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# Diversity of Butterflies in Gudalur forest area, Nilgiri hills, Southern Western Ghats, India

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**Abstract**

Butterflies were sampled during June 2014 to May 2015 using pollard walk method. Investigation was carried out on the diversity and abundance of butterfly fauna in Gudalur forest area, The Nilgiri hills, Southern Western Ghats. The Gudalur forest area is situated at the foot hills of Western Ghats (a part of Nilgiri Biosphere Reserve). The present study surveyed 64 butterfly species belonging to 5 families namely Papilionidae (12), Pieridae (15), Nymphalidae (18), Lycaenidae (11) and Hesperiidae (8) which revealed that Nymphalidae and Pieridae are that rich dominant, while hesperiidae and Lycaenidae are less in number. High incidences of butterfly population with wide distribution were observed during the months of the monsoon seasons (June-November) which diminish during December to January. It was observed that the occurrence and distribution of butterflies are closely associated with the availability of its larval and adult host plants. The butterfly population of a species is gradually decreasing in number due to human interference in the habitat and the destruction of host plants.

**Keywords:** Butterflies, diversity, abundance, seasonality, Papilionidae, Pieridae, Nymphalidae, Lycaenidae, Hesperiidae.

## Introduction

Butterflies are the most tantalizing and beautiful creatures among the insect group, they are often regarded as flagship species. These are perhaps the most studied and well-known insect groups. Butterflies act as indicators in monitoring environmental health play an important role in food chains and food webs. Butterflies along with moths comprise to the order Lepidoptera. In terms of indicator organisms for biodiversity studies, butterflies are an excellent choice as they are common almost everywhere, attractive and easy to observe. The butterfly diversity is high in the tropics compared to temperate regions of the world. Butterflies are excellent pollinators and bio control of weeds.

Butterflies are very sensitive to pollution and have been used as bio-indicators to detect the pollution levels. Certain species are used for experiments in genetic engineering. Butterflies are classified under three super families, Hesperiidae, consisting of Skippers, Papilionidae or 'true butterfly' and Hedyloidae, consisting of the 'American moth-butterflies (Scoble, 1986). The five families of true butterflies or Papilionidae are family Papilionidae, Pieridae, Lycaenidae, Riodinidae and Nymphalidae.
India has a rich butterfly fauna comprising of 1501 species out of 16,823 species recorded from all over the world (Gaonkar, 1996) of the various butterfly habitats found in india, the Western Ghats is one of the most diversified areas containing a wide variety of species due to the typical eco-climatic and geographic features. In the Western Ghats, maximum diversity is observed in The Nilgiri Biosphere Reserve (NBR) region of 330 species recorded from the Western

Ghats, 316 species have been reported from the NBR (Gaonkar, 1996). Butterflies are very important to the environment. They are excellent Group for communication information in science and conservation issues, and an excellent indicator of the ecological condition of the most terrestrial habitats (Koplins and Opler, 1997).

The southern Western Ghats is home to hundreds of species of rare, endemic and species of colourful butterflies, some of them extremely rare. Some species are so rare that they are found now where else in the world. The largest Indian butterfly (Common Birdwing) and the smallest (Southern Grass Jewel) occure in the peninsular India. The Nilgiri district has an area of 2, 452, 50 sq.km. The district is basically a hill region, situated at an elevation of 2000 to 2,600 meters above MLS. Almost the entire district lies in the Western Ghats. Its latitudinal and longitudinal dimensions being 130 Km (Latitude: 10-38 WP 11-49 N) by 185 Km (Longitude: 76.0 E to 77.15 E).

Two eco regions are covering the portions of the Nilgiris. The Southern Western Ghats are moist deciduous forests lie between 250 and 1000 meters elevation. These forests are home to the largest butterflies in India, who range from the Nilgiris across to the Eastern Ghats. The Nilgiris and the Southern Western Ghats is also one of the most important butterfly habitats left in india. The Southern Western Ghats montane rain forests eco region covers the portion of the range above 1000 meters elevation. These evergreen rain forests are among the most diverse on the planet. Above 1500 meters elevation, the evergreen forests begin to give way to stunted forests, called shoals, which are interspersed with open grassland.

