An aerial photograph of a multi-lane highway that curves through a hilly, forested landscape. The road is light-colored with clear lane markings. The surrounding area is a mix of green and brown, suggesting a transition between forest and open land. The sky is overcast.

Mitigation measures for small and medium-sized mammals along Highway 175

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Photo: <http://ici.radio-canada.ca/regions/saguenay-lac/2011/11/11/002-surveillance-aerienne-projet.shtml>

Context of the research project

Roads and traffic negatively impact many wildlife populations and ecological processes because they act as barriers to the movement of animals, reduce habitat accessibility, increase mortality, and reduce habitat quality next to the road. These limitations can affect an animal's migration patterns, its access to resources, its mortality rate, gene flow, and the dispersal opportunities for the young. Roads also can have several effects at the population level, such as changes in predator-prey relationships, decreases in species richness, and changes in overall community composition. For this reason, long-term monitoring projects of roads are essential to arrive at more accurate impact predictions in the future.

In 2012, the enlargement of HWY 175 from two lanes to four lanes was completed increasing the width of the road approximately three times. This enlargement may become a major barrier and fragment wildlife habitat, increasing the danger during movements across the highway due to traffic mortality and higher detectability of the animals by predators.

In order to reduce these impacts, fences for large and medium-sized mammals as well as wildlife passageways for large, medium-sized, and small mammals were put in place along HWY 175. These fences prevent animals from crossing the road at grade and direct them to the wildlife passages where they can cross safely under the highway. These measures re-establish habitat connectivity between the two sides of the highway if the animals find enough wildlife passages along the highway. The passageways along HWY 175 are among the first that have been built in Quebec, which provides a good opportunity to study their effects on the surrounding wildlife populations.



Figure 1: Red fox (*Vulpes vulpes*) crossing a wildlife passage (photo: April Martinig).



Figure 2: Mink (*Neovison vison*) crossing a wildlife passage (photo: April Martinig).

PROJECT OBJECTIVES:

1. To characterize the locations and rates of vehicle collisions with small to medium sized mammals and to evaluate the difference in the frequency of highway-related mortality between areas of the highway with mitigation measures and areas without;
2. To determine passageway effectiveness for small and medium-sized mammals;
3. To assess if the mitigation measures allow for movement and gene flow across the highway, with a focus on the American marten (*Martes americana*).

Conference in Quebec City on April 27-28, 2016:
**« Where roads and wildlife meet: A conference about science
and solutions » /**
« À la croisée des chemins : Colloque sur les routes et la faune »
More information: www.concordia.ca/events/conferences/road-ecology.html

Objective 1

During three years of field work (2012-2014), 733 mammals were found dead along Highway 175. The North American porcupine was the most represented species with 287 mortalities. Micromammals such as voles, shrews, and mice were second with 192 mortalities. Micromammal mortalities were highest in 2012 and greatly decreased in 2013 and 2014. This can be explained by the 4-year population cycles observed in boreal forests for that group of species. The details for the three years are presented in figure 5.



Figure 3: Dead groundhog (*Marmota monax*) on the side of the road (photo: Judith Plante).



Figure 4: Dead porcupine (*Erethizon dorsatum*) on the side of the road (photo: Judith Plante).

To characterize the road-kill locations of the mammals mortalities along the road, we will examine landscape features such as distance to water bodies, forest cover, and different forest types. We will also include in our analysis some road features such as road sinuosity and road profile.

In the analysis of all medium-sized and small mammals combined for the data from 2012 and 2013, we observed a reduction of mammal mortality in the road segments with exclusion fencing when compared to unfenced road segments (Fig. 3). However, the reduction was not statistically significant. There probably are some reductions in traffic mortality for some species (e.g., red squirrels, groundhogs, snowshoe hares), but the number of surveys is still too low to achieve statistical significance. Therefore, we cannot reliably conclude if these reductions are caused by the fences or are part of natural variability.

