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Research Article

BUTTERFLY (LEPIDOPTERA: INSECTA) DIVERSITY FROM DIFFERENT SITES OF JHAGADIA, ANKLESHWAR, DISTRICT-BHARUCH, GUJARAT

Ashok Kumar#
Asst. Manager, EIA Division, En-Vision Enviro Engineers Pvt. Ltd.
208, G-Tower, Shankheshwar Complex, Sagrampura Surat-395002, Gujarat (India)
Corresponding Author's Email: asokumr@gmail.com
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Abstract: Lepidoptera is a large order of insects that includes moths and butterflies. Lepidoptera is the second largest order in the class Insecta. Some of the butterfly species were identified as indicators of disturbance in any area. The present study conducted in three sites of taluka Jhagadia, Ankleshwar, District-Bharuch, Gujarat. In the present study a total of 484 individuals belonging to 58 species of 9 families were identified. Among which Pieridae was found to be the most dominant family. The area of study having rich diversity of butterflies, therefore it should be of great importance for conservation.
Keywords: Abundance, Biodiversity, Butterfly, Lepidoptera.
Postal Address: Dr. Ashok Kumar C/O Mr. Gyanedra K. Rathoure, Mayashivraj Sadan Gupta Colony Hardoi-241001 Phone: 09450501471

INTRODUCTION

Lepidoptera is the second largest order in the class Insecta. Lepidoptera are regarded as one of the important component of biodiversity (New and Collins, 1991) and are the second largest order among insects made up of approximately 1, 50,000 species so far known to the literature. These include moth (Hetrocera) and butterflies (Rhopalocera) of which 70,820 are butterflies according to more recent estimate (Shields, 1989). Although several estimate have been made from time to time, ranging from a low of 13,000 (Owen, 1971) to the maximum of 20,000 (Vane Wrights, 1978) earlier. The butterflies are very well known for their beauty as they bear beautiful wings of various colours. They have slender bodies, the wings are held vertically when at rest, and the antennae are slender and club-like at the tips. They are day fliers. The degree of diversity depends upon the adaptability of a species to a particular micro habitat. The dimension, population size and diversity of the species are most significant biological elements of an ecosystem (Bliss, 1962). India is known for its rich heritage of biological diversity, having already documented over 89, 000 species of fauna (Alfred et al., 1997) and 45,000 species of flora (Mudgal and Hajra, 1999) in its 10 biogeographic regions. Mountains have been the home for various species of flora and fauna, diversified landscapes, different climatic conditions and equally for numerous small creatures like insects since time immemorial. India is one among the twelve mega–diversity countries of the world. The Indian sub continent (CISC) has about 1439 species of butterflies out of which 100 species are endemic to it and at least 26 taxa are today globally threatened as per the IUCN (1990) Red List of threaten animals and insects (Singh and Pandey, 2004). According to Gaonkar (1996) India hosts 1,501 species of butterflies, of which peninsular India hosts 350, and the Western Ghats, 331. Butterflies are sensitive biota which gets severely affected by the environmental variation and changes in the forest structure as they are closely dependent on plants (Pollard 1990 and Blair, 1999). They also react quickly to any kind of disturbance and changes in the habitat quality making a good indicator to study changes in the habitat and landscape structure variations (Blair, 1999). Here an attempt is made to understand how the distribution and variation in butterfly diversity changes in heterogenous habitats in various sites in the western Himalayan region. An area rich in biodiversity is of great importance for conservation. Butterflies form an important component of biodiversity. Apart from their aesthetic appeal, they are good pollinators. As butterflies are highly sensitive to any environmental change and are delicate creatures, they act as good bio-indicators of the health of a habitat. However these creatures are under a real threat due to various developmental activities leading to habitat changes. The protection of these creatures should be given priority (Sidhu; 2011).

MATERIALS AND METHODOLOGY

The present study was carried out during Pre-monsoon Season 15th March, 2012 to 14th June, 2012.

Study Area: The present study falls under Jhagadia, Ankleshwar district Bharuch of Gujrat state.

