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Improving Turtle Road Mortality Sampling Methods in Hennepin County, Minnesota

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Abstract: Road mortality is an increasing threat to turtle populations in North America, and around the world. Across 30 sites in Minnesota specifically, more than 700 turtles were killed by vehicles in just one year. Hennepin County in particular has an urban landscape with wetlands that are often bisected by roads. Previous research has shown that proximity of a road to water, vegetative coverage, traffic volume, and time of year all contribute to turtle road mortality. Our goal was to find an optimal sampling method to reduce bias in turtle road mortality research in Hennepin County. 45 surveys were conducted, spanning 90 hours of survey time along 1,350 road miles from May 2021 through August 2021. Most dead turtles were within 100 meters of water and were more likely to be found on roads with higher traffic volume. Living turtles were more likely to be found on roads with lower traffic volume. The evidence suggests that to optimize the turtles found in each survey, researchers should monitor roads with higher traffic volume (>5,000 cars/day) that are within 100 meters of water.

Introduction

Mortality from car collisions on roads is one of the largest threats to freshwater turtle populations in North America (Gibbs and Shiver, 2002). This crisis is exacerbated by increased road development. This leads to increased habitat fragmentation, which causes more turtles to cross roads, and in turn, increases rates of turtle road mortality (Santoro, 2020). Road mortality is also worsened by the fact that turtles are relatively slow-moving and sometimes bask on roads for thermoregulation (Langen et al., 2009). Additionally, small increases in mortality can have a tremendous impact on turtle populations. One study found a 10% increase in adult mortality led to a 50% decrease in the population over time (Congdon, 1994). High rates of road mortality are leaving some turtle populations on the verge of extirpation (Piczak, 2019). A decrease in turtle populations is concerning because turtles play critical roles in trophic structures, mineral cycling, seed dispersal, and soil dynamics (Lovich, 2018).

Mitigation measures are needed to decrease instances of turtle road mortality. Without mitigation efforts, turtles and other herpetofauna species are likely to decline in areas with extensive road networks (Langen et al., 2009). Placing effective mitigation measures relies on an understanding of where turtles are the most vulnerable to road mortality. Road surveys are often conducted to find these "hot-spots" (Garrah et al., 2015; Langen, 2009). While work has been conducted globally to optimize turtle road mortality surveys, (Langen et al., 2012; Garrah et al., 2015) there has been little research focusing survey efforts in Minnesota. Specifically, within Hennepin County. This County offers a unique landscape for turtle road mortality surveys, because while urban, there are also many wetlands that are bisected by roads. These characteristics make Hennepin County an ideal place to further study turtle road mortality.

The work presented in this paper aims to increase the effectiveness of turtle road mortality surveys in Hennepin County so that mitigation measures can be appropriately implemented. Surveys were conducted from May through August 2021 corresponding with turtles' most active season. It is expected that more turtles will be found on roads closer to water, and even more so on roads that bisect water (Aresco, 2005). Turtle road mortality is expected to increase on roads with higher traffic volumes. While hatchlings are also subject to road mortality, they are more active in the late summer and early fall (Farmer & Brooks, 2012), therefore we expect to find fewer hatchlings than adults and adolescents. Additionally, we expect that most turtles will be found in June, in correspondence with the peak of nesting season (Beaudry, 2010). The results of this project will complement other work assessing the effectiveness of mitigation measures such as aquatic culverts, underpasses, turtle crossing signs, and U-shaped fences to prevent turtle road mortality. This research will give insights as to where sampling efforts are best directed in order to optimize study design.

Methods

Turtle Surveys:

We conducted 45 hour-long surveys covering 1,350 road miles from May through August 2021. This time frame was chosen because it aligned with the turtle's most active season (Farmer and Brooks 2012), and the most incidents of road mortality (Sack et al., 2017). All surveys were conducted in Western Hennepin County. The study area was chosen because of the number of roads within close proximity to bodies of water. Based on prior recommendations, surveys were conducted every other day to minimize bias (Santos, 2011). The areas surveyed varied widely in degrees of urbanization, habitat fragmentation, and wetland abundance. During each survey both dead and alive turtles were searched for and recorded. Each survey started from the same location, and a random route was taken each time. Routes were randomized by driving in a random direction with random turns for 1 hour. Turtles were located by looking on the road and curbs while driving. When a turtle was located, we pulled the car over to a safe location, and got out to further examine the turtle. When possible, we categorized each turtle's age into three categories based on size: hatchling, juvenile, and adult.

When a survey was complete, we recorded the traffic volume of each road where a turtle was found. Traffic volume was measured using the Annual Average Daily Traffic Volume (AADT) map from the Minnesota Department of Transportation. To measure each turtle's distance from water, the GPS location of the turtle was entered into Google Earth, and the distance from the turtle to the edge of the nearest body of water was recorded. If a turtle was found on a road with two bodies of water within 100 meters, that was also recorded. A body of water was defined as a gathering of water that could be seen on Google Earth on an 80-meter scale. This scale was chosen to exclude small pools of water where there were likely no turtles, but still include smaller ponds and creeks where turtles could be present.

