Research Article

Butterfly Diversity of Indian Institute of Forest Management, Bhopal, Madhya Pradesh, India

Sprih Harsh

WWF-India, Mandla, Madhya Pradesh 481661, India

Correspondence should be addressed to Sprih Harsh; sprih.harsh@gmail.com

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A study to find out the diversity of butterflies at the Indian Institute of Forest Management (IIFM), Bhopal, was carried out over a period of six months from October 2013 to March 2014. A total of 55 butterfly species belonging to 5 families, namely, Hesperidae (7 species), Papilionidae (4 species), Pieridae (10 species), Lycaenidae (13 species), and Nymphalidae (21 species), were recorded (with photographic record) during the study from three different habitats of campus: open scrub, dry deciduous, and urbanized habitat. Shannon diversity indices and Pielou's evenness index were calculated for all the habitats. Shannon index was found to be highest for open scrub (3.76). Out of 54 species, *Eurema brigitta* was the most dominant species followed by *Eurema hecabe*, *Junonia lemonias*, and *Phalanta phalantha*. Dominance of these species can be explained by the presence of their larval and host plants in the campus.

1. Introduction

Butterflies are one of the most conspicuous species of Earth's biodiversity. Being extremely responsive to any changes in their environment, namely, temperature, humidity, light, and rainfall patterns [1–4], these insects are identified as useful bioindicators. They have different requirements for different habitat types for mating, breeding, and nectaring and are, thus, in sync with the diversity and quality of their habitats.

The present study aims to examine the diversity and distribution of butterflies across three different habitats, namely, dry deciduous, open scrub, and urbanized habitat. A checklist of butterfly species is also provided.

2. Materials and Methods

2.1. Study Area. The study was done in Indian Institute of Forest Management, Bhopal (23.208371°N and 77.384417°E), from July 2012 to March 2013. The location of campus, built on a hill at an elevation of about 556 m and surrounded by water on three sides, along with the wide range of climatic conditions that it passes through brings in diverse

structure of habitats. The major types of vegetation included grasslands, open scrub forest, and dry deciduous forest and bamboo groves. The study was conducted in 12 transects (each approximately 300 to 500 m long) covering an area of 93-hectare campus.

For our study, transects were divided into three habitats according to general landscape attributes and vegetation present there. The chief habitat types were as follows: (1) open scrub, (2) dry deciduous, and (3) urbanized habitat.

2.2. Butterfly Survey. The survey of butterfly was done using Pollard walk method [5, 6] from 8 am to 10 am. The butterflies were observed within 2.5 meters to the left and right side and five meters in front of the observer. Butterflies were observed, captured, identified, and released immediately at the spot of capture. A butterfly net was used for this purpose. Many of the species were photographed in the wild. The dead specimens, many of them not in very good condition, were kept in butterfly collection boxes. Collecting live specimens was avoided during the study.

2.3. Data Analysis

(A) *Shannon Index* (H'). Species diversity was calculated using the Shannon Index [8]:

$$H' = - \sum p_i \ln p_i. \quad (1)$$

Here, p_i is the proportion of the i th species in the total sample. The number of species (species richness) in the community and their evenness in abundance (or equitability) are the two parameters that define H' .

(B) *Pielou's Evenness Index* (Equitability) or J' . The species evenness is the proportion of individuals among the species. Evenness of species indicates their relative abundance on site [8, 9]:

$$J' = \frac{H'}{\ln S}. \quad (2)$$

Here, S is the number of species present in the site.

3. Results

A total of 55 butterfly species with a total of 815 individuals belonging to 5 families were recorded (with photographic record) during the study. The butterfly list along with their abundance in different habitats is given in Table 1. There are 8 species with lowest individual number having abundance less than 5 in all the three habitats. The three most abundant species are *Eurema brigitta* (with 48 individuals) followed by *Eurema hecabe* (with 45 individuals) and *Junonia lemonias* (with 34 individuals). The greatest number of all these three species occurred in open scrub. Out of 55 species, 52 were found in open scrub followed by 49 species in dry deciduous habitat and then 44 species in urbanized habitat. A total of 815 individuals were recorded from the campus with highest abundance in open scrub ($n = 359$) followed by dry deciduous habitat ($n = 277$) and urbanized habitat ($n = 179$). Out of the five families of butterflies, Nymphalidae were the most commonly recorded, accounting for 38% ($n = 21$) of total species recorded followed by Lycaenidae 23% ($n = 13$), Pieridae 10% ($n = 10$), and Hesperidae 12% ($n = 7$) of total species and minimum was recorded for Papilionidae 7% ($n = 4$).

