Wildlife Usage of a Constructed Wildlife Underpass

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Introduction

As part of the Route 2 Crosby's Corner Safety Improvement Project in Lincoln and Concord, Massachusetts, the Massachusetts Department of Transportation (MassDOT) constructed a wildlife tunnel adjacent to Mill Brook which provides habitat connectivity and safe passage for wildlife. The tunnel is 8-ft x 6-ft and spans 130 feet, bisecting the Route 2 corridor. Construction of the tunnel was completed in the fall of 2015. MassDOT developed a comprehensive wildlife monitoring protocol to document the efficacy of the tunnel including the use of track beds, camera traps, a road mortality survey, and snow tracking. The lack of sufficient snowfall during the survey period prevented snow tracking from occurring to date.

STUDY AREA

The wildlife tunnel was constructed under Route 2 east of Sandy Pond Road in the Town of Concord, Massachusetts. The 2010 Average Daily Traffic (ADT) for Route 2 is 48,800; for 2030, the ADT is projected to be 59,500.

The tunnel provides contiguous access to high quality wildlife habitat adjacent to the north and south entrances including the Hapgood Wright Forest and Crosby Pond to the north and Walden Pond State Reservation and Flint Pond to the south. Route 2 conveys traffic east and west and bisects high quality wildlife habitat in the vicinity of the wildlife tunnel.

Track Beds and Camera Traps

The study area of the track beds and camera traps was limited to the area of the tunnel and the immediate area adjacent to the entrances. The tunnel substrate consisted of exposed loose soil with a high gravel and cobble content approximately 1 foot in depth. The walls and ceiling of the tunnel were comprised of concrete. Immediately adjacent to the north and south entrances of the tunnel consisted of upland grassy slopes.

Road Mortality Survey

The road mortality survey included an area extending 25 feet perpendicular from Route 2 extending 500 feet in both directions on the north and south sides of the tunnel.

Habitats adjacent to Route 2 in proximity to the tunnel consist of residential housing, constructed stormwater basins, successional mixed coniferous/deciduous upland forest, and a wetland mosaic with an associated perennial stream (i.e., Mill Brook). Residences are located south of the wildlife tunnel. No residences are located north of the tunnel. Constructed stormwater wetlands are located north and south of the tunnel. The adjacent forests consist of a mix of coniferous and deciduous species dominated by white pine (*Pinus strobus*), oaks (*Quercus spp.*), black cherry (*Prunus serotina*), red maple (*Acer rubrum*), and glossy buckthorn (*Frangula alnus*). Wetlands are located north and south of the tunnel and are associated with Mill Brook. The wetlands are palustrine forested wetlands dominated by red maple, speckled alder (*Alnus incana*), red osier dogwood (*Cornus racemosa*), lurid sedge (*Carex lurida*), tussock sedge (*Carex stricta*), skunk cabbage (*Symplocarpus foetidus*), and spotted joe-pye weed (*Euthrochium maculatum*). Mill Brook is documented as a perennial watercourse that flows north across Route 2 via a culvert located approximately 30 feet east of the wildlife tunnel.

METHODS

Track Beds

Three track beds, one at each end of the tunnel and one in the middle, were installed. Each bed was 8-ft x 6-ft and constructed from 2x4 pressure-treated lumber and installed flush to existing grade. The frames were filled with finely graded sand smoothed with a soft-bristled broom.

The northern track bed was set flush with the entrance of the tunnel and extended inward 6 feet. The middle bed was set 75 feet in the center of the tunnel. The southern bed was installed with half of the bed in the tunnel and half extending beyond the entrance to capture crossing attempts wherein individuals may approach the tunnel, but not enter.

Track beds were monitored twice weekly for 8 weeks from May to July 2016. Each individual track path or other wildlife sign captured within the bed was photographed with a photomacrographic scale placed next it. Track paths and sign were identified to species level when possible or characterized according to similar group (e.g., rodent, canine) A degree of certainty ranging from 1 (uncertain) to 4 (very certain) was assigned to each track path or sign. The num-

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ber and direction of track paths and sign was also recorded by sketching the general location and path on a bed-specific datasheet. Wildlife sign immediately adjacent to the beds was also recorded.

