National Park Service
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Natural Resource Stewardship and Science

2017 Amphibian Road Crossing Study

Cuyahoga Valley National Park, OH

Natural Resource Report NPS/HTLN/NRR—2018/1675

ON THE COVER
Ambystoma maculatum, spotted salamander, at its breeding pool in Cuyahoga Valley National Park.
Photo by Doug Marcum

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Abstract

Each year from February through April in northeastern Ohio, many amphibian species use temperature and moisture cues to emerge from their terrestrial burrows in the forest and begin migration en masse to vernal pools, where they breed. Cuyahoga Valley National Park (NP) has documented high quality vernal pools. Of the 14 species of anurans and five species of pond-type mole salamanders with spring migrations in Ohio, 11 (79%) have been documented in or near the park. Direct vehicle mortality during the migration season is one of many factors contributing to amphibian decline worldwide and the extensive road system throughout Cuyahoga Valley NP contributes to local seasonal mortality. Public land managers have an opportunity to preserve and protect the amphibians and breeding pools that occur within the boundaries of the lands they manage. This road crossing study was developed to estimate mortality rates during migration across Riverview Road, in a section of road that is adjacent to one of only about a dozen known breeding pools (Wetland 332, aka Everett Swamp) for ambystomid salamander reproduction within the park.

Heartland Inventory & Monitoring Network staff and Cuyahoga Valley NP Resource Management staff worked together to survey mortality during migrations across Riverview Road. We began surveys in late winter when weather conditions were appropriate for migrations, with forecasted low temperatures greater than 50°F and consistent precipitation or high humidity. We established a 212.14 m (696 ft) survey reach to estimate the mortality rates for amphibians moving east from the forested slopes along Oak Hill toward the western edge of Wetland 332. Counts of successful (live) and unsuccessful (dead) crossings were made throughout the survey reach.

We surveyed nine nights between February 28 and May 4 in 2017 and counted a total of 501 individuals, representing eight pond-breeding amphibian species. Migration activity was steady at the Riverview survey area during the breeding season because of the large and diverse breeding habitat at Wetland 332. However, 91.42% of the individuals moved on three "mass migration" nights. Spring peepers and American toads were the species observed most frequently during the survey and they also had the most road mortality, at 26.98% and 17.27% respectively. Wood frogs, spotted salamanders, grey tree frogs,and green frogs were also killed by road traffic. Mortality rates averaged 21.2% and were highest when weather patterns prompted amphibian movement to occur earlier in the night (8:40-9:40 p.m.) when vehicle traffic was not at its peak, but remained steady (32 cars/hr).

This study suggests that Wetland 332 is a valuable breeding pool for eight different amphibian species and efforts to minimize road mortality here could help to conserve local amphibian abundance. Cuyahoga Valley NP has an extensive road system adjacent to large wetland complexes and vernal pools, and similar sources of mortality have been observed in several other areas of the park. Some management considerations are provided regarding future monitoring needs and conservation actions.

Acknowledgments

Many individuals contributed to the success of this project. Cuyahoga Valley National Park's Operations Committee and Deputy Superintendent, Paul Stoehr, provided approval and management support for the road crossing study. Lisa Petit, Chief of Resource Management, and Maureen Finnerty, Field Operations Supervisor of Interpretation, Education, and Visitor Services allowed staff time towards completion of this project. Chris Davis, Ryan Trimbath, Dillon Dalton, Heather Berenson, Mike Greisiger, Margo Roseum, and Ashley Farinacci were on call and dependable field assistants. The Virginia Kendall Maintenance team provided silt fencing and traffic calming equipment to complete the project safely. They also provided a liaison with Summit County officials to help coordinate potentially conflicting road right-of-way maintenance schedules.

Introduction

Each year from February through April in northeastern Ohio, many amphibian species use temperature and moisture cues to emerge from their terrestrial burrows in the forest and begin migration en masse to vernal pools, where they breed (Andrews et al. 2015; Mitchell et al. 2006; Pfingsten et al. 2013). Cuyahoga Valley National Park (NP) has documented high quality vernal pools, which characteristically have forest cover within the surrounding 1000 meters (3280.84 ft), layered decaying leaf litter, woody debris, and no predatory fish (Micacchion 2004). Of the 14 species of anurans and five species of pond-type mole salamanders with spring migrations in Ohio (Pfingsten et al. 2013; FrogWatch USA™), 11 (79%) have been documented in or near Cuyahoga Valley NP (Table 1). Vernal pools are susceptible to degradation and loss nationwide, making amphibians that rely on these breeding areas correspondingly vulnerable (Hunter et al. 1999; Vial and Saylor 1993). Public land managers have an opportunity to preserve and protect these important ecological habitats within their boundaries.

Amphibian populations have been declining worldwide because of habitat loss, exploitation, environmental pollution and more recently, widespread disease and pathogens (Mitchell et al. 2006; Graeter et al. 2013). Direct vehicle mortality also contributes to amphibian declines during the migration season (Andrews et al. 2015). Amphibians usually live within a core terrestrial zone (450 ft or 137.16 m) around their breeding pools most of the year (Mitchell et al. 2006). Some amphibians, however, are highly mobile during the breeding season; some species travel up to 1600 meters (5249.34 ft) to their breeding pools (Pfingsten et al. 2013). These species may even follow the same route from their terrestrial home range to the breeding pool and back every year (Pfingsten et al. 2013).

