BEST METHODS FOR INSECT COLLECTION

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Abstract

The number of insects collected for a given project can be heavily influenced by the type of trap used. This project tested the effectiveness of three insect traps: pitfall, malaise, and jug. We compared the results to see which yielded the highest catch of insects. We theorized that the pitfall traps, given their compact, inescapable, and durable design, would catch us the highest number of insects. We also wanted to find which traps were better at catching a wide range of specimens. To do so, we sequenced the COI gene of certain specimens from our pitfall catch and combined our data with results from other groups who focused on malaise and jug traps. Biodiversity was analyzed using the Simpson's Diversity Index. Overall, we compared both total insect abundance and species diversity across all three trap types to evaluate which method was most effective. Our results showed differences in both the number of insects collected and the diversity of species depending on the trap used, allowing us to determine which trapping method worked best for capturing a broad range of insects.

Introduction

Studying insects helps scientists understand biodiversity and how species live in different environments. The type of trap used could play an enormous role in the number and diversity of insects captured during research. In our experiment, we utilized pitfall, malaise, and jug traps to determine which traps capture the maximum number and diversity of insects. A pitfall trap lures insects into a chamber in the ground containing ethanol. A jug trap is filled with ethanol and hung on a tree branch with openings that allow insects to enter and fall inside. A malaise trap is a tent-like structure designed to capture flying insects in mesh walls and a killing chamber with ethanol. Our hypothesis was that pitfall traps would capture the greatest number of insects. Using the COI sequence and Simpson's Diversity Index, we evaluated the most efficient traps for capturing a diverse range of insects.

Methods

- Sample collection involved placing traps in different locations and moving all specimens into vials.
- Samples were stored in tubes of ethanol to preserve the specimens and maintain their DNA.
- DNA extraction was performed by isolating genetic material (body fragments) from the specimens and grinding it up into a liquid using laboratory chemicals, procedures, and equipment, such as a centrifuge.
- PCR gel electrophoresis was run to confirm successful DNA amplification by separating the DNA fragments into visible bands and running them through a gel.
- Barcode analysis was completed by comparing the DNA sequences obtained from the insects to reference databases in order to identify species.
- Species were identified using both DNA barcode results and observable physical characteristics.
- Biodiversity analysis was conducted by comparing the number and variety of species collected from the pitfall, jug, and malaise traps.

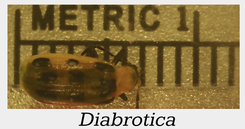
Figure 1: MUSCLE Multiple Sequence Alignment

The MUSCLE sequence alignment allowed us to accurately identify 17 of our specimens from pitfall traps. The MUSCLE shows a high level of genetic diversity among different insect species, suggesting that the sampling included a wide range of insects from different groups in the environment.

Figure 2: Specimens of Note

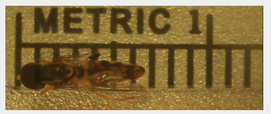
Graphocephala coccinea

Graphocephala coccinea can spread the bacterium *Xylella fastidiosa*, which causes plant diseases that damage trees, grapevines, and other important plants.



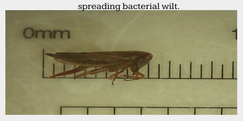
Diabrotica undecimpunctata

Diabrotica undecimpunctata also commonly known as a spotted cucumber beetle is a harmful North American insect, damages plants by eating roots and foliage, while spreading bacterial wilt.



Syrphidae

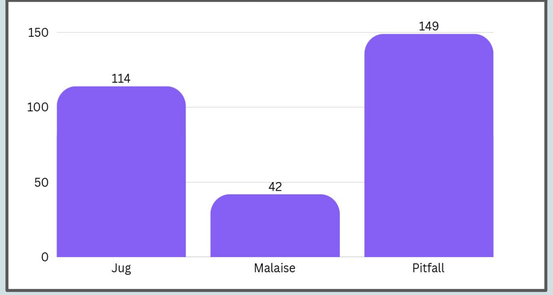
Syrphidae helps ecosystems by acting as a pollinator, transferring pollen between flowers while feeding on nectar.



Exitianus exitiosus

Cicadellidae can affect agriculture by feeding on grasses and sometimes acting as a vector for plant pathogens.

Figure 3: Number of Total Specimens Collected per Trap



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References

Figure 4: A common jug trap, note the openings on the sides.

Figure 5: A common malaise trap, note the mesh walls.

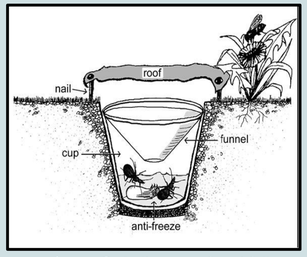

Figure 6: A diagram of a pitfall trap, note the funnel leading insects into the main chamber.

Results

Across 305 total specimens, the highest number of insects (140) caught out of any trap were obtained through pitfall traps. Furthermore, the pitfall catches included various types of insects rather than a single type alone. The Simpson's Diversity Index score (SDI) for pitfall traps was 0.867, the highest of the three. Jug traps collected 114 insects, not too far off from pitfalls total, but almost all insects collected using this method were fruit flies (109), with five house flies and no significant difference observed between species. As a result, the SDI score for jug traps was 0.085. Malaise traps collected the lowest number of insects (42) among the three types of traps used. The number of flies collected was 38, while three bees and one spider were also found. Malaise traps were therefore less effective in collecting insects compared to the other two types but ultimately yielded a slightly more diverse catch than jug traps, with the malaise trap SDI coming in at 0.180.

Discussion

Our experiment overall had some difficulties. In contrast to Youngs Farm, for example, Bailey's Arboretum had a much larger variety of insects, most likely attributed to different types of habitat, vegetation, and moisture level. These factors certainly impacted the diversity of insects collected from those locations. The types of traps used also influenced the results. Pitfall traps, for example, were more effective at catching terrestrial insects while jug traps caught more aerial insects that were attracted to the bait and ethanol. This highlights why using multiple trapping methods is important when studying insect biodiversity, since different insects live in different environments. Most insects were identified using DNA barcoding, but some could not be fully identified because the sequencing results were unclear. In a few cases, specimens we collected were damaged during preservation, which affected the sequencing results. Cooler fall temperatures may have also reduced insect activity. Finally, differences in sample sizes between locations and trap types should be taken into account when comparing the data.