known occurrence in the Project area (proximate to the N1 construction segment) was in 2004 (about 10,000 caribou; WRCS 2016).

5.3 Moose

Three sensitive moose ranges were identified for long-term monitoring (Manitoba Hydro 2015) which include: Tom Lamb Wildlife Management Area (GHA 8), Moose Meadows (portion of GHA 14) and Pine River (GHA 14A/19A). All three sensitive ranges occur in the boreal plain ecozone. One additional moose range (Split Lake) bisected by N1 construction segment of the Bipole III ROW occurs on the boreal shield ecoregion and was added (in Year 2) to the Bipole III moose monitoring program. Figure 4-3-1 illustrates the locations of each monitored moose range relative to adjacent reference moose populations.

5.3.1 Population Dynamics

Trends in regional moose population dynamics are important to understand in order to provide context to the baseline condition of each monitored moose range, and to ascertain through long-term monitoring whether the Bipole III Transmission Project will cause a significant positive or negative incremental effect on population performance of any of the sensitive moose ranges. Current population size is a function of past abundance and the demographic processes of survival, productivity, immigration and emigration (Skalski et al. 2005). These processes and their relative interactions affect population growth and abundance. Multiple surveys of winter populations across years provides a sequential time series of population abundance estimates that can be used to model population trend and change. The finite rate of population change (λ) characterizes the relative change in population abundance over time. Population trend modelling allows an assessment of various population performance metrics, including λ.

5.3.2 Population Demography

5.3.2.1 Tom Lamb WMA (GHA 8)

The Saskatchewan River Delta is an extensive alluvial landscape feature straddling the Saskatchewan-Manitoba border, consisting of upper and lower portions separated by The Pas Moraine ecodistrict, and totals about 10,000 km^2 in area. The delta landscape is significantly affected by two hydroelectric dams, E.B. Campbell Dam in Saskatchewan (upstream side at the outlet of Tobin Lake) and Grand Rapids Dam in Manitoba (downstream side at the outlet of Cedar Lake). Extremes of flood events are moderated by the dams since their construction in the 1960's. Mean annual hydrographic outflow from the delta have declined by 25 to 30% since records began in 1913, largely attributed to upstream irrigation consumption along the South Saskatchewan River. Collectively, the moderated flood regime and decline in hydrographic flow have likely affected the delta ecology, including vegetation succession / maturation, moose habitat suitability, and predator-prey dynamics.

Tom Lamb WMA/GHA 8 includes a large portion of the lower Saskatchewan River Delta (CEC 2013). Tom Lamb WMA is situated to the east of the upper portion of the Saskatchewan River Delta (which includes the Cumberland Delta in Saskatchewan and GHA6/6A in Manitoba), and is also adjacent to the north east portion of the Red Deer-Bog population (GHA 11/12), the north shore of Cedar Lake. Grass River population (GHA7/7A) abuts to the north edge of Tom Lamb WMA.

Population census data indicates Tom Lamb WMA has a moose population trend characterized by a history of fluctuation (Figure 5-3-1) affected by unsustainable harvest regimes and periodic flooding events (2005, 2007 and 2011) affecting distribution (Kent Whaley, 2015 GHA 8 Moose Survey Proposal, June 2, 2015). Regional moose population trends of surrounding moose populations all indicate declines in abundance of moose populations since at least 2000 (Figure 5-3-1). The following summarizes population assessment results for Tom Lamb WMA (GHA 8) by monitoring year:

- **Year 1 (2014/15) -** Amec Foster Wheeler 2016 conducted a population trend analysis of regional moose populations proximate to Tom Lamb WMA/GHA 8, which indicated a general regional population decline in moose population abundance in recent years (prior to Bipole III disturbance), including the Tom Lam WMA/GHA8 sensitive moose range.

- **Year 2 (2015/16) -** a Gasaway Population Survey of GHA 8 was conducted by MB Gov in January 2016 that yielded an estimate of 339 ±18.5% moose (0.107 moose/km^2). There was no significant change in winter moose abundance detected since the previous survey (317 ±32.0%, 0.101 moose/km^2; 47% below the long term mean) conducted in January 2012), suggesting that the declining trend in moose population abundance may have stabilized at a lower level of abundance, currently at 48% below the long-term (1971 to 2016) winter population mean (Table 5-3-1, Figure 5-3-1). The winter population structure estimates indicate an increase in the proportion of adult cows from 43.2% (January 2012) to 47.5% (January 2016) and calves from 20.2% (January 2012) to 24.8% (January 2016) in the winter population relative to adult bulls (36.6% in January 2012 to 27.4% in January 2016). This suggests the population has a slightly improved capacity for potential growth (greater reproductive capacity and greater calf recruitment into the adult population) compared to January 2012, assuming there are sufficient numbers of bulls in the population to allow effective breeding during the rut. Twinning rate also increased from 8.0% (January 2012) to 12.9% (January 2016).

- **Year 3 (2016/17) -** The population abundance and trend for Year 3 is expected to be similar to that of Year 2. MB Gov has scheduled a survey of GHA 7 (adjacent to the north side of Tom Lamb/GHA 8) for Year 4 (2017/18), which may yield some additional information on regional moose status and trend.

5.3.2.2 Moose Meadows (Portion of GHA 14)

Moose Meadows represents a sensitive local moose area that potentially interacts with the Bipole III ROW. Moose Meadows is also known as Bellsite Swamp (Shared Values Solutions 2015) characterized as a low lying area and considered to be a sensitive winter foraging refuge for local moose moving off of the east slopes of the Porcupine Hills (Manitoba Hydro 2014), as well as a spring moose calving area (Shared Values Solutions 2015). An additional habitat patch referred to as Novra Swamp lies immediately to the south of Moose Meadows (Shared Values Solutions 2015). Both swamps are adjacent to the east edge of the Porcupine Hills and are contiguous with the western portion of the Interlake Plain Ecoregion; both swamps lie within the Swan-Pelican MMU (GHA14/14A). Swan Lake and farmland occur to the south of Moose Meadows. The Bipole III ROW passes between Moose Meadows and the Porcupine Hills, paralleling a segment of Highway 10 that links the communities of Whitmore and Mafeking.

Moose Meadows is a small western portion of GHA 14 that tends to fluctuate in moose numbers depending on snow conditions in the Porcupine Hills (MB Gov, K. Rebizant, personal communication, November 3, 2014). Empirical evidence (telemetry) to confirm this habitat condition mediated movement is lacking. The Porcupine Hills are a large landscape hill complex mainly in Saskatchewan but extending into Manitoba. Historically, the Saskatchewan portion of the population was relatively stable across decades at about 5,300 moose (0.763 moose/km^2), with significant recent decline below the long-term mean (Figure 5-3-2). The Manitoba portion of the population is much smaller and over the last 10 years appears to be stable (Figure 5-3-2, Table 5-3-1). A Gasaway population survey of the MB portion of the Porcupine Hills was conducted by MB Gov in early February 2017. Results indicate the Manitoba portion of the population is at 1057±16.4% (0.408 moose/km^2). The long term population trend for the Porcupine Hills differs substantially with that observed for Moose Meadows sensitive moose area and GHA 14 (Figure 5-3-2).

There are no specific moose population surveys of Moose Meadows, as it is a portion of GHA 14. Typically, GHA 14 has been surveyed by MB Gov on its own, or in association with GHA 14A. As a moose population monitoring unit (Swan-Pelican MMU), moose in GHA 14/14A have experienced a significant decline beginning in the early-1990's (approx. 3,300 moose; 0.687 moose/km^2) to the current level of about 150 moose (0.030 moose/km^2; 89% below the long term mean) based on population surveys conducted in January 2011 and January 2014 (Table 5-3-1, Figure 5-3-2). The following summarizes population assessment results for Moose Meadows by monitoring year:

- **Year 1 (2014/15) -** Amec Foster Wheeler 2016 conducted a population trend analysis of regional moose populations proximate to Moose Meadows, which indicated a general regional population decline in moose population abundance in recent years (prior to Bipole III disturbance), including the Moose Meadows sensitive moose range.
- **Year 2 (2015/16) -** No survey was scheduled or conducted.
- **Year 3 (2016/17) -** No survey was conducted. A moose population survey led by MB Gov was recommended to occur in Year 3 (2016/17) for the Swan-Pelican MMU population (GHA 14/14A) in January 2017 as part of the Bipole III Mammals Monitoring Program. However, MB Gov advised that this population is not on the 2016/17 moose population survey schedule (MB Gov, V. Harriman, personal communication, November 4, 2016). No survey is scheduled for Year 4 (2017/18) by MB Gov for Swan-Pelican MMU (GHA 14/14A).

5.3.2.3 Pine River (GHA 14A/19A)

Pine River (GHA 14A/19A) represents a sensitive local moose population that potentially interacts with the Bipole III ROW. GHA 14A is considered to be sensitive because it is an area of winter use in an area of limited remote habitat adjacent to the northeast side of the Duck Mountains (Manitoba Hydro 2014). Highway 10 passes between the Duck Mountains and Pine River (GHA 14A/19A). Swan Lake and Pelican Lake are at the north edge of GHA 14A, and Lake Winnipegosis is on the east edge (Figure 4-3-1). GHA 14A and GHA 19A are transected by a section of Highway 20 linking the communities of Cowan and Camperville. GHA 19A has higher levels of anthropogenic disturbance and access development.

Moose population demographic data are limited for this population but based on modelling of available survey data for GHA14A/19A, it appears the population significantly declined from a high of 1,047 moose (0.336 moose/km^2) in January 1992 to 213 (0.068 moose/km^2) in January 2002, and has remained at a low level (Figure 5-3-3). The winter population in January 2014 was assessed by MB Gov to be about 100 ±19.0% moose (0.032 moose/km^2). Trends in regional moose population abundance (Swan Pelican MMU and Duck Mountain MMU) over the long term indicates a general decline (Figure 5-3-3). However, a Gasaway population survey of Duck Mountain MMU conducted in early February 2017 by MB Gov suggests this population is stable and possibly beginning to increase (Figure 5-3-3). The Duck Mountain MMU winter population was estimated to be 1,958 ±15.1% (0.269 moose/km^2), which is about 12.1% below the long term mean of 2,228 moose (0.310 moose/km^2). The following summarizes population assessment results for Pine River (GHA 14A/19A) by monitoring year:

- **Pre-construction (2013/14)** – A survey was conducted by MB Hydro in January 2014 that yielded a population estimate of 100 moose ±19.0 (95% CI) and a population structure ratio of 1.38 Bulls: Cow:0.77 Calves. A survey conducted by MB Gov in January 2013 which yielded a population estimate of 91 ±12.8 (95% CI) and population structure ratio of 0.38 Bulls: Cow:0.88 Calves. There is no significant differences between the abundance estimates, but historical trend data suggest a substantial population decline occurred for this population sometime between 1992 and 2001.

- **Year 1 (2014/15)** - No survey was scheduled or conducted. Amec Foster Wheeler 2016 conducted a population trend analysis of regional moose populations proximate to Moose Meadows, which indicated a general regional population decline in moose population abundance in recent years (prior to Bipole III disturbance), including the Pine River sensitive moose range.

- **Year 2 (2015/16) -** No survey was scheduled or conducted.

- **Year 3 (2016/17) -** No survey was conducted in Year 3 (2016/17). A moose population survey led by MB Gov (in collaboration with MB Hydro) was recommended for this population for January 2017 as part of the Bipole III Mammals Monitoring Program. However, MB Gov advised that this population was not on the 2016/17 moose population survey schedule (MB Gov, V. Harriman, personal communication, November 4, 2016). No survey is scheduled for Year 4 (2017/18) by MB Gov for Pine Hills GHA 14A/19A.

5.3.2.4 Split Lake Moose Study Area (GHA 9A)

MB Hydro monitors moose as a component of their Terrestrial Effects Monitoring Plan for the Keeyask Generation Project. The Keeyask survey area occurs in the eastern portion of GHA 9, with lesser portions in adjacent GHAs 1, 3 and 3A and 9A. A portion of the Keeyask survey area, specifically Study Zone 5 (hereafter referred to as Split Lake Moose Study Area) straddles the Nelson River from Thompson, through Split Lake to Stephens Lake, and is situated primarily in GHA 9A. The Split Lake moose study area overlaps the northern portion of N2 and most of N1 construction segments of the Bipole III Transmission Project ROW. Although the area was not identified as a sensitive moose range, it was added to the Bipole III moose monitoring program because it represents an area occupied by moose on the boreal shield ecozone that is intersected by the Bipole III ROW. The following summarizes population assessment results for the Split Lake Study Area:

- **Year 1 (2014/15) -** During January 2015 a moose population survey of the Keeyask survey area (including Split Lake study area) was conducted. Comparison of population abundance survey data obtained from MB Hydro indicates no significant difference between January 2010 (961 ±21.0%) and January 2015 (1,349 ±22.6%) because the confidence intervals of both estimates overlap. However, the 2015 abundance estimate is larger, suggesting the population may be growing at a 10-year mean λ = 1.022.

- **Year 2 (2015/16)** - No survey was scheduled or conducted by MB Hydro for this population.

- **Year 3 (2016/17) -** No survey was scheduled or conducted by MB Hydro for this population (MB Hydro, T. Barker, personal communication, November 3, 2017). MB Hydro conducted a moose survey for the Keeyask Project in January 2018 (MB Hydro, J. Wiens, personal communication, January 23, 2018). No survey is scheduled by MB Hydro for Year 4 (2017/18) and no surveys in the vicinity of this population are planned by MB Gov.

5.3.3 Distribution and Occurrence

Moose sightings and activity data were collected during the Ungulate-Wolf Distribution Survey concurrently with the Woodland Caribou Calf Recruitment Survey. This data is useful to assess moose distribution relative to the ROW, as well as predator-prey dynamics in the woodland caribou survey areas.

Moose distribution within 10 km of the ROW (N1-N4 and north part of C1) was also recorded as a component of the Multi-species Aerial Survey to assess coarse scale local distribution relative to the ROW.

Discussions between MB Hydro and MB Gov are ongoing with respect to moose population survey methods as a component of the Bipole III Mammals Monitoring Program, to monitor predicted effects to moose populations interacting with Project infrastructure and activities, and to ensure Project commitments, approval conditions, and EA License requirements are met with respect to moose monitoring.

5.4 Deer and Elk

Presence / absence and distribution of deer and elk were monitored using several methods which included (1) annual Ungulate-Wolf Distribution Surveys conducted concurrently with the Woodland Caribou Recruitment Survey, (2) Multi-species Aerial Survey of the Bipole III ROW along N1 – N4 and north half of C1 construction segments, (3) Winter Ground Transect Surveys, and (4) Remote IR Camera traps.

5.4.1 White-tailed Deer Ingress

A combination of winter aerial species distribution surveys, winter ground track transects and remote IR cameras are used monitor potential for Project-related white-tailed deer ingress and occurrence across seasons into areas transected by the ROW that historically have limited or no deer occurrence. The following summarizes deer and elk occurrence and distribution results relative to the ROW by monitoring year:

- **Year 1 (2014/15)**
  - Ungulate-Wolf Distribution Surveys were conducted in the P-Bog N-Reed and Wabowden Woodland Caribou Range survey areas; no white-tailed deer or elk observations or sign were detected.
  - Winter Ground Track Transect Surveys were conducted along N2 and N3 construction segments, including deployment of Remote IR Trail Cameras during March 2015 to monitor deer presence along the N2 and N3 portions of the ROW and within 1,500 m of the ROW; no deer evidence was detected during the winter ground track transect surveys or trail camera deployment effort.
- **Year 2 (2015/16)**
  - Ungulate-Wolf Distribution Surveys were repeated in P-Bog, N-Reed and Wabowden woodland caribou range survey areas with no evidence of deer or presence detected. Surveys were also flown in two *P. tenuis* surveillance areas situated along the ROW on either side of the P-Bog woodland caribou survey area; deer were detected on private land portions of the survey area in areas of historical occurrence; no elk or elk sign was observed.
  - The Alaskan Trackers conducted a Multi-species Aerial Survey; they detected deer in areas of historical occurrence, including in proximity of the P-Bog woodland caribou range along the ROW east of Red Deer Lake (Figure 5-4-1).
  - Winter Ground Track Transects were conducted in N1, N2 and N3, with no evidence of deer detection outside of areas of historical occurrence; there was one deer record of occurrence on N2-10).
  - Remote IR Trail Cameras deployed during Year 1 along N2 and N3 detected deer activity on transect N3-05 and N3-06, as well as at the BPIII_ACCESS_003 human access monitoring location.

- **Year 3 (2016/17)**
  - Ungulate-Wolf Distribution Surveys were repeated in P-Bog, N-Reed and Wabowden woodland caribou range survey areas with no evidence of deer or elk presence detected.
  - MB Hydro repeated the Multi-species Aerial Survey; the survey detected deer in areas of historical occurrence with minimal evidence of recent occurrence in close proximity (February 2016) and within (Feburary 2017) the P-Bog caribou study area (Figure 5-4-1).
  - Winter Ground Track Transect Surveys were conducted in N1, N2, N3, and N4 with no evidence of deer detection outside of areas of historical occurrence; of the 50 transects sampled, white-tailed deer activity was detected only on N4-07, which is within the expected area of occupancy.
  - Remote IR Trail Cameras deployed during Year 2 along N1, N2 and N3 detected deer activity on transect N3-05 and N3-06, as well as at the BPIII_ACCESS_003 human access monitoring location. During Year 3 deer were detected at BPIII Access_002 and again detected at N-06. No elk were detected either year.

There is some indication based on the Multi-species Aerial Survey of possible ingress in 2017 of white tailed deer into the northern periphery of the P-Bog caribou range along the ROW during the construction phase (Figure 5-4-1); continued monitoring is recommended during the operation phase. There is no evidence of elk ingress into areas outside of historical occurrence as a result of the ROW and associated Project disturbance during the construction phase.

5.4.2 *P. tenuis* Monitoring

In recent decades, research attention to wildlife movement corridors has increased, concurrent with concerns related to habitat fragmentation, and the spread of invasive species and disease vectors Panzacchi et al. 2015). Climate change may facilitate northward range expansion of white-tailed deer (Dawe 2011) with certain types of anthropogenic disturbances (including power line corridors) providing ecotones with excellent ungulate browse resources and accessible hiding cover in adjacent forest (Reimers et al. 2000, Wunschmann et al. 2015), and functioning as corridors for range expansion.

Parelaphostrongylus tenuis (*P. tenuis*; meningeal brain worm) was identified in the Bipole III EIS and Biophysical Monitoring Plan (Manitoba Hydro 2015) as the primary focus for monitoring. Meningeal worm is prevalent and common in white-tailed deer populations in eastern and central Canada (Lankester 2001). White-tailed deer have built up a resistance to the parasite and does not normally cause neurological symptoms. Other ungulate species (moose, elk and caribou) are less resistant, and even low intensity of parasite infections can cause severe neurological disorders leading to death (Trainer 1973, Weiland 2008, Lankester 2010). In some areas, infected white-tailed deer populations overlapping with moose and caribou have resulted in declines of these species (Weiland 2008).

P tenuis is a long-lived ungulate nematode parasite that can persist in adult form in the ungulate host for many years, which facilitates continual shedding of first stage larvae in ungulate fecal mucosa (Slomke et al. 1995). Gastropods (snails and slugs) ingest the first stage larvae when they feed on the mucosa. While in the gastropod host, the larvae develop into second and third stage larvae which are capable of infection. Infected gastropods residing on ungulate forage are incidentally ingested by the ungulate host, at which point the larvae move to the ungulate host's stomach wall, enter the central nervous system and brain where they develop into the third (adult) stage. In the ungulate host, female worms shed eggs into the host's circulatory system; the eggs migrate to the host's lungs where they develop into first stage larvae, are coughed up, swallowed and pass unharmed in ungulate feces to complete the life cycle (Weiland 2008). *P tenuis* transmission is related to deer population density and gastropod host abundance (mediated by temperature and climate). Transmission period is variable and related to the amount of time that ground snow cover is absent.

Diagnosis of *P. tenuis* can be conducted by analyzing deer fecal pellets for first stage larvae, and by post-mortem necropsy of the deer brain cavity to detect present of adult parasites (Wasel et al. 2003, Duffy et al. 2002, Slomke et al. 1995). Forrester & Lankester (1997) present a commonly used technique to generate quantitative estimates of prevalence (proportion of animals passing protostrongylid larvae) and mean intensity of infection (mean number of larvae passed / infected individual) using ungulate fecal samples. The following is a summary of results of the *P. tenuis* sample effort by year:

1. **Year 1 (2014/15) -** No deer fecal collection, or collection of harvested adult white-tailed deer heads, was undertaken in of the Bipole III Mammals Monitoring Program; that aspect of the Biophysical Monitoring Plan (Manitoba Hydro 2015) had not yet been approved by MB Gov to permit sampling.

2. **Year 2 (February 2016) -** White-tailed deer pellet collection was attempted along the ROW from two surveillance areas using a systematic aerial transect survey method to detect deer activity (Figure 5-4-1). However, sample acquisition was substantially hindered by inaccessibility to private land on portions of the ROW that deer sign was observed. There was also very little deer sign detected in the areas surveyed. Consequently, no samples were collected. No deer pellet samples were detected during the winter ground track transect survey, nor by MB Hydro environmental monitors along the ROW during winter construction.

3. **Year 3 (2016/17) -** A ground-based community deer pellet sample collection effort was conducted using students from UCN (University College of the North) and OCN (Opaskwayak Cree Nation) on February 21 to 23, 2017. The students gathered samples along the south end of N3 within Surveillance Area 1 (n = 114 samples), along N4 (including within Surveillance Area 2; n = 86 samples), and from the north end of C1

(n = 26) (Figure 5-4-1). The samples (n = 226) were submitted to Prairie Diagnostic Services (University of Saskatchewan) to undergo Baermann testing for presence of nematode spiney-tailed larvae (indicative of probable *P. tenuis* infection). Positives (n = 93) were detected in samples from all collection sites, suggesting a *P. tenuis* prevalence of 41.1% in the regional white-tailed deer population (Table 5-4-1). Prevalence was lower (25.4%, n = 114) in samples collected north of Pasquia-Bog Woodland Caribou Range (N3, *P. tenuis* Surveillance Area 1). Prevalence was greater (60.5%, n = 86) in samples collected south of the Pasquia-Bog Woodland Caribou Range (N4, including *P. tenuis* Surveillance Area 2) and in C1 (46.2%, n = 26).

5.5 Furbearers

5.5.1 Harvest Monitoring

Trapping has limited economic impact compared to decades prior to the 1980's, but it does influence social and economic programs of Manitoba through its northern registered trapline legacy (Berezanski 2004). MB Hydro actively works with trappers and mitigates to potentially reduce disruption of trapping activities when new power distribution lines ($\geq$115 Kv) affect the trapline (Berezanski 2004, MB Hydro Trapper Notification/Compensation Policy, MB Hydro presentation to the MB Clean Environment Commission). The Bipole III Project directly intersects 42 registered traplines including 4 community traplines (Table 5-5-1, Figure 4-4-1).

Annual furbearer harvest statistics are used to monitor effects of Bipole III on fur harvest from registered traplines intersected by the transmission line by comparing pre-Bipole III disturbance harvest statistics (by species and construction segment) to post-disturbance. There is a significant lag in MB Gov furbearer harvest statistics availability, therefore only pre-disturbance baseline data (2001/02 through 2013/14) and first 2 years of construction disturbance (2014/15 and 2015/16) were available for this report. The furbearer harvest data will be updated in a future annual monitoring report to update the significance of Project effects on furbearer harvest before and after disturbance.

Annual harvest (Table 5-5-2) and harvest rate (Table 5-5-3) of many of the other furbearer species from the monitored traplines appears to be limited and highly variable, which is likely related to a combination of factors including:

- Trapping effort - some traplines have no or limited harvest records in some years, which is likely related to trapping conditions in a particular year, trapper interest, trapping success, and pelt prices (Todd & Boggess 1999).
- Variable fur prices - reduced trapping effort during low fur pelt prices.
- Cyclical population fluctuations (Wolfe & Chapman 1999) – e.g., lynx have a classic population cycle linked to prey (hare) availability (Seton 1911, Elton 1924), marten in

Manitoba cycle at 4-year intervals (MB Gov, D. Berezanski, personal communication, September 1, 2015).

- Species distributions - some species are rare or absent as a function of their latitudinal distribution or habitat requirements (e.g., coyote, wolverine) relative to the Project location (Allen 1999, COSEWIC 2003).

- Variation in annual trapping license sales (number of trappers harvesting fur).

Four furbearer species (beaver, marten, wolf, wolverine) were identified in the Bipole III Project EIS (Manitoba Hydro 2011) as having particular concern because of potential Project disturbance effects (i.e., access resulting in overharvest, direct habitat loss and/or sensory disturbance). Harvest statistics for these species in particular will continue to be monitored and assessed as annual harvest data becomes available. The majority of annual harvest for these four species is variable across construction segments (Table 5-5-2). This is in part due to differences in the number (and physical extent) of traplines within each construction segment that are intersected or directly adjacent to the ROW. The same pattern is evident in the harvest rates for these species (Table 5-5-3) and means (Tables 5-5-2 and 5-5-3). The following is a summary by species of the fur harvest statistics:

- **Beaver** - Harvest statistics for beaver indicate harvest (number of pelts and harvest/license) during the initial construction phase (2014/15 and 2015/16) was consistently lower in construction segments N1-N4 relative to the 5-year (2009/10 to 2013/14) pre-construction means (Tables 5-5-2 and 5-5-3). This suggests there may be a reduced harvest of beavers in traplines intersected by the Bipole III ROW during construction.

