



THE STATE UNIVERSITY OF NEW YORK

Potsdam

Final Report: Testing the effectiveness of turtle crossing signs as a conservation measure.

**To: Peter O'Shea, St. Lawrence River Research and Educational Fund
cc: Maria Toirac, New York Power Authority**

**From: Glenn Johnson, Department of Biology, SUNY Potsdam, Potsdam, New York
13676; 315 267-2710; johnsong@potsdam.edu**

Introduction

Paved road networks have been implicated in causing declines of many reptile and amphibian populations through habitat fragmentation and direct mortality (Ashley and Robinson 1996, Mitchell and Klemens 2000, Trombulak and Frissell 2000, Carr and Fahrig 2001, Smith and Dodd 2003, Semlitsch 2003). Turtles are notorious for high levels of road mortality caused by terrestrial migrations to breeding, wintering or summering habitat (Aresco 2005, Gibbs and Shriver 2002, Steen and Gibbs 2004, Borman and Sazaki 2006, Beaudry et al. 2008).

Blanding's turtles are currently officially listed as a Threatened Species in New York State and the New York State Department of Environmental Conservation (NYSDEC) is charged with the responsibility to develop recovery plans and identify management needs for Blanding's turtles. This species of large, semi-aquatic turtle appears to be near the limits of its eastward range in northern New York (Petokas and Alexander 1993, Johnson and Wills 1997), where they typically inhabit shrub swamps, including wetlands adjacent to and influenced by the St. Lawrence River and most tributaries in St. Lawrence and Jefferson counties. Nesting occurs in areas with exposed sandy substrates and may be up to 2 km from resident wetlands. Blanding's turtles are late to mature, reaching sexual maturity between 13 and 20 years of age, and may not breed annually, thus limiting their reproductive potential (Congdon *et al.* 1993). Nest success is very low, and in some years up to 90% of nests fail, typically due to predation by mammalian carnivores (Congdon et al. 1983, Johnson and Crockett 2009). Given these demographic parameters, loss of just a few adult female Blanding's turtles from a local population can have huge negative impacts on population viability.

Mitigation measures designed to reduce the impact of roads on wildlife populations and reduce animal-vehicle collisions, include barriers to prevent movement across roads, ecopassages over or under roads, warning signs designed to alter driver behavior by reducing speed or increasing awareness, and a variety of mechanisms to alter animal behavior, primarily targeted to ungulates (Forman et al. 2003). Here we investigated some aspects of the effectiveness of signs. We installed turtle crossing signs immediately prior to the nesting season for Blanding's

turtles when movement rates are high and removed them at the end of the nesting season (about 1 month). It was expected that signs will then be a novel feature on the roadway for both regular and occasional drivers of the selected routes.

The major objective of this SLREEF project was to determine the effectiveness of turtle road crossing signs at 3-4 previously-identified hotspots of mortality for Blanding's turtle (*Emydoidea blandingii*) and other turtle species.

