- News bulletin -

Monitoring the effectiveness of wildlife passages for medium-sized and small mammals along HW 175

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Two news bulletins about this research project will be published per year.

Contents:

Introduction

There is increasing concern about the effects roads have at reducing connectivity for wildlife populations. Studies have shown that wildlife mortality for many species has increased with the presence of roads in the landscape. Roads are barriers to animals by limiting their movements and reducing the quality and the accessibility of the habitat that they need. Connectivity is important for many ecological processes such as access of animals to resources on both sides of the roads, migration of animals between their summer and winter habitats, gene flow across the roads, dispersal of young to find a territory for themselves when they leave their parents, the balancing between growing and declining populations, and the relationships between predators and their prey populations. Efforts need to be made to reduce the negative effects of roads. If left unattended there may be severe consequences for ecological processes and wildlife populations. For example, higher mortality, loss of species, reduced biodiversity, and shifts in the animal community composition can result. However, the size of these effects is difficult to predict in most cases, because long-term monitoring would be required, which is rarely done. In addition, many effects have a response delay to the construction of new roads, i.e., they become visible only after some time (several years or several decades). Mitigation measures need to be put in place to reduce the effects of roads on animal populations, at least to some degree. An important example is the combination of wildlife passages (underpasses and overpasses) and fencing along roads (Forman et al. 2003). Many studies have shown that wildlife passages help in diminishing the impacts of roads on wildlife for large mammals. However, much less research has been done on their effectiveness for medium-sized and small mammals. These measures require long-term monitoring to reveal how successful they are in decreasing the negative impacts roads have on wildlife populations. For example, the effectiveness of wildlife passages depends on the type of structure and their placement along the road. Increasingly, governments are looking to diminish the ecological impacts of already existing roads (Carsignol et al. 2005). This will also increase safety for drivers.

Project background

In the years 2006 to 2012, HWY 175 between Quebec City and Saguenay was widened from a two-lane road to four lanes. This was one of the largest road expansion projects in Canada at that time. Reasons for enlarging the HWY include traffic safety and an increasing traffic volume. Currently, about 5600 vehicles use the road per day, of which 19% are heavy trucks, and the numbers are rising. The total length of the widened road section is 174 km (between km 53 and km 227). The road passes through a large natural territory that provides important habitat for many wildlife species. One hundred and thirty-three kilometers of HWY 175 run through the Réserve Faunique des Laurentides, and a large section of the road is directly adjacent to the Parc national de la Jacques-Cartier. This expansion greatly increased the fragmentation of the habitat, separating the forest on either side of the highway by distances that may be difficult or impossible for small and medium mammals to safely cross. Various measures have been constructed with the goal of increasing the connectivity between the two sides of HWY 175. This includes measures to reduce negative impacts on wildlife populations and to increase traffic safety by reducing wildlife-vehicle collisions. With the exception of one passageway along Boulevard Robert-Bourassa in Quebec City, these are the first designated wildlife passageways for medium-sized and small fauna built in Quebec. In addition, six wildlife underpasses for large fauna are in place between km 60 and km 210. Therefore, this highway reconstruction project provides a good opportunity to investigate the positive effects of wildlife passages in Quebec.

A suite of mitigation measures have been installed along HW 175:

(a) Fences and passages for large fauna: Fences prevent species such as moose, caribou, and wolves from entering the right of way. Bears, however, are able to climb up the fence. The fences guide the animals to the under-passages for large fauna. Today, 67 km of the highway have been fenced. These fences are 2,4 m high and have a mesh size of about 30 cm x 18 cm. Thus, they are permeable for most medium-sized and all small species, i.e., these species can pass through this fence.

(b) Fences and passages for medium-sized and small fauna: 33 wildlife passages have been constructed for medium-sized and small species. These animals can also use the large passages mentioned above. The term "medium-sized and small fauna" includes all species that are size of or smaller than a wolf. The following species are expected to use the wildlife passages on HWY 175: American marten, porcupine, beaver, skunk, weasel, ermine, red fox, raccoon, mink, red squirrel, snowshoe hare, river otter, musk rat, lynx, fisher, as well as various shrew, vole, and mouse species.

