Reducing Wildlife Collisions: What is working in Northeastern Ontario

Andrew Healy, Environmental Planner, Ontario Ministry of Transportation
Kari E. Gunson, Road Ecologist, Eco-Kare International

Paper prepared for presentation
at the **Environmental Assessment and Protection – How We Got to Where We Are Today Session**

of the 2014 Conference of the
Transportation Association of Canada
Montreal, Quebec

Abstract

Wildlife/vehicle collisions pose a serious safety risk for motorists across Canada, and they are increasing annually. In Ontario alone, there are approximately 14 000 wildlife/vehicle collisions reported each year, with many more unreported. In Northeastern Ontario, wildlife collisions are even more frequent, and can account for as high as 50% of the total number of collisions along some highways. This paper describes the mitigation efforts on two major highways (Highways 11 and 69) over the past few decades. Prior to the last decade, wildlife collision reduction efforts in Ontario were primarily limited to installing wildlife warning signs and no discernable reduction in wildlife collisions was observed. In 2005, the Ontario Ministry of Transportation (MTO), Northeastern Region, commenced a more proactive approach to reducing wildlife/vehicle collisions by installing emerging mitigation methods such as crossing structures and fencing on both Highway 11 and 69. To date, the most extensive mitigation in Ontario is on Highway 69 between Parry Sound and Sudbury, where highway expansion and upgrades are currently being completed and one wildlife overpass, one underpass, twenty-seven one-way gates, two texas gates, and 10 km of fencing have been installed. In September 2011, mitigation effectiveness monitoring was initiated on this section of highway. Key results have shown that more species are using the wildlife overpass over time and that most animals, such as Moose and Deer prefer the wildlife overpass to the wildlife underpass. Preliminary data has shown a reduction in wildlife/vehicle collisions in the fenced section, and no Moose and Elk have breached the fencing system. Long-term monitoring is required to assess overall effectiveness of the crossing structure and fencing systems for all wildlife populations in the study area. Monitoring efforts are ongoing and are expected to produce additional results prior to the 2014 TAC Conference, such as an assessment of black bear population-level use of wildlife crossings through DNA analysis conducted on hair and scat samples.

Introduction

Wildlife/vehicle collisions pose a serious safety risk for motorists across Canada, and they are increasing annually. In Ontario alone, there are approximately 14 000 wildlife/vehicle collisions reported each year, with many more unreported. In Northeastern Ontario, wildlife collisions are even more frequent, and can account for as high as 50% of the total number of collisions along some highways. As Ontario's highway network expands and traffic volumes increase, the potential for wildlife/vehicle conflicts is increasing, as are the impacts of the highway system on wildlife populations and habitat.

Historically the Ontario Ministry of Transportation (MTO), Northeastern Region (NER) installed static wildlife signs as the primary means of reducing wildlife collisions. These static wildlife signs were prevalent throughout the region, and on some highways such as Highway 17 in Lake Superior Provincial Park signs were placed as frequent as every two kilometres. The other main strategy that was employed was periodic public education campaigns.

In 2005, the MTO, NER, commenced a more proactive approach to reducing wildlife/vehicle collisions by trialing emerging and effective mitigation methods that were being employed in Europe and western North America. Since that time, MTO has installed dozens of kilometers of wildlife exclusion fencing, constructed the province's first wildlife overpass and underpasses, installed three different wildlife/detection systems, and trialed various other collision mitigation strategies.

The most extensive example of new methods to mitigate wildlife collisions in Ontario is evident along Highway 69 between Parry Sound and Sudbury, where upgrading from two to four lanes is ongoing. These measures include one wildlife overpass, one wildlife underpass, one creek bridge pathway, ten kilometres of wildlife fencing, twenty seven one-way gates, two texas gates at highway interchanges along Highway 69 from Makynen Bridge to Lovering Creek Bridge (see figure 2). Since 201, the MTO has been monitoring the effectiveness of the mitigation strategy on Highway 69.

This paper will examine the transition of mitigation strategies employed by the MTO over the past few decades, with a focus on two major highways, 11 and 69. It will then focus on the key monitoring results that have currently been compiled for mitigation effectiveness on Highway 69.

Wildlife Collision Mitigation Then and Now: A Tale of Two Highways

An excellent example of how wildlife collision mitigation has evolved can be found in Northeastern Ontario, by comparing the expansion of Highway 11 with the expansion of Highway 69. Both Highway 11 and 69 are important transportation corridors linking northern and southern Ontario, and have been government priorities to upgrade from two to four lanes in recent decades (Figure 1).

