A BUG'S LIFE: DIVERSITY AND ABUNDANCE OF INSECTS ON PURCHASE COLLEGE CAMPUS

By Daniel Demopoulos, Georgie Humphries, and Isabella Wrobel

ABSTRACT

In this study, we surveyed 3 different areas of low shrubs, low shrubs and tall trees, and just tall trees to look at how each environment facilitates insect habitats. We used a stick and kite method (knock-down method) to shake bushes and trees, as well as a dragging sheet method (Sheet Method) to capture insects and place them in ethanol. We hypothesized that the mixed environment would have the highest abundance and diversity and that there would not be a large difference between low shrubs and tall trees for either variable. Our results showed that while a mixed environment of tall trees and low shrubs had the highest abundance of insects, low shrubs had a higher diversity of insects.

Keywords. Abundance, Diversity, Environment, Habitat, Insects

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INTRODUCTION

Insect species diversity are primarily determined by their environment and how well they adapt to it over time. Their unique characteristics are determined through a process called natural selection which determines their phenotypic traits that increase their chances for survival over a long period of time. Their abundance can depend on the vegetation density and richness, predation exposure, and climatic conditions. If all their needs are met, then their species will flourish and thrive.

It is important to learn and understand what insects inhabit certain locations because it can influence the balance of our surrounding environment. Especially if there is a keystone species that can influence trophic levels. For example, there was a study to determine if arthropod species diversity was influenced by plant species diversity and functionality. Their results demonstrated their hypothesis to be proven true. Arthropod species diversity was correlated with the diversity in plants. (Siemann 1997) Another research was conducted to determine if bark beetle species would spread to northern parts of the US where conifer trees are most present because of climate change. By using available population models and climate forecasts, they concluded that bark beetles could spread to northern regions as the climate warms. (Bentz 2010) If certain species are considered an important attribute to an environment than conservation efforts put into place to safeguard these species from extinction or dispersal.

Purchase College has approximately 550 acres of land occupied by academic buildings, student housings and scenic trails that house a wide variety of animal and plant species. But what kind of inspect species does it have? And what is their abundance? The purpose of our experiment was to determine the diversity and abundance of the insects here on Purchase college. We were curious to discover what species inhabited the campus. Our hypothesis was that there will be more diversity in areas that had mixed diversity of plants and very low abundance and diversity in areas with low shrubs and tall trees.

METHODS

To conduct this experiment, we had to determine three separate locations with specified different habitats within a close three-mile radius. Habitat is a possibly natal preference induction in insects, (Davis 2004) which implies that species found in each field site may be unique/prefer that site. Our first field site identified as “Location 1” was located outside of the entrance to the Neu Village at Purchase College Campus. This site consisted of tall trees and minimal low shrubbery, making it our first specific habitat. Our second field site or “Location 2” was located behind the Admissions Building at Purchase College Campus. The site we chose consisted of both tall trees and low shrubbery making it a specific habitat with the mix of both tall trees and low shrubbery that we were searching for. Our final field site or “Location 3” was located across the street from Location 2 and a little way uphill. This site consisted of strictly low shrubbery. These three locations gave us three separate habitats (tall trees, low shrubbery, Mix of both tall trees and low shrubbery) with generally low human foot traffic. Locations 1-3 were close enough in proximately that its soil and general weather were approximately the same. The weather the day of testing was 64 degrees Fahrenheit, with highs of 67 degrees and lows of 54 degrees, and overcast.

To study the diversity and abundance of these insect species in these 3 locations we needed to collect and count these specimens. To gather insects, we used methods similar to studies that rounded up and collected footman moths (Eilema Lurideola) to average their abundance in Rothamsted (Creighton 1938) and studies that used natural examination techniques (Savopoulou-Soultani 2012). The Sheet-Method and the Knockdown-Method were used for specimen collection. The Sheet-Method consisted of a white queen-sized sheet with handles made of duct tape for dragging. The sheet was dragged across the ground in a straight line for 10 meters twice for each location, then the sheet would immediately be inspected for insects, such insects on the sheet were collected and put into small vials of ethanol (Brand unknown) and counted to record abundance. To avoid unnecessary deaths of some of the insects, we avoided killing excess like many studies who used light traps (Frith 1979), and did not put easily identifiable insects such as standard black ants into ethanol for later identification. The Knock-down method consisted of a white sheet about 4ftx4ft held open by two wood sticks to make a square. While holding this square underneath a shrub/tree, another wood stick would be used to rustle or bang on said shrub/tree and catches the falling insects. This is repeated twice at each location, and just like the Sheet-Method we immediately counted and collected the insects immediately. In total, each location had four collection attempts with both methods. The collected insects were taken back for counting and species identification. Each location was statistically recorded by how many insects there were and what species occurred within that collected population. These rates were then analyzed into tables/figures to be compared to each other in terms of the diversity and abundance of each location and its respective habitat.

