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Species Diversity and Distribution of Butterflies in the Konni Ecotourism, Western Ghats, Southern India.

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Abstract

Butterflies are fascinating insects known for their vibrant colors and ecological importance. This study investigates butterfly diversity in Konni Eco-Tourism over a three-month period from January to March 2021. A total of 35 butterfly species from 5 families and 32 genera were recorded. The most abundant family was Nymphalidae with 16 species, followed by Lycaenidae (6 species), Hesperiidae (5 species), Pieridae (5 species), and Papilionidae (3 species) For this study, four different spots in and around the Konni ecotourism area were chosen. The study highlights the richness and diversity of butterflies in the study area, particularly in forest sites with dense vegetation, which provide favorable conditions for butterfly populations. The highest species richness found in forested area (Site-3), while children's park with in the ecotourism area (Site-4) recorded the least due to higher anthropogenic activities. Biodiversity indices (species richness, Shannon, and Simpson indices) indicated high diversity and evenness across sites. The Medicinal plant demonstration plot (Site-2) being the most diverse than others. The findings emphasize the importance of preserving natural habitats for maintaining butterfly diversity and suggest that conservation efforts should focus on minimizing human disturbances and maintaining plant diversity to support butterfly populations.

Keywords: Butterfly diversity, Konni Eco-Tourism, Species richness, Biodiversity indices, Conservation.

INTRODUCTION

Butterflies play a crucial role in the stability of food webs as herbivores (Rusman et al. 2016), pollinators (Atmowidi et al., 2007), hosts of parasitoids (Van Nouhuys & Hanski 2002), and prey for predators (Hammond & Miller 1998; Rusman et al., 2016). Numerous species of butterflies serve as biological indicators for the health of the environment and for ecological changes (Biswas et al., 2019), as they can react very sensitively to the fragmentation of habitats and climate change (Kunte, 2000). Butterflies make a major contribution to maintaining the community structure of the forums in tropical regions (Pahari et al., 2018). Empirical studies

show that around 1,318 butterfly species live on the Indian subcontinent (Varshney & Smetacek, 2015). In recent decades, various anthropogenic activities and sudden climatic changes have led to changes in habitat structure and function, which in turn have had a negative impact on butterfly diversity (Di Mauro et al., 2007). Recent studies have continued to highlight the critical impact on Canadian taxonomic and phylogenic diversity by urbanization and other anthropogenic activities (Lewthwaite & Mooers,2023). Therefore, butterfly diversity studies are crucial to determine the effects of urbanization on butterfly communities and other aspects of biodiversity conservation (Samanta et al., 2017). Butterfly diversity also indirectly reflects the diversity of different plant communities (Mukherjee et al., 2016). Pollard (1988) reported that biotic and abiotic factors also influence butterfly populations, indicating the bioindication potential of the group. There are numerous reports by various researchers on the diversity of butterflies from different parts of India (Harsh, 2014).

Butterflies belong to the class of insects, which is a division of the Arthropoda tribe. The wings of moths and butterflies are covered with tiny scales. These are the distinguishing features that suggested Lepidoptera as a name for the order. This comes from the Greek and means that the *Lepis* - a scale and a *pteron* - see. The order of butterflies is divided into suborder Rhopalocera for butterflies and suborder Heterocera for moths. The suborder Rhopalocera of butterflies exhibits one of the main characteristics of butterflies, having antennae with clubs. *Rhopa* is the Greek word for a club. Class Insecta is divided into 29 orders (Das & Parida, 2015). Butterflies are also good indicators of environmental change because they are sensitive and are directly affected by changes in habitats, atmospheric temperature, and weather conditions. Like distribution, the survival of butterflies depends on the availability of larval forage plants, which generally consist of trees, shrubs, creepers, saplings etc. Therefore, here an attempt was made to understand how the distribution and variation in butterfly diversity changes in heterogeneous habitats with different ecological parameters in various sites in the Konni ecotourism, Pathanamthitta. Understanding butterfly diversity is essential for multiple reasons. Firstly, butterflies are vital components of ecosystems, acting as pollinators, herbivores, and prey for other species, thus contributing to the stability and functioning of food webs. Their sensitivity to environmental changes makes them excellent indicators of ecosystem health and biodiversity.

