ANIMALS CROSSING ROADS IN THE LAURENTIANS: DOES USE OF CROSSING STRUCTURES HELP REDUCE WILDLIFE-VEHICLE COLLISIONS ON UNFENCED ROADS?

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ROAD MORTALITY SURVEYS AND WILDLIFE CROSSING OBSERVATION STUDY 2025-2027

- Identifying and evaluating wildlife roadkill quantities and culvert use along Route 117 (R117) and Chemin du Lac-Supérieur in the Laurentians (Ch. L.-S.)
- Summer 2025 surveys found:
  - 249 dead animals on R117
  - 1,864 dead animals on Ch. L.-S.
- Mammal mortality numbers were highest for red squirrels, raccoons, and white-tailed deer.
- Amphibian mortality was extremely high with 1,571 individuals, including 1,000+ green frogs.
- Monitoring includes 16 culverts with 74 cameras to assess wildlife movement under Route 117 and Ch. L.-S.

Figure 1. Survey team working on Route 117. (Photo credit: Daphné Mary, 2025)

BACKGROUND

Roads impact many wildlife populations through wildlife-vehicle collisions (WVCs) and the barrier effect. The barrier effect is the limiting effect that linear infrastructure like roads have on animal movements. The total road length in the province of Québec is more than 180,000 km. Roads managed by Quebec's Ministère des Transports et de la Mobilité Durable (MTMD) include over 31,000 km (MTMD, 2023). In 2022, almost 7000 WVCs with mostly large mammals were reported in Quebec, but this number does not represent all roadkill (SAAQ, 2024), because typically WVCs only get reported when damages exceed 1000$ which excludes collisions with medium-sized and small mammals, reptiles, birds, and amphibians (L-P Tardif and Associates, 2003) The costs associated with WVCs with a white-tailed deer in Quebec per accident are estimated at 13,453$ (10,671$ in 2017 according to Diarra et al., 2018; Bank of Canada, n.d.), of which 7124$ (53%) are associated with human injury, carcass removal, car repair and towing, and 6329$ (47%) are associated with the loss of human lives and animal lives.

Crossing structures under roads are often promoted as a viable option to reduce the impacts of roads on wildlife, but culverts are usually designed for the movement of water under the road rather than for use by animals. In Europe, thousands of wildlife passages have been explicitly built for animals to reduce the impacts of roads and ensure connectivity across roads. The United States has over 1500 crossing structures in 43 states (Knighton, 2024). Quebec has 170 wildlife crossing structures (underpasses), 80 of which have been expressly designed to aid large mammals in crossing roads (Gouvernement du Québec, 2025). Despite the presence of these crossing structures, Figure 2 shows that WVCs in Quebec have remained high over the last 22 years and fatalities resulting from WVCs have varied greatly over the same period. This indicates a need

