ANALYSIS OF FROG CALLING PATTERNS IN AND ADJACENT TO THE LUMBER RIVER IN WESTERN ROBESON COUNTY, NORTH CAROLINA

Honors Project

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ABSTRACT

In this study, I surveyed five sites for frog calls from March 16th - April 14th. I surveyed five sites located in western Robeson County, North Carolina. The purpose of my study was to determine the frog species calling at each of the five sites, patterns of call intensity for each species, and to relate these patterns to environmental parameters such as weather, disturbance and habitat type. Amphibians are sensitive to their environment, and because of this, I found that the sites with the least human disturbance exhibited higher frog species abundance while the sites with more human disturbance exhibited lower frog species abundance. Three possible factors explain my results. A change in weather during the survey likely affected the patterns seen in frog calling at each site. Also, the time of year affected what species were calling at each site based on the calling preference of individual species. Lastly, variation in habitat and disturbance at sites helped explain my results. Further research should be conducted in order to look at the full yearly pattern of frog calling in the area, and to determine if frog populations are increasing, decreasing, or remaining the same.

Keywords: Robeson County; Lumber River; frog calling intensity; CASP survey

INTRODUCTION

The Lumber River is a 115 mile long river which runs through the southeastern Coastal Plain of North Carolina. During the 1700s, timber harvesting was prominent and the river served as a major avenue for the transport of lumber, hence the name Lumber River (NCDPR 2015). The Lumber River was designated a state Natural and Scenic River and a state park in 1989 (NCDPR 2015), and a National Wild and Scenic River in 1998. Many areas adjacent to the Lumber River are cypress-gum swamps, which are ideal habitats for amphibians.

Amphibians are commonly found in and around wetlands, especially during late spring to late summer (Beane 2010). However, amphibians are currently suffering a world-wide decline. A primary cause of decline in amphibian populations is the degradation and loss of forest habitat (Alford and Richards 1999, Semlitsch 2000, Stuart et al. 2004, Graeter et al. 2008). Many amphibians are especially susceptible to environmental degradation which makes them potentially important indicators of overall environmental health (Aardema et al. 2015). Because most amphibians live in both terrestrial and aquatic habitats for some period of their life cycle, they can serve as indicators of ecological health for both wet and dry environments (Viernum 2012). Many amphibians also act as keystone species, meaning that they are important predators and/or important prey items. If a keystone species is to be removed from its habitat, many other species that depended on it will suffer in its absence (Viernum 2012).

The Lumber River runs through four North Carolina counties, one of which is Robeson County. Pembroke, a small town located in western Robeson County, is my study locale. The purpose of my study was to determine the frog species present at five sites along and adjacent to the Lumber River. By determining the species present at each site and determining the ecology of each site, I determined what habitats were best for frog species diversity and why. Further, I was able to investigate the temporal pattern of calling by different species.

STUDY SITES

I chose five sites to survey for frog calls in Pembroke, NC, see Figure 1.