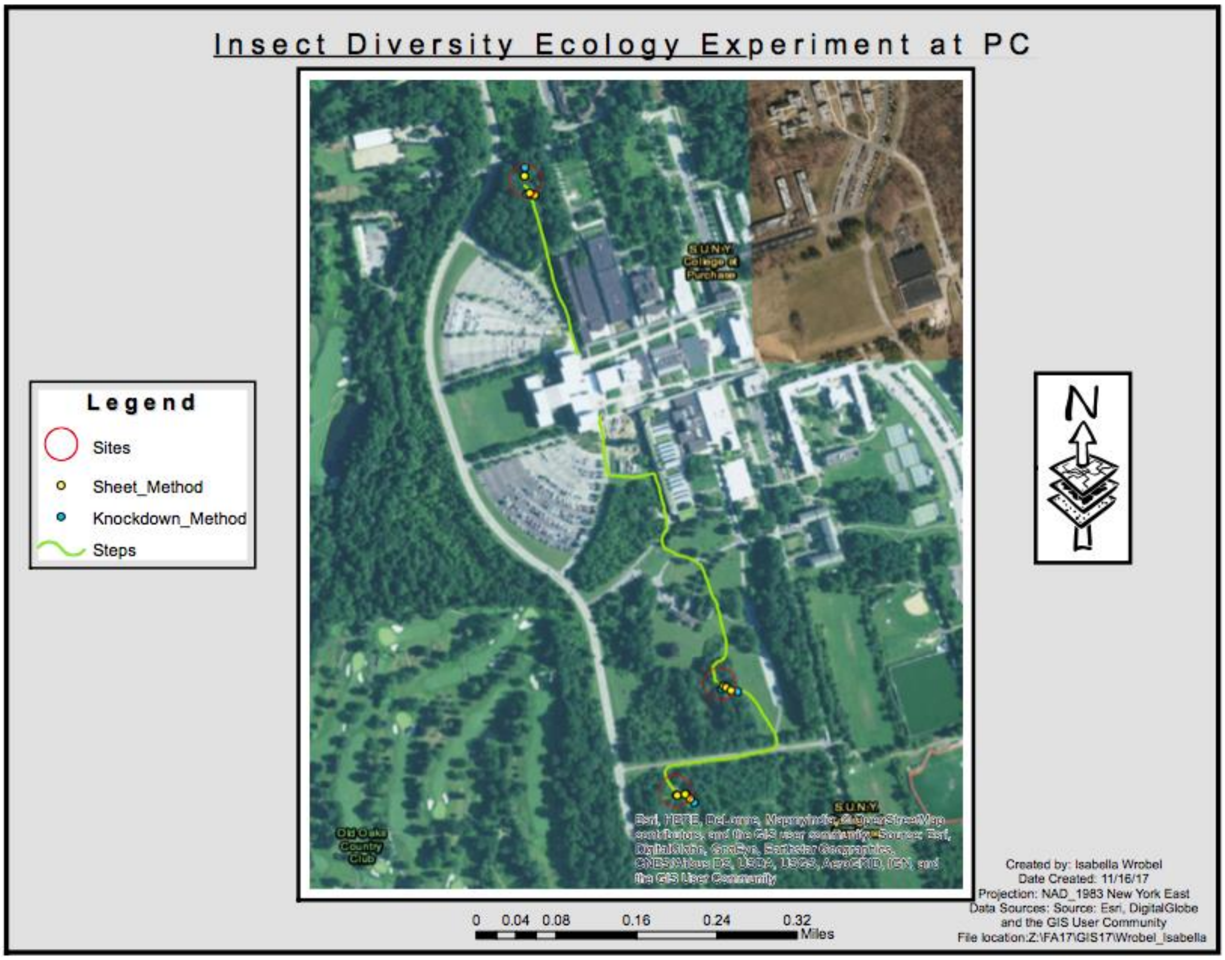


Figure 1: Map of Purchase College campus and the Locations respectively

RESULTS

We concluded that the three tested location habitats (High trees, low shrubbery, and combination of both) had distinct and varying abundance and species diversity in terms of insects. Location 1 consisted of high trees and had the lowest abundance and diversity of the three locations, with only 7 specimens collected and a total of 3 species of insect. These species found were 3 standard black ants, 3 tan sac spiders, and a single true cricket, (Figure 2). Location 2 consisting of a combination of both high trees and low shrubs did have the highest abundance with 17 specimens collected, but did not have the highest diversity with only 5 different species of insect. These species were 5 standard black ants, 8 tan sac spiders, a single daddy long leg, a single earwig, and 2 fruit flies, (Figure 3). Location 3 consisting of low shrubs had an abundance of 11 specimens collected, but the highest diversity with 7 different species of insect. These species were a single standard black ant, a single standard fly, 2 green leaf bugs, 3 grasshoppers, 3 red ants, and two different species of beetle totaling to 3 beetles, (Figure 4). Figures 2-4 demonstrate these findings with the x-axis containing the species found on each location and the y axis containing the abundance of each of these species found. Figure 1 demonstrates all the species (x-axis) and their abundance (y-axis) combined in conjunction to each location by differentiating location by different shades of grey. From this graph, we can see that the only species located on all three locations was the standard black ant, with tan sac spiders occurring in two of the three locations.

Table 1: The number of specimens of each insect species that occurred at each of the three locations

Species of Insect	Location 1	Location 2	Location 3
Standard black ant	3	5	1
Tan Sac Spider	3	8	0
True Cricket	1	0	0
Daddy Long Legs	0	1	0
Earwig	0	1	0
Fruit Fly	0	2	0
Standard Fly	0	0	1
Green Leaf Bug	0	0	1
Grasshopper	0	0	2
Red Ant	0	0	3
Beetles	0	0	3

