Effects of Anthropogenic Noise on Soundscape and the Stress Hormone Levels of the Gulf Coast Toad (*Incilius valliceps*) in Central Texas

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Abstract:

Environmental stressors affect all organisms and those stressors play a role in driving adaptive evolution. Stress may reduce reproductive success or suppress immune system responses, thus reducing fitness (Bee & Swanson 2007; Wollermann & Wiley 2002; Parris et. al. 2009; Rollinns-Smith et. al. 2011; Gabor et. al. 2013). One such stressor includes sound (Tennessen et. al. 2014), with variation in frequency, intensity, and source influencing how stressful a specific sound is for a particular species. All the sounds present within an environment make up a soundscape. With increasing fragmentation due to roads and highways, populations are becoming increasingly subjected to noise from traffic; particularly on the borders of the fragmented habitats. To understand the role road traffic noise plays in a soundscape we collected 123 sound samples within a wilderness preserve bordered by a major highway. Our results indicate that distance from the highway can explain 66.1% of noise variation within the preserve. Recent studies have shown that road noise does affect anuran behavior primarily in regards to mate choice (Bee & Swanson 2007; Wollermann & Wiley 2002; Parris et. al. 2009). Road noise may also indirectly affect reproduction if it triggers chronic stress. Therefore, we inquire if proximity to road noise is correlated with variation in corticosterone concentrations for a population of Gulf Coast toad (*Incilius valliceps*) in Wild Basin Wilderness Preserve, Austin, Texas. To answer this question we will quantify urinary corticosterone levels in toads, measure their distance from TX-360, and quantify the noise levels across the preserve.

Methods:

Study Site:

This study was conducted at Wild Basin Wilderness Preserve in Austin, Texas. Wild Basin is adjacent to the Capital of Texas Highway or Texas State Highway Loop-360 (TX-360). Rush hour occurs twice a day; in the morning from 6:00am to 10:00 am and evening from 3:00pm to 7:00pm. Sound sampling occurred during the rush hour time period.

Soundscape:

We recorded sound levels measured in decibels on Tuesdays, Thursdays, and Fridays between 4:00 and 6:00 PM, during the height of evening rush hour. This was performed by walking transects throughout the preserve while using a smartphone application with a microphone to record sound intensity every one hundred meters or so. The application and microphone are Occupational Safety and Health Administration (OSHA) approved (Kardous & Shaw 2014). The application was acquired through iTunes and is called SoundMeter. The microphone was a MicW i436 microphone. Each sound recording was thirty seconds long. The application gave us maximum, peak, and average decibel readings at each location. To find the coordinates of each location we used Backpacker GPS Trails Lite. We also recorded the time and weather conditions. We acquired a total of 123 data points. We used ArcGIS and the near analysis tool to find the distance of each sound coordinate from the Capital of Texas Highway. The distances were compared to decibels in a regression analysis using SPSS statistical software. We also used ArcGIS to create a map to show the variation in average sound intensity throughout the preserve.

Hormones:

The species chosen for this study was the Gulf Coast toad, *Incilius valliceps.* To collect the hormones we used a pipette to extract urine from its cloaca. The cloaca or vent is the exterior hole used to release waste. We also weighed, measured snout to vent length, and sex the toads (by presence or absence of a nuptial thumb) as well as take the location's coordinates and measure sound level in decibels.

Each urine sample collected is being stored at St. Edward's University in a -80 degrees Celsius freezer. When we have at least thirty, well distributed samples we will use a Corticosterone ELISA and a Urinary Creatinine kit to measure corticosterone concentrations in the urine. Once we get these measurements from the spectrophotometer, we will run a multiple regression test on the data. So far we have caught four toads.