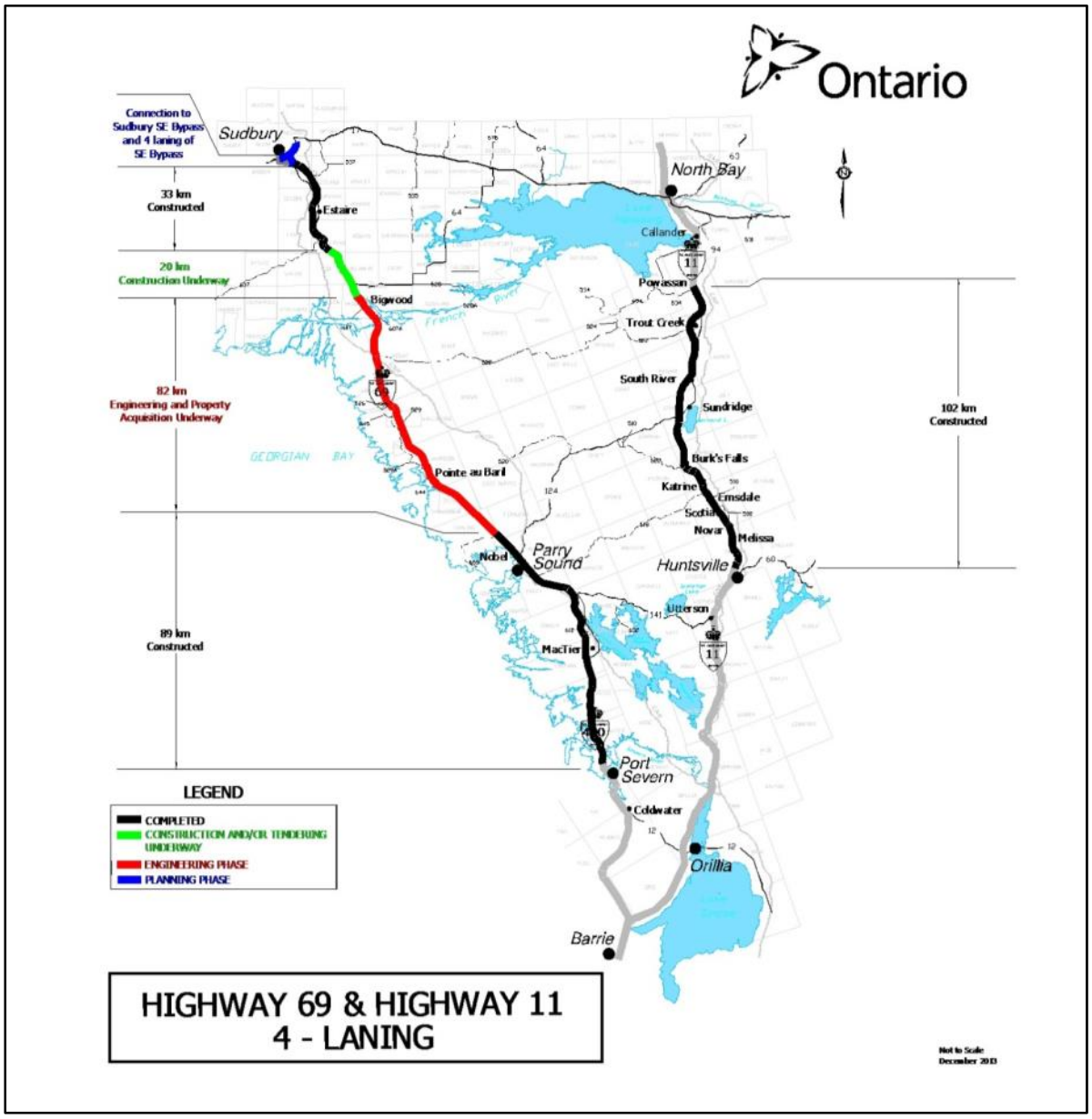


Figure 1. Key map showing Highway 69 between Parry Sound and Sudbury and Highway 11 between Huntsville and North Bay.

Highway 11

Four-laning of the remaining sections of Highway 11 between Huntsville and North Bay commenced in 1994, following route planning and environmental assessments (EA) done in the early 1990's (Figure 1). Wildlife collision hotspots were prominent along the highway, and while wildlife habitat areas were noted during the design, there was no discussion or implementation of wildlife collision mitigation other than installing static wildlife warning signs at collision hot spots (Photo 1).

Wildlife warning signs are known to be temporary measures and their effectiveness at reducing collisions is largely unknown or not effective at all. From 2000 to 2010 there were over a thousand wildlife collisions between Huntsville and North Bay, approximately 130 km of highway, with some hot spots experiencing as high as 3.1 collisions/km/year. In 2005, a new "enhanced" larger wildlife warning sign was installed at five hot spot locations on Highway 11 (Photo 2). Preliminary results showed that collisions increased from 110 to 127 when comparing frequency of collisions three years before and after the signs were installed.

Photo 1. Static warning sign, K. Gunson

Photo 2. Enhanced warning sign, MTO

Additional mitigation measures have been installed along Highway 11 in recent years. In 2006, MTO installed wildlife exclusion fence, which served as a trial project for larger scale mitigation efforts that were in the planning stage for Highway 69. Other hotspot areas were fenced in 2011 and 2012 and a wildlife underpass was completed in 2013. Installing wildlife fencing at an existing highway (retro-fit) has proven to be challenging, as issues such as property, utilities, at-grade entrances and end treatments are easier to deal with during the design and construction phases for a new highway.

Perhaps the greatest challenge when retro-fitting wildlife fencing on existing highways, is finding locations where wildlife can cross the road, e.g. existing underpass. Without wildlife crossing opportunities there is an increased risk of wildlife/vehicle collisions at fence ends. This concern was realized on Highway 11, which has only seen a 50% reduction of wildlife collisions in the first five years since it was constructed.

Another big challenge when implementing wildlife mitigation on existing highways is finding available funding. Fencing costs are considerable, especially in northern Ontario, at approximately one million dollars to fence a five kilometre hotspot. It is much easier to fund the mitigation when it is tied directly to the construction of a physical asset, and is only a fraction of the total project cost.

Highway 69

On June 28, 2005, it was officially confirmed that Highway 69 would be four-laned from Parry Sound north to Sudbury. Highway 69 had historically experienced higher than average rates of wildlife collisions, and while rates weren't as high as on Highway 11, moose collisions were more prevalent which account for higher rates of injury and fatality (1).

Around this time, monitoring results for the extensive mitigation measures in Banff National Park (2,3) had demonstrated the success of wildlife crossings and fencing at reducing wildlife collisions and maintaining habitat connectivity. Transportation planners, regulatory agencies as well as the general public were taking notice and there was mounting pressure to seriously address the wildlife collision problem in environmental assessment studies for Highway 69. In 2008, the first contract that included wide-scale wildlife mitigation was issued for construction. This 10 km section from approximately Nelson Road to Highway 637 included approximately 3 km of highway twinning and 7 km of new highway alignment and was opened to traffic in the summer of 2012 (Figure 2).

Wildlife mitigation measures along the newly constructed highway included (Figure 2):

- One 30 m wide wildlife bridge(wildlife overpass);
- One large wildlife underpass (twin 5m x 5m culverts);
- One wildlife creek-bridge pathway under the Lovering Creek bridge;
- Two wetland underpasses for smaller animals and herpetofauna (2.4m x 3.0m box culverts)
- Twenty total kilometers of wildlife exclusion fencing;
- Twenty seven one-way escape gates for potentially trapped animals; and
- Two ungulate gates (Texas gates) at the Highway 637 and Highway 69 intersections.

