FORUM

Animals Crossing the Northway: Are Existing Culverts Useful?

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Abstract

The proposed construction of the "Rooftop Highway" between Interstates 81 and 87 in Northern New York has drawn opposition from those concerned about conserving an important north-south animal migration route. This highway could affect the ecological integrity of the Adirondack ecosystem and further isolate the Park from other conservation areas such as Algonquin National Park. Proponents suggest that these effects could be mitigated by wildlife crossing points under the highway. To test the effectiveness of under-road passageways in the Adirondacks we monitored wildlife use of culverts beneath Interstate 87 with motion triggered cameras and snow tracking between 14 March and 29 April, 2002. Our results suggest that the culvert/underpass system beneath I-87 does not facilitate wildlife movement beneath the interstate, but does sustain regular human use. Therefore, we are dubious about the potential mitigating effects that standard wildlife passageways would have under the proposed "Rooftop Highway" were they to follow a design similar to those under I-87, and suggest that these would have to be significantly improved, at substantial cost, in order to promote animal movement.

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Introduction

The Adirondack region of New York is characterized by some of the lowest road densities in the Northeast. It has, however, become virtually isolated from other natural areas in the region by human settlement and agriculture (Figure 1). The area to the north is the least populated region abutting the Park and offers some chance for connectivity to northern wilderness areas in Ontario (Quinby, *et al.*, 1999). Large mammals, such as moose (*Alces alces*), have recently been documented making long-range movements from the Adirondack Park to the Algonquin National Park (Masters, 2001), and conservation planning to enhance potential movement corridors for wolves has been under way for several years (Quinby, *et al.*, 1999).

Some politicians and members of the business community have suggested that building an expressway just north of the Adirondack Park, connecting Interstate 81 and Interstate 87, would offer a significant economic stimulus to Northern New York (Tri-State Transportation Campaign, 2000). The proposed construction of this "Rooftop Highway" would widen the existing Route 11 from a two-lane road into a four-lane expressway, thereby increasing the existing environmental impacts of the route.

The presence of roads creates many documented negative impacts on wildlife. Perhaps the most direct and noticeable effect of roads is animal mortality through roadkill, particularly for reptiles and amphibians (Trombulak and Frissell, 1999). Collisions with vehicles cause the death of approximately one million vertebrates every day in the United States, which is a particular concern for endangered and threatened species, and can be a serious drain even on non-endangered populations (Forman and Alexander, 1998). Roads are also barriers to wildlife movement, causing individuals to relocate or redirect their movement patterns and limiting reproductive possibilities, thereby increasing the species' risk of extinction (Jackson, 2000; Primack, 1998; Lyren, 2001). Many species, such as black bear (*Ursus americanus*) and coyotes (*Canis latrans*), will simply avoid areas with high road density making them unsuitable habitat (Jackson, 2000; Kendrot, 1998; Trombulak and Frissell, 1999).

To help mitigate some of these impacts, environmentalists, engineers, and planners are developing ways to facilitate movement of wildlife across road barriers. One of the most popular measures is the use of wildlife underpasses (Forman and Alexander, 1998). Although generally behind other countries in addressing the myriad negative environmental impacts of roads, e.g., The Netherlands and Australia (Forman and Alexander, 1998), there are several examples of apparently effective wildlife underpass designs in America. These include Florida's herpetile culverts, the Florida black bear and panther under/overpasses (Roof and Wooding, 1996), as well as the salamander tunnels developed by the University of Massachusetts at Amherst (Jackson and Tyning, 1989).

Many different designs have been incorporated that target different species groups in different areas, but the general recommendations are that larger and more natural passes are the most successful, particularly for mammals (Jackson and

