- News Bulletin -

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

Jochen Jaeger, Rodrigo Lima, Katrina Bélanger-Smith, Kenzie Azmi, Anthony Clevenger

N° 3 – October 2013

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

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Effects of roads on wildlife populations

Studies have shown that roads and traffic increase the mortalities of a number of wildlife species through collisions with vehicles. It is also a growing concern among scientists that roads reduce habitat connectivity of animal populations in the wild. Limited connectivity may result in more restricted access to resources, reduced migration between summer and winter habitats, lowered genetic exchange, less dispersal of young to inhabit new territories, less homogenization between growing and declining populations, and skewed predator-prey relationships. The combination of only a few of these changes in natural ecological processes may result in higher vulnerability of wildlife populations, increased predation, unbalanced sex ratios, lower reproduction rates, reduced gene flow, loss of species, and shifts in community composition. However, there are measures available that can help alleviate the consequences of fragmentation. By combining wildlife crossing structures that pass under or bridge over roads with fencing that runs along the road, it is possible to reduce many negative ecological effects of roads. These measures have been in place in increasing connectivity in many countries such as France, Germany, Switzerland and the Netherlands for more than 20 years.

Enlargement of Highway 175 from 2 lanes to 4 lanes

The widening of HW 175 between Quebec City and Saguenay (between km 53 and km 227) in 2006-2012 was one of the largest road expansion projects in Canada. The surrounding area is made up mostly of natural territory that provides important habitat for various wildlife species. The expansion corridor runs through the Reserve Faunique des Laurentides with a large section adjacent to the Parc National de la Jacques-Cartier. The new road is approximately 3 times larger than before, growing from 30-35 m to 90-100 m wide and the gap in forest cover is often even significantly wider. There is a threat of habitat fragmentation that accompanies this expansion since it separates the forest on either side by distances that may be difficult or impossible for smaller sized mammals to safely cross.

Mitigation Measures

Various measures have been taken to mitigate the negative impacts of this road expansion. Their primary objectives are to reduce the environmental impacts by increasing connectivity for wildlife between the adjacent forest on both sides of the road, and to increase traffic safety by reducing wildlife-vehicle collisions. These measures include fencing along a large part of the highway accompanied by the placement of 33 wildlife passages for small and medium-sized fauna and six passages for large fauna. The fences prevent animals from crossing the highway and direct them to the passages that pass under the highway and allow them to safely cross to the other side. Most passages are located where a culvert was already needed for water flow. With the exception of one passageway along Boulevard Robert-Bourassa in Quebec City, these are the first designated wildlife passageways built in Quebec. Thus, this project provides a unique opportunity to investigate the positive effects of wildlife passages in Quebec.

Objectives of this project

The area around HW 175 is an important connectivity region that links protected natural habitats to ones where hunting, trapping and logging are practiced. As the highway decreases this connectivity, it is important to monitor the effectiveness of the wildlife passageways in restoring connectivity between these areas. This information is important for helping future road management implement wildlife passageways along new or existing roads, especially in southern Quebec where forests are more fragmented because of agriculture and urbanization. Many studies from Europe, North America and Australia have shown that a number of species use wildlife passages successfully. However, most research has been focused on large mammals, leaving a gap of information about small to medium-sized mammals. Although smaller, these animals can also pose a risk to drivers when they cross the road, causing drivers to swerve or lose control of their vehicle. Thus, this research project will determine whether the passageways are effective for medium-sized and small mammals and whether further road management is needed. The effectiveness of the mitigation measures for large mammals has been studied in a separate project. This four-year project will provide important information for adaptive management and long-term monitoring of road mitigation.

This research project has three main 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 the performance of the five types of passages for small to medium-sized 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 the American marten.

Traffic Mortality Survey (Objective 1)

The road mortality surveys assess by how much the fences and wildlife passages reduce traffic mortality of small to medium-sized mammals. The researchers search for road-killed or injured animals and record the species and location where they have been hit as well as related information (Figure 1). Sections of the highway with passageways and fencing are compared to sections of similar habitat without passageways or fencing to assess whether the mitigation measures are successful in reducing mortality numbers.

The effectiveness of the different types of passages will be compared as well. Results from the surveys from 2012 and 2013 show that porcupines are the most affected by road mortalities because they are slow moving mammals and stop to extend their spines when they feel threatened (Figure 2).

Figure 1: Researchers removing carcass from the road during a mortality survey.

