



THE SEASONAL PATTERNS IN THE ABUNDANCE OF BUTTERFLIES, THEIR BIOTOPES AND NECTAR FOOD PLANTS FROM MAVAL TAHSIL, PUNE DISTRICT, MAHARASHTRA, INDIA

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ABSTRACT: The present study was carried out at Maval Tahsil of Pune District, Maharashtra, India, during August 2007 to August 2009. A total of 85 species of butterflies were recorded from Maval Tahsil. Out of 85 species, 11 species of butterflies are scheduled species. Family Nymphalidae is dominating in study area, followed by Lycaenidae, Hesperidae, Pieridae, and Papilionidae. The seasonal pattern in the abundance of butterflies, their biotopes and nectar food plants were also studied. Mud-puddling is also observed among some butterflies. Forest biotope is found to be rich for butterfly species. Thirty two Nectar food plants were identified belonging to 15 plant families. Plants of Asteraceae family were found to be preferred by Butterflies as nectar food plants. Visits of Butterflies were more frequent to flowers with tubular corollas than to non-tubular ones, to flowers coloured yellow, white and red and to flowers with a bloom for longer period in the year. Peak species abundance was observed in the months during August to November. A decline in species abundance was observed from the months of December to January and continued up to the end of May. These findings are important with respect to monitoring Butterfly and plant diversity and defining conservation strategies in the Maval Tahsil.

Key Words- Butterfly diversity, food plants, seasonal abundance, biotopes, Maval Tahsil.

INTRODUCTION

Pune District is one of the important industrial Districts in the Maharashtra State. The increased industrialization and urbanization has affected the ecology of this region to a great extent. It has fourteen Tahsils, out of which, Maval Tahsil was selected for the study of Butterfly Diversity with respect to seasonal abundance, biotopes and nectar food plants. The tourist's hill stations like Lonavala and Khandala are in Maval. It is also famous for historical places and dams. Butterflies are scaled wing insects belonging to order Lepidoptera of class Insecta. There is an intimate association between Butterflies and plants and their lives are exceptionally interlinked [4], which leads to different patterns in their distribution depending on the availability of their food plants.

Feeding is a significant activity and food may be often the most decisive factor affecting distribution, abundance and movements of animals. In Butterflies, this has a special relevance because food and mode of feeding are different in the larval and adult stages [8]. Butterflies and their caterpillars are dependent on specific host plants for foliage, nectar and pollen as their food. Thus Butterfly diversity reflects overall plant diversity, especially, that of the herbs and shrubs, in the given area. The herbs and shrubs start their life cycle in the beginning of the Monsoon and complete it by the end of post-monsoon season. While some shrub like *Lantana camara* shows flowering throughout the year. Kunte [7] has studied seasonal patterns in Butterfly abundance and species diversity in four tropical habitats in Northern-Western Ghats. These four sites were close to Pune city within a radius of 20km. Further, Kunte [9] studied the Butterfly diversity of Pune City along human impact gradient. Rane and Ranade [15] studied Butterflies of Tamhini-Dongarwadi area, Mulshi, Maharashtra. Padhye [12] studied season and landscape wise distribution of Butterflies in Tamhini, Northern Western Ghats of India.

Sharma [16] studied the fauna of Bhimashankar Wildlife Sanctuary, Maharashtra. Tiple [18] have analyzed the factors influencing nectar plant resource visits by Butterflies and its implications for conservation at Amravati University campus. Further, Tiple [19] investigated Butterfly-Flower morphological interrelationships for 108 Butterfly species and 20 plants at Nagpur. Nimbalkar [11] studied Butterfly diversity in relation to nectar food plants from Bhore Taluk, Pune District, Maharashtra, India. The diversity studies are important for environmental protection. The present study was undertaken in view of the paucity of information on seasonal abundance, biotopes and food resources from Maval Taluk.

MATERIAL AND METHODS

The Study Area:

Taluk Maval (Vadgaon) is located 43 kms. from Pune at north-west direction. It is situated at 18°.45' North latitude & 73°.38' East longitude, altitude is about 631 meters. This Taluk area has irregular shape, having an area of 1131 sq. km., bordered by Taluk Haveli in the east, district Raigad in west, Taluk Mulshi on south and Taluk Khed towards the north. Figure 1 shows the location of Maval Taluk in Pune district. This is the hilly area with highest rain fall in Pune District. Water source is of Indrayani River and of a few lakes. Most of the area is covered with forest.