The extensive road system through Cuyahoga Valley NP leads to seasonal mortality of amphibians during the breeding season (Bingham and Marcum, personal observations). This road crossing study was developed to estimate mortality rates during amphibian migration across Riverview Road because we suspected this area may have high levels of mortality. This section of Riverview Road is adjacent to one of only 10 known breeding pools (Wetland 332, aka Everett Swamp) for ambystomid salamander reproduction within the park (Bingham, personal observation).

Amphibian crossing road sign.

Table 1. Pond breeding amphibian species with spring migrations and approximate breeding times (marked with an X and green shading) based on recent documentation within Summit and Cuyahoga Counties (Pfingsten et al. 2013; FrogWatch USA™).

Order	Family	Common Name	Taxonomic Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Anura	Bufonidae	American toad*	*Anaxyrus americanus*	–	–	X	X	X	X**	X**	–	–	–	–	–
Anura	Bufonidae	Fowler's toad	*Anaxyrus fowleri*	–	–	X**	X**	X	X	X	X**	–	–	–	–
Anura	Hylidae	eastern cricket frog	*Acris crepitans crepitans*	–	–	–	X**	X	X	X	X	–	–	–	–
Anura	Hylidae	gray treefrog*	*Hyla versicolor*	–	–	–	X	X	X	X	X**	–	–	–	–
Anura	Hylidae	northern spring peeper*	*Pseudacris crucifer crucifer*	–	X**	X	X	X	X	–	–	–	–	–	–
Anura	Hylidae	western chorus frog*	*Pseudacris triseriata*	–	X	X	X	X	X	–	–	–	–	–	–
Anura	Ranidae	American bullfrog*	*Lithobates catesbeiana*	–	–	–	X**	X	X	X	X	–	–	–	–
Anura	Ranidae	northern green frog*	*Lithobates clamitans melanota*	–	–	–	X**	X	X	X	X	–	–	–	–
Anura	Ranidae	pickerel frog*	*Lithobates palustris*	–	–	X	X	X	–	–	–	–	–	–	–
Anura	Ranidae	northern leopard salamander*	*Lithobates pipiens*	–	–	X	X	X	X**	–	–	–	–	–	–
Anura	Ranidae	wood frog*	*Lithobates sylvatica*	–	X	X	X**	X**	–	–	–	–	–	–	–
Caudata	Ambystomatidae	Jefferson salamander*	*Ambystoma jeffersonianum*	–	X	X	X	–	–	–	–	–	–	–	–
Caudata	Ambystomatidae	spotted salamander*	*Ambystoma maculatum*	–	X	X	X	–	–	–	–	–	–	–	–
Caudata	Ambystomatidae	small-mouthed salamander	*Ambystoma texanum*	X**	X	X	–	–	–	–	–	–	–	–	–

* Species documented in Cuyahoga Valley NP (total of 11 species).

** Indicates months with lower likelihood of movement.

Methods

Heartland Inventory & Monitoring Network staff and Cuyahoga Valley NP Resource Management staff surveyed mortality during migrations across Riverview Road. Surveys began in late winter when weather conditions seemed appropriate for amphibian species in our area to migrate. Temperature and humidity triggers are known to vary among species (Pfingsten et al. 2013). We targeted nights with forecasted low (minimum) temperatures greater than 7.2°C (45°F) and with consistent precipitation in the forecast to try to capture the earliest migrants. We surveyed nine different nights between February 28 and May 4 in 2017. Survey teams tracked temperature, percent humidity, and rainfall intensity (light [mist], moderate [steady], heavy [torrential]) on each survey night to help determine what kind of local weather conditions seem to trigger the most movement.

The Riverview Road survey reach was north of Everett Road and South of Deep Lock Quarry, adjacent to Wetland 332, which is better known as Everett Swamp (Figure 1). Wetland 332 is a 1.23-hectare (3.03- acre) buttonbush swamp located in a lowland depression that is landlocked between Riverview Road and the Ohio and Erie Canal/Towpath Trail. Previous surveys (Mazzer et al. 1984) and staff observations indicated that this swamp was an active breeding area; mortality is evident on the road each year.

We set up a 212.14-m (696-ft) survey reach to estimate the mortality rates of amphibians moving east from the forested slopes toward the western edge of Wetland 332. Ideally, we would deploy drift fence across the entire survey reach to capture all amphibians crossing the road. However, because the length of the survey area was large, we established two types of transects to estimate "true mortality" (TRUE) and "inflated mortality" (INFLATED), similar to Gibbs and Shriver (2005). We divided the reach into eight sections, and installed 6.4-m (21-ft) wide drift fence transects (51.21 m or 168 ft total) equally across the TRUE sections. Transects were marked with pin flags to count amphibians crossing within those sections.

Counts of successful (live) and unsuccessful (dead) crossings were made throughout the entire survey. The transects were barricaded at the edge of the road with a drift fence/pitfall trap combination that captured all amphibians that may not have been observed during their successful crossing (Figure 2). The fencing was angled towards the road in the direction from which we were expecting amphibians. Pitfall traps were checked and emptied at the end of a 20-minute survey interval and true mortality was calculated every 20 minutes by dividing the sum of dead animals over the total number of animals (sum of live and dead) during that time period. Amphibians were removed after they were counted.