Gudalur is located nearby Mudumalai area in the Nilgiri district in Tamilnadu. This area is famous for its different varieties of fauna and flora in the local. It is also notable for the scenic sun rise and sun set views near this area. This area is surrounded by tea and coffee plantations where visitors can buy tea production. Species richness was highest in late monsoon and early winter. Majority of the butterfly species also showed abundance peaks in these seasons. Fire plays a significant role in determining species composition in fire – affected areas and affected flight periods of some species but did not affect species richness. Grazing had a major impact on species composition and it favoured only those Lycaenids and Nymphalids whose caterpillars feed on herbs.

Increased urban features, including roads, buildings and moved lawns, correspond with decreases in butterfly species richness, diversity and abundance (Blair and Launer, 1997; Stefanescu *et al*., 2004; Clark *et al*., 2007). Orbanization also I associated with habitat degradation including decreased plant species diversity reduced water quality, and increased air and soil pollutions (Bastin, 1999; Hall *et al*., 1999). The reductions in amount and quality of natural habitat associate with urban development negatively affect nature biodiversity (Malagrino *et al*., 2008).

Urgent conservation measures are needed to save the threatened and rare species of butterflies from becoming extinct. Their natural habitats should be conserved by restricting deforestation, livestock grazing, indiscriminate felling of trees, etc. The use of chemicals such as pesticides, weedicides, etc., should be avoided or minimized, especially in wilderness areas which are butterfly habitats. Establishment of butterfly parks breeding centers and research stations in different parts of india, as in common in many parts of the world will increase scientific understanding the species and help augment its numbers. Spreading awareness among the public greatly minimize senseless killing of these beautiful insects for commercial and collection purposes.

## Materials and Methods

### Diversity of butterflies

Survey of butterflies was carried out in different habitat. In each habitat type, two transects have been laid across the habitat, so as to cover all features of the habitats. The length of each transect will be 2 km. Butterflies were observed up to 20 m on both sides of transects. Observations were made for the entire transects (2000 m). Transects were away from the influence of edges and ecotones and well within the vegetation types. Places which were areas of major disturbances were avoided.

In the 2 km transect line; all the butterfly species were counted. Ocular observations were made. The key characters used for identification were color pattern, wing span, mode of flight, etc. No collection of specimens was done. During the study, flight patterns, activity patterns and behaviour were also noted. The observations will be made between 7 am and 10 am. All the species of butterflies chosen for the study was counted in different months and seasons. During the survey, their perpendicular distances from the transect lines and the heights at which they have seen first, as well as the date, time, and general weather conditions were recorded.

### Identification of Butterfly Species.

Identification of the butterflies will be primarily made directly in the field. In critical condition, butterfly will be photographed or recorded by digital camera and the photograph will be taken to the laboratory for further identification with the help of field guide (Wynther-Blyth 1957; Gunathilagaraj 1998; Kunte 2000) and specialist.

### Data analysis

Raw data from the field were used to reveal species richness (Menhinik index), species diversity (Shannon-Weiner index), component of dominance (Simpson dominance index), and relative abundance of different species in a sampling site (Pielou's evenness index) (Magurran 1988).

## Results and Discussion

A total of 64 species and 5 families were identified. The numbers of species recorded with families are as follows. About 105 species of swallowtails (Papilios), out of the world's 700, are found in India, among them 19 species are present in peninsular India. Twelve species have been reported from our study area during our study period. The family includes two species (*Pachliopta hector* and *Papilio polymnestor*) which are endemic to Western Ghats and Sri Lanka. Lime butterfly (Papilio demoleus) of this family is most abundant in our study area whereas 3 other species found rare. Lycaenidae is the most abundant family of the Western Ghats, compared to all other families (Kunte, 2000). Similar pattern was also observed in our study area. Eleven butterfly species with many very common species and few common species belongs to family Lycaenidae was reported from the area during study period.