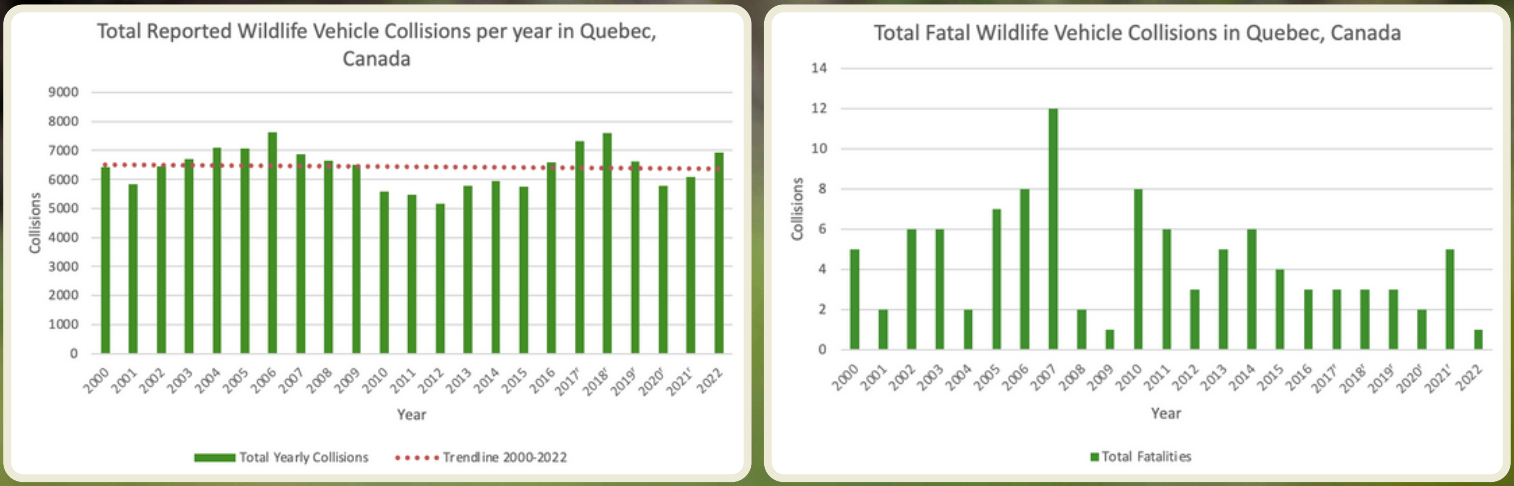

Figure 2. (Top) Graph showing the annual WVCs in Quebec involving mostly white-tailed deer, moose, caribou, and bears. (Bottom) Graph showing the numbers of human fatalities caused by WVCs in Quebec per year. Source: SAAQ (2024).

for action to reduce the frequency of WVCs.

Biodiversity is deteriorating across the planet. Mitigating the impacts of roads on biodiversity is needed to help reduce the pressure on wildlife populations. Currently, over 30% of amphibian species, over 20% of mammal species, and over 15% of reptile species are threatened globally (Vulnerable, Endangered, or Critically Endangered) (IPBES, 2019). Extinction rates are on the rise and species persistence is declining (IPBES, 2019). A study by Hill et al. (2019) investigated the major causes of mortality in wildlife populations globally. The study found that vehicles are causing 7% of all mortality in adult mammals and 2% in juvenile mammals, 1% in juvenile birds and 1% in adult birds, 13% in adult reptiles and 1% in juvenile reptiles and 4% in amphibians (Hill et al. 2019). Vehicles were found to be a more predominant cause of death in North America than in other parts of the world. Amphibians and reptiles are deemed the most vulnerable to WVCs and other anthropogenic stressors (Rytwinski et al. 2016, Currie & Marconi 2020). Fencing in combination with crossing structures can reduce WVCs and mitigate the impact of roads, but amphibians and reptiles are still not well represented (Hill et al. 2019; Soanes et al. 2024).

The Quebec Transport Ministry has emphasized the maintenance of ecological connectivity in their Sustainable Development Action Plan for 2023-2028 (Plan d'action de dévelopment durable 2023-2028, 2023). Findings from citizen science, such as the Carapace project and

Figure 3. Example of a structure designed for water passage under the roadway that can be used by animals to cross under the road. (Photo credit: Amanda-Faith Gélinas-Noble, 2025)

others on iNaturalist, have reported large numbers of animals on roads both alive and dead that far exceed the WVC counts reported by the SAAQ. This disparity is caused by the sizes of reported animals, as medium-sized and small animals are not a significant source of vehicular damage and often go unnoticed or unreported by the SAAQ (Bíl & Andrášik, 2020). The action plan must take into account this disparity paying special attention to protecting connectivity for these oft overlooked smaller animals.

Éco-corridors laurentiens (ÉCL) is a non-profit organization that is in the process of implementing a strategy for the conservation of natural environments and the protection of ecological corridors in the Laurentians in collaboration with other organizations, institutions, and citizens. Over the past few years, members of the board of directors, employees, volunteers, and interns have worked on drafting recommendations and identifying issues related to the implementation of wildlife crossings in the region.

The Laurentian region of Quebec has been identified as an important part of large-scale ecological corridors spanning the province. The Oka-Tremblant connection is an important one that is highlighted in the connectivity plan provided by Eco-corridors laurentiens (ECL, 2025). The current increase in the working-age population and the increased number of building permits (by $294.2 million

Figure 4. (Left) Research team working on Ch. L.-S. (Photo credit: Arielle Limoges, 2025)

dollars) indicate an impending expansion of the built-up areas across Quebec (Statistics Canada, 2025). These increases pose a threat to many mammals, birds, reptiles and amphibians in the area. Since the COVID-19 pandemic, a trend of population movement from urban to rural areas has occurred in Canada. In addition, rising housing costs have led to increased development outside of urban centers. These trends are putting more pressure on lands that have previously been undisturbed (Rowe, 2025; Wheeler, 2022). Identifying road-kill hotspots and the use of existing

crossing structures by wild animals will aid in identifying current threats to biodiversity and possible mitigation strategies for the region.

