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BUTTERFLY ABUNDANCE AND SPECIES DIVERSITY IN SOME URBAN HABITATS

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Abstract

Butterflies are important bioindicators which should be protected to conserve the biodiversity and environment. Different species of plants and habitats of Jhansi city attract wide variety of butterfly fauna, which play a vital role in pollination of various flowering plants besides a key component of food chain. The investigation on species diversity and abundance was carried out in some distinct habitat types; within the Jhansi viz. gardens, parks (Nagar Nigam, University, and Jhansi fort), green areas of medical college and engineering college, road sites and hilly areas. Regular survey was conducted from December 2010 to November 2011 during day time (7.00AM-11.00AM). Nine hundred and forty eight individuals of butterflies collected from various study sites, which include 38 identified species belonged to 29 genera and Six families viz., Nymphalidae-Brush-footed Butterfly family was the most dominant with 11 species followed by Pieridae-White and yellows (10), Lycaenidae-Blues (6), Danaidae-The tigers (4), Hesperidae-Skippers (4), Papilionidae-Swallotails (3). During work five urban habitats of Jhansi were selected for extensive sampling to determine the butterflies. The diversity was calculated by using diversity indices namely: Simpson's index (D), (1-D), (1/D), Margalef's index (d) and Shannon-Wiener index (H'). The calculated values of diversity indices showed that from district Jhansi the highest diversity was obtained from Jhansi fort and lowest diversity was obtained from Medical College. All sites were selected on the basis of their position in vegetation and accessibility.

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INTRODUCTION

Butterflies are the most beautiful and colorful creatures on the earth and have a great aesthetic value. More than 17000 species of butterfly are found all over world of these India is home to about 1501 species of butterfly which constitute 65% of total Indian fauna. Various ecosystems of our country support different species of butterfly. The Western Ghats alone support 330 species, out of which 48 are endemic to Nilgiri Biosphere reserve. About 50% of butterfly species of India is found in the state of Assam. The exact status of butterflies particularly of northern and central region of India is still not clearly known due to lack of proper study.

Among insects, butterflies are certainly most popular and eminent group. Butterflies occupy a vital position in ecosystems and their occurrence and diversity are considered as good indicators of the health of any given terrestrial biotope (Aluri and Rao, 2002; Kunte, 2000). Butterflies and moths (order Lepidoptera) offer good opportunities for studies on population and community ecology (Pollard, 1991).

India hosts about 1,504 species of butterflies (Tiple, 2011) of which peninsular India hosts 351 and the western Ghat 334. In central India the butterfly species diversity was reported earlier by D'Abreu (1931) and documented total 177 species occurring in the erstwhile Central Provinces (now Madhya Pradesh and Vidarbha). Some habitats

components that influence the patterns of the butterfly diversity are determined by abiotic and biotic factors such as vegetation including host plants, food availability, temperature and wind exposure (Khan et al. 2004; Jain and Jain, 2012; Kharat et al. 2012; Kumaraswamy and Kunte. 2013). In open grassy habitats we can find the major components of butterfly diet, which include flower nectar, sap, fruit juices, carrion, scat and wetland moisture (Weber, 2002). The resources such as host plants and food sources for butterflies available in grassy areas make them indispensable sites for their survival and consequently for our survey.

Kumar, 2011, 2012 total of species 23 belonging to 4 families and 27 species belonging to 5 families respectively were detected from the different sites of in and around Jhansi. Singh, 2009 a total of 3617 individuals of 147 species of butterflies were recorded during 11 sampling surveys out in Kedranath musk deer reserve, Garhwal Himalaya. Seventy species of butterflies belonging to 45 genera were recorded in the regional research laboratory campus, Jorhat, Assam, maximum number of species were observed in the family Nymphalidae (40), followed by Papilionidae (12), Pieridae (10), Lycaenidae (5) and Hesperidae (3) observed by Bhuyan et al. 2005. In Bir Shikargarh Wildlife Sanctuary, Haryana, a total of 24 butterfly species belonging to four families viz Nymphalidae, Papilionidae, Pieridae and Lycaenidae were documented during the survey (Uniyal and Bhargava, 2007).

The present study was started with a view to examine the diversity and dynamics of butterfly population across seasons and some urban habitats in Jhansi. Despite its limitations, this study did attempt, perhaps for the first time, butterfly monitoring in central India with wide objectives of study.