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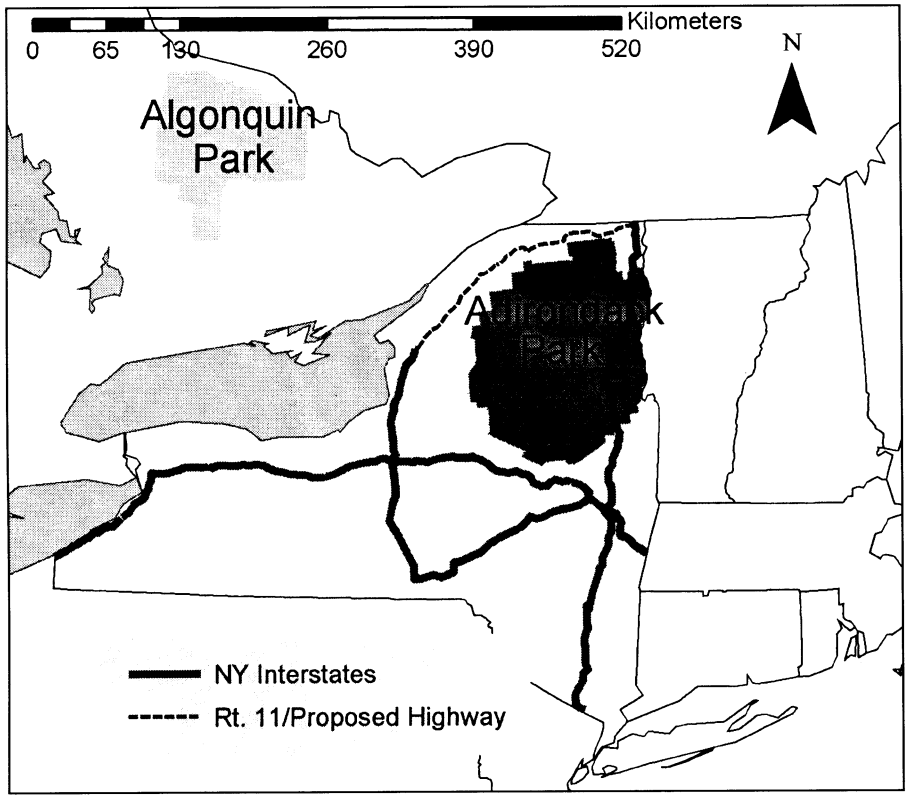

Figure 1.

Griffin, 2000). Reptiles and amphibians seem to prefer tunnels that are moist, naturally lighted, and are 30–100 cm wide (Jackson, 1997; Forman and Alexander, 1998). Small mammals are reported to favor tunnels that are inundated rarely and are at least 40 cm wide. Large mammals utilize tunnels that are 8 - 30 m wide, and are characterized by the least amount of human disturbance as possible (i.e. far away from homes and other development; Forman and Alexander, 1998; Jackson and Griffin, 2000).

The Adirondacks is presently affected by one interstate running through its boundaries. Interstate 87 (The Northway) was constructed in 1967 to connect Albany, N.Y. and Montreal. It has been the source of significant roadkill in the Park; for example, 18 of 37 (49%) lynx (*Lynx canadensis*) were hit by cars on I-87 during the reintroduction attempt in the early 1990's (Brocke and Gustavson, 1992). Because the proposed construction of the "Rooftop Highway" would complete the isolation of the Adirondack environment (Figure 1), it is of considerable interest to evaluate the extent to which standard culverts and underpasses constructed under I-87 are actually utilized by wildlife moving east-west.

There are a number of underpasses beneath I-87 and the goal of this research is to document wildlife use of these I-87 tunnels and the frequency of such use, to shed light on their potential to mitigate the negative effects of the proposed "Rooftop Highway." The original purpose of the existing I-87 tunnels is unclear. Some suggest they were intended for human use (i.e. hunting, hiking, etc.) while others maintain they were intended to facilitate the movement of white-tailed deer (*Odocoileus virginianus*) (M. Brown pers. comm.; F. Iaconetti pers. comm.). Regardless of their original purpose, these underpasses provide an opportunity to evaluate the effectiveness of tunnels in mitigating the ecological damage of another major interstate in the Adirondacks.

Methodology

The focus area of this project was the state land along I-87 within the boundaries of the Adirondack Park of New York. We determined potential monitoring locations by traveling I-87 and locating all underpasses/culverts/tunnels (herein referred to as culverts) that ran underneath at least one lane of traffic (either north or south bound). Thirty-eight culverts were found along a 141km stretch of highway, of which 19 were selected for the study conducted from 14 March 2002 to 29 April 2002.

The selected culverts were chosen specifically in order to provide a variety of locations including diversity in habitat, culvert size, extent of human disturbance, and degree of inundation. Initially, 17 locations were selected; over the duration of the study, however, some cameras were removed and relocated. Reselection of monitoring locations occurred mainly due to time and equipment constraints, but also as a result of any of several factors including theft of the monitoring device, frequent non-wildlife results, and/or seasonal inundation.