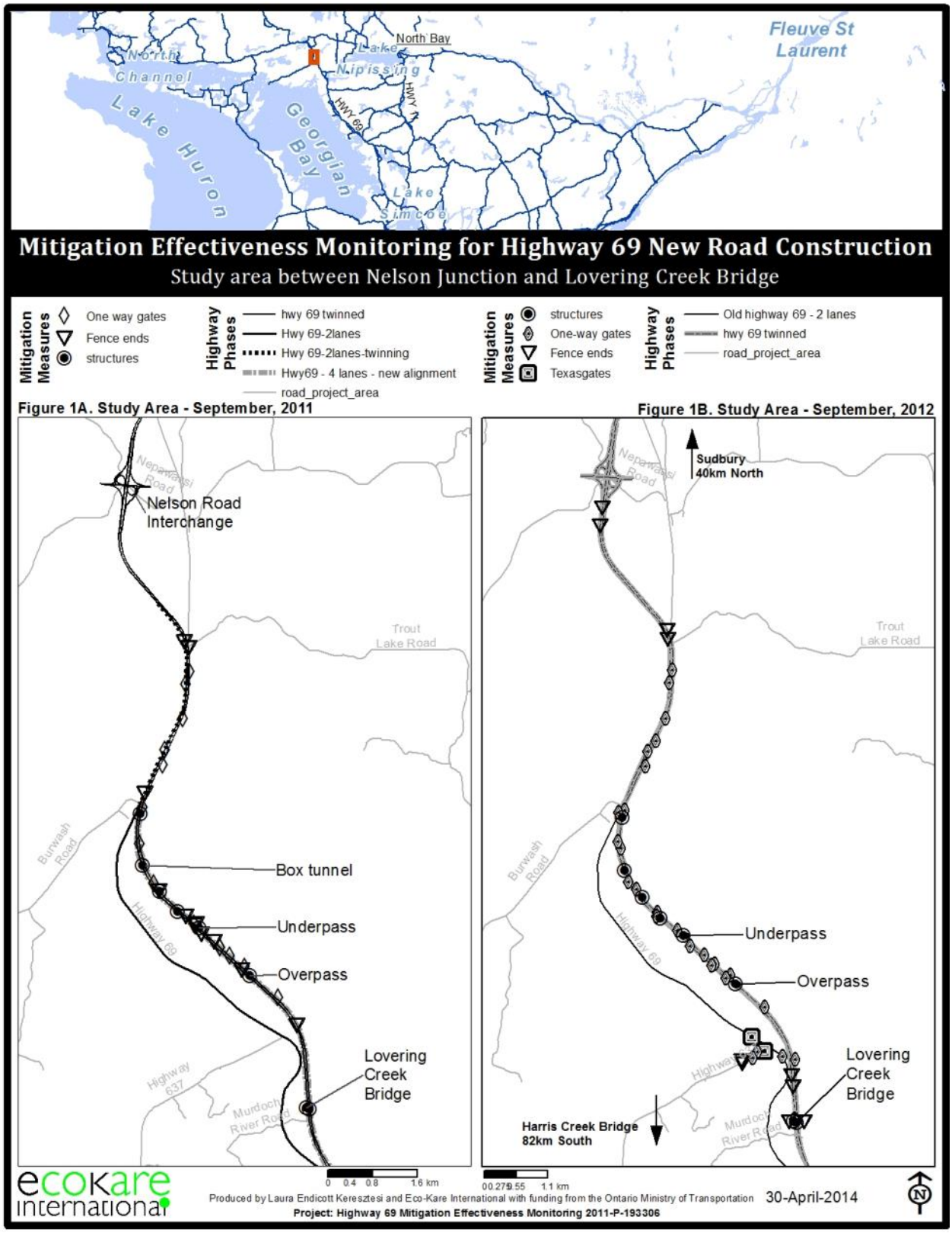


Figure 2. Map of study area showing mitigation measures and highway construction from 2011 to 2012.

Wildlife Monitoring Results for Highway 69

In 2011, The Ontario Ministry of Transportation retained Eco-Kare International to undertake effectiveness monitoring of the mitigation measures installed on Highway 69 from September 2011 to September 2014. The remainder of the paper summarizes the first two years of monitoring results (4). Monitoring is expected to continue for a minimum of five years post construction.

All data collections used non-invasive survey methods to evaluate wildlife behaviour, interactions and movements in relation to specific mitigation measures and the road (5). The main method for data collection was the use of thirty Reconyx infrared motion detected cameras placed throughout the study area. Camera data was supplemented with any additional or new interactions from species-specific tracks in sand or snow, pellets and scat, or live wildlife sightings. This data was collected when conducting systematic snow tracking surveys on transects or opportunistically during monthly routine camera data collections.

There are currently 3097 independent animal interactions with the mitigation measures captured by the cameras and an additional 136 additional interactions recorded from tracking methods. Deer activity has been captured the most (57%) followed by Red Fox (11%), Moose (10%), Black Bear (8%), Coyote and Elk (4% each), and Wolves (1%).

Wildlife Overpass

Deer continue to use the overpass the most with over 500 documented approach and passages (Figure 3). Moose and Red Fox use are about equal with approximately 50 documented encounters. Black Bear have also used the overpass over 30 times followed by Coyote (9 times), Wolves and Rabbit (4 times) and Bobcat (2 times). Passage rate is high (> 80%) for all species indicating that the animals are adapting well to using the structure when encountered (Photos 3 & 4).

Photo 3. Wildlife overpass

Photo 4. Moose on overpass

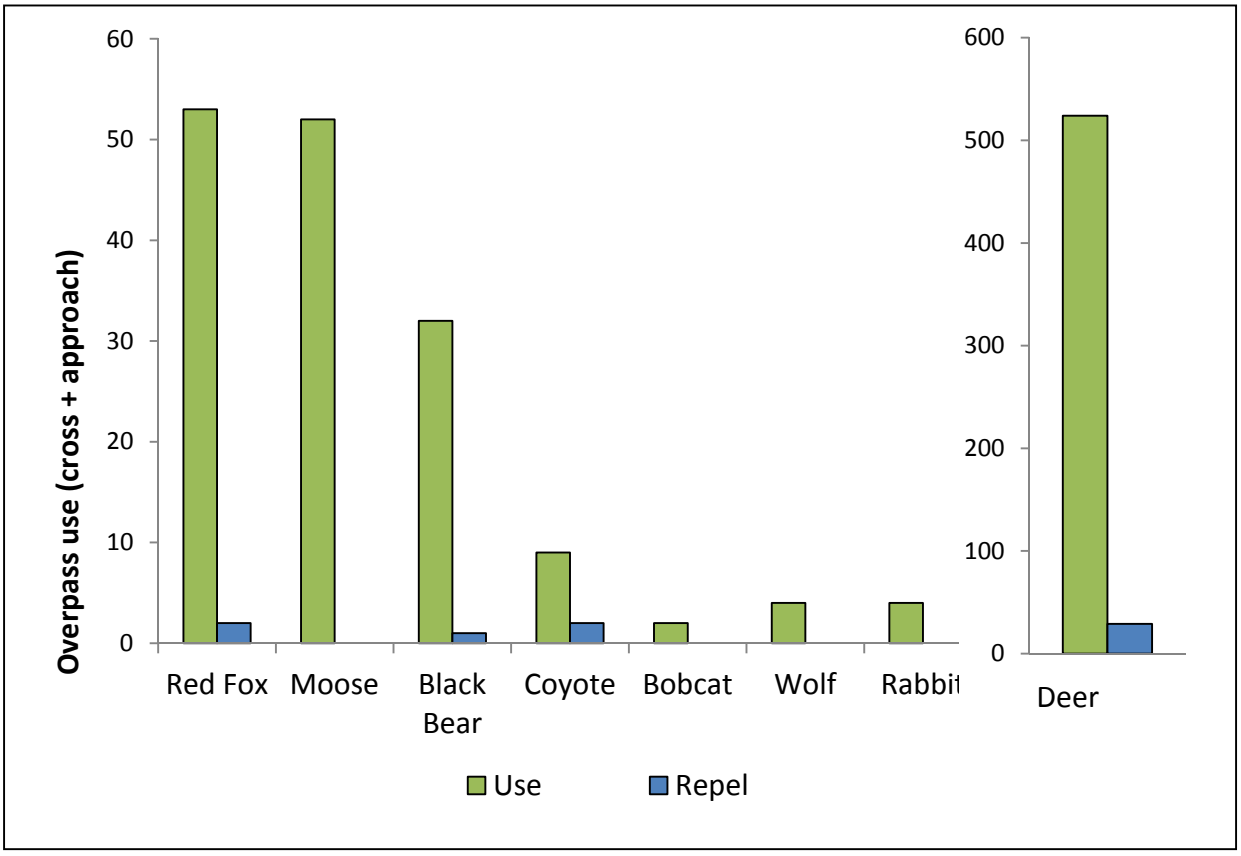


Figure 3. Summary of wildlife use (cross + approach) and repels at the overpass from Sep 5th 2011 to Mar 5th, 2014.

Time of day use of overpass

There is now over one year of post construction data (Sep 2012 to Mar 2014) to assess temporal trends, since the highway mitigation was completed and opened to traffic

(post-construction). Post-construction data was used for both the time of day (night and day), and seasonal comparison summaries. To calculate when ungulates used the overpass, the time an animal was documented on the crossing was rounded to the nearest 15 minute interval. Each event was then classified as night or day based on the sunrise and sunset for that day of the year.

Figure 4 shows that both Deer and Moose tend to use the overpass more at night, 60% and 70% of all crossings respectively. This finding is different than what was recorded at the overpass in Banff National Park. After five years of monitoring the Banff research found that 63% of the ungulate (Elk and Deer) use at the overpass occurred during the day (3).