Results & Conclusion:

It shows the gradient of anthropogenic noise levels throughout the preserve is shown in Figure 1. We believe the map provides visual support of our prediction that sound levels will decrease as distance from the highway increases and that noise in Wild Basin is caused primarily from traffic. This was further supported by the regression showing that the average sound in decibels at each point is negatively correlated with its distance from TX-360(Figure 2). This correlation is statistically significant with a p-value that is less than 0.001 and an r^2 of 0.661. This

means that 66.1% of the variation in sound intensity within the preserve is explained by distance from the highway.

We were unable to collect sufficient urine samples to test the effect of road noise on stress in Gulf Coast toads. Currently, there are no expectations to continue efforts to collect urine samples in the near future.

Figure 1: This map shows the gradient of average sound intensity from the Capital of Texas highway throughout Wild Basin Wilderness Preserve. The shades of color show different ranges of average sound intensity in decibels.

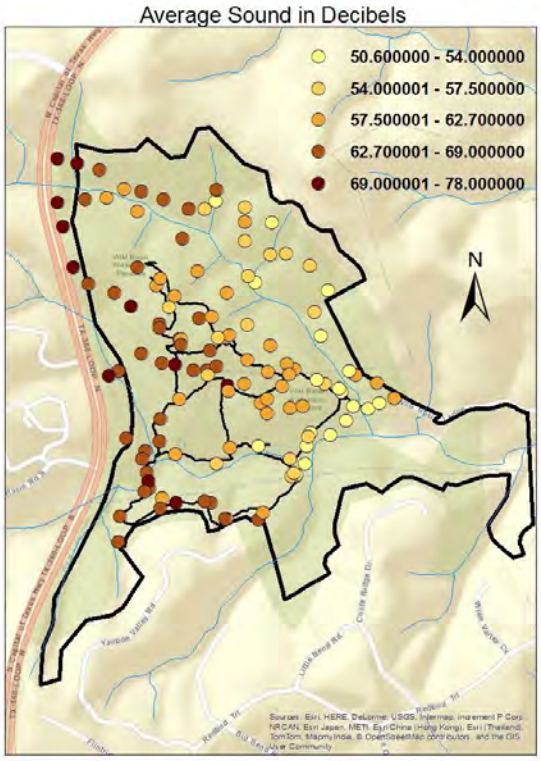
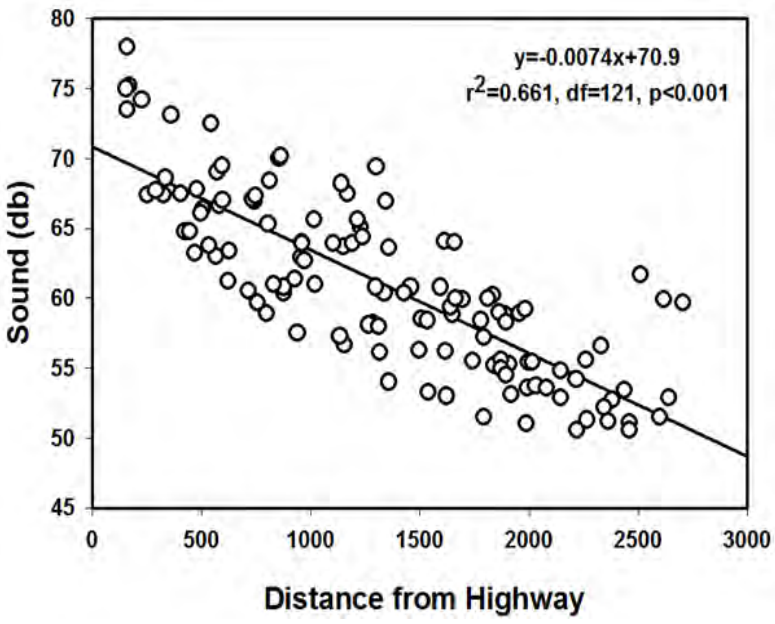


Figure 2: This graph shows the negative correlation between average sound intensity and distance from the Capital of Texas highway in meters. The r^2 value was 0.661, and the p-value is less than 0.001.



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