Service Learning Project

Amphibian Survey: Amphibian Abundance within the University of Central Florida's Natural Lands

BSC 4861L

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Abstract

Amphibians are considered to be an indicator species that thrive on both land and water making them sensitive to many ecological disturbances, including deforestation and pollution. We tested three different cypress domes that are known habitats for amphibians in areas that have a variety of contact with human impacts. In each cypress dome we set up aquatic traps, PVC pipe traps, and board traps that were checked four times a week for amphibians. The results showed that Cypress dome B, the second furthest dome from human activity, had the highest species diversity and richness. It is worth noting that cypress dome A, the closest dome to human activity, had the highest amount of amphibian individuals. We were unable to find a correlation between proximity to human impacts and amphibian population diversity and richness.

Introduction

Figure 1. UCF Cypress Dome located near Student Union.

Over the past few decades there have been rapid declines in global species biodiversity. This declining trend has been witnessed within all types of vertebrates and many are becoming threatened[1], endangered[2], or extinct[3]. Among all of Earth's vertebrates, it is the amphibians (frogs, salamanders, and caecilians) that have the greatest amount of species on the verge of extinction (Hamer and McDonnell 2008). There are many factors that have been linked to the decline in biodiversity[5], and some of the most important causative factors include pollution[6], changes in land use, invasive species, which are organisms that are not native to an area and are causing harm to the ecosystem (Ecology Dictionary), and overexploitation, the over use of land for its resources (Ecology Dictionary) (Frias-Alvarez et al. 2010).

Amphibians are usually found in wetland habitats, such as the cypress dome ecosystems[9] in Central Florida (See Figure 1). Cypress domes are shallow swamps found in the low elevation of terrains which can be found throughout Florida (Kurz and Wagner

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1 **Threatened-**Any plant or animal species likely to become an "endangered" species within the foreseeable future throughout all of a significant area of its range or natural habitat (Ecology Dictionary)

2 **Endangered-**Probability of extinction is 20% within 20 years (Begon et al 203)

3 **Extinct-**The complete disappearance of a species because of failure to adapt to environmental change (Ecology Dictionary)

5 **Biodiversity**- Variety and variability of living organisms encompassing ecosystems in relation to community, species, and genetic diversity (Begon et al 602)

6 **Pollution-** presence of a substance in the environment that because of its chemical composition or quantity prevents the functioning of natural processes and produces undesirable environmental and health effects (Ecology Dictionary)

9 **Ecosystem-** The biological community together with which they interact including the surrounding physical environment (Begon et al 499)

2012), making it a perfect habitat[10] for amphibians, whose survival depends on the availability of an appropriate aquatic habitat (Hamer and McDonnell 2008). Amphibians need water to reproduce and for cutaneous respiration[11], the main method of respiration[12] in many amphibian species (Dodd 2010).

Amphibians are considered to be an “indicator species”. This means that they are highly susceptible to changes in their habitats, which can lead to an increase or decrease in the number of species found there. Indicator species signal the overall health of an ecosystem. This is evident when amphibian habitats become polluted. An increase in pollution is harmful to amphibians because they are both terrestrial and aquatic, meaning they are more exposed to areas where a pollutant can linger (Hamer and McDonnell 2008). Also, because they breathe using their skin (see Figure 2), pollutants, which could be picked up from the land or water, are more likely to seriously harm them (Hamer and McDonnell 2008). Aside from just polluted areas, ecosystems with poor water or habitat quality are not likely to have healthy amphibian populations.

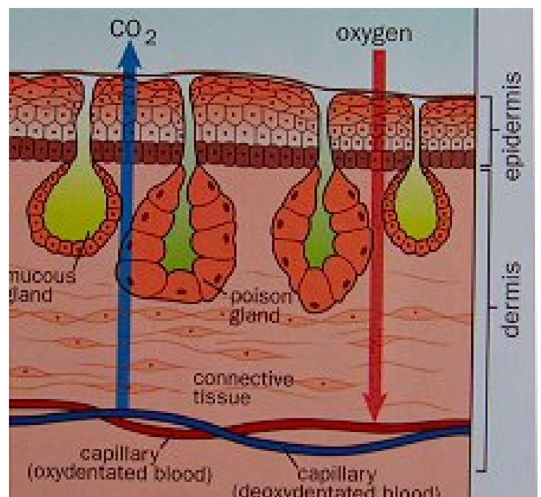

Figure 2. Amphibian respiration
Source: "Frogs and Toads."