Road mortalities found from June to October 2012 and 2013 and from June to September 2014

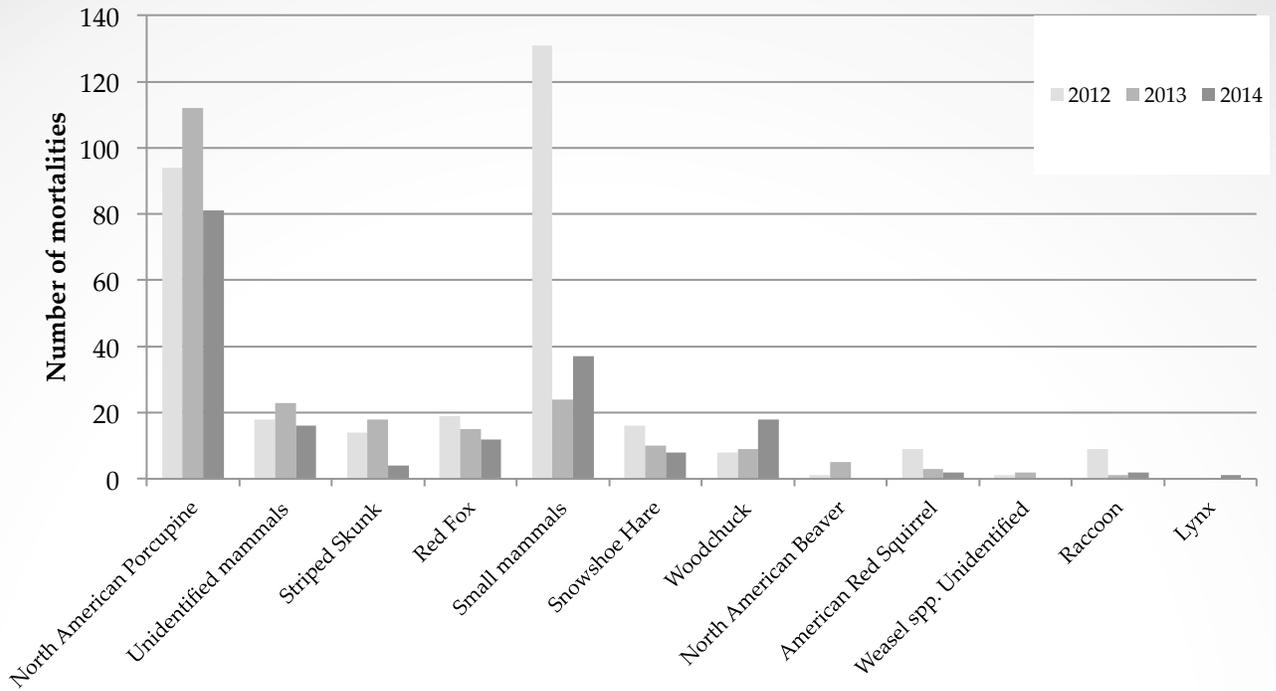


Figure 5. Observed road mortalities per year listed by species.

Average number of collisions on different road segments: with fence, at fence-ends, and without fence.