Site 1 Kharchi (S1): This study site was located approx 8 Kms radial from GIDC Jhagadia in WNW direction.

Site 2 Raneerpara (S2): This site was surrounded by thick vegetation and flowering plants in north direction. It was at road side where samples were collected.

Site 3 Limet (S3): This site was about 2 Kms radial from GIDC Jhagadia in south direction.

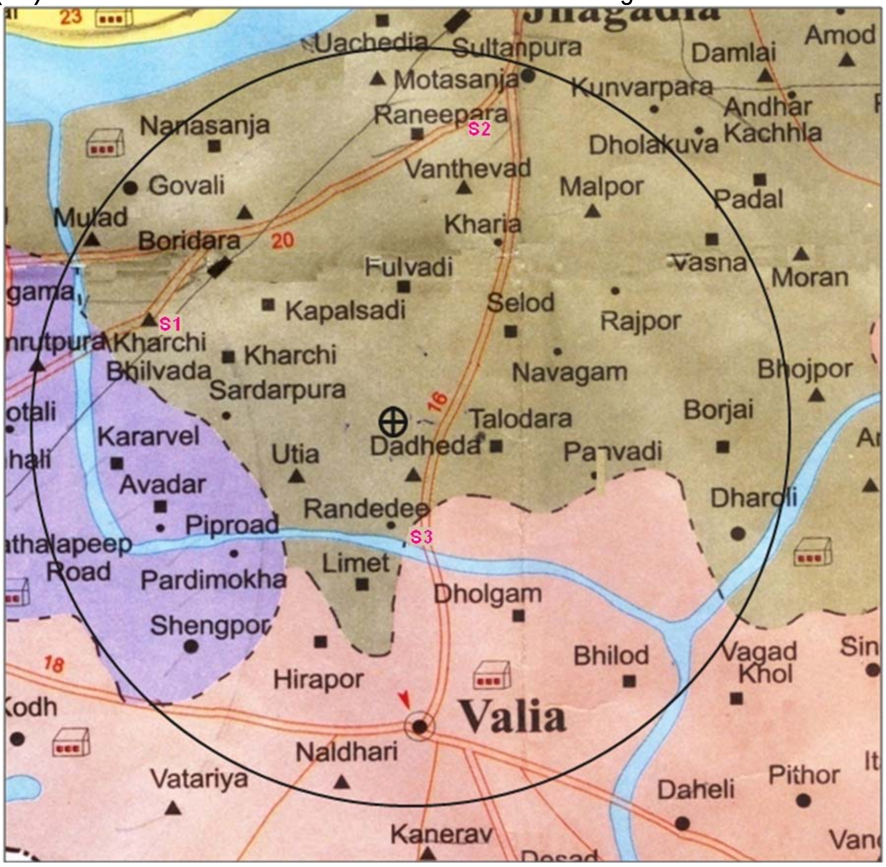

Figure 1. Study Area

Bharuch has a tropical savanna climate or tropical wet and dry climate, moderated strongly by the Arabian Sea. The summer begins in early March and lasts till June. April and May are the hottest months, the average maximum temperature being 40°C (104°F). Monsoon begins in late June and the city receives about 800 millimeters (31 in) of rain by the end of September, with the average maximum being 32°C (90°F) during those months. October and November see the retreat of the monsoon and a return of high temperatures till late November. Winter starts in December and ends in late February, with average temperatures of around 23°C (73°F). The four climatic seasons viz. pre-monsoon, monsoon, post-monsoon and winter could be considered as comprising of the following months:

Pre-monsoon : March, April and May
Monsoon : June, July, August and September
Post-monsoon : October and November
Winter : December, January and February

Sometimes, the monsoon commences in mid-June and ends in mid-September. Therefore, the boundaries between the seasons are not very rigid.

1. Abiotic Factors

The abiotic factors like temperature, humidity, wind and rainfall of an area have a great impact on the vegetation as well as on the fauna, particularly on the entomofauna. Keeping this fact in mind the temperature and humidity of the study area were recorded on each sampling date with the help of a thermo hygrometer. The monthly variations in all the two parameters for four months have been presented in Table-1.