Crossing rates were calculated by comparing the number of individuals per species that crossed each individual track bed to the total number of individuals per species crossing all three beds in each direction during each survey period. Individuals which crossed all three beds were considered to be have successfully crossed through the tunnel.

Camera Traps

Camera trap set-up were installed on the eastern wall of the tunnel adjacent to each of the track beds and consisted of Reconyx PC900 HyperFire Professional Covert Camera Traps enclosed in a HyperFire Series Heavy Duty Security Enclosure which was secured with shackle-protected padlocks. Cameras and security enclosures were attached to Reconyx Heavy Duty Swivel Mounts which were fastened to pressure-treated lumber mounting blocks. The blocks were then secured to the walls of tunnel with heavy-duty construction adhesive 32 inches from existing grade, approximately half-way up the tunnel wall. The camera traps were located at the corners of the track beds and angled approximately 45-degrees across the beds and slightly downward. The north and south cameras were angled towards the openings of the tunnel in an effort to capture wildlife attempts as well as successful tunnel crossings. Cameras were programmed so that multiple images were captured in rapid-fire succession each time the sensor was triggered. Silica packets were also placed inside each camera box to reduce the potential of moisture damage.

Cameras were monitored twice a week concurrently with the track beds between May and July 2016. Following the completion of track bed monitoring, the cameras were monitored every two weeks until October 2016 at which time the cameras, including locks and security enclosures, were removed for the winter. During each monitoring event, the camera trap assembly was inspected for damage, signs of wear, or other conditions that could lead to trap failure. Additionally, each SD card was exchanged for a blank card and the batteries were inspected and replaced if necessary. Once a month the silica packets were replaced.

Captured images were downloaded and sorted by survey period. Images were then characterized by the species which were captured. Crossing rates were calculated by comparing the number of individuals per species that were captured on each individual camera trap within a reasonable amount of time to the total number of individuals per species captured on all three traps in each direction. Individuals which were captured on all 3 camera traps travelling in the same direction were considered to have crossed the tunnel successfully.

Road Mortality

The road mortality survey area was divided into 4 separate quadrats divided by the wildlife tunnel and the centerline of the Route 2 travel lanes. Each quadrat was investigated using a meander survey to encounter any remains of wildlife struck by traffic and other signs of wildlife such as tracks and scat. A distinct field data sheet for each quadrat was developed which recorded the species (if identifiable), type of observation, and certainty of identification.

The Town of Concord Public Works Department and the MassDOT Highway Department were contacted to record data on any road mortalities that may have been recorded and subsequently removed (e.g., deer strikes). Data on the species, approximate location, and date encountered were recorded.

Data from the road mortality survey were analyzed to identify any common trends such as frequent highway wildlife crossings, time of year influxes, direction of migration, or other potential patterns.

RESULTS

Track Beds

In total, 18 different species of wildlife were identified. Table 1 summarizes the results of the track bed data. Turtles, field mice, and raccoons were the most frequently encountered wildlife within the track beds. The majority of the species were predominantly moving north through all of the track beds; however, rodents, meadow jumping mice, and Virginia opossum were travelling south more frequently, although only slightly. A total of 528 track paths were recorded from all three beds. Of those, 53 individuals successfully crossed the tunnel. Turtles, field mice, raccoons, fisher, and deer all successfully crossed the tunnel. Turtles overwhelmingly crossed the tunnel more frequently followed by raccoons, field mice, fisher, and deer. Table 2 summarizes crossing rate success.

Camera Traps

The camera traps also captured a total of 18 different species. Table 3 summarizes the camera trap data. Raccoons were the most frequently recorded species followed by eastern painted turtles, gray squirrels, groundhogs, and deer. Individuals most frequently were recorded as moving north; however, contrary to the track beds, the camera trap data shows that individuals moved north and south with similar frequency. Of the 336 individuals captured, 33 successful crossings were calculated. Raccoons crossed the tunnel most frequently, followed by turtles, gray squirrels, groundhogs, and deer. Table 2 summarizes crossing rate success.