Studying their diversity provides insights into the effects of urbanization, habitat fragmentation, and climate change on ecosystems. Secondly, butterflies indirectly reflect the diversity of plant communities, as their presence and survival depend on the availability of specific host plants for their larvae. This relationship can be used to gauge the overall health of plant communities and the broader ecological balance. By focusing on butterfly diversity in the Konni ecotourism area, this study aims to contribute to the conservation efforts in this region, highlighting the impacts of environmental changes and promoting sustainable ecotourism practices. Finally, this work can inform conservation strategies not only for butterflies but also for other species that share the same habitats. By documenting the variations in butterfly populations across different ecological parameters, the study provides valuable data that can guide habitat restoration and management efforts, ensuring the preservation of biodiversity in the face of ongoing environmental changes

MATERIALS AND METHODS

Study area

https://en.wikipedia.org/wiki/Konni_Forest_

Figure 1: Konni Forest Division, location in India, Kerala and Administrative map

The Konni Forest Division falls under Karunagappally and Pathanapuram Taluks of Kollam District and portions of Kozhencherry and Adoor Taluks of Pathanamthitta District (Figure-1). The division area lies between 9º 3' and 9º 15' North latitude and 76º 4' and 77º 6' East longitude. The forest tracts form part of the Western Ghats and are situated mainly on its western slopes. The area receives an average rainfall of 3464 mm from both the South-West monsoon (June to mid-August), and the North-East monsoon (mid-September to mid-November). The total area under this division is 331.655 sq.km. Ecotourism is a growing sector in this area with the elephant camp and the kraal at Konni and Bowl boat riding at Adavi. Four distinct locations within and surrounding the Konni ecotourism area were selected for this study (Figure-2).

Site 1: Medicinal Plants Demonstration Plot: Cultivates various medicinal plants, attracting butterflies due to nectar sources and host plants, supporting high species diversity.
Site 2: Children's Park in Konni Eco-Tourism: Playground with landscaped gardens of native and exotic plants, attracting common butterfly species, and used for educational activities.
Site 3: Thannithodu, Konni: Remote area with natural vegetation and minimal disturbance, high species diversity, crucial for conservation and ecological research.
Site 4: Konni Eco-Tourism, Entrance Area: A well-maintained entrance with manicured gardens, native, and ornamental plants, supporting butterfly species in a semi-natural habitat.
Site 5: Staff Quarters Area, Konni Eco-Tourism: Residential area with landscaped gardens, supporting common garden butterflies, contributing to urban biodiversity and sustainable landscaping.
Site 6: Forested Area, Konni: Natural Forest with rich biodiversity, minimal human intervention, supporting rare and endemic butterflies, crucial for conservation and maintaining ecological balance.

Site 1: Medical plants demonstrationplot

Site 2: Children's Park in Konni Eco-Tourism

Site 3: Natural vegetation near residential area

Site 4: Entrance area (a semi-natural habitat)

Site 5: Staff Quarters

Site 6: Forested Area

Figure: 2- Four distinct locations within and surrounding the Konni ecotourism area selected for this study

Butterfly collection and Identification

To assess the diversity and distribution of butterflies, the standard transect counting method was employed. Four transects, each measuring 50m x 50m, were identified across different habitats and monitored for butterfly fauna. Observations were made every seven days over a four-month period (January 2021 to March 2021). This study utilized direct observation methods, with butterflies photographed using cameras and mobile phones. The butterflies were primarily observed interacting with plants for nectar, food, shelter, breeding, and protection. Butterflies present in these areas was recorded on data sheets. Printed and electronic references were used to identify butterflies. Field guide (Kunte,2000) used to confirm their species and taxonomy and nomenclature have been updated after Kunte et al. (2011).

Statistical Analysis

Species abundance and richness was calculated using Simpson's Index D = $\sum$ (pi)2 Simpson's index of diversity = 1- D (Simpson, 1949). Species diversity was also calculated using the Shannon – Weiner Index, H' = -$\sum$ Pi ln Pi. Where, Pi = the proportion of the species in the total sample, ln = natural logarithm (Shannon-Weiner, 1949).

RESULT AND DISCUSSIONS

The present study was carried out on butterfly diversity in Konni Eco**t**ourism over a period of 3 months (January 2021 to March 2021)**.** A total of 35 species (Figure-4) belonging to 5 families and 32 genera were identified from the study area during the study (Table 1). The study area is located at a high altitude, receives fairly good rainfall and accommodates dense vegetation. These findings provide compelling evidence that butterflies are extremely selective and prefer to live within intact natural habitats. The family Nymphalidae was recorded as the most prominent group with 16 species followed by the family Lycaenidae with 6 species, Hesperiidae with 5 species, Pierridae with 5 species, and Papilionidae with 3 species (Figure -3).

