FROG MIGRATION IN SOUTHEAST VIRGINIA

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Abstract

Frog and toad species are currently on a global decline (Stuart et al. 2004). This decline is due in part to habitat loss caused by human development compounded by their complex annual habitat requirements which includes the use of wetland during the breeding season and upland habitat during the nonbreeding season. (Collins 2010). Current frog and toad management in the United States often solely focus on the breeding habitat and do not include management of upland habitat (Harper et al. 2008). In order to fill this knowledge gap, I am using a year-long line-transect survey of the area surrounding frog and toad breeding habitats in southeastern Virginia. We are still in the process of collecting data, but so far we have found variation among species in their use of upland habitat. Some species may stay near their breeding area while others are more likely to be found 50 m to > 100 m from their breeding habitat. We have also seen a clustering of frog and toad detections around water features away from the breeding area. My research shows that current management of forests surrounding frog and toad breeding areas should be expanded.

Introduction

Over the past several decades, disease, invasive species, climate change, and habitat destruction have decimated global amphibian populations. As a result, amphibians as a taxa are experiencing greater rates of extinction than mammals or birds (Stuart et al. 2004). Recent research suggests that 43% of amphibian species globally are experiencing some form of decline (Stuart et al. 2004) and that the number of sites occupied by amphibian species will be cut in half within the next 19 years (Grant et al. 2016). Among the species affected by this global decline are frog and toad species native to Virginia. The Fowler's toad (*Anaxyrus fowleri*) for example, saw a 53% decline in both Maryland and Virginia from 1999 to 2012 (Jones and Tupper, 2015). In order to ensure the survival of frog and toad species, we must understand the threats currently facing the species and how they can be averted at the local level.

Habitat destruction is one of the most significant factors behind frog and toad decline (Collins, 2010). As development and deforestation removes riparian habitat, frog and toad subpopulations become more isolated from one another, reducing genetic diversity and leaving the metapopulation as a whole more vulnerable to decline (Collins 2010; Gardner et al., 2007). Habitat destruction also impacts frog and toad populations by exacerbating the effects of other stressors such as disease and climate change (Collins 2010). For example, if a species of toad depends on shade to avoid overheating in summer, and the trees around its breeding locations are removed, then it will not be able to regulate its temperature as effectively and will be less likely to survive as temperatures increase. The only way to prevent this scenario is to understand the habitat requirements of this species and protect it accordingly.

In order to protect frog and toad populations, frog and toad habitat must be preserved. Before we can effectively do so, we must take into account the requirements of frogs and toads during their development from tadpoles and throughout their annual migration cycle as adults. Regulations are already in place to protect frog and toad breeding areas throughout the United States. However, these regulations vary, and many protect only a small area around these breeding ponds. As a result, they might help tadpoles, but do little to protect frogs and toads that travel beyond these barriers or spend much of their adult life outside of the breeding pond (Harper et al. 2008). This issue is exacerbated by the current lack of knowledge regarding adult frog and toad migration and microhabitat use (Rowley and Alford, 2007). Until the migration of frogs and toads is well understood, policies are unlikely to effectively mitigate population declines.

The extirpation or extinction of frog and toad species will have drastic consequences for the ecosystems they inhabit. Frogs and toads interact with a variety of species due to their complex life cycle and presence in both aquatic and terrestrial ecosystems. They are a food source for birds, mammals, and fish as well as predators to insects, algae, and worms. Due to these interactions, they provide a variety of ecosystem services by consuming pests and limiting the growth of algae (Hocking and Babbit 2014). To preserve the biodiversity of Virginian forests and ensure these ecosystem services remain present, measures must be taken to halt the decline of frog and toad species. Preserving their habitat is one such measure, but current regulations have been ineffective in protecting adult frogs and toads (Harper et al. 2008; Harper et al. 2015).

My first objective is to determine where frog and toad populations stay during the nonbreeding season. In order to determine how much forest habitat they utilize, we must learn how far they live from their breeding locations during the non-breeding season. To do so, we will utilize a line transects to examine the movement of a variety of species simultaneously. A line transect is a survey method in which an observer walks along a pre-determined line and counts the number of frogs and toads spotted while walking. The perpendicular distance between spotted individuals and the line can then be used to determine the density of frogs and toads around that line. By conducting line transects both close to, and far from, breeding locations, we will determine how far different species move from their breeding habitat during the nonbreeding season.

My second objective is to make recommendations to policy makers and conservation organizations on how to effectively protect frog and toad habitat. With the insights into frog and toad migration we gain from the line transects, we will learn more about what portions of habitat are of particular importance to these species. We can then use this information to create useful habitat protection recommendations for frog and toad conservation efforts.