Northern two-lined salamander on Riverview Road in Cuyahoga Valley NP. NPS/R.J. Trimbath

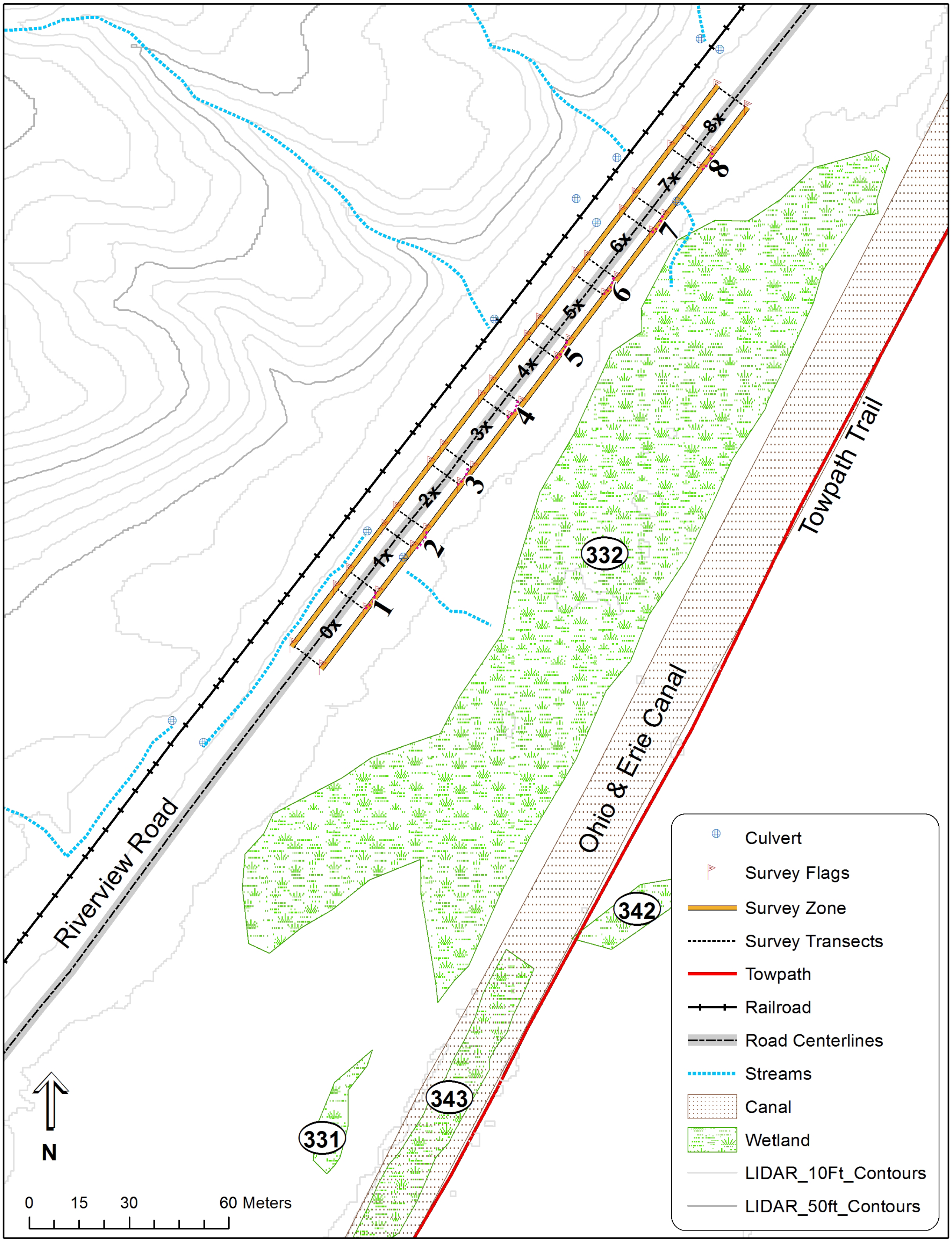

Figure 1. View of the Riverview Road survey area showing the survey zone, transects, nearby waterways, wetlands and park infrastructure in Cuyahoga Valley NP. The large whole numbers mark transects with drift fence installed (TRUE), and numbers with an x are transects without drift fence (INFLATED). Transect width was 18 m for INFLATED sections and 6.4 m for TRUE sections.

The same procedure applied to nine, approximately18-m wide (~59-ft) INFLATED mortality transects (160.94 m or 528 ft total), except these transects did not have the drift fence/pitfall trap barricade to retain amphibians that may have been overlooked during their crossing. The mortality rates in these sections are considered estimates and are likely inflated, or over-estimated, since some live animals may have crossed unnoticed between passes.

On survey nights, teams began the survey at 6:00 p.m. prior to March 12, 2017 and between 7:00 and 8:00 p.m. after March 12, 2017 (before and after daylight savings, respectively). Teams of two continually walked the survey reach, recording the following data in 20-minute intervals: (1) successful amphibian crossings (LIVE), (2) unsuccessful amphibian crossings (DEAD), (3) vehicle traffic and (4) weather (temperature, humidity, and precipitation). Counted animals were physically removed from the road between intervals. Pitfall traps were checked and emptied before the end of each 20-minute survey interval. Surveys were a minimum of two hours if there was little to no movement, but a maximum of five hours if movement was steady. The teams surveyed no later than 11:05 p.m. on the nights with most activity, which is when movement naturally tapered off. Live and dead individuals were tallied (1) within drift fence transects to calculate "true" mortality, and (2) within transects between drift fences, which provided "inflated" mortality rates. Vehicle traffic was counted and tallied for each 20-minute interval.