If indeed the overpass is functional in the sense that they provide a safe movement corridor for animals across the road, then it is expected that the temporal use of the overpass would be similar to their normal daily activity patterns. Ungulates are typically diurnal species (6), and more long-term monitoring will be needed to assess whether ungulates will adjust to using the overpass during normal activity periods (3).

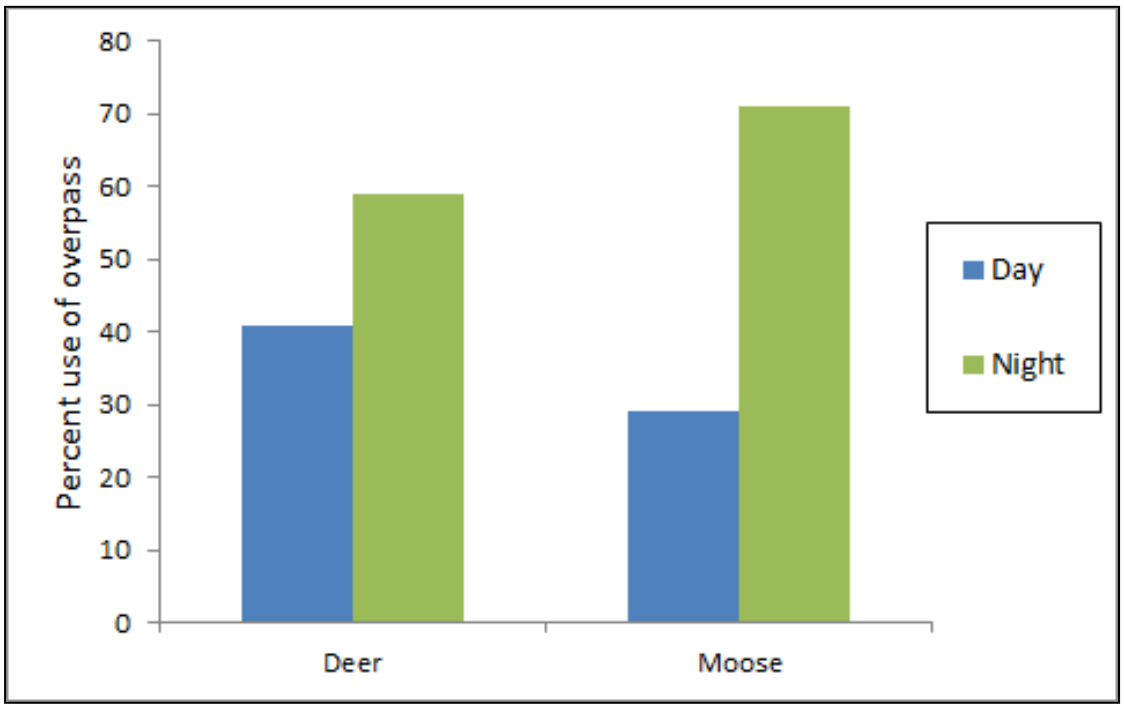


Figure 4. A comparison of night and day use of the overpass by Moose and Deer

Seasonal use of overpass

Post-construction data was summarized to assess seasonal differences in animal use of the wildlife overpass. Season was delineated by assigning an equal number of months

for each season; winter (December, January, February), spring (March, April, May), summer (June, July, August) and fall (September, October, November). Frequency of use was summed for each season for one full year of data from Sep 2012 to Sep 2013. In addition, there are 2 years of data for winter (2012-2013; 2013-2014) and fall (2012, 2013) allowing for a comparison of these 2 seasons between years.

Animal use (Deer, Moose, Black Bear, Coyote, and Red Fox) at the overpass differed between seasons (Figure 5). Wildlife activity on the overpass peaked during the fall and was largely driven by Deer activity. In all seasons,393 Deer were the most common species to use the overpass representing 60%, 83%, 93% and 91% of animal crossings for spring, summer, fall and winter respectively (Figure 3). Moose used the overpass more frequently in spring. Bears used the structure on four occasions in the fall of 2012, but not in the spring of 2013, then again on four occasions in the summer of 2013. During the first year of monitoring Deer, Moose and Fox were recorded on the overpass during all four seasons and Coyote and Black Bear were not recorded in the fall and spring respectively (Figure 5).

It is expected that Deer use of the overpass would occur in the fall months when animals are moving during the rutt and hunting seasons (7). However, sample size is still very low for seasonal comparisons with the other species.

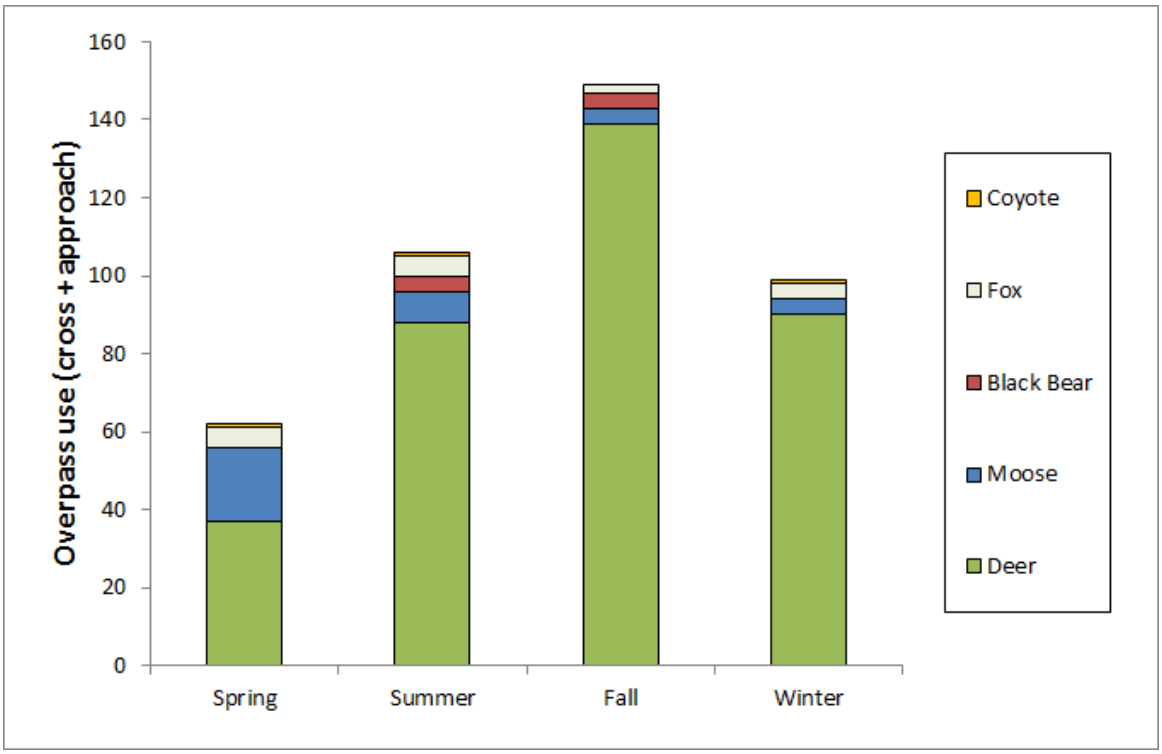


Figure 5. Summary of animal use by species at the overpass for the first full year of monitoring post construction from Sep 2012 to Sep 2013

A complete dataset exists for two fall seasons (2012 and 2013) and for two winter seasons (2012/2013 and 2013/2014). Annual trends of overpass crossing use can be assessed by comparing the same season between years. The number of animals crossing the wildlife overpass was higher in fall 2012 (154) compared to fall 2013 (132) (Figure 6). This decrease in crossings however is attributed solely to the marked reduction in Deer crossings. Deer crossings decreased from 139 to 93 in fall 2012 compared to fall 2013. Coyote, Raccoon, and Rabbit were three new species documented on the overpass in 2013 (Figure 4). Excluding Deer and Wild Turkey, every species increased in crossing frequency from fall 2012 to fall 2013 (Figure 6). The number of Black Bears that used the overpass increased drastically from four in fall 2012 to 21 in fall 2013 while Moose increased slightly from four to six.