Methods

Since May 24th 2020, I have been sampling sets of line transects at six study sites throughout Williamsburg, James City County, York County, and Newport News, Virginia. Each study site contains a wetland or water body with an independent frog and toad breeding colony as well as the area within 100m of the water body or wetland edge or shoreline. Each study site had between one and four sets of transects, with between three and five transects per set (figure 1). 14 sets of transects were used across the six study sites for a total of 61 transects.

Figure 1: Three sets of Transects at Newport News Park in Newport News VA.

Transects are approximately 250 m long, run parallel to the shoreline, and are spaced 25m apart. This 25 m spacing was determined based on the average daily movement of an American toad as measured by other members of the ACER lab at William and Mary. We separated transects in this manner in order to prevent a frog or toad spotted at one transect from moving to another before I walked through it (Check 2019; Windorf 2019). The 0 m transect was recorded by walking along the shoreline with a GPS unit while the 25m through 100m transects drawn parallel to the 0 m line using ArcGIS.

I surveyed all transects once per week from May to December 2020, once every other week from December to January 2020 when frogs and toads were in brumation, and once per week again from February 2021 to the present. I will continue to survey all transects once per week until the week of May 24th 2021 in order to complete one year of transects. I walked transects in the early morning and evening, targeting days with no frost or freezing temperatures in order to survey when frog and toad species are most active.

At the start and end of every transect, I recorded the temperature, humidity, wind speed, and time of day. When a frog or toad was spotted while walking a transect, I recorded the individual's species, approximate age, perpendicular distance from the transect line, substrate on which it was spotted, and the behavior upon detection. I also used a GPS device to record the location of the detection.

Preliminary Results

In total, I visually detected 1,456 individual frogs and toads among all six study sites. The species I spotted most frequently was the Eastern Cricket Frog (*Acris crepitans)* (Figure 2). There were four main genera of frogs and toads that made up the vast majority of visual detections. These genera were *Acris*: composed of eastern and southern (*Acris gryllus*) cricket frogs *Lithobates*: composed of "true" frogs such as the pickerel frog (*Lithobates palustris)*, bullfrog (*Lithobates catesbeianus)*, and coastal plains leopard frog (*Lithobates sphenocephalus utricularius*), *Hyla*: composed of treefrogs, and *Anaxyrus*: composed of American (*Anaxyrus americanus)* and Fowler's toads (*Anaxyrus fowleri*).