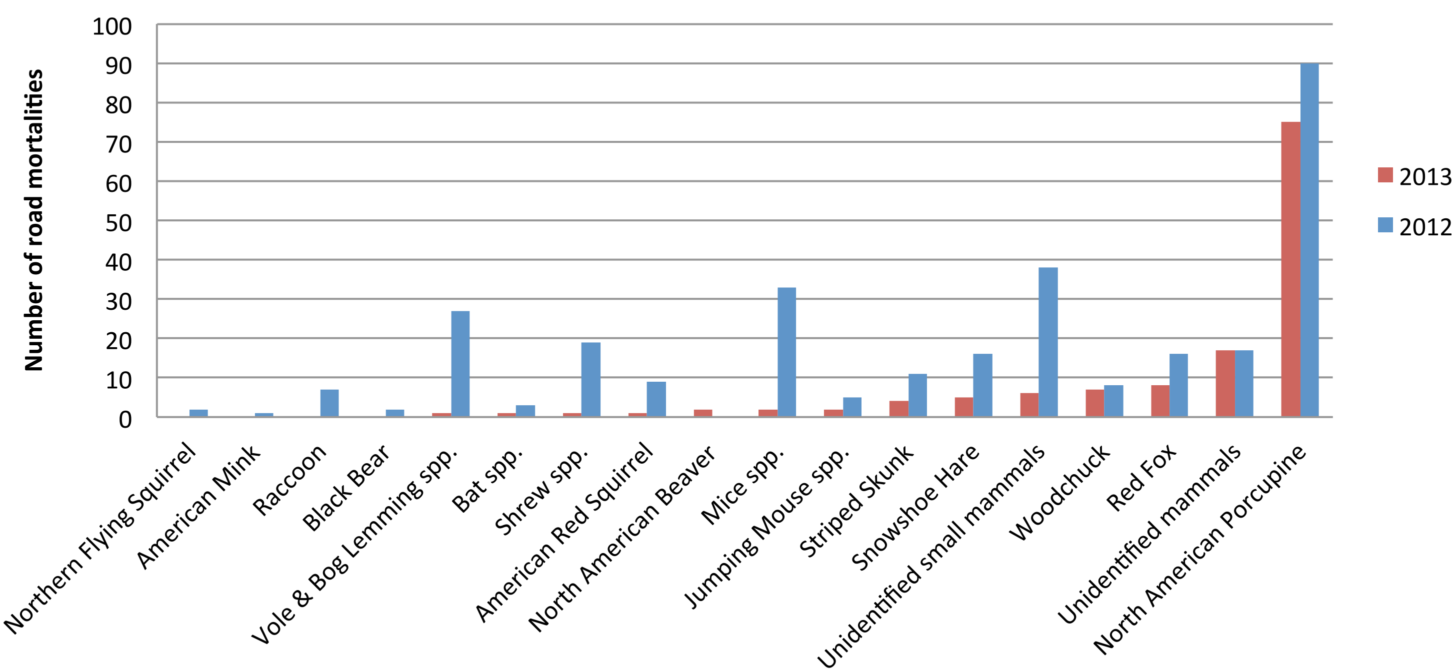

Figure 2: Number of traffic mortalities observed during mortality surveys in 2012 (June 11 to October 24) and 2013 (from June 3 to August 6), listed by species. No martens were found on the road.

Monitoring the use of wildlife passages using cameras (Objective 2)

The use of the passages is being observed year-round, night and day by digital Reconyx cameras. These cameras are equipped with infrared sensors that are triggered by heat and movement. They record images of any animal that enters or exits the crossing structures. The SD cards are collected every two weeks and replaced with empty ones, and the NIMH batteries are changed. During the winter, lithium batteries are used which do not have to be replaced during the entire season. The images are reviewed continuously and only the individuals that enter as well as exit a passageway are counted as successful passages. Species observed in the wildlife passages so far include: porcupines, red squirrels, woodchucks, chipmunks, foxes, racoons, skunks, ermines, minks, and long-tailed weasels, and micromammals such as mice, shrews, and voles.