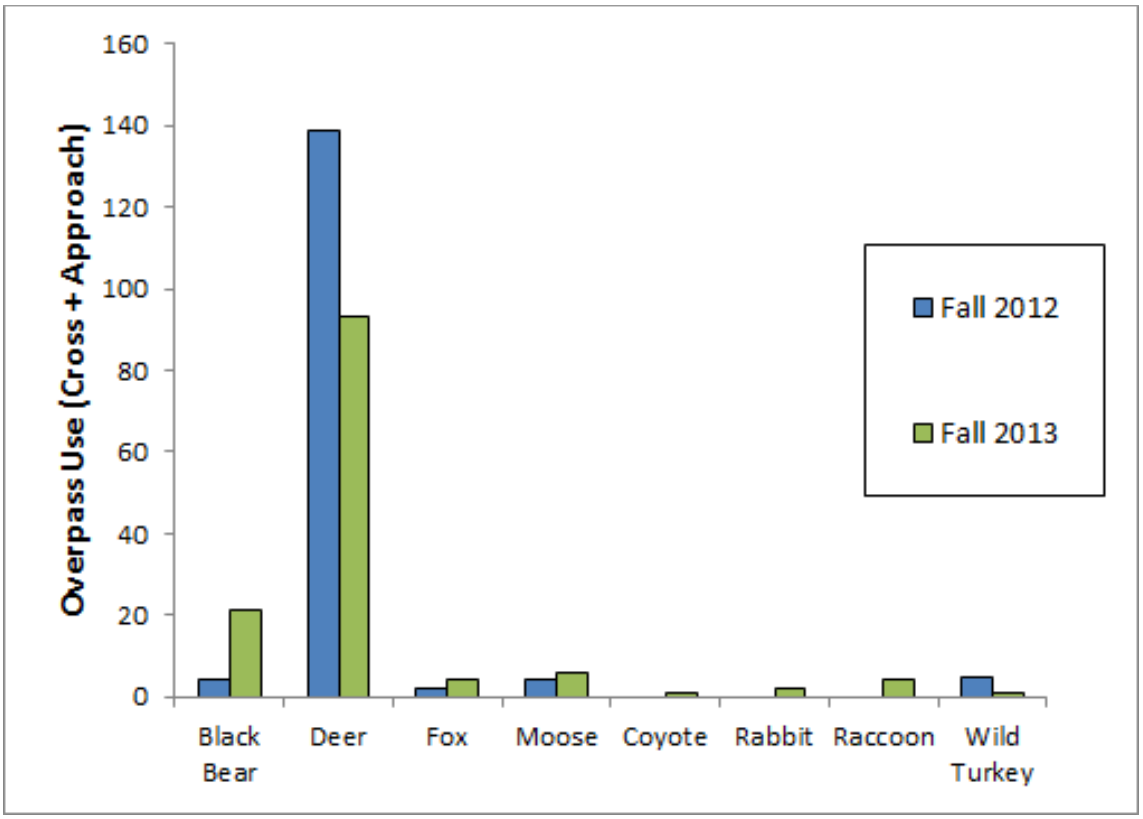


Figure 6. Summary of species use at the overpass during the fall in 2012 and in 2013.

Similar to fall, there was a significant reduction in wildlife use at the overpass from 99 in winter 2012/2013 to 40 in winter 2013/2014 (Figure 7). This is largely attributed to fewer Deer on the overpass from 90 to 17 counts. Wolves and Rabbits were two new species that used the overpass in the winter of 2013/2014.

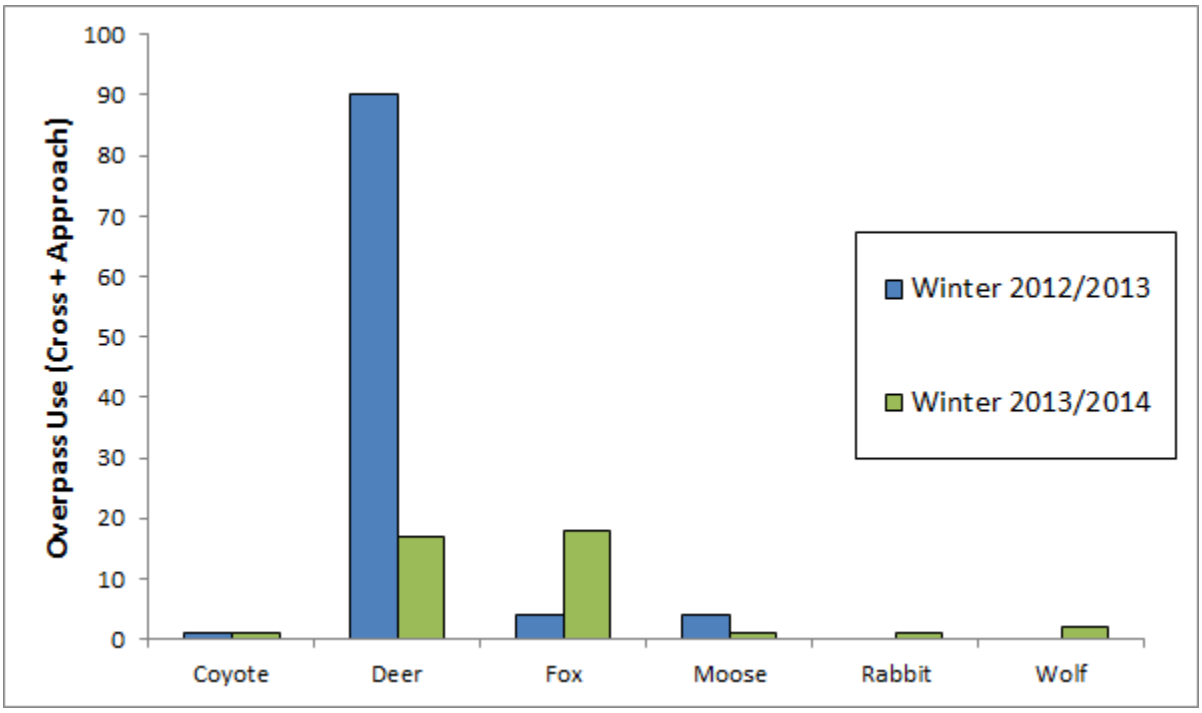


Figure 7. Summary of species use at the overpass during the winter 2012/2013 and winter 2013/2014.