MAP OF PUNE DISTRICT (TAHSILS)

(SHOWING LOCATION OF STUDY AREA)



Figure-1: Location of Study area

The study area was fully explored during August 2007 to August 2009 and then probable areas were decided. To study the seasonal patterns/diversity in Butterfly abundance in relation to nectar food plants, the entire year was divided into three seasons. The three seasons of the year are Pre-Monsoon i.e. from February to May, Monsoon i.e. from June to September and Post-Monsoon i.e. from October to January. The study area was visited twice in each season during the two years i.e. 2007-2008 & 2008-2009. In the said investigation the selected sites were surveyed mainly between 7.30 am to 12.30 pm. Butterfly species were identified directly in the field visually with the help of field guides followed by photography, in difficult cases, rarely by capture. Collection was restricted to those specimens that could not be identified directly. All scientific names and common English names were designated as per Varshney [20] and Wynter Blyth [22] respectively. Classification of Butterflies is after Gaonkar [5]. Benthum & Hooker [2] system of classification is followed for plants. Statistical analysis of the data was carried out using Ecological Analysis Package- Biodiversity Pro. Rainfall records were obtained from Indian Meteorological Centre, Mumbai. During field work from study area, hygrometer was used to keep record of humidity and temperature. Global Positioning System (GPS) instrument was used to record latitude, longitude and altitude.

Camera

DSLR Camera Sony Model No. DSLR A-200, 10.2 Mega Pixels

Hygrometer

Hi-Tech Temperature Clock / Humidity HTC-1

Global Positioning System (GPS) Instrument

GPS MAP 60 CSX

GPS Readings and Biotopes of a few sites in Maval Tahsil area are given below:

Table-1: Locations of Marval Tahsil

Locations in Maval Tahsil		GPS Readings			Type of Biotope
No.	Location	Latitude (N)	Longitude (E)	Altitude (Mtr)	
1	Kale	18°41.132'	73°40.156'	589	Plantation
2	Kamshet	18°45.668'	73°39.427'	619	Scrub
3	Talegaon Dabhade	18°44.136'	73°42.381'	586	Grassland
4	Tikona Peth	18°42.639'	73°35.319'	668	Forest
5	Vadgaon Maval	18°44.640'	73°37.848'	631	Garden

Statistical Analysis

Statistical analysis of the data was carried out using Ecological Analysis Package – Biodiversity Pro. The data was properly arranged in the format required for the software function. The arrangement of data was made so that the rows indicated the species whereas the columns indicated the total number of individuals of a particular species in premonsoon, monsoon and post monsoon seasons. Alpha and beta diversity analysis in relation to seasonal variation in occurrence of butterflies was done using Biodiversity Pro (V2).

RESULTS

During the course of study, eighty-five species of Butterflies belonging to five families were recorded in Maval Tahsil (Table 2). Out of Eighty-fives species, nine belong to Papilionidae, twelve to Pieridae, thirty to Nymphalidae, twenty to Lycaenidae and fourteen to Hesperidae. Species belonging to family Nymphalidae, were the most dominant (35%) followed by Lycaenidae (24%), Hesperidae (16%), Pieridae (14%), and Papilionidae (11%). The status recording was as follows: VC- very common (75-100 sightings), C- common (50-75 sightings), NR- not rare (25-50 sightings), R- rare (5-25 sightings) and VR- very rare (1-5 sightings). Among the species fifteen were found very common, thirty-four species common, twenty-seven species not rare and nine species were found rare. None of the species were observed in very rare category from study area. Eleven species (*Pachliopta hector*, *Pareronia valeria*, *Appais indra*, *Cepora nerissa*, *Euploea core*, *Neptis jumbah*, *Hypolimnas misippus*, *Castalius rosimon*, *Lampides boeticus*, *Jamides alecto* and *Acytolepis puspa*) come under the protection of the Indian Wildlife (Protection) Act 1972. Out of the eighty-five species thirty species were recorded from botanical and nursery garden, seventy-six from forest area, forty from grassland, seventy-two on plantation and sixty-one from scrub biotope. Results are indicated in Table 3. Nectar Food Plants and other food sources of butterfly species and floral characteristics of plants are indicated in Table 3 and Table 6 respectively. Mudpuddling is usually observed in males. However, females of *Hypolimnas bolina* and *Hypolimnas misippus* were observed while mudpuddling (Table 4).

Thirty two plants belonging to, fifteen families of Plants are used by Butterflies as Nectar Food Plants. Nine plants of family Asteraceae are recorded from study area, three plants of family Apocynaceae, two plants of each family viz. Amaranthaceae, Asclepiadaceae, Boraginaceae, Caesalpiniaceae, Fabaceae, Malvaceae, and Verbenaceae, while only one plant of each family viz., Icacinaceae, Moringaceae, Rhamnaceae, Rubiaceae, Thymeleaceae and Zygophyllaceae. Visits of Butterflies were more frequent to flowers of Herbs and Shrubs rather than to flowers of Trees (Table 4). The descriptive statistics of the butterflies with relation to seasonal variation is given in Table 4 while Table 5 indicates the seasonal diversity index and abundance of butterfly species from the study area. The species richness in the study area is indicated in Figure 2 with number of singletons observed in three different pooled samples.