Methods

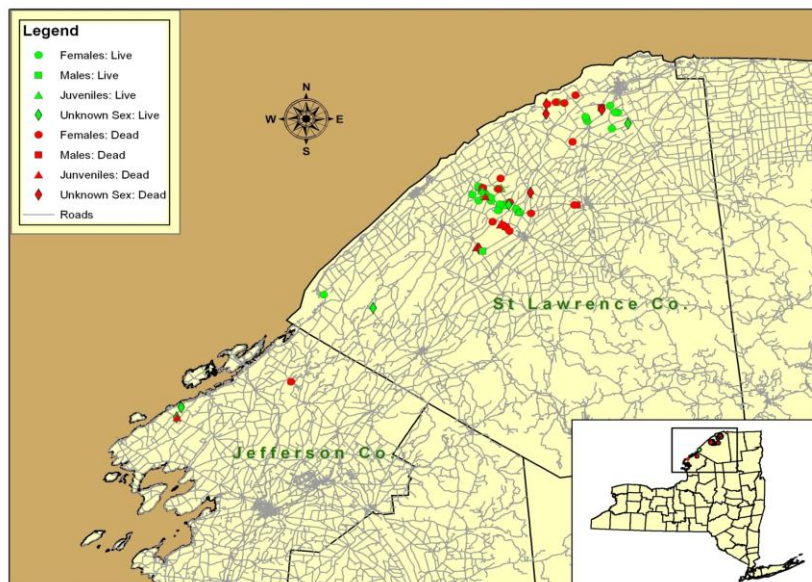


Fig. 1. Known Blanding's turtle road crossings in the North Country of New York State

The study area includes paved roads in St. Lawrence County, NY that were selected for survey based upon the known occurrence of road kill and/or sightings of Blanding's turtles on roads (Figure 1). We used two measures to determine the potential influence of turtle crossing signs, road mortality and average driver speed. We collected this information on 9 road stretches in 2008 (a 10th road was added in 2009) prior to signs being erected and again in 2009, when signs were placed along 5 roads. Signs (Appendix) were placed

on 1 June and removed on 31 June. It was expected that these signs will be a novel feature on the roadscape and this time frame coincides with the maximum movement of female Blanding's turtles in northern New York (Johnson and Crockett 2009).

To quantify the magnitude of turtle mortality, we conducted both driving and walking surveys, following the methodology of Langen et al. (2007) where all wildlife, dead or alive, encountered on the road was tabulated. Dead animals were removed from the roadway to prevent double counting. Driving surveys were conducted daily over the 30 day period, while walking surveys were conducted 1-2 times each week over the period 1 June-1 July. For walking surveys, at each survey point, we delineated a 50 m transect and walked in each direction from the center point, for a total road transect length of 100 m. Survey points at the 10 routes were located at the presumed center of each. Surveyors walked each side of the road, and tabulated any dead reptile or amphibian. For both surveys types, each animal found dead on the road was identified, and the precise location (± 5 m) was recorded using a Global Positioning System (GPS) with a Wide Area Augmentation System (WAAS) correction (spatial accuracy typically ± 5 m). Living animals detected crossing the road or walking along the roadside verge were also recorded.

Speed surveys were conducted at each route in mid-June in 2008 and 2009, during each of three time periods; 6-8 am, 4-6 pm, 8-10 pm. Speed was determined with a radar gun. In 2009, we also determined average vehicle speed at a point 1- 3 km away from the road stretch with signs. In 2009 we also conducted speed surveys at each route 14 days after signs were removed.

Results

Using data from the Driving Surveys, there was no evidence that there was a difference in road mortality, measured as Dead-On-Road (DOR)/km/day, between roads with signs and roads without (Table 1). Using a repeated measures ANOVA, no differences were detected in the interaction of Year and Treatment ($F = 0.00$; $P = 0.990$). Similarly, Walking Surveys (Table 2) also revealed no detectable significant differences in road mortality between roads with signs and road without signs or between years.

We found no differences in average vehicle speed on all roads with signs during the sign period and after the signs were removed; this relationship held between years as well (Fig. 2). Similarly, there was no detectable significant difference between average vehicle speed in the road stretch 2- 3 km before encountering a crossing sign and within the stretch bounded by crossing signs (Fig. 3). Highest average vehicle speed and traffic volumes were observed, as expected, along state highways.

Data collected during the 2008 and 2009 surveys revealed that painted turtles were the most commonly found turtle species, dead or alive, on both the walking and driving transects. Blanding's turtles were the least common road kill turtle found (Table 1). In 2008, 11 Blanding's turtles (5 DOR) were detected on survey routes and 8 Blanding's turtles (4 DOR) were detected in 2009. At one location, 7 Blanding's turtles were detected, suggesting a hotspot of road crossing.