The number of species and frequency of use on the overpass is changing over time emphasizing the need for long-term use to understand and evaluate these changes such as being done with the long-term monitoring project in Banff National Park (6). Frequency of species use increased for all species but Deer and this was most noticeable for Black Bear. The decrease in Deer crossings from 2012 to 2013 for both fall and winter may likely reflect changes in Deer population numbers and survival. Deer use peaked in fall 2012, when the previous 2011/2012 winter was relatively mild and short, i.e., Burwash was snow free by early March 2012. Deer use declined in the fall 2013, which followed a relatively severe winter and Burwash was not snow free until mid to late April. Deer are not adapted to severe winters and winter severity can influence white tailed deer population dynamics (7).

Wildlife Underpass

At the wildlife underpass use was summed for all approach and confirmed crossings (Photos 5 & 6). Over the quarterly monitoring period (Dec 2013 to Feb 2014) ungulates were active at the underpass during Dec 2013, and all animal activity was minimal in Jan and Feb 2014 with only one Moose crossing. Deer and Moose have not used the structure (repels) more than they have used the structure (Figure 8) when encountered,

i.e. passage rates are 46% and 47% respectively. Black Bear passage rate is 86% and Red Fox and Coyote use the structure all the time when encountered (Figure 8).

Photo 5. Wildlife underpass

Photo 6. Moose using underpass

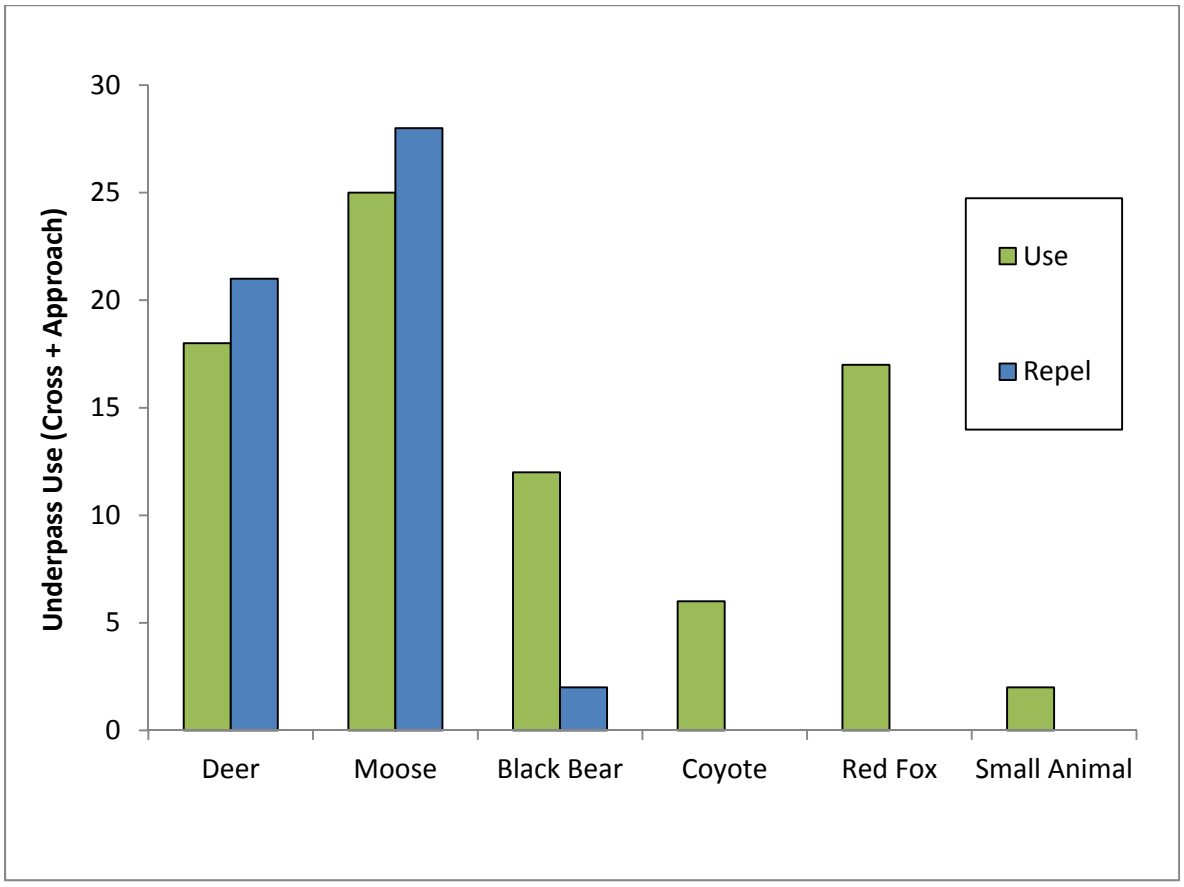


Figure 8. Summary of wildlife use (cross + approach) and repels at the underpass from September 5th 2011 to March 5th, 2014.

Lovering Creek Bridge

All approaches and confirmed crossings were summed to present animal use at Lovering Creek bridge. Wildlife activity and species use has steadily increased at Lovering Creek bridge and first time use by three Wolves was documented during the monitoring period. Red Fox and Coyote use was also noticeably higher during the monitoring period (Figure 8). For the large animals Deer and Black Bear have used the structure seven times each and four Moose have been documented on the east approach (Figure 9).