STUDY AREA

Route 117 (R117) and Chemin du Lac Supérieur (Ch L.-S.) transect Mont Tremblant, Lac-Supérieur, and Mont Blanc, Quebec. The region features mixed forests, with deciduous trees like sugar maple at lower elevations and conifers like balsam fir at higher elevations.

Common mammals species in the area include White-tailed deer, moose, Black bear, beaver, Red fox, River otter, raccoon and Snowshoe hare, American marten, mink, fisher, and multiple small rodent species. Sépaq identified the wolf as a species of particular interest in its Conservation Plan 2022-2027 for Mont Tremblant National Park. Amphibian and reptile species of interest include Eastern garter snake, common snapping turtles, map turtles, painted turtles, wood frogs, and spring peepers (especially around Lac Supérieur).

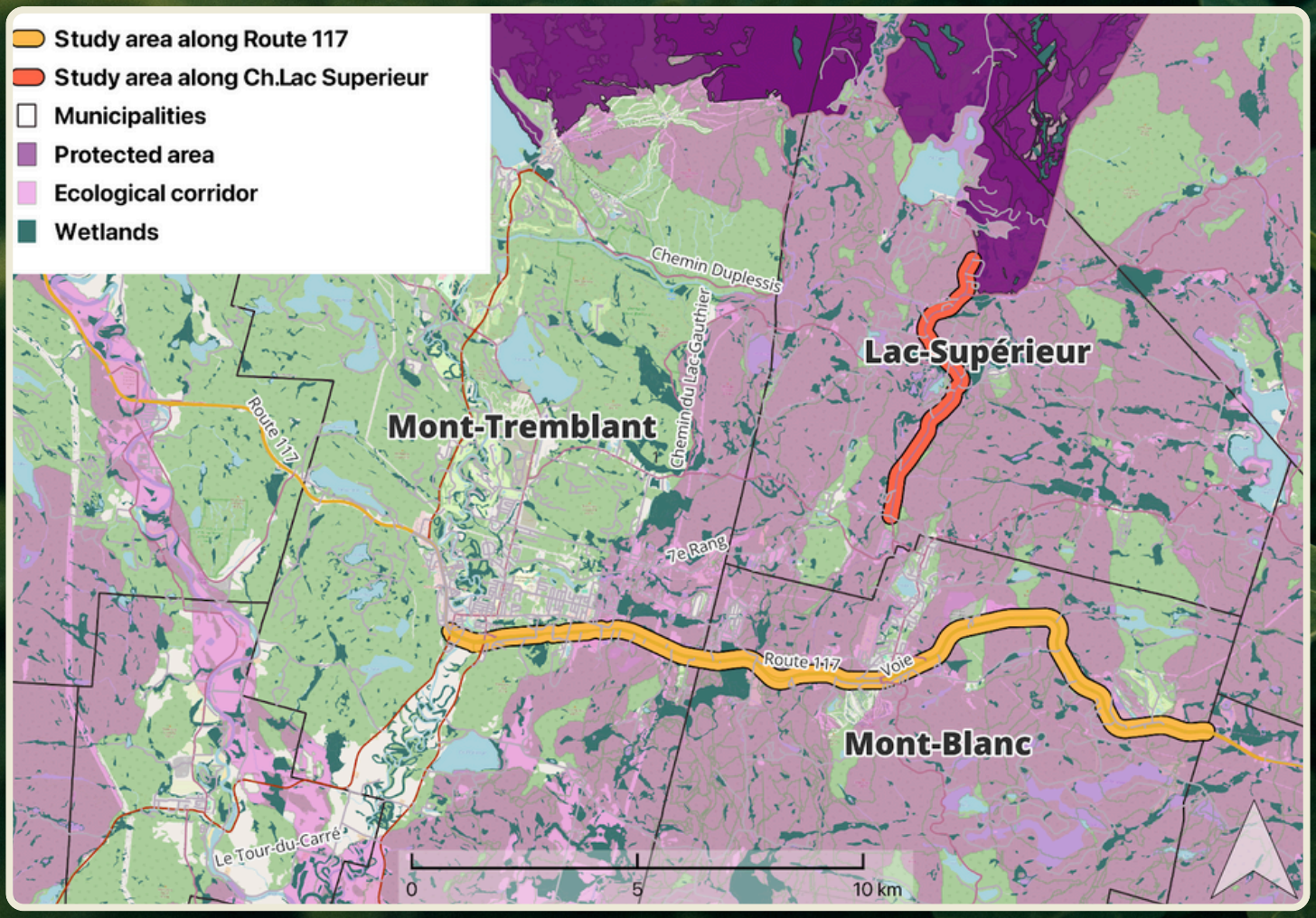

Figure 5. Map of study area in Laurentians featuring ecological corridors, protected areas, and wetlands (types: marsh, peatland bog, peatland fen, peatland forested, shallow water, swamp, and wet meadow) Quebec. Source: Daphné Mary - Éco-corridors Laurentiens, 2025 and OpenStreetMaps, 2025.

RESEARCH QUESTIONS

1. **At what locations and how often are animals killed on Route 117 and Chemin du Lac-Supérieur in the Laurentians?**
2. **What species use the existing crossing structures below them?**
3. **How are road mortality and the use of crossing structures related?**

SUBQUESTIONS RELATED TO RESEARCH QUESTION 1:

1. **Which species present in the Laurentians are found dead on the roads and which are not?**
2. **How do the road mortality numbers differ in time and space between species?**
3. **How do the results differ between different road sections?**

SUBQUESTIONS RELATED TO RESEARCH QUESTION 2:

1. **Which species present in the Laurentians are using the crossing structures and which are not?**
2. **How do the ratios of successful crossing through the structure and aversion to the structure differ between species and different times of day?**
3. **How do the results differ between the structures?**
4. **How do human activities impact the use of crossing structures by different species?**

SUBQUESTIONS RELATED TO RESEARCH QUESTION 3:

1. **How do the numbers of animals killed on different road sections relate to their distance to the existing crossing structures?**
2. **How does the frequency of use of the structures by different species relate to the number of animals killed on the road sections at different distances from the structures?**

