



## A comparative study of entomological diversity and biochemical niche partitioning: Implications for environmental clinical biochemistry, human health, and metabolic resilience in Grant Parish, Louisiana

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### Abstract

This study investigates insect species richness and community composition across two distinct microhabitats in Grant Parish, Louisiana: a managed residential garden and a protected tract of the Kisatchie National Forest. Utilizing a dual-methodology sampling protocol (sweep netting and pitfall trapping), specimens were evaluated to determine the impact of anthropogenic disturbance on biochemical niche partitioning. Results indicate that the Kisatchie National Forest maintains significantly higher taxonomic diversity compared to the residential site. From a clinical biochemistry perspective, these findings suggest that undisturbed habitats serve as critical reservoirs for diverse metabolic pathways and enzymatic detoxification systems, such as the Cytochrome P450 complex. This research establishes that environmental biodiversity is a foundational "blessing to men," serving as a bio-sentinel for human endocrine health and a primary source of natural product chemistry.

**Keywords:** Clinical biochemistry, human health, Kisatchie National Forest, metabolic resilience, xenobiotic metabolism, grant parish, anthropogenic disturbance, bioindicators

### Introduction

Insects are fundamental bioindicators, with their population dynamics reflecting the underlying health of an ecosystem's biochemical infrastructure. Beyond their recognized roles in pollination and nutrient cycling, insects are sophisticated biological models for metabolic homeostasis. Their ability to navigate environmental stressors—such as temperature fluctuations or chemical exposure—is dictated by their clinical biochemical profiles, specifically the efficiency of their antioxidant defenses and xenobiotic metabolism.

In Central Louisiana, the transition from complex forest tracts to manicured residential land significantly alters the available nutritional biochemistry of the landscape. While previous surveys, such as those by the LSU AgCenter (2025)<sup>[5]</sup>, have documented regional pest distributions, there is a critical need to understand how "biotic homogenization" in anthropogenic sites affects the specialized metabolic niches required for ecosystem resilience. This study aims to quantify the disparity in insect diversity between these microhabitats, providing a framework for understanding how habitat degradation leads to a "metabolic simplification" that mirrors clinical vulnerabilities in human health.

### Literature Review

The "Power of Observation" in garden landscapes underscores that while many residents view insects as pests, they are fundamental to soil chemistry and garden health (Burgess, 2020)<sup>[3]</sup>. However, research by Breed et al. (2022)<sup>[2]</sup> suggests that even purposefully engineered native gardens struggle to match the biodiversity of natural tracts, as they often lack the full spectrum of secondary plant metabolites required for specialized insect metabolic processes.

In contrast, forest ecosystems provide a stable biochemical buffer. As EcoTree (2026)<sup>[4]</sup> notes, the structural

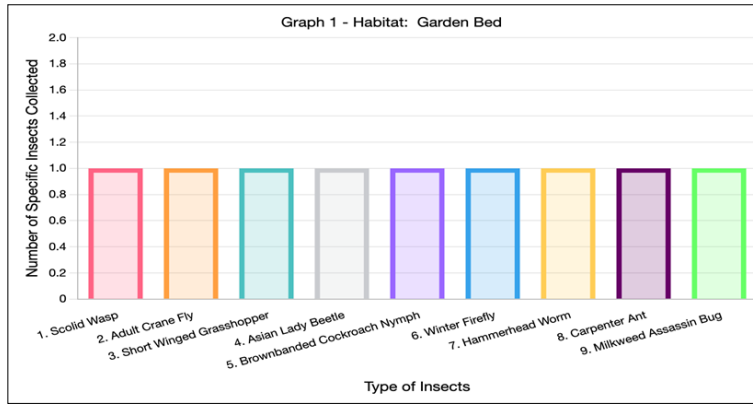
complexity of these habitats supports intricate food chains that rely on specific enzyme-substrate interactions. Studies in urban forest fragments near Panama City demonstrate that community composition is significantly more stable in larger, undisturbed tracts compared to urbanized fragments (Abrego & Medianero, 2025)<sup>[1]</sup>. Furthermore, anthropogenic disturbances and seasonality have been shown to drastically alter ant communities (Yek et al., 2023)<sup>[7]</sup>, likely due to shifts in the availability of semiochemicals. Methodologically, while sweep netting is a standard for sampling the herbaceous layer, its efficacy in capturing the full scope of arthropod composition must be carefully balanced with ground-dwelling data (Spafford & Lortie, 2013)<sup>[6]</sup>.