MATERIALS AND METHODS

Study sites, collection and identification

Jhansi, the gateway of Bundelkhand is located in the plateau of central India at 25° 26'N and 78° 34'E latitude. This region has tropical dry equable climate having three main seasons i.e. cold, summer and rainy. Survey of five sites University Campus, Medical College, Narayan Bagh, Jhansi Fort, and Bundelkhand institute of engineering and technology was done for butterfly sampling for one year from December 2010 to November 2011. All surveys and sampling were limited to day time from 7.00 am to 11.00 am, when butterflies were more active. Temperature and humidity were also recorded.

During the survey butterflies were caught using an aerial net, then transferred to killing jars, are used as a sort of "small scale fumigation" to kill collected butterflies as rapidly as possible, using a liquid fumigant or killing agent (ethyl acetate) that produces a toxic atmosphere that the butterfly cannot breathe. The captured butterflies were brought to the laboratory and their wings were spread on the spreading board and these butterflies were stored in insect boxes by pinning them. And then the dried specimens were kept in insect boxes for study and future reference. Butterflies were identified based on standard monographs of Wynter-Blyth 1957; Kunte 1996, 1997 & 2000.

Statistical Analysis

The diversity was calculated by using diversity indices namely: Simpson's index (D), (1-D), 1/D (1949), Margalef's index (d) (1969) and Shannon-Wiener index (H') (1963). The formula for calculating Simpson's index (D) is

presented as: $D = \frac{\sum n_i(n_i - 1)}{N(N - 1)}$ where n_i = the total number of organisms of each individual species N = the total

number of organisms of all species. The form of the Margalef's index used is: $d = S - 1 / \log_e N$, Where, S is the number of species and N is the total number of individuals. The form of the Shannon-Wiener index used is: $H' = -\sum p_i \ln p_i$ where, p_i is the proportion within the sample of the number of individuals of i^{th} species and it is n_i/N , Where n_i is number of individuals in i^{th} species and N is the total number of individuals.

RESULTS AND DISCUSSION

Nine hundred and forty eight individuals of butterflies collected from various study sites, which include 29 genera and 38 identified species belonging in six families (Table-1). Nymphalidae-Brush-footed Butterfly family was the most dominant with 11 species followed by Pieridae-White and yellows (10), Lycaenidae-Blues (6), Danaidae-The tigers (4), Hesperidae-Skippers (4), Papilionidae-Swallotails (3).

In University Campus 179 butterflies belong to 38 species collected, these are *Atella phalanta* (4), *Precis lemonias* (1), *Precis orithya* (2), *Precis hierta* (2), *Precis atlites* (4), *Hypolimnas missipus* (2), *Hypolimnas bolina* (2), *Argynnis hyperbius* (4), *Euthalia nais* (3), *Ergolis merione* (1), *Byblia lithyia* (4), *Ixias marianne* (21), *Catopsilia pyranthe* (3), *Catopsilia florella* (3), *Eurema brigitta* (36), *Catopsilia crocale* (6), *Anaphaeis aurota* (8),