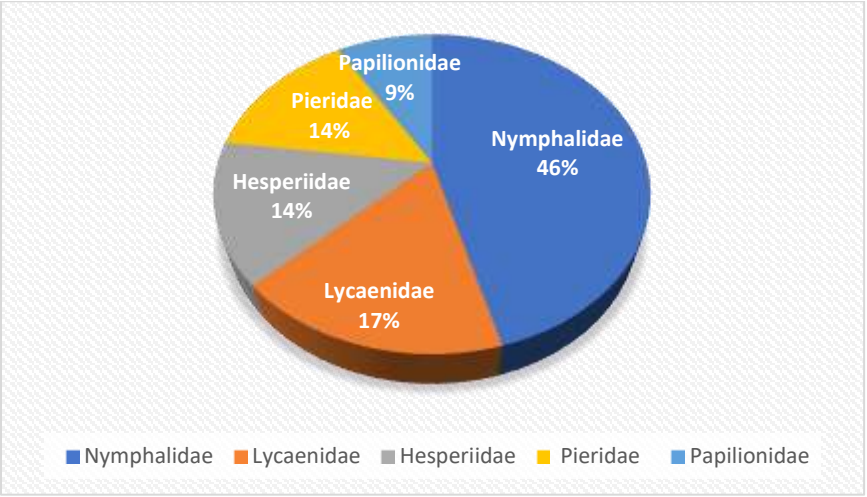

Figure 3: Species-richness pattern of families in the study area.

Table 1: Check list of butterflies observed from the study area

FAMILY	SCIENTIFIC NAME	COMMONNAME	VERNACULAR NAME
Nymphalidae	*Hypolimnas bolina*	Great Eggfly	Vanchotta Shalabham
	Tirumala septentrionis		Karineela Kaduva
	Neptis hylas	CommonSailor	Pondha chuttan
	Euthalia aconthea	Baron	Kanithozhi Shalabham
	Ypthima huebneri	Common Four Ring	Naalkanni
	Euploea core	Common Crow	Arali Shalabham
	Parantica aglea	Glassy Tiger	Thelineela Kaduva
	Acraea terpsicore	Tawny Coster	Theechirakan
	Tanae cialepidea	Grey Count	Pezhalan
	Melanitis leda	Common Evening Brown	Kariela Shalabham
	Danaus genutia	Striped Tiger	Varayan Kaduva
	Moduza procris	Commander	Vellela Thozhi
	Ariadne ariadne	Angled Castor	Chithrakan
	Cupha erymanthis	Rustic	Vayankathan
	Junonia iphita	Chocolate Pansy	Chocolate Shalabham
	Neptis jumbah	Chestnut-Streaked Sailer	Eruvarayan Pondhachuttan
Lycaenidae	*Euchrysops cnejus*	Gram Blue	Payarneeli
	Jamides celeno	Common Caerulean	Pottuvalatti
	Talicada nyseus	Red Pierrot	Chenkomali
	Rathinda amor	Monkey Puzzle	Iruthalachi
	Castalius rosimon	Common Pierrot	Nattukomali
	Zizula hylax	Tiny Grass Blue	Chinna pulneeli
Pieridae	*Catopsilia pomona*	Common Emigrant	Manjatha karamuthi
	Leptosia nina	Psyche	Pottuvellatti
	Cepora nerissa	Common Gull	Nattupatha
	Delias eucharis	Indian Jezebel	Vilasini
	Eurema hecabe	Common Grass Yellow	Manjapappathi
Hesperiidae	*Potanthus pseudomaesa*	Indian Dart	Nattupottan
	Suastus gremius	Indian Palm Bob	Panam kurumban
	Spialia galba	Indian Grizzled Skipper	Pullichadan
	Tagiaamilydes litigiosa	Water Snow Flat	Elamungi Shalabham
	Lambrix salsala	Chestnut Bob	Chenkaruppan
Papilionidae	*Papilio demoleus*	Lime Snow Tail	Naraga Shalabham
	Papilio polytes	Common Mormon	Naragakali
	Papilio clytia	Common mime	Vazhana Shalabham
Family 5	Species 35		