- **Marten** - During the initial 2 years of construction, harvest statistics data indicate N3 harvest and harvest rate for marten was significantly higher in N3, and harvest was significantly lower in N4, compared to the 5-year (2009/10-2013/14) pre-construction means (Tables 5-5-2 and 5-5-3). However, no significant differences were evident when the data were pooled for the entire N1 through N4 construction segment portion of the ROW.

- **Wolf** - No significant difference was detected when comparing pre-disturbance to initial construction phase with respect to harvest or harvest rate in the monitored construction segments or the pooled ROW harvest data.

- **Wolverine** - No significant difference was detected when comparing pre-disturbance to initial construction phase with respect to harvest or harvest rate in the monitored construction segments or the pooled ROW harvest data.

- **Red Fox** – Total harvest was significantly lower during initial construction compared to pre-disturbance (Table 5-5-2), but was not significant with respect to harvest rate

(Table 5-5-3), which suggests the lower harvest is a result of fewer trappers trapping during initial construction.

- **Muskrat** – Muskrat harvest and harvest rates were lower during the initial construction phase compared to pre-disturbance in all monitored construction segments (N1 – N4), but the difference was found to be significant only for N4. When data were pooled, there was a significant decrease in harvest (Table 5-5-2) but not harvest rate (Table 5-5-3), which suggests the lower harvest is a result of fewer trappers trapping during initial construction.

- No other significant harvest trends were detected for the remaining furbearer species (Tables 5-5-2 and 5-5-3).

5.5.2 Distribution and Occurrence

5.5.2.1 Winter Ground Transect Surveys

Winter ground track transects surveyed during Year 3 (n = 50) along construction segments N1, N2, N3, and N4 detected most of the expected furbearing species including weasel, marten/fisher (genus *Martes*), wolf, fox, coyote, otter, mink, lynx, snowshoe hare, squirrel, beaver (transect N2-16 only), as well as ungulate species including moose and white-tailed deer (transect N2-10 only) (Figures 5-5-1 to 5-5-3). Woodland caribou, elk and wolverine were not detected in 2017 but have been detected in earlier years.

Each species distribution was modelled separately to assess levels of occurrence as a function of the distance to the Project during winter construction, results are summarized for each target species (Tables 5-5-4 to 5-5-12). For animals that are wide-ranging with large home ranges (e.g., wolf, wolverine) the assumption of independence of detection data from different sample units is likely to be violated (Webb & Merrill 2012). Most species were detected more frequently at distances farther from the Project during winter construction, than closer to the Project (Figures 5-5-4, 5-5-5, 5-5-6, 5-5-7, 5-5-8, 5-5-9, 5-5-10, 5-5-11 and 5-5-12). As the ground transects are measuring occurrence within 1 km from the Project, resultant patterns reflect very local responses to the Project. Whereas aerial surveys and satellite telemetry measure larger landscape level responses.

Power analysis was updated using the most recent ground survey data collected in the winter of 2017. All power analyses were run using effect sizes from the best model fits with and without covariates. In 2016, a power analysis was undertaken to assess the extent to which the current sample size of transects was sufficient for analytical requirements. Results in 2016 indicated that additional years of data were required for coyote, ermine/weasel, fox, wolf, lynx, squirrel, and wolverine but that sufficient samples was achieved for fisher/marten and rabbit/hare. In 2017, power analysis revealed that the larger mammals including caribou, moose, gray wolf and lynx still required between 30 to 50 more transects to be sampled per year to achieve a power of 80% but aside from squirrel the remaining species had sufficient sample sizes for the analysis:

- For coyote, track density was positively correlated with distance to the ROW indicating that coyote occurrence was higher at distances father away from the Project. A power analysis was run using the effect size of 0.39 and revealed that power was already above 80%. Therefore, no additional transects are needed at this time.

- For ermine/weasel, the best fit model included vegetation community type as a covariate. A positive correlation with track density was found for distance to the ROW indicating that more ermine/weasel were detected at distances farther from the Project. A power analysis was run using the effect size for distance to ROW using an effect size of 0.39 and revealed that power for this analysis is already above 80%. Therefore, no additional transects are needed at this time.

- For fisher/marten the best fit model included vegetation community type as a covariate. A positive correlation with track density was found for distance to the ROW indicating that more fisher/marten were detected at distances farther from the Project. Power analyses were run using the effect size of 0.059 and revealed that the power is already above 80% for this analysis.

- The best fit model for fox included vegetation community types as covariates. Track density was not correlated with distance to the ROW. Power analyses were run using the effect size for of 0.2 revealing that a power of 80% had been reached for this analysis.

- The best fit model for gray wolf included track age as a covariate. Track density was positively correlated with distance to ROW. Power analyses were run using an effect size of 0.35 and revealing that 80% power would be obtained by surveying a minimum of 80 transects.

- The best fit model for rabbit/hare was that which included temperature and vegetation community covariates. Track density differed among years and was positively correlated to distance from the ROW. Power analysis was conducted using an effect size of 0.08. Power for the current analysis is at 99% and therefore sufficient.

- For lynx, the best fit model was that without covariates and revealed a significant positive effect of distance to the ROW. Power analyses were conducted using an effect size of 0.074. Results revealed that 114 transects would have to be surveyed to achieve a power of 80%.

- For moose, the best fit model included vegetation communities as covariates. No correlation was found between track density and distance to the ROW. Power analyses were run using an effect size of 0.096. Results revealed that 85 transects would have to be sampled to achieve a power of 80%.

- The best fit model for squirrel did not include covariates. Track density did not significantly correlate with distance to ROW. Power analysis using an effect size of 0.027 revealed that 230 transects would have to be sampled to achieve a power of 80%.

5.5.2.2 Remote IR Camera Traps

Camera trap deployments are summarized in Table 5-5-13 and below:

- **Year 1 (2014/15) -** Camera traps (n = 37) were deployed in construction segments N2 and N3 during March 2015, and were serviced in January 2016. ROW clearing progress and access restrictions prevented camera deployments in N1 and N4.

- **Year 2 (2015/16) -** Memory cards were retrieved in February 2016 from the N2 and N3 camera traps and the cameras were serviced to continue image collection. Camera images were classified by an independent consultant on behalf of MBHydro. The cameras captured images of most of the expected mammal species, however, sample sizes were low for many of the mammal species, preventing meaningful statistical analysis. In addition, 20 cameras were deployed on N1, resulting in a total deployment of 57 remote cameras.

- **Year 3 (2016/17) -** Camera traps (n = 57) were deployed in Year 2 along N1, N2 and N3 construction segments) of which 41 were serviced, 6 were retrieved with 2 replacements deployed, 3 were missing, and 7 were not serviced. An additional 20 cameras were deployed on N4, resulting in a total deployment of 63 serviced and 7 un-serviced cameras deployed in N1-N4.

Camera trap results from memory cards retrieved in Year 2 and Year 3 were used to compare occurrence of mammals near the ROW versus 1.5 km (all seasons pooled). No significant differences were detected for mammals with respect to proximity to ROW (Table 5-5-14), although there are trends suggesting selection or avoidance of the ROW for some of the species (Figure 5-5-13). There were more observations of wolves, fox, fisher, woodland caribou, moose and white tailed deer at camera traps positioned close to the ROW compared to those 1.5 km from the ROW (Table 5-5-14; Figure 5-5-13). Conversely, there were fewer black bear, coyote, wolverine, marten, lynx and snowshoe hare detected at cameras near the ROW compared to 1.5 km from the ROW (Table 5-5-14; Figure 5-5-13). These patterns will continue to be assessed and integrated into the analysis using ground transect data as more observation accumulate.

As additional years of data continue to accumulate the analysis and interpretation of this data set will continue to improve. Behavior of some species may also change once construction is complete and sensory disturbance diminishes at the ROW from construction activities.

5.5.2.3 Beaver Monitoring

The Bipole III Transmission Project EIS predicted:

- Localized population effects where the Project intersects riparian habitat as a result of sensory disturbance (functional habitat loss in the form of temporary avoidance or displacement from suitable habitat in proximity to the ROW during construction),

- Direct loss of habitat (reduced availability of material to build lodges where the Project intersects suitable habitat from mechanized clearing),

- Forage increase (as a consequence of maintaining portions of the ROW in suitable habitat at an earlier successional stage).

- No measurable population-level decline and potential localized mortality due to increased ROW access creating potential for increased trapping.

The CEC review of the Project (CEC 2013) concluded that beaver were unlikely to be affected because they are numerous and adaptable. Habitat is not limiting at the population scale.

MB Hydro Environmental Monitors were provided a survey methodology to conduct presence / absence surveys for beaver activity at ROW intersections with riparian habitat including ±200 m on either side of the crossing. The survey was conducted in Year 2 (2015/16), with observations noted in C1 construction segment at Aqua 117 and Eco 300, and in N2 construction segment in Aqua 144 (Figure 5-5-14) (MB Hydro, T. Barker, Pers Comm. 20 December 2016). There are no pre-disturbance data available for comparison.

The Multi-spp Aerial Survey was used to assess beaver occurrence relative to the ROW based on beaver lodge detections in construction segment C1 (Figure 5-5-14). The survey indicated active beaver lodges were commonly distributed within the area surveys with no indication of ROW effects on relative distribution (i.e., attraction to or avoidance of the ROW).

5.6 Altered Mortality

The mammals monitoring program study design includes cause-specific direct mortality hazards for various mammal VECs using several methods (discussed in the subsequent report sections):

- Telemetry collar mortality signal investigations of boreal woodland caribou.

- Winter Ungulate-Wolf Distribution Surveys conducted concurrently with annual Woodland Caribou Winter Calf Recruitment Surveys, and periodic Moose Aerial Population Surveys.

- Harvest Monitoring (furbearer trapping statistics, ungulate licensed harvest surveys) obtained from MB Gov. The ungulate licensed harvest data are not collected at a resolution sufficient to monitor at a GHA scale and are more appropriately applied at a larger regional scale (V. Harriman, personal communication, October 6, 2016). Therefore, provincial ungulate hunter harvest statistics are not useful as a component of the Bipole

III Mammals Monitoring Program applicable at a spatial scale needed to monitor for potential harvest mortality effects resulting from ROW access.

- Incidental ungulate harvest monitoring during the Project construction phase by MB Hydro environmental monitors.
- Documentation of Project-related wildlife-vehicle collisions during the Project construction phase by MB Hydro environmental monitors.
- Ungulate disease/parasite monitoring specifically for *Parelaphostrongylus tenuis* (*P. tenuis*; meningeal brain worm) prevalence and occurrence in white-tailed deer populations associated with the Project ROW.
- White-tailed deer ingress monitoring using Remote IR Camera Traps, Winter Ground Track Transects and incidental observations during Wildlife Aerial Surveys to document potential annual changes (e.g., ingress) in white-tailed deer occurrence in proximity to the ROW relative to other ungulate species.
- Human access monitoring using Remote IR Camera Traps to capture seasonal occurrence of non-Project construction related human access of the ROW at main access points and along construction segments N1 through N4. The information may provide insights on Project effect of altered access in relation to hunting activity.

5.6.1 Telemetry Collar Mortality Signal Investigations

5.6.1.1 Woodland Caribou

Observed mortality (for adult female boreal woodland caribou fitted with biotelemetry collars) involved investigation of mortality location and probable cause. Investigations were conducted as soon as possible after receipt of a mortality signal. Mortality investigations (n = 63) of collared adult females, indicates predation constituted 80.9% of known mortality sources (n = 42), primarily by wolves (76.8%) (Table 5-6-1, Figure 5-6-1). Wolf predations occurred in all months except December, with a distinct peak in July (Figure 5-6-1).

Most documented adult female caribou predation events in monitored woodland caribou ranges intersected by the Project occurred prior to initiation of vegetation clearing activities. Since ROW disturbance initiated in Year 1 (2014/15) there have been three wolf predations in Wabowden range and 5 wolf + 1 bear predations in the P-Bog range. The closest predation mortality was 3.96 km from the cleared ROW in Wabowden Range (WAB1404; July 2014) and 3.31 km from the ROW in P-Bog Range (BOG1206; July 2014); the remaining predation mortalities were >15 km from the cleared ROW (Figure 5-6-2).

There are two known caribou-vehicle collisions that have occurred during the construction phase; neither involved Project vehicles nor occurred on Project construction access (Figure 5-6-2). One occurred in the P-Bog range with a collared caribou (BOG1408, December 2014, 18.1 km from the ROW; Table 5-6-1, Figure 5-6-2) but it was unrelated to the ROW or Project-related activities (MB Hydro, T. Barker, personal communication, October 6, 2015). A second caribou-vehicle mortality occurred in the Wabowden range (WAB1304, April 2017, 10.9 km from ROW).

The closest mortality of a collared caribou in relation to the ROW occurred in the P-Bog range (BOG1602, October 2016, 2.9 km from ROW, undetermined cause, Figure 5-6-2).

5.6.1.2 Forest-tundra Caribou

Telemetry collar mortality assessments have been conducted for the Pen Islands and Cape Churchill Caribou Range Distribution Project (Trim 2015). The mortality assessment investigations (n = 36) identify mortality sources to consist of a mixture of wolf kills (confirmed and suspected), black bear kills (suspected) and hunter harvests (Trim 2015). Some mortalities could be confirmed as non-predator mortalities, but it could not be determined whether the deaths were attributed to natural causes (e.g., old age, disease or malnutrition) or some other cause (Trim 2015). Trim (2015) reported that the majority of mortalities investigated occurred in the spring and summer months when female caribou incur the greatest demands from calving, calf rearing and predation avoidance. No mortality investigations were conducted in 2016/17, and none are planned for future years as the study in nearing completion.

5.6.2 Altered Predator-Prey Dynamics

Gray wolf and black bear are the primary large mammal predators monitored for the Bipole III Transmission Project. Carnivores play a vital role in ecological communities by cascading trophic effects, stabilizing and destabilizing food webs, and by affecting energy and nutrient transfer processes (Lesmeister et al. 2015). Predators select areas where prey are not only more abundant, but are also easier to capture (Keim et al. 2011, Messier 1985, Andruskiw et al. 2008). Anthropogenic disturbance can result in substantive changes in predator-prey dynamics by altering prey carrying capacity and predator-prey encounter rates (Leclerc et al. 2012, Wittmer et al. 2007, Festa-Blanchet et al. 2011). The synchronous birth of calves in ungulate populations provides a predictable and relatively stable food resource pulse (Rayl et al. 2015), which may be more accessible by anthropogenic disturbance. Predators respond to prey abundance through several interactive processes (Messier 1995, Rayl et al. 2015):

- **Functional response -** increased consumption rate of prey where prey are locally concentrated (e.g., pulsed resource such as an ungulate calving ground).

- **Demographic numerical response -** increased predator population growth via change in reproduction and/or survival rates due to increased prey density (e.g., moose responding to increased browse from landscape disturbances from fire or logging; lynx population response to hare population).

- **Aggregative numerical response** – change in predator population via immigration (distributional shift) to an area of concentrated prey (e.g., deer yarded by deep snow).

5.6.2.1 Wolf Predation-risk

Wolves are large carnivores and habitat generalists that can have population level effects on ungulates, despite their relatively sparse distribution (Ausband et al. 2014). Wolf predation on adult ungulates can be especially high for low-density prey populations residing in landscapes where alternative ungulate prey support predators at high densities (DeCesare et al. 2010, Wittmer et al. 2013). Wolf pack territory spatial requirements are dictated by access to sufficient prey to sustain the wolf pack (Messier 1985), which ultimately limits wolf population size and distribution at a landscape scale (Messier 1995, Allen 1999, Fuller et al. 2003, Klaczek et al. 2015). They will alter territory size in response to local variation in habitat quality, to balance trade-offs between territorial defense costs and energetic gains from prey acquisition (Kittle et al. 2015).

Linear features can improve wolf travel efficiency to access prey resulting in increased susceptibility of prey to predation (Environment Canada 2012). Wolves will select natural (waterways) and anthropogenic linear features for travel. Selection for anthropogenic linear features increases with increasing density of those features, with a compensatory decline in selection of natural travel corridors (Newton et al. 2017). Predation is the proximate limiting factor of woodland caribou populations (Environment Canada 2012, Wittmer et al. 2005). The susceptibility of boreal woodland caribou to predation has led to habitat use and predator avoidance strategies that separate caribou from other ungulate species in the same geographic area (Wittmer et al. 2005).

Landscape Scale

At the **landscape scale**, winter distribution surveys of ungulate species, wolf and wolverine were conducted in each boreal woodland caribou study area concurrent with the Woodland Caribou Recruitment Survey in 2017 to collect data on relative distribution, as this may provide insight into predation-risk. This data are compared annually to assess spatial variation in distribution in order to track annual changes is extent of winter range of these species relative to the Bipole ROW. A reduction in range extent for a population may indicate a declining population and potential diminished probability of population persistence (Makenzie & Nichols 2004, MacKenzie 2005).

Ungulate predation-risk was assessed within each boreal woodland caribou study area using Ungulate-Wolf Distribution Survey data by comparing the distance of observed moose and caribou from recent wolf sign and observed wolves (Table 5-6-2, Figure 5-6-3):

1. In P-Bog study area, there were no statistically detectable differences between woodland caribou vs moose with respect to wolf predation-risk in Years 1, 2 or 3 (Figure 5-6-3). The amount of wolf observations/sign has consistently been the lowest of all caribou study areas annually in P-Bog. This suggests a lower wolf population within the P-Bog study

area, which is likely due to lower overall ungulate prey densities to support higher wolf numbers compared to other monitored ranges.

2. In the Wabowden study area, moose had a statistically higher wolf predation-risk than caribou during Years 1 and 2 (Table 5-6-2).

3. In the N-Reed study area, the survey data for Year 1, 2 and 3 suggests that predation risk to boreal woodland caribou was significantly greater than for moose (Table 5-6-2; Figure 5-6-3). Among monitored boreal woodland caribou ranges, predation-risk to caribou each year was greatest in the N-Reed study relative to the other woodland caribou study areas (Table 5-6-2) as a function of caribou distance to wolf.

4. In the Charron Lake study area, predation risk to boreal woodland caribou was significantly greater than for moose annually (Table 5-6-2; Figure 5-6-3). In addition, there were substantially less observations of moose each year relative to woodland caribou, further supporting the notion that wolves were likely focusing on caribou as primary prey in mid-winter.

Relative density surfaces were developed using observation data from the Ungulate-Wolf Distribution Survey for each woodland caribou survey area to visually assess areas with greatest overlap of ungulate prey and wolf occurrence, with the intention of understanding relative predator-prey distribution and locations of greatest predation-risk in relation to the Bipole III ROW (Figures 5-6-4 through 5-6-7):

1. In the P-Bog study area (Figure 5-6-4), wolf distribution was greatest in the northern portion of the study area where most caribou and some moose also occurred. Based on relative distribution it appears that wolves were focused on portions of the study area with greatest distribution of both ungulate species, suggesting similar predation-risk for both ungulate species.

2. In the Wabowden study area (Figure 5-6-5), there was greater overlap of wolves with moose and caribou in the southern portion of the study area, which was also where most of moose distribution occurred. This is consistent with a greater relative predation-risk for moose relative to caribou.

3. In the N-Reed study area (Figure 5-6-6), wolf-caribou distribution were more similar to each other than wolf-moose distribution, indicating greater relative predation-risk for caribou compared to moose.

4. In the Charron Lake study area (Figure 5-6-7), moose occurrence and distribution was minimal compared to caribou; wolves and caribou were more evenly distributed, resulting in greater predation-risk for caribou compared to moose.

In each woodland caribou survey area, the overlap of highest wolf densities corresponded to areas of greater relative ungulate prey density, which is consistent with studies of wolf occurrence being influenced by prey abundance (Messier 1995, Allen 1999, Fuller et al. 2003, Klaczek et al. 2015). Areas of highest wolf predation-risk to woodland caribou or moose did not appear to be related to the ROW at the landscape scale.

Local Scale

At the **local scale**, winter ground track transects and remote IR cameras were deployed to collect data on ungulates and associated predators relative to the ROW across seasons. Remote IR cameras deployed along the ROW indicate wolves tend to occur more frequently on the ROW relative to areas 1.5 km from the ROW (Table 5-5-5, Figure 5-5-12); additional years of data are needed for a more rigorous analysis.

Multi-species Aerial Survey data were used to assess general relative caribou moose and wolf distribution along the Project. Wolf distribution was associated more strongly with the distribution of moose rather than caribou along the ROW in both the northern (Figure 5-5-8) and southern (Figure 5-5-9) portions of the ROW sampled in January 2017. Wolf occurrence and densities appear to have increased in frequency from 2015 to 2017 in the southern portion of the study area (Figures 5-6-8 and 5-6-9). These patterns will be statistically evaluated in the next report where additional sample years may be available to include to allow for more robust assessment.

5.6.2.2 Black Bear Predation-risk

Black bears are generalist consumers (omnivores) that can effectively exploit pulsed forage resources because of their capacity to switch to alternative resources (Rayl et al. 2015). They are known to be predators of ungulate neonates (Tigner et al. 2014) particularly during the first few weeks following birth (Zager & Beecham 2006, Dussault et al. 2012). Consequently, bears can have an additive effect on neonate mortality before calf body condition mediates vulnerability to predation (Zager & Beecham 2006, Rayl et al. 2015). Black bear effect on prey populations is highly variable and is dependent on prey population size, bear population size, prey population resilience to predation intensity, and bear-ungulate neonate encounter rates (Bastille-Rousseau et al. 2011, DeCesare 2012, Hebblewhite et al. 2005). Black bear foraging decisions are determined by food resource availability both spatially and seasonally (Costello & Sage 1994, Gunson 1993, Pelton et al. 1999, Pelton 2000). Although less predatory than wolves, their population density can be an order of magnitude greater that wolves, and therefore can have a significant effect on ungulate neonate mortality in some populations (Tigner et al. 2014). Predation rates are thought to be facilitated by linear development. However, bears will avoid linear development with active human activity Jalkotzky et al. 1997, Forman et al. 1997). They are active foragers in all seasons except during winter hibernation.

Local Scale

Remote IR Cameras installed along N1through N4 construction segments were used to monitor local scale bear occurrence relative to the ROW, and in relation to caribou ranges intersected by the ROW. Figure 5-6-10 illustrates annual black bear occurrence. Remote IR Cameras deployed along the ROW indicate black bears tend to occur less frequently on or near the ROW relative to areas 1.5 km from the ROW (Table 5-5-5, Figure 5-5-13); additional years of data are needed for a more rigorous analysis.

5.6.2.3 ROW Effect on Predator-Prey Distribution

The Multi-species Aerial Survey dataset was used to assess local distribution of large and medium sized mammals as a function of the distance from the ROW. At this time, there seems to be no annual trend or significant effect of ROW distance on density of observations on either side of the ROW even when analysis was corrected for survey effort and observer bias. Variation around the means for each bin is high and likely contributing to the current pattern (Figures 5-6-11 to 5-6-17). Certainly, for wolverine (Figure 5-6-17), white-tailed deer (Figure 5-6-16) and gray wolf (Figure 5-6-14), a trend of higher densities at locations farther from the ROW is apparent. However, this relationship is not currently statistically significant due to wide confidence intervals around the density estimates.

5.6.3 Harvest Mortality

Ungulate licensed harvest data is not readily available from MB Gov and has not been substantively collected in recent years. There are no reliable sources of rights-based subsistence harvest data for ungulates available for the Project area. Therefore, no monitoring of licensed hunting or rights-based subsistence hunting of ungulates is possible as a component of the mammals monitoring for Bipole III Transmission Project.

Furbearer harvest statistics are reported in Section 5.5.3 of this report.

5.6.4 Wildlife-Vehicle Collisions

Project-related vehicle collisions are recorded by MB Hydro staff. The following is a summary of known wildlife-vehicle collisions in the Project area that did not involve Project vehicles:

- **Year 1 (2014/15)** - One of the collared caribou (BOG1408) from the P-Bog range was killed on December 25, 2014 as a result of a wildlife-vehicle collision; the mortality location was 18.1 km from the Bipole III ROW (Figure 5-6-2) and was not associated with a Project access road, nor did it involve a Project construction vehicle.

- **Year 3 (2016/17)** - A caribou-vehicle collision occurred on 23 April 2017 (WAB1304) in the Wabowden range; the caribou mortality location was 10.9 km from the Bipole III ROW along Highway 39 and was not associated with a Project access road or a Project vehicle.

The following is a summary of wildlife-vehicle collisions involving Project vehicles:

- **Year 2 (2015/16) -** A deer-vehicle collision occurred at 18:40 hrs on December 7, 2015 in proximity of S1 construction segment along Highway 16 north of Portage (MB Hydro, T. Barker, Personal Communication, November 14, 2017).

- **Year 4 (2017/18) -** A deer-vehicle collision occurred at 07:40 hrs on August 6, 2017 in proximity of S1 construction segment on Highway 305 (5.8 km south of Road 48N – Power Line Road). A second deer-vehicle collision occurred at 06:48 hrs on September 16, 2017 in proximity of S1 construction segment on Highway 242 near Westbourne(MB Hydro, T. Barker, Personal Communication, November 15, 2017): .