Fieldwork for this project will occur over two years and will include road mortality surveys to answer questions 1 and 3, and culvert observation using cameras to answer questions 2 and 3. Road mortality surveys will occur in summer from May to August in 2025 and 2026. Camera observation of culverts will extend from July 2025 to May 2027. Camera observation will be suspended from December to March due to snow preventing access to the culverts.

METHODS

ROAD MORTALITY SURVEYS (QUESTION 1)

In summer 2025, road mortality surveys were conducted from May to August inclusively on both roads to locate hotspots of mortality. Surveys were conducted in the mornings and evenings for eight periods of ten days. For the first period, Ch. L.-S. was surveyed in the morning while R117 was surveyed in the evening. For the second period R117 was surveyed in the morning while Ch. L.-S. was surveyed

in the evening. The time of survey for each road switched every period to assess the differences in mortality between morning and evening surveys. On R117, the surveys were conducted by car on a total road length of 34 km. The study team was composed of three researchers, one drove the car, one surveyed the emergency lane and right lane, the third surveyed the left lane. They drove at 20 km/h in the emergency lane and stopped at every carcass. On Ch. L.-S., the surveys were done by foot on a 10 km stretch of road. Two researchers walked on the side of the road, stopping at every carcass.

For each dead animal, the location was noted with QField and a GPS (Garmin GPSMAP 64). Relevant information was collected as well, such as species, position on the road, presence of fences, and the state of disintegration of the animal (Table 1). For each survey session, the start and end times were noted, climate data and the moon phase were documented, and traffic intensity was estimated. The mortality data collected in the surveys will be used to locate areas of concern (hotspots) on the roads and to assess the effectiveness of current structures for mitigating wildlife-vehicle collisions.

Species	Group	Lane Position	Fence Type	State
	Small Mammal	Right Shoulder	Fence	Fresh
	Medium Mammal	Emergency Lane	Guard Rail	Moderately disintegrated
	Large Mammal	Right Lane	Cable Barrier	Completely Disintegrated
	Bird	Left Lane	Concrete Jersey Barrier	Alive
	Amphibian	Left Shoulder		
	Reptile			

Table 1. Information collected for each animal found on the road.