1.Common Caerulean
2.Red Pierrot
3.Great Eggfly
4.Psyche
5.Dark Blue Tiger
6.Monkey Puzzle
7.Common Sailor
8.Indian Dart
9.Baron
10.Indian Grizzled Skipper
11.Common Four Ring
12.Common Mormon
13.Chestnut Bob
14.Common Pierrot
15.Common Crow
16.Indian Jezebel
17.Glassy Tiger
18.Tawny Coster
19.Tiny Grass Blue
20.Common Mime
21.Common Evening Brown
22.Grey Count
23.Common Emigrant
24.Lime Snow Tail
25.Striped Tiger
26.Common Gull
27.Commander
28.Angled Castor

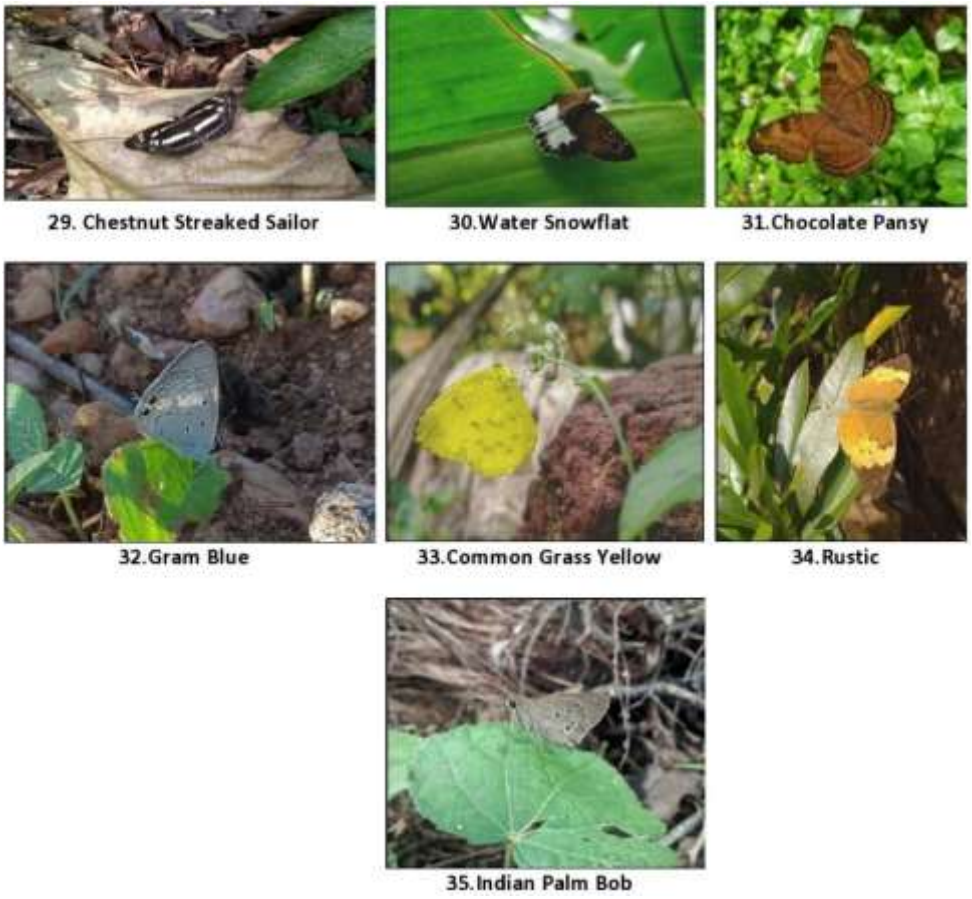

Figure -4: Photographs of the species of butterfly observed in the study area

The current study highlights the diversity and abundance of butterflies in Konni Ecotourism. The greatest number of species (34 species) were sighted in the forested area of Konni Forest Division, due to the abundance of host plants and other vegetation, and Children's Park within ecotourism recorded the fewest (30 species). This diversity highlights the ecological richness and suitability of the Konni Ecotourism area for supporting a wide variety of butterfly species. Ecotourism because it is an area of anthropogenic activities. Butterflies, being highlysensitive to environmental conditions might find it difficult to survive in such disturbed habitats and this could limit their abundance in the area. The species diversity found in the Konni Eco-Tourism supports the fact that forest habitats provide highly favorable ecologicaland climatic conditions for the growth and survival of butterflies.