An unexpectedly warm night occurred on February 24, 2017 before our survey protocol was finalized and the survey reach was established. NPS staff scouted the site that night and observed a large migration of spotted salamanders. Staff recorded their counts of live and dead animals within a 40-minute visit to the site, and we note those observations in this report for record but they are not included in the data summary and analysis.

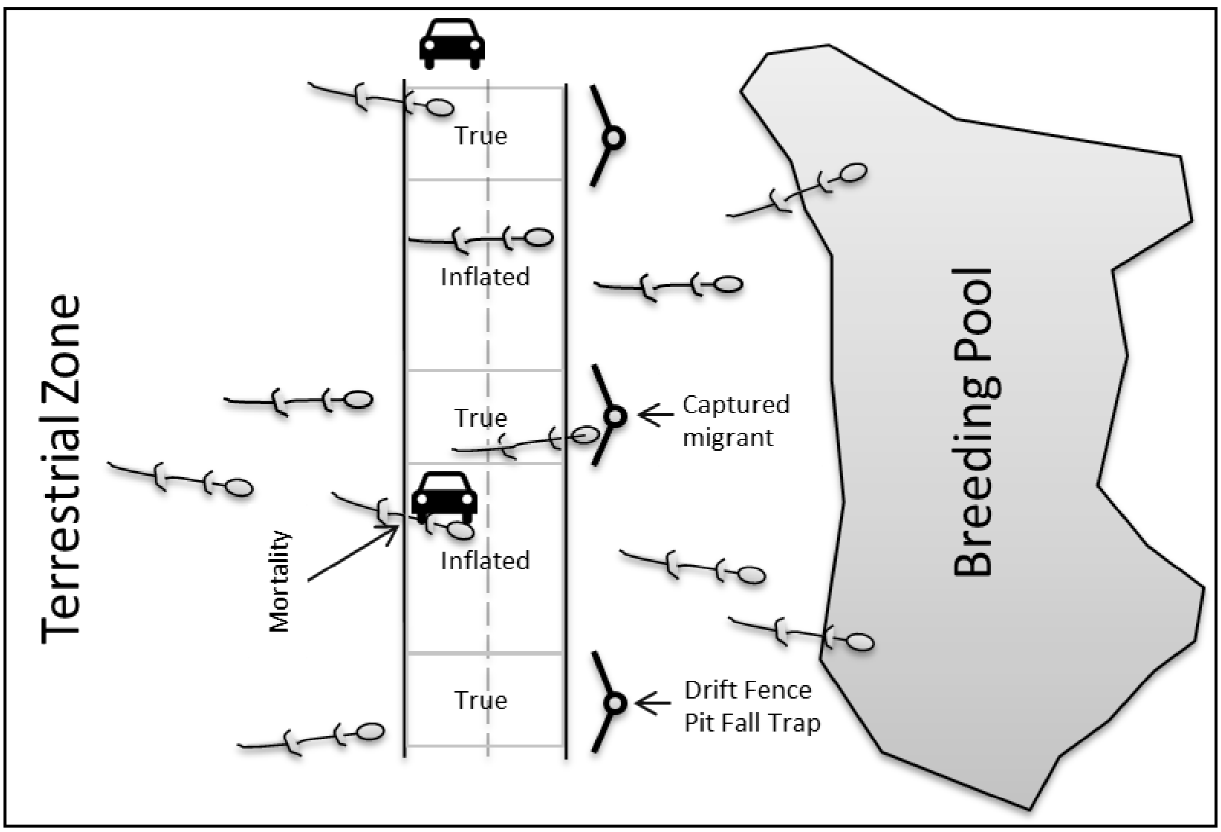

Figure 2. Sampling design used to estimate rates of amphibian road mortality at the Riverview Road survey area in Cuyahoga Valley NP. "True" represents the true mortality zone at drift fence transects where all amphibians are either seen or captured. "Inflated" represents the transects without drift fence where mortality rates may be inflated since successful crossing may have passed unnoticed. This diagram is based on an image created by Gibbs and Shriver (2005).

Results

We counted a total of 501 individuals, representing eight pond-breeding amphibian species across nine survey nights. Five species were most frequently observed (Figure 3), with spring peepers and American toads being the most abundant within the reach. They also suffered the most road mortality, at 26.98% and 17.27% respectively (Table 2). Wood frogs, spotted salamanders, gray treefrogs, and green frogs were also killed by road traffic.