- No elk or moose-vehicle collisions have been documented during construction to date.

5.7 Habitat Disturbance during Construction

Year 1 (2014/15) of construction along C1 and N1- N4 construction segments focused on establishing ROW access points, clearing the ROW centerline and portions of the ROW, including application of mitigations (i.e., routing and selective clearing for vegetation leave areas intended as wildlife movement corridors). Year 2 (2015/16) construction involved completion of ROW clearing and preparation of tower piers. Year 3 (2016/17) construction involved installation of 3,100 towers and line stringing along portions of the ROW. Year 4 (2017/18) will involve completion of the construction phase. Unseasonably warm winters during the construction phase resulted in a 12 to 15 month delay in Project completion. The Project in-service date (operation phase) is scheduled for 2018.

5.8 Environmentally Sensitive Sites (ESS)

5.8.1 Ungulate Mineral Licks

Mineral licks provide a source of sodium (Na) and minerals such as sulfur (S), calcium (Ca, and magnesium (Mg) to ungulates. Mineral lick use occurs year-round and are related to mineral loss in females due to pregnancy, parturition and lactation and for males related to demands of antler production on mineral balance (Atwood & Weeks 2003). Dietary requirements for these elements are also obtained from natural forages, but mineral licks provide a concentrated source.

Several sources of information were used for mineral lick detection which included Traditional Local Knowledge, baseline surveys conducted for the EIS, Multi-species Aerial Survey of the ROW, Ungulate-Wolf Winter Distribution Surveys in woodland caribou ranges (Wabowden, N-Reed, P-Bog), numerous overflights of the ROW, and incidental observations via environmental monitors during the construction phase.

The Manitoba Métis Federation commissioned a Metis land occupancy and use study (Shared Values Solutions 2015) which identified 27 ungulate mineral lick locations within the geographical extent of their study area. Most of those locations are distant from the ROW and would not be affected by Project activities. The three closest locations identified were situated east of Red Deer Lake along construction segment N4 (Figure 5-7-1) and included 5004-22 (678 m from ROW), 4002-15 (961 m from ROW) and 3001-27 (1,003 m from ROW), none of which are anticipated to have a significant interaction with the Project, nor be directly impacted by construction activities, nor during the Project operation phase. It is unclear from the report as to which sites are dry salt licks versus wet mineral seeps.

The following is a summary of mineral lick detections by year:

- **Pre-monitoring Phase (Prior to 2014/15) -** No mineral licks were detected in proximity to the Project prior to implementation of the 2014/15 mammals monitoring program.

- **Year 1 (2014/15) -** No mineral licks were detected during field survey monitoring efforts in close proximity to the ROW.

- **Year 2 (2015/16) -** One mineral lick (wet mineral seep) was detected during aerial surveys on 28 February 2016 at: 14U 362682E 5823496N. The location was 2,408 m from construction segment N4 of the ROW (Figure 5-7-1), and was not in a location that would be disturbed by the Bipole III ROW construction or operation activities.

- **Year 3 (2016/17) -** No new mineral licks were detected during field surveys or concurrent with construction activities. Clearing and construction are nearing completion with no additional surface disturbance anticipated, therefore, no further effort is required to monitor for affected mineral licks in Year 4.

5.8.2 Black Bear Hibernation Dens

Black bears are particularly sensitive to noise disturbance within 200 m of overwintering (hibernation) dens, with effects as great as 1 km, and may abandon the den in response to disturbance, especially early in the denning period (Linnell et al. 2000). Hibernation dens are seldom reused in consecutive years. Therefore, loss of a single denning site from human disturbance is not deleterious if alternative sites are available within the home range (Linnell et al. 2000). The following is an annual summary of bear dens encountered during Project construction:

- **Year 1 (2014/15) -** One bear hibernation den was encountered during winter construction clearing activities (mulching) on February 2, 2015 at the north end of construction segment C2 near tower station 5016 (UTM: **REDACTED**) (Figure 5-7-1). See Amec Foster Wheeler 2016 for further details.

- **Year 2 (2015/16) -** No bear dens were encountered during winter construction (MB Hydro, T. Barker, personal communication, October 11, 2016).

- **Year 3 (2016/17) -** No bear dens were encountered during winter construction (MB Hydro, T. Barker, personal Communication, November 3, 2017). Mechanized clearing was completed and line construction (tower installation and line stinging) well underway in Year 3. No further monitoring for effects of the Project on bear dens is anticipated to be required in Year 4.

5.8.3 Wolverine Winter Dens

Wolverines have specific habitat requirements for natal and maternal den sites; multiple dens may be used in sequence through the duration of maternal litter care. Dens are constructed in boulders, under deadfall, or in snow tunnels, with individuals reoccupying den sites or denning habitats in successive years (COSEWIC 2003). They are snow-dependent in order to den. Den sites may also function as rendezvous sites between females and their kits (COSEWIC 2003). Denning females are sensitive to disturbance, potentially resulting in relocation or litter abandonment. Wolverines mate in summer but fertilized egg implantation is delayed until winter. Typically <50% of adult females will produce a litter in a given year, making them demographically vulnerable and susceptible to disturbance impacts (Inman et al. 2012, COSEWIC 2003). Gestation is about 45 days long with peak parturition occurring between February and mid-March (Inman et al. 2012). Lactation period occurring over about a 10 week period from February to April (Inman et al. 2012). Young are nutritionally independent from the mother by fall, and will on average make exploratory dispersal movements by 11 months of age (Inman et al. 2012). The natal den is occupied for a few weeks before the litter is moved to a maternal den.

Annual wolverine winter occurrence is illustrated in Figure 5-8-1. The following is an annual summary of wolverines encountered during Project construction and monitoring:

- **Year 1 (2014/15) -** No wolverine dens were encountered during Project construction.

- **Year 2 (2015/16) -** No wolverine dens were encountered during Project construction. Locations of wolverine sign (tracks) and observations during mammal aerial and ground based field survey programs varied from 227 m to 8,247 m from the ROW, with a median distance of 3,266 m (n = 58 observations).

- **Year 3 (2016/17) -** No wolverine dens were encountered during Project construction (MB Hydro, T. Barker, personal communication, November 3, 2017. Wolverine occurrences detected during aerial and ground based field survey programs varied from 236 to 39,123 m from the project ROW, with a median of 1,228 m (n = 40 observations). Project clearing was completed and line construction (tower installation and line stinging) well underway in Year 3.

5.8.4 Wolf Natal Dens and Rendezvous Sites

Wolf den locations are generally randomly situated within the pack territory, with the outer 1 km periphery avoided; the larger the territory, the closer the den is to the center (Mech & Boitani

2003, Packard 2003). Rendezvous site are usually located in the general denning region. Pack foraging excursions may be up to 48 km from the den or pups. Several dens within each home range may be used for pup rearing, with natal dens usually located near water (Packard 2003). Peak of parturition occurs near the end of April through early May. Pups are highly associated with the den for their first 8 weeks. Den proximity to human disturbance is dependent on whether they have experienced negative interactions with humans. Disturbance is unlikely to have an effect unless it is widespread and intensive (Fuller et al. 2003). Dens and rendezvous sites have been documented within 1 to 2 km of active roadways and as close as 400 m to paved roadways (Fritts et al*.* 2003).

The timing of winter mechanized clearing and winter construction activities in boreal habitats occupied by wolves mitigates potential for negative effects on wolf den disturbance. Consequently, no den searches were necessary because there was no overlap of winter construction activities with spring wolf denning activities. No conflicts occurred with respect to wolf den or rendezvous sites and construction were reported for Year 1 or Year 2 (MB Hydro, T. Barker, personal communication, October 11, 2016), nor in Year 3 (MB Hydro, T. Barker, personal communication, November 3, 2017). ROW mechanized clearing was completed by Year 3 and installation of towers and line stringing was well underway; Construction in Year 4 will occur within the existing disturbance footprint and consist of completion of tower installation and line stringing. Potential for Project effects on wolf dens or rendezvous sites was considered negligible at this stage of construction. Therefore, no monitoring for this ESS type will be necessary during Year 4, nor for future years.

5.9 Human Access Monitoring

MB Hydro utilized trail cameras installed at all-weather construction access points (n = 14 locations during Year 2 and n = 9 locations during Year 3) to monitor human access of the ROW. In addition, trail cameras associated with the winter ground track transects were installed along the ROW in construction segments N2 and N3 during Year 2 (n = 18 locations sampled) and along N1, N2 and N3 during Year 3 (n = 24 locations sampled). Results of the sampling effort (Table 5-9-1) indicates the majority of ROW access for a known purpose was for Project construction (99.14%, n = 1,612 observations during Year 2 and 99.25%, n = 1974 observations during Year 3) with limited local public access (0.84%, n = 14 observations during Year 2 and 0.75%, n = 15 observations during Year 3) for recreation and resource use.

5.10 Mitigation Effectiveness Monitoring

Clearing activities relevant to mammals monitoring were undertaken in the majority of construction segment N3 from February through March 2014, and in N2, south portion of N3 and N4 (primarily centerline clearing), prior to initiation of Year 1 (2014/15) of the mammals monitoring programs in January 2015. Clearing activities along the N3 and N4 ROW construction segments was completed during Year 2 (2015/16). In Year 3 (2016/17) tower erecting and line stringing was undertaken. In Year 4 (2017/18) construction activities will be completed to allow operation phase to begin in summer of 2018.

This report concentrates on analysis from the construction phase of the Project for the various mammal VECs being monitored at local and/or landscape scales through each Project phase. An updated assessment of use on mitigation areas within P-Bog range was undertaken as data on the location of each vegetation leave area was available. Caribou did use the vegetation leave areas to cross the Project during the initiation of construction and continued to do so through 2017. Results from the 2016 report (Amec Foster Wheeler 2017) revealed that caribou used these same locations during the pre-construction phase, suggesting that the placement of these mitigation areas was well informed on local caribou movement dynamics. As caribou continued to use these areas during the construction phase, they have been effective in ensuring that caribou continue to move across the landscape in the same ways as before construction, reducing disruption to local movement dynamics.

No project-related effects have been detected during the construction phase with respect to ungulate (i.e., woodland caribou, moose) population abundance or trend (Sections 5.1.2.2, 5.2 and 5.3), or altered annual or seasonal range use or changes in predator-prey dynamics (Section 5.6.2), suggesting that mitigations applied to the project such as project routing, vegetation management mitigations, and winter construction windows have aided in reducing potential impacts to these species. ZOI and crossing analysis have revealed that the Project is a semi-permeable barrier on the landscape; caribou typically avoid spending long periods of time within 1 to 2 km of the Project but will still cross the Project on occasion using the vegetation leave areas.

Ingress of white-tailed deer into the P-Bog range along the project ROW is a possible project effect and concern because of potential transmission of *P. tenuis* to woodland caribou. White-tailed deer sign was detected along the north end of the P-Bog survey area in Year 3 during the Multi-spp Aerial Survey (Section 5.4). All current monitoring methods should continue to be used to assess the extent of, and potential for, white-tailed deer ingress.

There were 3 deer-vehicle collisions involving project vehicles during the construction phase to date, all collisions were in vicinity of the S1 construction segment and no other project-related wildlife-vehicle collisions have occurred (Section 5.6.4). No incidents of construction project-staff interactions (e.g., staff hunting or feeding wildlife, or problem wildlife incidents) with wildlife have been reported.

Public use of the project for access to date has been minimal (Section 5.9) and unlikely to have altered ungulate mortality from hunting.

No environmentally sensitive site (ESS) issues have been reported during construction with the exception of one black bear hibernation den disturbed during Year 1 along construction segment C2 (Section 5.8).

Effects of the project on furbearer species harvest levels and rates appear to be unaffected by the project during construction with the exception of a suspected reduction of beaver harvest during the initial two years of construction in traplines intersected by the Project. The Multi-spp

Aerial Survey indicates beaver are common and widely distributed. This is consistent with predicted project effects of temporary local effects to beaver of no measurable population-level decline; but evidence of localized effects because of sensory disturbance during construction reflected in the lower harvest of beaver (Section 5.5). Some furbearers are more frequently recorded at distances farther from the ROW than closer suggesting a very local level of avoidance for some species. However local avoidance is not anticipated to have population level consequences.

Table 5-1-1: Average Annual and Seasonal Home Range Sizes for each Woodland Caribou Range by Project Phase

Range	Annual Home range (km^2)*	Overwintering Areas (km^2)*	Calving Areas (km^2)*
Pre-construction Phase			
Wabowden	512.2 +/- 360.6 (n = 44)	103.4 +/- 67.7 (n = 25)	25.4 +/- 49.9 (n = 94)
N-Reed	384.9 +/- 428.5 (n = 30)	110.35 +/- 121.8 (n = 20)	28.1 +/- 63.4 (n = 38)
P-Bog	469.7 +/- 278.4 (n = 52)	62.02 +/- 60.1 (n = 44)	24.7 +/- 30.4 (n = 111)
Charron Lake	1166.9 +/- 890.01 (n =34)**	152.17 +/- 91.2 (n = 61)**	29.4 +/-38.6 (n =76)
Construction Phase			
Wabowden	766.8 +/- 412.1 (n=19)	123.5 +/- 55.6 (n=15)	30.9 +/- 59.1 (n=9)
N-Reed	623.4 +/- 417.2 (n=14)	111.9 +/- 47.4 (n=7)	4.3 +/- 2.1 (n = 11)
P-Bog	498.6 +/- 371.2 (n=19)	81.1 +/- 51.5 (n=15)	14.8 +/- 19.9 (n=14)
Charron Lake	1097.8 +/- 596.9 (n=21)**	204.4 +/- 86.2(n=19)**	38.1 +75.9 (n=16)

Notes:

* Annual home range estimates based on 90% kernel estimates, overwintering and calving areas based on 70% kernel estimates

** Significantly different from all of the other ranges (P <0.05)

Table 5-1-4: Summary of Population Structure, Winter Calf Recruitment and Kaplan-Meier (K-M) Adult Female Survival Estimates for Boreal Woodland Caribou from Mid-winter Aerial Surveys and Telemetry Study

Caribou Range	Year	Number of Caribou Observed					Bulls /100 Cows	Calves /100 Cows	Calves /100 Adults	% Calves	K-M Adult Female Survival Rate (%)	Population Trend ***
		Bulls	Cows	Calves	Unkn*	Total						
P-Bog	January 23-29, 2015	12	53	13	4	82	22.6	24.5	20.0	16.7	90.0	Stable
	February 25-26, 2016	5	49	11	1	66 **	10.2	22.4	20.4	16.9	88.0	Stable **
	January 20-24, 2017	6	49	11	0	66 **	12.2	22.4	20.0	16.7	90.2	Stable **
N-Reed (Boreal Plain portion of population)	January 29, February 1, 2015	15	52	11	5	81	28.8	21.2	16.4	14.1	82.9	Declining
	January 14-15, 2016	1	25	11	0	37 **	4.0	44.0	42.3	29.7	86.7	Stable **
	January 25-27, 2017	13	50	13	0	76	26.0	26.0	20.6	17.1	88.6	Stable (possibly increasing)
Wabowden (Boreal Plain portion of population)	January 19-22, 2015	17	61	15	7	100	27.9	24.6	19.2	16.1	84.4	Stable
	January 12-13, 2016	24	68	14	1	107	35.3	20.6	15.2	13.2	81.5	Stable
	January 17-18, 2017	10	44	9	0	63 **	22.7	20.5	16.7	14.3	87.0	Stable **
Charron Lk	February 3-6, 2015	19	50	16	2	87	38.0	32.0	22.5	18.8	91.7	Increasing
	January 17-19, 2016	58	131	23	0	212	44.3	17.6	12.2	10.8	90.6	Stable
	February 1-5, 2017	39	108	17	11	175	36.1	15.7	10.8	10.4	90.9	Stable

Notes:

* Not classified to age or sex.

** Small sample size for caribou observations; interpret with caution.

*** Demographic Indicators of Population Trend:

- Assuming annual adult survival is >85%, if the proportion of calves (% Calves) in winter is >15% the population is likely growing, stable if 12 to 15%, or in decline if <10%.
- Calf recruitment rates >28.9 calves/100 cows indicates a stable to increasing population (assuming annual adult female survival is ≥85%). If calf recruitment drops below this threshold and/or annual female survival rates are <85%, the population is likely declining.

Table 5-1-5: CMR Population Abundance Estimates of Boreal Woodland Caribou Winter Ranges, Year 1 (2014/15) and Year 3 (2016/17).

Caribou Range	Survey Area Size (km²)	Survey Year	Survey Area				Range			
			# Unique Genotypes (from CMR sampling)	Minimum Count (from winter calf recruitment survey)	CMR Population Estimate ±95% CI	CMR Density Estimate (Caribou /km²)	100% MCP Size (km²)	Projected Population Size	Projected Population Density Estimate (Caribou/km²)	MB Gov's Caribou Population Size Estimate (as of 2015)
P-Bog	2,224	January 2015	88	82	120 ± 3.5	0.0542	5,476	146.6	0.0268	175-200
		January 2016	---	66	---	---		---	---	
		January 2017	97	66	229.6 ±9.3	0.1032		229.6	0.0419	
N-Reed	1,822	January 2015	109	81	294.0 ± 11.6	0.1614	6,329	343.1 (boreal plain portion)	0.0542	250-300
		January 2016	---	37	---	---		---	---	
		January 2017	143	76	357.7 ±11.0	0.1964		357.7 (boreal plain portion)	0.0565	
Wabowden	2,130	January 2015	107	100	108 ± 1.8	0.0504	3,919	128.1 (boreal plain portion)	0.0327	150-200
		January 2016	---	107	---	---		---	---	
		January 2017	101	63	170.0 ±5.2	0.0798		201.1 (boreal plain portion)	0.0513	
Charron Lk	2,032	February 2015	130	87	831.6 ± 40.7	0.3514	15,777 (in MB)	1163.8	0.0738	300-500
		February 2016	---	212	---	---		---	---	
		February 2017	178	175	880.0 ±31.2	0.4332		1231.5	0.0781	

Notes:

Adjusted range abundance estimates for P-Bog, N-Reed and Wabowden were proportionately calculated based on the amount of winter core area of occupation estimated from a 70% kernel probability isopleth estimator within each study area, relative to the amount occurring within the Boreal Plain Ecozone for each respective caribou range. A 20% correction factor was then applied to account for potential caribou occurrence on the remaining unaccounted portion of non-core winter range occurring within the Boreal Plain Ecozone for each respective caribou range. This yields a projected population estimate for the portion of each caribou range occurring on the Boreal Plain Ecozone (i.e., excludes the portion of range occurring on the Boreal Shield). An adjusted range abundance estimate for the Charron Lake range (portion within Manitoba) was proportionately calculated based on the amount of winter core area of occupation estimated from a 70% kernel probability isopleth estimator within the area sampled relative to total amount within the caribou range, all of which occurs on the Boreal Shield Ecozone.

Table 5-2-1: Summary of Winter Calf Recruitment Results for Forest-tundra Caribou Populations, 2012 to 2017.

Caribou Range	Year	Active Telemetry Collars		Adults	Calves	Unclassified	Total	Calves/100 Adults
		Deployed	Relocated					
Cape Churchill	2012	19	18	311	64	0	375	20.6
	2013	17	17	238	33	0	271	13.9
	2014	17	17	300	35	0	335	11.7
	2015	Not Surveyed						
	2016	Not Surveyed						
	2017	Not Surveyed*						
	Mean							**15.4**
Pen Islands	2012	21	17	228	49	0	277	21.5
	2013	20	20	354	56	0	410	15.8
	2014	20	20	406	58	0	464	14.3
	2015	Not Surveyed						
	2016	20	17	257	41	0	298	16.0
	2017	Not Surveyed *						
	Mean							**16.9**

Note:
* No future recruitment surveys are planned for either caribou population because of the limited number of active GPS collars remaining in the study (MB Gov, V. Trim, personal communication, August 14, 2017)

Table 5-3-1: Comparison of Long-term Mean Population Metrics and Recent (≥2010) Survey Results for Modeled Moose Populations Intersected by the Bipole III Transmission Project ROW

Moose Population	Year	Winter Population (±90% CI)	Winter Density (#/km²)	Adult Sex Ratio (M/100F)	Calf Recruitment (calves/100F)
Monitored / Sensitive Moose Populations					
Tom Lamb WMA (GHA 8)	**Long Term Mean (1971-2017)**	**642**	**0.204**	**61.3**	**58.8**
	January 2012	317 ±32.0%	0.101	84.5	46.6
	January 2016	339 ±18.5%	0.107	57.7	52.1
Moose Meadows (portion of GHA 14)*	**Long Term Mean (1971-2017)**	**80**	**0.431**	**35.7**	**56.0**
	January 2011	7	0.040	72.7	52.3
Pine River (GHA 14A/19A)	**Long Term Mean (1971-2017)**	**535**	**0.172**	**50.8**	**47.9**
	January 2013	104 ±12.8%	0.033	37.5	87.5
	January 2014	100 ±19.0%	0.032	138.5	76.9
Split Lake (Keeyask GS 2015 Survey Area)	**Long Term Mean (1971-2017)**	**1,110**	**0.066**	**93.8**	**45.8**
	January 2010	961 ±21.0%	0.057	118.3	35.5
	January 2015	1,349 ±22.6%	0.080	50.0	51.4
Regional Reference Moose Populations in Manitoba					
Upper SK Delta (GHA 6/6A)	**Long Term Mean (1971-2017)**	**357**	**0.193**	**48.2**	**47.4**
	January 2010	255 (100% census)	0.141	---	---
Red Deer Bog (GHA11/12)	**Long Term Mean (1971-2017)**	**506**	**0.105**	**48.3**	**46.7**
	January 2013	199 ±24.6%	0.042	31.6	34.2
	January 2016	100 ±46.7%	0.043	66.7	66.7
Swan-Pelican (GHA14/14A)	**Long Term Mean (1971-2017)**	**1,538**	**0.269**	**40.1**	**54.4**
	January 2011	144 ±12.8%	0.029	72.7	52.3
	February 2014	150 ±18.9%	0.030	---	---
Porcupine Hills (GHA 13/13A)	**Long Term Mean (1971-2017)**	**807**	**0.311**	**47.8**	**42.0**
	February 2011	817 ±17.8%	0.315	32.3	30.5
	February 2017	1,057 ±16.4%	0.408	63.6	48.7
Duck Mountains (GHA 18/18A/18B/18C)	**Long Term Mean (1971-2017)**	**2,228**	**0.398**	**65.0**	**45.4**
	February 2011	1,466 ±12.4%	0.257	63.0	45.0
	February 2017	1,958 ±15.1%	0.344	69.3	34.7

Note:
* Estimates for Moose Meadows were projected (based on proportion of habitat area) from the Swan-Pelican moose population model using GHA 14 data only to gain insight on relative population size and trend.

Table 5-4-1: Summary of *P. tenuis* analysis of white-tailed deer pellet samples collected February 2017.

