International Journal of Zoology Studies
ISSN: 2455-7269; Impact Factor: RJIF 5.14
Received: 04-11-2019; Accepted: 06-12-2019
www.zoologyjournals.com
Volume 5; Issue 1; January 2020; Page No. 10-14

Distribution and status of butterfly (Order: Lepidoptera) fauna with some habitats in Lucknow city, India

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Abstract
Butterflies are one of the most admired insects because they present brilliant pattern of coloration, metamorphosis birth and striking reproduction, nutrition behavior and death. The wide distribution of butterflies in the study site is an important element in the dynamic of this urban ecosystem. The butterflies are recognized by the scientific community as bio indicator as well as good pollinator. Regular survey was conducted from September 2016 to August 2017 during day time (7.00AM-11.00AM). Nine hundred and thirty individuals of butterflies have seen from various study sites, which include 35 identified species belonged to 27 genera and 6 families *viz*., Nymphalidae-Brush-footed Butterfly family was the most dominant with 12 species followed by Pieridae-White and yellows (8), Lycaenidae-Blues (5), Danaidae-The tigers (5), Hespiridae-Skippers (2), Papilionidae-Swallotails (3). The calculated values of population of butterflies showed that from district Lucknow the highest diversity was obtained from SS-3 and lowest diversity was obtained from SS -4. All sites were selected on the basis of their position in vegetation and accessibility.

Keywords: butterfly, lepidoptera, population, urban habitats, dominant index

Introduction
Butterflies are the most beautiful and attractive than other insects and have fascinated human imagination and creativity, no group of insects is more charismatic than the order lepidoptera. The butterflies are valuable as pollinators when they move from plant to plant. Many of butterfly species are strictly seasonal and prefer only a particular set of habitats (Kunte, 1997) [25] and they are good indicators in terms of anthropogenic disturbance and habitat quality (Kocher and Williams, 2000) [18]. Butterflies are called day-flying insects which are in the order of Lepidoptera, Lepidos means "scales" and Ptera means "wings". The order Lepidoptera is ecologically very important. The adult butterflies generally feed on nectar and serve as important pollinators of flowering plants and their larvae feed on foliage frequently as the primary herbivores in ecosystems and are important in the transfer of radiant energy fixed by plants, making it available to the other organisms in the ecosystem. Butterflies are potentially useful ecological indicators of urbanization because sensitive to changes in microclimate, temperature (Thomas *et al*., 1998) [36]. Increased urbanization one of the main cause of decreases in butterfly species richness, diversity and abundance (Blair and Launer, 1997 [3]; Clark *et al*., 2007 [10]; Pocewicz *et al*., 2009) [31]. The reduction in amount and quality of natural habitat associate with urban development negatively affect nature biodiversity (Malagrino *et al*., 2008) [29].
India hosts about 1,504 species of butterflies (Tiple, 2011) [37] 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) [11] 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 determine by abiotic and biotic factors such as vegetation including host plants, food availability, temperature and wind exposure (Khan etal. 2004 [16]; Jain and Jain, 2012 [14]; Kharat *et al*. 2012 [17]; Kumaraswamy and Kunte. 2013) [24]. In open grassy habitats we can find the major components of butterflies 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 survivor and consequently for our survey
Kumar, 2011, 2012 & 2014 [19, 20, 21,], species 23 belonging to 4 families, 27 species belonging to 5 families and 38 species belonging to 6 families respectively were detected from the different sites of in and around Jhansi. Singh, 2009 [33] a total of 3617 individuals of 147 species of butterflies were recorded during 11 sampling survey out in Kedranath musk deer reserve, Garhwal Himalaya. Bhuyan etal. 2005 [2] total 70 species of butterflies belonging to 45 genera and 5 family were recorded in the regional research laboratory campus, Jorhat, Assam. In Bir Shikargarh Wildlife Santury, Haryana, a total of 24 Butterflies species belonging to four families *viz* Nymphalidae Papilionidae, Pieridae and Lycaenidae were documented during the survey (Uniyal and Bhargav, 2007) [39]. In 5 urban forest fragments at Lucknow total 643 butterflies belonging to 5 family of 26 genera were observed by Kumar and Rana, 2018. The present study was conducted for diversity and status of the butterfly across the year with different seasons in four urban habitats at Lucknow.