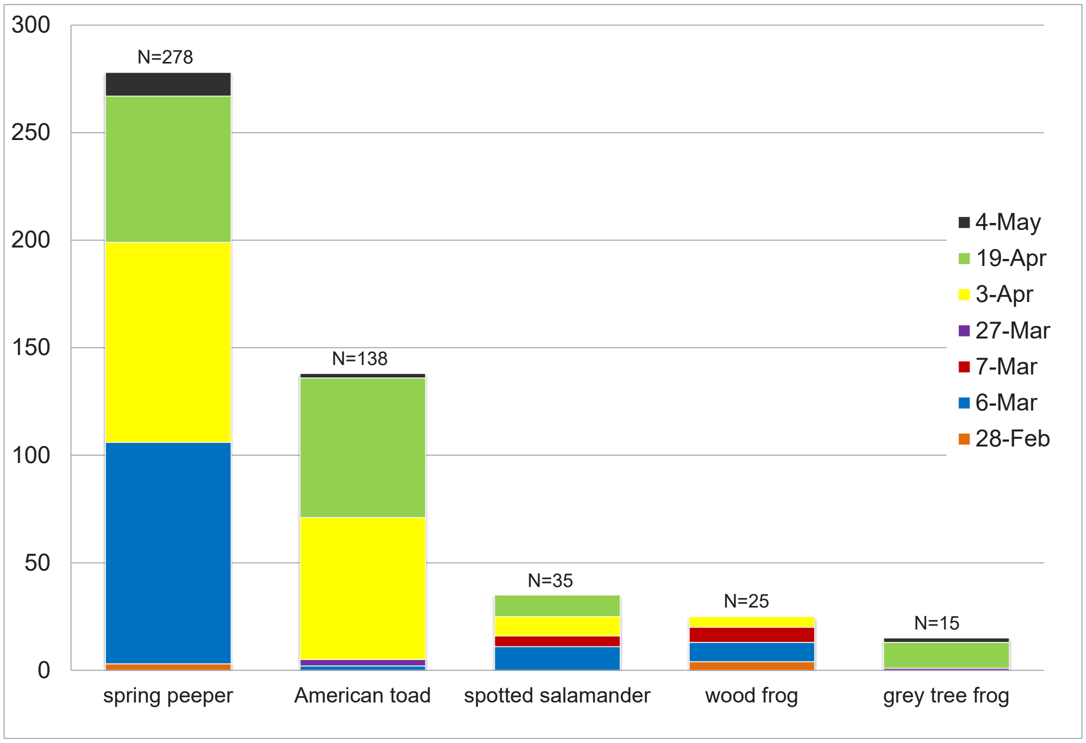

Figure 3. Most frequently observed amphibian species during the 2017 road crossing survey on Riverview Road in Cuyahoga Valley NP (not including April 20 and March 1, which only had 1 or 2 individuals of one species). Spring peepers and American toads were the most abundant species observed. Green frogs, bullfrogs, and salamanders within the Jefferson complex were also seen in low numbers during these dates.

Table 2. Mortality rates for all pond-breeding amphibians observed during the 2017 road crossing survey at the Riverview Road location in Cuyahoga Valley NP.

Scientific Name	Common Name	Live	Dead	Mortality Rate (%)
Lithobates sylvaticus	wood frog	23	3	11.54
Pseudacris crucifer	spring peeper	203	75	26.98
Anaxyrus americanus	American toad	115	24	17.27
Ambystoma maculatum	spotted salamander	32	3	8.57
Hyla versicolor	grey treefrog	14	1	6.67
Rana clamitans melanota	green frog	3	0	0
Lithobates catesbeianus	American bullfrog	2	0	0
Ambystoma sp.	Jefferson salamander complex	1	0	0

Northern leopard frog in Cuyahoga Valley NP. NPS/R.J. Trimbath

Table 3. Amphibian mortality survey dates and associated weather conditions during the 2017 road crossing survey at Cuyahoga Valley NP. Rainfall intensity was recorded as light (LR), moderate (MR) or heavy (HR).

Date	# Amphibians	Survey Duration (hrs)	Temperature (°F)	% Humidity	Rainfall Intensity
24-Feb*	48	1	61	80	LR/HR
28-Feb	7	3	55	88	None
1-Mar	2	2	47	85	LR
6-Mar	125	5	51	93	LR/HR
7-Mar	12	3	55	74	LR/MR
27-Mar	4	3	57	76	none
3-Apr	175	3	60	85	LR/HR
19-Apr	158	3	61	98	LR/HR
20-Apr	1	1.5	67	76	none
4-May	17	1.5	55	91	LR

* Data from this date are not included in any summaries or analyses. Weather are from an Akron, Ohio weather station (timeanddate.com) at 11:54 p.m. on each date.

Migration activity was steady at Riverview Road during the breeding season because of the large and diverse breeding habitat at Wetland 332. However, 91.42% of the individuals moved on three nights (Table 3). In general, amphibians started moving almost immediately around sunset and tapered off around 10:40 p.m. on nights with ideal movement conditions (rain, humidity > 84%, temps > 10°C [50°F]). Amphibians crossing in the vicinity of Transect 6 (5X, 6, 6X, 7, and 7X) comprised 44.3% (222 out of 501) of the total animals that crossed during the survey. Mortality rates were highest when weather patterns caused amphibian movement to happen earlier in the night when vehicle traffic was not at its peak, but steady. This usually occurred between 8:40 p.m. and 9:40 p.m. (Figure 4). TRUE amphibian mortality rates were calculated at 31.3%, 19.4%, and 17.9% on the three largest migration nights (Table 4). However, calculations of mortality across all survey nights for both TRUE and INFLATED sections were similar, at 21.2%. Road traffic volumes averaged 72 cars between 6:00 and 7:00 p.m., compared to 42 cars between 7:00 and 8:00 p.m., 32 cars between 8:00 and 9:00 p.m., 21 cars between 9:00 and 10:00 p.m., and 12 cars between 10:00 and 11:00 p.m. (based on nine surveys from February to May).

We suspect that the largest movement of wood frogs and spotted salamanders occurred on February 24. A total of 17 wood frogs and 31 spotted salamanders were observed within two 20-minute intervals (11:55 p.m. – 12:35 a.m.). However we were not able to estimate mortality since the observations were made before we began standardized surveys.

