How Does the Small Mammal Cross the Road?

Hint: the answer is under the asphalt. BY KERRY FORESMAN

PHOTO ILLUSTRATION BY LUKE DURAN

A new UM study shows how shrews, voles, and other tiny travelers can move underneath Montana's growing number of highways

To meadow voles, Columbian ground squirrels, and many other small mammals, a highway is a sea of pavement, the opposite shore far from sight. As Montana's highway system expands, those seas are widening. For example, the current expansion of U.S. Highway 93 through the Bitterroot Valley south of Missoula to four lanes has created a 90-foot-wide swath of pavement and shoulder that many small animals attempt to traverse. (For a person, that would be like trying to run the length of four asphalt football fields.) Not only do meadow voles and other small mammals move slowly on short legs, they have to dodge high-speed vehicles and avoid predators that can see them clearly on the flat surface. Highways and wildlife don't mix well.

States don't record the number of small mammals killed each year on highways, but many document collisions between deer and vehicles. Michigan, for example, reports roughly 35,000 deer collisions per year, resulting in about 1,500 human injuries. The Insurance Institute for Highway Safety estimates that 1.5 million wildlife collisions occur yearly in the United States, totaling $1.1 billion in property damage. According to the U.S. Department of Transportation, approximately 200 people die each year nationwide in vehicle collisions with animals, which also cause nearly 30,000 injuries.

Most of this damage comes from deer, not deer mice. But statistics indicate the trouble larger mammals have negotiating highways and the damage caused to both animals and drivers. Considering that small mammal populations vastly exceed those of large mammals, it's likely that vehicles kill millions of small animals each year. What's more, insurance and injury figures don't factor in the many accidents caused by drivers swerving to avoid squirrels, marmots, and other small mammals crossing the pavement.

The harm that highways cause wildlife will worsen. Montana has built or widened several highways over the past decade, such as Montana Highway 56 near Libby. Plans are in place to widen Montana Highway 83 between Clearwater Junction and Seeley Lake and several other highways.

Additional roads don't only cause more wildlife deaths. They also fragment wildlife habitat into smaller and smaller pieces. Grizzly bears, elk, and other big mammals need large, contiguous parcels of habitat to survive. But smaller mammals also suffer when their habitat it broken up, especially small wetlands. A short-tailed weasel, for example, hunts throughout a wetland to find enough prey to survive. Other small species that live in wetlands and woodlands are harmed by highways cutting through their habitats.

In 2000 the Montana Department of Transportation (MDT) began planning to widen U.S. Highway 93 to handle increasing traffic in the Bitterroot Valley. Framed by the Bitterroot Mountains to the west and the Sapphire Range to the east, the lush valley has seen a housing boom over the past 20 years. The area is also home to many small but productive wetlands. At public meetings held to discuss the proposed high-

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The author, a UM professor, holds a short-tailed weasel caught as part of the study in wetlands (above) off U.S. Highway 93.

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way, citizens voiced concern about possible damage to wetlands and small mammals.

No feasible way existed to prevent the highway from bisecting wetlands. But MDT biologists thought there might be a way to facilitate the movement of wildlife from one side of the highway to the other. When a highway is built in wet areas, engineers place small, 4-foot-diameter drainage culverts under the pavement to allow water to move unimpeded after rain and spring snowmelt. If water levels are low, small animals can run through the dry culverts, avoiding the vehicles above. But even a few inches of water in the culverts prevents small animals from using these tubular transportation corridors.

To solve the problem, MDT biologists designed long, metal shelflike platforms and placed them inside the culverts. The idea was that mice, skunks, badgers, and other small mammals could use the culverts even when water was present. Pat Basting, an MDT biologist, asked me if I could help him learn whether small mammals would actually use the shelves. I jumped at the chance and thus began three years of collaborative research.

The main questions I hoped to answer with the study were: Which species lived in the wetlands next to the highway? Which, if any, would purposely move through these small culverts? And which of these mobile species would adapt to walking on the shelf above flowing water rather than take their chances dodging vehicles above ground?

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Habitat fragmentation caused by highway growth has become a growing issue across the country. Believing this study would be a great way to enhance their future careers, I selected several talented undergraduates to help me and my technician, Jeremy Moran.

To learn which species lived in the immediate area, we placed a line of small live-traps next to the entrances of our three study culverts, located about 10 miles south of Missoula. We mounted remote cameras inside the culverts. Triggered by body heat and motion, the cameras photographed any animal moving along the corridor.

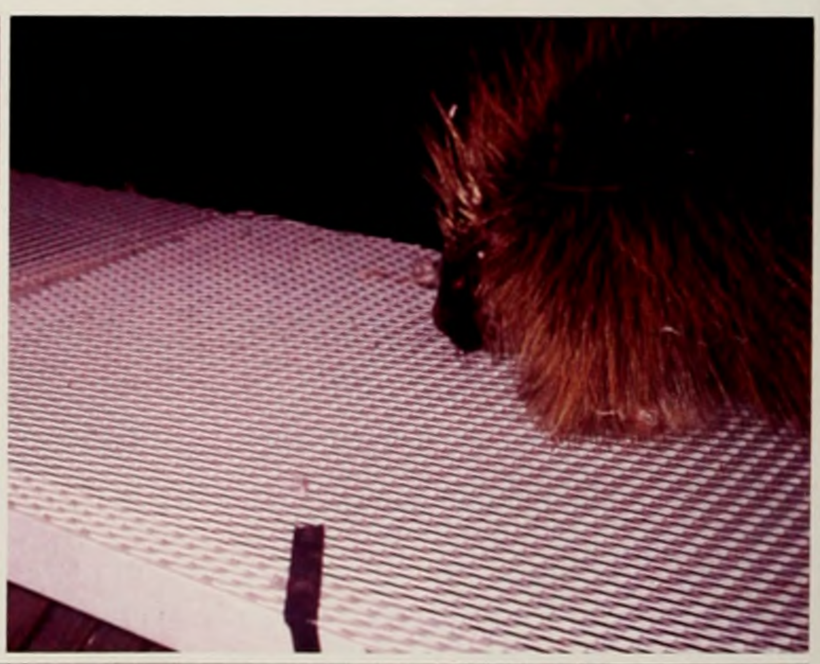
The traps showed us which species lived in the area and had the opportunity to use the culverts. The cameras told us which species actually used the culverts.