The Nymphalids are a large group of robust bodied butterflies that come in almost every shape and colour. Highest number of butterfly species (18 species), belongs to this family among the total reported in the area. The species of this family are distributed throughout the area. The family Pieridae has some of the most familiar butterflies. Over 35 species are represented in this family in peninsular India out of which 33 species are found in Western Ghats and 15 species are found in Gudalur forest area. The family Hesperidae is the third largest family of the butterflies in the world. Only 8 species belongs to this family were reported from the area during our study period.

Butterflies are seasonal in their occurrence. They are common for only a few months and rare or absent in other parts of the year (Kunte, 2000). Butterflies are sensitive to the changes in the habitat and climate, which influence their distribution and abundance (Winter-Blyth, 1957). In general, the phenological patterns found in this study are similar to those described by de la Maza and de la Maza (1985a, b) and Austin *et al*. (1996), with peak butterfly diversity at the end of the dry season and another peak during the rainy season. Reduced species diversity was observed from the end of the rainy season to the middle of the dry season.

The most diverse families in the study area are those showing the largest variation in species richness throughout the year (Nymphalidae (18 species), Lycanidae (11 species), Hesperiidae (8 species), Pieridae (15 species) and Papilionidae (12 speices). In contrast to other families, peak diversity of Papilionidaewas observed during the late dry season into the early rainy season, as reported by Austin *et al*. (1996) for the Tikal area. Relative abundance of Papilionidae was distributed irregularly throughout the year, but the greatest number of individuals and species was recorded in post monsoon season.

**Table 1. Abundance and diversity of butterfly species in Gudalur forest area**

| S.No. | Butterfly family | No. of butterfly species |
|---|---|---|
| 1 | Papilionidae | 12 |
| 2 | Pieridae | 15 |
| 3 | Nymphalidae | 18 |
| 4 | Lycaenidae | 11 |
| 5 | Hesperiidae | 08 |
| Total | | 64 |

Phenology Considering the Relative Abundance of Species Wolda (1988b) concluded that there are differences in phenological patterns among insect faunas typical of temperate and tropical zones. Under the assumption that seasonal changes are minimal in the tropics, adults of the majority of species should be present throughout the year (Owen 1971), whereas in temperate zones adults are restricted to the most favorable seasons (usually spring and summer). Nevertheless, upon examining climatic variations for each year of our study, the expected uniformity in phonological patterns of butterfly species at our tropical study sites does not exist. During the study, there were important differences in precipitation levels, and to a lesser degree, in temperature, which caused levels of evaporation to differ between seasons. Our results indicate a species turnover of more numbers (as represented by adults), from the dry to rainy season.

**Table 2. Abundance of Papilionidae butterflies in Gudalur forest area**

| S.No. | Butterfly species | Common Name | No. of individuals |
|---|---|---|---|
| | Papilionidae | Swallowtails | |
| 1 | *Pachliopta aristolochiae* Fab. | Common Rose | 17 |
| 2 | *Pachliopta hector* Linn. | Crimson Rose | 2 |
| 3 | *Graphium sarpedon* Linn. | Common Blue bottle | 10 |
| 4 | *Graphium nomius* Esper | Spot Sword Tail | 4 |
| 5 | *Graphium doson* C&R Felder | Common Jay | 7 |
| 6 | *Graphium antiphates (*Cramer) | Five Bar Sword tail | 5 |
| 7 | *Papilio crino* Fab. | Common Banded Peacock | 8 |
| 8 | *Papilio demoleus* Linn. | Lime butterfly | 6 |
| 9 | *Papilio polytes* Linn. | Common Mormon | 2 |
| 10 | *Papilio polymnestor* Cramer | Blue Mormon | 5 |
| 11 | *Papilio helenus* Linn. | Red Helen | 3 |
| 12 | *Papilio paris* Linn. | Paris Peacock | 2 |