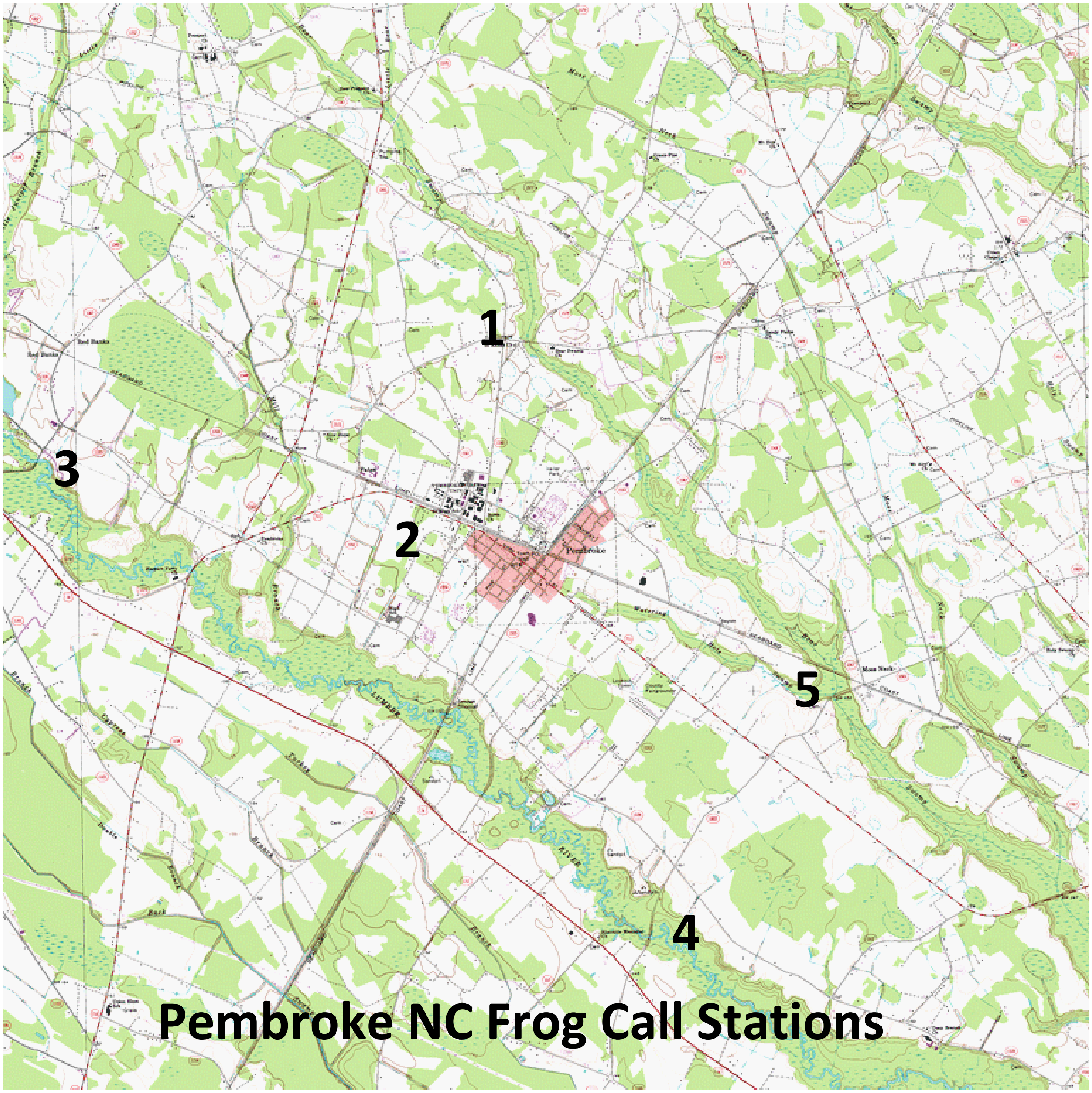


Figure 1 Topographic map of Pembroke, NC showing 5 sites.

Site 1 (34.702974, -79.193615) was a Coastal Plain small stream swamp (Shafale & Weakley 1990) and was located at a major three-way intersection near a busier part of northern Pembroke, NC. This site was less than 50 m from a neighborhood and was characterized by heavy traffic. Many empty bottles and other miscellaneous trash littered the roadside. This site was not an ideal site for amphibians due to the trash and vehicular disturbance. However, it was heavily vegetated and contained a small, slow moving stream which passed beneath the road.

Site 2 (34.682526, -79.208635) was a small Pine/Scrub Oak Sandhill forest (Shafale & Weakley 1990) with approximately 30-45 cm of stagnant water. It was located between a large apartment complex and a small neighborhood; approximately 100 m from the Apartment complex and less than 20 m from the small neighborhood. Two roads ran adjacent to this site; however the roads were less frequented by cars than other sites. This site was virtually litter-free, and it was the smallest site in this study. Besides the adjacent buildings, this site seemed to be a relatively ideal site for amphibians.

Site 3 (34.691401, -79.254802) was a Coastal Plain bottomland hardwood forest (Shafale & Weakley 1990) located at a bridge which crossed the Lumber River. A two lane road crosses the bridge and carried heavy traffic. A small field occupied one bank and a wooded area with houses was present on the other bank. Human litter was present at this site.