Figure 1 shows that proportion of rare species tends to increase from open scrub to dry deciduous to urbanized habitat. The proportion of uncommon species is similar in open scrub and dry deciduous environment while it tends to decrease in urbanized structure. The proportion of common species, on the other hand, indicates a decreasing trend from open scrub to dry deciduous to urbanized environment.

The diversity of butterfly species in three different habitat types in IIFM is presented in Table 2. The open scrub has the greatest species number with 52 species while urbanized habitat ranks lowest with 44 species. The same order follows for abundance and diversity index with highest diversity index for open scrub and least for urbanized habitat and greatest individual numbers for open scrub and least for

FIGURE 1: Proportion of species abundance in each habitat. *Note.* Rare: species with individuals less than 5; Uncommon: species with individuals between 6 and 10; Common: species with individuals more than 10.

urbanized environment. The greatest species number of open scrub habitat leads to the high diversity index although it has a lower evenness index than dry deciduous habitat. The evenness index is almost similar in the entire three habitats with the index being highest in dry deciduous habitat where there is not any dominating species with high individual number.

4. Discussion

Fifty-five species of butterflies were documented during the survey. Open scrub, the least disturbed, was found to have the highest species richness followed by dry deciduous habitat and the lowest in urbanized habitat, the most disturbed. These results can be attributed to the presence of host and larval plant species, whose occurrence impacts distribution of butterflies [10]. There are many studies that have shown higher butterfly diversity in disturbed habitat or forest gaps than that in dense forest or closed canopy [11–14]. This study, therefore, shows some sort of contradictory results which might be due to different levels of disturbance among these habitats, more in open scrub in terms of human interference in the form of fuel wood gathering, cattle grazing, forest fire, and so forth, but less in urbanized habitat where there are well maintained gardens. These human interferences result in more gaps, edges which provide more light and space, and diversity in plant structure to support more butterfly species than natural forest [3, 13, 15]. The correlation of disturbance and occurrence of butterflies is attributed to the emergence of secondary vegetation like *Lantana camera*, *Eupatorium odoratum*, and so forth, which are good food sources for many butterfly species [14].

One important aspect of study is the statistics of common species between different habitats which indicates the beta diversity and how different (or similar) these habitats are in terms of the variety and abundance of species found in them. The open scrub and dry deciduous habitat showed

TABLE 1: List of butterfly species and their abundance in different habitats (Source [7]).