2. Collection of Insect Samples and Preservation

An extensive and regular monthly collection of entomofauna was made during 15th March, 2012 to 14th June, 2012. Collection of insects was carried out using the Hand picking method; net sweeping method and tree beating method (Jonathan, 1990; Arora, 1990 and Ghosh, 1990 respectively). Net sweeping were carried out to collect the insects. The collected insects were transferred into bottles containing ethyl acetate soaked cotton. All the specimens were brought to the laboratory for further studies. The specimens were stretched, pinned and oven dried at 600C for 72 hour and then set into wooden boxes and labelled. The specimen which could not be identified on the basis of available keys.

3. Measuring diversity of Butterflies

Diversity indices provide important information about rarity and commonness of species in a community. The ability to quantify diversity in this way is an important tool for biologists trying to understand community structure (Beals, 1999). The insect data collected in the field over the study period was analyzed and charted for species richness (the number of species), abundance (the number of individuals) and equitability (evenness) using a diversity index.

RESULTS AND DISCUSSION

(1) Temperature: The maximum temperature was recorded in the month of June in all study sites whereas minimum temperature was recorded in the month of March. The data has been presented in Table 01. In the insect life temperature is one of the most critical factors. Insects are cold-blooded so that within narrow limits their body temperature is the same as that of the surroundings medium except for a few unusual instances. Insects are unable to control the temperature of their medium; instead they have physiological adjustments that enable each species to survive temperature extremes normally occurring in its habitat. The honeybee is the best example of an insect that regulates the temperature of its surrounding medium, in this case, air within the hive. In summer the hive is maintained at about 95°F. If the temperature rises above this point bee at the hive entrance set up ventilating currents by fanning their wings and other bees may bring water and put it on the comb to obtain the cooling effect of its evaporation. In winter the bees keep the hive up to a safe temperature by heat obtained through oxidation of foods in the insect bodies. Other social bees and ants also exercise certain amount of control over nest temperature. The temperature has a marked effect on insect development and activities. The chemical reactions of metabolism increase with the increase in temperature. But all chemical reactions do not respond at the same rate to temperature increase, and certain physical factors such as solubility of gases in liquids, tend to prentice unfavourable metabolic conditions as temperature increase. As a result, insect development is not equally responsive to changes over the entire temperature scale. The development of the insects also stops at a definite law temperature. Similarly there is also a definite high point for each species at which development stops. This point is usually very close to that of lethal high temperature.

Each species has to own individual rate of development. The rates of development for eggs and nymphs of red-legged grasshopper are extremely different from each other. For the nymphs the developmental rate increases steadily with increases in temperature to a point close to the lethal high temperature. The rate of the eggs increases with the lower range of increased temperature and then decreases with additional temperature increase. With the eggs this point of decreased development is reached for below the lethal temperature. These cases show the necessity of studying separately the various stages of the life history in order to obtain accurate information on the developmental phase of the species. The temperature range that insects can with stand varies tremendously with the species.

The most heat resistant insects known to die at temperature of 118 to 1250°F. majority of insects die at 100 to 1100°F. Insects of tropical origin usually die as the temperature drops near freezing, where as insects occurring in regions having freezing winters almost invariably show a different temperature tolerance in each stage of their life cycles. In their natural environment insects are well adjusted to prevailing usual temperatures. Temperature operates as a restricting factor unusual or unseasonable periods of hot or cold weather.

(2) Humidity: The maximum humidity was recorded in the month of June (72%) in Site 3, where as it was recorded minimum in the month of March in Site 2 (54.6%). The detailed data has been presented in Table 1. It is difficult to separate the factors of humidity and evaporation in their effect on insects. Humidity pertains to the amount of moisture in the air, and evaporation to the actual water loss of a surface. It insects are subjected to low humidity, the evaporation from their bodies increases. Because of their small size, increased evaporation quickly depletes the water control of insect bodies. This depletion of water is replenished by feeding. There is little conclusive evidence available for making generalizations regarding the effect of humidity on insects. Available data indicates that in general, humidity is not so critical a factor as is temperature, but each species has an optimum, which may be different for various stages of the life cycle. Humidity also affects mortality rate. Low humidity has been found to increase mortality of Drosophila, and high humidity is recorded as interfering with hatching and moulting in some species of aphids. The humidity and evaporation constitute the barrier that restricts the geographic range of many species of insects.