Species Richness and Habitat Preferences

Taxa_S (species richness) ranges from 30 to 34 across the sites, showing a relatively high species richness throughout the study area. Site-6 exhibited the highest species richness (Taxa_S = 34), while Site-2 showed the lowest (Taxa_S = 30). Individuals count varies from 70 to 85, with Site-1 having the highest number of individuals (85) and Sites 3, 5, and 6 having the lowest (70). D (Dominance) values indicate that Site-2 has the lowest dominance (0.03748), suggesting a more even distribution of individuals among species. Conversely, Site-1 has the highest dominance (0.04886), indicating a few species are more dominant in this site. Simpson_1-D values are high for all sites, ranging from 0.9511 to 0.9625, reflecting a high level of diversity. Site-2, with the highest Simpson_1-D value (0.9625), is the most diverse, while Site-1, with the lowest value (0.9511), is the least diverse in comparison. Shannon_H indices are also high across all sites, ranging from 3.214 to 3.336. Site-5 has the highest Shannon index (3.336), indicating a high species diversity and evenness, whereas Site-1 has the lowest Shannon index (3.214), suggesting a lower diversity and evenness (Table -2)

The data reveals that the Nymphalidae family is the most prominent with 16 species, indicating a strong presence in the study area. The least represented family is Papilionidae, with only 3 species observed. The distribution of species across different families is consistent with previous studies suggesting that Nymphalidae, being a highly diverse family, often dominates in terms of species richness in many habitats

(Kunte et al., 2022). Site-specific observations indicate that Site-3, the forest area in Konni, recorded the highest number of species. This can be attributed to the richness of host plants and dense vegetation that provide favorable conditions for butterflies. Conversely, Site-4, the Children's Park area, recorded the least number of species, likely due to higher anthropogenic activities that disrupt natural habitats. Butterflies are known to be sensitive to environmental changes and prefer undisturbed natural habitats, which was evident from the study of Lewthwaite & Mooers on 2023.

Table 2. Species richness, abundance and diversity of butterfly fauna sampled in six study areas

	Site 1 Medical plants demonstration plot	Site 2 Children's Park in Konni Eco-Tourism	Site 3 Natural vegetation Near residential area	Site 4 Entrance area (a semi-natural habitat)	Site 5 Staff Quarters	Site 6 Forested Area
Taxa_S	32	30	31	31	33	34
Individuals	85	78	70	79	70	70
Dominance_D	0.04886	0.03748	0.04531	0.04054	0.04122	0.04449
Simpson_1-D	0.9511	0.9625	0.9547	0.9595	0.9588	0.9555
Shannon_H	3.214	3.334	3.256	3.305	3.336	3.318

Ecological Implication

The findings underscore the importance of preserving natural habitats, as the highest butterfly diversity was recorded in the least disturbed areas. The study reaffirms that dense vegetation and minimal human interference are crucial for sustaining butterfly populations. The data also suggests that anthropogenic activities negatively impact butterfly diversity, as seen in Site-4. These results align with broader ecological studies that emphasize the role of natural habitats in supporting biodiversity. Conservation efforts should focus on maintaining and restoring natural habitats to promote butterfly diversity and, by extension, the overall health of ecosystems (Bonebrake et al., 2021).

CONCLUSION

The study of butterfly diversity in Konni Eco-Tourism over three months highlighted the area's rich butterfly fauna, with 35 species from 5 families. The variation in species richness and diversity across different sites underscores the importance of habitat quality. The species abundance observed in Konni Eco Tourism could be attributed to the dense vegetation and the minimum human interference associated with the forest area. Also, the area under study was rich in flora and fauna. Hence, there was an easy accessibility of host plants for the butterfly larvae and adults and this contributed to the immense diversity of butterfly species. Among the butterfly community indices analysed, the strongest correlationwas detected between butterfly species richness and nectar plant species richness at each site.Another close correlation was detected between the species richness of nectar plants and herbaceous plants at each site. These results suggest that herbaceous plant species richness ina habitat plays a central role in its nectar plant species richness, and the nectar plant richness is a highly important factor supporting its adult butterfly species richness. Consequently, we propose that the maintenance and management of herbaceous plant species richness in a butterfly habitat, which lead to those of its nectar plant species richness, are very important for conservation of butterfly diversity. Forested areas with dense vegetation support higher butterfly diversity, while disturbed areas show reduced species richness. These findings can inform conservation strategies aimed at protecting and enhancing butterfly habitats in eco-tourism areas.

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