**Table 3. Abundance of Pieridae butterflies in Gudalur forest area**

| S.No. | Butterfly species | Common Name | No. of individuals |
|---|---|---|---|
| | Pieridae | White and yellow | |
| 1 | *Catopsilia pyranthe* Linn. | Mottled Emigrant | 8 |
| 2 | *Catopsilia pomona* Fab. | Common Emigrant | 16 |
| 3 | *Erurema hecabe* Linn. | Common Grass Yellow | 5 |
| 4 | *Eurema brigitta* Cramer | Small Grass Yellow | 10 |
| 5 | *Eurema laeta* Cramer | Spotless Grass Yellow | 4 |
| 6 | *Eurema blanda* Boisduval | Three Spot Grass Yellow | 2 |
| 7 | *Colias nilagiriensis* C&R Felder | Nilgiri Clouded Yellow | 3 |
| 8 | *Delias eucharis* Drury | Common Jezebel | 4 |
| 9 | *Ixias marianne* Cramer | White Orange Tip | 5 |
| 10 | *Pieris canidia* Linn. | Indian Cabbage White | 7 |
| 11 | *Appias albino* Boisdvual | Common Albatross | 6 |
| 12 | *Appias indra* Moore | Plain Puffin | 8 |
| 13 | *Appias libythea* Fab. | Striped Albatross | 7 |
| 14 | *Appias lycida Cramer* | Chocolate Albatross | 2 |
| 15 | *Appias wardii* Moore | Lesser Albatross | 6 |

**Table 4. Abundance of Nymphalidae butterflies in Gudalur forest area**

| S.No. | Butterfly species | Common Name | No of individuals |
|---|---|---|---|
| | **Nymphalidae** | **Brush Footed Butterflies** | |
| 1 | *Melantis leda* Linn | Common Evening Brown | 3 |
| 2 | *Cryrestis thyodamas* | Common Map | 5 |
| 3 | *Hypolimmas misippus* Linn | Danaid Eggfly | 7 |
| 4 | *Hypolimnas bolina* | Great Eggfly | 15 |
| 5 | *Mycalesis perseus* Fab | Common Bush Brown | 8 |
| 6 | *Ariadne merione* Cramer | Common Castor | 5 |
| 7 | *Junonia lemonias* Linn | Lemon Pansy | 6 |
| 8 | *Junonia iphita* | Chocolate Pansy | 9 |
| 9 | *Junonia almana* | Peacock Pansy | 15 |
| 10 | *Junonia atlites* | Grey Pansy | 5 |
| 11 | *Junonia lemonias* | Lemon Pansy | 12 |
| 12 | *Tirumala limniace* Cramer | Blue Tiger | 19 |
| 13 | *Orsotriena medus* Fab | Nigger | 21 |
| 14 | *Ypthima chenui* Guerin Meneville | Nilgiri Four Ring | 18 |
| 15 | *Vindula erota* Fab | Cruiser | 25 |
| 16 | *Cethosia nietneri* C&R Felder | Tamil Lacewing | 4 |
| 17 | *Phalanta phalantha* Drury | Common Leopard | 6 |
| 18 | *Neptis hylas* Moore | Common Saler | 2 |

**Table 5. Abundance of Lycaenidae butterflies in Gudalur forest area**

| S.No | Butterfly species | Common Name | No. of individuals |
|---|---|---|---|
| | **Lycaenidae** | **Blues** | |
| 1 | *Castalius rosimon* Fab. | Common Pierrot | 15 |
| 2 | *Actolepis puspa* Horsfield | Common Hegde Blue | 5 |
| 3 | *Zizula gaika* Fab. | Tiny Grass Blue | 2 |
| 4 | *Jamides celeno* Camer | Common Cerulean | 2 |
| 5 | *Talicada nyseus* Guerin meneville | Red Pierror | 1 |
| 6 | *Arhopala amantes* Moore | Large Oakblue | 4 |
| 7 | *Spindasis vulcanus* Fab. | Common Silverline | 3 |
| 8 | *Tajuria cippus* Fab. | Peacock Royal | 2 |
| 9 | *Rapala manea* Moore | Slate Flash | 1 |
| 10 | *Caleta caleta* (Hewitson) | Angled Pierrot | 2 |
| 11 | *Discolampa ethion* Westwood | Banded Blue Pierrot | 1 |