Cepora nerissa (5), Colotis fausta (2), Terias laeta (2), Terias hecabe (2), Chilades prrhasius (6), Zizina otis (2), Catochrysops strabo (2), Lampides boeticus (6), Tarucus extricatus (3), Azanus jesous (4), Danaus genutia (5), Danaus chrysippus (6), Tirumala limniace (3) Euploea core (3), Udaspes folus (4), Telicota ancila (3), Tatractrocera maevius (4), Potanthus confucius (2), Papilio demoleus (4) Papilio ploytes (4), Pachliopta aristolochiae (1); in medical college Campus 175 butterflies belong to 35 species recorded, these are Atella phalanta (2), Precis lemonias (2), Precis orithya (4), Precis hierta (3), Precis atlites (5), Hypolimnas missipus (3), Hypolimnas bolina (4), Argynnis hyperbius (6), Euthalia nais (5), Byblia ilithyia (3), Ixias marianne (17), Catopsilia pyranthe (4), Catopsilia florella (5), Eurema brigitta (39), Catopsilia crocale (1), Anaphaeis aurota (3), Cepora nerissa (6), Colotis fausta (3), Terias laeta (4), Terias hecabe (5), Chilades prrhasius (2), Catochrysops strabo (2), Lampides boeticus (4), Azanus jesous (2), Danaus genutia (2), Danaus chrysippus (4), Tirumala limniace (3) Euploea core (6), Udaspes folus (6), Telicota ancila (1), Tatractrocera maevius (5), Potanthus confucius (4), Papilio demoleus (6) Papilio ploytes (3), Pachliopta aristolochiae (2); in Jhansi Fort 173 butterflies belong to 37 species recorded, these are Atella phalanta (3), Precis lemonias (8), Precis orithya (1), Precis hierta (5), Precis atlites (8), Hypolimnas missipus (3), Hypolimnas bolina (2), Argynnis hyperbius (2), Euthalia nais (4), Ergolis merione (2), Byblia ilithyia (5), Ixias marianne (17), Catopsilia pyranthe (3), Catopsilia florella (2), Eurema brigitta (32), Catopsilia crocale (2), Anaphaeis aurota (1), Cepora nerissa (8), Colotis fausta (1), Terias laeta (3), Terias hecabe (2), Chilades prrhasius (2), Zizina otis (1), Lampides boeticus (7), Tarucus extricatus (1), Azanus jesous (5), Danaus genutia (4), Danaus chrysippus (6), Tirumala limniace (2) Euploea core (5), Udaspes folus (8), Telicota ancila (1), Tatractrocera maevius (3), Potanthus confucius (4), Papilio demoleus (5) Papilio ploytes (4), Pachliopta aristolochiae (1); in Narayan Bagh 257 butterflies belong to 37 species recorded, these are Atella phalanta (5), Precis lemonias (2), Precis orithya (11), Precis hierta (6), Precis atlites (10), Hypolimnas missipus (4), Hypolimnas bolina (4), Argynnis hyperbius (5), Euthalia nais (7), Byblia ilithyia (6), Ixias marianne (33), Catopsilia pyranthe (3), Catopsilia florella (4), Eurema brigitta (51), Catopsilia crocale (3), Anaphaeis aurota (3), Cepora nerissa (6), Colotis fausta (1), Terias laeta (4), Terias hecabe (6), Chilades prrhasius (2), Zizina otis (3), Catochrysops strabo (3), Lampides boeticus (8), Tarucus extricatus (1), Azanus jesous (7), Danaus genutia (8), Danaus chrysippus (1), Tirumala limniace (5) Euploea core (7), Udaspes folus (9), Telicota ancila (2), Tatractrocera maevius (6), Potanthus confucius (6), Papilio demoleus (8) Papilio ploytes (6), Pachliopta aristolochiae (1) and in Bundelkhand institute of engineering and technology 164 butterflies belongs to 37 species recorded, these are Atella phalanta (3), Precis lemonias (2), Precis orithya (8), Precis hierta (7), Precis atlites (4), Hypolimnas missipus (2), Hypolimnas bolina (3), Argynnis hyperbius (3), Euthalia nais (4), Ergolis merione (2), Byblia ilithyia (2), Ixias marianne (12), Catopsilia pyranthe (4), Catopsilia florella (3), Eurema brigitta (28), Catopsilia crocale (4), Anaphaeis aurota (3), Cepora nerissa (7), Colotis fausta (1), Terias laeta (3), Terias hecabe (3), Chilades prrhasius (3), Zizina otis (2), Catochrysops strabo (4), Lampides boeticus (4), Tarucus extricatus (2), Azanus jesous (3), Danaus genutia (6), Danaus chrysippus (2), Tirumala limniace (4), Euploea core (8), Udaspes folus (2), Telicota ancila (2), Tatractrocera maevius (3), Potanthus confucius (2), Papilio demoleus (4) Papilio ploytes (4).

Ergolis merione is not found in both medical college campus and Narayan Bagh. Zizeeria otis and Tarucus extricates are also not found in medical college campus. Catochrysops Strabo, Pachliopta aristolochiae are not found in Jhansi Fort and Bundelkhand institute of engineering and technology respectively. (Table-1 & 2). During the survey 209 butterflies (22.04%), 7 genera (24.13%), 11 species (28.94%); 428 butterflies (45.14%), 7 genera (24.13%), 10 species (26.31%); 91 butterflies (9.59%), 6 genera (20.68%), 6 species (15.78%); 90 butterflies (9.49%), 3 genera (10.34%), 4 species (10.52%); 77 butterflies (8.12%), 4 genera (13.79%), 4 species (10.52%) and 53 butterflies (5.59%), 2 genera (6.89%), 3 species (7.89%) are recorded in family Nymphalidae-Brush-footed butterfly, Pieridae-White and yellows, Lycaenidae-Blues, Danaidae-The tigers, Hesperidae-Skippers and Papilionidae-Swallotails respectively (Table-3)