MONITORING (QUESTION 2)

A total of 74 cameras were installed in 16 culverts and structures along Route 117 and Chemin du Lac Supérieur in Mont Blanc and Mont Tremblant (QC). Of these, 22 are time-lapse cameras set to take a picture every 30 seconds to capture herpetofauna, and 52 cameras are motion-triggered to capture mammals and birds. Cameras are visited monthly by the researchers and volunteers to change out SD cards and batteries.

Culverts along both roads were visited in April and May 2025 for evaluation for selection. Criteria to select the structures included presence of aquatic vegetation (to attract turtles), sun exposure at the culvert entrance, presence of muddy or sandy substrate, water depth, and water flow intensity. Of the culverts selected, 3 are monitored using only time-lapse photography, 4 are observed using only motion-triggered photography, and the rest are under observation of both time-lapse and motion-triggered cameras. The cameras were fully installed by late-July 2025.

Figure 6. Researcher installing a camera in a culvert (Photo credit: Daphné Mary, 2025)

A typical culvert observed by motion-triggered and time-lapse cameras has a total of 6 cameras, i.e., 3 at each entrance. One motion-trigger camera is pointing inward, angled downward to capture small and medium-sized mammals. Another is pointing outward, i.e., facing the culvert entrance. A third (time-lapse) camera is installed on the roof of the culvert pointing directly down to the substrate. This camera installation allows for the observation of small and medium-sized mammals and herpetofauna. Large mammals may be observed in the larger structures, whereas the concrete and plastic culverts being observed would not suit large mammals because they are too small for them. Pictures collected are to be examined with support by AddaxAI (van Lunteren, 2023). This software will identify photos with animals present and will support the identification of species. It will create count data which will be used to model the use of each culvert with predictive variables such as the culvert selection criteria and some other topographical and environmental features present at each culvert. The count data will be cross-referenced with the roadkill mortality data (question 1) to determine the relationship between road-kill hotspots and most-used culverts along both roads (question 3).

PRELIMINARY RESULTS

ROAD MORTALITY SURVEYS (QUESTION 1)

High numbers of roadkill were recorded in summer 2025 on both roads. On R117, a total of 249 carcasses were found comprising 55 different species (Figure 7; Table 2). The majority of carcasses were birds with a total number of 126 individuals from 27 different species. Sparrows and American crows showed the highest road mortality numbers at 30 and 20 individuals, respectively (Table 3). In terms of mammals, Red squirrels, raccoons and White-tailed deer were the most often found for small, medium and large size respectively. Amphibians and reptiles were not common.

On Ch. L.-S., a total of 1864 carcasses were found from 45 species (Table 2). The majority of carcasses were amphibians with a total number of 1571 from 8 species. Green frogs showed the highest road mortality number at 1058 individuals (Table 3). Small mammals, mostly Red squirrels, represented the majority of mammals killed on the road. For reptiles, Red-bellied snakes, Common garter snakes and Painted midland turtles showed the highest mortality numbers.