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[10] **Habitat-** Location where an organism lives (Begon et al 31)

[11] **Cutaneous Respiration**- Breathing through the skin; in some vertebrates the body surface has become highly vascularized for gaseous exchange (Allaby 1999)

[12] **Respiration-** The oxidative process occurring within living cells by which the chemical energy of organic molecules is released in a series of metabolic steps involving the consumption of oxygen and the liberation of carbon dioxide and water (Ecology Dictionary)

The movement of amphibians from one habitat to another is a critical component of amphibian dispersal (Hamer and McDonnell 2008). Research has shown that there is a direct relationship between the amount of road traffic, which has increased in volume in recent years, and the number of frogs found dead (Fahrig 1995). This is not only from the cars driving on the roads, but it is also caused by road-related factors, such as pollution, noise, and water runoff (Fahrig 1995). Worldwide there has been an increase in both traffic volumes and amount of roads, which are contributing to declines in amphibian populations (Fahrig 1995), particularly in populated areas, like UCF.

Urbanization is not the only factor causing many amphibians to become threatened, endangered, or extinct. Increasing numbers of invasive species have also contributed to the high number of extinct amphibians. Invasive species have also further displaced amphibian life, thus changing the species biodiversity (Frias-Alvarez et al. 2010). One example of invasive species is the Cuban Tree-frog, *Osteopilus septentrionalis*. These frogs were accidentally brought to Florida in the 1920s and they are considered invasive because of their voracious appetites. Cuban treefrogs are known to eat several different species of native frogs and their tadpoles compete with native tadpoles for food (Johnson et al. 2007).

The main purpose of our study is to survey amphibian richness and biodiversity within the University of Central Florida's (UCF) main campus. Through our study, we hope to find trends in amphibian species diversity and richness related to location. We plan to do this by recording the amount and type of amphibian species in these areas and comparing our data sets. We hypothesize that the wetland ecosystems that are furthest from human activity will have the greatest amount of amphibian diversity and richness.

Increasing proximity to human activity also brings about many other factors, including an increase in pollution, amount of roads, land change, and increased noise (Fahrig 1995).

Research has shown that the decrease in species populations is far more severe in some amphibian families than others (Frias-Alvarez et al. 2010). Our data, once collected, will be able to show us if any amphibian families known to be in Central Florida seem to be on the decline, which we will be able to calculate based on the number of times we catch them in relation to other amphibian families. This study should be able to show if any invasive amphibian species are present, which will give light to possible reasons for the current amphibian biodiversity.

All three of the amphibian habitats are cypress dome ecosystems located on the UCF's main campus, which is home to 58,698 students ("Facts About UCF"). The first Cypress dome is located next to the campus' Student Union, a very heavily populated area. The second Cypress dome is located in the Arboretum, which is surrounded by two of the campus' busiest roads (Gemini Boulevard and Orion Boulevard). The third Cypress dome, located the furthest from campus, is found off of Neptune Drive (See figure 3). We believe that the area closest to human activity, the one within the main campus and next to the student union, will have the least amphibian diversity and richness while the furthest from campus will have the highest amphibian diversity and richness.