Statistical Analysis:

One turtle was found on a freeway 247.7 meters from water with a traffic volume of 13,500 cars per day. For ease of data interpretation and visualization, this data point was removed from all analysis. When the data point was left in, figures were difficult to interpret because it skewed the data strongly to the left.

Results

Using the aforementioned study parameters, we found 21 turtles across all surveys. Of these, 9 were alive and 12 were dead. Additionally, 7 were hatchlings, 13 were adults, and 1 was an adolescent. Hatchlings were more likely to be found dead than adults (85.7% vs. 38.5%).

Dead turtles were more likely to be found on roads with higher traffic volumes (>5,000 cars/day) within 100 meters of a body of water (Figure 1; Figure 2). The most turtles were found during June, and the fewest turtles were found in May (Figure 3).

Discussion

From the data shown above, we found that dead turtles are more likely to be found on roads with traffic volumes at or above 5,000 cars per day than alive turtles. Additionally, both living and dead turtles were more likely to be found within 100 meters of water; 18 of 21 turtles were found within 100 meters of a body of water.

While most of our results were consistent with findings from previous studies, there were some notable differences. We expected to find the most turtles in June. This was confirmed as we found the most turtles were found in June, and the fewest turtles were found in May. More hatchlings were found than originally expected, especially in May and June. Previous research suggested that more hatchlings would be found as the season continued (Farmer & Brooks, 2012), however we found fewer hatchlings as the season progressed. Additionally, hatchlings were more likely to be found dead than adolescents or adults. We suspect this difference in mortality may be because hatchlings are more difficult to see on the roads, so people may not be aware enough to avoid them. Dead turtles were more likely to be found on roads with higher traffic volume (above 5,000 cars per day), and alive turtles were more likely to be found on roads with lower traffic volume (fewer than 5,000 cars per day).

One of the primary limitations of this study is that surveys were only conducted over the course of one active season, meaning that survey methods could not be compared between years. The sample size of 21 turtles was too small to yield many significant results. A more robust sample size would have given more information on survey methods. Given the limitations of this study, we recommend future turtle road mortality research be conducted over multiple years to ensure a sufficient sample size. Based on these results and limitations, we recommend that future turtle road mortality surveys in Minnesota be conducted on roads with traffic volumes between 5,000 and 15,000 cars per day that are also within 100 meters of a body of water. Multiple years of data collection may be needed for significant results because turtles are only actively on the roads for a few months of the year. Mitigation measures would be less effective if they were not placed in areas where road mortality is more likely to occur, such as high traffic volume roads within 100 meters of water. Overall, these results will help to maximize the placement of road mortality mitigation measures.

Supplements

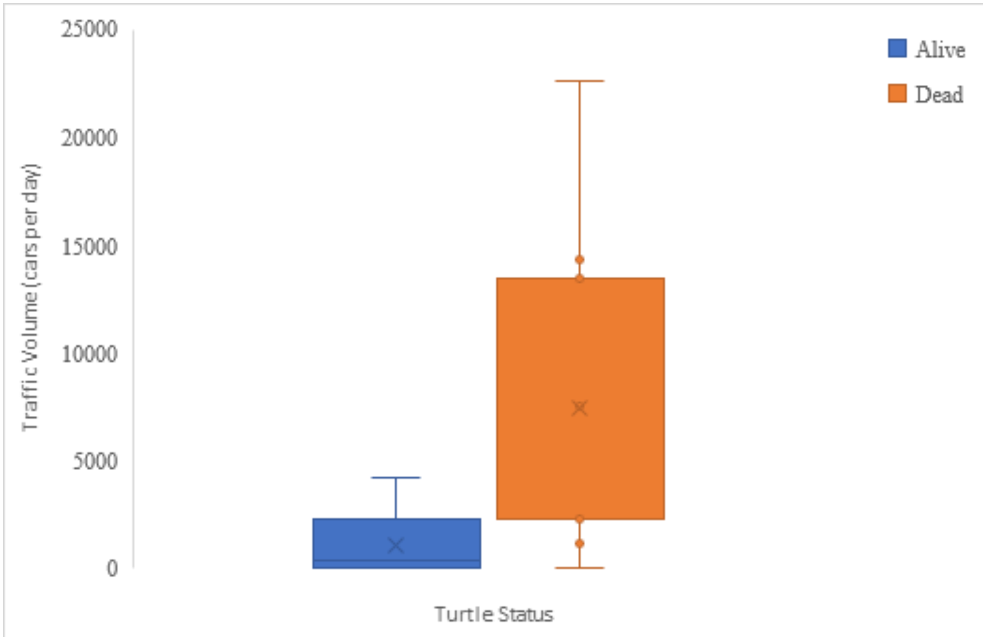

Figure 1. Traffic volume where living (blue) and dead (alive) turtles were found.