Almost all passages were placed at locations where water is flowing under the highway. Fives types of wildlife passages were used (see photos in News Bulletin 1 of September 2012). The different types of passageways were modeled after previous trials conducted in France (Carsignol et al. 2005).

Mitigation measures serve three general objectives:

A. To reduce the risk of traffic mortality of wildlife and to increase traffic safety for drivers;

B. To improve the permeability of the highway, i.e. to increase access to habitats on either side of the highway for animals of all species;

C. To maintain connectivity of ecological processes across the road and provide for the long-term persistence of wildlife populations in the area.

Objectives of the research project

This research project has three main objectives:

(1) To characterize the locations and rates of vehicle collisions with medium-sized and small mammals and to evaluate the changes in the frequency of highway-related mortality due to the mitigation measures;

(2) To determine the performance of the five types of wildlife passages for medium-sized and small mammals;

(3) To assess how well the mitigation measures provide for the permeability of the highway for individuals and for gene flow across the road, with a focus on American marten.

Road mortality survey

The first road mortality surveys were conducted from June 11, 2012 to October 24, 2012 along highway 175. The objective of the road mortality surveys is to evaluate the effectiveness of the mitigation measures put in place (wildlife passages and fences) at reducing road mortality. The total number of mortality surveys conducted in 2012 was 90 (60 during the morning and 30 during the evening). On average, each mortality survey took three hours to complete following a loop of 136 km of road (68 km southbound and 68 km northbound). Overall, a total of 324 mortality events were recorded, including 18 different types of mammals (species or groups of species) (Figures 1 to 3). In addition, information about their age and gender (in possible), the time of day, and the location (km) was collected. This data will permit the comparison of mitigated zones vs. non-mitigated zones (no fences and no passages).

Figures 4 and 5 illustrate the locations where mortalities of medium-sized and small mammals were recorded. There is no obvious pattern visible in the spatial distribution of these locations. Statistical data analysis is needed to determine the relationships between these locations and the placement of the fences and wildlife passages.