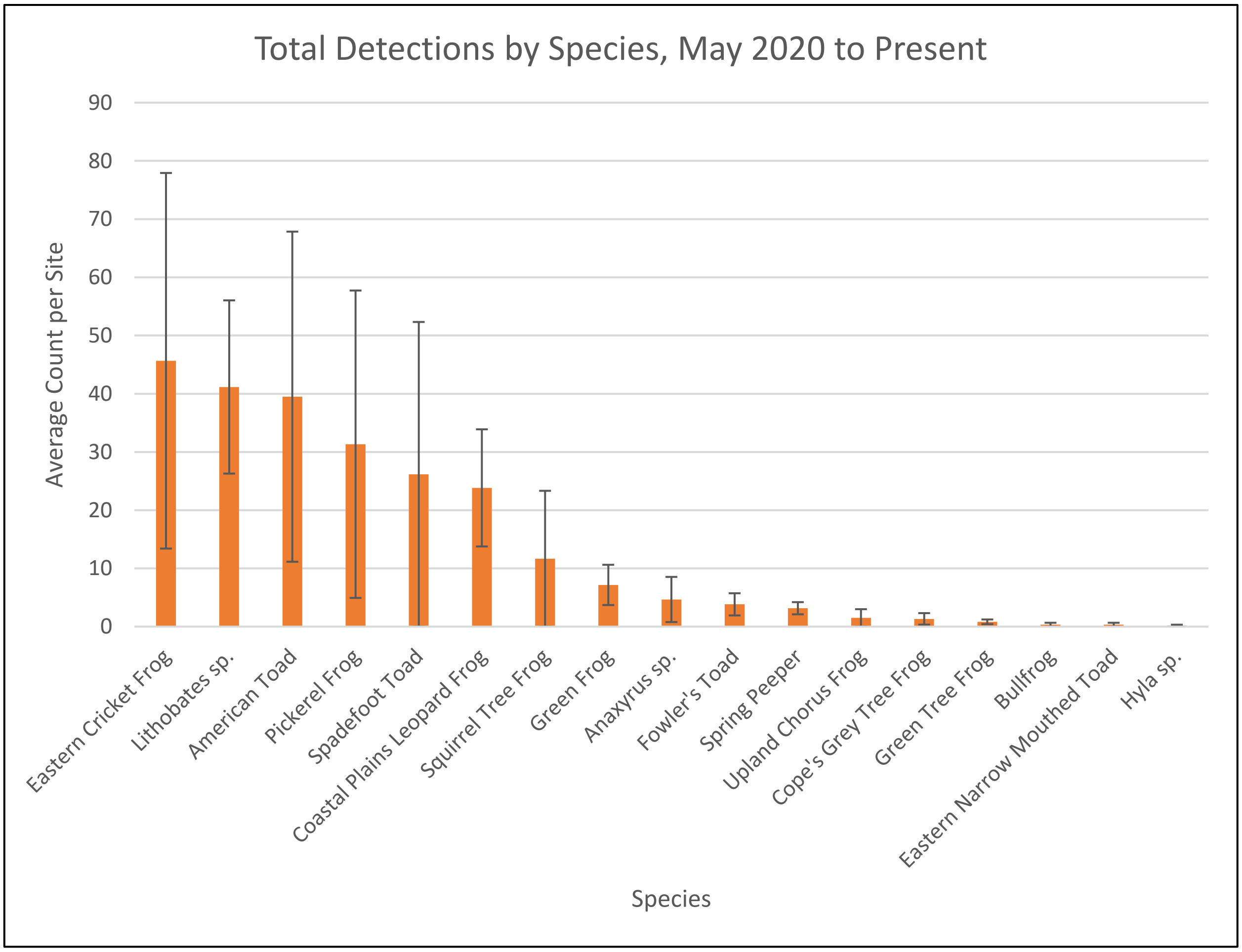

Figure 2: Average species count per site. In the event I spotted a frog or toad and was unable to identify the exact species, I identified the genus.

Across all species, the most frogs were spotted at the 0 m transect line and the second most were spotted at the 50 m transect line. On average, over half of all *Lithobates* frogs at each site were found at the 0 m transect line. The other genera on the other hand, were more evenly distributed throughout each site (Figure 3).

Upon examining the GPS locations of each detection, we found that frog and toad detections were clustered at certain study sites. Often, these clusters were located around areas that were prone to flooding or contained a temporal water body such as a stream or puddle. *Lithobates* detections were frequently clustered in this manner while *Anaxyrus* detections were more uniform (Figure 4). *Acris* and *Hyla* detections were also clustered around these wet areas, though there were much fewer *Hyla* detections overall when compared to the other genera (Figure 3).

Discussion

In Virginia, the Chesapeake Bay Preservation Act specifies that riparian buffers, or areas of protected habitat, should extend 100 ft, or approximately 30 m, from bodies of water that are designated as "Resource Protection Areas." Based on my current results, this buffer is likely insufficient to protect the habitat frogs and toads use as