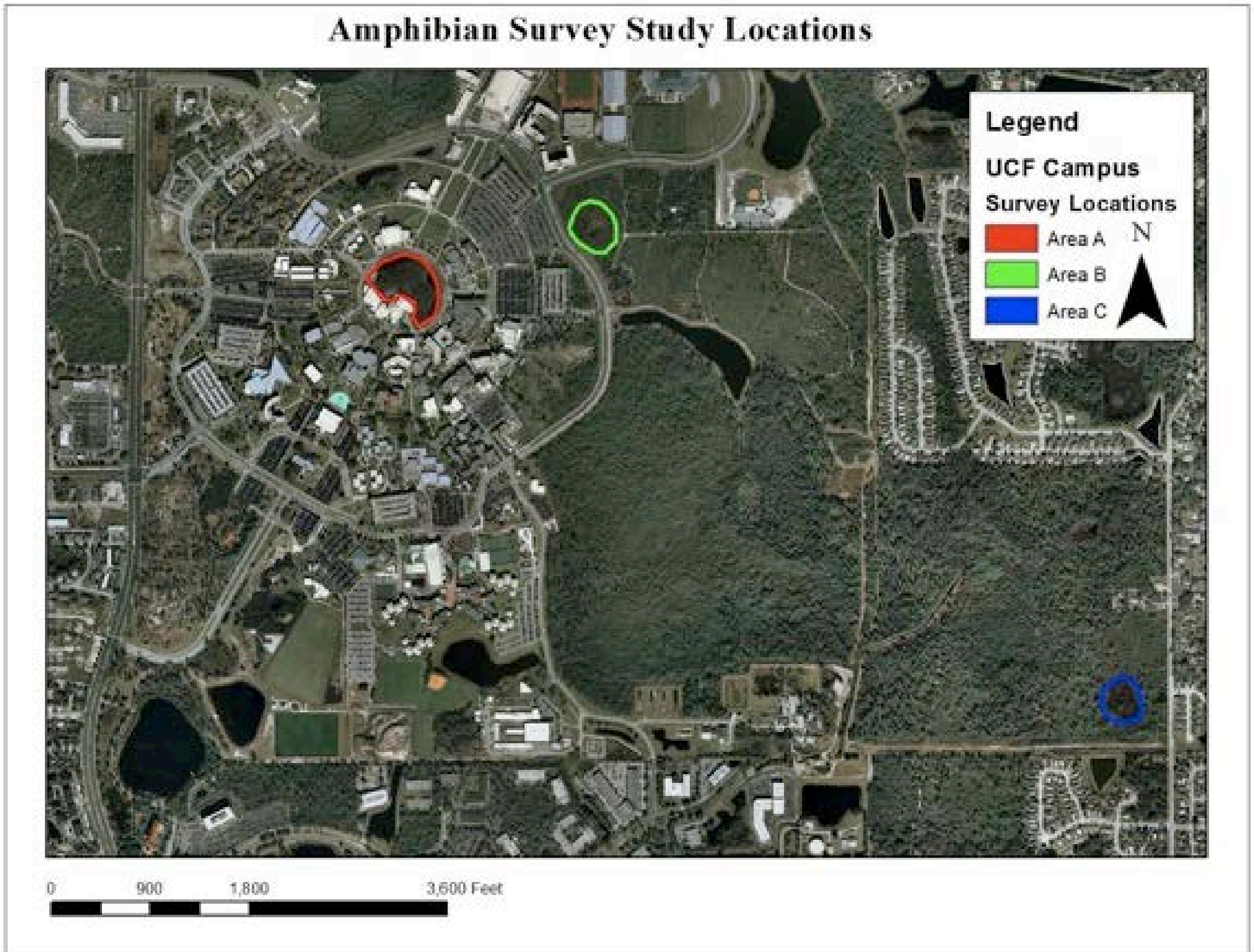

Figure 3. A map of the locations of our three cypress domes on UCF campus.

Triple Bottom Line

Conducting this research and answering our hypothesis is important because vital habitats for endangered or threatened amphibian species may be susceptible to impacts that are caused directly by the university. UCF is growing at a rapid rate, this growth could now, or in the future, impact considerations for places on campus to be used for additional buildings, student housing, recreation areas, or road development. By understanding which areas function as important ecosystems to endangered or threatened amphibians, it is possible to prevent them from being altered or destroyed.

This research will help establish which areas around campus are the most suitable habitat for species diversity in regards to amphibians and their proximity to humans. The cypress domes we will be working in are protected and are representatives of non-protected cypress dome ecosystems around UCF and what their amphibian populations may be like, assuming they have comparable ecological factors. This could help protect areas that are not already federally protected by implementing more laws to protect these fragile environments, keeping them from being altered or polluted. Environmentally, this is important because it can help keep sensitive areas rich in biodiversity, which could help amphibians thrive.

Economically this research can provide an understanding of the important amphibians and wildlife found on our campus, which could in turn help us receive grants for further research of these areas and the species found within. This research should also show the requirements needed by these ecosystems to remain or become healthy and sustainable. In the future UCF may decide to create further jobs for the purpose of maintaining the health of the arboretum, our research will be able to show them how to help the amphibians in the area, saving them time and money.

This study will also increase the amount of knowledge we currently have on wildlife found within the UCF main campus and allow us to have a better understanding of the UCF protected lands. This will also help environmental studies and biology students at UCF better understand wildlife and the importance of conservation. The understanding of the diversity of amphibian species in these wetlands could end up leading to an increase in the quality of these cypress dome habitats. This could raise the aesthetic purposes of the arboretum and lead to an increased amount of hiking and recreational uses of the natural lands by students and faculty of UCF and the surrounding community.

Methods

In order to try and catch a variety of different amphibian species our study used three different approaches for data collection. Each of the three designated survey areas was set up with aquatic[15] traps, PVC pipe traps, and plywood board traps. During the first three weeks of the study we used all three types of traps, after which the aquatic traps were removed but the other two types stayed in place for the remaining three weeks. All the traps were set within the designated survey areas the afternoon before the primary scheduled test date. Each of the designated survey areas was tested four times a week for a total of six weeks (see Table 1).