(3) Wind: Wind speed was generally high during the period from March to June. The wind rose diagram illustrated in figure 2.

(4) Temperature of Humidity: These two factors together have a marked effect on the general development and distribution of insect species. Their action is frequently critical on different phases of a species and at different times of the year. Critical cold temperatures, for instance might operate in winter against the hibernating mature larvae, whereas adverse humidity might operate during the summer against eggs or actively feeding larvae. During the heat of a summer day, if the humidity is depressed, many insects will be relatively inactive, frequently cooler and moisture habitat.

Table 1: Monthly Variation in Temperature (°C) and Humidity (%) during the study period

S.No.	Month	Site 1		Site 2		Site 3	
		T(°C)	H(%)	T(°C)	H(%)	T(°C)	H(%)
1.	March	26.5	56.5	23.3	54.6	25.2	55.8
2.	April	29.5	55.2	25.8	55.7	28.6	57.0
3.	May	30.2	69.6	29.4	65.2	29.5	68.1
4.	June	32.5	70.1	31.7	68.8	33.2	72.0

(Data based on assessment during March-June 2012)

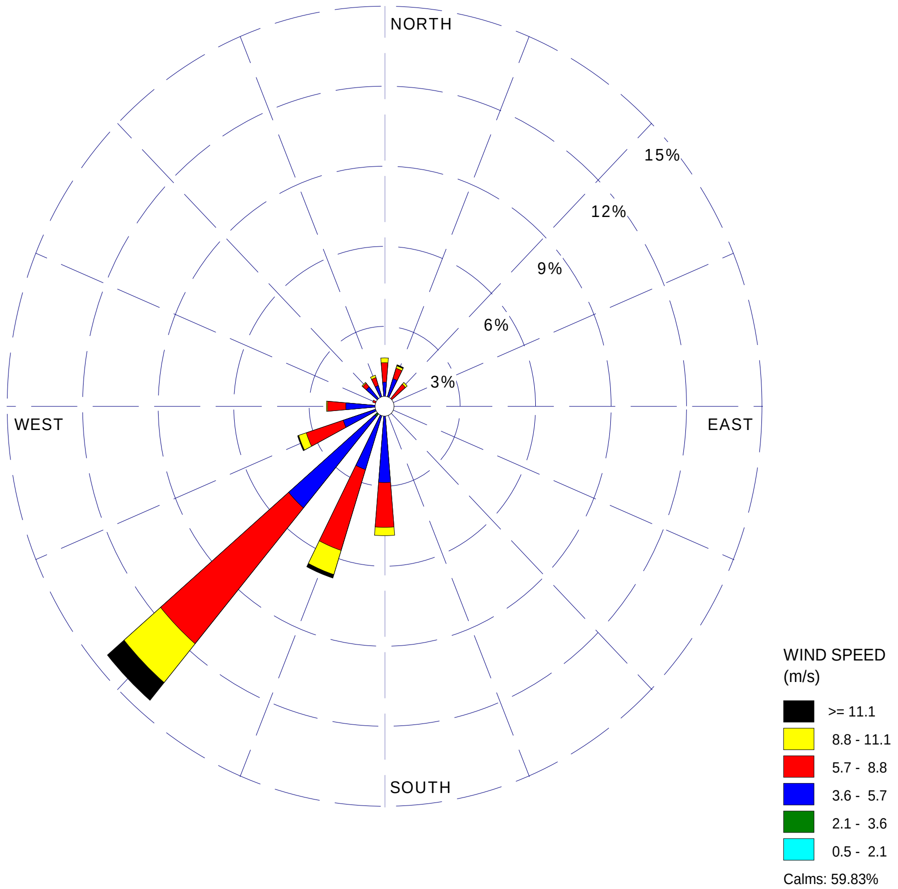

Figure 2. Wind Rose Diagram (Sourced from EIA Division, Envision Enviro Engineers Pvt. Ltd.)