The localities which yielded higher diversity (University campus and Narayan bagh) have very dense vegetation and abundant flowering plants and high trees which provide very favorable habitat to the butterflies. Their larvae can easily find the host plants and the dense vegetation provide excellent shelter to the adult butterflies, particularly during the summer The Calculated values of this index showed that butterflies are more or less equally distributed at all the localities of district Jhansi because the statistics data did not show the much difference among the sites (Table-2)

Shannon-Wiener index (H'). Component ranged from 1.4387 (Medical college) to 1.5989 (Jhansi fort), indicating that the lowest equitability was calculated from Medical college and the highest diversity was calculated from Jhansi fort. Both the values indicate that the butterfly fauna is more or less evenly distributed at all the localities of Jhansi. (Table-2). The calculated values of Margalef's index at the different localities of Jhansi city

ranged from 23.7806 (Bundelkhand institute of engineering and technology) to 37.3488 (Narayan Bagh), indicating that butterflies are more abundant at Narayan Bagh and less Abundant at Bundelkhand institute of engineering and technology, remaining all the habitats show more or less the same abundance (Table-2) Simpson's index give the species abundance and diversity by D. As D increase diversity decrease and the Simpson's index is usually express as 1-D or 1/d. This index is heavily weighted towards the most abundant species and being less sensitive to species richness.

The calculated values of Simpson's index D ranged from .2552 (Narayan Bagh) to .3084 (Medical college). The calculated values of 1-D ranged from .6916 (Medical college) to .7440 (Jhansi fort). Similarly 1/D ranged from 3.2425 (Medical college) to 3.906 (Jhansi fort). This index showed that the lowest abundance was obtained from Medical College and the highest abundance was obtained from Narayan Bagh. The flora of the Narayan Bagh is densely rich which supported high diversity whereas, at Medical College lower diversity was due to reason that the difficult terrain could not be sampled properly

Similar studies have been conducted in other part of India, like in the Kerala (Nair, 2002), Poonch and Sudhnoti, Azad Kashmir (Khan, et al. 2004), Birshikargarh wildilife sanctuary, Haryana (Uniyal and Bhargav, 2007), Nashik and Dhuledistricts Maharashtra (Kharat, et al. 2012), Jhansi, Uttar Pradesh (Kumar, 2011 & 2012, Kumar & Ratnakar, 2013) and Hadoti region, Rajasthan (Jain & Jain, 2012); It is likely that relative impoverishment of the present butterfly fauna of four sites of Jhansi is due to the much greater extend and persistence of rural man and livestock-related deforestation (Versteeg and Ruiz, 1995; Beers et al. 1997). In the recent past, several researchers have studied butterflies from some districts and conservation areas of Madhya Pradesh and Chhattisgarh (Singh, 1977; Gupta, 1987; Chaudhury, 1995; Chandra et al., 2000a, b; 2002; Singh & Chandra, 2002; Siddiqui & Singh, 2004; Chandra, 2006; Tiple, 2012). Chandra et al. (2007) recorded 174 species of butterflies belonging to eight families from Madhya Pradesh and Chhattisgarh. The study sites representing habitats under different vegetation communication and levels of disturbance were selected (Table-4). Level of disturbances was determined by observing the various anthropogenic activities in different study sites during the investigation period.

The present study is the first of this type of study in the area. Therefore, it is very difficult to say whether the diversity of butterflies in the area is increasing or decreasing. Therefore, it is suggested that the area under the study should be continuously monitored to observe any change in the discovery of butterflies, because the changes in the diversity can only observed through continuous monitoring and comparing the data of every year. As the district was undergoing urbanizing many new residential colonies were getting established. Establishing residential colonies means cutting of trees and other supporting plants for shelter of butterflies, in turn increasing pollution, soil erosion etc. All these factors add up destruct the natural habitat. Despite the dry weather of Jhansi district, occurrence of 38 species was a vital sign of healthy biodiversity. In order to maintain and further enhance this picture it is necessary to conserve the biodiversity for achieving sustainable development.