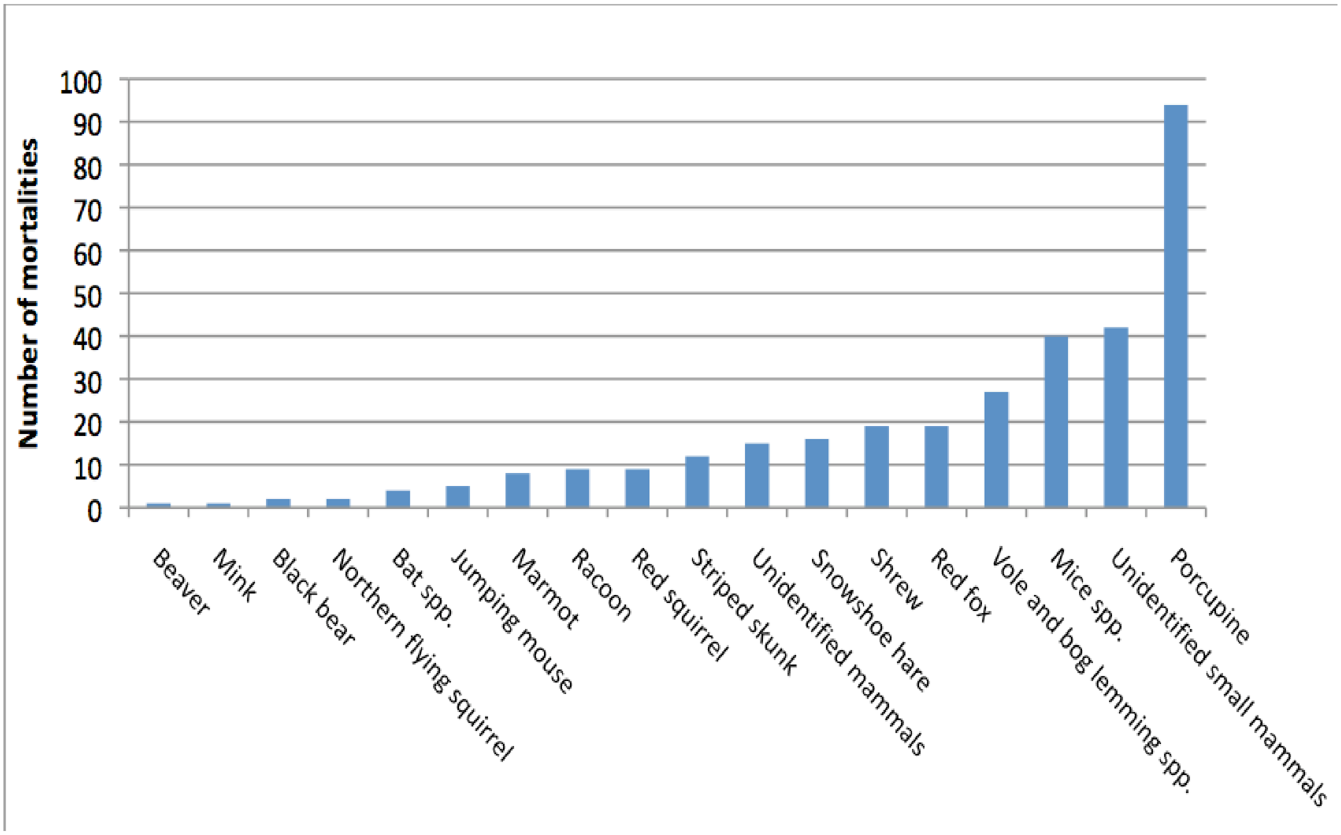

Figure 1: Number of traffic mortalities observed in the mortality survey between June 11 and October 24, 2012, listed by species, in order of increasing number of animals detected.

Figure 2: Woodchuck hit by a vehicle.

Figure 3 : Porcupine hit by a vehicle.

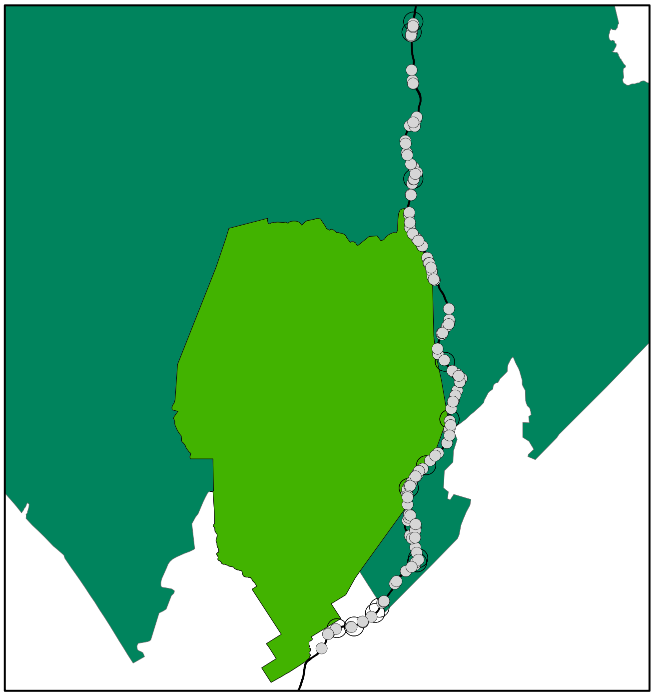

Figure 4: Spatial distribution of medium-sized mammal mortalities.