Materials and Methods
Lucknow is capital of Uttar Pradesh and geographical position is 26.84'N latitude and 80.92'E longitude, located at on elevation of 126 meters above sea level and in the plain of northern India, Lucknow has diverse weather

patterns and climate change. Four contrasting forest areas were chosen in the present study depending upon the plant diversity. SS -1 (College Campus), SS-2 (Bijli Pasi Quila), SS-3 (Buddha Park) and SS -4 (Vrindavan Colony), and. The butterfly fauna was Surveyed from September 2016 to August 2017. All surveys and sampling were limited to day time from 7.00 am to 11.00 am, when butterflies were more active. The butterflies were collected with the help of insect net. Photographs was also captured by using of handy camera. Collected adult butterflies were killed in killing bottle by using ethyl acetate, stretched and preserved in insect box. Photographs and preserved butterflies were identified using the available literature. Wynter-Blyth 1957 [43]; Kunte 2000; 2001 [26, 27], Makris 2003 [28], Varshney 2010 [40].

Results and Discussion

Nine hundred and thirty individuals of butterflies collected from various study sites, which include 27genera and 35 identified species belonging in six families (Table-1). Nymphalidae-Brush-footed Butterfly family was the most dominant with 12 species followed by Pieridae-White and yellows (8), Lycaenidae-Blues (5), Danaidae-The tigers (5), Hespiridae-Skippers (2), Papilionidae-Swallotails (3).