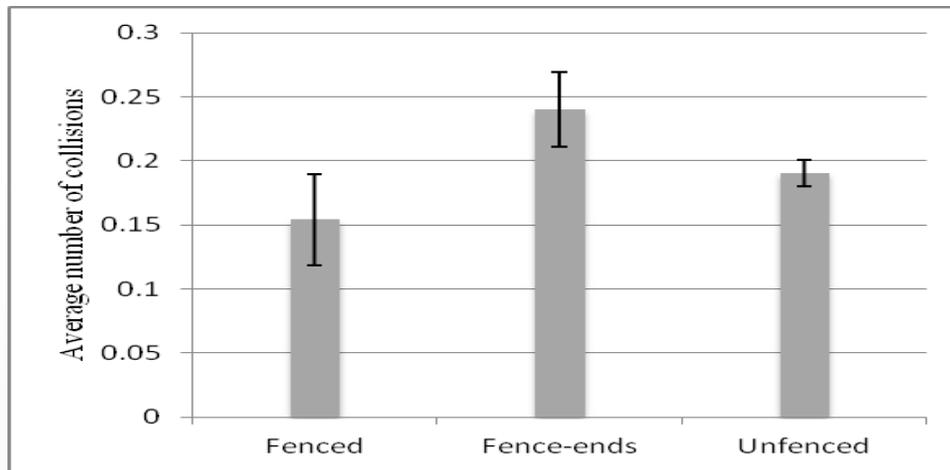


Figure 6: Average number of collisions (with standard error bars) observed in 50 m sections for all medium-sized and small mammals combined ($n = 528$) observed in the summers 2012 and 2013.

There seems to be an overall pattern that mortality in the fenced sections is lower than in the unfenced sections, but the mortality at the fence ends is higher than in the unfenced sections. Therefore, the effects may cancel each other out. If this observation is true, then the fenced sections would have to be much longer than they are right now (but longer fences could also further increase the mortality at the fence ends). In our study, we suspect that the lack of reduction in mortality is also due in part to the mesh size of the fence being too large, fence height potentially being too low, and the lack of a top barrier or overhang to repel climbing species.

Furthermore, as all of the species detected in this road mortality study are common species, it may be tempting to assume that road mortality does not constitute a threat to their population size and persistence. However, the effects of additive road mortality on populations of seemingly common species can be quite substantial. The effects of road mortality may accumulate over time, and in combination with increased habitat fragmentation, the negative implications of road mortality on population viability greatly increase.



Figure 7: American porcupine (*Erethizon dorsatum*) on the side of the road (photo: Judith Plante).

Objective 2

From the images collected inside the wildlife passages, we will be able to better understand the discovery and use of the passages by local fauna by wildlife. We expect that a wildlife passage should be more likely to be discovered depending on:

- 1) passage type,
- 2) distance to cover,
- 3) presence of artificial light around the passage,
- 4) species-specific traits (such as use or avoidance of open areas), and
- 5) year passage was constructed (time for habituation).

Once an individual has discovered the wildlife passage, its use should depend on:

- 1) passage type,
- 2) passage openness,
- 3) number of passage segments, and
- 4) species-specific traits.

Passages that are best suited to the largest number of species are expected to be used most often and by the widest variety of species.



Figure 8: Groundhog and kits (*Marmota monax*) (photo: Katrina Bélanger-Smith).



Figure 9: Red fox and kit (*Vulpes vulpes*) (photo: Katrina Bélanger-Smith).

Objective 3

Radio telemetry study

A radio telemetry study is under way to further characterize the behaviour of martens in the study areas and to identify the influence of the roads on their movement behaviour. Animals receive a numbered ear tag for identification and they are fitted with a VHF collar to allow the researchers to triangulate their position remotely. Repeated measures of an animal's position in the landscape allow for the estimation of its home range and activity pattern. If an animal's home range overlaps with the road it can be inferred that the road is not an important barrier for that individual. However, if the animal is always located only on the same side of the road and the shape of its home range is somehow stretched along the road this would indicate that the road represents either a barrier or a territorial boundary for that individual.

Preliminary radio telemetry results

So far, we have found that martens along the 4-lane mitigated highway (HWY 175) are less likely to cross the road when compared to martens along the 2-lane highway (HWY 381, control site). The majority of martens on HWY 175 limit their movements right at the edge of the forest next to the highway, never venturing across the 4-lane highway. Our results suggests that the widened and mitigated highway still represents a more significant barrier for martens than a 2-lane unmitigated highway and that it might limit the gene flow between the sub-populations on the two sides of the 4-lane highway.