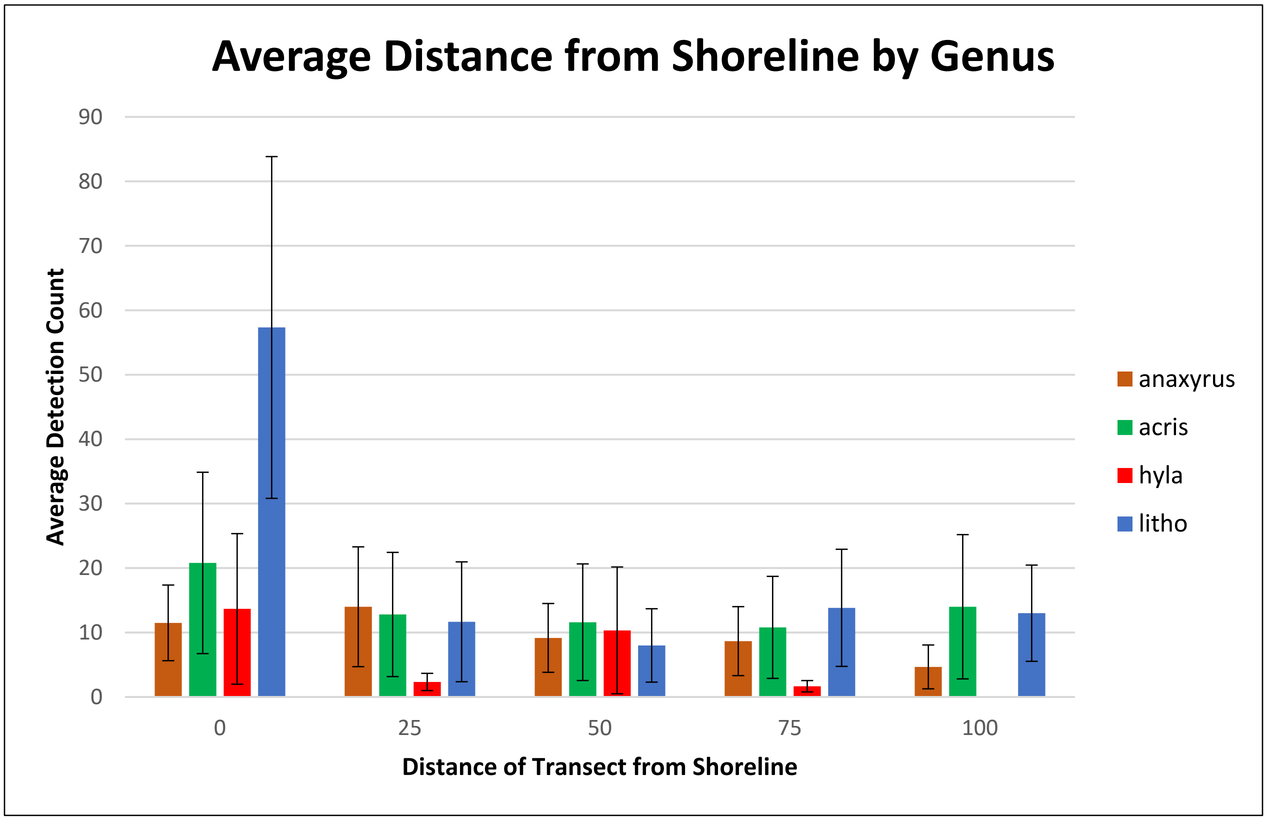

Figure 3: Average visual detection count among all six study sites of the most frequently spotted genera.

adults. Frogs and toads spend the majority of their adult life in their nonbreeding habitat (Harper et al. 2008). Therefore, it is essential that amphibian conservation efforts ensure frogs and toads are able to use this habitat. So far, I have regularly spotted a variety of frogs and toads at transects between 50 m and 100 m from breeding locations. This indicates that frogs migrating away from breeding habitat to wintering grounds will travel beyond current protective barriers in Virginia. Based on these results, I would recommend that riparian buffers be extended beyond 100 m to encompass an area that will be more likely to support a frog or toad population.

Between now and the end of summer 2021 I will finish collecting data from my transects and be able to examine the distribution of frogs during the early breeding season from January to May. I will also be able to combine these results with my current

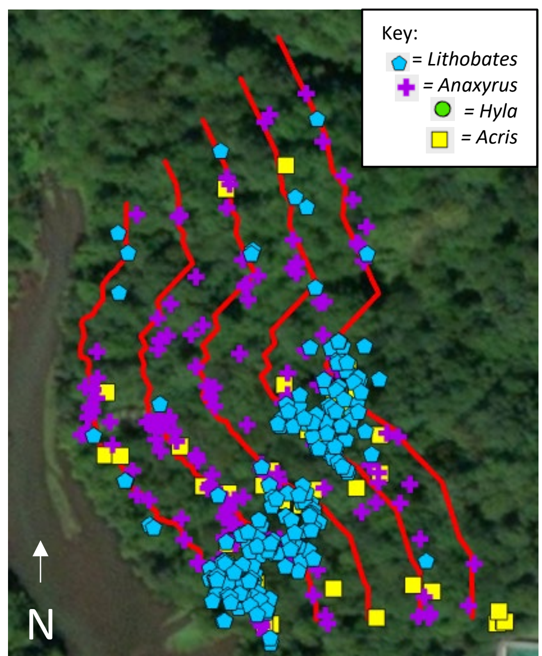

Figure 4: Set of Transects at Lake Matoaka in Williamsburg VA. At this site, *Lithobates* detections are clustered around a stream that runs through the site while *Anaxyrus* detections are more uniformly spread out.

data to thoroughly compare the distributions of frog and toad species as well as how they change over the course of the year. I am also currently collecting data on the ground cover and vegetation composition along my transects. With this information, I intend to examine the relationship between environmental factors and the distribution of adult frogs and toads. With this information we will be able to gain a better understanding of why frog and toad detections are clustered and vary by genera.

Acknowledgements

Funding for this research was provided by the Virginia Space Grant Consortium and the William & Mary Graduate Program.

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