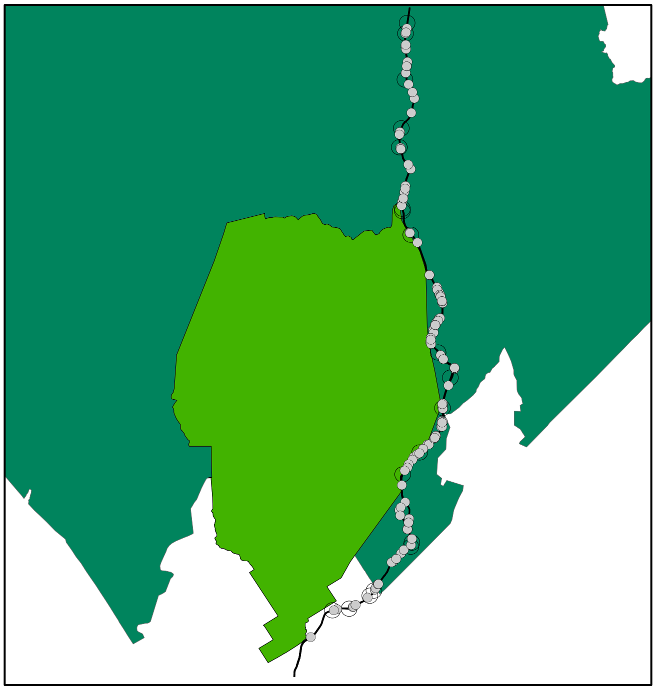

Figure 5: Spatial distribution of small fauna mortalities.

Animal detection by cameras

Remote sensory cameras allow researchers to identify and create a permanent record of the animals using wildlife passages along HWY 175. This is a non-invasive survey technique that takes a photo of the animal in its natural state (walking, running, or foraging). For the duration of the project, wildlife passages are being observed continuously (night and day, year-round). The cameras equipped with infrared sensors, are triggered by heat and movement and record images of wildlife entering and exiting crossing structures. Various species have already been observed in the passages (Figures 6 and 7). The cameras also record the time of the photo taken and the temperature. Results about species identified using the wildlife passages will be presented in future news bulletins.

Estimating relative abundance

In order to accurately evaluate the effectiveness of the wildlife passages, the researchers also need to estimate the relative abundance of each species in the forests adjacent to the highway. The reason is that the abundances will influence the frequencies of expected passage use and at-grade crossings of the road. The goal is to obtain an index of the efficiency of the passages regarding their ability to facilitate wildlife crossings by comparing the expected to the actual use of those passages (so-called performance index). To be able to give an estimate of expected use it is necessary to know the relative abundances of the species present in the vicinity of the highway.

Species identified with track boxes

To estimate relative abundances of medium-sized and small mammals in the summer and fall, track boxes are installed in the forest. They are 120 cm long, 50 cm wide, and 60 cm high (Figure 8).

The animals are attracted by a scent lure to the boxes, where ink and paper are laid out and so the animals leave tracks on the paper in the center of the box (Figure 9). The relative abundance data will be used to determine the passageway characteristics that may influence the amount of usage per passage. A total of more than 700 tracks of about 15 mammal species (or species groups) were found in the track boxes until October 24, 2012.

Figure 6: Mink carrying prey while moving through a wildlife passage.

Figure 7: Fox crossing through a round concrete culvert.

Figure 8: Track box being installed in the forest.

Figure 9: Tracks identified on brown paper used in the track boxes.

Species identified by snow tracks

In winter (when snow is present), the estimate of relative abundance is discovered by using the method of snow track identification on allocated transects at the monitored passages. The transects for snow tracking were established in autumn 2012. Trails are 300 m perpendicular to the highway on both sides of each passage (Figures 10 and 11). This resulted in 36 transects, 2 at each of the 18 passages monitored. The transects have been monitored since December 2012, and the work is continued till March 2013, snow conditions permitting. Snow tracking can only be successful when specific favorable conditions are met. There needs to be enough snow cover initially on the ground (at least 3 cm) and a good tracking surface of the snow (Figure 12). Typically, good conditions are met 12 hours after initial snowfall of a minimum of 3 cm. Snow tracking conditions are favorable for only 3 days after the initial snowfall event, due to the accumulation of tracks. The surveys are conducted on foot or snowshoes, depending on snow depth.