### Materials and Methods

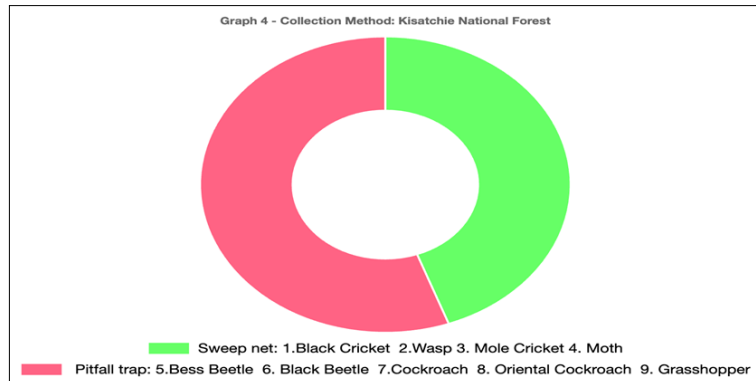
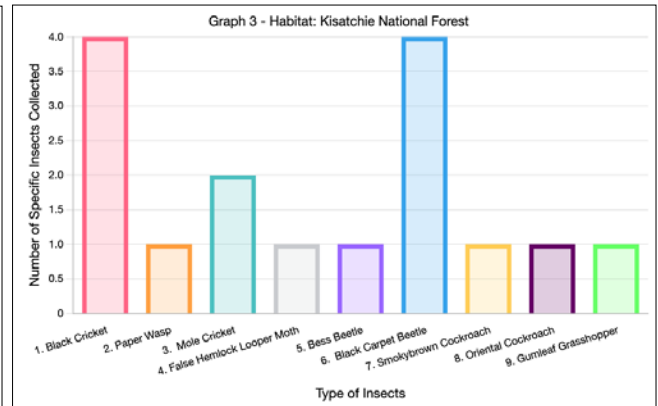
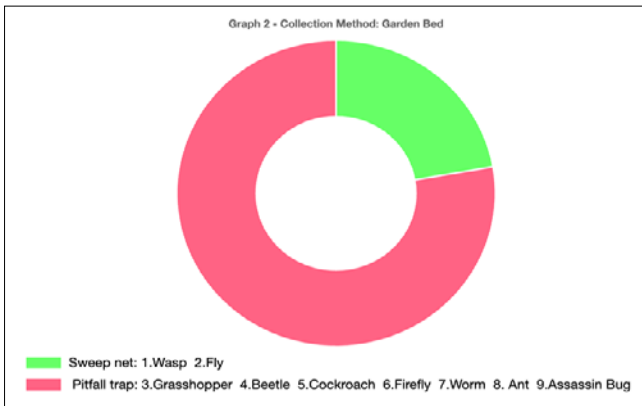
- 1. Study Sites:** The study was conducted in Grant Parish, LA. Site A (Garden Bed) represented a high-disturbance area, while Site B (Kisatchie National Forest) represented a low-disturbance natural area.
- 2. Sampling Techniques**
  - **Sweep Netting:** Following the methodology explored by Spafford & Lortie (2013)<sup>[6]</sup>, sweep netting was conducted in 15-minute intervals to sample the foliage-dwelling community.
  - **Pitfall Traps:** 16oz containers were embedded flush with the soil to capture the epigeic (ground-dwelling) community, reflecting the detritus-based food web.

### Results

The data collected reveals a clear correlation between habitat management and taxonomic complexity, reflecting underlying biochemical niche availability.







**Fig 1:** Bar Graph of Species Richness. Site B (Forest) exhibited a markedly higher species count, suggesting a broader nutritional landscape capable of supporting diverse metabolic requirements.







**Fig 2:** Pie Chart of Order Distribution. The forest community showed a balanced distribution of specialized detritivores, whereas the garden was dominated by generalist Orders, suggesting that only species with high metabolic plasticity can thrive in anthropogenic sites.