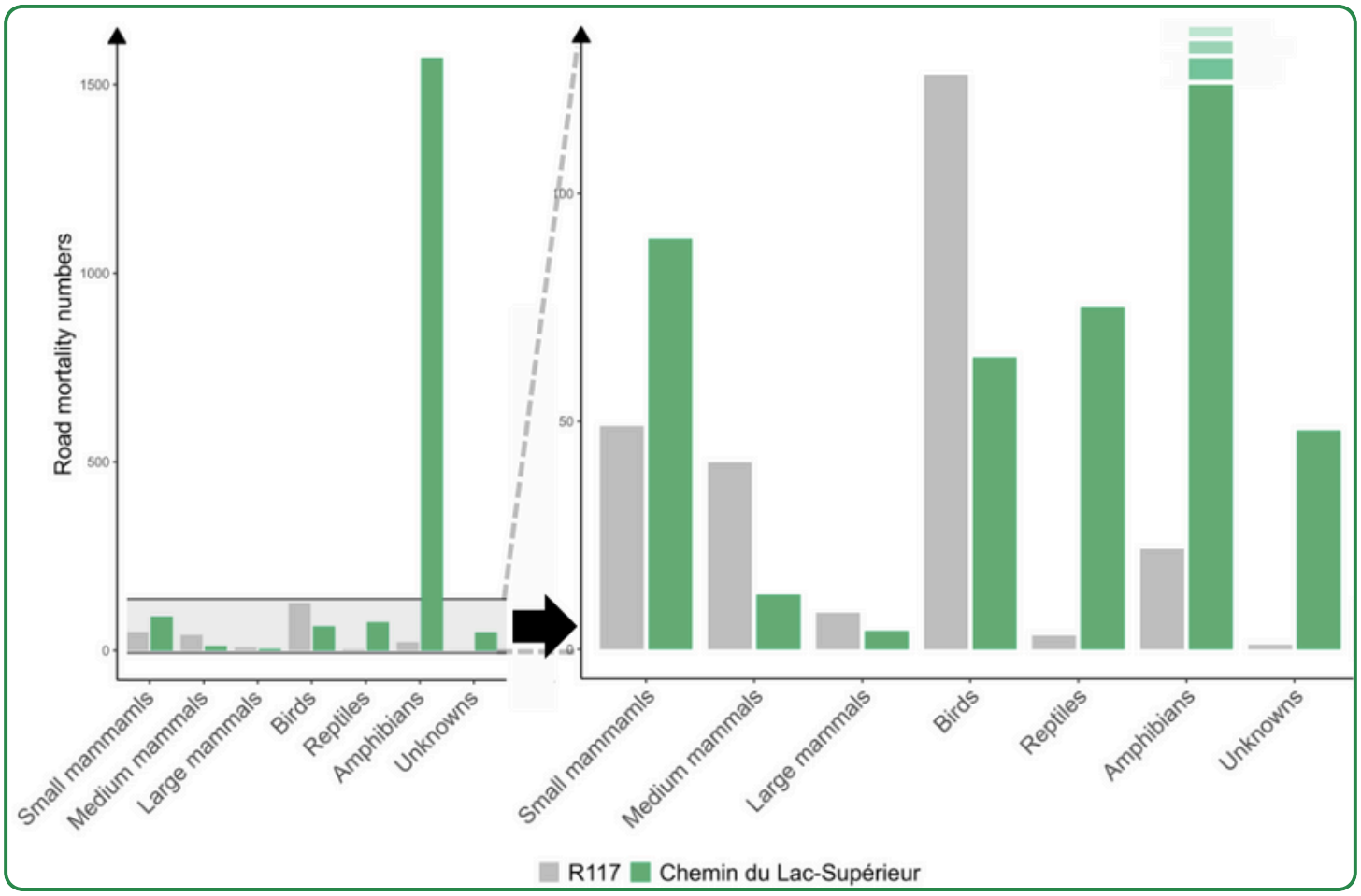

Figure 7. Road mortality numbers for each group along R117 (shown by grey bars) and Ch. L.-S. (green bars) in 2025.

Figure 8. Animals on the road. Raccoon (a), White-tailed deer (b), White-throated sparrow (c), American crow (d), Green frog (e) and Painted turtle (f). (Photo credit: Daphné Mary and Arielle Limoges, 2025)

Group	R117	CH. L-S.	Total
Small Mammals	49	90	139
Medium Mammals	41	12	53
Large Mammals	8	4	12
Birds	126	64	190
Reptiles	3	75	78
Amphibians	22	1571	1593
Unknown	0	48	48
Total Roadkill	249	1864	2113

Table 2. Road mortality numbers for each group of species found along R117 and Ch. L.-S. in summer 2025