Every animal track crossing a transect is recorded including:

- a GPS waypoint (recorded in a hand-held GPS unit)
- species
- a picture of the track including a scale
- track measurements (Figure 14):
    - Visible outline (i.e., visible width and length of front and rear feet)
    - Minimum outline (i.e., minimum width and length of front and rear feet)
    - Straddle (i.e., distance between the line of travel connecting the left heels and line of travel connecting the right heels, if discernible)
    - Stride (i.e., distance traveled during the act of forward movement, completed when the legs have returned to their initial relative position, measured from toes to toes of the prints of the same foot)

Tracks are recorded for all species encountered and each one is measured and photographed. However, for some very common species, such as snowshoe hare, red squirrel, weasels and micro-mammals, measurements are taken only on the first occurrence on each transect. So far 1781 tracks of 13 different species (or groups of species) were encountered during the surveys conducted in December 2012 and February and March 2013. The most common species identified were snowshoe hare (853), *Mustela* species (the tracks of which are difficult to distinguish) (217), and red squirrel (225) (Figure 14).

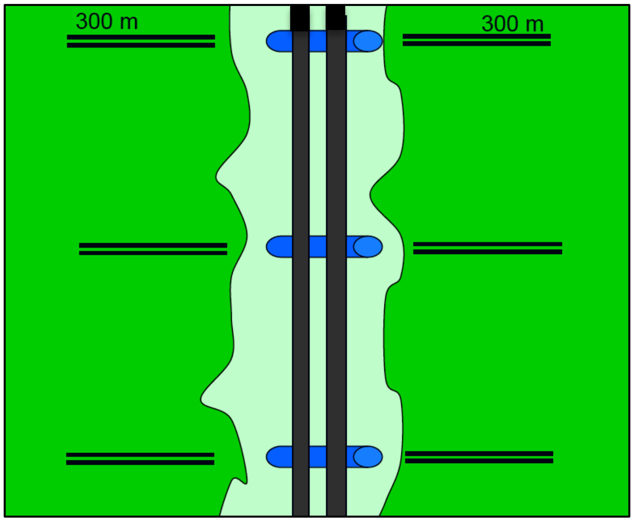

Figure 10: Layout of the snow transects.

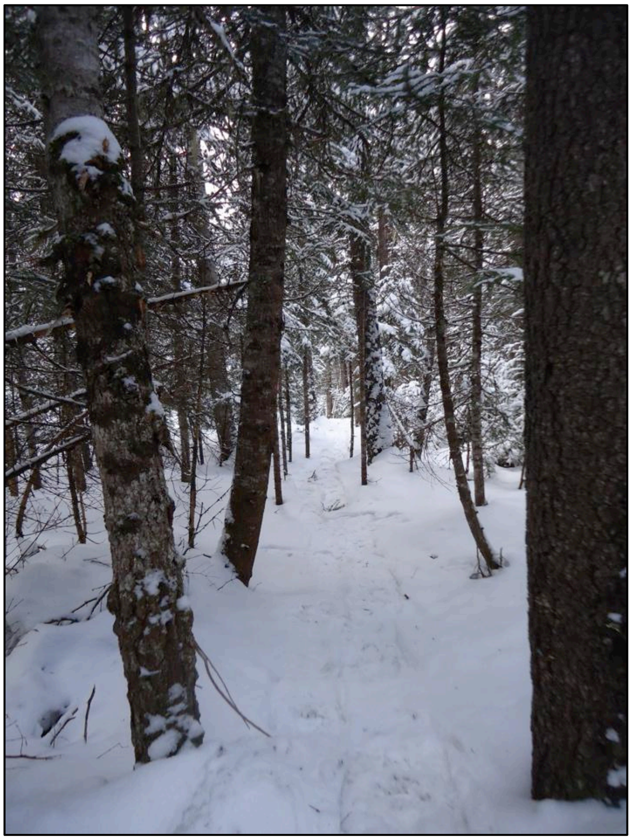

Figure 11: Transect in the forest.