<table>
<tr><th>Construction Segment</th><th>P. tenuis Surveillance Area</th><th>Sample Size</th><th>Samples with Spiney-Tailed Larvae</th><th>Prevalence (%)</th></tr>
<tr><td>N3</td><td>1</td><td>114</td><td>29</td><td>25.4</td></tr>
<tr><td rowspan="2">N4</td><td>2</td><td>22</td><td rowspan="2">52</td><td rowspan="2">60.5</td></tr>
<tr><td>n/a</td><td>54</td></tr>
<tr><td>C1</td><td>n/a</td><td>26</td><td>12</td><td>46.2</td></tr>
<tr><td colspan="2">Pooled</td><td>226</td><td>93</td><td>41.2</td></tr>
</table>

Table 5-5-1: Registered Traplines Intersected by Construction Segment

Construction Segment	Registered Traplines	Community Traplines	Intersected Total
N1	8	2 (Limestone 530-05, Split Lake 520-25)	10
N2	14	2 (Thicket Portage 440-10, Wabowden 430-21)	16
N3	13	1 (Cormorant 350-04)	14
N4	2	0	2
Total	**37**	**5**	**42**

Table 5-5-2: Comparison of Pre-construction 5-year Mean (2004/05 – 2013/14) Annual Harvest to Year 1 (2014/15) and 2 (2015/16) of Construction, by Construction Segment and Species

Species	Project Phase	N1 (n = 11 RTLs)	N2 (n = 16 RTLs)	N3 (n = 13 RTLs)	N4 (n = 2 RTLs)	Total (n = 42 RTLs)
Beaver	**Pre-Construction** **Construction**	**42.2 ±25.8** **8.0 ±2.0**	**37.4 ±24.7** **0.5 ±1.0**	**63.6 ±31.8** **4.5 ±8.8**	**545.6 ±211.2** **191.5 ±89.2**	**688.8 ±142.5** **204.5 ±79.4**
Coyote	Pre-Construction Construction	--NR-- --NR--	--NR-- --NR--	11.8 ±12.9 6.0±2.0	28.2 ±11.8 47.0 ±45.1	40.0 ±7.8 53.0 ±47.0
Fisher	Pre-Construction Construction	0.4 ±0.8 --NR--	1.4 ±1.8 2.0 ±3.9	18.8 ±12.7 21.0 ±23.5	42.2 ±12.9 37.0 ±19.6	62.8 ±14.0 60.0 ±47.0
Fox Cross	Pre-Construction Construction	3.4 ±0.8 2.5 ±2.9	3.2 ±2.1 --NR--	0.2 ±0.4 0.5 ±1.0	0.6 ±0.8 0.5 ±1.0	7.4 ±1.1 3.5 ±4.9
Fox Red	Pre-Construction Construction	6.8 ±2.3 6.0 ±3.9	3.0 ±2.1 --NR--	14.2 ±6.7 6.5 ±4.9	5.4 ±2.6 4.5 ±2.9	29.4 ±4.1 17.0 ±2.0
Fox Sliver	Pre-Construction Construction	1.2 ±1.1 0.5 ±1.0	0.6 ±0.8 --NR--	1.0 ±1.2 0.5 ±1.0	--NR-- --NR--	2.8 ±1.3 1.0 ±2.0
Fox White	Pre-Construction Construction	5.4 ±7.3 3.5 ±6.9	--NR-- 0.5 ±1.0	--NR-- --NR--	--NR-- --NR--	5.4 ±5.2 4.0 ±7.8
Lynx	Pre-Construction Construction	6.8 ±3.6 5.5 ±1.0	27.0 ±28.4 9.5 ±16.7	27.0 ±27.4 15.0 ±15.7	13.2 ±9.3 10.0 ±5.9	70.8 ±24.5 40.0 ±39.2
Marten	**Pre-Construction** **Construction**	**373.4 ±110.2** **141.5 ±140.1**	**140.2 ±104.9** **95.5 ±120.5**	**79.2 ±28.0** **126.5 ±20.6**	**323.0 ±74.9** **181.0 ±2.0**	**915.8 ±110.4** **544.5 ±279.3**
Mink	Pre-Construction Construction	14.4 ±6.9 17.5 ±26.5	36.2 ±19.1 23.5 ±18.6	27.8 ±14.5 18.5 ±2.9	59.8 ±36.4 54.5 ±36.3	138.2 ±34.3 114.0 ±84.3
Muskrat	Pre-Construction Construction	8.0 ±11.5 4.5 ±8.8	27.2 ±49.9 13.0 ±25.5	564.8 ±743.0 93.0 ±111.7	434.0 ±276.6 45.5 ±85.3	1034.0 ±716.4 156.0 ±213.6
Otter	Pre-Construction Construction	4.2 ±2.1 3.0 ±2.0	10.0 ±7.1 11.5 ±14.7	12.4 ±12.7 9.0 ±3.9	27.6 ±14.4 8.0 ±2.0	54.2 ±10.5 31.5 ±14.7
Squirrel	Pre-Construction Construction	--NR-- --NR--	0.4 ±0.5 --NR--	11.2 ±10.4 3.0 ±5.9	126.6 ±53.6 84.5 ±46.1	138.2 ±39.1 87.5 ±51.9
Weasel	Pre-Construction Construction	0.4 ±0.5 1.0 ±2.0	19.2 ±9.7 23.0 ±45.1	24.4 ±14.5 15.0 ±7.8	133.0 ±42.6 83.0 ±31.4	177.0 ±29.5 122.0 ±86.2
Wolf	**Pre-Construction** **Construction**	**1.0 ±0.9** **0.5 ±1.0**	**6.0 ±1.2** **--NR--**	**1.8 ±1.9** **1.5 ±1.0**	**7.0 ±4.0** **11.0 ±2.0**	**15.8 ±2.3** **13.0 ±2.0**
Wolverine	**Pre-Construction** **Construction**	**1.8 ±1.7** **1.5 ±2.9**	**2.8 ±2.0** **1.5 ±1.0**	**1.0 ±0.9** **--NR--**	**--NR--** **--NR--**	**5.6 ±1.3** **3.0 ±3.9**

Notes: RTL = Registered Trap Line
--NR-- = no reported harvest for the period assessed
Highlighted cells indicate significant difference between project phases for that species

Table 5-5-3: Comparison of Pre-Construction 5-year Mean (2009/10 - 2013/14) Harvest Rate (#/license) to Construction 2-year Mean (2014/15 - 2015/16), by Construction Segment and Species

Species	Project Phase	N1 (n = 11 RTLs)	N2 (n = 16 RTLs)	N3 (n = 13 RTLs)	N4 (n = 2 RTLs)	Total (n = 42 RTLs)
Beaver	**Pre-construction**	**0.641 ±0.345**	**0.642 ±0.244**	**0.804 ±0.187**	**2.299 ±0.608**	**1.515 ±0.352**
	Construction	**0.132 ±0.102**	**0.010 ±0.019**	**0.085 ±0.166**	**1.435 ±0.765**	**0.698 ±0.384**
Coyote	Pre-construction	--NR--	--NR--	0.135 ±0.092	0.125 ±0.059	0.087 ±0.017
	Construction	--NR--	--NR--	0.096 ±0.004	0.304 ±0.008	0.162 ±0.039
Fisher	Pre-construction	0.003 ±0.006	0.023 ±0.023	0.241 ±0.109	0.189 ±0.072	0.143 ±0.055
	Construction	--NR--	0.038 ±0.075	0.317 ±0.289	0.272 ±0.128	0.188 ±0.011
Fox Cross	Pre-construction	0.059 ±0.038	0.062 ±0.025	0.002 ±0.003	0.002 ±0.003	0.016 ±0.004
	Construction	0.046 ±0.069	--NR--	0.009 ±0.018	0.006 ±0.012	0.016 ±0.039
Fox Red	Pre-construction	0.146 ±0.158	0.052 ±0.018	0.181 ±0.069	0.023 ±0.010	0.066 ±0.014
	Construction	0.086 ±0.009	--NR--	0.113 ±0.111	0.032 ±0.011	0.061 ±0.056
Fox Sliver	Pre-construction	0.024 ±0.024	0.012 ±0.014	0.019 ±0.027	--NR--	0.006 ±0.004
	Construction	0.006 ±0.011	--NR--	0.007 ±0.014	--NR--	0.002 ±0.006
Fox White	Pre-construction	0.047 ±0.060	--NR--	--NR--	--NR--	0.011 ±0.015
	Construction	0.040 ±0.078	0.010 ±0.019	--NR--	--NR--	0.009 ±0.025
Lynx	Pre-construction	0.074 ±0.048	0.482 ±0.364	0.334 ±0.128	0.049 ±0.028	0.150 ±0.054
	Construction	0.085 ±0.033	0.209 ±0.269	0.228 ±0.188	0.072 ±0.030	0.120 ±0.048
Marten	**Pre-construction**	**8.166 ±8.191**	**2.412 ±1.170**	**1.120 ±0.449**	**1.368 ±0.170**	**2.054 ±0.455**
	Construction	**1.925 ±0.972**	**2.724 ±0.579**	**2.059 ±0.254**	**1.534 ±1.452**	**1.810 ±0.669**
Mink	Pre-construction	0.326 ±0.316	0.671 ±0.100	0.363 ±0.168	0.236 ±0.085	0.306 ±0.091
	Construction	0.217 ±0.265	0.817 ±0.358	0.301 ±0.038	0.386 ±0.126	0.360 ±0.005
Muskrat	Pre-construction	0.104 ±0.154	0.395 ±0.685	5.502 ±6.205	1.748 ±1.077	2.059 ±1.773
	Construction	0.092 ±0.180	0.250 ±0.490	1.396 ±1.405	0.209 ±0.360	0.422 ±0.506
Otter	Pre-construction	0.076 ±0.063	0.175 ±0.088	0.141 ±0.120	0.107 ±0.031	0.119 ±0.029
	Construction	0.043 ±0.005	0.326 ±0.078	0.153 ±0.107	0.064 ±0.047	0.106 ±0.046
Squirrel	Pre-construction	--NR--	0.010 ±0.015	0.125 ±0.080	0.527 ±0.159	0.296 ±0.086
	Construction	--NR--	--NR--	0.042 ±0.083	0.619 ±0.281	0.286 ±0.071
Weasel	Pre-construction	0.003 ±0.004	0.550 ±0.446	0.315 ±0.120	0.570 ±0.130	0.389 ±0.066
	Construction	0.011 ±0.022	0.442 ±0.867	0.238 ±0.059	0.637 ±0.393	0.388 ±0.026
Wolf	**Pre-construction**	**0.009 ±0.007**	**0.142 ±0.072**	**0.019 ±0.016**	**0.032 ±0.025**	**0.036 ±0.010**
	Construction	**0.006 ±0.011**	**--NR--**	**0.026 ±0.023**	**0.089 ±0.071**	**0.047 ±0.041**
Wolverine	**Pre-construction**	**0.031 ±0.029**	**0.054 ±0.030**	**0.015 ±0.017**	**--NR--**	**0.012 ±0.003**
	Construction	**0.017 ±0.033**	**0.055 ±0.032**	**--NR--**	**--NR--**	**0.008 ±0.009**

Notes RTL = Registered Trap Line
--NR-- = no reported harvest for the period assessed
Highlighted cells indicate significant difference between project phases for that species

Table 5-5-4: Model Output for the Linear Mixed Model Testing the Correlation between Density of Coyote Tracks and Distance to the ROW during Winter Construction

	Estimate	SE	T	Lower CI	Upper CI
Intercept	0.89094	0.57695	1.544	-0.17974	1.961609
distance	0.39298	0.11041	3.559	0.188096	0.597865
Year 2016	1.00811	0.68166	1.479	-0.25688	2.273097
Year 2017	0.09263	0.58417	0.159	-0.99144	1.176701
cloud	-0.32543	0.12922	-2.518	-0.56523	-0.08564

Table 5-5-5: Model Output for the Linear Mixed Model Testing the Correlation between Density of Ermine/Weasel Tracks and Distance to the ROW during Winter Construction

	Estimate	**SE**	**T**	**Lower CI**	**Upper CI**
(Intercept)	0.442	0.250	1.766	-0.040	0.921
Distance	0.078	0.025	3.062	0.028	0.126
Year 2016	-0.245	0.255	-0.963	-0.734	0.247
Year 2017	-0.304	0.253	-1.201	-0.789	0.185
Hab81	0.073	0.026	2.775	0.016	0.128

Table 5-5-6: Model Output for the Linear Mixed Model Testing the Correlation between Density of Fisher/Marten Tracks and Distance to the ROW during Winter Construction

	Estimate	**SE**	**T**	**Lower CI**	**Upper CI**
(Intercept)	0.123	0.033	3.773	0.059	0.187
distance	0.024	0.015	1.555	-0.006	0.054
Year 2016	-0.001	0.046	-0.017	-0.091	0.090
Year 2017	-0.001	0.037	-0.015	-0.072	0.071
Hab33	-0.093	0.015	-6.145	-0.123	-0.064

Table 5-5-7: Model Output for the Linear Mixed Model Testing the Correlation between Density of Fox Tracks and Distance to the ROW during Winter Construction

	Estimate	SE	t	Lower CI	Upper CI
Intercept	-0.052	0.034	-1.518	-0.119	0.016
Distance	-0.043	0.040	-1.064	-0.109	0.044
Habitat 33	-0.262	0.039	-6.635	-0.329	-0.176

Table 5-5-8: Model Output for the Linear Mixed Model Testing the Correlation between Density of Gray Wolf Tracks and Distance to the ROW during Winter Construction

	Estimate	SE	T	Lower CI	Upper CI
(Intercept)	0.353	0.287	1.233	-0.174	0.899
Distance	0.256	0.122	2.103	0.030	0.484
Year 2016	-0.884	0.401	-2.204	-1.652	-0.156
Year 2017	-0.549	0.354	-1.552	-1.205	0.100
Trackage	-0.393	0.135	-2.914	-0.639	-0.147

Table 5-5-9: Model Output for the Linear Mixed Model Testing the Correlation between Density of Lynx Tracks and Distance to the ROW during Winter Construction

	Estimate	SE	T	Lower CI	Upper CI
(Intercept)	0.170	0.064	2.646	0.045	0.294
Distance	0.074	0.031	2.364	0.013	0.134
Year 2016	-0.070	0.156	-0.451	-0.372	0.244
Year 2017	0.038	0.077	0.496	-0.110	0.187

Table 5-5-10: Model Output for the Linear Mixed Model Testing the Correlation between Density of Moose Tracks and Distance to the ROW during Winter Construction

	Estimate	SE	T	Lower CI	Upper CI
(Intercept)	0.181	0.072	2.507	0.043	0.316
Distance	0.026	0.039	0.666	-0.052	0.099
Year 2016	-0.067	0.095	-0.706	-0.218	0.087
Year 2017	-0.087	0.093	-0.933	-0.229	0.067
Hab33	-0.149	0.039	-3.794	-0.213	-0.067

Table 5-5-11: Model output for the linear mixed model testing the correlation between density of squirrel tracks and distance to the ROW during Winter Construction

	Estimate	SE	T	Lower CI	Upper CI
(Intercept)	0.166	0.042	3.960	0.084	0.247
Distance	0.027	0.018	1.508	-0.009	0.062
Year 2016	-0.026	0.056	-0.465	-0.135	0.082
Year 2017	0.024	0.047	0.513	-0.067	0.115

Table 5-5-12: Model Output for the Linear Mixed Model Testing the Correlation between Density of Woodland Caribou Tracks and Distance to the ROW during Winter Construction

	Estimate	SE	T	Lower CI	Upper CI
(Intercept)	0.144	0.100	1.436	-0.043	0.330
distance	-0.031	0.083	-0.373	-0.187	0.124
year2016	0.356	0.168	2.119	0.043	0.668

Table 5-5-13: Summary of Remote IR Camera Trap Deployments for Bipole III

Construction Segment	Year Deployed	Number of Active Cameras Deployed			Comments
		Near the ROW	1.5 km from ROW	Total	
N1	1	---	---	---	No access / not sampled in 2015
	2	10	10	20	Cameras deployed on 10 transects
	3	6	5	11	An additional 4 cameras are deployed but inactive (not serviced in February 2017); 3 cameras deployed in 2016 were missing/stolen and not replaced; 2 from 2016 were retrieved for servicing and not replaced
N2	1	8	10	18	Cameras deployed on 10 transects
	2	10	9	19	2 additional cameras deployed; 1 camera deployed in 2015 was stolen and not replaced
	3	9	8	17	2 cameras deployed in 2016 were retrieved for servicing but not replaced
N3	1	10	9	19	Cameras deployed on 10 transects
	2	9	9	18	1 camera deployed in 2015 was missing (trees cleared) and not found/replaced
	3	8	7	15	An additional 3 are deployed but inactive (not serviced in February 2017)
N4	1	---	---	---	No access / not sampled in 2015
	2	---	---	---	No access / not sampled in 2016
	3	10	10	20	Cameras deployed on 10 transects
Total	**Year 1 (March 2015)**	**18**	**19**	**37**	
	Year 2 (February 2016)	**29**	**28**	**57**	
	Year 3 (February 2017)	**33**	**30**	**63**	An additional 4 cameras on N1 and 3 cameras on N3 are deployed but not active (for logistical reasons were not accessed for servicing in Year 3)

Table 5-5-14: Comparison of Observations from Camera Trap Data, near ROW vs 1.5 km from ROW, Year 2 and 3 pooled

Mammal Species	Number of Observations		Number of Transects Species was Detected (n)	Mean Number of Observations *		t-Test Paired Two Sample for Means		
	ROW	1.5 km		ROW	1.5 km	t Stat	p (1-tailed)	df
Black Bear	28	42	12	1.56	2.33	-0.7160	0.2419	17
Wolf	13	7	12	1.08	0.58	0.8971	0.1944	11
Coyote	1	4	3			Sample size too small for analysis		
Fox	9	3	8	1.00	0.33	1.5119	0.0845	8
Woodland Caribou	27	5	1			Sample size too small for analysis		
Moose	25	11	10	2.50	1.10	1.0689	0.1565	9
White-tailed Deer	14	1	2			Sample size too small for analysis		
Wolverine	0	2	1			Sample size too small for analysis		
Marten	1	3	3			Sample size too small for analysis		
Fisher	3	0	1			Sample size too small for analysis		
Lynx	9	51	10	0.82	4.64	-1.2730	0.1159	10
Snowshoe Hare	25	57	9	2.27	5.18	-1.4801	0.0848	10

Notes:
* Mean Number of Observations was calculated (all seasons pooled) using only transects and years where the species occurred in the camera trap data (either at the ROW camera trap station, or 1.5 km camera trap station, or both, on a particular transect)

Table 5-6-1: Summary of Boreal Woodland Caribou Mortality Source and Kaplan-Meier Annual Survival Rates for Collared Adult Female Boreal Woodland Caribou, as of September 2017

Boreal Woodland Caribou Range	Telemetry Study Duration	# of Collared Caribou	Mortality Investigations	Mortality Source (number)	Annual Adult Female Survival Rate (%)
P-Bog	February 2010 – September 2017	68	23	Natural cause (3) Wolf predation (12) Bear predation (1) Vehicle collision (1) Undetermined (6)	90.2
N-Reed	Jul 2010 – August 2016	55	11	Natural cause (2) Wolf predation (4) Bear predation (1) Undetermined (4)	88.6
Wabowden	January 2010 – August 2016	66	18	Wolf predation (12) Vehicle collision (1) Undetermined (6)	87.0
Charron Lk	January 2011 – August 2016	60	11	Natural cause (1) Wolf predation (3) Bear Predation (1) Undetermined (6)	90.9
Total		249	63	Known Source = 41 Undetermined = 22	

Table 5-6-2: Comparison of Wolf Distance to Ungulate Prey in the Monitored Boreal Caribou Survey Areas in mid-Winter, Year 1 – Year 3

Woodland Caribou Survey Area	Monitoring Year	Mean Distance (km) from Wolf ±95%CI		Paired 2-sample t-Test for Means			
		Woodland Caribou	Moose	t Stat	P (1-tailed)	df	Predator Encounter Risk
P-Bog	Year 1 (2014/15)	9.9 ±2.62	12.4 ±8.45	0.506	0.317	5	No significant difference
	Year 2 (2015/16)	4.4 ±1.70	3.0 ±1.26	-1.420	0.086	19	No significant difference
	Year 3 (2016/17)	3.9 ±1.10	4.1 ±1.10	0.322	0.375	39	No significant difference
Wabowden	Year 1 (2014/15)	11.2 ±3.06	8.2 ±1.28	-1.786	**0.043**	27	**Significantly higher for Moose**
	Year 2 (2015/16)	4.6 ±1.11	3.4 ±0.94	-2.381	**0.013**	25	**Significantly higher for Moose**
	Year 3 (2016/17)	5.0 ±1.38	5.2 ±0.93	0.232	0.409	38	No significant difference
N-Reed	Year 1 (2014/15)	4.9 ±1.34	7.6 ±2.68	2.248	**0.021**	14	**Significantly higher for W Caribou**
	Year 2 (2015/16)	2.2 ±0.37	5.6 ±1.02	6.447	**<0.001**	61	**Significantly higher for W Caribou**
	Year 3 (2016/17)	2.9 ±0.38	11.4 ±1.66	9.474	**<0.001**	61	**Significantly higher for W Caribou**
Charron Lk	Year 1 (2014/15)	6.9 ±1.30	24.9 ±3.10	13.470	**<0.001**	16	**Significantly higher for W Caribou**
	Year 2 (2015/16)	2.7 ±0.46	5.7 ±0.82	6.353	**<0.001**	71	**Significantly higher for W Caribou**
	Year 3 (2016/17)	3.5 ±0.82	6.5 ±1.67	3.674	**<0.001**	22	**Significantly higher for W Caribou**

Note

No other ungulate species (i.e., white-tailed deer or elk) were detected in any of the woodland caribou survey areas in any monitoring year sampled.

Table 5-8-1: Number of Human Access Observations Recorded along the ROW, All Seasons Pooled

Camera Trap ID	Project-related Access		Public Access / Recreation		Unknown	
	Deployment Year		Deployment Year		Deployment Year	
	2015	2016	2015	2016	2015	2016
BPIII_003	0	---	0	---	0	---
BPIII_012	0	0	0	0	1	1
BPIII_018A	0	---	0	---	6	---
BPIII_021	48	---	1	---	0	---
BPIII_022	36	---	0	---	0	---
BPIII_027	28	---	0	---	0	---
BPIII_031	25	---	0	---	0	---
BPIII_033	2	---	0	---	1	---
BPIII_035	1	---	0	---	0	---
BPIII_038	0	0	0	0	1	1
BPIII_039	---	0	---	0	---	1
BPIII_040	---	0	---	0	---	2
BPIII_ACCESS_001	182	0	0	0	0	0
BPIII_ACCESS_002	---	0	---	0	---	12
BPIII_ACCESS_003	111	---	0	---	0	---
BPIII_ACCESS_004	4	---	0	---	0	---
BPIII_ACCESS_005	188	55	11	0	0	0
BPIII_N1Multi_010	---	4	---	0	---	0
BPIII_N2Multi_002	---	0	---	0	---	79
N1-01_ROW	---	56	---	0	---	0
N1-03_ROW	---	18	---	1	---	0
N1-05_ROW	---	141	---	0	---	0
N1-07_ROW	---	72	---	0	---	0
N1-08_ROW	---	-cm-	---	-cm-	---	-cm-
N1-09_ROW	---	65	---	0	---	0
N1-11_ROW	---	90	---	2	---	0
N1-12_ROW	---	-ns-	---	-ns-	---	-ns-
N1-13_ROW	---	26	---	0	---	0
N1-15_ROW	---	-cm-	---	-cm-	---	-cm-
N2-02_ROW	150	212	0	0	0	0
N2-04_ROW	95	93	0	6	0	0
N2-06_ROW	---	2	---	0	---	0
N2-08_ROW	28	64	0	0	0	0
N2-10_ROW	23	12	0	0	0	0
N2-12_ROW	---	2	---	0	---	0
N2-14_ROW	47	53	0	2	0	0
N2-16_ROW	3	0	0	0	0	0
N2-18_ROW	194	178	0	3	0	0
N2-20_ROW	2	3	0	0	0	0
N3-01_ROW	8	123	1	0	0	0
N3-05_ROW	9	-ns-	0	-ns-	0	-ns-
N3-06_ROW	17	91	1	0	0	0
N3-08_ROW	2	1	0	0	0	0
N3-10_ROW	66	133	0	1	0	0
N3-12_ROW	130	186	0	0	0	0
N3-14_ROW	47	116	0	0	0	0
N3-16_ROW	2	-ns-	0	-ns-	0	-ns-
N3-18_ROW	158	178	1	0	0	0
N3-20_ROW	6	0	0	0	0	0
TOTAL (%)	1612 (99.26%)	1974 (94.68%)	14 (0.86%)	15 (0.72%)	9 (0.55%)	96 (4.60%)

Notes:
- --- = no camera deployed
- -cm- = camera missing
- -cf- = camera
- -ns- = no sample (camera card not retrieved)

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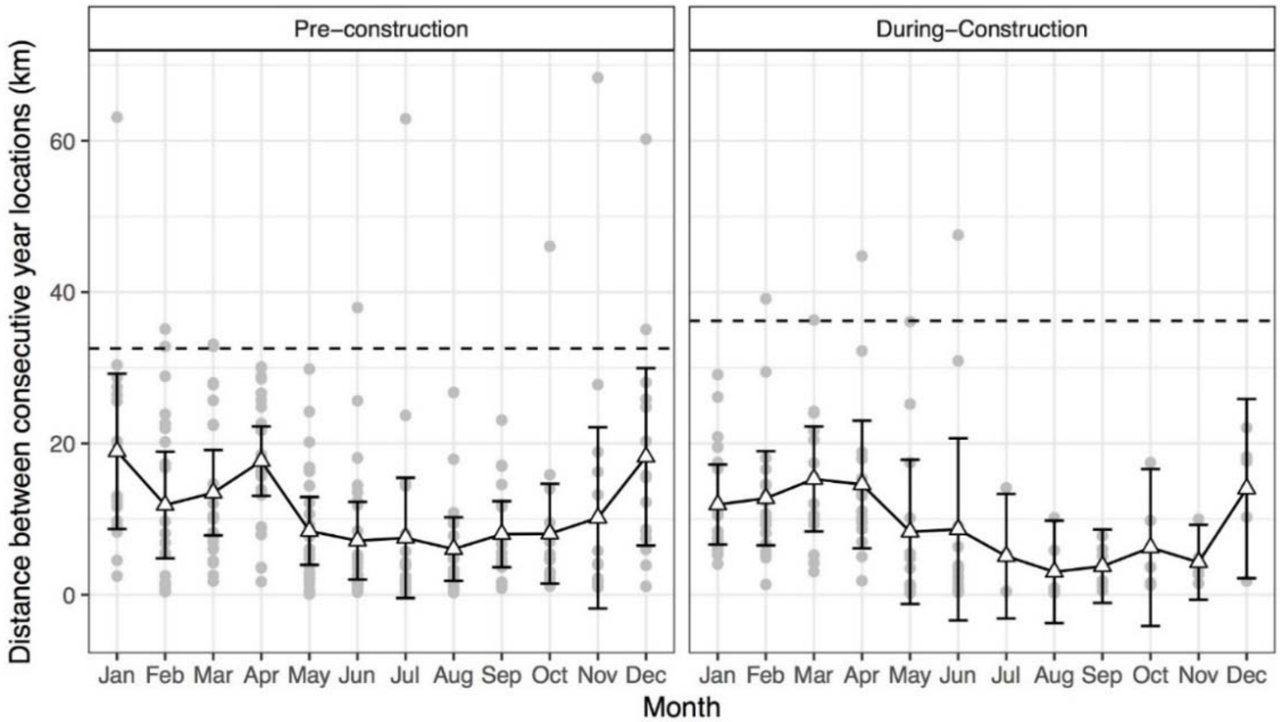

Figure 5-1-13: Population Scale Site Fidelity Dynamics Observed in the Wabowden Range during Pre-construction and Construction Project Phases

Population scale site fidelity dynamics observed in the Wabowden range during pre-construction and construction Project phases. As confidence intervals do not encompass the null expectation, strong fidelity to calving areas within the annual range is occurring during all Project phases. Weaker but significant fidelity to wintering areas is also occurring.