In SS-1 241 butterflies belong to 27 genera and 35 species collected, these are Atella phalanta (1), Precis lemonias (2), Precis orithya (4), Precis hierta (2), Cethosia cyane (3), Hypolimnas missipus (11), Hypolimnas bolina (15), Byblia ilithyia (11), Ergolis Ariadne (6), Ergolis merione (2), Argynnis children (5), Argynnis hyperbius (4), Ixias marianne (41), Catopsilia pyranthe (2), Eurema brigitta (46), Terias libythea (3), Catopsilia crocale (3), Terias hecabe (2), Pieris brassicae (18), Colotis fausta (2), Chilades contracta (2), Zizeeria Otis (3), Catochrysops Strabo (3), Lampides boeticus (2), Azanus jesous (4), Danais limniace (4), Danais Melissa (5), Euploea core (6), Euploea alcathoe (3), Hestia lynceus (2), Udaspes folus (7), Taractrocera maevius (5), Papilio demoleus (5), Zetides Agamemnon (3) and Tros aristolochiae (2) in SS-2 247 butterflies belong to 27 genera and 35 species recorded, these are Atella phalanta (3), Precis lemonias (2), Precis orithya (7), Precis hierta (2), Cethosia cyane (4), Hypolimnas missipus (7), Hypolimnas bolina (6), Byblia ilithyia (7), Ergolis ariadne (7), Ergolis merione (4), Argynnis children (2), Argynnis hyperbius (5), Ixias Marianne (20), Catopsilia pyranthe (1), Eurema brigitta (43), Terias libythea (2), Catopsilia crocale (5), Terias hecabe (6), Pieris brassicae (9), Colotis fausta (2), Chilades contracta (12), Zizeeria Otis (8), Catochrysops strabo (7), Lampides boeticus (6), Azanus jesous (7), Danais limniace (9), Danais melissa (8), Euploea core (7), Euploea alcathoe (6), Hestia lynceus (3), Udaspes folus (9), Taractrocera maevius (11), Papilio demoleus (5), Zetides Agamemnon (4) and Tros aristolochiae (4) in SS-3 243 butterflies belong to 26 genera 34 species recorded, these are Precis lemonias (2), Precis orithya (12), Precis hierta (1), Cethosia cyane (4), Hypolimnas missipus (8), Hypolimnas bolina (14), Byblia ilithyia (11), Ergolis Ariadne (7), Ergolis merione (3), Argynnis children (4), Argynnis hyperbius (12), Ixias Marianne (13), Catopsilia pyranthe (2), Eurema brigitta (42), Terias libythea (2), Catopsilia crocale (4), Terias hecabe (2), Pieris brassicae (3), Colotis fausta (2), Chilades contracta (3), Zizeeria Otis (4), Catochrysops Strabo (4), Lampides boeticus (17), Azanus jesous (5), Danais limniace (7), Danais Melissa (8), Euploea core (7), Euploea alcathoe (5), Hestia lynceus (2), Udaspes folus (8), Taractrocera maevius (11), Papilio demoleus (7), Zetides Agamemnon (4) and Tros aristolochiae (3) and in SS-4 199 butterflies belong to 26 genera and 32 species recorded, these are Atella phalanta (1), Precis orithya (4), Precis hierta (1), Cethosia cyane (2), Hypolimnas missipus (4), Hypolimnas bolina (8), Byblia ilithyia (4), Ergolis Ariadne (6), Argynnis children (2), Argynnis hyperbius (14), Ixias Marianne (18), Catopsilia pyranthe (4), Eurema brigitta (27), Catopsilia crocale (2), Terias hecabe (5), Pieris brassicae (8), Colotis fausta (3), Chilades contracta (8), Zizeeria Otis (1), Catochrysops Strabo (3), Lampides boeticus (5), Azanus jesous (4), Danais limniace (7), Danais Melissa (7), Euploea core (7), Euploea alcathoe (8), Hestia lynceus (1), Udaspes folus (7), Taractrocera maevius (12), Papilio demoleus (6), Zetides Agamemnon (4) and Tros aristolochiae (4). Ergolis merione and Terias libythea is not found in SS-4, Atella phalanta and Precis lemonias are not found in SS-3 and SS-4 respectively. (Table-2). During the survey the family wise dominant indices are Nymphalidae-Brush-footed butterfly 246 butterflies (26.45%), 7 genera (25.92%), 12species (34.28%); Pieridae-White and yellows 341 butterflies (36.66%), 7 genera (25.92%), 8 species (22.85%); Lycaenidae-Blues 110 butterflies (11.82%), 5 genera (18.51%), 5 species (14.28%); Danaidae-The tigers 112 butterflies (12.04%), 4 genera (14.81%), 5 species (14.28%) Hespiridae-Skippers 70 butterflies (7.52%), 2genera (7.40%), 2 species (5.71%); and Papilionidae 51 butterflies (5.48%), 2 genera (7.40%), 3 species (8.57%) are recorded. (Table-1) The localities which yielded higher diversity (SS-1 and SS-2) 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 sites of Lucknow because the statistics data did not show the much difference among the sites. (Table-1) The lowest Pouplation of butterfly was calculated from SS-4 due to highest disturbance and the highest population was calculated from SS-3 due to lower disturbance. All the values indicate that the butterfly fauna is more or less evenly distributed at all the localities of Lucknow because it is running to developing city (Table-2). This index showed that the lowest abundance was obtained from SS-4 and the highest abundance was obtained from SS-3. The flora of the SS-3 is densely rich which supported high diversity whereas, SS-4 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 southern part Kerala (Nair, 2002) [30], in coastal area of cuddalore district, Tamil Nadu (Kanagaraj and Kathirvelu, 2018) [15]. Poonch and Sudhnoti northern Azad Kashmir (Khan, etal. 2004) [16], Birshikargarh wildilife sanctuary, Haryana (Uniyal and Bhargav, 2007) [39], Hadoti region, Rajasthan (Jain & Jain, 2012) [14]; western Nashikand Dhuledistricts Maharashtra (Kharat, etal. 2012) [17], Sakoli Taluka of Bhandara District, Maharashtra (Dharmik and Khaparde 2018) [12] and Jhansi, Uttar Pradesh (Kumar, 2011, 2012 & 2014 [19, 20, 21], Kumar & Ratnakar, 2013) [23]. 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 [41]; Beers etal. 1997) [1]. In the recent past, several researchers have studied butterflies from some districts and conservation areas of Madhya Pradesh and Chhattisgarh (Singh, 1977 [35]; Gupta, 1987 [13]; Chaudhury, 1995 [9]; Chandra *et al*., 2000a [6], b; 2002 [34]; Singh & Chandra, 2002 [34]; Siddiqui & Singh, 2004; Chandra, 2006; Tiple, 2012) [38]. Chandra *et al*. (2007) [8] 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-3). Level of disturbances was determined by observing the various human activities in different study sites during the investigation period. Therefore, it is very difficult to say whether the diversity of butterflies in the area is Increasing or decreasing and 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. Butterfly habitat specificity can be directly related to the availability of food plants but the study area is undergoing urbanizing many new residential colonies are 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 Lucknow district, occurrence of 35 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: Family wise dominant index of butterflies showing individuals, genera and species recorded from different sites