Estimating the relative abundance of wildlife populations

In order to accurately evaluate the use of the passages, the researchers need to estimate the relative abundances of species in the forest around the passageways. If there is a species present in the forests adjacent to a passageway but does not appear in the images from the passage cameras, the researchers would know that the passages are not accepted by that animal. To estimate relative abundances, four track boxes are placed on either side of the passageway, in the surrounding forest. These boxes are large enough so that any animal smaller than a wolf can enter them. A sheet of blank paper is placed in the center of the box, and ink is painted on both sides of that paper. A scent lure is also placed in these boxes to attract animals to the box. When an animal steps into the box to investigate the smell of the lure, it steps in the ink, and imprints onto the track paper. These papers are then collected every two weeks, and other blank papers are placed instead. The researchers can then identify the tracks and acquire an estimate of relative abundance of each species around every passageway location. Bears are often attracted to the track boxes and cause considerable damage while investigating them. Track boxes are built with coroplast, which makes them easy to reassemble after a bear visit. Species observed in the track boxes so far include: micromammals (mice, voles, and shrews), jumping mice, red squirrels, chipmunks, snowshoe hares, weasels (ermines, minks, and long-tailed weasels), porcupines, skunks, racoons, martens, black bears, lynxes, and also birds and amphibians.

Figure 3: Researchers assembling a track box.

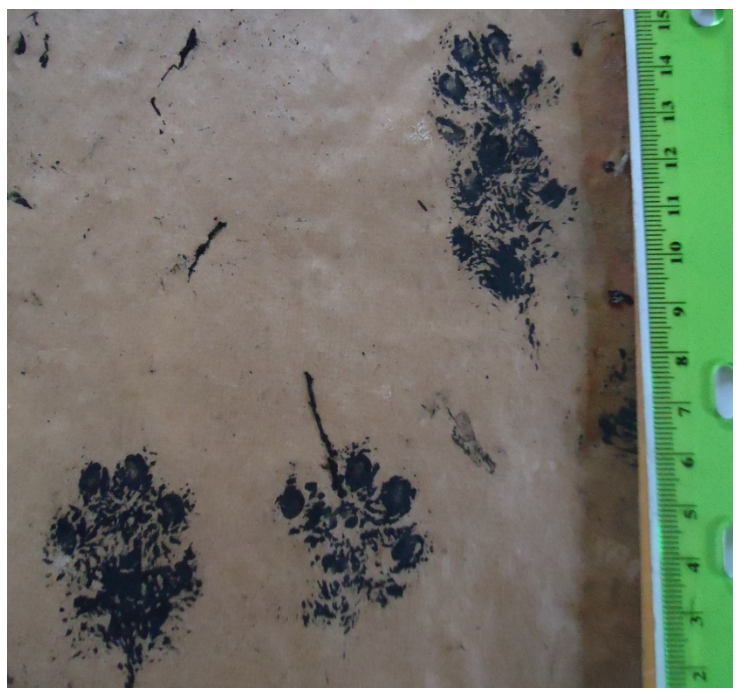

Figure 4: American marten tracks.

Permeability of the highway for individuals and for gene flow across the road for the American marten (Objective 3)

The objective of this part of the project is to assess how well the fences and passageways provide for the permeability of the highway for individual martens as well as for gene flow in the population across the road. The permeability of the road is a measure of how much the road impedes or allows for movement and dispersal of individuals. All work performed on Highway 175 (our study site) is replicated on Highway 381 between the Parc National des Grands-Jardins and the ZEC des Martres (our control site), which is a two lane highway. Thus, we can compare the barrier effect of the two roads and assess how much stronger the barrier effect of the 4-lane road is than of the 2-lane road.

Marten capture and VHF radio collaring

We live trapped martens in forest environments adjacent to Highways 175 and 381 using Tomahawk traps. The trap is camouflaged with natural materials and equipped with a chloroplast roof that protects the captured animals against heat and rain. Traps are baited with sardines, and a mix of raspberry jam and fish oil. Skunk and castoreum lures are used to attract animals from far away. Sometimes the bait and the lures also attract unwanted visitors, such as bears, that may displace or even destroy the traps. The traps are checked once every day. If a marten is captured, it is anaesthetized using iso-flurane gas. This gas has important advantages over the use of injected anaesthetics, among which are shorter recovery times, easily adjustable doses reducing the risk of premature recoveries and overdose. The researchers then weigh, sex, measure, age and mark the individual with ear tags, fit it with a VHF radio collar if it is of sufficient weight to carry the collar. They also take a hair sample from the animal's tail for DNA extraction. After a few minutes of recovering from the anaesthesia the animal is given water and fed raspberry jam, and released in the same location where it was captured. In the first summer of study, 21 martens have been captured and marked along Highway 175, six of which were fitted with radio collars. Seven martens have been captured and 5 have received a radio collar along Highway 381, and we have recorded three cases of road crossing on highway 381, all three done by the same individual.