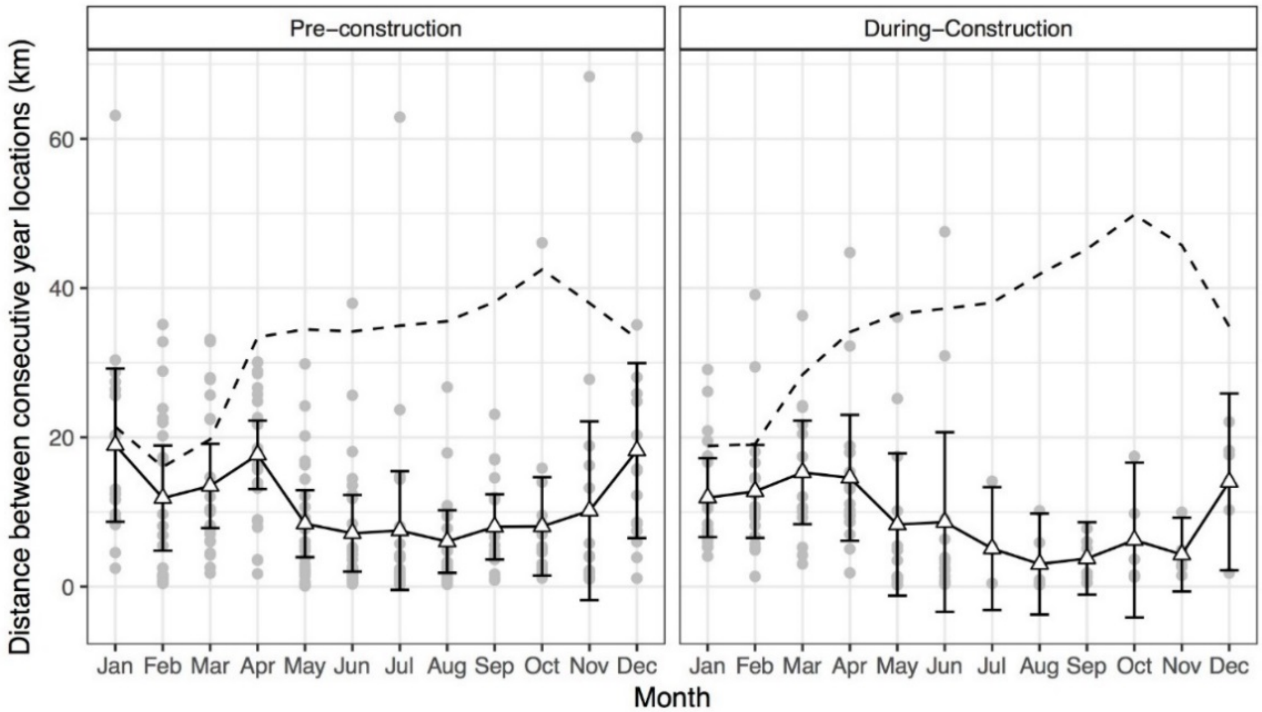

Figure 5-1-14: Seasonal Scale Site Fidelity Dynamics observed in the Wabowden Range during the Pre-construction and Construction Project Phases

As confidence intervals do not encompass the null expectation during the calving period strong site fidelity is occurring during all Project phases. As confidence intervals within the monthly ranges encompass the null January to February in the pre-construction phases, fidelity is absent. However, during construction fidelity to these ranges was displayed again.

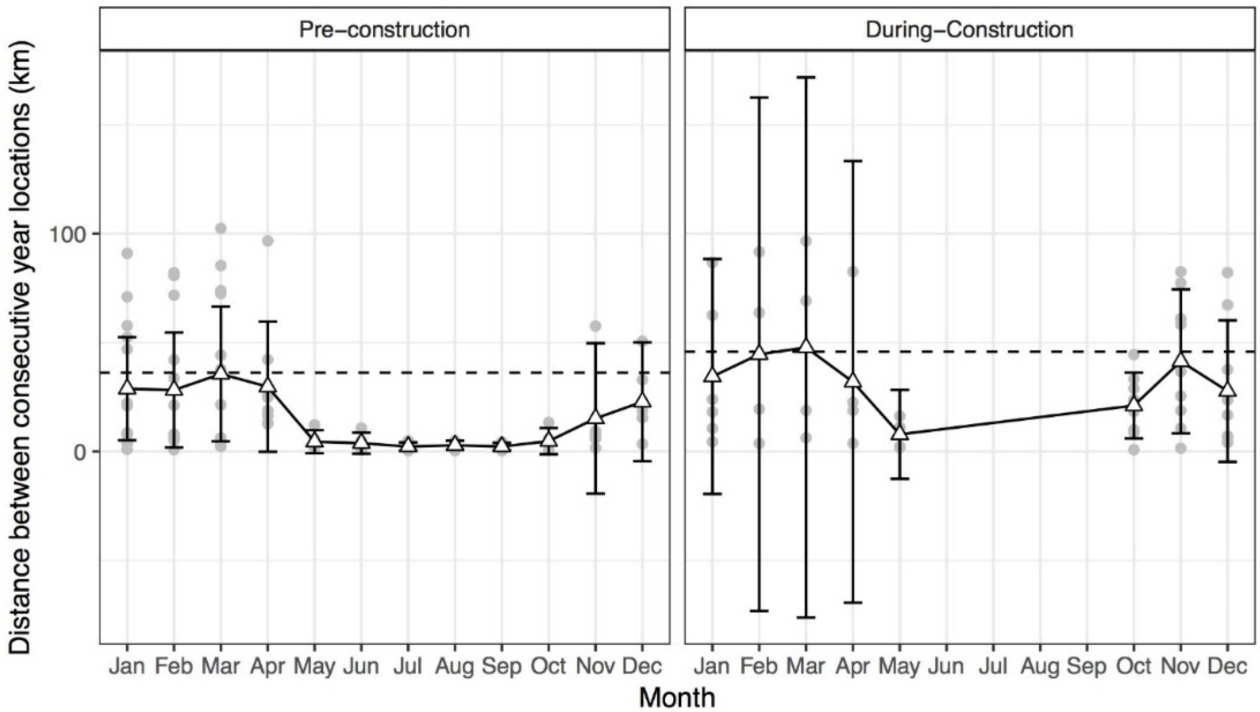

Figure 5-1-15: Population Scale Site Fidelity Dynamics observed in the N-Reed Range during the Pre-construction and Construction Project Phases

Population scale site fidelity dynamics observed in the N-Reed range during the pre-construction and construction Project phases. As confidence intervals do not encompass the null expectation during the calving period strong site fidelity is occurring during all Project phases. As confidence intervals within the winter monthly ranges encompass the null November to April, fidelity is absent during both Project phases.

**Currently during the construction phase from June – September there are no caribou who were collared during that period for consecutive years so data is not available. This will be updated in the next 2018 report.

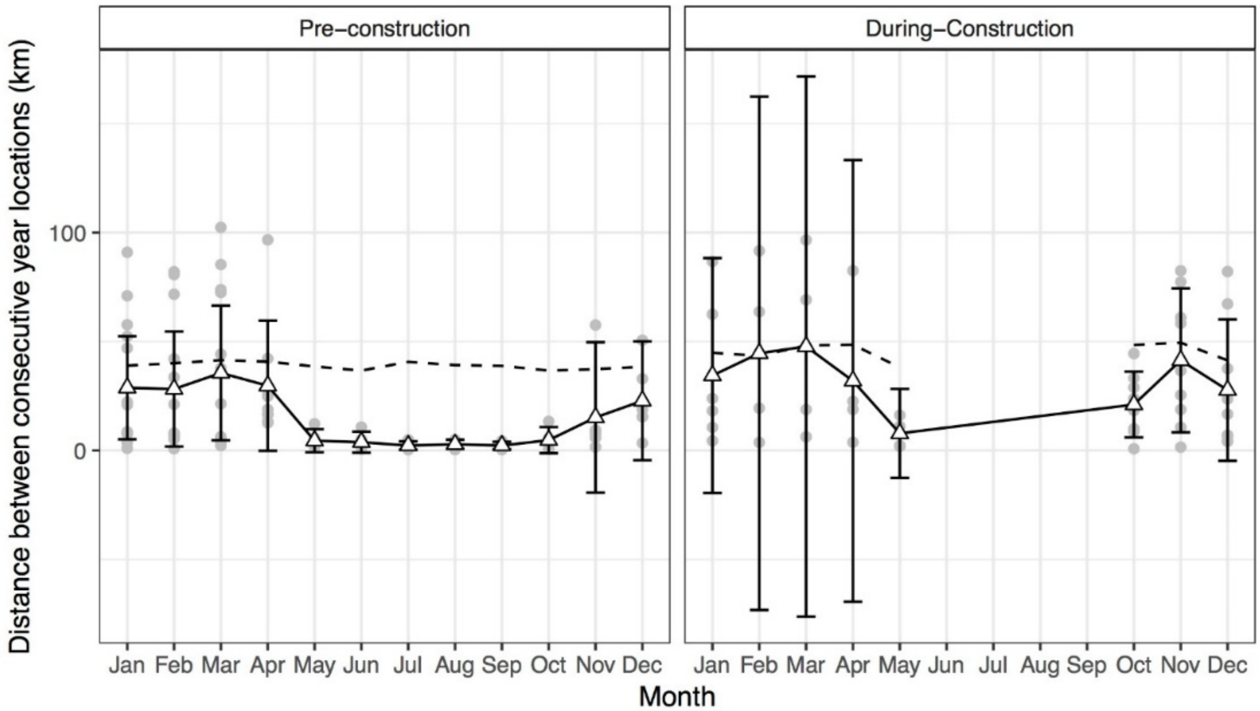

Figure 5-1-16: Seasonal Scale Site Fidelity Dynamics observed in the N-Reed Range during the Pre-construction and Construction Project Phases

Seasonal scale site fidelity dynamics observed in the N-Reed range during the pre-construction and construction Project phases. Similar to the population scale, as confidence intervals do not encompass the null expectation during the calving period, strong site fidelity is occurring during all Project phases. As confidence intervals within the winter monthly ranges encompass the null November to April, fidelity is absent during both Project phases.

**Currently during the construction phase from June – September there are no caribou who were collared during that period for consecutive years so data is not available. This will be updated in the next 2018 report.

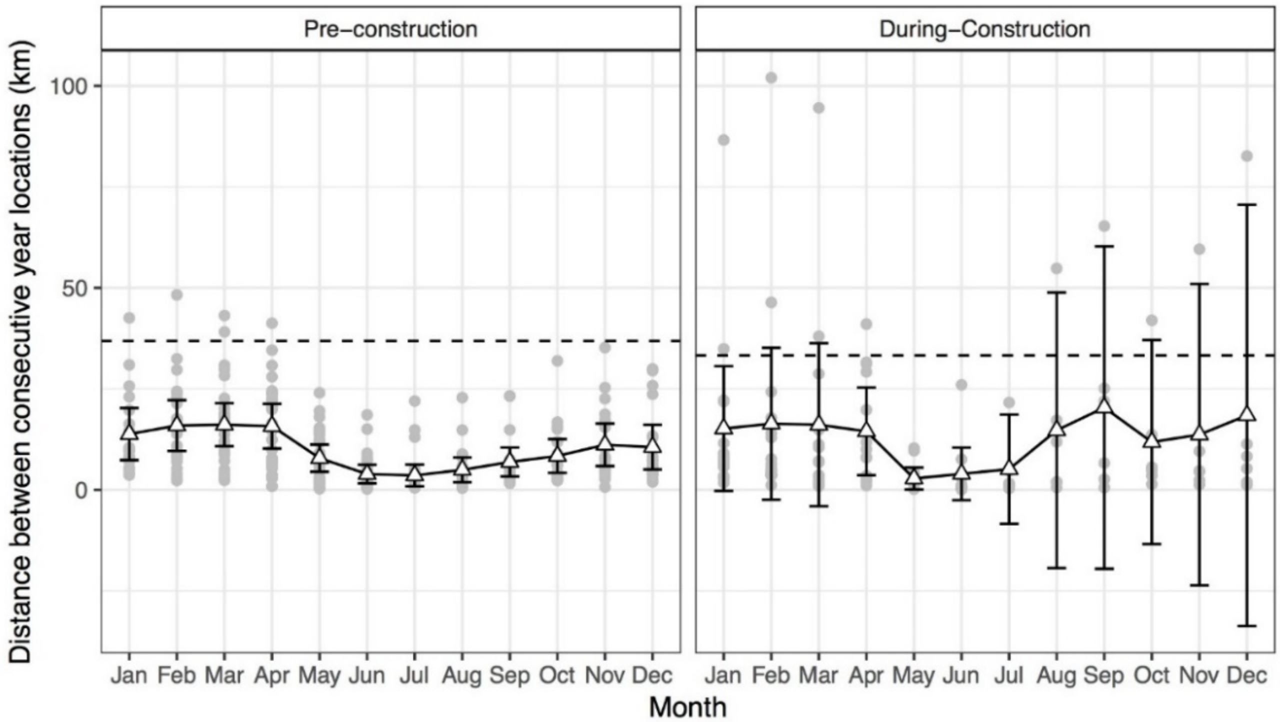

Figure 5-1-17: Population Scale Site Fidelity Dynamics observed in the P-Bog Range during the Pre-construction and Construction Project Phases

Population scale site fidelity dynamics observed in the P-Bog range during the pre-construction and construction Project phases. As confidence intervals encompass the null expectation, site fidelity is occurring throughout the year during the pre-construction phase. As confidence intervals within the winter monthly ranges encompass the null August to March, fidelity is absent during the fall and winter during construction phase; however fidelity to calving areas remains strong. This pattern will continue to be monitored and updated as more data accumulates. Kernel range analysis does not reveal any drastic shifts in the distribution of core use areas.

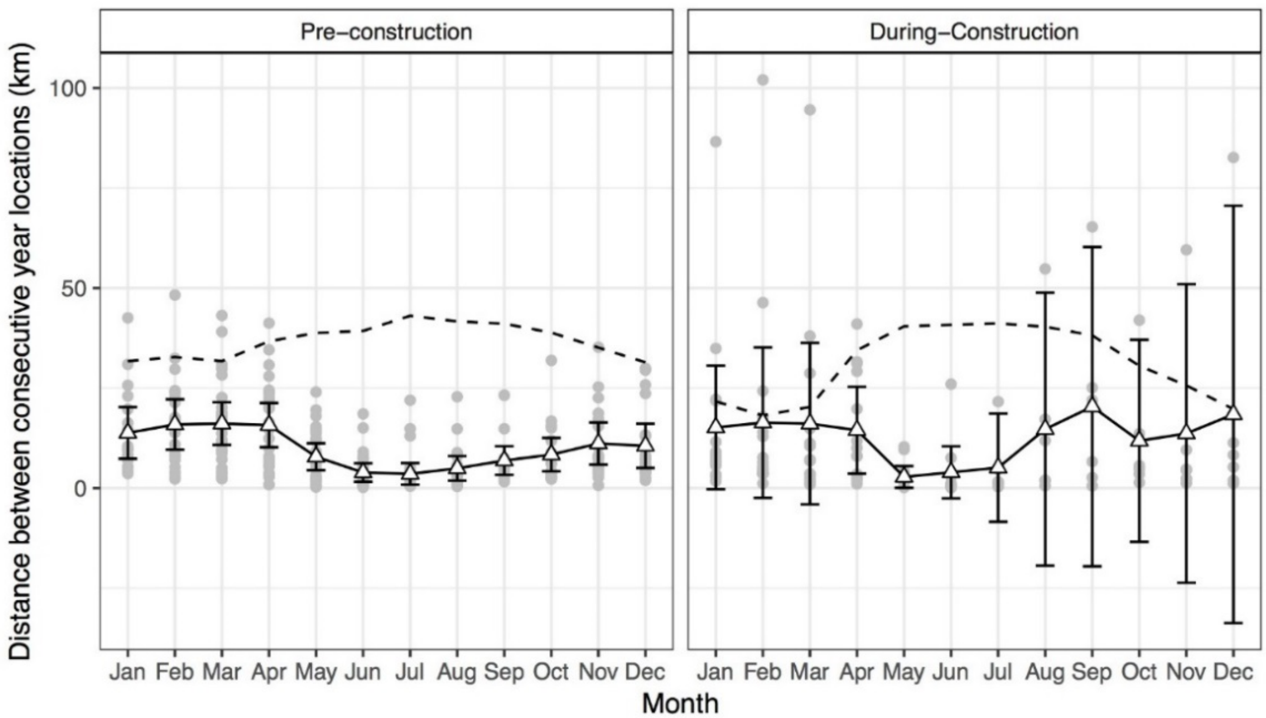

Figure 5-1-18: Seasonal Scale Site Fidelity Dynamics observed in the P-Bog Range during the Pre-construction and Construction Project phases

Seasonal scale site fidelity dynamics observed in the P-Bog range during the pre-construction and construction Project phases. Similar to the population scale, as confidence intervals encompass the null expectation, site fidelity is occurring throughout the year during the pre-construction phase. As confidence intervals within the winter monthly ranges encompass the null August to March, fidelity is absent during the fall and winter during construction phase; however fidelity to areas within calving ranges remains strong.

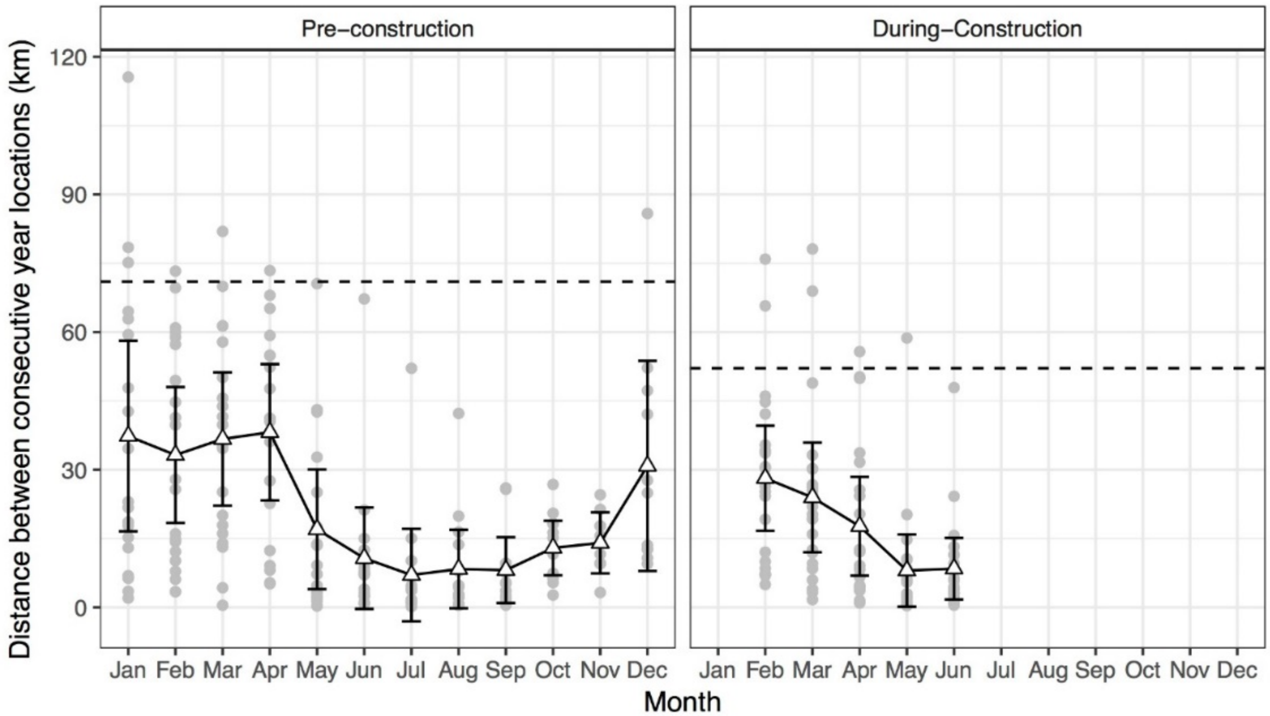

Figure 5-1-19: Population Scale Site Fidelity Dynamics observed in the Charron Lake Range during the Pre-construction and Construction Project Phases

Population scale site fidelity dynamics observed in the Charron Lake range during the pre-construction and construction Project phases. As confidence intervals encompass the null expectation, site fidelity is occurring throughout the year during both Project phases.

**Currently during the construction phase from July – December there are no caribou who were collared during that period for consecutive years so fidelity data is not available. This will be updated in the next 2018 report

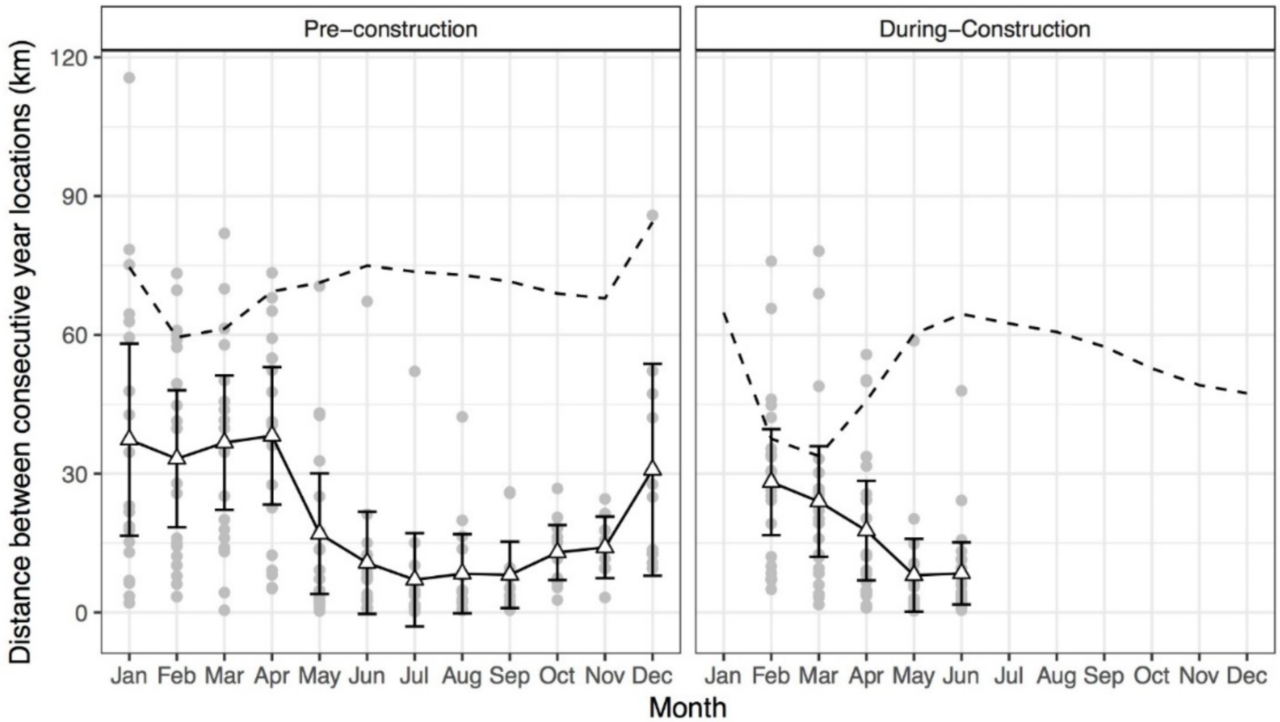

Figure 5-1-20: Seasonal Scale Site Fidelity Dynamics observed in the Charron Lake Range during the Pre-construction and Construction Project Phases

Seasonal scale site fidelity dynamics observed in the Charron Lake range during the pre-construction and construction Project phases. As confidence intervals encompass the null expectation, site fidelity is occurring throughout the year during the pre-construction phase. Fidelity to wintering areas became weaker during the time construction was initiated. As this range does not interact with the Project, this result indicates that fidelity can be affected by other factors. This pattern will continue to be assessed as data accumulates.

**Currently during the construction phase from July – December there are no caribou who were collared during that period for consecutive years so fidelity data is not available. This will be updated in the next 2018 report. There were some caribou tracked in the same month, but separated by two years allowing for the calculation of the seasonal null expectation.