Table 1. Checklist of butterfly species recorded from different study sites in Jhansi

S.No.	Family/Genera/Species	Common name	U.C.	M.C.	J.F.	N.B	BIET
	Nymphalidae / 7 / 11						
1	Atella phalanta	Common leopard	4	2	3	5	3
2	Precis lemonias	Lemon pansy	1	2	8	2	2
3	Precis orithya	Blue pansy	2	4	1	11	8
4	Precis hierta	Yellow pansy	2	3	5	6	7
5	Precis atlites	Grey pansy	4	5	8	10	4
6	Hypolimnas missipus	Danaid eggfly	2	3	3	4	2
7	Hypolimnas bolina	Great eggfly	2	4	2	4	3
8	Argynnis hyperbius	Indian fritillary	4	6	2	5	3
9	Euthalia nais	Baronet	3	5	4	7	4
10	Ergolis merione	Common castor	1	-	2	-	2

11	Byblia ilythia	Joker	4	3	5	6	2
	Pieridae / 7/ 10						
12	Ixias marianne	White orange tip	21	17	17	33	12
13	Catopsilia pyranthe	Mottled emigrant	3	4	3	3	4
14	Catopsilia florella	African emigrant	3	5	2	4	3
15	Eurema brigitta	Small grass yellow	36	39	32	51	28
16	Catopsilia crocale	Common emigrant	6	1	2	3	4
17	Anaphaeis aurota	Pioneer	8	3	1	3	3
18	Cepora nerissa	Common gull	5	6	8	6	7
19	Colotis fausta	Large salmon arab	2	3	1	1	1
20	Terias laeta	Spotless grass yellow	2	4	3	4	3
21	Terias hecabe	Common grass yellow	2	5	2	6	3
	Lycaenidae / 6 / 6						
22	Chilades prrhasius	Small cupid	6	2	2	2	3
23	Zizeeria otis	Lesser grass blue	2	–	1	3	2
24	Catochrysops strabo	Forget me not	2	2	–	3	4
25	Lampides boeticus	Pea blue	6	4	7	8	4
26	Tarucus extricatus	Rounded pierrot	3	–	1	1	2
27	Azonus jesous	African babul blue	4	2	5	7	3
	Danaide /3 /4						
28	Danais genutia	Striped tiger	5	2	4	8	6
29	Danais chrysippus	Plain tiger	6	4	6	1	2
30	Tirumala limniace	Blue tiger	3	3	2	5	4
31	Euploea core	Common crow	3	6	5	7	8
	Hespiridae / 4 / 4						
32	Udaspes folus	Grass Demon	4	6	8	9	2
33	Telicota ancila	Dark Palm Dart	3	1	1	2	2
34	Taractrocera maevius	Common Grass dart	4	5	3	6	3
35	Potanthus confucius	Tropic dart	2	4	4	6	2
	Papilionidae / 2/ 3						
36	Papilio demoleus	Lime butterfly	4	6	5	8	4
37	Papilio ploytes	Common Mormon	4	3	4	6	4
38	Pachliopta aristolochiae	Common rose	1	2	1	1	–

- U.C. — University Campus
- M.C. — Medical College

- **N.B.** – Narayan Bagh
- **J.F.**-Jhansi Fort
- **BIET.** — Bundelkhand institute of engineering and technology

Table-2: Calculated values of Diversity indices different Habitats of Jhansi

Sr.NO.	Name of Sites	Total species	Simpson's index (D)	Simpson's index (1-D)	Simpson's index (1/D)	Margalef's index (d)	Shannon-Wiener index(h)
1	U.C.	179	.2973	.7027	3.3636	25.9690	1.4503
2	M.C.	175	.3084	.6916	3.2425	25.3855	1.4387
3	J.F.	173	.2560	.7440	3.906	25.0937	1.5989
4	N.B.	257	.2552	.7248	3.6337	37.3488	1.506
5	BIET	164	.2563	.7437	3.9016	23.7806	1.511

Table 3. Total Number and percentage of individuals, genera and species indifferent family

S.No.	Family	No./percentage of individuals	No./Percentage of genera	No. /Percentage of species
1	Nymphalidae	209/22.04	7/24.13	11/28.94
2	Pieridae	428/45.14	7/24.13	10/26.31
3	Lycaenidae	91/9.59	6/20.68	6/15.78
4	Danaide	90/9.49	3/10.34	4/10.52
5	Hespiridae	77/8.12	4/13.79	4/10.52
6	Papilionidae	53/5.59	2/6.89	3/7.89
	TOTAL	948	29	38

Table 4. Anthropogenic activities in four selected sites.

S.No.	Sites	Activities
1	U.C.	Visitors (students and their relatives),noise, insecticide application
2	M.C.	Visitors (students, Patients),noise, insecticide application
3	J.F.	Visitors (tourist, staff), noise
4	N.B.	Gardening, manuring, watering, visitors, picnic
5	BIET	Visitors (students, staff), noise

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