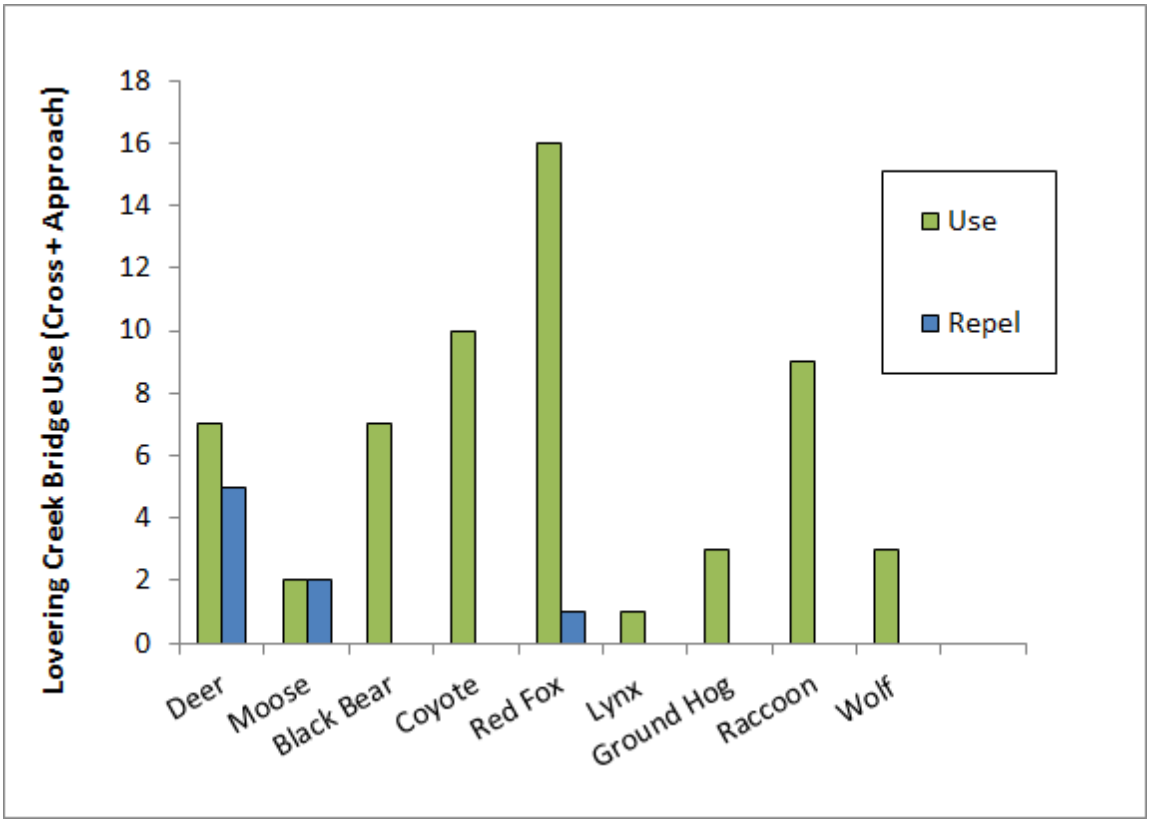
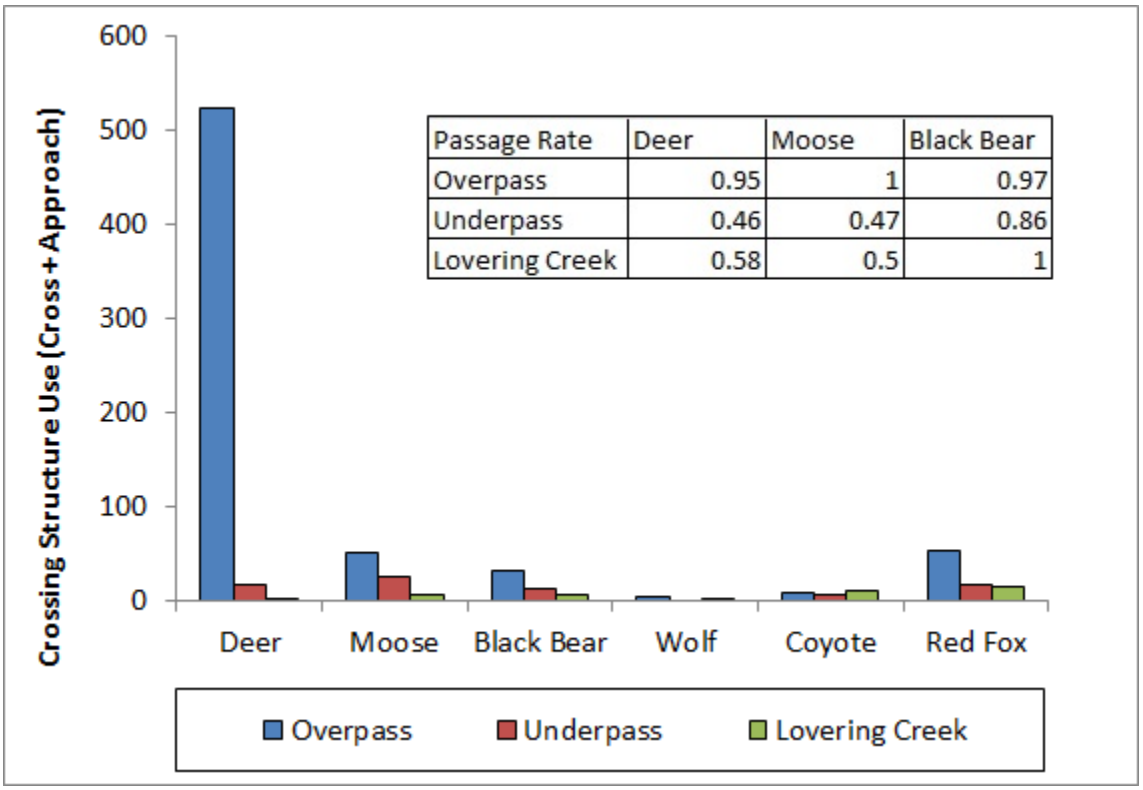


Figure 9. Summary of wildlife use (passage + approach) and repels at Lovering Creek Bridgefrom September 5th 2011 to December 3rd 2013.

Crossing structure comparison

When comparing species-specific use at all three crossing structures use is highest for Deer, Moose, Black Bear and Red Fox at the overpass (Figure 10). Passage rates for both Deer and Moose at both the underpass and Lovering Creek bridge are considerably lower (46-58%) than at the overpass (95-100%). Black Bears tend to use all three structures once encountered and passage rates vary from 86% to 100%. Canid use is consistently low at all three structures so it is not yet known if they prefer one structure to another.



Passage Rate	Deer	Moose	Black Bear
Overpass	0.95	1	0.97
Underpass	0.46	0.47	0.86
Lovering Creek	0.58	0.5	1

Figure 10. Species-specific use at the three crossings with passage rates for Deer, Moose, and Black Bears.

One-way gates & Fencing

All animal approach and repels were summed together as an approach, and compared to the number of passages through the one-way gates (Figure 11; Photos 5 & 6). To date four Deer and three Black Bear have been documented using the one-way gates to move from the road-side to the safe-side of the fence. Not surprisingly several smaller animals (Red Fox and Rabbits) regularly use the gates to go back and forth between the road-side and the safe-side of the fence (Figure 11). There have been 138 combined approaches and repels at the one-way gates by Deer and the likelihood of more usage is anticipated because Deer continually notice the gates but are hesitant to push through.