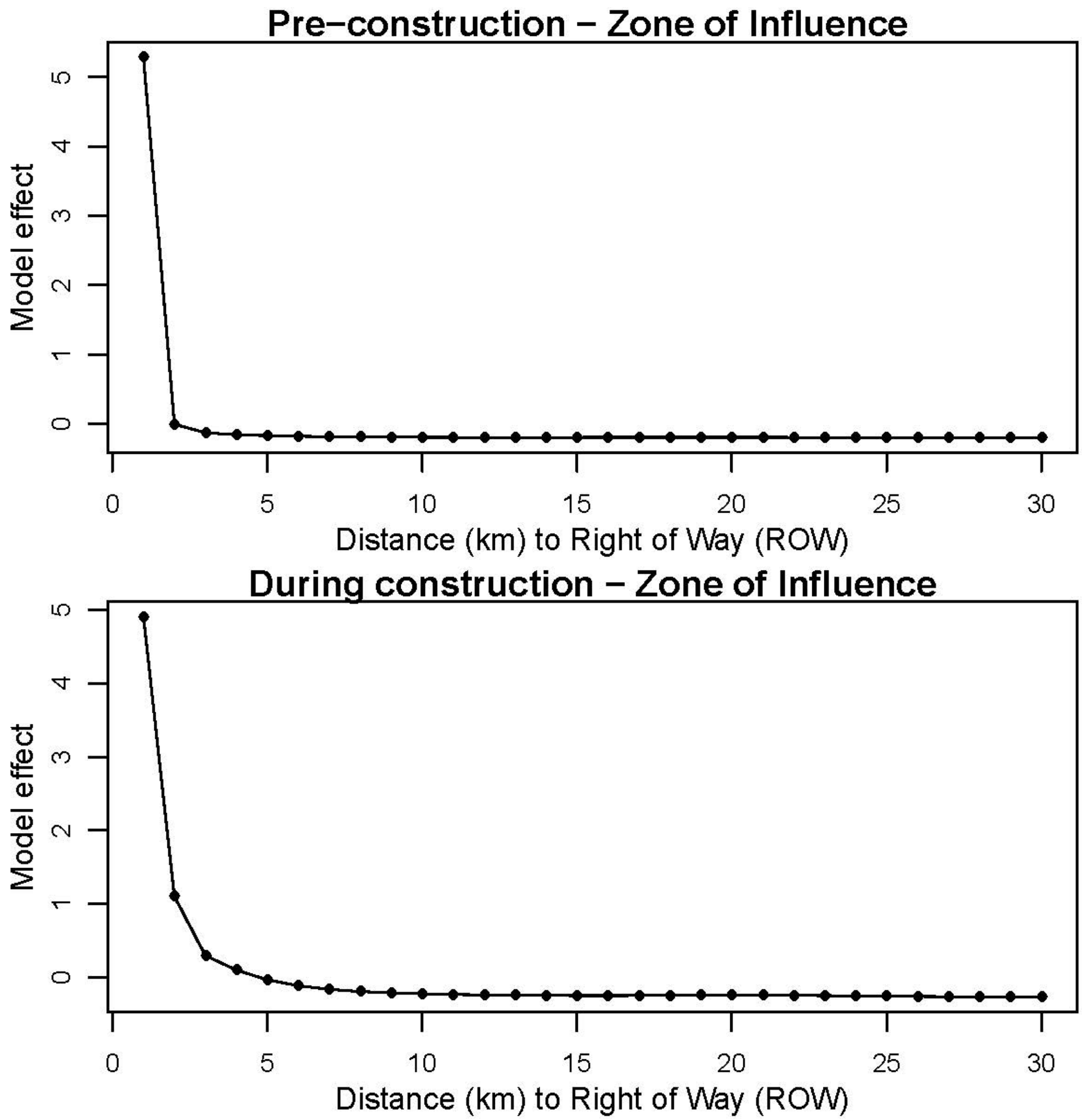

Figure 5-1-21: Zone of Influence as Measured by Model Effect Pooled across Seasons for Pre-construction to Construction

Comparison of the ZOI generated using locations pooled across seasons for each phase in Wabowden range. Caribou avoided the pre-existing linear corridor by 1 to 2 km and this avoidance pattern continued during the construction phase. The ROW was widened for most of this range and avoidance was already occurring on the landscape prior to the Project being installed.

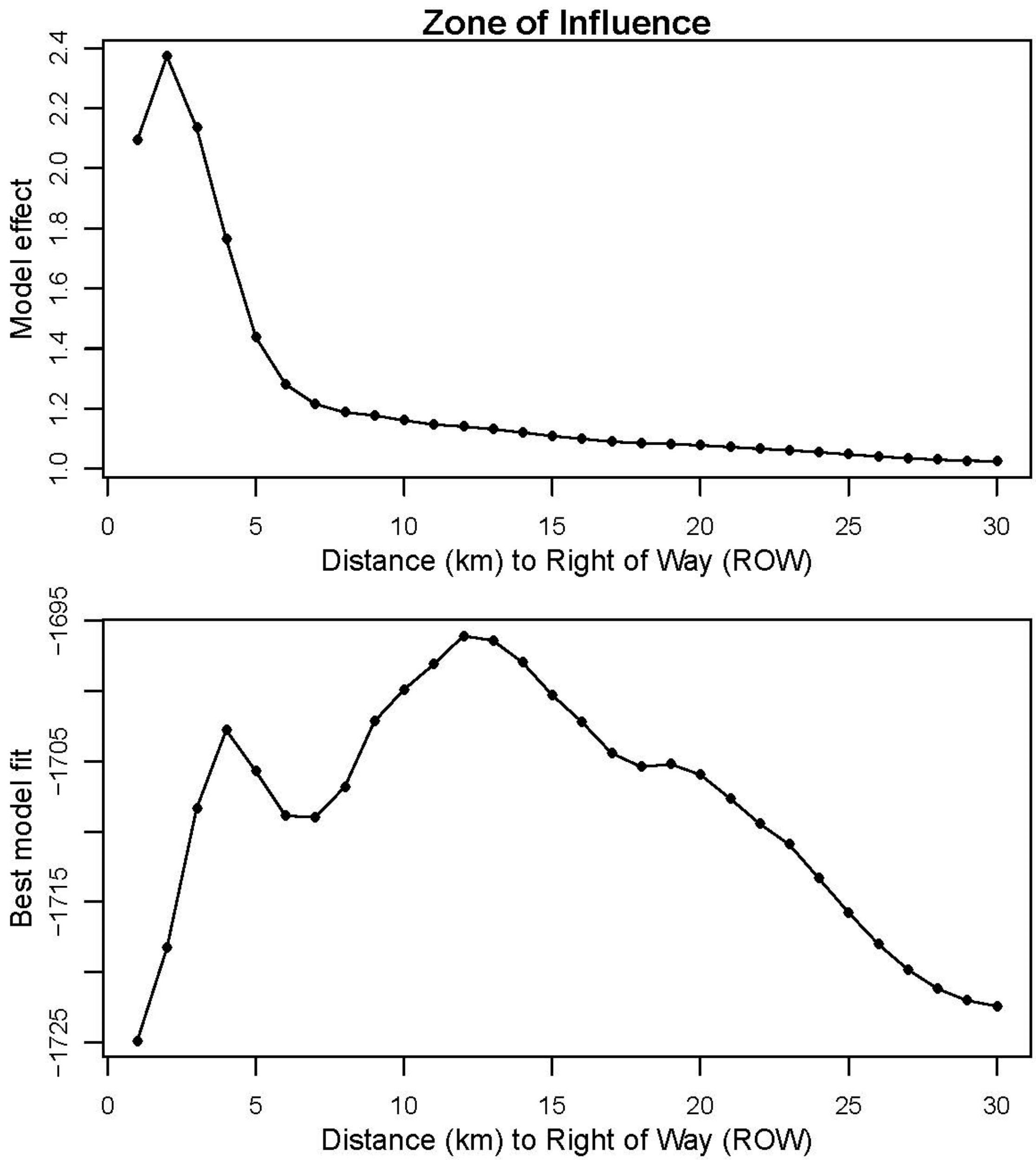

Figure 5-1-22: Current Zone of Influence during the construction phase in Early Winter in the Wabowden Range

Caribou continue to avoid the Project ROW by approximately 2 km during the construction phase in early winter. This is the same level of avoidance exhibited during the pre-construction phase. The best model fit indicates that there is no strong pattern this will continue to be monitored as more data accumulates in the construction phase.

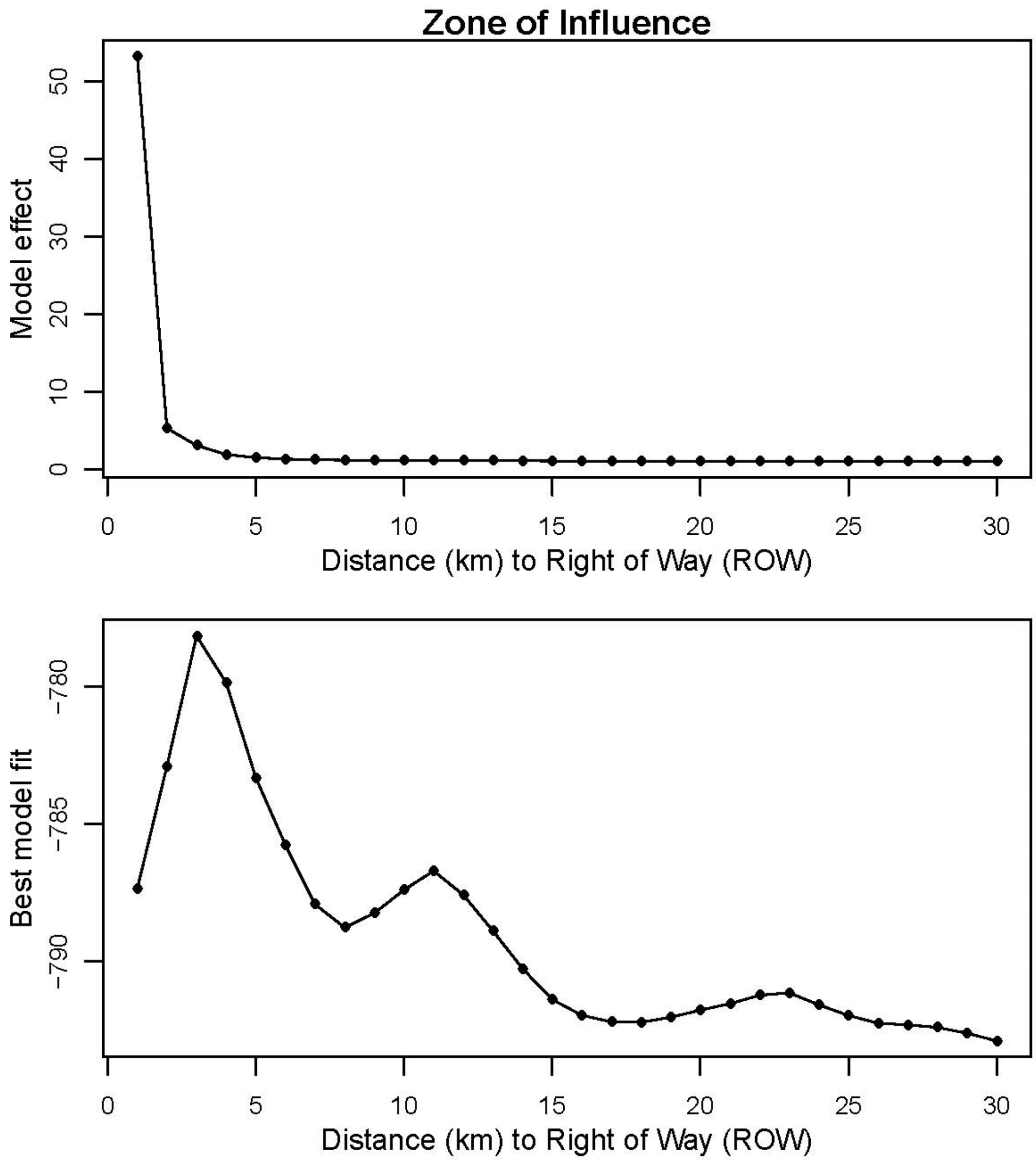

Figure 5-1-23: Current Zone of Influence during Early Winter in the Wabowden Range

Model effect illustrates that caribou continue to avoid the Project ROW by approximately 1 to 2 km during the most recent construction phase period in late winter. The best model fit indicates a good fit for avoidance of 2 to 3 km. This is the same extent of avoidance exhibited during the pre-construction phase. The best model fit indicates that there is no strong pattern this will continue to be monitored as more data accumulates in the construction phase.

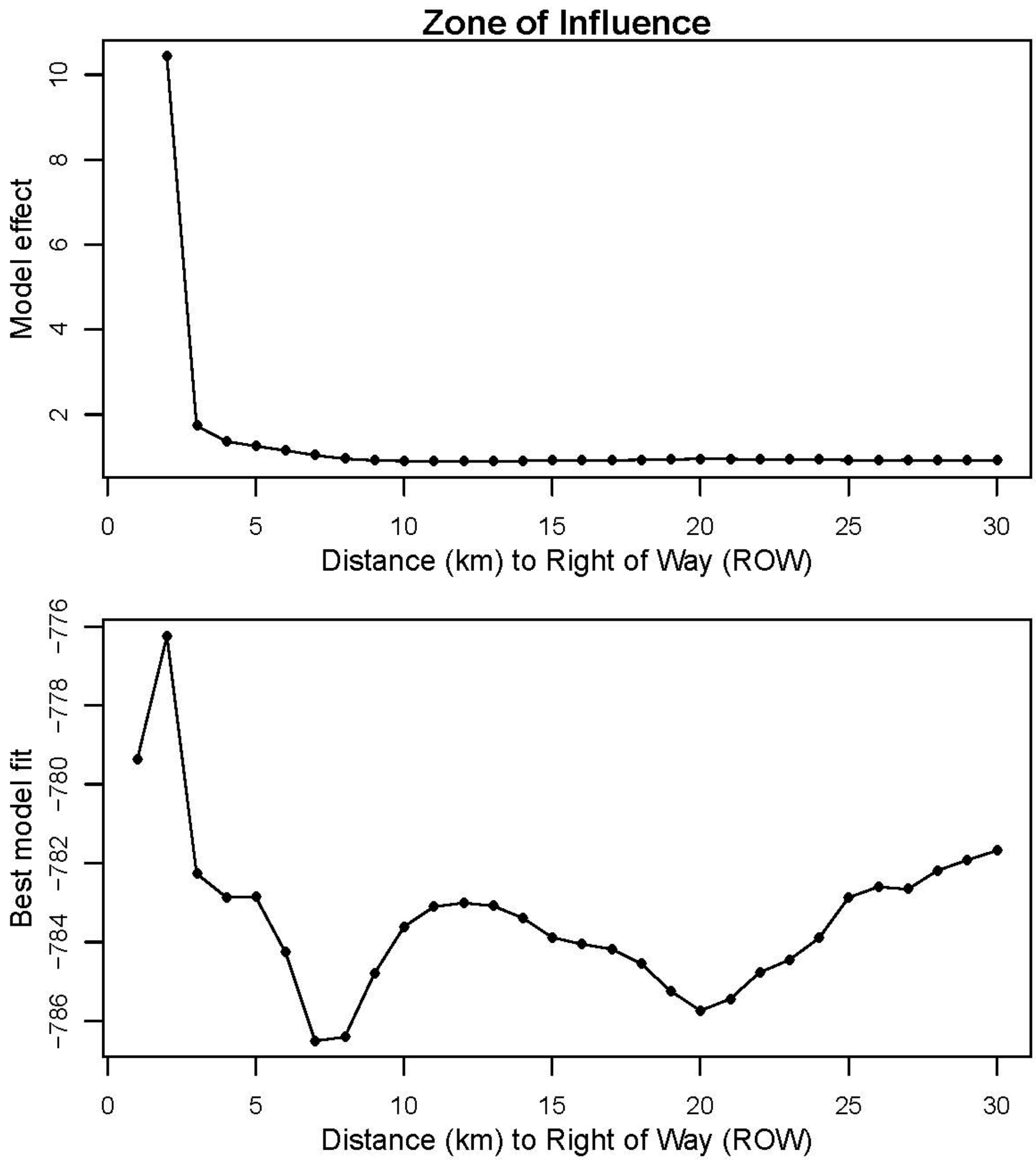

Figure 5-1-24: Current Zone of Influence during the Spring in the Wabowden Range

Model effect illustrates that caribou continue to avoid the Project ROW by approximately 2 km during the most recent construction phase period in spring. The best model fit indicates a good fit for avoidance of 2 km. This is the same level of avoidance exhibited during the pre-construction phase.

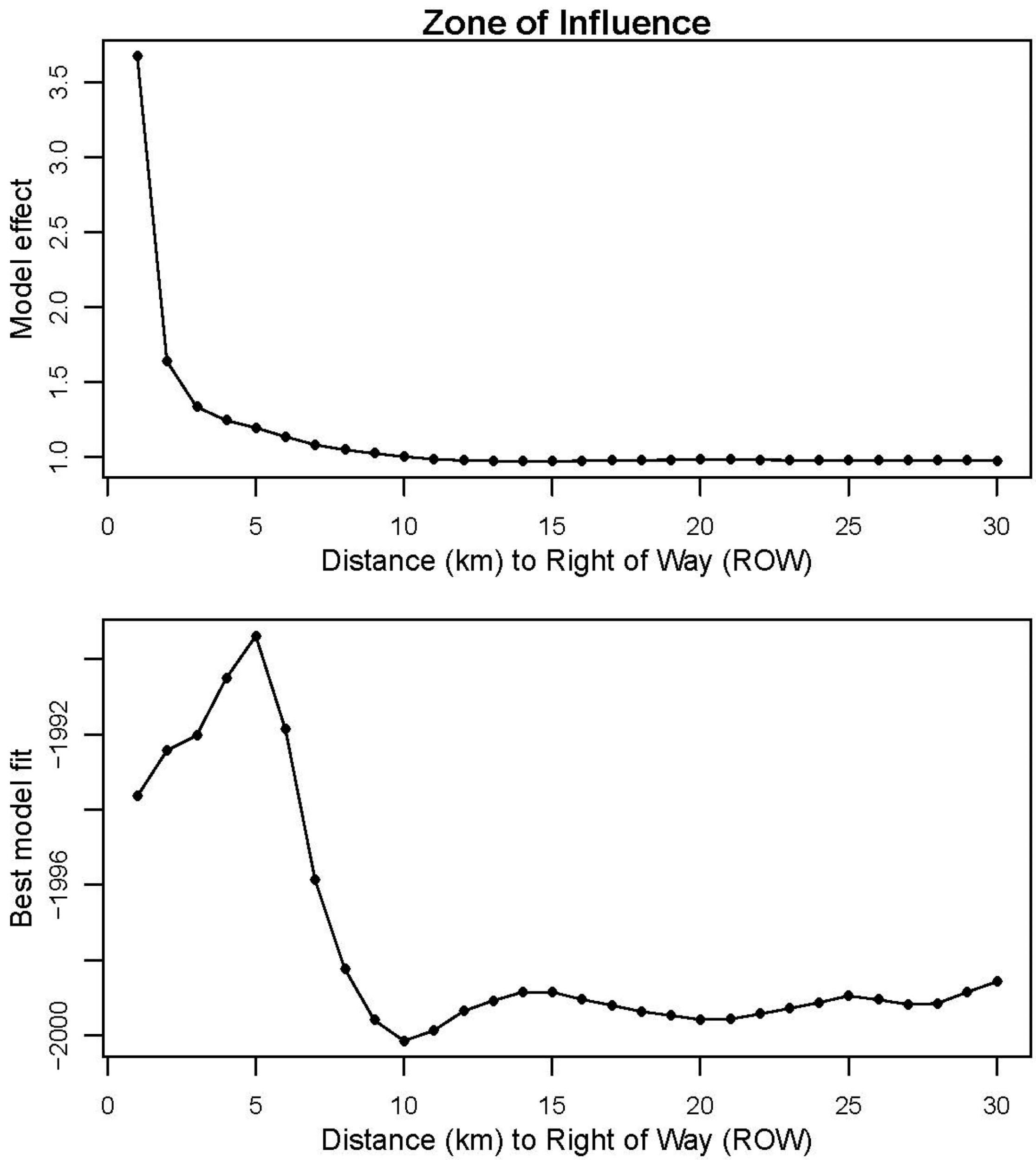

Figure 5-1-25: Current Zone of Influence during the Summer in the Wabowden Range

Model effect illustrates that caribou continue to avoid the Project ROW by approximately 1 km during the construction phase period in the summer. The best model fit indicates a good fit for avoidance of 5 km. The best model fit indicates that the avoidance distance may be larger than that indicated by the model effect. This pattern this will continue to be monitored as more data accumulates in the construction phase.

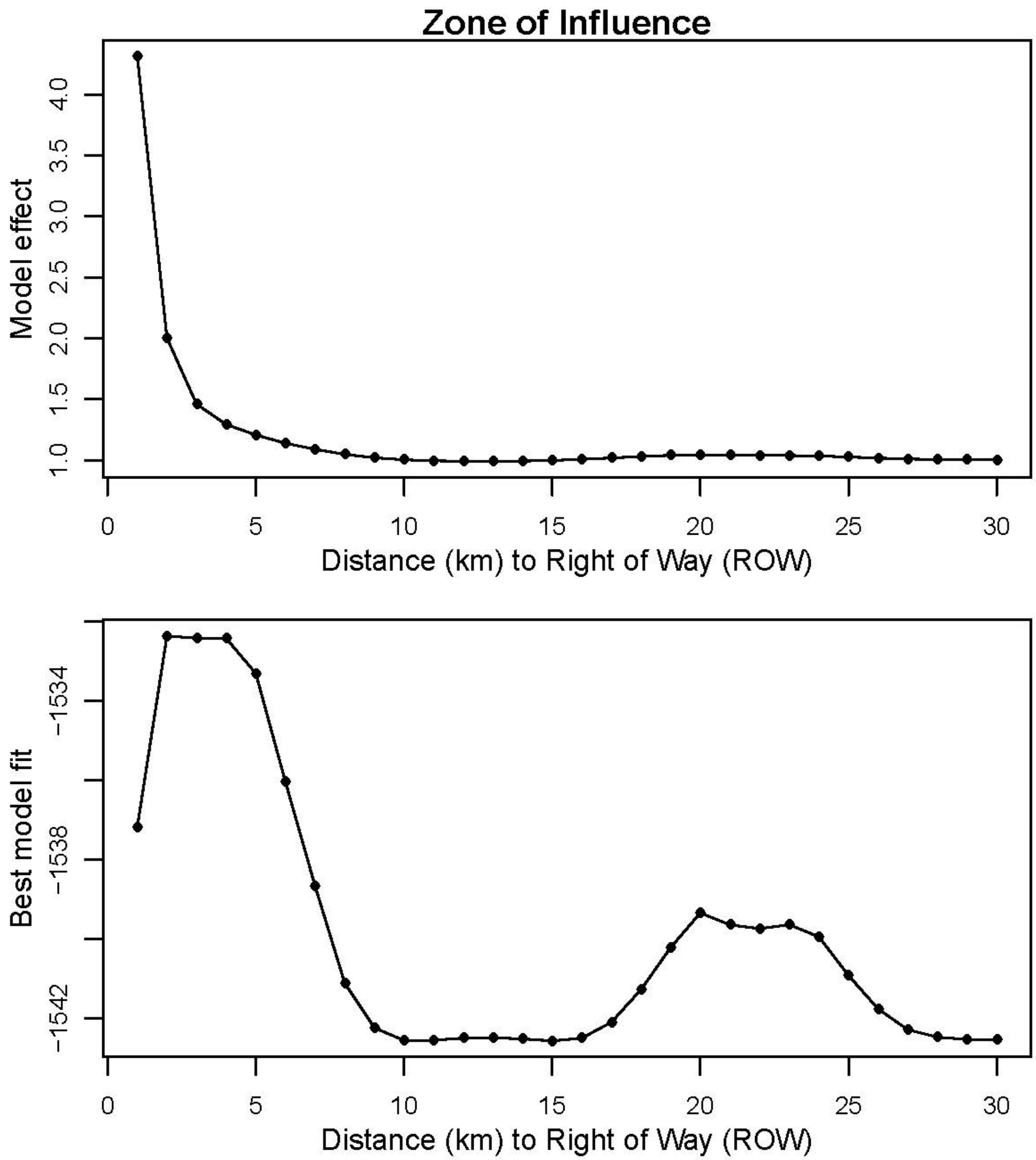

Figure 5-1-26: Current Zone of Influence during the Fall in the Wabowden Range

Model effect illustrates that caribou continue to avoid the Project ROW by approximately 1 km during the construction phase in the fall. The best model fit indicates a good fit for avoidance of 2 to 4 km. The best model fit indicates that the avoidance distance may be larger than that indicated by the model effect. This pattern this will continue to be monitored as more data accumulates in the construction phase.