Figure 6: Researcher baiting an installed and camouflaged live trap.

Figure 5: Researcher installing a live trap.

Figure 7: Live trap displaced and partially destroyed by a bear.

Capture/recapture and VHF radio tracking

The permeability of the road will be assessed using two different methods. The first method is a capture/recapture study, in which we will compare "along road" against "across road" movements based on the recaptures of marked martens in traps different from those where they were originally captured.
The second method determines the permeability of the road by the number of crossings by the individuals that are captured and fitted with VHF radio collars. After checking traps, the researchers triangulate the locations of the collared martens using radio telemetry. This is a method that consists in using antennas that detect the radio waves emitted by the VHF radio collars to find the approximate location of the individual. If the researchers find that the animal is on the other side of the road than the previous day, it can be inferred that it has crossed the road. The researcher can also determine the home ranges of the martens and their daily movements, thus revealing how their home ranges relate to the road, e.g., whether or not the home ranges intersect with the road.

Figure 8: Anaesthetized marten receiving a radio collar.

What is VHF radio tracking?

VHF telemetry serves to study of the spatial behaviour of martens by locating martens while they perform their natural activities. It is commonly used for studying elusive wild animals in their natural habitat. It enables researchers to collect information about the behavior of their study animals in the landscape without the need to directly observe them. Radio telemetry (also called radio tracking) has been used by wildlife biologists since the early 1960s, and has been applied in studies of many different animal species, from small birds to large whales.
The basic principles of radiotelemetry are quite simple: The researcher attaches a radio transmitter to the study animal and then locates the signal emitted by the transmitter with a radio receiver connected to a directional antenna. The transmitter can be attached to the animal in many ways, for example, with a collar (as is the case in our study on martens), with a harness (commonly used for birds), or glued directly to the animal's body (such as turtles' shells).
Once the animal is tagged with a radio transmitter, its position can be estimated by finding the direction of the signal from two or more different places. The researchers place themselves at suitable spots where the radio signal can be properly received, estimate the direction of the signal using the directional antenna, and take a bearing of this direction using a compass. The lines corresponding to the directions of the signal received from different spots will (ideally) intercept each other at some point in space: This is the estimated location of the animal. When there are more than two receiving spots (which is advisable for accuracy), the direction lines will usually form a polygon; in these cases the estimated position of the animal is the centroid of the polygon. This method is called triangulation.
This process is repeated over several months or even years to learn about the movement of the animal during an extended period of time. From the set of recorded locations, the researchers can conclude how often the animals crossed the road and can determine its use of different habitat types. The home range, which is the area used by an animal for its normal foraging and reproductive activities, can also be calculated from this set of recorded locations.
This summer we have collected a total of 51 locations from 6 martens along highway 175 and 39 locations from 5 martens along highway 381, with 2 to 12 locations per individual. We will collect data on these 11 martens for one year.

Figure 9: Researcher determining the direction from where the signal of the marten comes using a receiver and a directional antenna.

