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Impact Of Habitat Characteristics On Butterfly Population Dynamics In Thoothukudi And Tirunelveli Districts, Tamil Nadu

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Abstract
Butterflies (Lepidoptera) are valuable bioindicators of environmental health and biodiversity. Their population dynamics are strongly influenced by habitat characteristics such as vegetation type, temperature, humidity, and human activity. This study investigates how habitat characteristics impact butterfly population dynamics in the Thoothukudi and Tirunelveli districts of Tamil Nadu, India. By assessing butterflies in three different habitat types—forests, agricultural lands, and urban areas —the research examines how factors like vegetation cover, plant diversity, and land-use patterns contribute to variations in species abundance and diversity. The findings underscore the importance of habitat preservation and the need for targeted conservation efforts to maintain butterfly populations in these regions.

Keywords: Butterfly Population Dynamics, Habitat Characteristics, Vegetation, Habitat Conservation, Thoothukudi, Tirunelveli, Tamil Nadu.

Introduction

Butterflies (Lepidoptera) are among the most ecologically significant groups of insects, with roles extending far beyond their aesthetic value. They are essential for pollination, contributing to the reproduction of a variety of plants, including both wildflowers and crops. Furthermore, butterflies are valuable bioindicators; their populations and distributions reflect changes in environmental conditions, such as climate shifts, habitat degradation, and pollution. As such, understanding the dynamics of butterfly populations can provide crucial insights into the health of ecosystems and help in the development of conservation strategies.

In India, and particularly in Tamil Nadu, butterfly diversity is abundant and varied across different ecosystems, from tropical dry forests to agricultural lands and urban areas. The Thoothukudi and Tirunelveli districts in southern Tamil Nadu are known for their rich biodiversity, yet the impact of habitat characteristics on butterfly populations in this region remains underexplored. The variation in butterfly populations across habitats such as forests, farmlands, and urban spaces offers a unique opportunity to study how different environmental factors influence butterfly diversity and abundance.

The primary objective of this study is to assess the influence of habitat characteristics on butterfly population dynamics in Thoothukudi and Tirunelveli districts. Specifically, this research aims to evaluate how the vegetation, land-use practices, and human activities in forests, agricultural lands, and urban areas affect butterfly populations. Through this study, we aim to provide valuable insights for butterfly conservation efforts in the region, considering habitat-specific factors that influence species distribution and abundance.

Materials and Methods

Study Area

The study was conducted in the Thoothukudi and Tirunelveli districts, which are located in the southernmost part of Tamil Nadu, India. The region features diverse habitats, including tropical dry forests, agricultural fields, and urban areas. These habitats are subjected to varying degrees of human influence, from agricultural practices to urban development. The climate is typically tropical, with distinct monsoon and dry seasons that significantly influence vegetation growth and resource availability for butterflies.

The habitat types surveyed include:

1. **Forests** – Tropical dry forests with dense vegetation that provide critical habitat for butterfly species.
2. **Agricultural Lands** – Fields dominated by crops such as paddy, sugarcane, and cotton, where butterflies often interact with agricultural practices.
3. **Urban Areas** – Parks, roadside gardens, and green spaces within urban environments, offering fragmented habitats for butterflies.

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Data Collection

Data were collected from January to December, with monthly surveys conducted across the three habitat types. A combination of observational methods and butterfly netting was used to record species present in each habitat. The survey duration for each habitat was one hour per visit. Environmental factors, such as temperature, humidity, and vegetation cover, were recorded for each survey to assess their potential impact on butterfly populations.

In addition to species identification, habitat characteristics such as plant diversity, vegetation density, and canopy cover were recorded. The presence of host plants for larvae and nectar sources for adults was also noted. Data on human activities, such as agricultural practices, urbanization, and land-use changes, were incorporated into the analysis to evaluate their effects on butterfly populations.

Data Analysis

Species diversity was measured using the Shannon-Weiner Diversity Index (H'), which accounts for both species richness and their relative abundance. Seasonal variations in butterfly abundance were examined by comparing the number of individuals observed during the summer, monsoon, and winter seasons. Statistical analyses were conducted using SPSS, and a regression analysis was performed to identify correlations between habitat characteristics and butterfly diversity.

Results

Species Composition

A total of 80 butterfly species from five families—Papilionidae, Pieridae, Nymphalidae, Lycaenidae, and Hesperiidae—were recorded across the three habitat types. **Nymphalidae** emerged as the most diverse family, followed by **Pieridae** and **Papilionidae**. The forest habitats supported the highest diversity, with a significant number of species found in agricultural lands as well. However, urban areas exhibited the lowest butterfly diversity, likely due to habitat fragmentation and reduced vegetation.