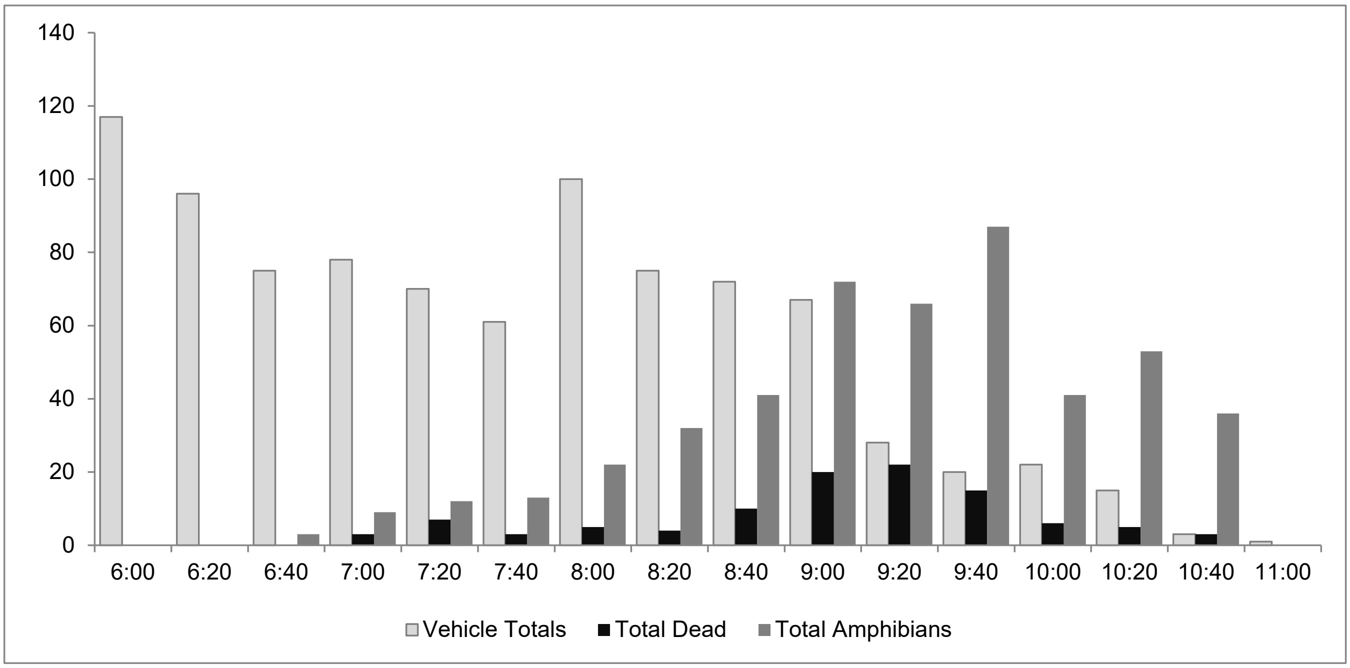

Figure 4. Total number of vehicles and amphibians recorded during 20-minute surveys intervals on migration dates with more than 10 individuals observed (March 6th, March 7th, April 3rd, April 19th, and May 4th) at the Riverview Road survey area in Cuyahoga Valley NP. The total number of dead amphibians is also shown.

Table 4. Road mortality estimates at the Riverview Road reach during the 2017 road crossing survey (February 28 – May 5) in Cuyahoga Valley NP. The TRUE values represent drift fence sections where all individuals that successfully crossed the road should have been captured. INFLATED values represent no-fence sections where individuals that successfully crossed may have been overlooked. The average mortality rates use the Live, Dead, and Total numbers for both TRUE and INFLATED sections on that night.

Date	TRUE Live	TRUE Dead	TRUE Total	TRUE Mortality	INFLATED Live	INFLATED Dead	INFLATED Total	INFLATED Mortality	Average	Most Abundant Species
28-Feb	2	1	3	33.3%	4	0	4	0.0%	12.5%	wood frog
1-Mar	1	0	1	0.0%	1	0	1	0.0%	0.0%	wood frog, Jefferson salamander
6-Mar	21	10	31	32.3%	80	14	94	14.9%	19.0%	spring peeper, spotted salamander, wood frog
7-Mar	3	0	3	0.0%	7	2	9	22.2%	16.7%	wood frog, spotted salamander
27-Mar	1	0	1	0.0%	1	2	3	66.7%	50.0%	spring peeper, American toad
3-Apr	25	6	31	19.4%	108	36	144	25.0%	24.0%	spring Peeper, American toad
19-Apr	23	5	28	17.9%	100	30	130	23.1%	22.2%	spring peeper, American toad
20-Apr	0	0	0	0.0%	1	0	1	0.0%	0.0%	American toad
4-May	6	0	6	0.0%	11	0	11	0.0%	0.0%	spring peeper
Average	**395**	**106**	**501**	–	–	–	–	–	**21.2%**	–

Dead spotted salamander crushed on Riverview Road at Cuyahoga Valley NP. NPS/R. J. Trimbath

Discussion

This study suggests that Wetland 332 is a valuable breeding pool for eight different amphibian species and efforts to minimize road mortality here would protect numerous amphibians. Road mortality rates for amphibians averaged 21% for both TRUE and INFLATED numbers over all times and dates that experienced any movement. The study does not account for the risk amphibians experience when re-crossing roads to return to their terrestrial habitats after breeding. Fall migration activity was observed at the survey reach on October 8th and 23rd, two warm, rainy nights (19.4°C [67°F] and 13.9°C [57°F], respectively; Marcum, personal observation). Therefore, these individuals are exposed to multiple potentially fatal encounters with vehicles. After tadpoles and larval salamanders metamorphose, they also seek terrestrial habitat in the fall and face similar dangers.