Site 4 (34.642325, -79.179876) was at a bridge crossing the Lumber River and where the river passed through a Cypress-Gum swamp (Blackwater subtype) (Shafale &Weakley 1990). A two lane road crosses this bridge and has a buffer of grassy land, 15-20 m in width, on both margins. This site seemed to be relatively undisturbed, other than the noise and frequency of vehicular activity. No houses or neighborhoods were adjacent to this site, and the large expanse of swamp made this appear to be an ideal amphibian habitat.

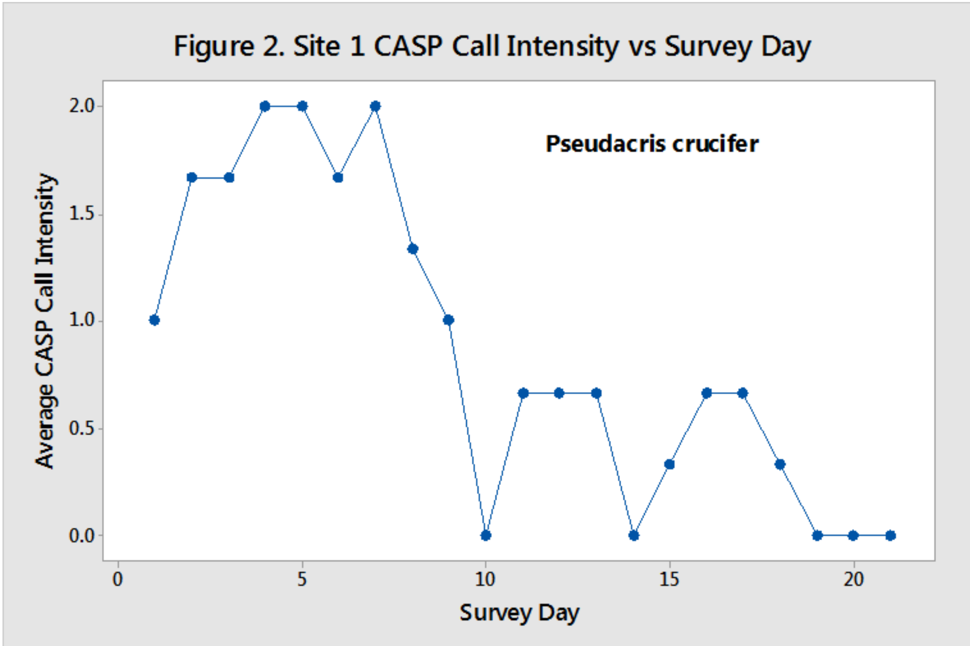
Site 5 (34.666184, -79.156394) was in a small tributary stream, northeast of the Lumber River, which contained a small pond bordered by Cypress-Gum swamp (Blackwater subtype) (Shafale &Weakley 1990). A two lane road ran adjacent to the site with a small buffer of grassy land, 5-10 m in width. This site seemed moderately undisturbed, with noise and frequency of vehicular activity, an adjacent railroad track and a moderate amount of human litter. No houses or buildings were adjacent to this site.