The 19 monitored culverts were categorized into four main groups: drainage, pedestrian underpass, truck use, and bridge (Table 1). The 7 culverts categorized as "drainage" ranged in size between 0.6m x 0.6m and 1.5m x 1.5m, and were at least temporarily inundated by water during the study. The 9 "pedestrian underpasses" measured 2.25m x 1.65m and were designated as such by the New York State Department of Transportation (M. Bonfey, pers. comm.). The two culverts categorized as "truck use" were 3.0m x 3.75m and 3.6m x 4.8m, and were classified as such based on the presence of an occasionally used dirt road. Finally, the one culvert categorized as "bridge" measured 0.9m - 4.5m x 36.9m and was a bridge over the Boquet River.

At most of the culverts (89%), forested habitat was present on at least one side of I-87. At nine culverts, the surrounding

Table 1. Dimensions and habitat descriptions for each camera monitoring location along Interstate 87 within the Adirondack Park

Monitoring Location (Culvert #)	Hght in mtrs.	Wdth in mtrs.	Lngth in mtrs.	Culvert Type*	Habitat on West Side	Habitat on Median	Habitat on East Side	Comments
1710-1230	0.60	0.60	33.45	Drainage	Pine Site	Open	Mixed Woods/Logged	House near south side
1710-1324	1.65	1.65	28.50	Drainage	Mixed	Pine Site	Pine Site	Road on north side
1710-1330	1.65	1.65	26.13	Drainage	Swamp/Marsh	Swamp/Marsh	Swamp/Marsh	Jenkins Swamp
1211-1094	3.60	4.80	91.50	Truck	Pine Site	No Median	Mixed Woods	Truck Culvert
1211-1114	2.25	1.65	57.90	Pedestrian Underpass	Pine Site/Logged	No Median	Pine Site	Near Stream
1211-1122	2.25	1.65	35.79	Pedestrian Underpass	Mixed/Stream	Open/Stream	Pine Site	Near Stream
1211-1148	2.25	1.65	55.26	Pedestrian Underpass	Pine Site	No Median	Pine Site/Stream	Near Stream
1211-1162	1.50	1.50	29.73	Drainage	Pine Site/Stream	Mixed/Stream	Pine Site/Stream	Stream
1211-1171	2.25	1.65	25.59	Truck	Pine Site	No Median	Pine Site/Logged	Truck Culvert
1211-1214	2.25	1.65	26.88	Pedestrian Underpass	Logged	Pine Site	Pine Site	
1211-1237	2.25	1.65	30.90	Pedestrian Underpass	Pine Site	Open	Pine Site	Next to Exit 30
1211-1269	2.25	1.65	59.70	Pedestrian Underpass	Pine Site/Swamp/Marsh	Open	Pine Site	
1211-1287	2.25	1.65	39.90	Pedestrian Underpass	Mixed	Open	Mixed	Near Stream
1211-1293	2.25	1.65	32.40	Pedestrian underpass	Mixed	Mixed	Mixed	Near Stream
1211-1356	0.90	0.90	35.73	Drainage	Mixed/Logged	Open	Mixed/Logged	Near U-turn
1211-1391	0.9-4.5	36.90	45.30	River	Pine Site	Open/Stream	Mixed	Boquet River
1211-1408	0.90	0.90	41.43	Drainage	Open	Open	Open	Beaver Disturbance
1211-1473	1.35	1.35	44.03	Drainage	Swamp/Marsh	Open	Pine Site/Swamp/Marsh	Stream
1211-1507	2.25	1.65	25.53	Pedestrian Underpass	Swamp/Marsh	Open	Mixed/Logged	

Swamp/Marsh – at least partially inundated, contains: *Alnus incana*, *Thuja occidentalis*, and/or *Typha latifolia*
Pine Site – contains: *Pinus stobus, Populus tremuloides, Tsuga Canadensis,* and/or *Betula papyrifera*
Mixed Woods – contains: Pine Site species, *Acer rubrum, Populus tremuloides,* and/or *Fagas Grandifolia*
Logged – evidence of recent logging activities, usually pioneer species beginning
Open – dominated by grasses, usually the result of roadside mowing or agriculture
Stream – waterway present
*Culvert type: one of four types based on dimensions and predominant use of each culvert.

habitat was categorized as agricultural, wetland, or logged areas (Table 1).

Wildlife use of the culverts of northern I-87 was assessed using camera traps and supplemental tracking. At each camera monitoring location we recorded the location and dimensions of the culvert and evaluated the surrounding habitat, including dominant tree species along with general habitat characteristics (i.e. logging, canopy cover, water presence, etc.).