Turtle crossing signs used for this study were different depending on whether the sign was erected along a county road (allowed use of silhouette) or state highway (did not allow use of silhouette). State highways are restricted to use of signs with Federal Highway Administration approval; the sign with the turtle silhouette was not approved as of June 2009.

At two of the five routes with signs, theft and vandalism was a significant factor in evaluating the effectiveness of turtle crossing signs. At one route (County Route 30) signs were repeatedly stolen and defaced by gunshots despite replacement.

Table1. Average hourly traffic volume (measured in 2009) and turtle road mortality measures from driving surveys in 2008 and 2009 in St. Lawrence County, New York.

Route	2008	2008	2008	2008	2009	2009	2009	2009	
Average Hourly Traffic Volume (Car/hr)	DOR All turtles (Blanding's turtles)	Live and DOR	Proportion DOR	DOR/km/day	DOR All turtles (Blanding's turtles)	Live and DOR	Proportion DOR	DOR/km/day	
No Signs									
Irish Settlement	7.0	2 (0)	17	0.12	0.013	5 (0)	23	0.22	0.030
Swamp Rd	12.7	0 (0)	1	0.00	0.000	1 (1)	2	0.50	0.023
CR 27	78.7	1 (0)	1	1.00	0.046	2 (1)	4	0.50	0.088
CR 37	259.3	4 (0)	5	0.80	0.080	3 (0)	4	0.75	0.054
SH 56	93.3	-	-	-	-	5 (0)	5	1.00	0.200
Subtotal		7 (0)	24	0.29		16 (2)	38	0.42	
Sign Added 2009									
Potsdam Morley Rd	70.0	1 (0)	3	0.5	0.029	4 (2)	5	0.80	0.107
CR 30	25.7	0 (0)	0	0.0	0.000	0 (0)	0	0.00	0.00
CR 39	42.3	4 (1)	7	0.63	0.055	7 (0)	12	0.58	0.080
SH 68	668.0	12 (1)	13	0.94	0.213	14 (0)	23	0.61	0.231
SH 310	123.3	3 (0)	8	0.46	0.077	1 (0)	2	0.50	0.024
Subtotal		20 (2)	31	0.69		26 (2)	42	0.62	

Table 2. Turtle road mortality measures from walking surveys in 2008 and 2009 in St. Lawrence County, New York.

Route	2008 DOR All turtles (Blanding's turtles)	2008 Live and DOR	2008 Proportion DOR	2008 DOR/km	2009 DOR All turtles (Blanding's turtles)	2009 Live and DOR	2009 Proportion DOR	2009 DOR/km
No Signs								
Irish Settlement	1 (0)	2	0.50	1.66	0 (0)	3	0.00	0.00
Swamp Rd	1(1)	1	1.00	0.71	0 (0)	0	0.00	0.00
CR 27	0 (0)	0	0.00	0.00	0 (0)	0	0.00	0.00
CR 37	2 (0)	2	1.00	1.43	5 (0)	5	1.00	2.50
SH 56	-	-	-	-	7 (0)	7	1.00	4.38
Subtotal	4 (1)	5	0.80		12 (0)	15	0.80	
Sign Added 2009								
Potsdam Morley Rd	1 (0)	1	1.00	1.00	3 (0)	3	1.00	1.66
CR 30	0 (0)	0	0.00	0.00	1 (0)	1	1.00	0.50
CR 39	1 (0)	1	1.00	1.25	4 (0)	9	0.44	2.50
SH 68	4 (0)	4	1.00	5.00	15 (0)	16	0.94	8.33
SH 310	3 (2)	5	0.40	5.00	0 (0)	1	0.00	0.00
Subtotal	9 (2)	11	0.82		23 (2)	30	0.77	