Photo 5. One-way gate

Photo 6. Black bear using one-way gate

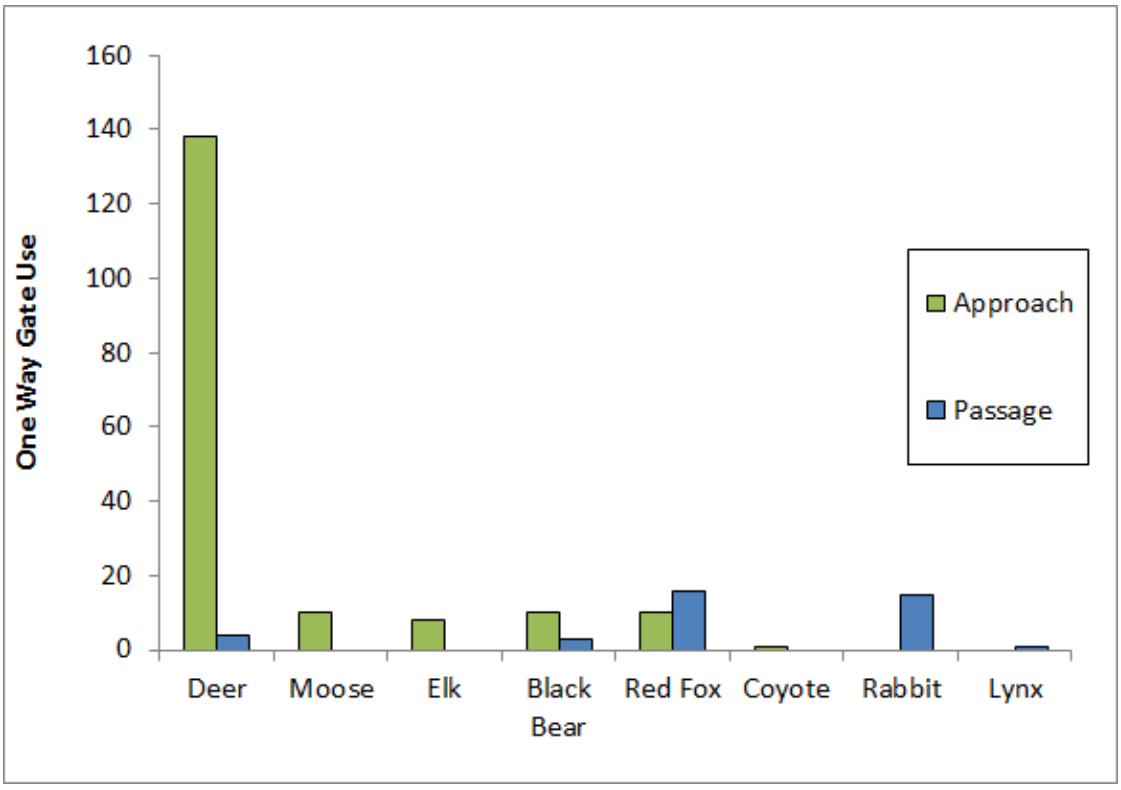


Figure 11. Summary of wildlife approach and passages at the one-way gates from Sep 2011 to March 2014.

Since October 31st 2012, when the fence was complete there have been 33 independent breaches (animals documented road-side) of the fence by Deer. There have been eight breaches by Black Bear documented near the south and north fence ends as well as near the overpass. No fence breaches have been observed for Moose or Elk since the mitigation was complete.

Texas Gates

On Oct 8th, 2013, two cameras were placed at the texas gates. To date, two Wolves and two Black Bears have been documented crossing the gates, and in the last monitoring period a Deer was documented jumping the gate at Burwash Road. Two wolves have also approached the gate and did not cross.

Mitigation Effectiveness-Wildlife Road Mortality

To measure the reduction in wildlife/vehicle collisions before and after the fencing, the frequency of collisions in the unfenced and fenced highway segments (Trout Lake Road to Lovering Creek bridge) were examined using two datasets detailed in Table 1.

Table 1 A summary of wildlife road mortality data sets collected along Highway 69 used to assess pre and post mitigation effectiveness

Data set holder	How collected	Data description	Limitations
1) Ontario Provincial Police (OPP); Road User Safety (RUS) division (crash data)	OPP personnel file a crash report (over $1,000 damage) and describe location to the nearest land mark or side road that is then referenced to a provincial linear highway referencing system by the MTO	Data received in shapefile for all of Ontario from Traffic Safety Office (Zoe Lam) from Jan 01 2001 to Dec 03 2010; all provincial highways	-Not species specific -Spatial accuracy varies from 516 ± 808 m (Gunson et al. 2011) -2001-2010 -Sampling effort more consistent
2) Eco-Kare International; research project with MTO (2011-P-193306) (project-specific data)	Research team (Eco-Kare, Laurentian and Cambrian students and professors) document and record carcass location with GPS found while conducting research or when commuting to and from work; MTO also reports findings to the research team	Data collected from Oct. 2011 to current on highway 69 between Harris River Bridgeand Sudbury	-2011 to present -Opportunistic; however most likely best reporting of the three data sets available for the time period

Two datasets were used because the OPP data is not yet available for 2011 to 2014. From Trout Lake Road to Lovering Lake Road, there were 78 wildlife/vehicle collisions (wvc) between 2000 and 2010. This accounts for on average 7.8 collisions per year, or also 0.83 wvc/km/year (dataset 1, Table 1). In the first full year of monitoring (dataset 2; Table 1), there were 3 wildlife carcasses found within the fenced area (2 deer and 1 black bear). It is unknown if these incidents were reported to the OPP and if a collision record was generated. If assuming all three incidents were reported, this would represent a 62% reduction in collisions for the first year. There has been no wildlife carcasses found in the fenced area since October 2013, which makes it likely that the mitigation's effectiveness will increase in subsequent years. Additionally, no Moose or Elk have been documented breaching the wildlife fence, suggesting the mitigation is effective for larger ungulates, which pose the largest safety hazard for motorists.

Conclusions

Preliminary monitoring has shown the effectiveness of the crossing structure and fencing system and the importance of long-term monitoring. Lessons learned can be applied to ongoing highway expansions and retro-fits on MTO highways.

Even with only two years of monitoring assessments of wildlife preferences of crossing structures and temporal changes in use have been documented. Passage rates are highest for Deer, Moose and Black Bear at the overpass vs. the other crossings structures, and this may change as wildlife habituate to the crossings. There was a significant drop in ungulate movement and use of the crossing structures in the 2013/2014 fall and winter seasons most likely due to high snow depth; and also possibly because Deer population numbers have declined from increasingly harsher winters throughout the monitoring period. Time of day (night vs. day) overpass crossing use analyses have shown ungulates use the overpass and underpass more at night and this suggests that movements across Highway 69 are not yet part of normal daily activities.

Wildlife collision reduction analyses are still very preliminary when considering all wildlife species. However, the data shows that the mitigation system is effective at excluding Moose and Elk from the highway as there have been no wildlife/vehicle collisions, or breaches along the fenced section since the highway was opened to traffic. Furthermore, Moose regularly use the overpass to cross the highway. These results are promising from both a traffic safety and connectivity perspective, and warrants investment in effective wildlife mitigation planning.

References

1 –Mountrakis, G. and Gunson, K.E. 2009. Multi-scale spatiotemporal analyses of moose-vehicle collisions: a case study in northern Vermont. International Journal of Geographical Information Science 23:1389-1412.

2.-. Eco-Kare International. 2014. Effectiveness monitoring of large mammal collision mitigation measures on Highway 69 between Sudbury and Parry Sound. Progress Report 9 submitted to the Ontario Ministry of Transportation, St. Catharines, Ontario.

3 - Clevenger, A.P., Chruszcz, B., Gunson, K., and Wierzchowski, J. 2002. Roads and wildlife in the Canadian Rocky Mountain Parks - Movements, mortality and mitigation. Final report to Parks Canada. Banff, Alberta, Canada.

4 - Clevenger, A. P., A. T. Ford and M. A. Sawaya. 2009. Banff wildlife crossings project: Integrating science and education in restoring population connectivity across transportation corridors. Final report to Parks Canada Agency, Radium Hot Springs, British Columbia, Canada. 165pp.

5 - Chapman, J.A. and Feldhamer, G.A. 1982. Wild mammals of North American biology, management and economics. John Hopkins University Press, Baltimore, Maryland.

6 - Puglisis, M.J, J.S. Likdzey, E.D. Bellis. 1974. Factors associated with highway mortality of white-tailed deer. Journal of Wildlife Management, 38:799-807.

7 – Long, R.A., MacKay, P., Zielinski, W.J., Ray, J.C. Noninvasive survey methods for carnivores. Island Press, Washington D.C., USA.

8 - Eco-Kare International. 2009. Monitoring strategy for wildlife crossings and fencing on Highway 69, north of Highway 637. Final Report submitted to the Ministry of Transportation, Northeastern Division, North Bay, Ontario, Canada.