We installed one motion sensitive camera (CamTrak South, Inc., Watkinsville, Ga.) at each location. Cameras were placed on either side of the highway depending on availability. Cameras located within the median were preferred in order to provide stronger evidence that the animal did in fact use the culvert to access the median. The cameras operated continuously with a 20-second delay between photos. Each camera was checked twice a week for a varied number of days (14 - 46 days, mean = 44.9).

The date and time of successful passes by an animal or human through a culvert was determined from time stamps on the photos. A successful pass was indicated either by an obvious photo of an animal within a culvert or if the photos chronologically suggested that the animal did pass through. One "pass" was counted as an individual animal/human successfully passing through the culvert and not returning within 3 minutes (Lotz et al, 1996). Opportunistic snow tracking was also used to supplement the results from the photographs. The presence of tracks was recorded whenever substrate permitted, as well as any other possible indications of animal activity.

Results

For the 17 cameras recovered (two were stolen), the mean duration of camera monitoring was 39.6 days. Photos documented only four animal passes, all made by Northern Raccoons (*Procyon lotor*) through one drainage culvert. Therefore, the rate of wildlife use of these 17 culverts based on camera results was 0.004 passes per 30 days.

When possible, photo results were compared with track records for each culvert. Snow was present at every monitoring location between 14 March and 1 April 2002, and again between 22 and 29 April 2002; some (n = 4) culverts had suitably sandy substrate for tracking without snow. Despite the number of animal tracks near the culverts, at no time did this animal activity result in a photograph. In four instances, the tracks/scat were present before or after the cameras were set up (Table 2). At the other four occasions, the animal did not move within the effective range of the camera.

Combining track records and photo results suggest that the culverts were utilized by raccoons five times during this study (increasing the passage rate to 0.005 per 30 days) and two times (fox and weasel) before the initiation of this study. Two "pedestrian underpasses" were used by a raccoon and a weasel, and a fox passed beneath the "bridge" over the Boquet River. Neither of the two "truck" culverts was utilized by animals. Of the six animal passes through four different culverts, three of the culverts had wetland habitat on at least one side of I-87, the other culvert was surrounded by mixed woods habitat.

Photos also documented 12 passes made by pedestrians and 20 passes made by humans on ATV's. The 12 pedestrian passes were made at three different culverts (all "pedestrian underpasses") at a rate of 0.009/30 days. One of the passes made by an ATV was made through a "truck" culvert, the other 19 through a single "pedestrian culvert" for a rate of 0.016/30 days. No documented wildlife passes occurred at any of these culverts.

Discussion

The results of this study make it clear that the culverts along I-87 benefit humans, but are rarely utilized by animals. There were virtually no passes recorded by the cameras and supplemental tracking during the duration of this study. The raccoons recorded in the four passes could have been foraging in the stream and may not have actually used the culvert as a means of crossing I-87. Similarly, the fox, as detected by its tracks, may have been foraging along the Boquet River and the weasel scat could also be a result of the animal foraging in the wetland adjacent to I-87.

The 30-day passage rates determined by this study (0.003 for all species, 0.053 for raccoons) were much lower than those found in similar published studies where culvert dimensions were much larger. Roof and Wooding (1996) determined 30-day passage rates for black bear to be 0.385, coyotes 0.308, white-tailed dear 0.154, raccoons 4.69, and rabbits 5.38 through culverts the dimensions of which were 2.4m H x 7.3m W x 14.3m L (Roof and Wooding, 1996). Where culverts were larger than those reported by Roof and Wooding 30-day passage rates for black bear were determined to be 0.33, white-tailed dear 10.80, fox 1.00, raccoons 21.07, rabbits 0.20, and bobcats 12.07 (Lotz *et al.*, 1996).

It should be noted that this study was conducted during the spring. Many animals native to the Adirondack Park restrict their movements during the winter and emerge to breed during the vernal months. Hence, animal activity and movement typically increase during the spring, especially for males. There is also potential for increased animal movement in the fall as offspring disperse, but our data do not address this type of dispersal movement.

An unanticipated by-product of this study was the documentation of high rates of all-terrain vehicle use within the Adirondack Park. While this activity is not illegal, our results suggest that high human use of culverts might be a contributing factor to the relatively low rates of wildlife passage. This issue deserves further scrutiny.