Species	R117	Ch. L.-S.	Total	Species	R117	Ch. L.-S.	Total
Small mammals							
Vole (unspecified)	0	1	1	Masked Shrew	0	6	6
Meadow Vole	1	0	1	North American Pygmy Shrew	0	3	3
Rock Vole	1	0	1	Star-nosed Mole	0	1	1
Southern Bog Lemming	1	0	1	Hairy-tailed Mole	3	1	4
Southern Red-backed Vole	1	0	1	Hoary Bat	1	0	1
Mouse (unspecified)	3	2	5	Little Brown Bat	1	1	2
Deer Mouse	7	4	11	Northern Long-eared Bat	1	0	1
House Mouse	1	1	2	Eastern Chipmunk	0	4	4
Woodland Jumping Mouse	1	0	1	Eastern Gray Squirrel	3	0	3
Northern Short-tailed Shrew	0	1	1	Red Squirrel	11	28	39
Medium mammals							
American Marten	1	0	1	Groundhog	6	0	6
Long-tailed Weasel	2	0	2	Striped Skunk	6	3	9
Ermine	0	1	1	Northern Raccoon	11	0	11
American Mink	3	0	3	Red fox	1	0	1
Snowshoe Hare	9	3	12	Domestic Cat	2	0	2
Large mammals							
White-tailed Deer	6	2	8				
Birds							
American Crow	20	0	20	Thrush (unspecified)	1	2	3
American Robin	7	2	9	Hermit Thrush	2	0	2
Blue Jay	8	3	11	Swainson's Thrush	0	1	1
Cedar Waxwing	3	1	4	Turkey Vulture	1	0	1
Common Grackle	7	0	7	Blue-headed Vireo	1	0	1
European Starling	2	0	2	Red-eyed Vireo	2	0	2
Flycatcher (unspecified)	1	0	1	Warbler (unspecified)	1	3	4
Eastern Phoebe	1	1	2	Northern Parula	0	2	2
Gray Catbird	1	0	1	Chestnut-sided Warbler	2	0	2

Table 3. Road mortality numbers for the species found along R117 and Ch. L.-S. in 2025 (continued on next page)

Species	R117	Ch. L.-S.	Total	Species	R117	Ch. L.-S.	Total
Birds							
Indigo Bunting	1	0	1	Nashville Warbler	0	1	1
Mallard	1	1	2	Magnolia Warbler	1	2	3
Red-winged Blackbird	1	0	1	Pine Warbler	1	0	1
Rock Pigeon	3	0	3	Black-and-white Warbler	0	1	1
Ruffed Grouse	0	3	3	Tennessee Warbler	0	1	1
Sparrow (unspecified)	7	1	8	Cape May Warbler	0	1	1
Chipping sparrow	5	0	5	Winter Wren	1	0	1
Savannah sparrow	1	0	1	Wild Turkey	1	0	1
Song sparrow	11	2	13	Northern Flicer	1	1	2
White-throated sparrow	6	9	15	Yellow-bellied Sapsucker	1	0	1
Amphibians							
Anura (frogs and toads)	3	132	135	American bullfrog	0	2	2
American toad	2	235	237	Northern spring peeper	0	55	55
Wood frog	0	18	18	Gray treefrog	1	6	7
Pickerel frog	0	7	7	Salamander (unspecified)	0	1	1
Northern leopard frog	0	4	4	Blue-spotted salamander	0	7	7
Northern green frog	15	1058	1073	Red-spotted newt	0	7	7
Reptiles							
Snake (unspecified)	0	1	2	Smooth greensnake	0	4	4
Common gartersnake	1	24	25	Common snapping turtle	1	2	3
Red-bellied snake	1	29	30	Midland painted turtle	0	15	15
Unknown							
Unknown	42	154	195				

Table 3 (cont'd). Road mortality numbers for the species found along R117 and Ch. L.-S in 2025

WILDLIFE MONITORING (QUESTION 2)

A recent study conducted by Valérie Bolduc along Autoroute 15 and Route 117 observed three of the same culverts as this study. The findings from Bolduc et al. (2025) demonstrate that the presence of dry paths inside the structures has a significant positive effect on the use of the structures by mammals. Individuals from 11 mammal species were found to have fully crossed at least one of the structures. Similar findings are expected in this study, although less distance between the culverts selected in this study will lead to more insights into culvert selection. Additionally, the use of time-lapse cameras will allow for additional findings regarding the use of culverts by herpetofauna as a safe passage across roads.

CONCLUSION

As the study progresses, we seek to identify hotspots and relative usage of culverts to better understand animal movements in the region. The aim of this data collection is to identify areas along the roads where animals are most often killed. Those areas will then be recommended for mitigation efforts such as fencing or adapted crossing structures to accommodate animals so they can safely cross the two roads.

Figure 9. Photo (edited to increase contrast) of a racoon using a culvert along R117 at night to cross under the road. (Photo credit: Concordia University, 2025)

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