Table 2: Lepidopteran Species Recorded from Different Sites

S.No.	Taxonomic Composition	Site 1	Site 2	Site 3
	1.Family- Nymphalidae			
1.	Nephis yerburys But	+	+	+
2.	Precis almana almana	+	-	+
3.	Cupha erymanthis	+	-	-
4.	Atella phalantop Drury	+	+	+
5.	Precis lemomas	+	-	+
6.	Precis orithyia	+	-	-
7.	Vanessa caschmirensis	+	+	+
8.	Pieris iphata-iphata	+	+	+
9.	Precis hieria hieria	+	+	+
10.	Egrulis marion	+	-	-
11.	Dodona durga	-	+	+
12.	Vanessa indica Herbrt	+	+	+
13.	Curetis bulis	+	-	-
14.	Phalonta alcippe alcippoides De Niceville	+	-	+
15.	Egrulis marion	+	-	-
16.	Argyreus hyperlsius	-	+	-
17.	Kallima inachus Boisduval	-	+	+
18.	Argyreus sp.	+	+	-
19.	Precis atlites Linn	+	+	+
	2. Family -Pieridae			
20.	Pieris canida	+	+	+

21.	Delias cacharis Drury	+	-	-
22.	Genopteryx rhamni nepalensis	-	+	+
23.	Terias hecabe hecabe Linn	+	+	+
24.	Anopheis aurota aurota	+	-	-
25.	Pareronia valeria hippie Fabr	-	+	-
26.	Appias indra moore	+	-	-
27.	Hebomoia glaucippe Linn	+	+	+
28.	Appias albina darada	+	-	+
29.	Ixias pyrena familiais But	+	+	+
30.	Pareronia valeria hippia F.	+	-	-
31.	Pieris dubernardi chumbiensis De Niceville	+	+	+
32.	Pareronia valeria F.	+	-	-
33.	Pieris dubernardi De Niceville	+	+	+
34.	Pieris brassicae Linn	+	-	+
35.	Aporio aguthonyphryrce	+	-	-
36.	Pieris pyranthe dubernardii De Niceville	+	-	+
37.	Colias electo fieldi Menestries	+	+	+
38.	Catopsilia pyranthe Linn	+	+	+
39.	Catopsilia crocale	+	+	+
40.	Phalenta alcippe Drury	+	+	-
41.	Eurema sp	+	-	-
	3. Family - Danaidae			
42.	Euploea core- core	+	+	+
43.	Danaus Chrysippus	+	+	+
44.	Danus algae Stoll	+	+	+
45.	Prantica algae	-	+	+
46.	Prantica sita	+	+	-
	4. Family -Satyridae			
47.	Yapthima balada balda	-	+	-
48.	Parage shakaro Koll	+	-	-
49.	Lethe verma Koll	+	+	-
50.	Ypthima balda b.	+	+	+
	5. Family -Lycanidae			
51.	Lampides bocticus	+	+	+
52.	Narathura fulla ignara riley	+	+	-
53.	Heodes kavana Koll	+	+	+
	6. FAMILY -HESPERIDAE			
54.	Pernara gullatus	+	-	+
	7. Family -Papilionidae			
55.	Princeps polytes romulus Cramer	+	+	-
56.	Princeps demoleus Linn	+	-	+
57.	Princeps sp.	+	+	+
58.	Papilio polytes Linnaeus	+	+	-
59.	Papilio d. Demoleus Linn	+	-	+
60.	Papilio sp.	-	-	+
61.	Graphium cloanthus	-	+	+
62.	Parides philoxinus Gray	+	-	-
	8. Family -Eupterotidae			
63.	Eupterote lineosa	+	-	-
	9. Family-Heometidae			