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Road Mortality Survey

No wildlife strikes other than small reptiles, birds, and small mammals were observed. A total of 13 species remains were observed (mostly in the southwest quadrant). Eastern painted turtles were the most common species' remains encountered, with 198 strikes, predominantly located in the SW Quad. The unusually high number of eastern box turtle strikes is hypothesized to be the result of the drought conditions, with the turtles migrating from a smaller (drier) pond and wetland system south of the roadway to a larger wetland system north of the highway. The turtles were migrating through the SW Quad, northerly toward the larger wetland system. Twelve other species' remains were infrequent and observed within the roadway from vehicle strikes with only occasional encounters along an adjacent road or vegetated habitats. Other wildlife signs observed including scat, tracks, burrows, and numerous live encounters.

DISCUSSION

Using multiple methods to document wildlife usage of the tunnel was beneficial. Each method provided benefits and worked well in concert with each other.

Track Beds

The track beds were effective in accurately recording species' movements; however, it was often difficult to properly identify the individual tracks to species level due to being weathered and tracked over. As the season progressed, the north and south beds experienced aggressive weed growth resulting in false triggers of the camera traps and reduced the effectiveness of the beds.

Camera Traps

The camera traps captured clear pictures and provided confirmation of which species were utilizing the tunnel. They allowed for species identification of similar tracks and provided confirmation of which individuals successfully traversed the tunnel and at what times wildlife utilized the tunnel most frequently.

Several challenges to effectively capture pictures of the wildlife were encountered. The height and location of the camera mounts provided limited flexibility to adjust the angle of the camera and the height at which they were installed created blind spots. The narrow width of the field prevented the successful capture of individuals traveling quickly or that were too small to trigger the sensor. Views of the tunnel entrances were also not possible. Thus, attempts at crossing were restricted to wildlife at the entrances that at least partially entered the tunnel.

Road Mortality Survey

The road mortality survey effectively documented wildlife that were not utilizing the tunnel and were instead crossing Route 2. The walking meander survey provided an effective method of documenting wildlife; however, the danger of the Route 2 travel lanes prevented removal and extensive investigation of wildlife remains. The unusually high number of strikes of eastern painted turtle may have been associated with the unusual drought conditions in 2016, evidenced by migration from a smaller pond on the south side of the highway to a larger pond on the north side.

RECOMMENDATIONS

Documenting wildlife usage of the tunnel underpass utilizing a combination of track beds and camera traps has been a success. Despite the challenges noted above, the methodology of utilizing multiple techniques provides more thorough collection of data. In order to improve the quality of data collected, the following recommendations and improvements are provided:

Track Beds

- Line the beds with geotextile/weed barrier to reduce vegetative growth through the tracking medium (i.e., sand); and
- Refill the beds to within 0.25-inches with fine sand to replace the volume of settled sand.

Camera Traps

- Relocate the traps lower on the wall so that the motion sensors are just above the top of the track bed frames so more wildlife trigger the sensors;
- Reposition the traps to the center of the length of the track beds so the camera angle can be better manipulated to encounter a greater number of individuals as they cross the beds; and
- Add 2 additional camera traps that are installed outside of the tunnel and positioned to aim towards the entrances down the tunnel to document wildlife attempts.

Road Mortality Survey

- GPS locate and/or remove remains and/or other signs during each survey period. This is only feasible for lesser travelled roadways.

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Table 1. Summary of Track Bed Utilization