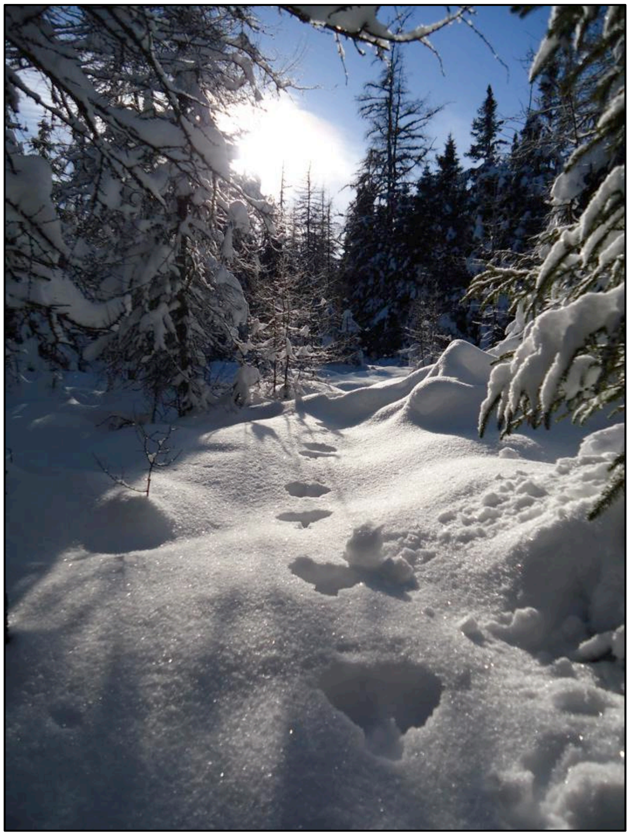

Figure 12: Tracks of a snowshoe hare on a transect.

Figure 13: Field technician measuring snow tracks.

