Why did the turtle cross the road? Examining culvert location and design to reduce Blanding's Turtle road mortality

Lauren White[1], David Burdick[1], Tom Ballestero[2]
[1]Department of Natural Resources, University of New Hampshire
[2]Department of Civil and Environmental Engineering, University of New Hampshire

Background: Blanding's Turtles are a threatened species in New Hampshire. They are often victims of road mortality, struck by vehicles while crossing roads that bisect their residential wetlands. They are a long-lived species that reach reproductive maturity around 14 years of age (Compton, 2007). As with many slow-to-mature species, the death of a few Blanding's individuals, particularly mature females, can be detrimental to population health.

Vehicle collisions pose a great threat to Blanding's population such that conservation efforts should be directed at reducing the probabilities of these encounters.

Eco-passages are widely used to reconnect fragmented landscapes and reduce vehicles collisions. For roads that bisect wetlands there is an opportunity to utilize existing hydraulic culverts for eco-passage functionality. This project will investigate a select list of stream crossings, highlight sites that pose high risk of road mortality for Blanding's, identify design components that promote successful passage and create conceptual restoration designs for five sites.

Fig. 1: Blanding's Turtle found crossing a road.

Fig. 2: Lauren checking a culvert for line of sight (LOS).

Research Questions: When designing eco-passages to promote and enable the successful passage of Blanding's Turtles, what design components should be included? And, out of all the existing identified culverts, which sites should be prioritized for restoration?

H1: A suite of factors (Table 1) are crucial for successful passage. Crossings without these factors will experience greater numbers of road mortality than crossings with these factors.

Fig. 3: Example of re-constructed eco-passage for turtles in Weymouth, MA. Picture taken during a research team trip to talk with MA Fish and Game and MA DOT about creating safe passageway for vulnerable wildlife.

Table 1: Five factors of culvert design that may predict likelihood of Blanding's using the culvert as an eco-passage

Factor	Optimal	Mechanism / Predictor	Source
Fencing and Guidewalls	Fences with ends curved back towards the wetland, embedded material, and angled lip	Directs wildlife back towards crossing, prevents burrowing under and climbing over the fence	(Woltz et al. 2008, Heaven et al. 2019, Read and Thompson 2021)
Outlet Drop aka "Perched"	No drop, water at grade	Blanding's show no evidence of climbing vertical heights >0.4m	(Read and Thompson 2021)
Line of Sight (LOS)	Full LOS, open top design	Increases success of passage as light increases	(Sievert and Yorks 2015)
Openness Ratio*	General: >0.82 ft Optimal: >2.45 ft	Increase success of passage as ratio increases	(Sievert and Yorks 2015)
Screen Barrier	None	Blanding's and other wildlife will be unable to enter or exit a culvert with screening present	

*Cross sectional area divided by structure length

References
Baker, S. K. 2022. An Adaptive Design to Reduce Animal Road Mortality: Analyzing the Effectiveness of a Fence-Culvert Ecopassage Design on Highway 401, Ontario. M.E.S., Queen's University (Canada), Ontario, CA.
Compton, B. 2007. Status Assessment for the Blanding's Turtle (Emydoidea blandingii) in the Northeast. Page 118. University of Massachusetts, Amherst, Department of Natural Resources.
Heaven, P. C., J. D. Litzgus, and M. T. Tinker. 2019. A Unique Barrier Wall and Underpass to Reduce Road Mortality of Three Freshwater Turtle Species. Copeia 107:92.
Read, K. D., and B. Thompson. 2021. Retrofit ecopassages effectively reduce freshwater turtle road mortality in the Lake Simcoe Watershed. Conservation Science and Practice 3:e491.
Sievert, P. R., and D. T. Yorks. 2015. Tunnel and fencing options for reducing road mortalities of freshwater turtles. Massachusetts. Dept. of Transportation. Office of Transportation Planning.
Woltz, H. W., J. P. Gibbs, and P. K. Ducey. 2008. Road crossing structures for amphibians and reptiles: Informing design through behavioral analysis. Biological Conservation 141:2745–2750.

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Summer 2022

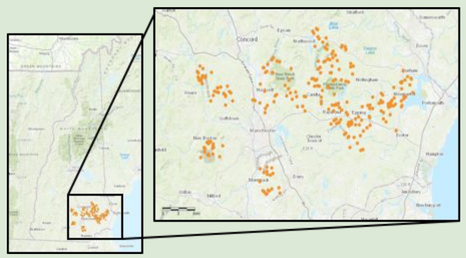

Fig. 4: 270 wetland-wetland road crossing sites within Blanding's Turtle Range in NH.

Actions:
1. Literature review and development of research question, H1, and Table 1
2. Creation of survey and protocol for assessing characteristics of 270 identified field sites
3. Completion of field site surveys and preliminary data analysis

Fall & Winter 2022-2023

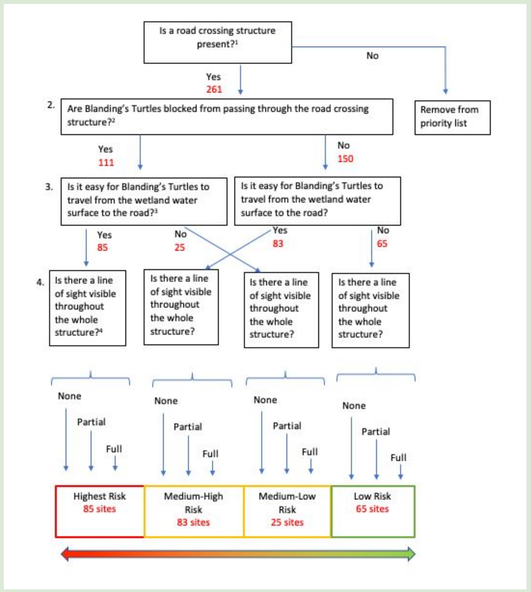

Fig. 5: Flow chart used to prioritize sites for restoration based on risk of road mortality.

Actions:
1. Finalize and code model that sorts the surveyed culverts according to the risk they pose for Blanding's Turtle road mortality based on four factors:
1) Culvert Presence,
2) Culvert Passability,
3) Road Accessibility and Exposure, and
4) Line of Sight

Spring/Summer 2023

Actions:
1. Select 12 sites, 6 high risk and 6 low risk to verify validity of model (Fig. 5).
2. Implement Monitoring Program
   a. Camera traps
   b. Road Surveys (modified from Baker, 2022)
   c. Rapid Visual Assessments (RVAs), (protocol from NHFG)
3. Analyze data to create design guidance for Blanding's Turtle safe road passage.

Fig. 6: Browning Strike Force Apex camera (picture: bit.ly/3Klo1Oh)

Monitoring design will use both TimeLapse+ and Motion Detection to capture images of wildlife interacting with road crossing structure or crossing the road.

Beyond

Expected Results:
Sites that were ranked as 'higher risk' per the model will have greater instances of associated road mortality than sites that ranked as 'higher risk'. Similarly, stream crossing structures that are associated with lower rates of road mortality will consist of more 'optimal' design factors as described in Table 1 than sites with higher road mortality.

Actions:
1. Create conceptual structure designs for five monitored sites using design guidance.
2. Share findings with state agencies in ME and MA
3. Engage in public education and outreach

Have questions or want to talk more? Contact: lauren.white1@unh.edu