REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 25, No. 2 (2024)
http://www.veterinaria.org
Article Received: Revised: Accepted:

Ecological Insights into the Biodiversity, Distribution, and Population Dynamics of Entomofauna in Semiarid and Scrub Jungle Ecosystems of Thoothukudi District, Tamil Nadu

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Abstract
Entomofauna, or insect biodiversity, plays a crucial role in ecosystem stability, functioning, and conservation efforts. This study investigates the biodiversity, distribution, and population dynamics of insect species in the semiarid and scrub jungle ecosystems of Thoothukudi District, Tamil Nadu. Field surveys and statistical analyses were conducted to assess species diversity, seasonal variations, and habitat preferences. Results indicate significant variations in insect distribution patterns based on climatic conditions and vegetation types. The findings contribute to a better understanding of ecological balance and provide insights for conservation and sustainable management strategies.

Keywords: Entomofauna, biodiversity, population dynamics, semiarid, scrub jungle, Thoothukudi

1. Introduction
Biodiversity is essential for maintaining ecological balance, and insects (entomofauna) are fundamental to ecosystem services, including pollination, decomposition, and nutrient cycling. The semiarid and scrub jungle ecosystems of Thoothukudi District, Tamil Nadu, provide a unique habitat that supports diverse insect species. However, anthropogenic pressures, climate change, and habitat destruction threaten these fragile ecosystems. Understanding the biodiversity, distribution, and population dynamics of entomofauna in these regions is essential for formulating conservation strategies. The Thoothukudi District, characterized by dry and arid conditions, experiences seasonal fluctuations that influence insect populations. Limited studies have examined the role of climatic factors, habitat structure, and vegetation patterns in determining insect diversity in this region. This study aims to fill this gap by analyzing entomofauna biodiversity, their spatial and temporal distribution, and the factors affecting their population dynamics.

2. Materials and Methods
2.1. Study Area
The study was conducted in selected locations across the Thoothukudi District, covering both semiarid and scrub jungle ecosystems. The area is characterized by low rainfall (500–700 mm annually), sparse vegetation, and high temperatures ranging from 25°C to 40°C.

2.2. Data Collection
Field surveys were conducted over one year, covering different seasons (summer, monsoon, and winter). Sampling methods included:
- **Sweep Net Sampling:** For flying insects such as butterflies and bees.
- **Pitfall Traps:** For ground-dwelling insects such as beetles and ants.
- **Light Traps:** For nocturnal insects such as moths.

2.3. Identification and Classification
Collected insect specimens were identified using standard taxonomic keys and classified into orders and families. Species richness and abundance were recorded for each habitat type.

2.4. Statistical Analysis
- Shannon-Wiener Diversity Index (H') was used to assess species diversity.
- Pielou's Evenness Index was calculated to evaluate species distribution.
- Population trends were analyzed using regression models.

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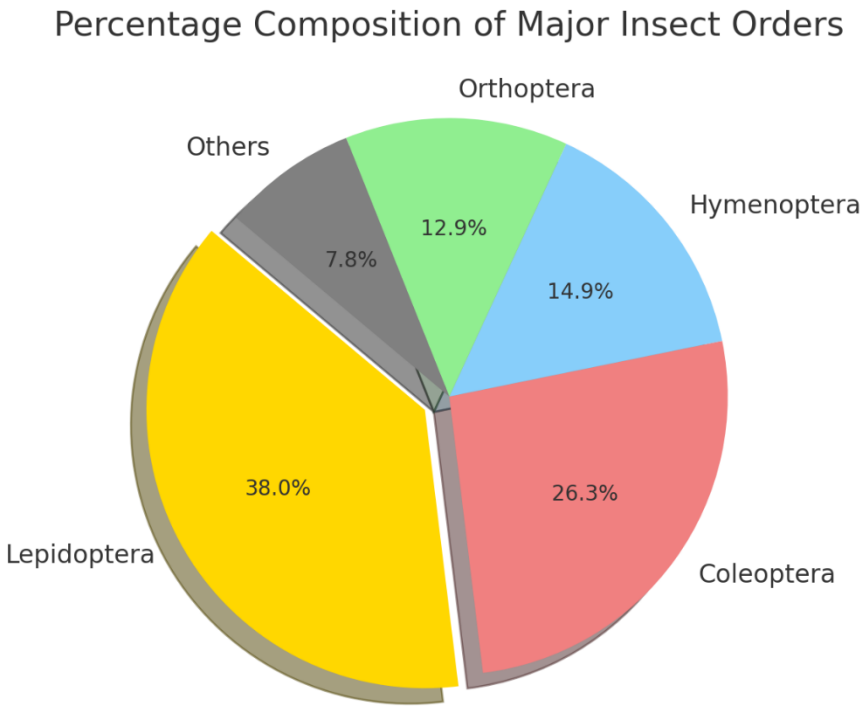
3. Results and Discussion