For nearly three years, we trapped 2,200 animals comprising 18 different small mammal species living in the wetlands. It turned out that many of these species did not use the culverts. After examining 4,500 photographs, we learned that house cats were the most common animal traveling in the metal corridors. In the 3-mile highway study section, we identified 12 different cats from neighboring homes traversing the culverts after dark. They were probably hunting mice and voles throughout the meadows before they went home for the night. We also saw many deer mice, raccoons, and striped skunks.

Another surprise: Few smaller species actually walked on the shelf, and then only on the frame and not the metal mesh floor. To learn why, we installed video cameras in the culverts. The cameras showed that the original 1-inch-square metal mesh floor had too much space to provide good footing. Watching mice was like watching a person trying to walk along railroad tracks. The tiny mammals would either turn back or run down the solid metal frame supporting the floor.

We began testing a variety of different floor materials. After a year of installing materials and reviewing thousands of photographs and hundreds of hours of video, we found a durable, fine-mesh floor surface that most species would use but still allowed water to pass through when water levels in the culvert rose.

We also redesigned the entrances to the shelves so that animals could reach them



The researchers were surprised to learn that house cats were the most common animal to use the original shelf design. Two red squirrels scamper along the finer mesh of the final shelf design. A porcupine lumbers along a shelf, cars and trucks on U.S. Highway 93 buzzing overhead. Of the 18 species inhabiting the adjacent wetlands, 14 used the culvert shelves the researchers modified during the three-year study.

from the side of a culvert entrance rather than directly in front of the entrance. In the original design, the ramp we built leading up to the shelf turned out to impede water flow.

One problem we hadn't solved was how to encourage meadow voles to use the culverts. Meadow voles were the most common mammal caught in our live-traps, yet they never showed up in photographs taken from inside the culverts.

Meadow voles evolved to live in tiny tunnels they make in grassy meadows, where they can hide from raptors such as kestrels. The entrance to the culverts, as well as the culverts themselves, apparently were too open for a vole's comfort. Yet we knew that voles were mobile and they probably needed to move to the other side of the highway.

We reasoned that they might feel comfortable entering and running through a narrow tube placed within the culvert. As an experiment, we bought 180 feet of rain gutter downspouts, which we taped together and hung in a culvert under a shelf. To make sure the voles could get into these tubes, we built a funnel extending sideways from the culvert entrance out into the grass cover.

To determine whether voles actually ran through the tubes, we used a tracking plate I'd developed several years ago to survey small forest carnivores such as American martens. The plate is covered in soot and surrounded by sticky contact paper that shows the tracks of animals running over it. We put the plate in the middle of the 180-foot-long tube, cutting a door in the side of the tube so we could see what transpired. I

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was so curious about whether or not the tube would work that I drove to the study site early the next morning and hurried hunched over down the culvert. I opened the tube door and was thrilled at what I saw inside—hundreds of black sooty vole tracks covering the contact paper. Not only had voles used the tube, but overnight it had become a veritable vole highway. (Later we learned that other small species also used the tubes, notably short-tailed weasels.)

With the design complete, I then worked with the company that made the culverts and shelves, Roscoe Steel & Culvert Co. of Missoula, to create new shelves and vole tubes for final testing. After installing these devices, my technician, students, and I analyzed several thousand additional photographs to learn what other small mammals used the new shelves in the culverts as transportation corridors. In the end, we identified 14 species, from shrews and deer mice to raccoons and even porcupines.

The shelves are so effective in allowing small mammals safe passage under highways that the University of Montana and Roscoe Steel now jointly hold a patent (see roscoebridges.com/prod_critter_crossing.html) on the device, which has garnered considerable interest from highway departments in other western states and Canada. We also designed the shelves to be installed in existing culverts, so agencies and counties don't need to wait for new construction before helping conserve small wildlife living along highways. Keeping in mind cost, we designed a shelf that will extend within a culvert under four lanes of highway to sell for less than $5,000. MDT has recently provided guidelines for the state suggesting that these structures be routinely considered, where appropriate, for all new highway construction.

The hazard of highways to wildlife is nothing new. Nearly 70 years ago, New York forester James Simons published the classic book *Feathers and Fur on the Turnpike*, the first analysis of the problem of wildlife mortality on highways. However, not until the 1980s did biologists begin seriously studying the subject. Most research has been on deer, elk, and bears. In parts of North America, such as in Banff National Park, over- and underpasses have been built to allow large animals to move from one side of a highway to the other. Now we know there are ways for small mammals to cross (under) the road, too.

PHOTOS BY KERRY FORESMAN

A pair of deer mice move through the culvert underneath the highway. A muskrat pauses to feed while on a shelf submerged in flood water. Without the shelves, most small mammals would not use the culverts when filled with more than a few inches of water. A short-tailed weasel makes its way home. The University of Montana researchers also learned that weasels and meadow voles prefer to travel through plastic tubes strung under the shelves.