S.N.	Family	Total Individuals	Individuals (%)	Total Genera	Genera (%)	Total Species	Species (%)
1	Nymphalidae	246	26.45	7	25.92	12	34.28
2	Pieridae	341	36.66	7	25.92	8	22.85
3	Lycaenidae	110	11.82	5	18.51	5	14.28
4	Danaide	112	12.04	3	11.11	5	14.28
5	Hespiridae	70	7.52	2	7.40	2	5.71
6	Papilionidae	51	5.48	3	11.11	3	8.57
	Total	930		27		35	

Table 2: Site wise distribution of species according to their families

Families	S.N.	Scientific Name	Common Name	SS-1	SS-2	SS-3	SS-4	Abnce
Nymphalidae (7/12)	1	Atella phalanta	Common leopard	1	3	–	1	R
	2	Precis lemonias	Lemon pansy	2	2	2	-	R
	3	Precis orithya	Blue pansy	4	7	12	4	C
	4	Precis hierta	Yellow pansy	2	2	1	1	R
	5	Cethosia cyane	Leopard lacewing	3	4	4	2	C
	6	Hypolimnas missipus	Danaid eggfly	11	7	8	4	C
	7	Hypolimnas bolina	Great eggfly	15	6	14	8	C
	8	Byblia ilithyia	joker	11	7	11	4	C
	9	Ergolis ariadne	Angled Caster	6	7	7	6	C
	10	Ergolis merione	Common castor	2	4	3	-	R
	11	Argynnis childreni	Large silverstipe	5	2	4	2	C
	12	Argynnis hyperbius	Indian fritillary	4	5	12	14	C
Pieridae (7/8)	1	Ixias marianne	White orange tip	41	20	13	18	M.C.
	2	Catopsilia pyranthe	Mottled emigrant	2	1	2	4	C
	3	Eurema brigitta	Small grass yellow	46	43	42	27	M.C.
	4	Terias libythea	Small grass yellow	3	2	2	-	C
	5	Catopsilia crocale	Common emigrant	3	5	4	2	C
	6	Terias hecabe	Common grass yellow	2	6	2	5	C
	7	Pieris brassicae	Large cabbage white	18	9	3	8	C
	8	Colotis fausta	Large salmon arab	2	2	2	3	C
Lycaenidae (5/5)	1	Chilades contracta	Small cupid	2	12	3	8	C
	2	Zizeeria otis	Grass blue	3	8	4	1	R
	3	Catochrysops strabo	Forget me not	3	7	4	3	R
	4	Lampides boeticus	Pea blue	4	6	17	5	R
	5	Azanus jesous	African Babul blue	4	7	5	4	C
Danaidae 3/5	1	Danais limniace	Blue tiger	4	9	7	7	C
	2	Danais melissa	Dark blue tiger	5	8	8	7	C
	3	Euploea core	Common indian crow	6	7	7	7	C
	4	Euploea alcathoe	Striped black crow	3	6	5	8	C
	5	Hestia lynceus	Tree nymphs	2	3	2	1	R
Hespiridae (2/2)	1	Udaspes folus	Grass Demon	7	9	8	7	R
	2	Taractrocera maevius	Common Grass dart	5	11	11	12	R
Papilionidae (3/3)	1	Papilio demoleus	Lime butterfly	5	5	7	6	C
	2	Zetides agamemnon	Tailed Jay	3	4	4	6	R
	3	Tros aristolochiae	Common rose	2	4	3	4	C

SS-1- College Campus, SS-2- Bijli Pasi Quila, SS-3- Boddha Park, SS-4- Vrindavan Colony M.C.- Most common, C- Common, V.R. -Very rare, R – Rare, Abnce- Abundance

Table 3: Human activities in the sites.

S.N.	Sites	Activities
1	SS-1	Visitors (students and their relatives), noise, insecticide application
2	SS-2	Visitors (morning & evening walk), noise, Gardening, manuring, watering,
3	SS-3	Visitors (morning & evening walk, staff), noise, Gardening, manuring, watering, insecticide application
4	SS-4	Construction work, cutting of supporting plats, air pollution, soil erosion, noise

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