Table 1: Butterfly Species Composition by Habitat Type

Family	Forests	Agricultural Lands	Urban Areas
Papilionidae	16	8	5
Pieridae	13	14	7
Nymphalidae	32	20	10
Lycaenidae	14	12	8
Hesperiidae	5	4	4

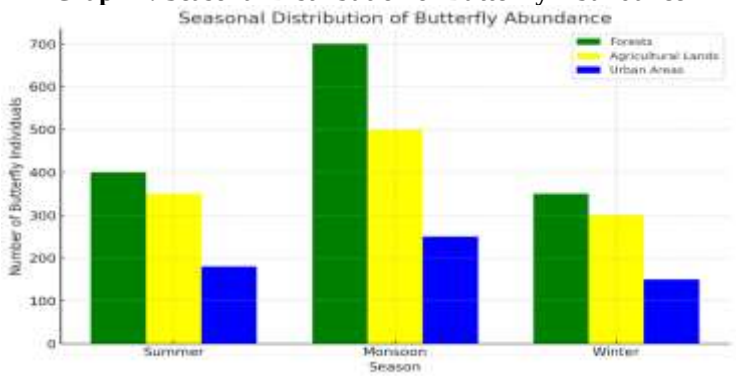
Seasonal Variations in Abundance

The study found significant seasonal variations in butterfly populations, with the highest abundance observed during the monsoon season. **Forests** supported the highest population of butterflies during the monsoon, with a notable increase in species diversity. Agricultural lands showed moderate increases during the monsoon, while urban areas exhibited minimal seasonal variation.

Table 2: Seasonal Variations in Butterfly Abundance by Habitat Type

Season	Forests (Individuals)	Agricultural Lands (Individuals)	Urban Areas (Individuals)
Summer	400	350	180
Monsoon	700	500	250
Winter	350	300	150

Graph 1: Seasonal Distribution of Butterfly Abundance



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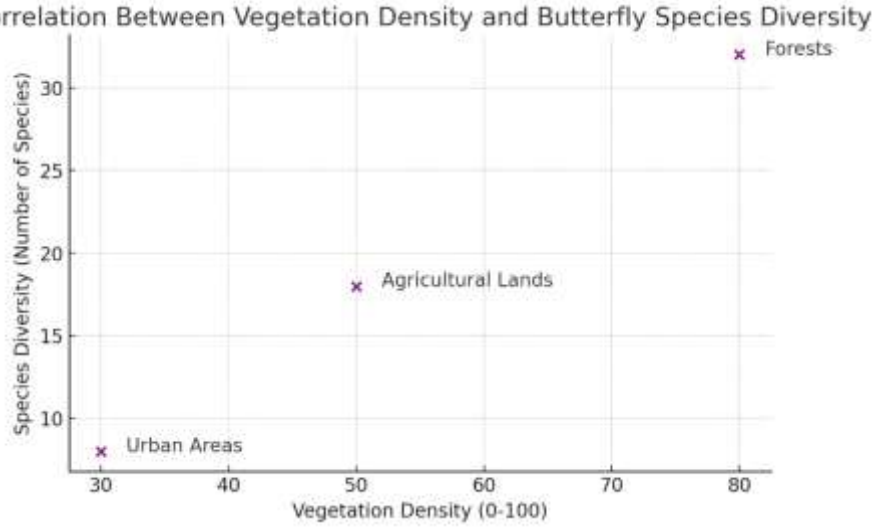
Graph 2: Correlation Between Vegetation Density and Butterfly Species Diversity



Discussion

The results highlight the significant impact of habitat characteristics on butterfly population dynamics. Forests, with their dense vegetation and high plant diversity, supported the highest species diversity and abundance, especially during the monsoon season. Agricultural lands, though rich in nectar sources, had lower species diversity due to monoculture practices and the use of pesticides, which may limit suitable habitats for butterflies. Urban areas, with their fragmented and often sparse vegetation, showed the lowest diversity and abundance of butterflies, further emphasizing the importance of contiguous natural habitats.

Seasonal patterns in butterfly populations were strongly influenced by climatic conditions, with the monsoon season providing optimal conditions for butterfly reproduction and feeding. The monsoon brought increased plant growth and nectar availability, contributing to a spike in butterfly populations. In contrast, the dry summer season saw a decline in butterfly numbers, likely due to reduced vegetation and the availability of resources.

The findings suggest that forested habitats play a crucial role in sustaining butterfly diversity and that conservation efforts should focus on preserving these ecosystems. Additionally, agricultural practices need to be managed to reduce habitat destruction and pesticide use, while urban planning should prioritize green spaces that support butterfly populations.

Conclusion

This study demonstrates that habitat characteristics, including vegetation cover, plant diversity, and human activities, have a significant impact on butterfly population dynamics in Thoothukudi and Tirunelveli districts. Forests are critical for maintaining butterfly biodiversity, while agricultural and urban habitats offer varying degrees of support depending on land-use practices. The seasonal variations observed in butterfly populations further highlight the need for habitat-specific conservation strategies. Protecting and restoring butterfly habitats, promoting sustainable agricultural practices, and incorporating green spaces into urban environments are essential for ensuring the survival of butterfly species in the region.

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