**Table 6. Abundance of Hesperiidae butterflies in Gudalur forest area**

| S.No | Butterfly species | Common Name | No.of individuals |
|---|---|---|---|
| | Hesperiidae | Skippers | |
| 1 | *Hasora chromus* Cramer | Common Banded Awl | 5 |
| 2 | *Hasora tminatus* Hubner | White Banded Awl | 8 |
| 3 | *Hasora badra* Moore | Common Awl | 15 |
| 4 | *Hasora vitta* Butler | Plain Banded Awl | 3 |
| 5 | *Badamia exclamations* Fab | Brown Awl | 2 |
| 6 | *Celaenorrhinus leucocera* Kollar | Common Spotted Flat | 8 |
| 7 | *Celaenorrhinus ambareesa* Moore | Malabar Spotted Flat | 3 |
| 8 | *Celaenorrhinus ruficornis* Mabille | Tamil Spotted Flat | 2 |

**Table 7. Abundance, diversity and richness of butterflies in the study area**

| S. No | Family | Abundance | Diversity Index | Richness |
|---|---|---|---|---|
| 1 | Papilionidae | 71 | 2.273 | 2.581 |
| 2 | Pieridae | 93 | 2.569 | 3.089 |
| 3 | Nymphalidae | 185 | 2.683 | 3.256 |
| 4 | Lycaenidae | 38 | 1.978 | 2.749 |
| 5 | Hesperiidae | 46 | 1.844 | 1.828 |

Unique environmental attributes of each region should cause phenological patterns among the butterfly fauna to vary among them. Some reviews of butterfly phenology suggest that climate is the main factor controlling the activity of these organisms (Brakefield and Shreeve 1992; Warren 1992; Gutiérrez and Menéndez 1998). However, climatic factors may be influenced by differences between habitats or years, correlated with microclimatic changes at local or regional levels. In this study, phenological similarities were found with respect to species richness trends throughout the year.

The group of rare species may change from year to year due to seasonal and environmental variables, which have been poorly studied. Therefore, details on the specific mechanisms that lead to seasonal variation in the composition of rare species are needed to fully understand phenological patterns in any area. If we consider precipitation and temperature (causes of available humidity) as principal factors in determining the phenological patterns of vegetational communities, and therefore of butterflies, the timing and severity of the dry season is likely to be one of the most consequential factors in determining regional phenological patterns.

Papilionidae is composed of few species, most of which are large-bodied, often with small population sizes. Longer survivorship due to their large adult size may allow this family to maintain relatively constant levels of species richness throughout the year. Larger butterflies are good at maintaining their water balance (Janzen and Schoener 1968), the greatest problem confronted by insects during the dry season. The effect of humidity is important with respect to insect body size, and those organisms with small bodies desiccate more easily than those with medium to large bodies (Young 1982). In addition, the relatively consistent diversity of Papilionidae across the seasons could be related to phenological patterns of larval food plants or the availability of adult nectar or mineral resources. For species with long reproductive lives), availability of nectar resources may be especially important in determining phenological patterns (Gilbert and Singer 1975).

The difference in diversity between wet and dry seasons was evident only in all forest area. Previous studies have indicated that one of the main impacts of habitat modification such as selective logging is to reduce the spatial heterogeneity within forests (Hamer and Hill 2000, Hamer *et al*. 2003), and the results of this study indicate a similar effect on temporal heterogeneity. Dry and wet season preferences of butterflies are also shows distinct variation of the proportional abundance in both the seasons. These differences of butterfly abundances are due to well defined dry and wet seasons and as well as distinct plant phenological state in different seasons of

the year. But, this result contradicts with the findings of Wolda (1988), that there is no distinct variation of dry and wet season leading to less well-defined seasonal peak. Study reveals that the butterflies of study area are highly seasonal. This result is supported by the view of Hamer *et al.* (2003), who suggested that, highly dispersive opportunistic species are highly seasonal. Butterfly diversity and species abundance are differed significantly among wet and dry seasons. The species diversity is consistently higher during wet season than dry.

Faunal studies on Lepidoptera of tropical regions based on systematic sampling methods conducted during all months of the year are scarce. Likewise, few studies have investigated seasonality in tropical lepidopteran faunas. The information presented herein explains butterfly abundance and diversity, and should be useful in future studies on the phenology of this immensely diverse group.

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