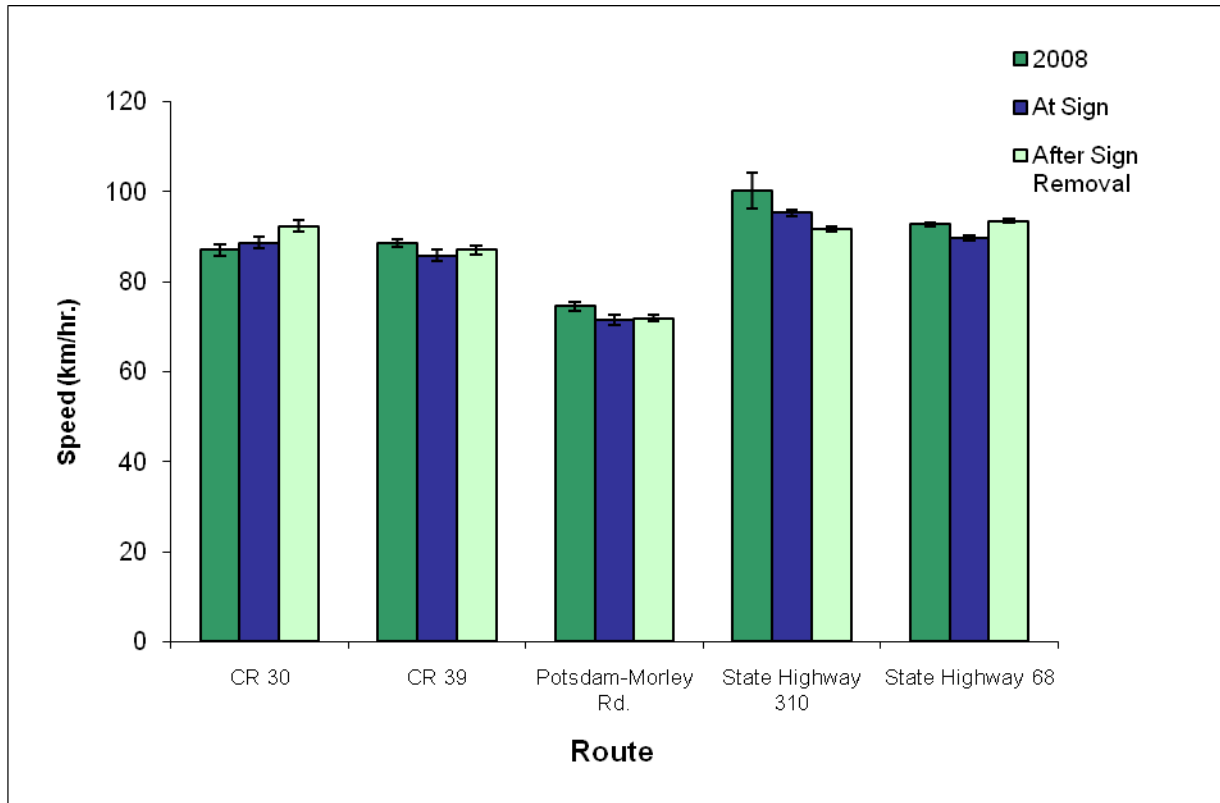


Figure 2. Average driving speed detected along routes with signs installed 1 – 31 June 2009 in St. Lawrence County in June 2008, in June 2009 and July 2009 following sign removal.

