More Ant Biodiversity in Areas Treated with Insecticides Than in Untreated Areas

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Abstract:

The decline in ant biodiversity, attributed to insecticide exposure and overall biodiversity decline, is a pressing ecological concern. To assess the impact of insecticides on ant biodiversity, we conducted a study at Friends Academy, comparing ant species richness between areas with and without insecticide application. Using pitfall traps, we collected ant specimens from two locations: one treated with Organic Tick and Flying Insect Control near the Jackson House, and another, Forest School, where no insecticides were used. We processed the specimens for DNA analysis to determine species diversity. Contrary to our hypothesis, the area with insecticide had higher ant biodiversity (Simpson's Diversity Index = 0.777) than the insecticide-free area (Simpson's Diversity Index = 0.244). Our results suggest that insecticides may not significantly impact ant biodiversity, and other factors may play a more substantial role.

Introduction:

Ants are ecologically vital insects, playing key roles in nutrient recycling and ecosystem balance. However, their populations are declining due to various factors, including insecticide exposure (Owens 2013). insecticides, touted as environmentally friendly alternatives, are widely used to control pests like ticks, flies, and ants. Understanding their impact on ant biodiversity is crucial for sustainable pest management practices. We hypothesized that areas treated with insecticides would have lower ant diversity than insecticide-free areas. According to a study by Frontiers in Environmental Studies, insecticides negatively affect 70.5% of soil invertebrates (Gunstone et al. 2021). We conducted a study at Friends Academy to investigate how insecticides affect ant biodiversity. To do so, we employed pitfall traps, a common method for collecting ants, to collect specimens from both types of areas. Our study aims to shed light on the impact of insecticides on ant biodiversity and contribute to the broader understanding of insecticide effects on ecosystems.

Materials and Methods:

- Deployed five pitfall traps (Figure 5) in each designated area—one with insecticides and one without (Figures 4 & 3)—marking and photographing the sites.
- Left traps in place for one month, checking them weekly to collect specimens and ensure they remained functional.
- Stored collected specimens in >95% ethanol and kept them in a freezer until lab processing.
- Processed ant samples in the lab by photographing and identifying each specimen to the species level.
- Extracted DNA using silica protocol and amplified region of the COI gene using PCR
- Added the data to the Sample Database and calculated Simpson's Diversity Index for both locations.
- Analyzed the impact of insecticides on ant biodiversity using the diversity index results.

Figure 3: Jackson House

Figure 4: Forest School

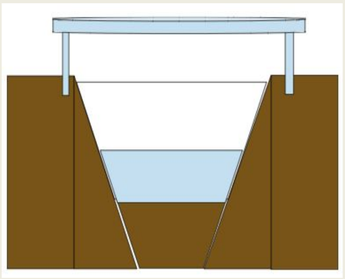

Figure 5: Pitfall Traps

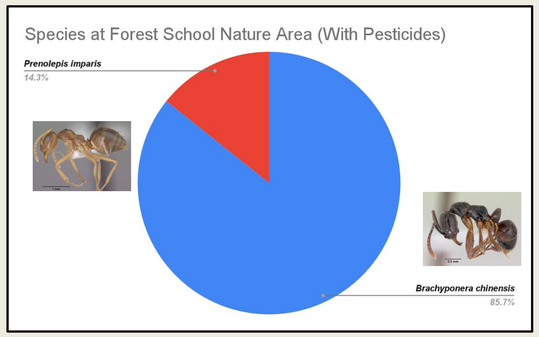

Figure 1: Ant species abundances at Forest School

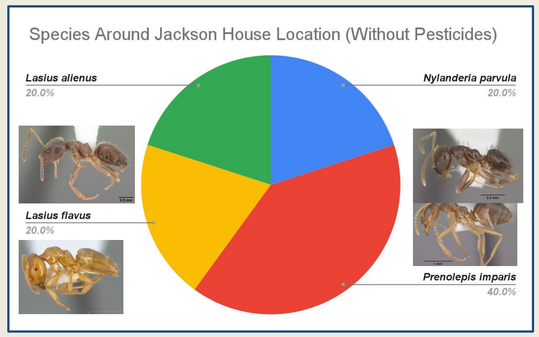

Figure 2: Ant species abundances at Jackson House

Results:

Overall, 13 out of 20 samples were able to be processed and identified. The Forest School, the location without insecticides, had very interesting sample identification results. Of the seven samples, six of them were *Brachyponera chinensis* also known as the Asian needle ant. This ant is not native to the United States and is an invasive species. The other sample was a *Prenolepis imparis* which is a Small honey ant. The Forest School location had a Simpson's Diversity Index of 0.244. Figure 1 shows the ant species found at the Forest School. The Jackson House, the location with insecticides, had more diverse results. There were 6 successful samples at the Jackson House. 2 of them were *Prenolepis imparis* also known as winter ant, false honey ant, or false honeypot ant. The other four were *Aphaenogaster aff* (Carpenter ant), *Nylanderia parvula* (Robust Crazy Ant), *Lasius flavus* (yellow meadow ant), an invasive species, and *Lasius alienus* (Cornfield Ant). The Simpson's Diversity Index was 0.777. Figure 2 shows the ant species found at the Jackson House.

Discussion:

We hypothesized that the area at Jackson House, where insecticides are applied, would exhibit lower ant diversity compared to Forest School, which does not use insecticides. However, our findings did not align with this hypothesis. Surprisingly, Jackson House showed significantly greater biodiversity than Forest School. This was determined using Simpson's Diversity Index, with Jackson House scoring 0.777 and Forest School scoring 0.244, indicating that Jackson House had approximately three times the biodiversity of Forest School. It is important to note that our sample size was limited to thirteen specimens, which may not provide a comprehensive representation of the actual biodiversity in both locations. Despite the presence of insecticides at Jackson House, our results do not suggest a significant impact of insecticides on ant diversity. Other factors may have influenced biodiversity in these areas like construction, harsh weather, water availability, soil characteristics, and constant truck fumes. At Forest School, the predominant ant species in our samples was *Brachyponera chinensis*, an invasive species introduced to the United States from Japan in the early 1930s. The presence of this invasive species may have suppressed the prevalence of other ant species in the area, as *Brachyponera chinensis* lacks natural predators and has a longer lifespan compared to native species.

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