METHODS

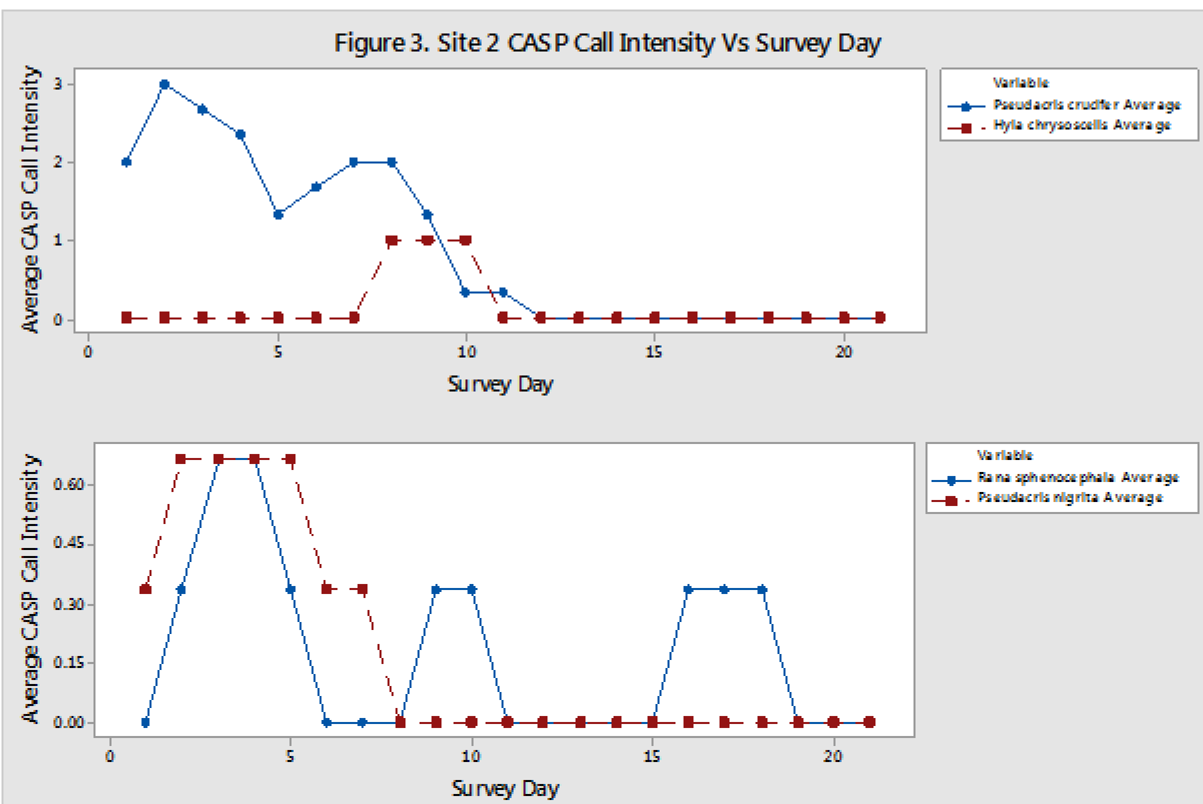
This survey took place from March 16th- April 14th, 2015 and consisted of 21 survey days. I used the calling amphibian survey program (CASP) general protocol, frog call data collection sheet, with a few modifications based on my specific project, (Appendix 1). I surveyed the five sites at least four days each week, depending on the weather and my schedule. I used a GPS to determine the coordinates of each site, making sure to stay in the same general area during each survey conducted. The GPS coordinates are listed with each site description in the previous section. I began surveying approximately thirty minutes after sunset each night; around 8:00- 8:30 pm. Every night, before survey initiation, I recorded the temperature in degrees Celsius, the relative humidity, the wind code, and the sky code (Appendix 1). At each site, I listened for frog calls for five minutes, using my cell phone as a timer. I used a handheld recorder and recorded any unfamiliar calls or sounds. At the end of my survey each night, I compared unknown sounds or calls with frog call recordings found at Herpsofnc.com to determine which frog species matched my recordings. Raw data was encoded into an Excel spreadsheet for future analysis. A three day running average of frog call intensity was calculated in order to more easily discern trends in frog call intensity.

RESULTS

I created eight separate figures that interpret data collected at each site. At sites where I found more than two species, I created two separate graphs so that the data could be easily interpreted. At site 1, a trend of three peaks in frog calling was found with the first peak being of the highest average intensity and the second two peaks being similar but of a lower average of intensity than the first (Figure 2).



At site 2, a trend of three peaks was found with the first peak exhibiting the highest average call intensity and the second two peaks being of lower average intensity (Figure 3).



At site 3, a trend of three peaks was found with the first exhibiting the highest average call intensity, the second exhibiting a lower average intensity and the third exhibiting the lowest average intensity (Figure 4).