64.	Vrapteryx obuleatea	+	+	+
	10. Family-Melanites			
65.	Leada ismeni	+	+	-
	11. Family-Noctuidae			
66.	Spodotera litura	+	+	-
67.	Rhesala sp.	+	-	+
68.	Spodotera sp.	-	+	-
	Total Species	58	42	40

As shown in Table 2, a total of 24 common species were reported from all the study sites including Atella phalantop Drury, Vanessa caschmirensis, Pieris iphata iphata, Precis hieria hieria, Vanessa indica Herbrt, Pieris canida, Genopteryx rhamni nepalensis, Terias hecabe hecabe Linn., Hebomoia glaucippe Linn., Ixias pyrena familiais But, Pieris dubernardi chumbiensis De Niceville, Pieris dubernardi De Niceville, Colias electo fieldi Menestries, Catopsilia pyranthe Linn., Catopsilia crocale, Euploea core core, Danaus Chrysippus, Danus algae Stoll, Ypthima balda b., Lampides bocticus, Heodes kavana Koll, Princeps polytes romulus Cramer, Princeps sp. and Vrapteryx obuleatea.

Table 3: Individuals of Lepidopteran Species Recorded from Different Sites

S.No.	Taxonomic Composition	Site 1	Site 2	Site 3
	1.Family- Nymphalidae			
1.	Nephis yerburys But	4	2	1
2.	Precis almana almana	1	0	5
3.	Cupha erymanthis	3	0	0
4.	Atella phalantop Drury	1	3	4
5.	Precis lemomas	1	0	2
6.	Precis orithyia	1	0	0
7.	Vanessa caschmirensis	6	2	3
8.	Pieris iphata iphata	2	5	5
9.	Precis hieria hieria	3	4	2
10.	Egrulis marion	2	0	0
11.	Dodona durga	0	3	4
12.	Vanessa indica Herbrt	4	2	2
13.	Curetis bulis	1	0	0
14.	Phalonta alcippe alcippoides De Niceville	2	0	2
15.	Egrulis marion	1	0	0
16.	Argyreus hyperlsius	0	2	0
17.	Kallima inachus Boisduval	0	3	2
18.	Argyreus sp.	3	2	0
19.	Precis atlites Linn	0	1	1
	2. Family -Pieridae			
20.	Pieris canida	12	19	16
21.	Delias cacharis Drury	2	0	0
22.	Genopteryx rhamni nepalensis	4	3	2
23.	Terias hecabe hecabe Linn	5	1	4
24.	Anopheis aurota aurota	2	0	0
25.	Pareronia valeria hippie Fabr	3	4	0
26.	Appias indra moore	1	0	0
27.	Hebomoia glaucippe Linn	2	1	2
28.	Appias albina darada	1	0	1
29.	Ixias pyrena familiais But	4	4	3

