Investigating the Effect of Phosphorus Levels on Ant Diversity in Young's Farm and the Forest School at Friends Academy, New York.

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References:

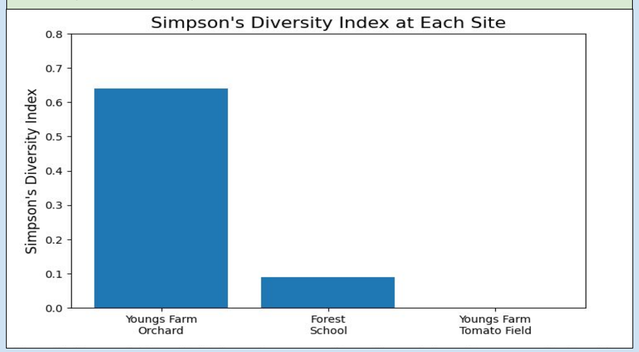
Abstract

Ant populations can change depending on phosphorus levels in the environment, making ants useful indicators of ecosystem health and biodiversity. We collected approximately 20 ant specimens from sites near Locust Valley, NY, including fertilized areas at Youngs Farm and lower-phosphorus forested areas at the Forest School at Friends Academy. Soil phosphorus levels were measured using phosphorus test kits, and DNA barcoding was used to identify collected species. Multiple species were identified, including *Myrmica americana*, *Tetramorium immigrans*, *Pheidole tysoni*, and *Brachyponera chinensis*. Youngs Farm Orchard, which had adequate phosphorus levels, showed the highest diversity, while the highly fertilized tomato field showed very low diversity because only one dominant species was collected. These findings suggest that phosphorus availability may influence arthropod diversity and that excessive phosphorus may reduce biodiversity by favoring dominant species.

Introduction

Human activity can cause phosphorus levels to become too high, which may unbalance ecosystems by allowing some species to increase while others decline. This can reduce biodiversity and ecosystem stability. Research in tropical forests found a relationship between added phosphorus and ant species diversity (Bujan et al. 2016). Although phosphorus does not usually poison ants directly, too much or too little can change the soil, plants, and food resources ants depend on. By comparing ant diversity in areas with different phosphorus levels, we can better understand how this nutrient influences ecosystems. This study asked: How do differences in phosphorus levels across Youngs Farm and the Forest School at Friends Academy affect ant species diversity?

Figure 1- Simpson's Diversity Index values comparing arthropod diversity across collection sites



Acknowledgements:

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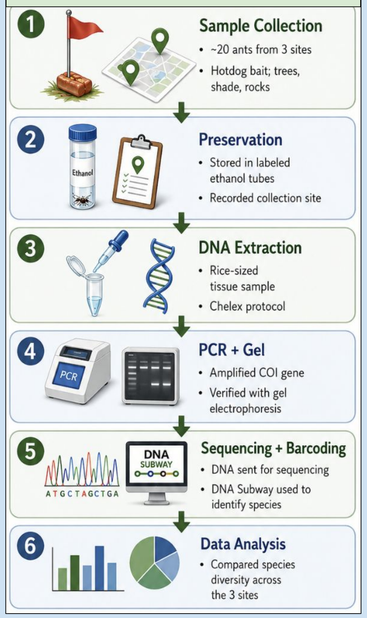
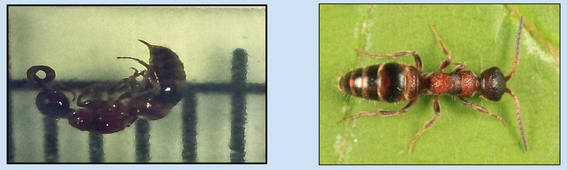
Materials & Methods



Discussion

The results partially supported our hypothesis that phosphorus levels influence ant diversity. Youngs Farm Orchard, which had adequate phosphorus levels, showed the highest diversity and contained three ant species: *Myrmica americana, Tetramorium immigrans*, and *Pheidole tysoni* (see Figure 3). In contrast, the highly fertilized Youngs Farm Tomato Field showed no diversity because only one species was collected, suggesting that excessive phosphorus may favor dominant species rather than support balanced biodiversity. Forest School, which had deficient phosphorus levels, showed low diversity and was dominated by the invasive Asian needle ant, *Brachyponera chinensis*. This dominance likely reduced the number of other species present at the site. One unexpected finding was the identification of *Myrmosa unicolor* (see Figure 2). Although it resembled an ant, DNA barcoding revealed that it was actually a rare wingless wasp species. Female *Myrmosa unicolor* lack wings and mimic ants in appearance and movement, showing the importance of DNA barcoding for accurate species identification. Overall, the findings suggest that phosphorus availability may influence arthropod diversity and that extreme nutrient conditions may reduce species balance within ecosystems.

Figure 2- Comparison of collected *Myrmosa unicolor* (Left) specimen and field guide image (Right).



Results

Soil phosphorus testing revealed differences between the study locations. Youngs Farm Tomato Field showed surplus phosphorus levels, Youngs Farm Orchard showed adequate phosphorus levels, and Forest School showed deficient phosphorus levels. DNA barcoding identified multiple arthropod species across the sites. At Youngs Farm Orchard, the species identified were *Myrmica americana*, *Tetramorium immigrans*, and *Pheidole tysoni*, with a Simpson's Diversity Index of 0.64. At Forest School, most specimens were identified as *Brachyponera chinensis*, with an additional specimen identified as *Myrmosa unicolor.* Forest School had a Simpson's Diversity Index of 0.089. Youngs Farm Tomato Field showed no measurable diversity because all collected specimens belonged to the same species, resulting in a Simpson's Diversity Index of 0 (see Figure 1).

Figure 3- Evolutionary relationships between specimens collected from our project:

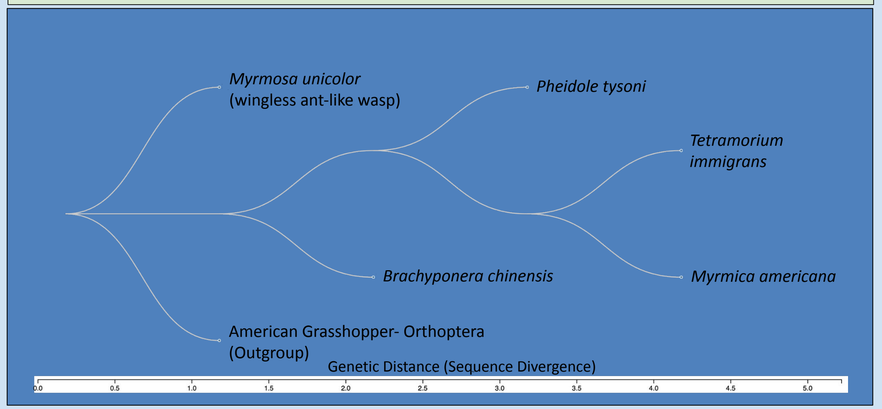


Figure 4- MUSCLE DNA Sequence Alignment

The MUSCLE DNA sequence alignment compares genetic similarities and differences among specimens to help confirm species identification and relationships through DNA barcoding.