Serial number	Name	Scientific name	Author name of species	Family	Abundance
1	Common Banded Awl	<i>Hasora chromus</i>	Pieter Cramer		12
2	Malabar Spotted Flat	<i>Celaenorrhinus ambareesa</i>	Frederic Moore		10
3	Indian Skipper	<i>Spialia galba</i>	Johan Christian Fabricius		1
4	Spotted Small Flat	<i>Sarangesa purendra</i>	Frederic Moore	Hesperiidae	3
5	Tricolored Pied Flat	<i>Coladenia indrani</i>	Frederic Moore		9
6	Bevan's Swift	<i>Pseudobordo bevani</i>	Frederic Moore		11
7	Small Branded Swift	<i>Pelopidas mathias</i>	Johan Christian Fabricius		9
8	Common Mime	<i>Chilasa clytia</i>	Carolus Linnaeus		10
9	Common Mormon	<i>Papilio polytes</i>	Carolus Linnaeus	Papilionidae	18
10	Lime Butterfly	<i>Papilio demoleus</i>	Carl Linnaeus		16
11	Crimson Rose	<i>Atrophaneura hector</i>	Carl Linnaeus		9
12	Small Grass Yellow	<i>Eurema brigitta</i>	Pieter Cramer		48
13	Common Grass Yellow	<i>Eurema hecabe</i>	Carl Linnaeus		45
14	Spotless Grass Yellow	<i>Eurema laeta</i>	Jean Baptise Boisduval		32
15	Common Emigrant	<i>Catopsilia pomona</i>	Johan Christian Fabricius		11
16	Mottled Emigrant	<i>Catopsilia pyranthe</i>	Carl Linnaeus	Pieridae	13
17	Plain Orange Tip	<i>Colotis eucharis</i>	Johan Christian Fabricius		5
18	Common Wanderer	<i>Pareronia valeria</i>	Carl Linnaeus		19
19	Common Gull	<i>Cepora nerissa</i>	Johan Christian Fabricius		3
20	Common Jezebel	<i>Delias eucharis</i>	Dru Drury		2
21	Pioneer	<i>Belenois aurota</i>	Johan Christian Fabricius		10
22	Guava Blue	<i>Deudorix isocrates</i>	Johan Christian Fabricius		19
23	Zebra Blue	<i>Leptotes plinius</i>	Johan Christian Fabricius		7
24	Common Cerulean	<i>Jamides celeno</i>	Pieter Cramer		27
25	Forget Me Not	<i>Catochrysops strabo</i>	Johan Christian Fabricius	Lycaenidae	22
26	Rounded Pierrot	<i>Tarucus nara</i>	Arthur Gardiner Butler		8
27	Dark Pierrot	<i>Tarucus ananda</i>	Lionel De Nicéville		7
28	Dark Grass Blue	<i>Zizeeria karsandra</i>	Frederic Moore		21
29	Pale Grass Blue	<i>Pseudozizeeria maha</i>	Vincenz Kollar		11
30	Lesser Grass Blue	<i>Zizina otis</i>	Johan Christian Fabricius		14
31	Tiny Grass Blue	<i>Zizula hylax</i>	Johan Christian Fabricius		8
32	Gram Blue	<i>Euchrysops cnejus</i>	Johan Christian Fabricius		9
33	Small Cupid	<i>Chilades parrhasius</i>	Johan Christian Fabricius		8
34	Lime Blue	<i>Chilades lajus</i>	Pieter Cramer		11
35	Blue Tiger	<i>Tirumala limniace</i>	Pieter Cramer		22
36	Striped Tiger	<i>Danaus genutia</i>	Pieter Cramer		21
37	Plain Tiger	<i>Danaus chrysippus</i>	Carl Linnaeus		23
38	Glassy Tiger	<i>Parantica aglea</i>	Caspar Stoll		24
39	Anomalous Nawab	<i>Polyura agraria</i>	Dru Drury	Nymphalidae	6
40	Common Evening Brown	<i>Melanitis leda</i>	Carl Linnaeus		29
41	Common Threering	<i>Ypthima asterope</i>	Klug		3
42	Common Fourring	<i>Ypthima huebneri</i>	Kirby		4
43	Tawny Coster	<i>Acraea violae</i>	Carl Linnaeus		10
44	Common Leopard	<i>Phalanta phalantha</i>	Dru Drury		32
45	Common Sailer	<i>Neptis hylas</i>	Carl Linnaeus		11
46	Baronet	<i>Euthalia nais</i>	Forster		21
47	Blue Pansy	<i>Junonia orithya</i>	Carl Linnaeus		25
48	Yellow Pansy	<i>Junonia hierta</i>	Johan Christian Fabricius		11
49	Chocolate Pansy	<i>Junonia iphita</i>	Pieter Cramer		12
50	Grey Pansy	<i>Junonia atlites</i>	Carl Linnaeus		9
51	Lemon Pansy	<i>Junonia lemonias</i>	Carl Linnaeus		34

TABLE 1: Continued.

Serial number	Name	Scientific name	Author name of species	Family	Abundance
52	Great Eggfly	<i>Hypolimnas bolina</i>	Carl Linnaeus		19
53	Danaid Eggfly	<i>Hypolimnas misippus</i>	Carl Linnaeus		17
54	Autumn Leaf	<i>Doleschallia bisaltide</i>	Pieter Cramer		2
55	Common Crow	<i>Euploea core</i>	Pieter Cramer		12

TABLE 2: Results of different ecological indices for different habitats.

Ecological indices	Open scrub	Dry deciduous habitat	Urbanized habitat
Evenness (<i>J</i>)	0.94	0.96	0.93
Species richness (<i>S</i>)	52	49	44
Total abundance	359	277	179
Shannon-Wiener diversity index (<i>H</i>)	3.76	3.74	3.53

highest number of shared species (47 species), as these areas are relatively more rich in food resources in terms of nectars for butterflies. Species community structure was different among habitats, but rather similar in the open scrub and dry deciduous habitat. Many species of butterflies depend on remnant vegetation or secondary forest for survival, especially in urban areas [15, 16]. So for the conservation of species in human dominated landscape, any institutional campus maintaining high plant diversity and different types of habitats is a good option.

Conflict of Interests

The author declares that there is no conflict of interests regarding the publication of this paper.

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