Population declines leading to eventual local extirpation in spotted salamanders are expected with annual risk of road mortality greater than 10% (Gibbs and Shriver 2005), and levels between 20 and 30% could lead to population extirpation within 25 years. Gibbs and Shriver (2005) suggest that limiting rates of traffic-caused mortality to less than 10% of all individuals crossing could maintain self-sustainable populations. While these population projections based on road mortality rates were developed for spotted salamanders, it is a good reference range to consider as an overall recommendation for amphibian species.

Some species, such as Jefferson salamanders and wood frogs, may migrate to their breeding wetlands before the ice has completely melted and there is still some snow cover (Pfingsten et al. 2013). These species will move early in the season, even when daytime highs are still around 7.2°C (45°F) and the lows (minimum temperatures) at night are above 4.4°C (40°F). Future road mortality surveys should attempt to capture these early migrants in February and early March by surveying when the temperature forecast for the night is greater than 4.4°C (> 40°F) with consistent precipitation or high humidity (> 85%). Based on our records, the temperature trigger at Cuyahoga Valley NP for most other species is greater than 10°C (50°F), therefore surveys can be scheduled with 10°C as the minimum temperature after the salamanders and wood frogs migrate.

Mating wood frogs on Riverview Road in Cuyahoga Valley NP. NPS/Sonia Bingham

Management Considerations

Spotted salamander crossing through a culvert at Cuyahoga Valley NP. NPS/R. J. Trimbath

In an effort to reduce amphibian mortality in Cuyahoga Valley NP to 10% or less, management options include, but are not limited to (1) closing roads during migration, or (2) developing migration tunnels under roads. These actions may be more effective in combination with educational programs and amphibian crossing signs.

Temporary Road Closures

Road closures and traffic diversions on potential mass migration nights (i.e., when temperature forecasts are 4.4°C [40°F] degrees at dusk with high humidity and rain in the evening forecast) may be a good short-term option for Riverview Road. Although we only observed three mass migration nights with these conditions in 2017, roads would have to be closed on all nights that have mass migration potential from late February to late April during times when traffic volume overlaps with migration. For example, the recommended closures on Riverview Road would extend from Everett Road to Major Road beginning at 7:00 p.m. Traffic is heaviest between 6:00 and 7:00 p.m. and amphibian movement is minimal during this time. Oak Hill Road and Akron-Peninsula Roads provide alternate routes around this reach.

Closures of Riverview Road on March 6, April 3, and April 19, would have reduced observed mortality by 91%. Temporary road closures will be inconvenient to the public, however, and require acceptance and support from a variety of stakeholders. Closures also require staff time and daily weather monitoring for conditions during the entire breeding season, including weekends. A long-term solution, such as migration tunnels, may be more convenient and sustainable over time.

Long-Term Migration Tunnels

The placement of underground migration tunnels, possibly by retrofitting existing drainage structures (i.e., culverts) or in addition to existing structures, might be a more desirable option where road closures would be too problematic. Tunnels are often coupled with road barriers to prevent attempted road crossings and to force amphibians to use the tunnels. Larger migration tunnels should reduce mortality rates for most amphibian species, but may not reduce hylid frog (i.e., spring peepers, grey tree frogs) mortality rates substantially since they are climbers and can scale barriers. Various passage designs exist (Andrew et al. 2015) and should be reviewed for feasibility. In general, designs would mimic natural and ideal conditions (e.g., low light, heat stability, air circulation, high humidity, and natural floor substrates). Federal road funds can be used for projects that help mitigate environmental damage (Andrews et al. 2015). As an example of a design consideration, amphibians crossing over Riverview Road might benefit from construction of at least one of these migration tunnels near Transect 6 (Figure 5). This was the location of the crossing of most (44.3%) amphibians, which are likely following the path of water flow down the slopes and across the road. If successful, this tunnel could be used as a case study for these types of structures in other locations.

We mapped four different stream channels on the forested tract to the west of Riverview Road that drain across the 2017 road crossing study reach (Figure 5). These streams must cross under the Cuyahoga Valley Scenic Railroad and Riverview Road through undersized culverts that do not have the capacity to handle the increased water volume during big storm events. The excess water flow is diverted away from the culverts, which creates flooding, erosion and sedimentation problems. These processes threaten the integrity of park infrastructure, create problematic maintenance concerns, and are ecologically destructive. Larger migration tunnels could be designed in lieu of the existing culverts to allow animal use as well as restore a more natural hydrological connection, to minimize flooding over the roads and reduce erosion and maintenance.

Amphibian mortality was documented at more than a dozen other migration sites within Cuyahoga Valley NP in 2017 and 2018 assessments (unpublished data). Because the risk to amphibians at Riverview Road exists at other sites within the park, we suggest these road closures and tunnels for those sites as well. We recognize, however, that all options to address this issue need to be carefully considered. We propose a decision-making process that fully captures and evaluates protection alternatives as the next step in this process.