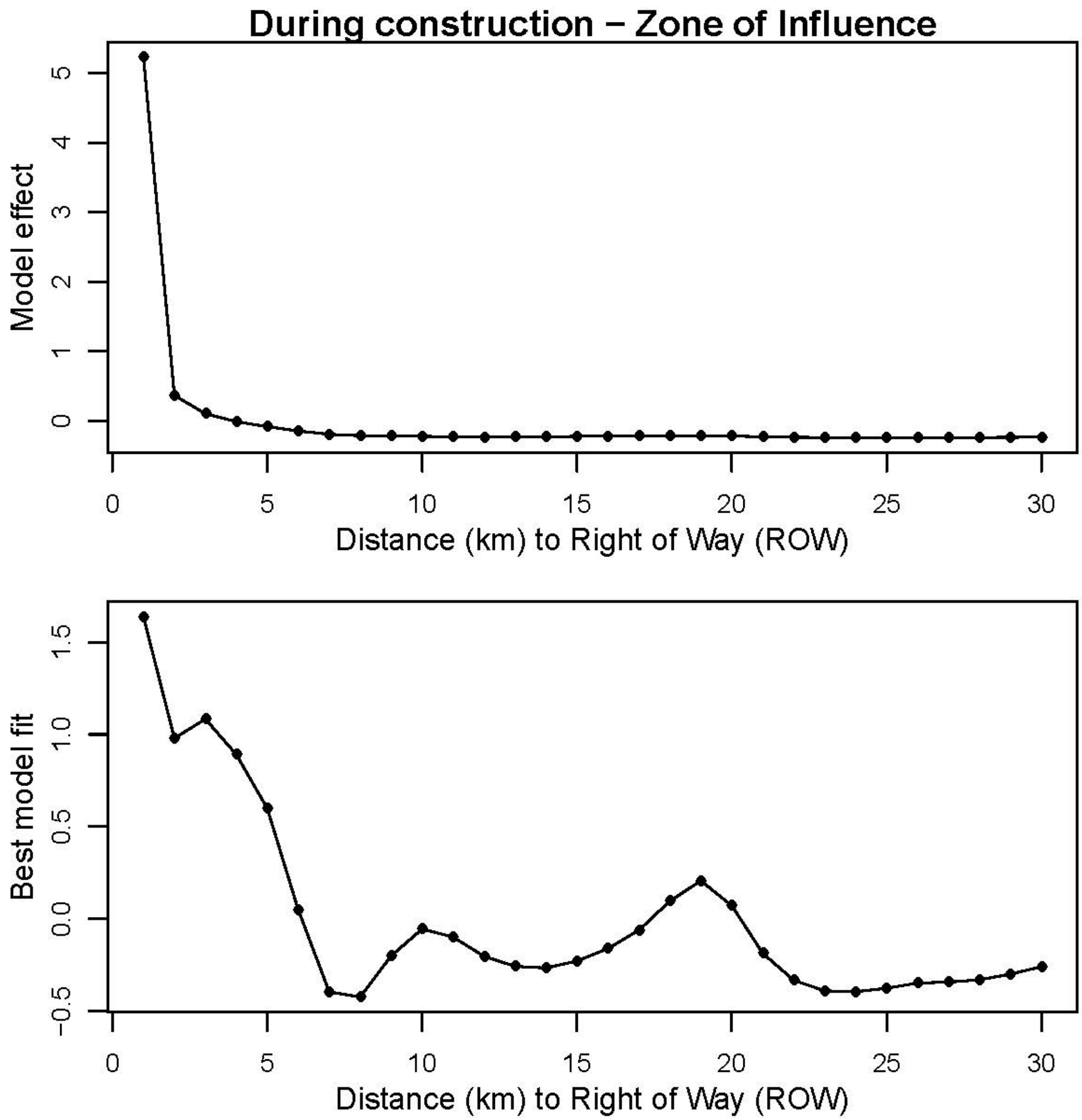

Figure 5-1-27: Zone of Influence as Measured by Model Effect and Model Fit Pooled across all Seasons during the Construction Phase to Date in the P-Bog Range

Model effect illustrates that caribou avoid the Project ROW by approximately 1 km during the construction phase. The best model fit also indicates a good fit for avoidance of 1 km.

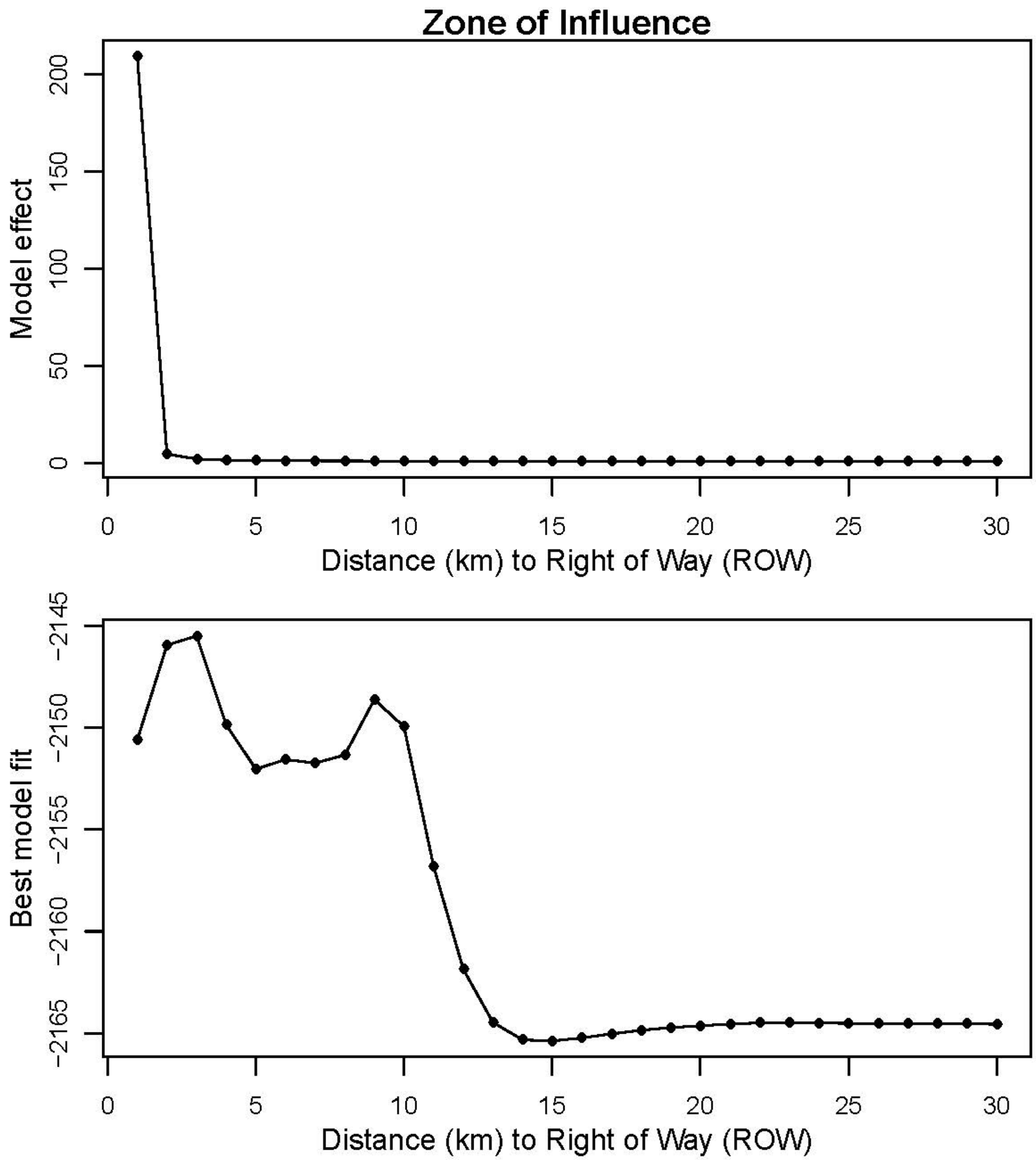

Figure 5-1-28: Current Zone of Influence during Early Winter in the P-Bog Range

Caribou avoid the Project ROW by approximately 1 km during the construction phase in early winter. The best model fit indicates that avoidance may be 2 to 3 km. This pattern will continue to be monitored as more data accumulates in the construction phase.

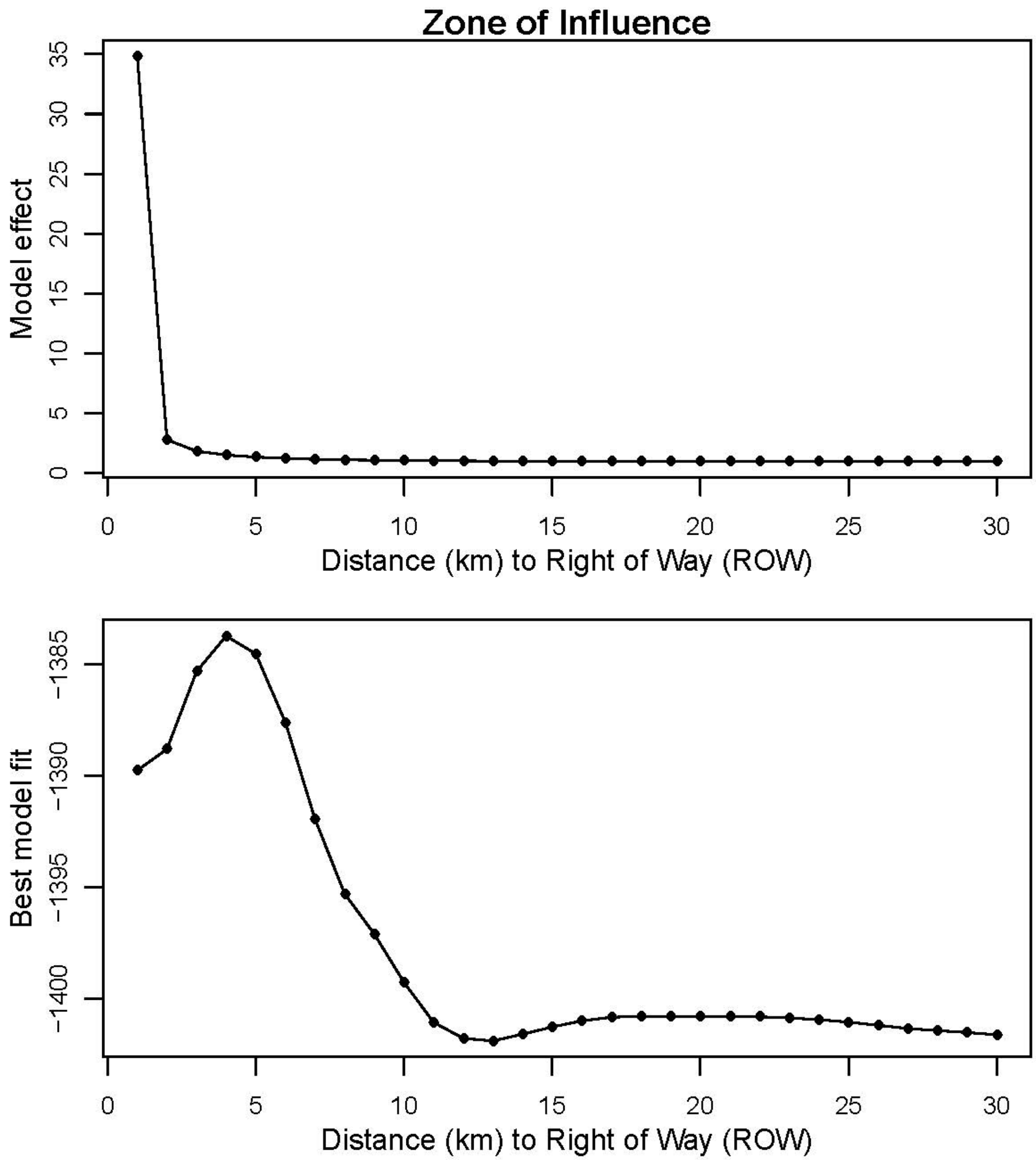

Figure 5-1-29: Current Zone of Influence during the Late Winter in the P-Bog Range

Caribou continue to avoid the Project ROW by approximately 1 km during the construction phase in late winter. The best model fit indicates a good fit for avoidance of 4 to 5 km. The best model fit indicates that the avoidance distance may be larger than that indicated by the model effect. This pattern this will continue to be monitored as more data accumulates in the construction phase.

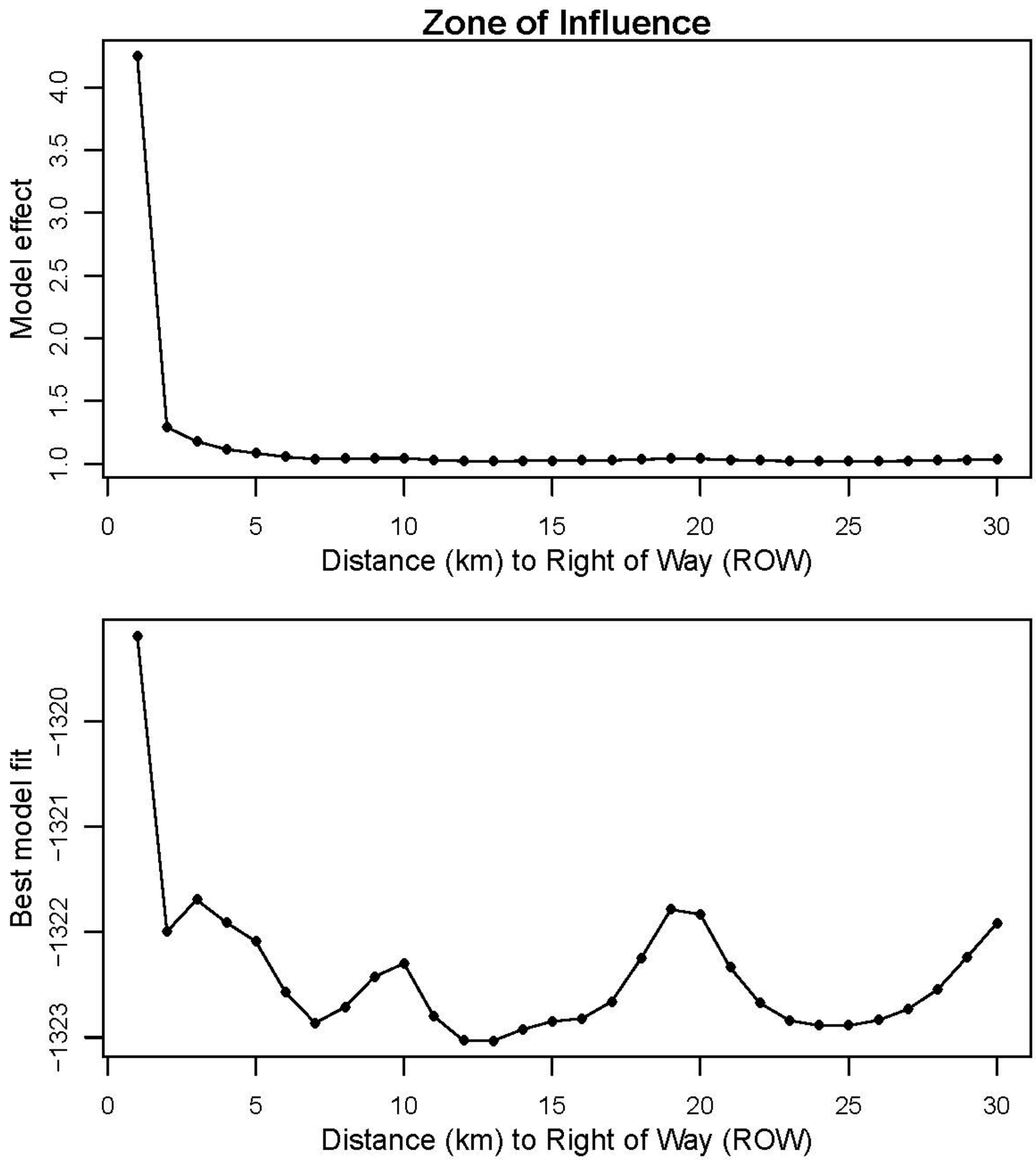

Figure 5-1-30: Current Zone of Influence during the Spring in the P-Bog Range

Caribou continue to avoid the Project ROW by approximately 1 km during the construction phase in the spring.

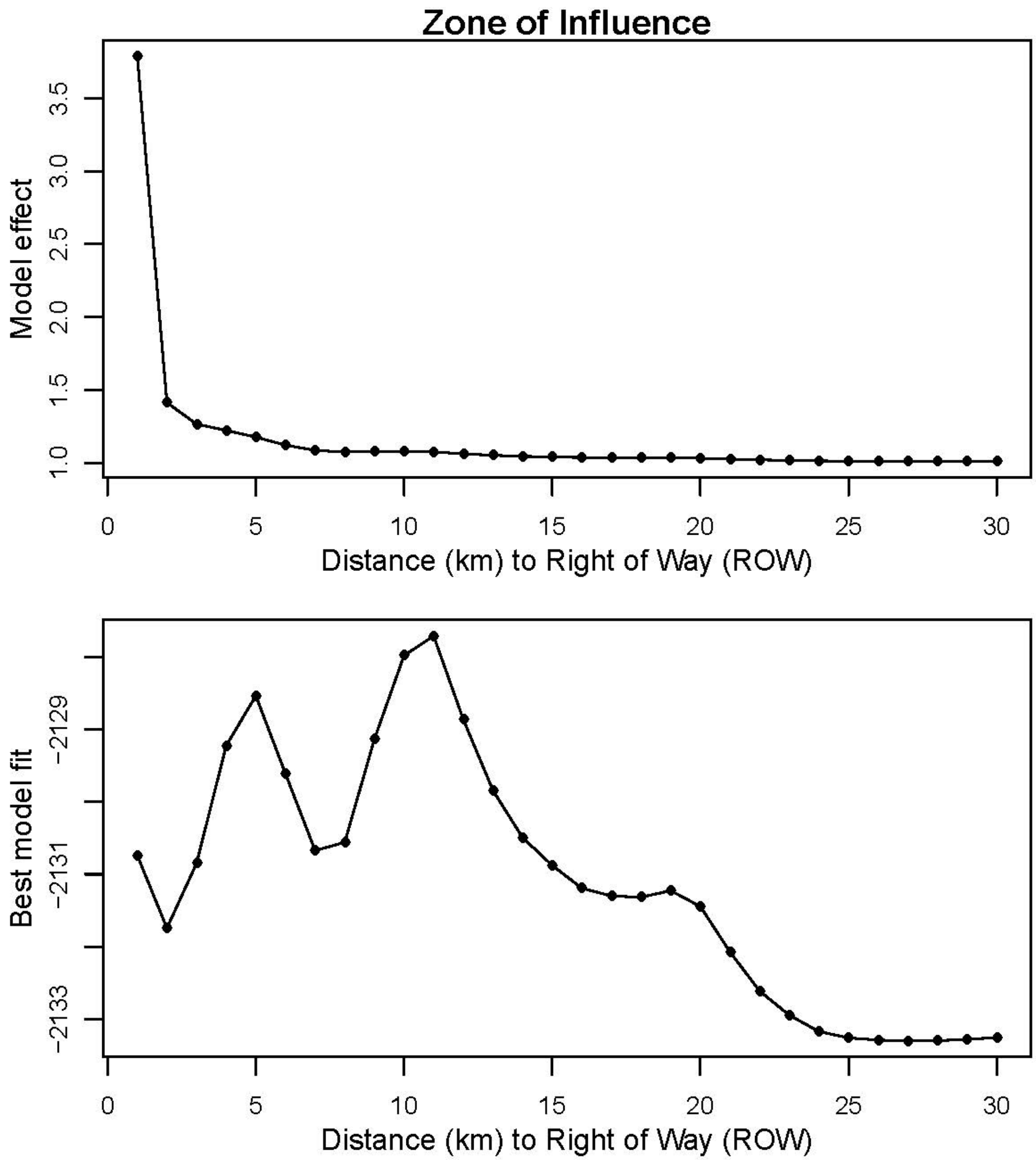

Figure 5-1-31: Current Zone of Influence during the Summer in the P-Bog Range

Caribou continue to avoid the Project ROW by approximately 1 km during the construction phase in the summer. The best model fit indicates that there is no strong pattern of avoidance; this pattern will continue to be monitored as more data accumulates in the construction phase.

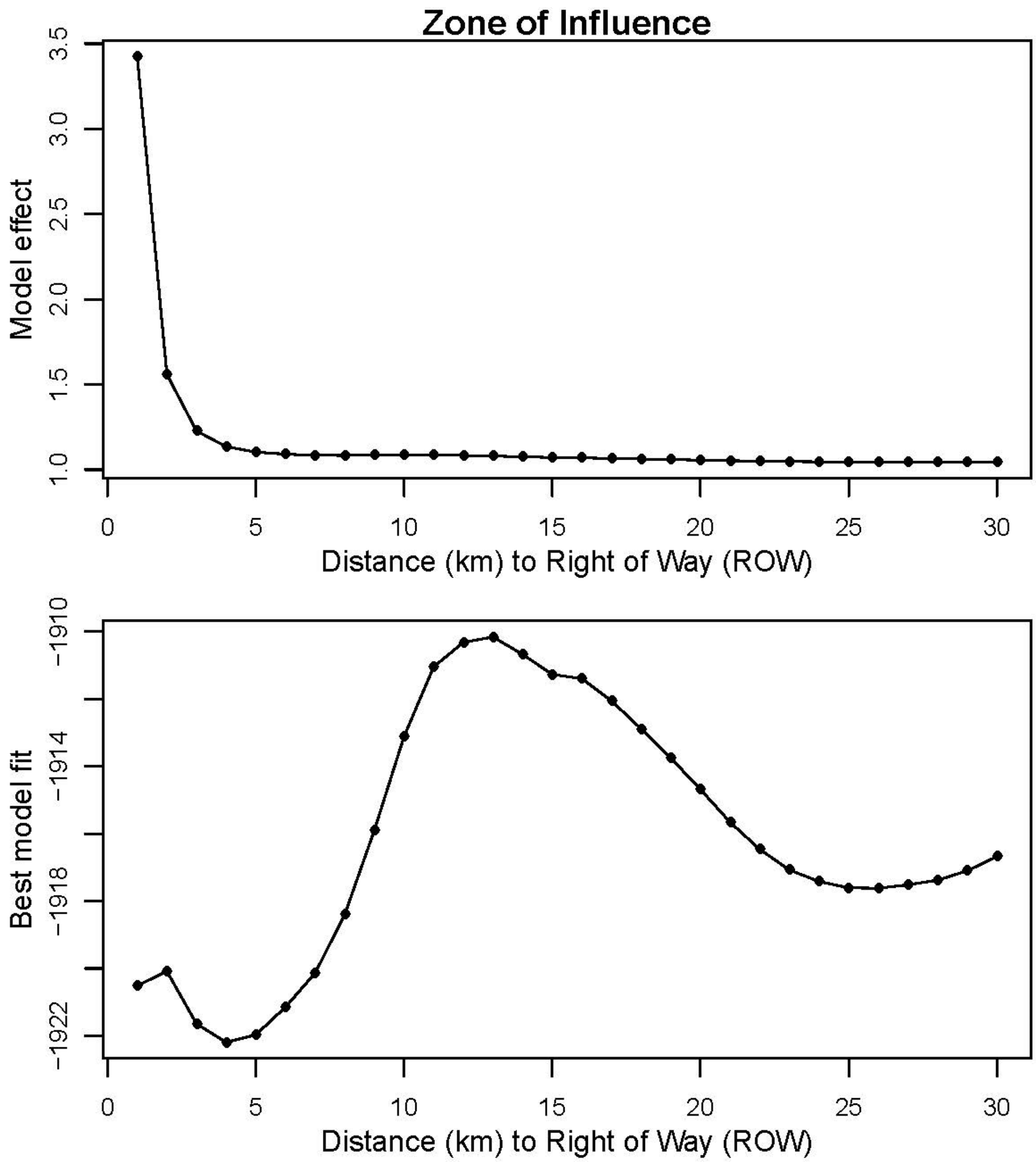

Figure 5-1-32: Current Zone of Influence during the Fall in the P-Bog Range

Caribou continue to avoid the Project ROW by approximately 1 km during the construction phase in the summer. The best model fit indicates that there is no strong pattern of avoidance; this pattern will continue to be monitored as more data accumulates in the construction phase.

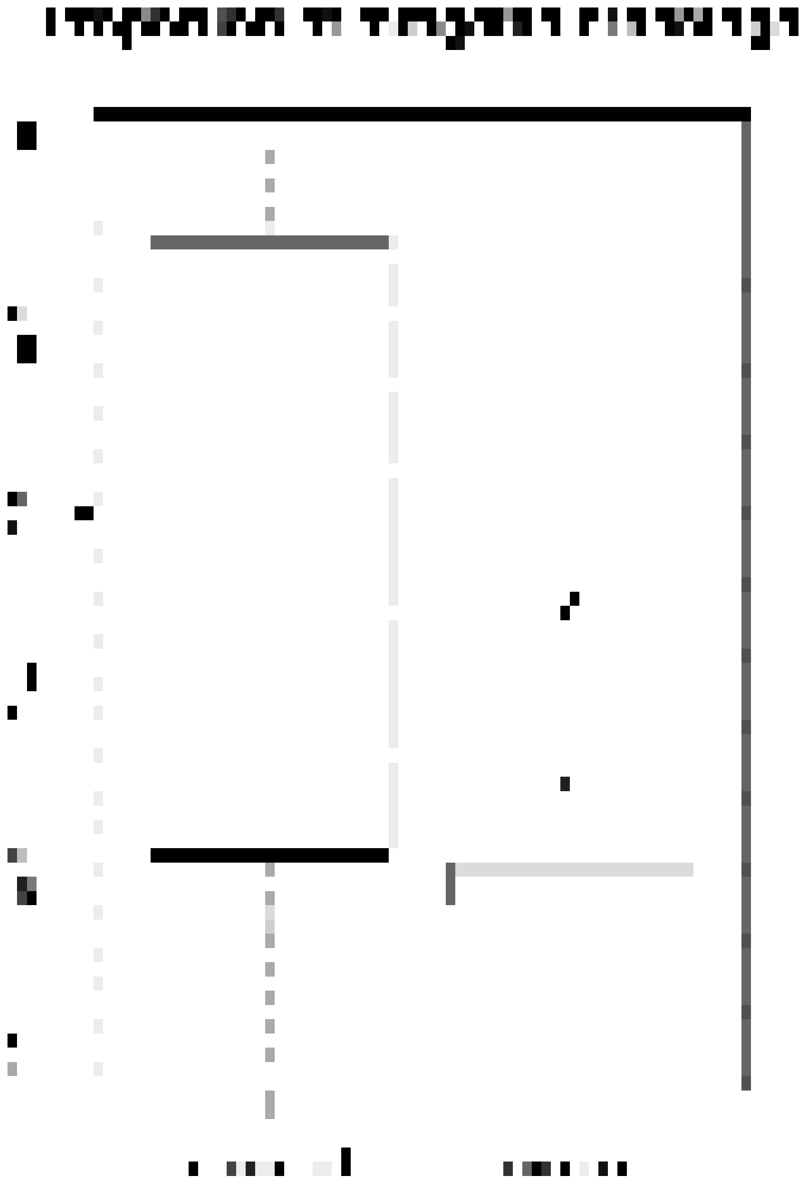

Figure 5-1-33: The Proportion of Crossings at the Mitigated Areas in the P-Bog Range

Caribou continue to cross the Project ROW in areas with vegetation mitigation applied significantly more frequently than random; suggesting that mitigation was successful in ensuring that caribou continued to move across the landscape.