Table 1. Weekly trapping schedule by location

Location	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
Area A	Test	Test	Test	Test
Area B	Test	Test	Test	Test
Area C	Test	Test	Test	Test

While within the designated survey areas all researchers were required to wear protective snake chaps and bite proof footwear. The afternoon before the scheduled test date researchers placed three aquatic traps in each of the designated survey areas (see object A in Figure 4). The aquatic traps were anchored in the middle of the cypress domes where there is more standing water. Each trap had a minimum distance of ten feet separating it from the other aquatic traps. The aquatic traps were placed partially submerged in the water with roughly one to two inches of the trap exposed to the air, the gap from the water's surface to the top of the trap allowed captured specimens to breathe.

[15] **Aquatic-** Growing or living in water; frequenting water (Ecology Dictionary)

On the scheduled days each aquatic trap was removed from the water to check for specimens. If a specimen was found researchers would collect water from the location surrounding the trap in a collection bucket where the captured specimen was then emptied for further examination and data collection. Researchers wore latex gloves because amphibians have delicate skin that can be harmed by the oils on human hands. While examining the species, researchers would determine the species type and measure the organisms' size in centimeters from snout to vent. After examination, all specimens were released back into the location in which they were captured. These steps were repeated four times a week for a total of three weeks. At the end of the third week all traps were removed.

During the second and third trapping approaches, researchers used PVC pipes and plywood traps for specimen collection. The afternoon before the scheduled test day researchers set four PVC pipes near the base of trees within each of the designated survey areas (see object B in Figure 4). Each PVC trap was set vertically in the ground. This allowed for an opening at the top of the pipe to be exposed, while the bottom few inches of the pipe remained in the ground. The PVC traps were used to collect arboreal[16] frogs.

Researchers randomly placed two plywood boards on dry ground within each of the survey areas (see object C in Figure 4). The plywood boards are used to attract amphibians such as frogs, toads, and salamanders seeking a place of refuge during the day. Both types of traps were checked during the afternoon of the scheduled test days. When checking the PVC pipe traps, researchers would first remove the pipes from the ground and then gently tap the sides of the PVC pipe to displace any collected specimens

[16] **Arboreal-** inhabiting or frequenting trees (Merriam-Webster)

into a collection bucket. The collected frogs and/or specimens were further examined to determine their species type and size for data collection. In order to check the plywood traps, researchers would slowly lift up the board, examine, and record any specimens found beneath them.

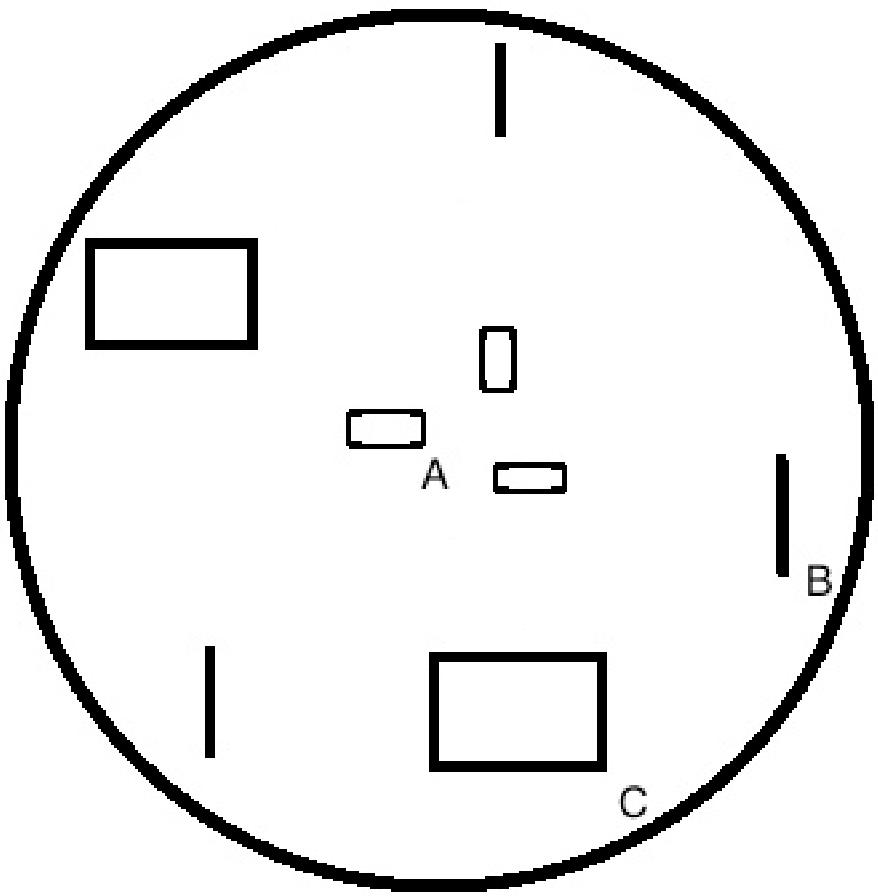

Figure 4. A layout of the traps within the cypress domes.