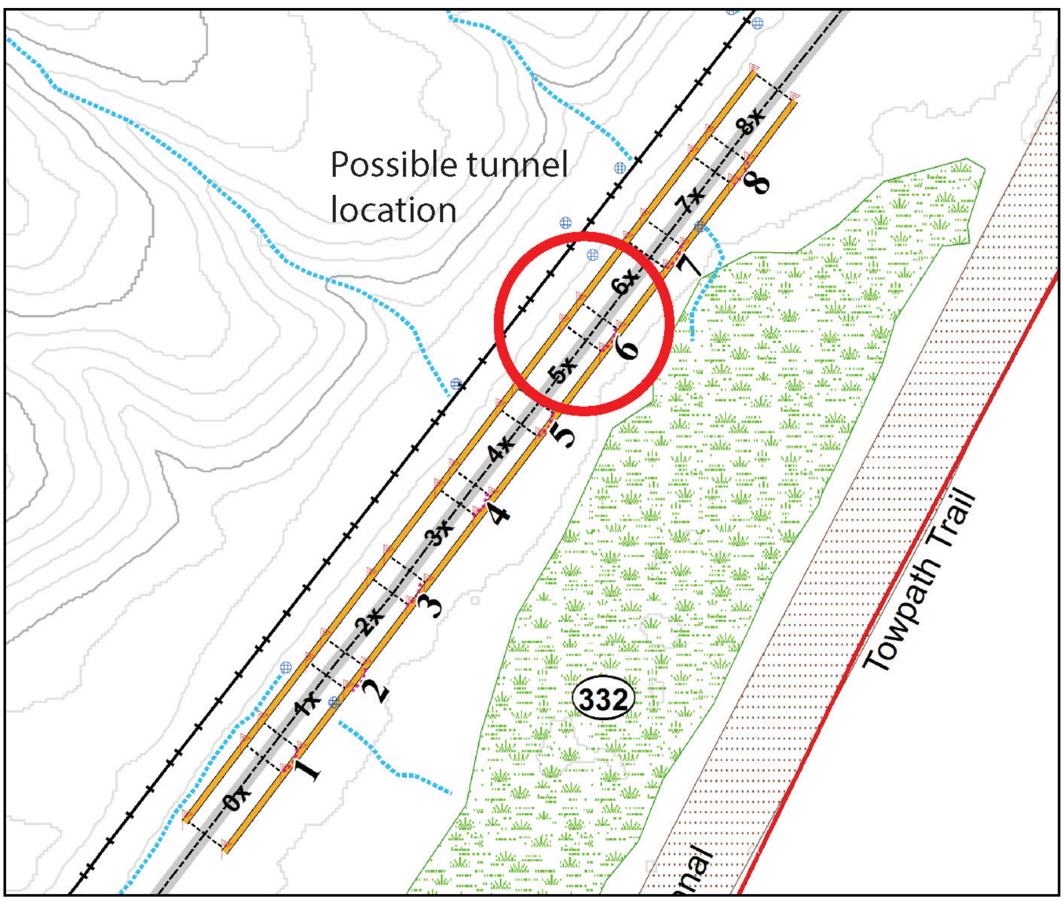

Figure 5. Zoomed in view of the Riverview Road survey area, showing the area (near Transect 6) that should be considered for the placement of a migration tunnel.

Literature Cited

Andrews, K. M., P. Nanjappa, and S. P. D. Riley. 2015. Roads and ecological infrastructure: Concepts and applications for small animals. John Hopkins University Press, Baltimore, MD.

Gibbs, J. P., and W. G. Shriver. 2005. Can road mortality limit populations of pool-breeding amphibians? Wetlands Ecology and Management 13: 281-289.

Graeter, G. J., K. A. Buhlmann, L. R. Wilkinson, and J. W. Gibbons (eds.). 2013. Inventory and monitoring: Recommended techniques for reptiles and amphibians. Partners in Amphibian and Reptile Conservation Technical Publication IM-1, Birmingham, Alabama.

Hunter, M. L., Jr., A. J. K. Calhoun, and M. McCollough. 1999. Maine amphibians and reptiles. The University of Maine Press, Orono, ME.

Mazzer S. J., L. P. Orr, and D. W. Waller. 1984. A wildlife survey of the Cuyahoga Valley National Recreation Area. Published Report-138498.

Micacchion, M. 2004. Integrated wetland assessment program. Part 7: Amphibian index of biotic integrity (AmphIBI) for Ohio wetlands. Ohio EPA Technical Report WET/2004-7. Ohio Environmental Protection Agency, Wetland Ecology Group, Division of Surface Water, Columbus, Ohio.

Mitchell, J. C., A. R. Breisch, and K. A. Buhlmann. 2006. Habitat management guidelines for amphibians and reptiles of the Northeastern United States. Partners in Amphibian and Reptile Conservation, Technical Publication HMG-3, Montgomery, Alabama.

Pfingaten, R. A., J. G. Davis, T. O. Matson, G. J. Lipps, Jr., D. Wynn, and B. J. Armitage (eds.). 2013. Amphibians of Ohio. Ohio Biological Survey Bulletin New Series. Volume 17 Number 1.

Vial, J. L., and L. Saylor. 1993. The status of amphibian populations: A compilation and analysis. ICUN/SSC Declining Amphibian Populations Task Force Working Document No. 1.

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