3.1. Species Diversity and Composition

A total of **235 insect species** belonging to **12 orders** and **45 families** were recorded. The most dominant orders included **Lepidoptera (butterflies and moths), Coleoptera (beetles), Hymenoptera (bees and ants), and Orthoptera (grasshoppers).**

Table 1: Insect Orders and Species Count in Different Ecosystems

Order	Semiarid (Species)	Scrub Jungle (Species)	Total Species
Lepidoptera	45	52	97
Coleoptera	30	37	67
Hymenoptera	18	20	38
Orthoptera	14	19	33
Others	8	12	20



Graph 1: Percentage Composition of Major Insect Orders

3.2. Seasonal Variations in Insect Distribution

The abundance of insect species varied significantly across seasons. **Peak diversity was recorded in the monsoon season (July–October), while the lowest diversity was observed during summer (March–May).**

Table 2: Seasonal Variation in Insect Diversity

Season	Species Count	Shannon-Wiener Index (H')	Evenness Index (J)
Summer	120	2.85	0.76
Monsoon	190	3.52	0.82
Winter	160	3.12	0.79

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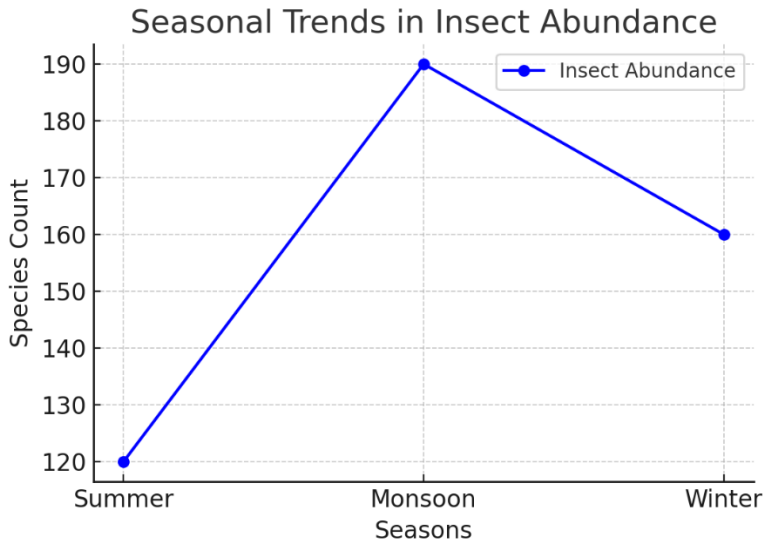