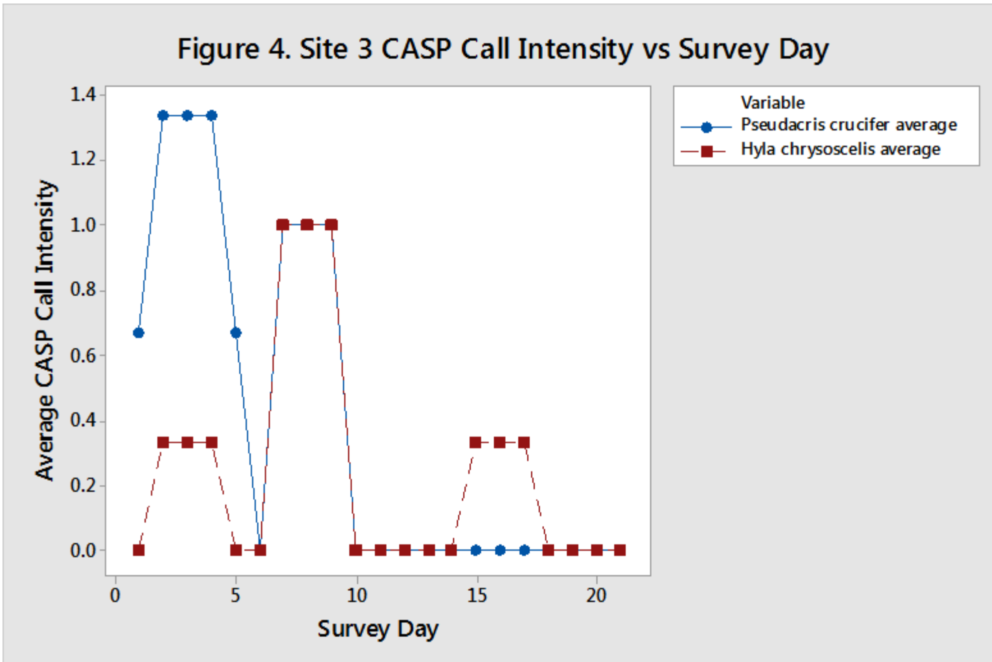
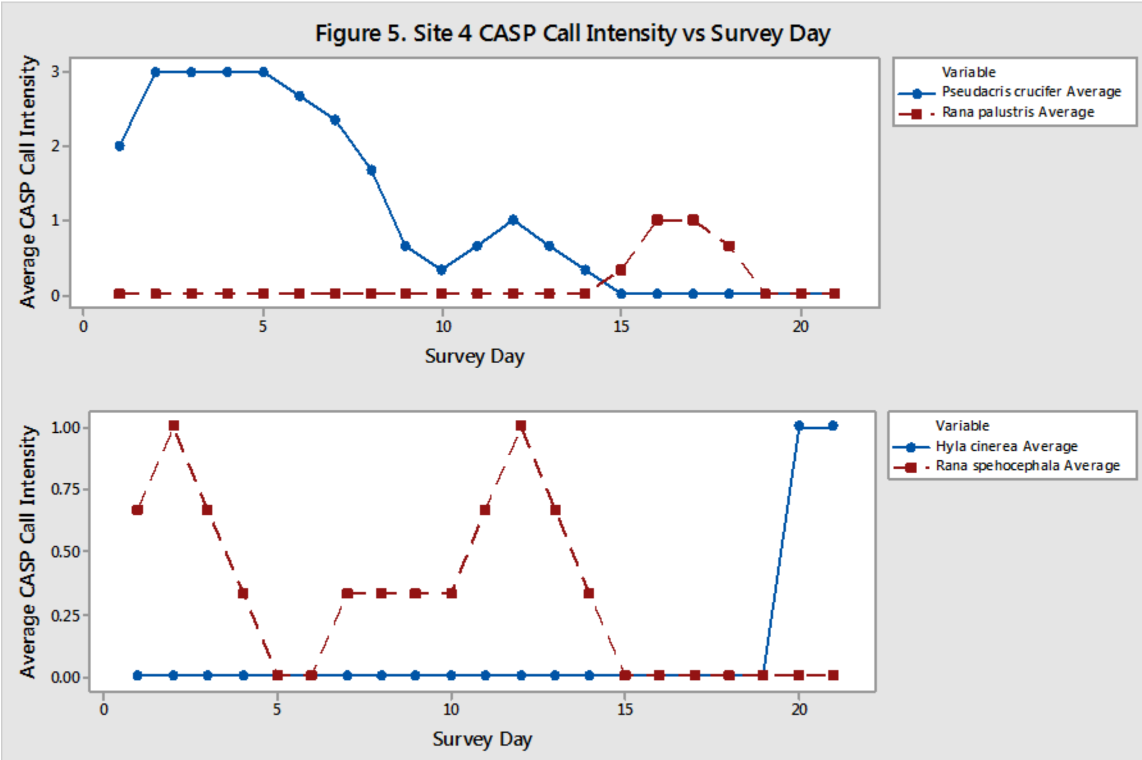