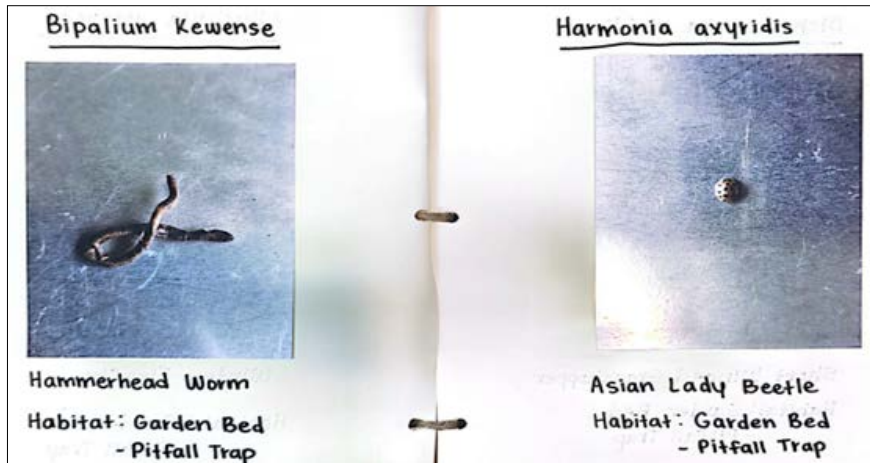
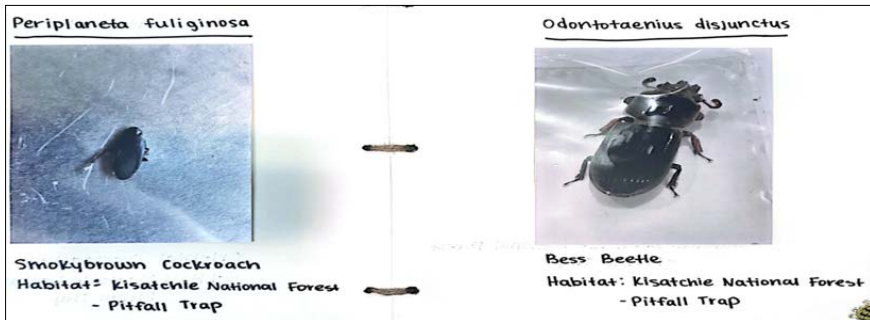
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|---|--|
| <p><u>Dichromorpha viridis</u></p>  <p>Short Winged Grasshopper<br/>Habitat: Garden Bed<br/>- Pitfall Trap</p> | <p><u>Camponotus pennsylvanicus</u></p>  <p>Carpenter Ant<br/>Habitat: Garden Bed<br/>- Pitfall Trap</p> |
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| <p><u>Neoscapteriscus borellii</u></p>  <p>Mole Crickets<br/>Habitat: Kisatchie National Forest<br/>- Sweep Net</p> | <p><u>Teleogryllus commodus</u></p>  <p>Black Field Cricket<br/>Habitat: Kisatchie National Forest<br/>- Sweep Net</p> |
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| <p><u>Pollistes humilis</u></p>  <p>Paper Wasp<br/>Habitat: Kisatchie National Forest<br/>- Sweep Net</p> | <p><u>Nepytia canosaria</u></p>  <p>False Hemlock Looper Moth<br/>Habitat: Kisatchie National Forest<br/>- Sweep Net</p> |
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| <p><u>Goniaea australasiae</u></p>  <p>Gumleaf Grasshopper<br/>Habitat: Kisatchie National Forest<br/>- Pitfall Trap</p> | <p><u>Blatta orientalis</u></p>  <p>Oriental Cockroaches<br/>Habitat: Kisatchie National Forest<br/>- Pitfall Trap</p> |
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| <p><u>Tipula paludosa</u></p>  <p>Crane Fly<br/>Habitat: Garden Bed<br/>- Sweep Net</p> | <p><u>Zelus longipes</u></p>  <p>Milkweed Assassin Bug<br/>Habitat: Garden Bed<br/>- Pitfall Trap</p> |
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**Fig 3:** Photo Plate of Key Specimens. Identified taxa in the forest include species known for their complex enzymatic detoxification abilities.

## Discussion

1. **Metabolic Specialization and Chemical Defense** The results support the hypothesis that increased structural complexity in the Kisatchie National Forest favors higher insect diversity. This is driven by the metabolic specialization required for forest survival. Many forest-dwelling insects have evolved specific Cytochrome P450 enzyme systems to detoxify secondary plant metabolites (such as tannins and lignins). The absence of these specialists in the garden bed (Site A) suggests a "biochemical desert" where the lack of host-plant metabolites prevents the establishment of specialized metabolic niches.
2. **Implications for Clinical Biochemistry and Men's Health** From a clinical biochemistry standpoint, the insects identified serve as analogues for human metabolic response to environmental toxins. Insects possess steroid hormone signaling pathways (such as ecdysteroids) that are functionally analogous to human androgen signaling. A decline in insect diversity in managed gardens warns of a "toxic load" that can interfere with human hormonal balance. The high diversity in the forest implies a robust "metabolic library" where species have developed unique pathways to handle oxidative stress.
3. **A Blessing to Men Biopharmacology and Environmental Health** The biodiversity of Grant Parish is a direct "blessing to men" through the provision of natural product chemistry. Many pharmaceutical breakthroughs, including anticoagulants and anti-inflammatory agents, have their origins in insect-plant biochemical interactions. Protecting this diversity ensures that we do not lose the chemical templates needed for future clinical treatments for metabolic syndrome and age-related decline.
4. **Contribution to Knowledge** This research contributes a unique interdisciplinary bridge between field entomology and environmental clinical biochemistry. It establishes that undisturbed silvicultural habitats are sophisticated reservoirs of diverse enzymatic detoxification systems. Furthermore, it frames Ecological Conservation as a Public Health Strategy, arguing that the maintenance of the "metabolic library" in our forests is a direct investment in the long-term clinical health and hormonal well-being of the human population.

## Conclusion and Take-Home Point

This study concludes that anthropogenic land use in Grant Parish significantly reduces entomological diversity and simplifies biochemical trophic webs. The Kisatchie National Forest remains a vital stronghold for species with specialized metabolic profiles.

The Take-Home Point for the Community: Biological diversity is synonymous with biochemical health. For the men and families of Central Louisiana, a biodiverse environment is a "blessing" that offers preventative health. When insects thrive, it signifies that our shared environment is free from the biochemical noise and pollutants that disrupt human metabolic and endocrine health. Conservation of the forest is, therefore, the conservation of the human "metabolic shield."

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