During the course of this study, researchers were testing for richness and biodiversity within each of the designated survey areas. The following data was recorded during each of the three approaches: location, date, temperature, humidity (%), wind speed, trap type, amphibian type, species name, size (cm), photo #, invasive, and any other observations made by the researchers (see Figure 5). Each of the three designated survey areas was given a folder with a corresponding color-coded title where recorded data sheets were placed. After the recordings were complete, researchers transferred data from the three folders to an Excel document. The data was then analyzed in excel with focus on richness and biodiversity. This correlation of data was used to help answer our purposed hypothesis.

Once the data had been inputted into excel the species richness was determined by looking at the number of species found in each dome. The proportion of species for each dome was calculated by taking the species richness and dividing it by the overall number of amphibians caught in that dome. Next, diversity index was calculated by using the Shannon-Wiener diversity equation; which is used to find the biodiversity of a habitat (Figure 6).

$$H' = -\sum p_i \ln p_i$$

Figure 6. Shannon-Wiener equation with *pi* representing the proportion of the species and *ln* is the natural logarithm.

Changes

Once we began to conduct our project we decided to change various components of our original methods. One approach that we agreed to dispose of was the use of an audio recorder to identify amphibians by their call. This would have been a time consuming process that would likely have resulted in no data collection. Aquatic trap use was also extended by an extra week than previously planned. Once we began our research we found that these traps were the most effective in capturing amphibian species and through continuation we would be likely to obtain a higher number of species to survey. The number of PVC pipe traps used in each dome was changed as well from three to four in order to increase our chance of amphibian capture. Our weekly trapping schedule based on location was also modified to four times a week in each dome as opposed to four times a week alternating between the different domes, each dome being visited twice a week. This was due to our belief that we would collect more data if we checked each cypress dome more often.

Materials

- *Reptiles and Amphibians* Peterson Field Guides
- Florida Frog Species Calls CD
- 4x5' Plywood Sheets (6)
- PVC amphibian Trap (9)
- Excel
- ArcGIS
- Snake Chaps (5)
- Audio Recorder
- Nets (2)
- Camera
- Notebooks (3)
- Aquatic Amphibian Trap (9)
- Latex Gloves
- Plastic collection bucket
- Caliper
- Flash Light
- Rubber Boots (5)
- Thermometer

Amphibian Monitoring **Cypress Dome ____________**

Date/time: ____

Surveyor(s): ____

Weather

Temperature	Humidity (%)	Wind speed	Observation (overcast, etc.)

Amphibian Data

Trap type	Amphibian type	Species name	Size (cm)	Photo #	Invasive

Observations (water level, injured amphibians, etc.)

Figure 5. A copy of the data sheet used to collect research

Results

Overall our data does not support our hypothesis that wetland ecosystems furthest from human activity will have the greatest amount of amphibian biodiversity and richness. Calculations of species richness shows that cypress dome A (student union) and C (east parcel) where both found to contain 4 different species of amphibian, while cypress dome B (North Orion) contained 6 different species of amphibian (Table. 2). Though we expected for the east parcel to have the most and the union to have the least, these two were actually tied and behind the North Orion parcel. Amphibian abundance was highest in the Union Parcel with 26 amphibians, closely followed by North Orion parcel, which had 23. The East Parcel only had six.

Calculations of amphibian biodiversity again showed cypress dome B as the area with the highest biodiversity. This was followed by cypress dome C and then cypress dome A (Figure. 7). Cuban treefrogs were found in B (North Orion) making up 9% of the amphibian population (Figure 8). And we found Cuban treefrogs in C (East Parcel) that made up 40% of the amphibian population (Figure 9). No Cuban treefrogs were found in A. No other invasive species were found in any of the cypress domes.

Table 2. Species Richness of 3 different cypress domes showing species richness and Total abundance.