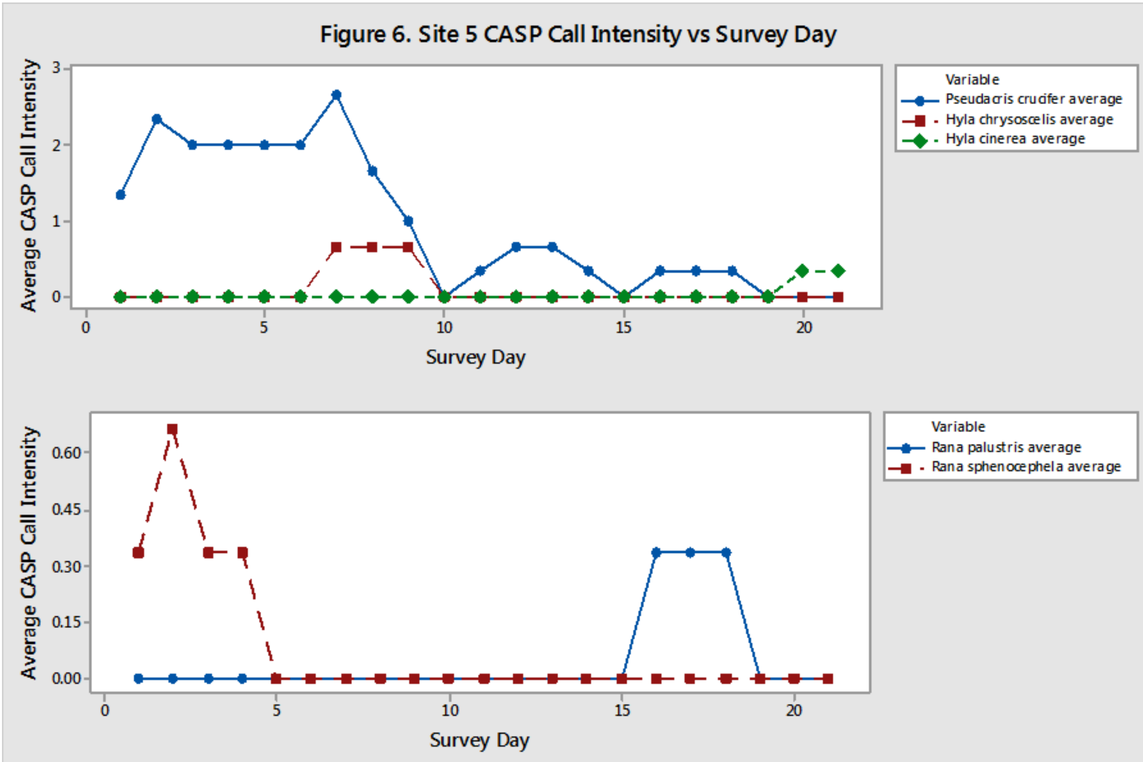