Implications for the "Rooftop Highway"

Larger roads allow higher traffic densities and speeds, thus increasing the existing negative impacts of a road as well as creating new negative impacts (Newmark et al., 1996; Ruediger *et al.*, 1999; Kendrot, 1998; Forman and Alexander, 1998). The proposed "Rooftop Highway" could create impacts on wildlife movement similar to those found along I-87. Thus, if the same small, unplanned and unsatisfactory culvert designs are used, wildlife movement would be severely restricted. This would clearly have negative impacts on north-south migratory animal movements between the Adirondack Park and Algonquin Provincial Park in Ontario, Canada.

Learning from successful wildlife underpass systems incorporated into the construction of other major highways across the country could mitigate the negative effect of the proposed highway. Most successful systems include underpasses that are 8–30m wide by >2.5m tall, and are combined with natural vegetation and fencing (Forman and Alexander, 1998). Careful attention is also required for the selection of underpass location. Placing underpasses in naturally covered/protected areas and in places where animals are already accustomed to crossing increases success rates (Finch, 2000). However, the pattern of culvert use by humans in our study suggests that simply making larger underpasses in the right locations will not solve the wildlife movement problem. It will likely be necessary to prohibit human use as well.

A well planned and expensive wildlife underpass system would be needed to mitigate any potential negative impacts on wildlife. According to one report (Lotz, *et al.*, 1996), a single effective wildlife underpass would cost approximately $180,000 based on figures from

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White-tailed deer.

Table 2. Supplemental tracking results displaying mammal activity near monitored culverts.

Culvert Number	Species Detected	Date	"Pass"?	Comment
1710-1324	White-tailed deer	Present before camera installation	No	
1211-1114	White-tailed deer	Present before camera installation	No	
1211-1114	Coyote	Present before camera installation	No	
1211-1148	Coyote	Present before camera installation	No	
1211-1214	Coyote	4/11/02	No	Animal was traveling north through median
1211-1214	Coyote	4/29/02	No	Animal was traveling north through median
1211-1237	Rabbit sp.	4/29/02	No	Animal apparently avoided culvert and attempted to cross I-87
1211-1269	Weasel sp.	Present before camera installation	No	Weasel sp. scats
1211-1293	Northern Raccoon	4/11/02	Yes	Animal did not move into the affective range of the camera
1211-1391	Fox sp.	Present before camera installation	Yes	

the late 1980's. It is unclear how many of these large underpasses would be needed for the proposed "Rooftop Highway," and such a recommendation is beyond the scope of this study. A starting point for determining the number of culverts is to determine where wildlife currently crosses Route 11. While large wildlife underpasses are preferable, they may not be necessary at every location. Herpetile and small mammal underpasses, for example, are much less expensive and could supplement the more infrequent large mammal underpasses, especially near wetlands. Design recommendations and suggestions for wildlife underpasses can be found in Jackson and Griffin (2000), Jackson (1997), Jackson and Tyning (1989), and Lotz, *et al.* (1996).

This study illustrates the complexities and challenges of trying to mitigate the negative effects of major interstates on animal movement. Small culverts get little use, while large (and expensive) culverts are so often used by humans that they get no wildlife use. Because studies conducted elsewhere unanimously indicate that larger culverts/underpasses are preferable to facilitate movement of all wildlife species, the next real question would be the extent to which motorized access should be limited to allow for effective wildlife passage through such a barrier. These major points, and the associated monetary expenses must receive careful consideration in any discussions over whether to build the "Rooftop Highway" or to leave Rt. 11 as it is.

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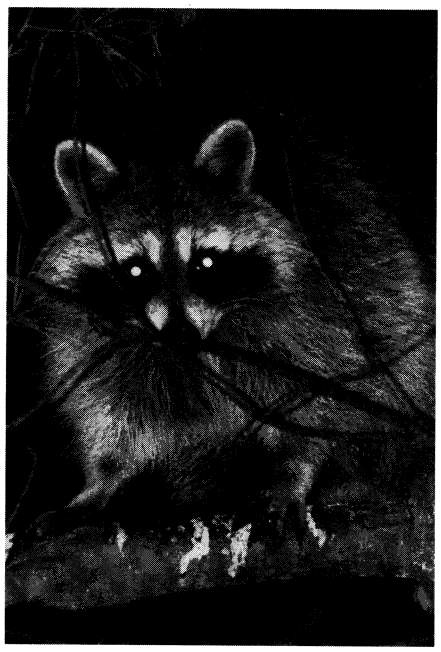

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Northern Raccoon

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