Ant Biodiversity in Long Island Environments

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Abstract: The purpose of our project is to investigate the impact the environment has on ants living in both unfertilized and fertilized areas. We will be able to see if the chemicals found in fertilizers have an impact on the biodiversity of ant species. We will compare the mitochondrial DNA of the ants we collect to one another and see if there is a greater variety of species in one area. We will go through the barcoding process by using the silica method. We will isolate the DNA from each ant, amplify the DNA, and analyze it through gel electrophoresis and DNA Subway. We expect to find more ant biodiversity in the unfertilized area than the fertilized area. We will take into consideration the chemicals added into the fertilizer, how often the grass is cut, and the possible ways this changes the ants' environment compared to a wild, grassy area that is not maintained with fertilizer.

Introduction: The most common types of ants on Long Island are pavement ants, odorous house ants, and carpenter ants. Fertilizer is helpful for plants, but the toxins from the fertilizer build up inside the nearby living organisms. Using this information, we will study the effects the fertilizer has on the ant species. Based on current studies, the use of fertilizer affects all the resources ants need to survive. It is possible that over a long period of time while living in a fertilized area, certain species of ants may move to areas that are unfertilized in order to survive, or may adapt over time to the fertilizer. This may lead to a decrease in ant biodiversity in either the fertilized area or the unfertilized area. The groundskeeper at our school informed us about the fields we will be using. Mr. O'Brien helped us obtain the information we needed to know about the fields.The landscapers at our school fields cut the playing field areas twice per week and common areas once per week (O'Brien 1). Pesticides are not applied to the grass in any areas. Two hundred pounds of fertilizer per acre are applied to the fields. In the spring and early summer, when we will be collecting our samples. The NPK number (nitrogen-phosphorus-potassium ratio) is 22-0-3.

Materials & Methods: Samples were collected at the Charles B. Wang Athletic Fields in Huntington, NY. We were able to collect samples on April 30th, 2019. Ten ants were collected from the fertilized area and ten ants were collected from the unfertilized area at the same complex. We preserved them in 95% ethanol for identification in the laboratory (Ranga 1). We took pictures of the ants in the habitats, the habitat itself, and each ant under a microscope for taxidermists to possibly verify the species if necessary. The species of the ten samples were identified by us before the barcoding process began. We stored our ants in a freezer overnight to humanely kill them after they had been taxonomically identified. To begin the barcoding process, we removed a small piece of tissue from each ant for DNA isolation. We did so by using the silica method, which is very effective for invertebrates (DNALC 11). We then used the PCR Amplification Process in order to amplify the COI gene. Once this process was finished, we were able to more effectively analyze the DNA samples (DNALC 19). In order to analyze our amplified DNA, we used the gel electrophoresis process. The DNA samples that displayed bands in the gel correctly were sent to be sequenced (DNALC 21). We then uploaded our sequences to DNA Subway to further analyze them.

Collection site of unfertilized samples

Collection site of fertilized samples

Sample: XQN-004

Sample: XQN-017

Sample: XQN-020

The Phylogenetic Tree demonstrates the relationship between the fertilized sample (004) and the Prenolepis imparis ant species and the two unfertilized samples (017 and 020) and the Tapinoma Sessile ant species.

Results: After running the gels, we were only able to see DNA was present in seven of the twenty samples. Unfortunately, after sending in the samples for sequencing, only three of the samples had DNA sequences that we were able to read and analyze. One sequence from the fertilized area matched the Prenolepis imparis, false honey ant species. The other two samples were sequences from the unfertilized area and we found them to match the Tapinoma Sessile Ant species, also known as the sugar ant.

Discussion: When we received the sequences, we were able to compare the results of the ants from the fertilized fields and the unfertilized area. Not only did our results from the Charles B. Wang Athletic Fields lead to conclusions about ant biodiversity at this location, but support the idea that this specific fertilizer that is used most likely can cause a disruption on the ant biodiversity in other areas as well. Since the samples were taken from areas that were very close to each other and different species were found between the fertilized and unfertilized areas, it could be concluded that the fertilizer affects the biodiversity of the ant species if more samples were successfully sequenced. Further studies should be done to strengthen this conclusion. It is important for gardener/field keepers to take note of this because the use of fertilizer disrupts the biodiversity of ant species, and potentially other species. It is possible that the Prenolepis Imparis Honey Ant species has specific genes that allows it to survive better in the presence of fertilizer than the Tapinoma Sessile Ant species, which was only found in the fertilized area. Also, errors when storing, isolating, and amplifying the samples most likely occured which is why we didn't get results from some of the samples. For example, by storing them in the fridge with the other materials, the samples may not have been kept at the appropriate temperature for long enough. Another way we could have made errors in this process is by possibly not crushing the ant sample enough or as thoroughly as we should have.

References

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