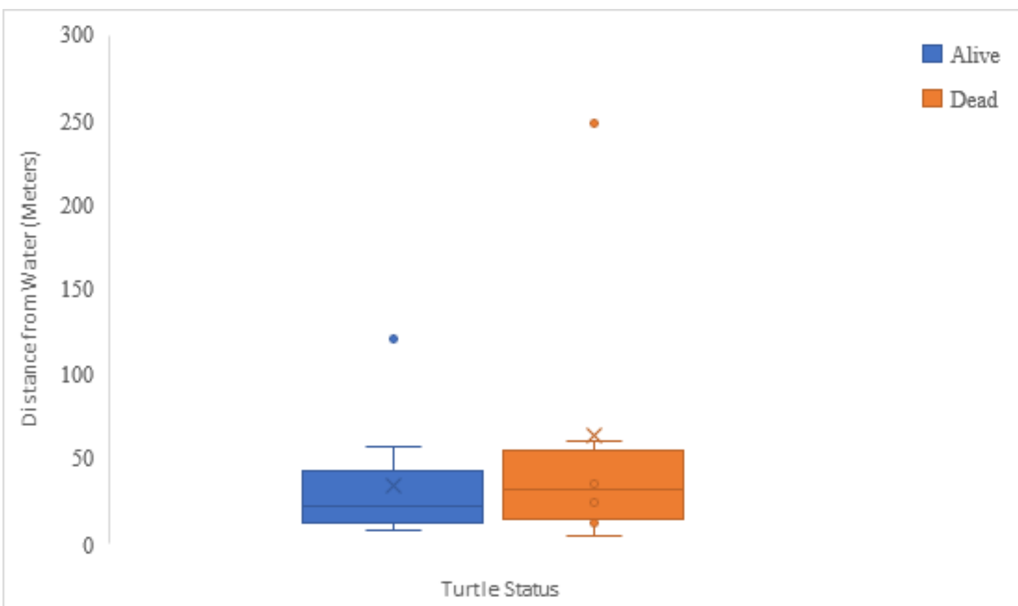

Figure 2. Distance (meters) from water for each living (blue) and dead (orange) turtle found

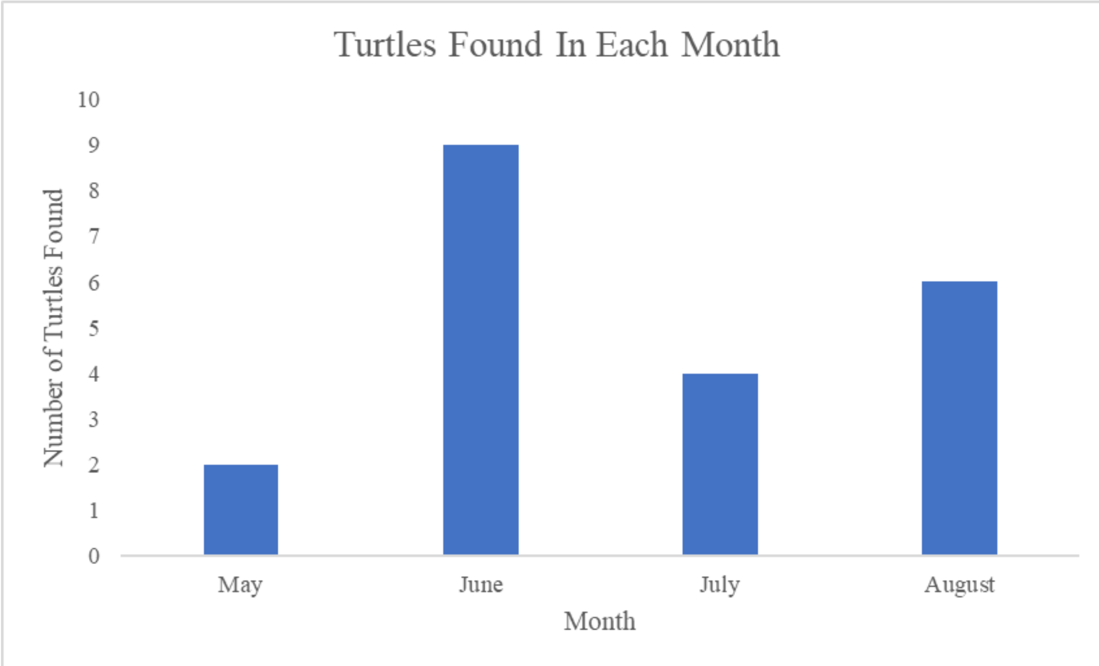

Figure 3. Number of turtles (alive and dead) found in each month data collection.

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