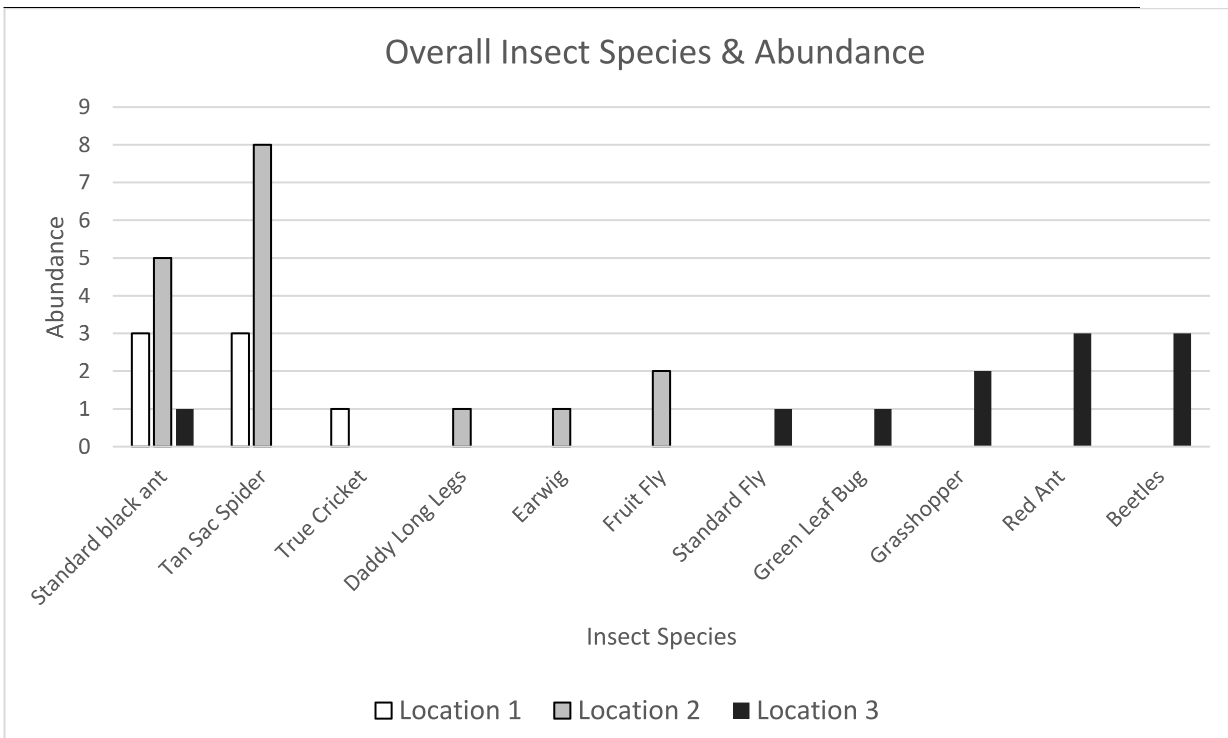
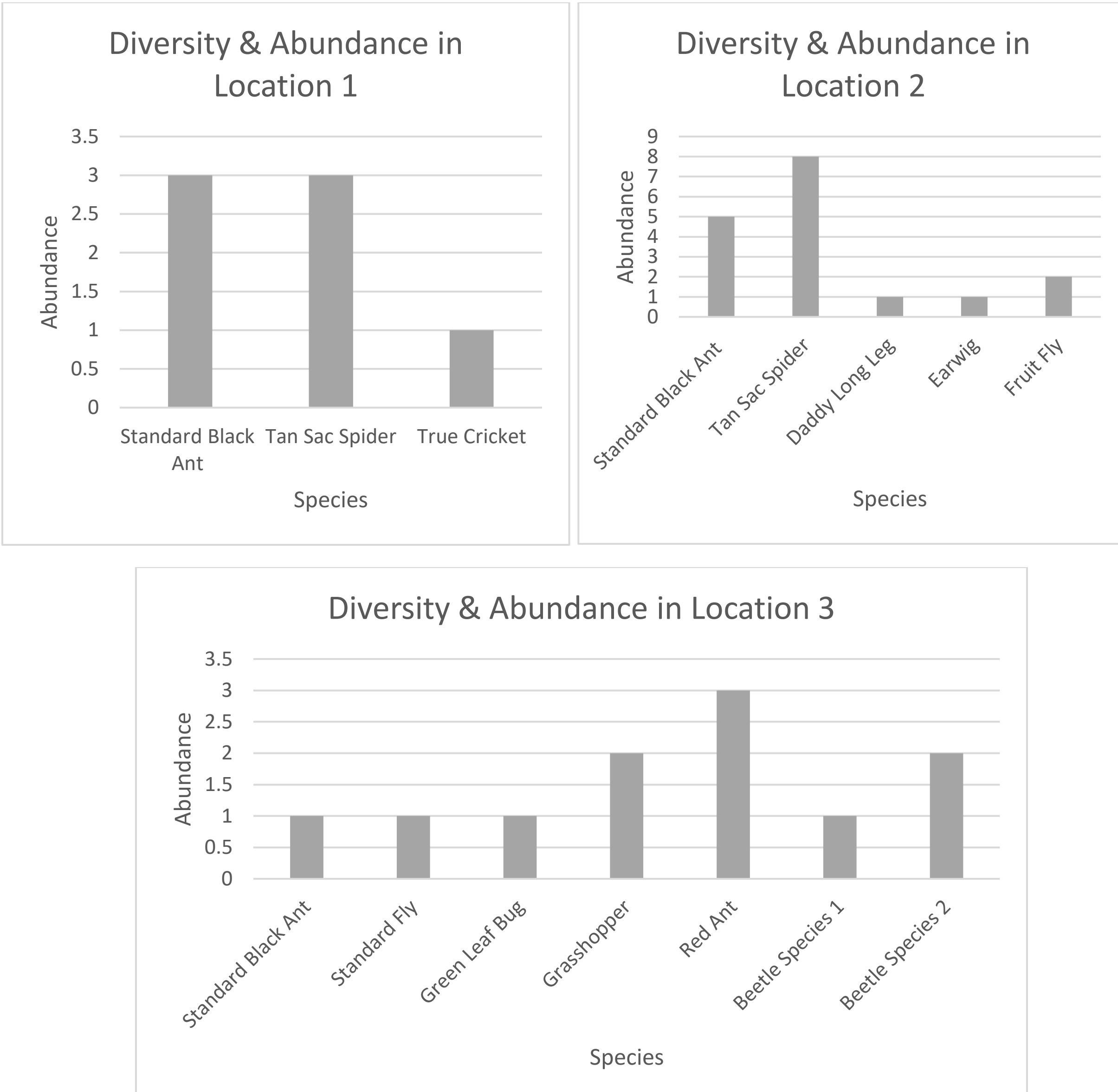


Figure 2: The number of specimens of each insect species that occurred at each of the three locations in conjunction to each other