Taxonomic name	Common Name	South Track Bed		Middle Track Bed		North Track Bed		Total	
		North	South	North	South	North	South	North	South
Testudinidae spp.	Turtle	48	15	43	6	29	1	120	22
Anaxyrus americanus	American toad	1	0	0	0	0	0	1	0
Aves spp.	Bird spp.	2	1	0	0	2	0	4	1
Rodentia spp.	Rodent	1	5	3	5	1	3	5	13
Neotominae spp.	Field mouse	12	8	34	11	37	13	83	32
Zapus hudsonius	Meadow jumping mouse	3	4	2	1	4	4	9	9
Tamius striatus	Eastern striped chipmunk	3	1	4	2	1	1	7	4
Sciurus spp.	Squirrel	0	4	4	4	3	1	7	9
Sylvilagus floridanus	Eastern cottontail	1	0	0	0	0	0	1	0
Marmota monax	Groundhog	1	1	0	0	1	0	4	3
Didelphis virginiana	Virginia opossum	0	2	0	0	0	0	0	2
Mephitis mephitis	Striped skunk	2	1	4	0	1	1	7	2
Procyon lotor	Raccoon	18	20	22	8	33	13	73	41
Canidae spp.	Fox	0	4	6	4	9	4	15	12
Canis latrans	Coyote	1	1	2	0	0	0	3	1
Neovison vison	American mink	1	0	0	0	0	0	1	0
Martes pennanti	Fisher	7	6	6	5	5	5	18	16
Odocoileus virginianus	White-tail deer	1	0	1	0	1	0	3	0
Total		*100*	*73*	*131*	*46*	*130*	*48*	361	167

Table 2. Summary of Successful Tunnel Crossings

Taxonomic name	Common Name	Track Beds		Camera Traps	
		North	South	North	South
Testudinidae spp.	Turtle	22	1	–	–
Chrysemys picta	Eastern painted turtle	–	–	2	1
Neotominae spp.	Field mouse spp.	9	2	0	0
Sciurus carolinensis	Eastern gray squirrel	0	0	0	1
Marmota monax	Groundhog	0	0	0	1
Procyon lotor	Raccoon	12	4	5	22
Martes pennanti	Fisher	2	0	0	0
Odocoileus virginianus	White-tail deer	1	0	1	0
Total		*46*	*7*	*8*	*25*

– Species not observed

View of the south tunnel entrance and track bed.

A view looking south through the tunnel from the north track bed.

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Table 3. Summary of Camera Trap Captures

Taxonomic name	Common Name	South Track Bed			Middle Track Bed			North Track Bed			Total
		North	South	Attempt	North	South	Attempt	North	South	Attempt	
Chrysemys picta	Eastern Painted Turtle	4	1	0	3	2	0	2	1	0	13
Turdus migratorius	American robin	0	0	0	0	0	0	3	0	0	3
Cyanocitta cristata	Blue jay	0	0	1	0	0	0	0	0	0	1
Spizella passerina	Chipping sparrow	0	0	0	0	0	0	0	0	1	1
Melospiza melodia	Song sparrow	0	0	2	0	0	0	0	0	0	2
Rodentia spp.	Rodent spp.	0	0	4	0	0	0	0	0	0	4
Neotominae spp.	Field Mouse spp.	0	0	0	0	0	5	2	2	1	10
Zapus hudsonius	Meadow jumping mouse	1	2	6	0	0	0	0	5	15	29
Tamius striatus	Eastern striped chipmunk	0	0	1	0	1	0	1	2	0	5
Tamias carolinensis	Eastern gray squirrel	0	5	0	2	3	0	0	2	0	12
Tamais hudsonicus	Red squirrel	1	0	0	0	0	0	0	0	0	1
Marmota monax	Groundhog	1	2	0	0	2	0	1	1	0	7
Didelphis virginiana	Virginia opossum	2	0	0	0	0	0	1	0	0	3
Mephitis mephitis	Striped skunks	2	0	0	1	0	0	0	2	0	5
Procyon lotor	Raccoon	40	62	14	36	49	0	21	56	8	286
Urocyon cinereoargenteus	Gray fox	9	0	0	2	1	1	0	2	0	15
Martes pennanti	Fisher	14	1	0	6	2	0	5	2	4	14
Odocoileus virginianus	White tailed deer	0	0	0	0	0	0	1	0	0	1
Total		*76*	*73*	*28*	*51*	*60*	*6*	*38*	*79*	*29*	**446**

A white tail deer inspects the south track bed.

A fox with prey captured by the middle camera trap.

A Virginia opossum captured by the north camera trap.

A groundhog existing the north tunnel entrance.