Figure 4. Site 3 CASP Call Intensity vs Survey Day

At site 4, a trend of three peaks was seen with the first exhibiting the highest average call intensity and the second two peaks being similar but exhibiting a lower intensity than the first (Figure 5).



At site 5, a trend of four peaks in call intensity was seen with the fist exhibiting the highest average intensity with the next three peaks declining in intensity in their order of occurrence (Figure 6).



DISCUSSION

I developed three possible explanations for the patterns observed in the data obtained. The first explanation is due to change in weather during the survey period. The second is due to the natural occurrence of certain frog species based on the time of year. The third is due to variation in site habitat and location. I will discuss each of these in detail.

Change in Weather

Each night that I surveyed, I documented the temperature and the relative humidity. In the temperature chart there is a large peak towards the beginning of the survey, two smaller peaks in the middle and a large peak towards the end, see Figure 7. This coincides with the three peaks I observed, on average, in the frog call intensity for the five sites. I believe frog call intensity is influenced by temperature: the higher the temperature, the higher the intensity of frog calls.

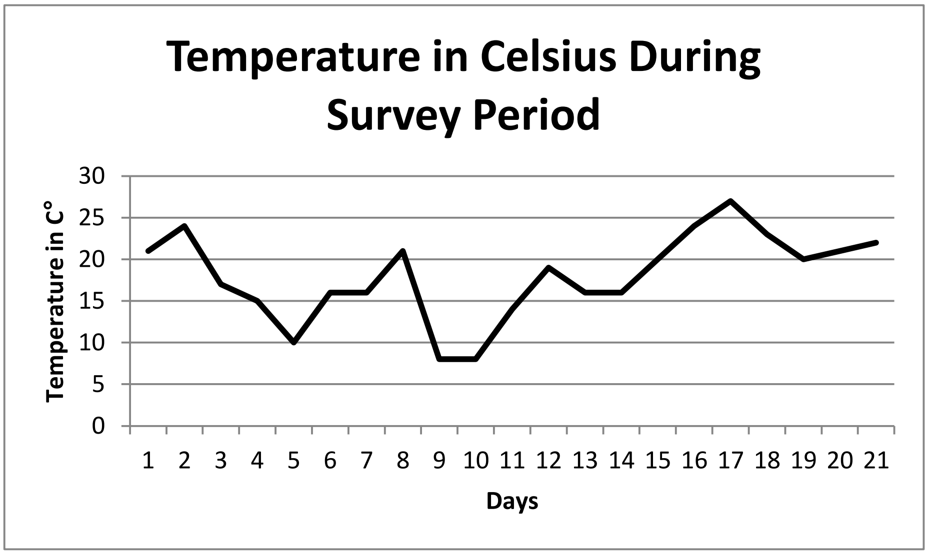


Figure 7 Graph of the temperature change during the survey period.

Relative humidity also played a role in the patterns observed in the results section. Figure 8, below, shows a peak towards the beginning of the survey, two peaks in the middle, and the formation of a peak towards the end. I conclude that when humidity is higher, intensity of frog calls is higher.

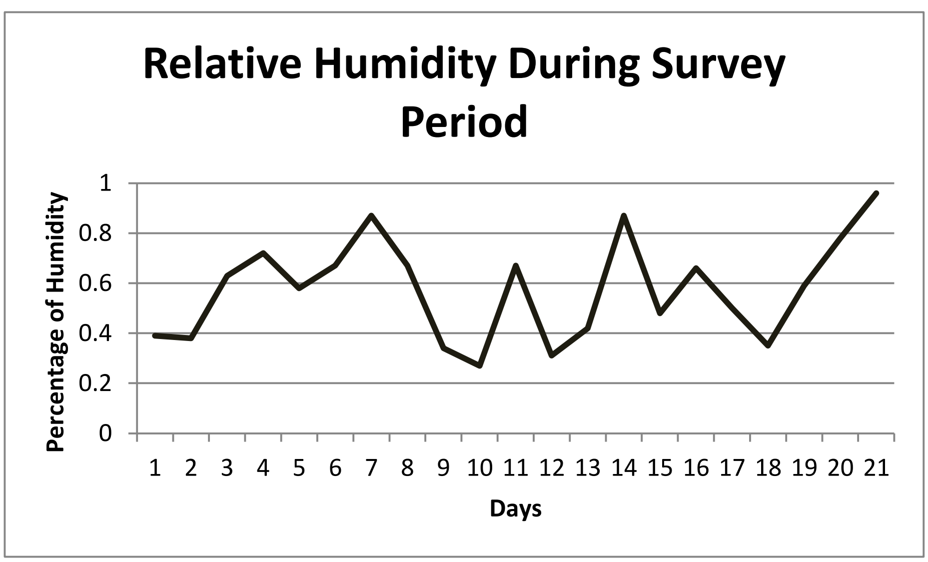


Figure 8 Graph of the relative humidity change during the study period.

An increase in frog call intensity during times of high temperature and high humidity can be explained by discussing amphibian physiology. All amphibians are ectotherms meaning that they depend on external sources of heat in order to regulate body temperature. This may explain why when the temperatures were warmer, more frogs were calling. Along with breathing through their lungs, amphibians also exhibit cutaneous respiration: respiratory gas processing through the skin (Mueller 2012). After sunset it is generally more humid, possibly promoting enhanced frog calling on more humid days.