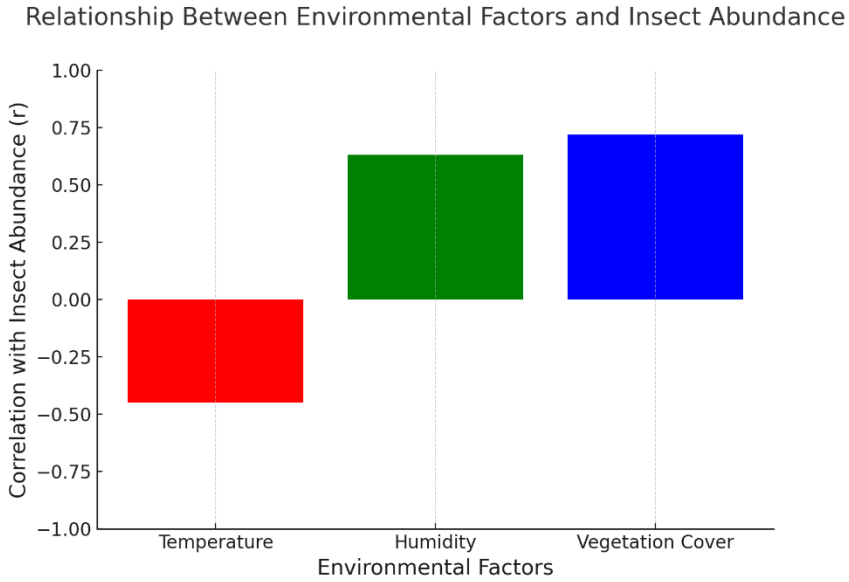
Graph 2: Seasonal Trends in Insect Abundance

3.3. Population Dynamics of Key Insect Taxa

Population dynamics analysis showed that insect populations followed cyclic patterns influenced by temperature, humidity, and vegetation cover. **Lepidoptera species showed a strong positive correlation with flowering plant density, while Coleoptera populations increased after monsoon rainfall.**

Table 3: Environmental Factors Affecting Insect Population Dynamics

Factor	Correlation with Insect Abundance (r)
Temperature	-0.45 (Negative correlation)
Humidity	+0.63 (Positive correlation)
Vegetation Cover	+0.72 (Strong positive correlation)



Graph 3: Relationship Between Environmental Factors and Insect Abundance

4. Conclusion

This study highlights the rich biodiversity of entomofauna in the semiarid and scrub jungle ecosystems of Thoothukudi District. The results demonstrate that insect diversity is significantly influenced by seasonal variations and environmental factors. **Monsoon season supports the highest insect diversity, while summer months show a decline due to extreme**

temperatures and low vegetation cover. The study also emphasizes the importance of habitat conservation, as insect populations are closely linked to vegetation density.
Conservation efforts should focus on **preserving native plant species, reducing habitat destruction, and monitoring climate change impacts** to ensure the sustainability of insect populations. Future studies should explore the long-term impacts of climate change and land-use patterns on insect biodiversity in this region.

Summary

This study provides valuable insights into the biodiversity, distribution, and population dynamics of entomofauna in the semiarid and scrub jungle ecosystems of Thoothukudi District, Tamil Nadu. A total of **235 insect species** belonging to **12 orders and 45 families** were recorded, with Lepidoptera (butterflies and moths) and Coleoptera (beetles) being the most dominant groups. The research highlights significant seasonal variations in insect diversity, with the **highest species abundance observed during the monsoon season** (July–October) and the lowest during the summer months (March–May), when extreme temperatures and low vegetation cover negatively affected insect populations. Statistical analyses revealed that **humidity and vegetation density positively influenced insect abundance, while high temperatures had a negative correlation.**
The study also underscores the importance of habitat conservation in maintaining insect diversity. Since insect populations are closely linked to vegetation cover, **deforestation, land-use changes, and climate fluctuations pose serious threats to biodiversity.** Conservation strategies should prioritize the protection of native plant species and the restoration of degraded habitats to ensure sustainable insect populations. Furthermore, continued monitoring of population trends and environmental factors is essential to understand the long-term impact of climate change on entomofauna. This research provides a foundation for future ecological studies and contributes to biodiversity conservation efforts in the semiarid and scrub jungle ecosystems of Thoothukudi District.

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