A (Student Union)			
Species	Abundance		Results
Green Tree Frog	3	**Species Richness**	4
Southern Toad	15	**Total Abundance**	26
Squirrel Tree Frog	4		
Southern Leopard Frog	4		
B (North Orion)			
Two Toed Amphuma	2	**Species Richness**	6
Green Tree Frog	2	**Total Abundance**	23
Squirrel Tree Frog	7		
Eastern Narrowmouth Toad	8		
Cuban Tree Frog	2		
Southern Leopard Frog	2		
C (East Parcel)			
Cuban Tree Frog	2	**Species Richness**	4
Barking Tree Frog	1	**Total Abundance**	5
Pine Woods Tree Frog	1		
Southern Leopard Frog	1		

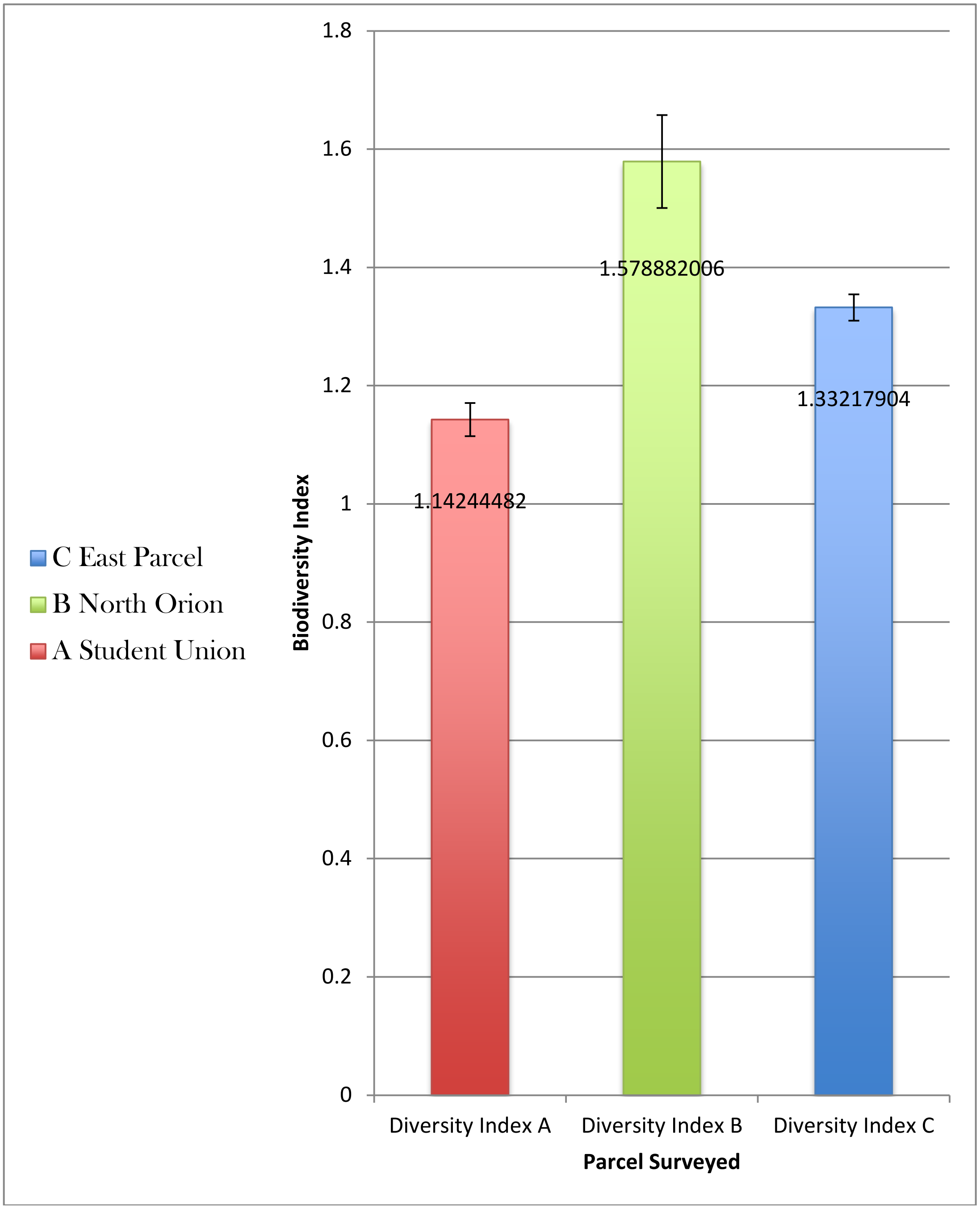

Figure 7. Biodiversity of each Parcel surveyed containing diversity index and standard deviation.