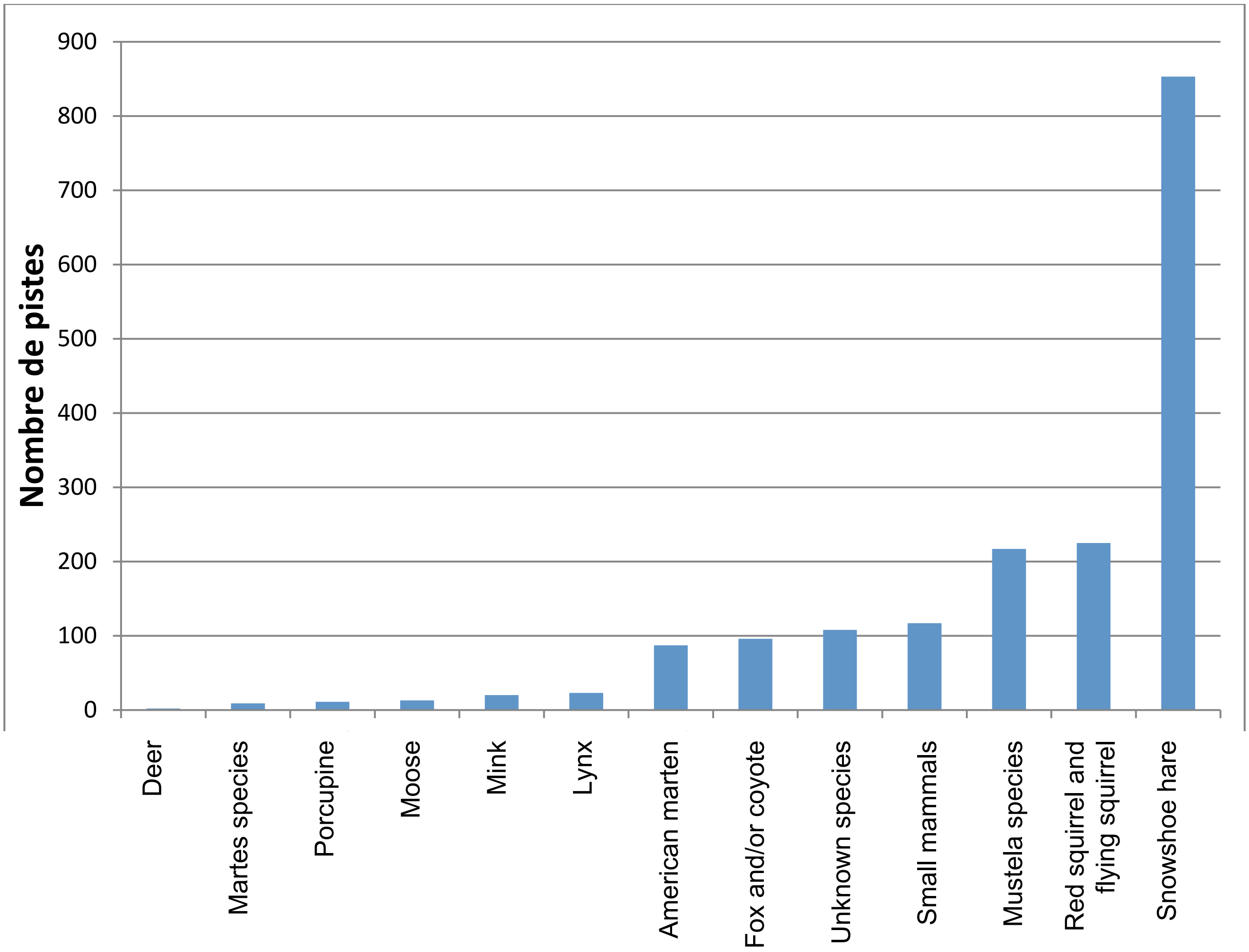

Figure 14: Number of snow tracks identified between December 2012 and March 2013, listed by species, in order of increasing number of tracks detected. *Martes species* indicates American martens or fishers (depending on snow conditions, their tracks can be difficult to distinguish) and *Mustela species* indicates long-tailed weasel or ermine (and despite their rarity, perhaps least weasel). Tracks of red squirrel and flying squirrel can sometimes be indistinguishable.

Looking ahead

For the upcoming summer field season in 2013, the researchers will also address objective 3 of the project: to assess the permeability of the highway for individuals and for gene flow across the road, focusing on the American marten. Road mortality surveys will be continued between the months of June and October 2013 to assess to what extent the mitigation measures help decrease the negative impacts of roads on wildlife populations. Also the observation of the passageways by cameras will be continued. Relative abundances will be estimated by track boxes. The results will be presented in future news bulletins.

Were you can find further information

You can find more information about the wildlife passages along HW 175 here:

Bédard, Y., É. Alain, Y. Leblanc, M.-A. Poulin, M. Morin (2012) : Conception et suivi des passages à petite faune sous la route 175 dans la réserve faunique des Laurentides. Le Naturaliste Canadien 136(2) : 66-71.

More information about the ecological effects of roads and various mitigation measures is given here:

Carsignol, J., V. Billon, D. Chevalier, F. Lamarque, M. Lansiart, M. Owaller, P. Joly, E. Cuenot, P. Thievent, P. Fournier (2005): Aménagements et measures pour la petite faune. Guide technique. Sétra (service d'études techniques des routes et autoroutes). Bagneux Cedex, France.

Fahrig, L., T. Rytwinski. 2009. Effects of roads on animal abundance: an empirical review and synthesis. *Ecology and Society* 14(1): 21. [online] URL: http://www.ecologyandsociety.org/vol14/iss1/art21/

Forman, R. T. T., D. Sperling, J. A. Bissonette, A. P. Clevenger, C. D. Cutshall, V. H. Dale, L. Fahrig, R. France, C. R. Goldman, K. Heanue, J. A. Jones, F. J. Swanson, T. Turrentine, and T. C. Winter. 2003. *Road ecology: science and solutions.* Island Press, Washington, D.C., USA.