30.	Pareronia valeria hippia F.	2	0	0
31.	Pieris dubernardi chumbiensis De Niceville	2	3	4
32.	Pareronia valeria F.	4	0	0
33.	Pieris dubernardi De Niceville	2	1	2
34.	Pieris brassicae Linn	18	0	9
35.	Aporio aguthonyphryrce	4	0	0
36.	Pieris pyranthe dubernardii De Niceville	3	0	4
37.	Colias electo fieldi Menestries	9	7	9
38.	Catopsilia pyranthe Linn	5	7	3
39.	Catopsilia crocale	4	3	4
40.	Phalenta alcippe Drury	2	1	0
41.	Eurema sp	7	0	0
	3. Family -Danaidae			
42.	Euploea core core	4	6	4
43.	Danaus Chrysippus	5	4	2
44.	Danus algae Stoll	3	4	4
45.	Prantica algae	0	1	1
46.	Prantica sita	2	5	0
	4. Family -Satyridae			
47.	Yapthima balada balda	0	3	0
48.	Parage shakaro Koll	5	0	0
49.	Lethe verma Koll	3	2	0
50.	Ypthima balda b.	5	4	1
	5. Family -Lycanidae			
51.	Lampides bocticus	6	3	4
52.	Narathura fulla ignara riley	1	2	0
53.	Heodes kavana Koll	3	4	5
	6. Family- Hesperidae			
54.	Pernara gullatus	3	0	1
	7. Family -Papilionidae			
55.	Princeps polytes romulus Cramer	7	2	0
56.	Princeps demoleus Linn	1	0	3
57.	Princeps sp.	4	3	4
58.	Papilio polytes romulus Cramer	4	5	0
59.	Papilio d. Demoleus Linn	5	0	4
60.	Papilio sp.	0	0	2
61.	Graphium cloanthus	0	3	1
62.	Parides philoxinus Gray	3	0	0
	8. Family -Eupterotidae			
63.	Eupterote lineosa	2	0	0
	9. Family-Heometidae			
64.	Vrapteryx obuleatea	1	3	1
	10. Family-Melanites			
65.	Leada ismeni	2	1	0
	11. Family-Noctuidae			
66.	Spodotera litura	1	2	0
67.	Rhesala sp.	3	0	2
68.	Spodotera sp.	0	3	0
Total		206	143	135

Pieris canida was found to be the most dominant species in the study area. Pieris brassicae was found to be the most dominant species in Site I, where as Pieris canida was the most dominant species in Site II and Site III. The detailed data has been presented in Table 3. Thus it can be concluded that Pieris canida prefers the disturbed sites and if it is the dominant species in any area it indicates the ecological imbalance in any area.

Table 4: Total Number of Species Recorded from Different Lepidopteran Families

FAMILY	SITE 1	SITE 2	SITE 3	TOTAL
Nymphalidae	16	11	12	39
Pieridae	20	12	13	45
Danaidae	04	05	04	13
Satyridae	03	03	01	7
Lycanidae	03	03	02	8
Hesperidae	01	00	01	2
Papilionidae	06	04	05	15
Eupterotidae	01	00	00	1
Heometidae	01	01	01	3
Melanites	01	01	00	2
Noctuidae	02	02	01	5
TOTAL	58	42	40	140

A total of 68 species were recorded from all the three study sites. A maximum of 58 species were reported from Site I followed by site II and a minimum of 40 species were reported from Site III. Table 3 Shows the relative number of species of different Lepidopteran families recorded during the study period. Maximum number of species belonged to family Pieridae (45) followed by Nymphalidae (39), Papilionidae (15), Danaidae (13), Lycaenidae (8), Satyridae (7), Noctuidae (5), Hoemetidae (3), Melanites and Hesperidae (2 each) and Eupterolidae (1). There was no record found for current study area for butterfly biodiversity. Wynter Blyth (1957) recorded as many as 835 species from Eastern Himalayas, while 415 species from Western Himalaya. Singh (1963) reported 5 species belonging to 4 families of order Lepidoptera from North West Himalaya. Arora et al. (1995) reported 223 species of butterflies belonging to 9 families viz. Popilionidae, Pieridae, Danaidae, Satyridae, Acraeidae, Nymphalidae, Erycinidae and Hesperiidae from Western Himalayas, Uttar Pradesh. It has been estimated that approximately 1450 species of Lepidopteran fauna (Insecta: Rhopalocera) exists in the country, which include about 325 species from Garhwal Himalayas (Mackinnon and de Niceville, 1997, 98; Ollenbach, 1930–31) and 350 species from Kumaon hills (Hannyngton, 1910–11).

CONCLUSION

Lepidoptera inhabit all terrestrial habitats ranging from desert to rainforest, from lowland grasslands to montane plateaus but almost always associated with higher plants, especially angiosperms. Although many Lepidoptera are valued for their beauty and a few are useful in commerce the larvae of these insects are probably more destructive to agricultural crops and forest trees than any other group of insects. The stated area had rich butterfly diversity. The development of industrial area within this area having chemical zone can affect to the butterfly diversity. The butterfly diversity study suggested that there are number of different flowering species exist in the study area.

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