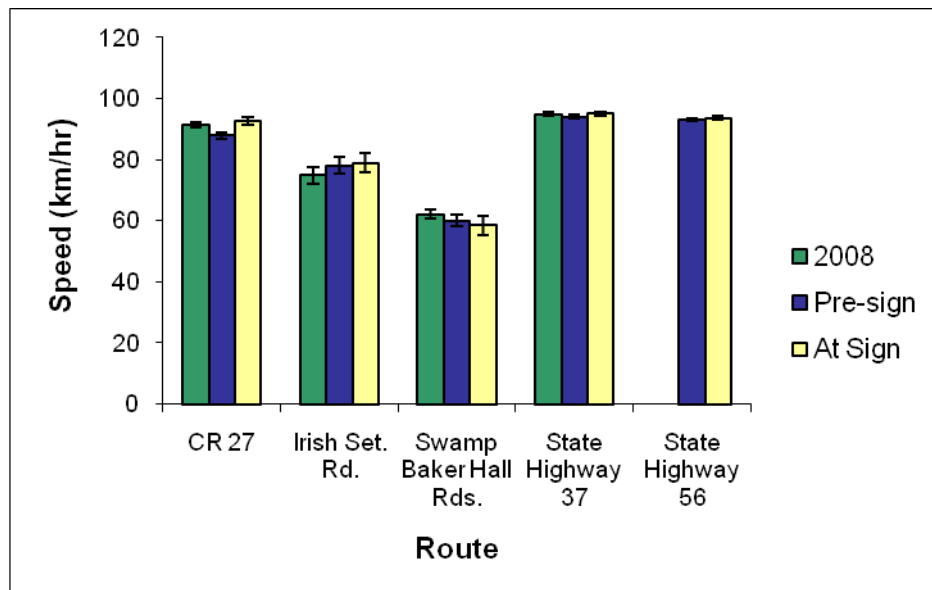


Figure 3. Average driving speed detected along routes without signs installed in St. Lawrence County in June 2008, in June 2009 at intended sign location, and 1-2 km away from the intended sign location.

Discussion

In general, warning signs used to increase awareness of motorists to areas of high animal crossing frequently have proven to be largely ineffective, particularly for ungulates, primarily because drivers become accustomed to the signs and pay them less and less attention over time (Putnam 1997, Tanner and Perry 2007). However, installing signs for a limited amount of time may increase their effectiveness, where it is expected that signs will then be a novel feature on the roadway for both regular and occasional drivers of the selected routes; this has been shown effective in deer/car collisions (Sullivan et al. 2004). Additionally, limiting signs to times when turtles are most at risk may also increase their effectiveness (Beaudry, et al. 2009)

In our study, turtle crossing signs appear to provide no detectable differences in turtle mortality or motorist behavior, as determined by driving speed, in one year of implementation. It is unknown if there was any increase in driver awareness of turtle crossing due to sign placement. We propose to increase the number of survey routes in future years to 1) increase the power of statistical tests and 2) determine if driver awareness, as measured by reduction in turtle mortality rates on roads, will change over multiple years. We encountered chronic sign vandalism (theft, shootings) at two of the five sites, so methods will be explored to reduce this. We were unable to use signs with a turtle symbol on state routes (see photos at left) without Federal Highway Administration approval; we are preparing a proposal to allow their use in future years, as we believe they may prove more effective.

Personnel Involved

1. Glenn Johnson (PI)
2. Summer students
 - Abbie Rupp (SUNY Potsdam Research assistant)
 - James Flaherty (SUNY Potsdam Research assistant)
 - Jing Bi (SUNY Potsdam Research assistant)
 - Samantha Bell (SUNY Potsdam Research assistant)

Conference Presentations

1. Can turtle crossing signs be an effective tool in reducing turtle road mortality? 11-13 August 2009. Northeast Partners in Amphibian and Reptile Conservation Annual meeting, Watkins Glen, NY.
2. Can turtle crossing signs be an effective tool in reducing Blanding's turtle road mortality? 23-24 March 2010, Social marketing and Chelonian Sustainability Workshop, Toronto, Ontario, abstract accepted.

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APPENDIX 1. Examples of Turtle Crossing Signs



Example of turtle crossing sign used on county and town roads in June 2009. Note use of turtle silhouette. The location of the illustrated sign is along Potsdam Morley Road in the Village of Morley, Town of Canton.



Example of turtle crossing sign used on state roads in June 2009. Use of turtle silhouette was not approved as of June 2009 for these signs. The location of this sign was along SR 68 near Upper and Lower Lakes Wildlife Management Area in the Town of Canton.