Jaeger, J. A. G., J. Bowman, J. Brennan, L. Fahrig, D. Bert, J. Bouchard, N. Charbonneau, K. Frank, B. Gruber, and K. Tluk von Toschanowitz. 2005. Predicting when animal populations are at risk from roads: an interactive model of road avoidance behavior. *Ecological Modeling* 185: 329–348.

van der Ree, R., E. van der Grift, C. Mata, and F. Suarez. 2007. Overcoming the barrier effect of roads—how effective are mitigation strategies? An international review of the use and effectiveness of underpasses and overpasses designed to increase the permeability of roads for wildlife. Pages 423–431 *in* C. L. Irwin, D. Nelson, and K. P. McDermott, editors. *Proceedings of the 2007 International Conference on Ecology and Transportation.* Center for Transportation and Environment, North Carolina State University, Raleigh, North Carolina, USA.

Members of the project team and project partners

To put this project into place, the Quebec Ministry of Transport (MTQ) brought together a team of scientific researchers:

- Yves Bédard, Direction de la Capitale-Nationale of the MTQ. He is the responsible person at the Ministry of Transport.
- Dr. Jochen Jaeger, Concordia University, Montreal. He is the principal investigator of the project.
- Katrina Bélanger-Smith, MSc student in Biology at Concordia University.
- Évan Hovington, MSc, field technician.
- Mary-Helen Paspaliaris, Honor's student in Geography at Concordia University.
- Dr. Anthony P. Clevenger, Montana State University. He is a wildlife researcher who has more than 14 years of experience in monitoring the effectiveness of wildlife passages along the Trans-Canada Highway in Banff National Park, Alberta.
- Dr. André Desrochers, Université Laval, Québec City.
- Dr. Jeff Bowman, Ontario Ministry of Natural Resources and Trent University, Peterborough.
- Dr. Paul J. Wilson, Trent University, Peterborough.
- Yves Leblanc, AECOM Inc., Quebec City.
- and various research assistants who worked in the field: Sarah Courtemanche, Bertrand Charry, Megan Deslauriers, Valérie Hayot-Sasson, Gregor Pachmann; or in the office: Megan Chan, Lasoi Ketere, Rochelle Methot.

The researchers are supported by the members of the Enlarged Advisory Committee which meets annually. This committee includes representatives of the main groups and organisations affected by the project (in alphabetical order):

- Éric Alain, Ministère des Transports du Québec
- Jean-Emmanuel Arsenault, Parc national de la Jacques-Cartier, Sépaq
- Héloïse Bastien, Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs du Québec
- Pierre Blanchette, Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs du Québec
- Sylvan Boucher, Réserve faunique des Laurentides, Sépaq
- Mathieu Brunet, Parc national de la Jacques-Cartier, Sépaq
- Dr. Marianne Cheveau, Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs du Québec
- Louis Desrosiers, Ville de Stoneham
- Martin Lafrance, Ministère des Transports du Québec
- Hugues Sansregret, Forêt Montmorency
- Audrey Turcotte, Ministère des Transports du Québec

The committee is informed about the progress of the project and discusses the results and the next steps.

The organizations more or less closely involved in this project are (in alphabetical order):

- AECOM Inc.
- Association forestière des deux rives (AF2R)
- Concordia University Montreal (Department of Geography, Planning and Environment, and Department of Biology)
- Forêt Montmorency
- Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs du Québec
- Ministère des Ressouces naturelles du Québec
- Ministère des Transports du Québec
- Parc national de la Jacques-Cartier
- Société des établissements de plein-air du Québec – Réserve faunique des Laurentides
- Sureté du Québec
- Ville de Stoneham

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Dr. Anthony Clevenger: Western Transportation Institute, Montana State University (WTI-MSU).

Please contact Dr. J. Jaeger for obtaining future editions of this information bulletin. The PDFs of the bulletins are also available on this website: http://gpe.concordia.ca/faculty-and-staff/jjaeger/

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