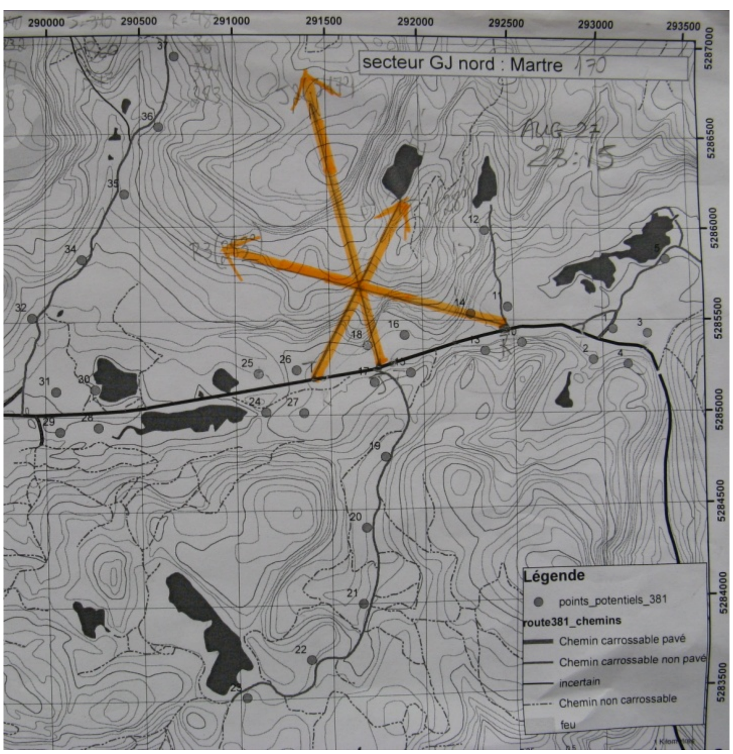

Figure 10: Map showing the use of triangulation. The marten's estimated position is the intersection of the three orange lines.

The use of cameras to monitor marten movement

If a marten has been found to have crossed the highway and it is simultaneously detected in the cameras located in a passageway nearby its location, we can infer that the individual has used that passageway to cross the road successfully. Otherwise, it has likely crossed the road elsewhere. In this case, the marten may have crossed at a drainage culvert that has not been managed into a wildlife passageway, or crossed the highway above ground. To know exactly what the behaviour of the animal was, cameras are placed at drainage culverts (that have not been managed into wildlife passageways) nearby in a one-kilometer radius from the locations where the martens were captured. Thus, researchers gain information about when and where the martens cross the road.

Marten translocation experiment

In the fall of 2013, two martens will be captured, fitted with radio collars, and translocated to the opposite side of Highway 175. These animals will be monitored through radio telemetry for 24 hours a day after they are released until they cross the road back to their original home ranges or until they establish themselves on the side of the highway to where they have been translocated. This experiment will provide further information on road avoidance and road crossing behaviour of the martens.

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.
- Rodrigo Lima, research associate at Concordia University.
- Solène Tremblay-Gendron, MSc, field technician.
- Véronique Bouchard, field technician.
- Dr. Marianne Cheveau, researcher at the Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs du Québec.
- Sarah Sherman Quirion, field technician at the Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs du Québec.
- 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: Sandra Anastasio, Kenzie Azmi, Tanya Barr, Josephine Cheng, Mark Dodds, Melanie Down, Joey O'Connor, Sarah Courtemanche, Bertrand Charry, Megan Deslauriers, Valérie Hayot-Sasson, Juliette Lees, Gregor Pachmann, Simon Tapper, Carlos Zambrano; or in the office: Ross Bushnell, Megan Chan, Lasoi Ketere, Lisa Bidinosti, 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
• 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)
• Association régionale des trappeurs Laurentiens
• Concordia University Montreal (Department of Geography, Planning and Environment, and Department of Biology)
• Forêt Montmorency
• Huron-Wendat Nation
• 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
• Parc national des Grands-Jardins
• Société des établissements de plein-air du Québec – Réserve faunique des Laurentides
• Sureté du Québec
• Ville de Stoneham
• Zec des Martres

NOTICE TO TRAPPERS

This research project on **American martens** is being conducted at the Réserve Faunique des Laurentides, the Jacques-Cartier National Park, the Grands-Jardins National Park, and the ZEC des Martres. This project is developed by Concordia University in collaboration with the Ministère du Développement durable, de l'Environnement, 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 radio collars. Telemetry monitoring will allow the study of habitat selection by martens and the relation between martens' movements and Highways 175 and 381. It is possible that you capture an animal fitted with ear tags or a black collar. We would like to count on your cooperation and we kindly ask you to please contact the persons mentioned bellow, so we can recover the radio collars which have precious information. 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 would make it useless.

Concordia University will pay an amount of $20 (+ shipment fees) to the trappers who return a collar in order to compensate for their help, and we will also send you 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:

Rodrigo Lima at 514 688-6795 or 514 848-2424 (extension 5484)

or

Jochen Jaeger at 514 848-2424 (extension 5481).

Affiliations of the authors:

Dr. Jochen Jaeger, Rodrigo Lima, Katrina Bélanger-Smith, Kenzie Azmi: Concordia University, Department of Geography, Planning and Environment, 1455 de Maisonneuve Blvd. W., Suite H1255, Montréal, Quebec, H3G 1M8, Canada. Email: jochen.jaeger @ concordia.ca, phone: (514) 848 2424 ext. 5481.
Dr. Anthony Clevenger: Western Transportation Institute, Montana State University (WTI-MSU).

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