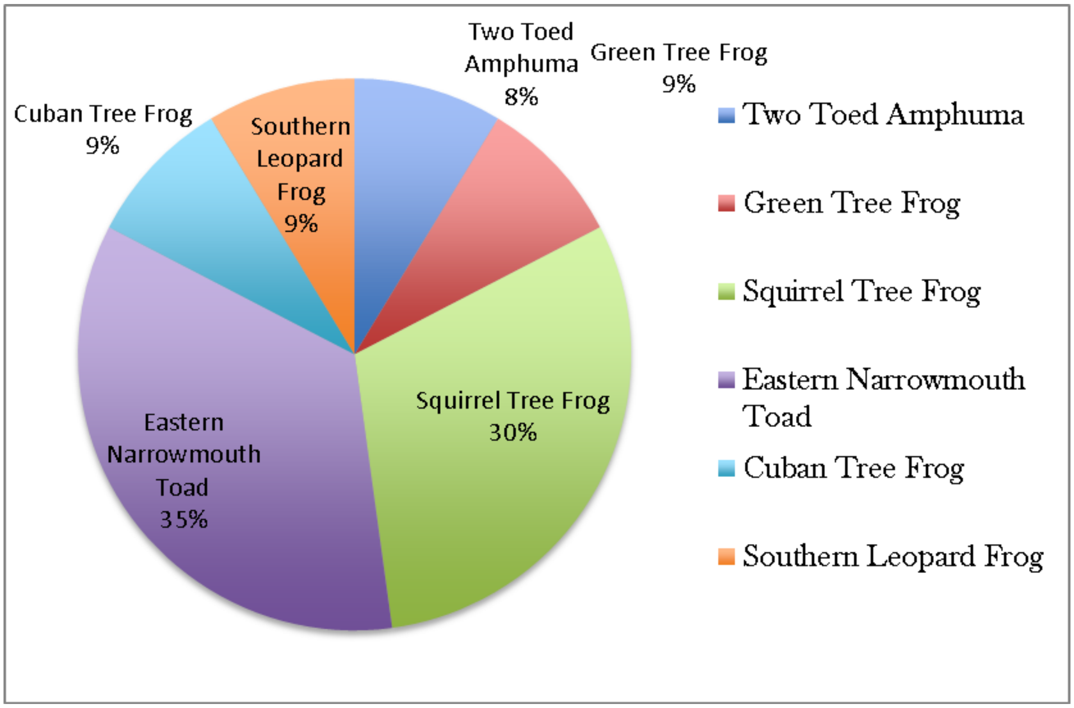

Figure 8. Abundance of each species of amphibian within cypress dome B (North Orion).