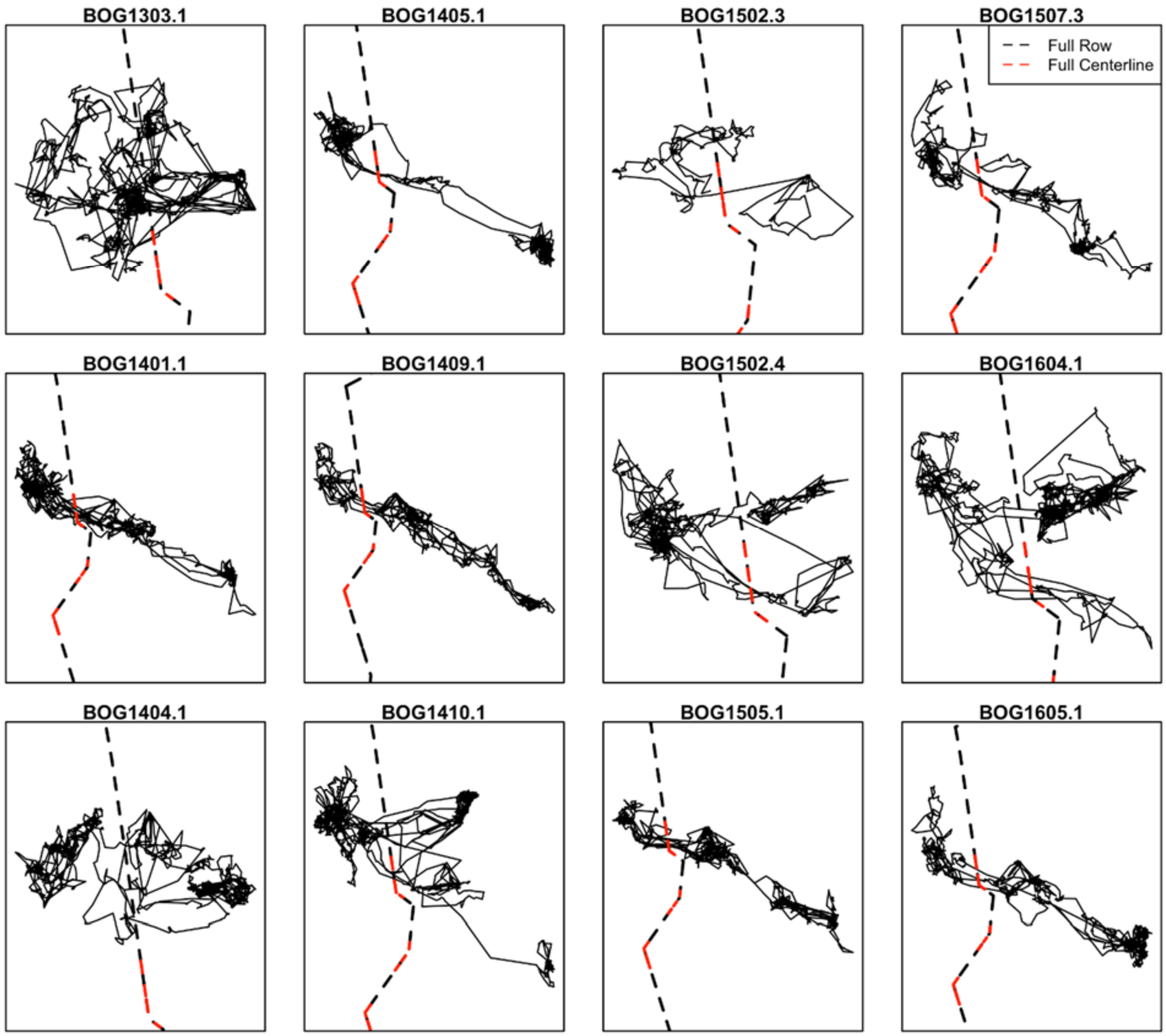

Figure 5-1-34: Movement Trajectories of Caribou in the Construction Phase using Mitigated Areas to Cross the Project ROW

This figure demonstrates that caribou were crossing the landscape in areas where mitigation was applied. Some caribou such as BOG1303.1 and BOG 1404.1 do not use the mitigated areas, but the remainder of the collared caribou do appear to prefer these narrower portions of the ROW when they decide to cross. Red lines are the mitigation portions of the ROW and black lines are the non-mitigated areas portions of the ROW.

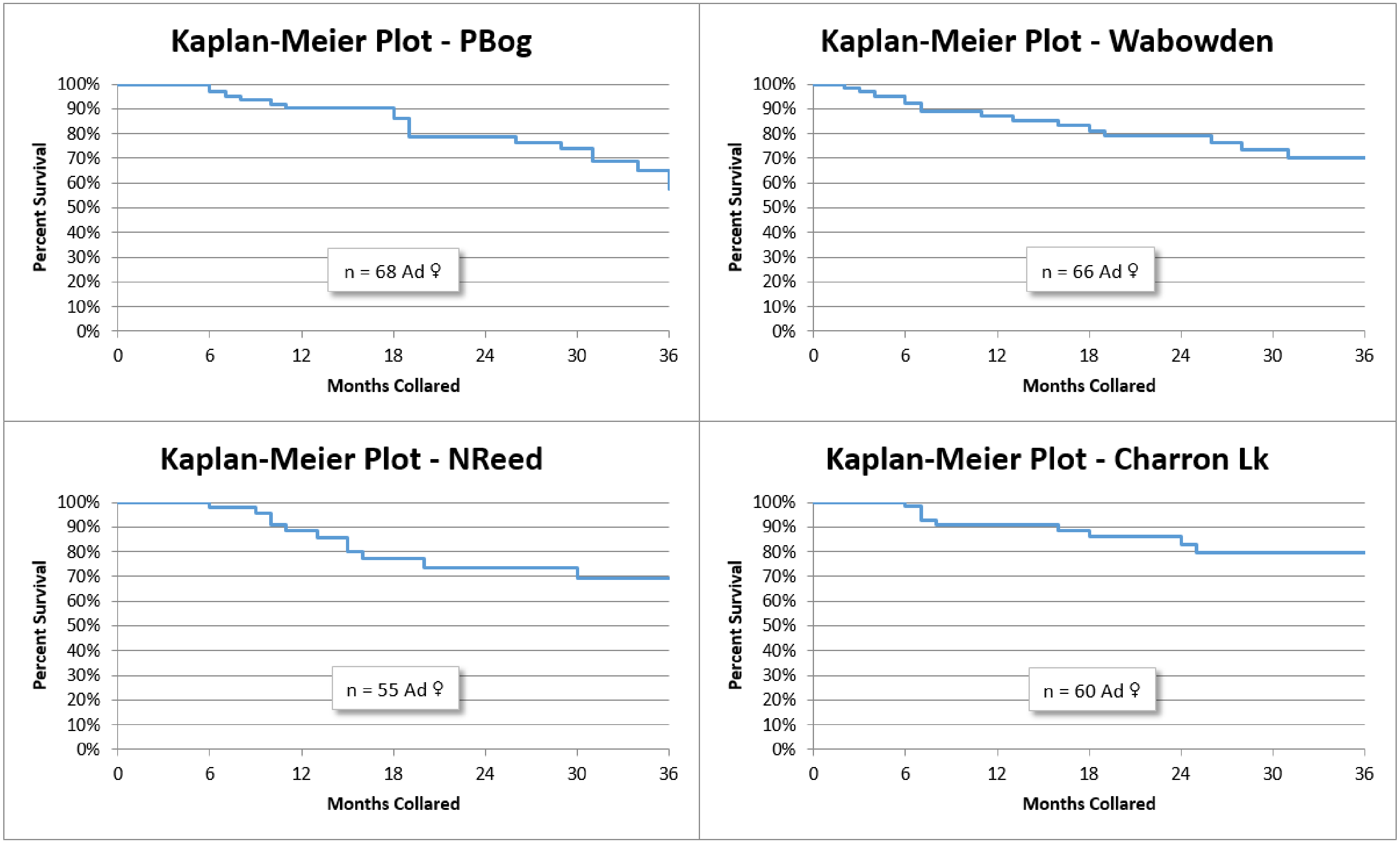

Figure 5-1-35: Kaplan-Meier Plots of Adult Female Woodland Caribou Monitored using GPS Telemetry Collars, February 2010 to September 2017

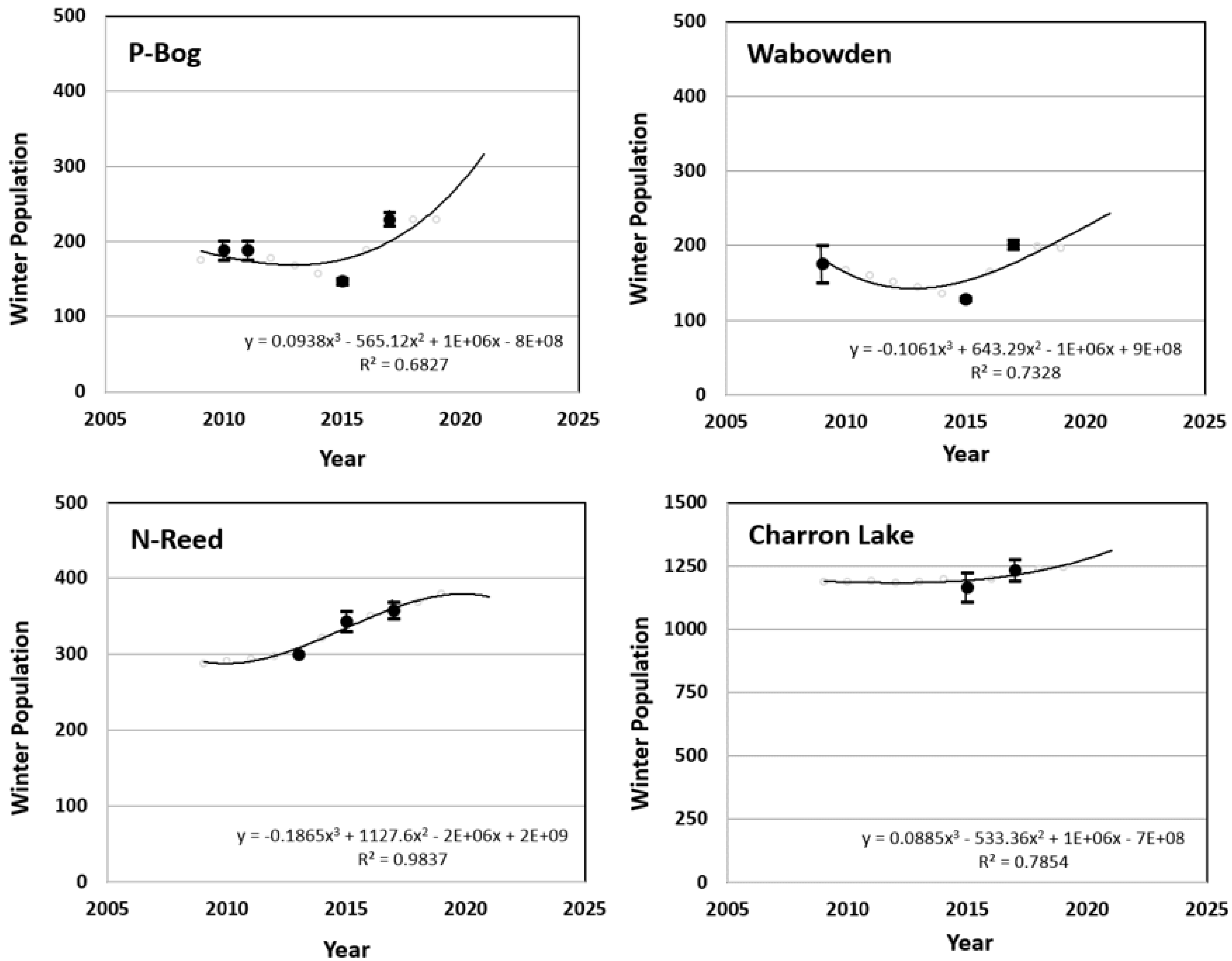

Figure 5-1-36: Preliminary Abundance Trend Models of Woodland Caribou based on Genetic Capture-Mark-Recapture (CMR) Genotyping Analyses and Historical Population Estimates, 2009 to 2017

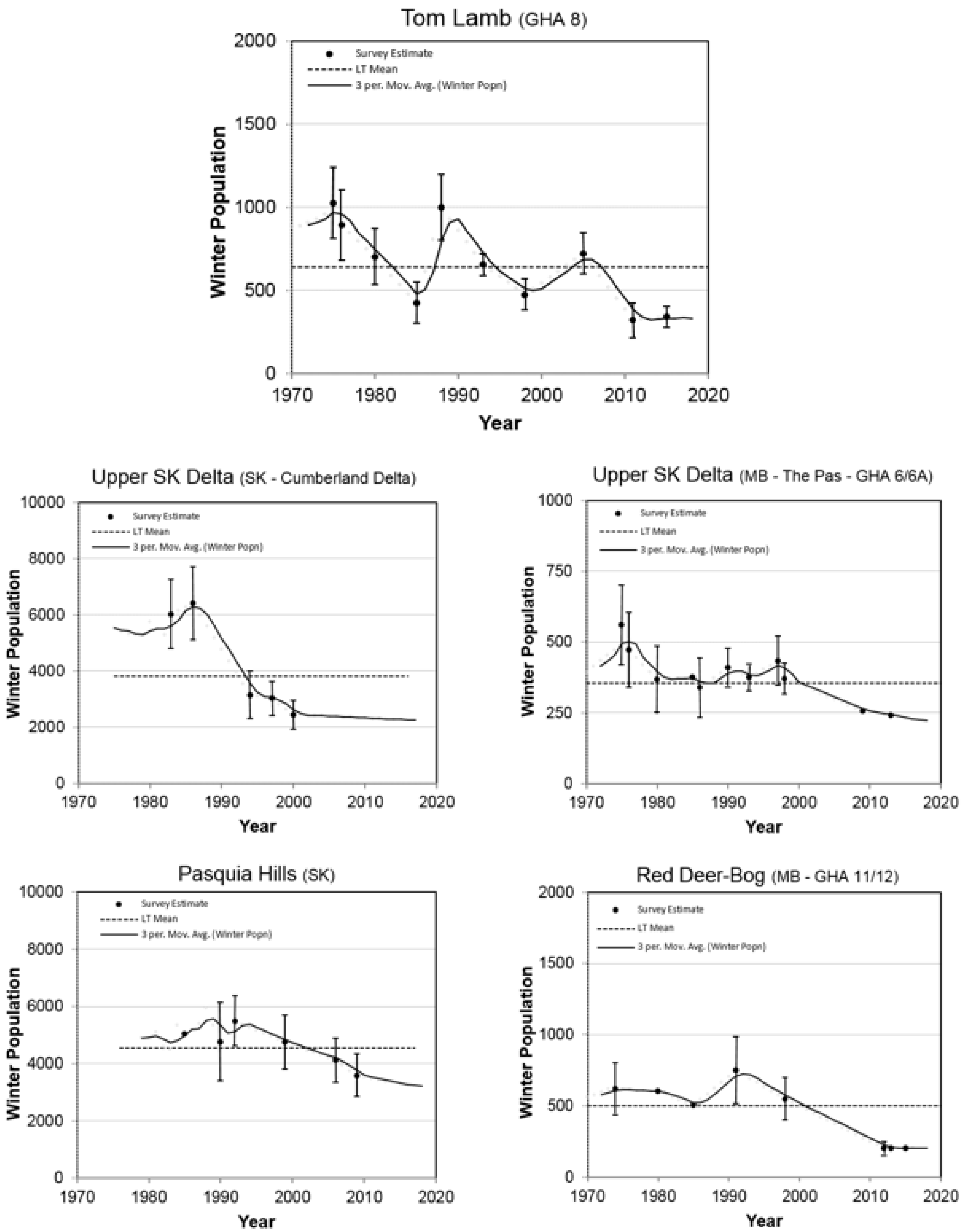

Figure 5-3-1: Tom Lamb/GHA8 Sensitive Moose Area and Reference Populations – Long term Abundance Trends

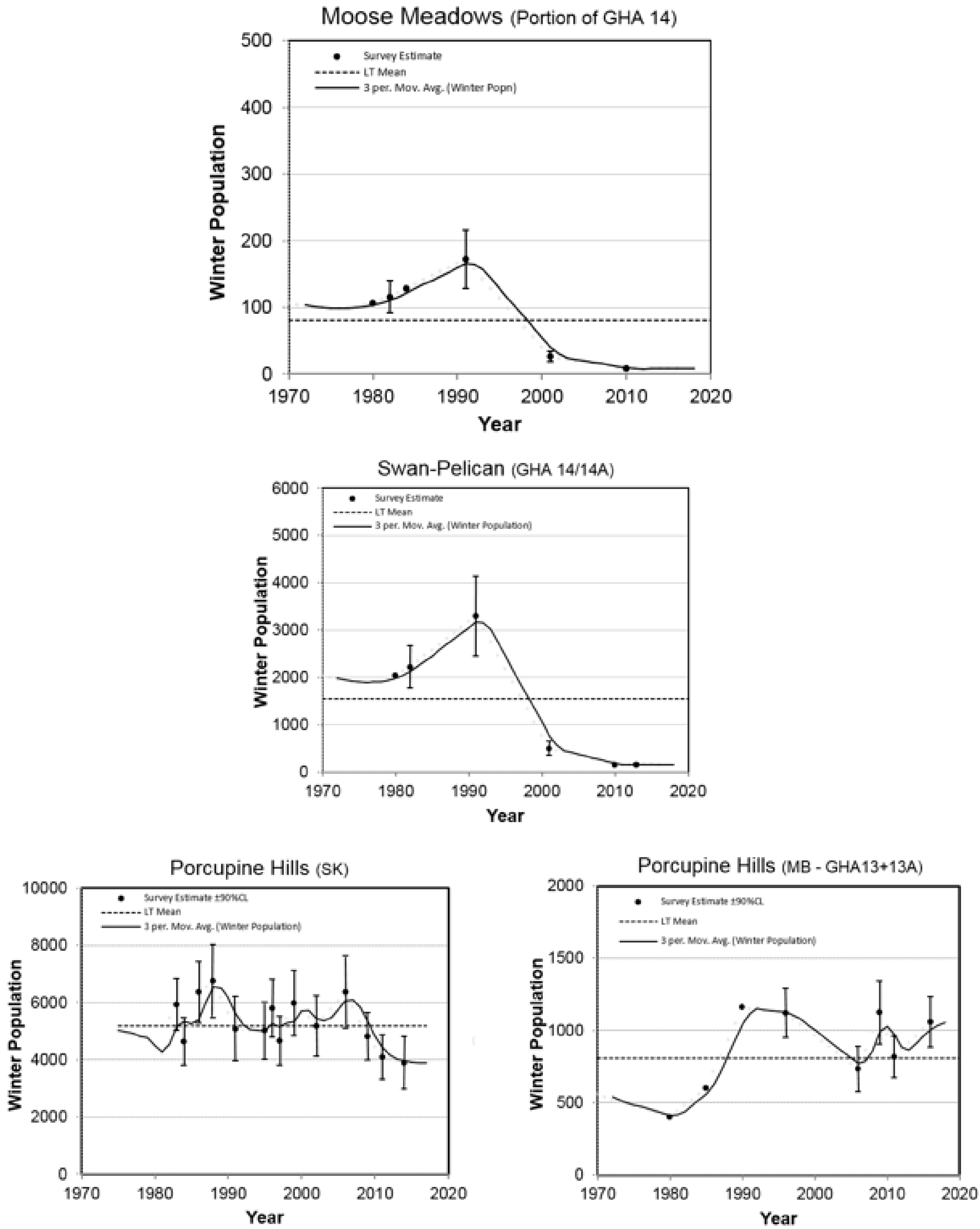

Figure 5-3-2: Moose Meadows Sensitive Moose Area and Reference Populations – Long Term Abundance Trends

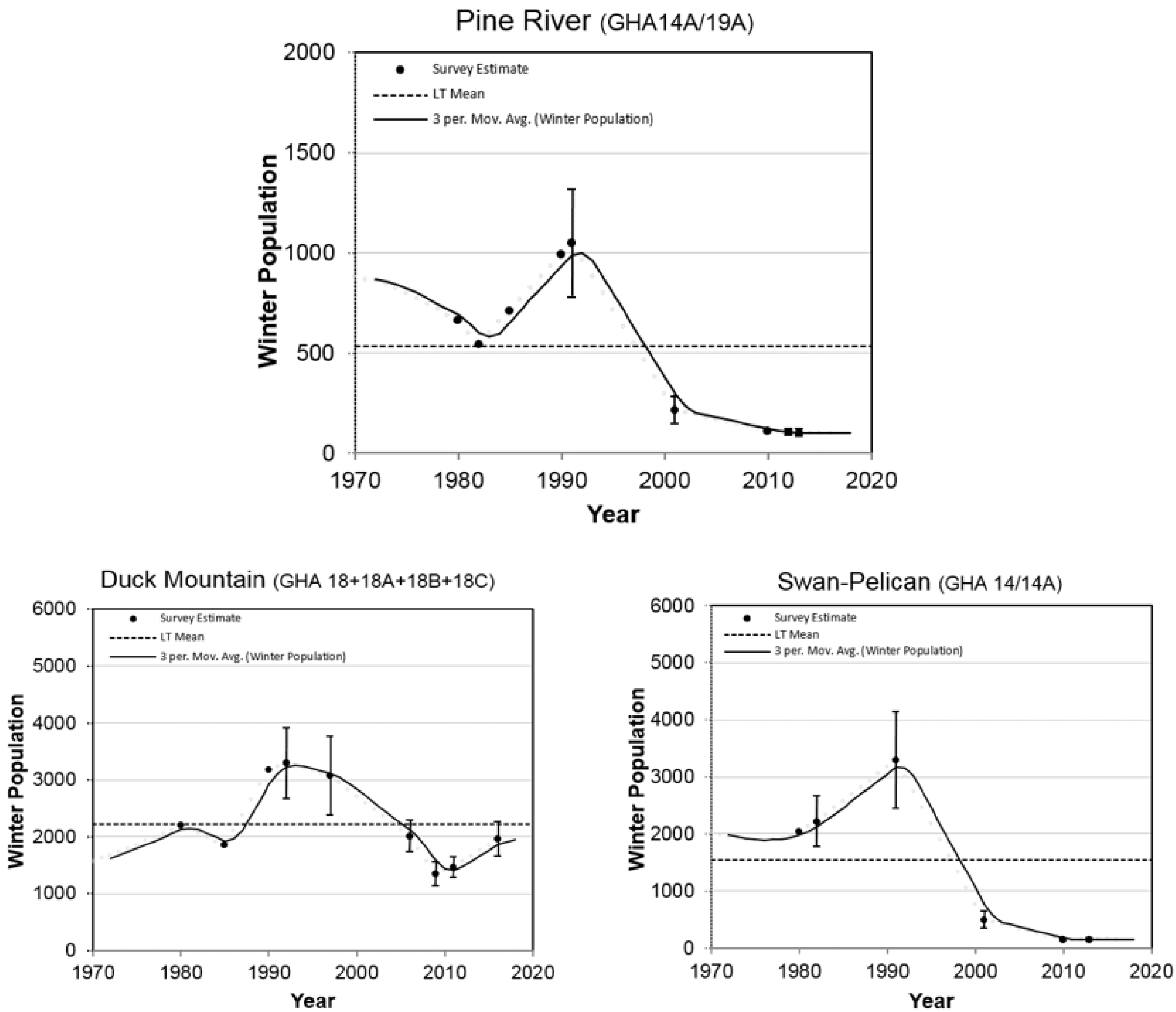

Figure 5-3-3: Pine River/GHA 14A/19A Sensitive Moose Area and Reference Populations – Long Term Abundance Trends