Comparison of Insect Biodiversity Between Farmland and Nature Preserves

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BARCODE LONG ISLAND

References

Abstract

Insect biodiversity can be influenced by habitat type and the level of human disturbance within an environment. This project compared insect biodiversity across three Long Island habitats: the natural wildland of Bailey Arboretum, the semi-managed woodland of Friends Academy Forest School, and the agricultural habitat of Youngs Farm. We hypothesized that the more natural habitat would support greater biodiversity than the more human-managed habitats. Insects were collected using pitfall traps, malaise traps, and jug traps, then preserved in ethanol for DNA extraction. A segment of the cytochrome c oxidase I (COI) gene was amplified using polymerase chain reaction (PCR) and analyzed through DNA barcoding for species identification. Biodiversity was evaluated using Simpson's Diversity Index. Bailey Arboretum showed the highest biodiversity (0.774), followed by Forest School (0.602) and Youngs Farm (0.587). These findings suggest that habitats with lower levels of human disturbance may support greater insect biodiversity.

Introduction

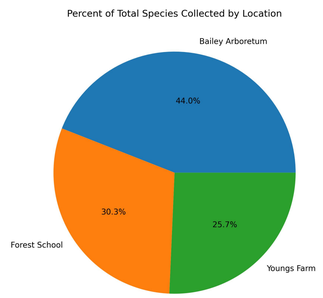
Insect biodiversity is influenced by habitat structure and human disturbance, making insects important indicators of ecosystem health. This study compared biodiversity across three Long Island habitats: Bailey Arboretum, Friends Academy Forest School, and Youngs Farm. Because arboreta offer diverse vegetation while active farms are subject to pesticide use and monoculture cropping, biodiversity was predicted to decrease across the three sites respectively. Insects were collected using pitfall, malaise, and jug traps and identified through DNA barcoding using the COI gene. Biodiversity was then analyzed using Simpson's Diversity Index to examine how land use may affect insect diversity.

Methods

Our Collection Methods Included:
Pitfall Traps: Small containers buried at ground level to capture ground-dwelling insects such as beetles, ants, and spiders as they move across the soil surface (Fig. 6).
Malaise Trap: A tent-shaped trap designed to collect flying insects such as flies and wasps by guiding them upward into a collection chamber (Fig. 6).
Jug Traps: Milk jugs with a hole cut out the side with wine in the middle of the jug. Ethanol is placed at the bottom of the jug, The jug is tied to a branch to catch flying insects (Fig. 6).
DNA Barcoding: Steps of this process are illustrated in Figure 5.

Percent of Total Species Collected by Location

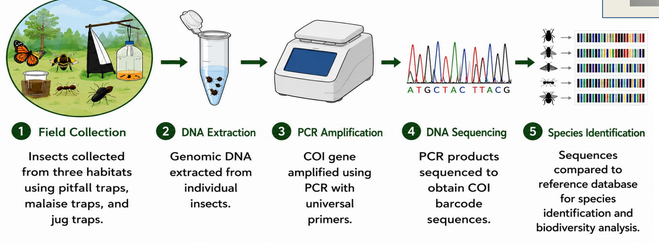
Figure 1



MUSCLE Multiple Sequence Alignment

Figure 2

Figure 5: Methods



Results

DNA barcoding results showed that each habitat contained different groups of organisms. Our biodiversity calculations included both our group's specimens and shared separate specimens from a collaborating group. Bailey Arboretum had the largest sample size, with 48 total specimens, including ants, worms, spiders, isopods, and camel crickets. It also had the highest Simpson's Diversity Index of 0.774, suggesting that its community was more evenly distributed and less dominated by one species. Friends Academy Forest School had 33 total specimens and included spiders, bees, ants, and small bees, with an middle diversity value of 0.602. Youngs Farm had 28 total specimens, including our groups specimens and two the collaborating groups specimens, *Forficula auricularia and Exitianus exitiosus*. Youngs Farm had the lowest diversity value of 0.587 because the sample was strongly dominated by fruit flies. Overall, Bailey Arboretum showed the greatest biodiversity, while Youngs Farm showed lower biodiversity due to dominance by a smaller number of species.

Figure 3: Specimens and their MUSCLE Identification

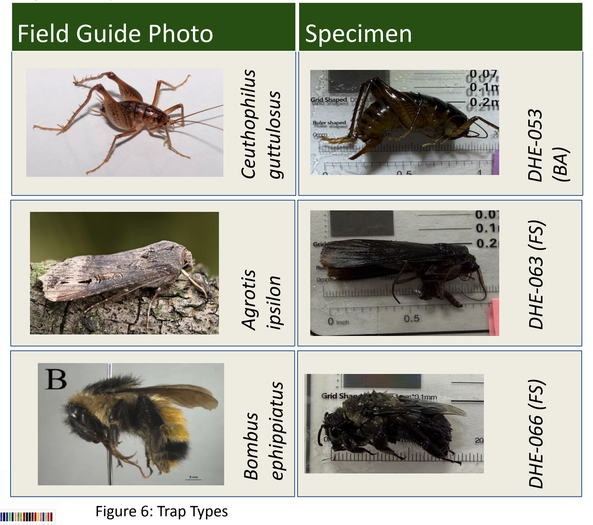
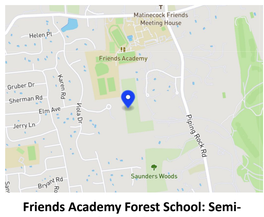


Figure 6: Trap Types

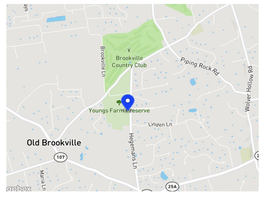
Discussion

The biodiversity patterns observed in this study varied among the three habitats. Bailey Arboretum had the greatest biodiversity, while Youngs Farm had the lowest, and Friends Academy Forest School showed moderate biodiversity levels. This trend is consistent with the expected effects of land use intensity: Bailey Arboretum's diverse vegetation and minimal management support greater insect richness, while Youngs Farm pesticide use and monoculture cropping are known to suppress insect communities. This is supported by the Simpson's Diversity Index values shown in Table 1, while Figure 1 shows how total collected species were distributed across the three locations. The field guide and specimen comparisons in Figure 3 show examples of how visual identification was compared with collected specimens, while the maps in Figure 4 show the sampling locations used across the three habitats. Although DNA barcoding improved species identification, some specimens could not be successfully sequenced due to limited sample quality or quantity. A small number of organisms were also identified through visual observation, which may have reduced overall identification accuracy.

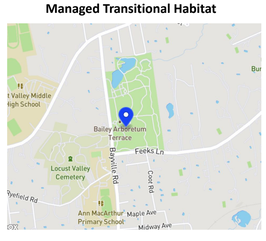
Figure 4: Locations of Insect Collection Sites



Friends Academy Forest School: Semi-Managed Transitional Habitat



Youngs Farm: Agriculture habitat



Baileys Arboretum: Nature Preserve

Habitat	Simpson's Diversity Index
Bailey Arboretum	0.774
Forest School	0.602
Youngs Farm	0.587

Table 1: Simpson's Diversity Index Across Habitats

Acknowledgements

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