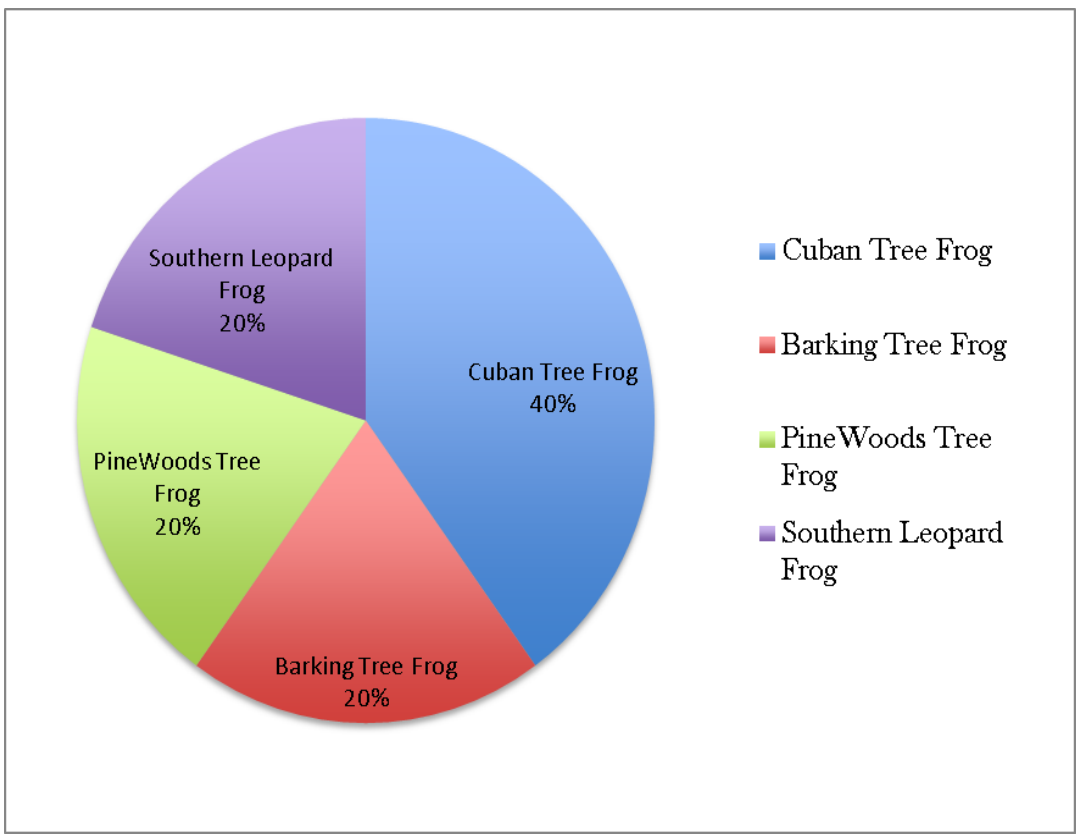

Figure 9. Abundance of each species of amphibian with in cypress dome C (East Parcel).

Discussion

Though the diversity and richness of the amphibian populations did vary greatly in each different cypress dome, it seems that they did not correlate with their proximity to human impact. The healthiest ecosystem appears to be cypress dome B followed closely by cypress dome A. It seems the least healthy was cypress dome C. Cypress dome B was likely the healthiest because it was not as heavily effected by human impacts as cypress dome A. A was located right next to a building and directly under two high trafficked wooden walkways, because of this A had a higher amount of pollution and liter. Also, B was connected to the UCF arboretum, which meant wildlife could come and go from the cypress dome safely, which could have increased the biodiversity. Buildings and roads locked in parcel A preventing any access to other undisturbed ecosystems.

Though cypress dome A had the highest amount of amphibians caught, it also had the lowest species diversity. This was because the southern toad represented 57% of the amphibians caught. Southern toads are not known to outcompete or harm other amphibian species, so this high percentage should not be a concern (Guzy 2010).

It may have seemed like cypress dome C was the least disturbed and likely the healthiest, the data showed otherwise. We have debated a few different possibilities for why cypress dome C had an amphibian abundance that was three times less than in cypress dome A and we have concluded that either we made errors while collecting our research or there were unforeseen environmental factors in this cypress dome harming the amphibian populations.

A possible collecting error we could have made was not fully appreciating the size of this cypress dome compared to the other two. Cypress dome C was our largest cypress dome, which meant that the amphibians could be more spread out in this area as compared to the others, as they had a larger area to forage, hunt, and search for mates. We are curious as to if it would have been more beneficial to calculate the approximate size of each cypress dome and determine the number of traps to lay out based off of that. This dome had the same amount of traps as the other two, which may have decreased our chance of finding as many amphibians.

Another possible explanation for the low richness of the cypress dome could be unforeseen environmental factors. The water level in this dome was constantly above two feet as apposed to the other two, where the water levels were much lower. This could have created a better-suited habitat for carnivorous insect species that prey on amphibian eggs and tadpoles, decreasing the amphibian populations (Morin et al 1988). Another factor could be the amount of invasive amphibian species in this area. Of the amphibians we did manage to catch in this dome, 40% were Cuban treefrogs, an invasive species that is known to compete with and predate on other amphibian species.

While conducting our research we were met with a few barriers that we had to overcome. One barrier was the initial inability to catch any amphibians; this problem was resolved after realizing that amphibians were not going to be showing up every single time we went out. We increased our amount of traps and moved some of them around and slowly began finding results. We also began using **nets** to catch amphibians as we walked around checking our traps, which ended up yielding 47% of our total amphibian catches.

Though a correlation between proximity to human impact and the calculated diversity and richness was not found, the overall health of these ecosystems is known. We suggest further research into the amphibian populations in these cypress domes. Future studies should be prepared to set aside more time than six weeks and set out a higher number of traps in each cypress dome. Researchers should try to survey through a wide variety of weather conditions and continue using a wide variety of trap types. Future researchers should set more time into discovering why cypress dome C had such a poor amphibian population. They should look at possible pollution levels and other species that may be competing with the native amphibian species.

Though many people do not understand the importance of amphibians, our natural lands would not be as enticing without them. If our amphibian populations went into a sharp decline, mosquito and insect populations would increase while larger wildlife populations would decrease. This would take away from the aesthetic purposes of our natural lands, leading to a possible decrease and tourism along with the decline that would happen in biodiversity.

Amphibians are considered indicator species, which means any significant change in their population numbers would imply that changes are happening within their ecosystems. By conducting amphibian surveys on a relatively regular basis, ecologists would be able to find out if there may be a problem in an ecosystem, such as pollution or invasive species, before it harms the environment and the wildlife too much.

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