Figures 3-5: Species found in each location and their abundance

DISCUSSION

One pattern found was that while there was a higher abundance of insects in the mixed habitat of tall trees and short shrubs, there was more diversity in the short shrubs. One explanation could be that location 2 had different types of plants that had less niches than location 3 which only had low shrubs. An alternate explanation could be that there was outside influence, such as people walking through location 2 before we got there that scared off the insects there and caused there to be less insects when we got there. Another significant pattern found was that location 2 had the highest abundance of insects. This finding was expected because location had a variety of low shrubs and tall trees, as opposed to just tall trees in location 1 and just low shrubs in location 3. A higher variety of niches means that there will be a higher carrying capacity of life in that area. Tall trees also had an unexpectedly low diversity. There were spiders, ants and one cricket found. This could be due to the tree not being healthy or having defenses against insects. The spiders might have also eaten or driven away the other insects. We also found that insects tend to live close together, often multiple species occupying a single bush. This shows that the distribution of insects is quite small, considering how many can live within the same plant. (Taylor 1984) Even spiders coexisted with prey insects like ants and beetles, which was not expected. This finding is the opposite of what was found by Flecker et al. who found that large insects, over 8 mm, were much more abundant when there were not predators within the vicinity. (Flecker et al. 1984)

One issue with our methods was that we could not replicate the plant species for each location, meaning that there was unaccounted for variation, which influenced both abundance and distribution. While we studied the same plant life on campus, in a small area, the environment was not controlled, meaning there was some differences in the environments besides the height of the plants, such as predators, distance from water, pesticide usage and more. We also could not control other people walking through the area we were observing.

L.R. Taylor studied the distribution between different insect species to see what their ideal niche is and how far away they like to live from each other. He found that to study insects properly, they need to be in a contained environment to prevent outside factors from influencing the data. However, when he tried to contain them in an enclosure, the natural distribution was thrown off. He concluded that insect distribution is better left to being a theoretical study than a practical one. This relates to our study because it discusses the challenges of studying insects in the field versus in a closed environment. Getting significant results with outside factors having an effect is just as hard as maintaining a natural distribution in a laboratory.

A separate study by Flecker, A.S. & D., Allen investigated the factors that play a role in insect distribution found that predation, substrates available, and spatial refugia all had effects on the distribution of insects. Substrates, the surface of the floor, that contained a lot of empty spaces were occupied more frequently than small, tightly packed ground surface. Predators had a significant effect on the abundance of large insects, which had much higher numbers when there were no predators around. Spatial refugia and substrate type still had a larger effect though, said to be caused by an affinity for surface area and trapped detritus. This relates to our own study in that we also found a high abundance of insects clumped together in bushes and grass. In contrast to the lotic insects, we found large insects and predators such as spiders coexisting within the same bush or tree.

We could have recorded better results by having more days of field testing to lower the chance of outliers, influences from weather, influences from temperature. Another way we could have gotten more accurate results would have been to record data use two different examples of each habitat so that there would have been a lower chance of variation between habitats. A third way to ensure more accurate results would have been to use more methods of catching insects such as a net.

In the future, we could use our data to observe the abundance and diversity of lotic and lentic insects. Understanding how insects in the woods could help us study how insects behave in the water and how parallels could be drawn between water quality and forest quality and how that impacts the insects and the animals that interact with them. Another direction we could explore would be to measure the abundance and diversity between seasons every year and measure if climate change is affecting how long insects are living at Purchase College. (Ulrichs et al. 2008) Furthermore, since climate change is such a quickly growing field, we could also observe where the insects are moving if their current habitat becomes too different or inhospitable due to changes in climate. If certain keystone insects move to a different location, it could create a trophic cascade, in a positive or negative way. (Régnière et al. 2012)

Our study shows that Purchase College has a tentatively low number of insects on campus. That's bad because insects are near the base of the food chain, so if they are not thriving, then it is safe to assume that the animals that depend on insects as food are also not thriving. It could also be a sign that the plant life is dying as winter gets closer, which would also explain the low number of insects found. During the fall, it's probable that animals are eating as many insects as they can before the winter comes when food sources are harder to find.

CONCLUSIONS

After collecting the data, preparing our samples, and quantifying our findings. We have found in total 35 insects and 15 identifiable species out of the total of insects captured. Our hypothesis was supported by the abundance and diverse species that we collected in areas of low shrubs with diverse plant species

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