Sky code and wind code were documented each night; however there was no pattern which affected frog calls during the survey period.

Natural Occurrence of Frog Species vs. Time of Year

Different species call at different times during the year (Beane 2010), and this was observed in this study. Southern chorus frogs (*Pseudacris nigrita*), leopard frogs (*Rana sphenocephala*), and spring peepers (*Pseudacris crucifer)* were calling at the beginning of the study and tapered off towards the end. Green tree frogs (*Hyla cinerea*) and pickerel frogs (*Rana palustris*) were not calling at the beginning of the study but began calling in the last few days. This shows that some frog species prefer to call in the late Spring while others prefer to call in the early Summer. My data supports the well-documented species-species-specific calling sequence predicted in the literature.

Variation in Sites

When looking at the relationship between sites and observed species, I discerned definite differences in the frog species presence. Thus, I gained some insight into the habitat preferences of some of the species observed. For example, the leopard frog (*Rana sphenocephela*) was present at sites 2, 4 and 5 but not present at sites 1 and 3. A reason for this might be simply that different frog species prefer different habitat types. Perhaps the leopard frog liked only habitats which contained stagnant water and pine trees. This would explain why the presence of leopard frogs was only at sites 2, 4, and 5. Another example is seen with the Spring peeper (*Pseudacris crucifer*) when comparing site 3 to site 4. The Spring peeper was calling at both sites, however, at site 3 the call intensity is less than half of the call intensity at site 4 in the first half of the survey. This may be due to site 3 being a moderate habitat and site 4 being a pristine habitat in terms of vegetation type. Difference in habitat disturbance may also help to explain why some sites have higher diversity than others. A combination of land degradation and land fragmentation can decrease frog species richness and abundance (Beebee 1997; Pope et al. 2000; Joly et al. 2001). In sites 1 and 3, where human disturbance and fragmentation occur, the call intensity and species richness was lowest. In sites 2, 4 and 5 where human disturbance was lowest, the call intensity and species richness was highest.

Further analysis of frog call data needs to be done to determine any other trends or patterns. Because I recorded the GPS coordinates and explained my surveying methods, other surveyors can recreate this study in order to create a working data base. This might allow other trends or patterns to be observed based on a temporal scale. Certainly, the time period could be expanded to include dates later in the spring. Additionally, the relationship between species and specific habitats could be explored more thoroughly than I was able to. Long term data sets compiled by a series of students might shed light on whether or not amphibian populations are declining or increasing from year to year.

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Appendix A

HERPS Frog Call Data Collection Sheet

Observer's Name(s) ____Date (day/month/year)_______________
Exact location of capture: County_______________, NC, Site Name_______________, UTM Zone 17 or 18
Number in party _________ Beginning Time ____________AM / PM Ending Time ___________AM / PM
Environmental Parameters at Start of Run
Air Temp. _______F /C Relative Humidity ________% Wind Code ________ Sky Code _______
Rain amt. w/in last 24 hrs ________mm # of Days since last rainfall ________ Moon Phase _____
Environmental Parameters at End of Run
Air Temp. ________F /C Relative Humidity _________% Wind Code _______ Sky Code ________

Instructions
At each stop listen for 2 minutes (recording start time), then record the air temperature, the amphibian calling index for each species heard, and whether moon light was visible or not.

	Per Stop Information				
Stop #	1	2	3	4	5
Start Time (Military)					
Air Temperature (°C)					
Species ↓ Stop # →	1	2	3	4	5
Moon or Moon-light visible: yes or no					

Amphibian Calling Index

1 = Individuals can be counted; there is space between calls

2 = Calls of individuals can be distinguished but there is some overlapping of calls

3 = Full chorus, calls are constant, continuous and overlapping

Beaufort Wind Codes

0 = Calm (< 1 mph)

1 = Light Air (1-3 mph)

2 = Light Breeze (4-7 mph), leaves rustle, can feel wind on face

3 = Gentle Breeze (8 – 12 mph), leaves & twigs move around, small flag extends

DO NOT conduct survey if windier than a 3.

Sky Codes

0 = Few clouds

1 = Partly cloudy (scattered) or variable sky

2 = Cloudy or overcast

4 = Fog or smoke

5 = Drizzle or light rain