Figure 10: Recaptured marten (*Martes americana*) inside a trap. Its collar and ear tags are visible (photo: Marianne Cheveau).



Figure 11: Recently released marten (*Martes americana*) in early November 2014 (photo: Geneviève D. Timmons).

However, it is possible that with time, animals along the highway get habituated to the widened road and the mitigation measures, but in order to know whether or not this is the case, a more long-term monitoring of the affected populations would be necessary.

NOTICE TO TRAPPERS

This project is conducted at the Réserve Faunique des Laurentides, the Jacques-Cartier National Park, the Grands-Jardins National Park, and the ZEC des Martres. It was developed by Concordia University in collaboration with the Ministère des Forêts, de la Faune et des Parcs, and the Ministère des Transports du Québec. Many martens have been captured and fitted with numbered ear tags or a radio collar along Highways 175 and 381. It is possible that you capture an animal fitted with ear tags or a black collar. We count on your cooperation and we kindly urge you to contact the persons mentioned below, so we can recover the radio collars for our research.

To remove the collar from the animal's neck, please unscrew the nut on the base of the collar; please do not cut the collar with a knife, which will make it unusable. Concordia University will pay \$ 20 (+shipment fees) to trappers who return a collar as compensation and will also send a map showing the marten's movements before its capture. **We thank you for your cooperation and we wish you an excellent trapping season.**

If you trap an animal with ear tags or a collar, please contact:

- **Marianne Cheveau (MFFP) at 418-627-8694 ext. 7515, or**
- **Jorge Gaitan-Camacho (Concordia Univ.) at 514 848-2424 ext. 5484 or 514-688-6795, or**
- **Jochen Jaeger (Concordia Univ.) at 514 848-2424 ext. 5481.**

PARTNERSHIP

To put this project into place, the Quebec Ministry of Transport (MTQ) brought together a team of scientific researchers, which presently includes: **Martin Lafrance**, Direction de la Capitale-Nationale of the MTQ; **Dr. Jochen Jaeger**, Concordia University; **Judith Plante**, MSc student in Geography, Planning and Environment at Concordia University; **April Martinig**, MSc student in Biology at Concordia University; **Dr. André Desrochers**, Laval University; **Katrina Bélanger-Smith**, MSc student in Biology at Concordia University; **Jorge Gaitan-Camacho**, research associate at Concordia University (since September 2014); **Dr. Marianne Cheveau**, researcher at the Ministère des Forêts, de la Faune et des Parcs du Québec; **Sarah Sherman Quirion**, field technician at the Ministère des Forêts, de la Faune et des Parcs du Québec; **Yves Leblanc**, AECOM Consultants Inc.; **Dr. Anthony Clevenger** (WTI - Montana State University), **Dr. Jeff Bowman** (Trent University), **Dr. Paul J. Wilson** (Trent University), and various other personnel: Rodrigo Lima, Robby Marrotte, Carling Dewar, Dylan Robinson, Carlos Zambrano, Simon Tapper, Stephen Macfarlane, Amy Jones, Mary-Helen Paspaliaris, Sandra Anastasio, Kenzie Azmi, Tanya Barr, Josephine Cheng, Melanie Down, Joey O'Connor, Sarah Courtemanche, Bertrand Charry, Megan Deslauriers, Valérie Hayot-Sasson, Gregor Pachmann.

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You can find more information about this project in our previous news bulletins:

http://gpe.concordia.ca/documents/suivi_efficacite_passages_rte175_bull_1.pdf

http://gpe.concordia.ca/documents/Jaeger_suivi_efficacite_passages_rte175_bull_2.pdf

http://gpe.concordia.ca/documents/Jaeger_et_al.2013_Suivi_efficacite_passages_rte175_bull_3-final-1.pdf

http://www.concordia.ca/content/dam/artsci/geography-planning-environment/docs/jaeger/Martinig_et_al_2014_MonitoringWildlifePassages_HW175_bull_5_opti.pdf