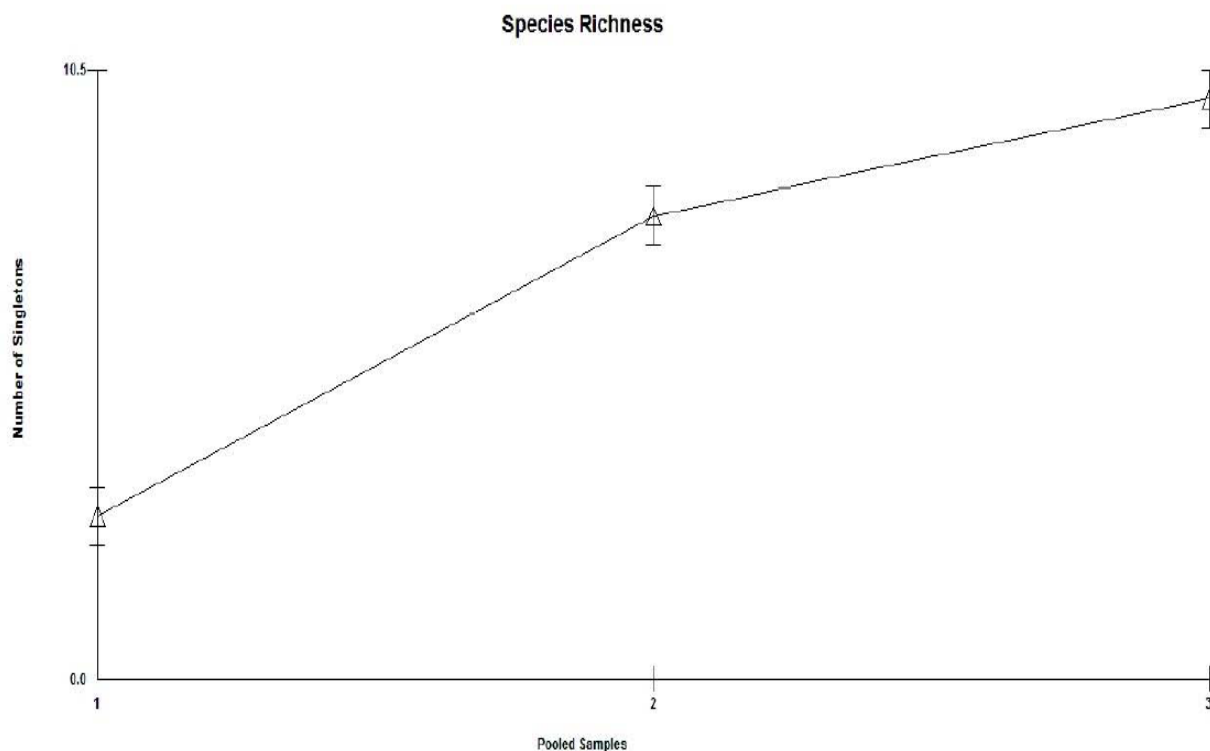


Figure-2: Species richness in study area

Table 2: List of Butterfly Species Observed from Maval Tahsil

S. No	Common Name	Scientific Name
Suborder : Rhopalocera		
I. Family: PAPILIONIDAE		
Subfamily 1: Papilioninae		
1	Common Bluebottle	<i>Graphium sarpedon</i> Linnaeus
2	Common Jay	<i>Graphium doson</i> C & R Felder
3	Tailed Jay	<i>Graphium agamemnon</i> Linnaeus
4	Common Mormon	<i>Papilio polytes</i> Linnaeus
5	Red Helen	<i>Papilio helenus</i> Linnaeus
6	Blue Mormon	<i>Papilio polymnestor</i> Cramer
7	Lime Butterfly	<i>Papilio demoleus</i> Linnaeus
8	Common Rose	<i>Pachliopta aristolochiae</i> Fabricius
9	Crimson Rose*	<i>Pachliopta hector</i> Linnaeus

Table-2 cont..

II. Family: PIERIDAE		
Subfamily 1: Coliadinae		
10	Small Grass Yellow	<i>Eurema brigitta</i> Cramer
11	Common Grass Yellow	<i>Eurema hecabe</i> Linnaeus
12	Spotless Grass Yellow	<i>Eurema laeta</i> Boisduval
13	Common Emigrant	<i>Catopsilia pomona</i> Fabricius
14	Lemon Emigrant	<i>Catopsilia crocale</i> Cramer
15	Mottled Emigrant	<i>Catopsilia pyranthe</i> Linnaeus
2. Subfamily: Pierinae		
Subfamily 2: Pierinae		
16	White Orange Tip	<i>Ixias marianne</i> Cramer
17	Common Wanderer*	<i>Pareronia valeria</i> Carmer
18	PlainPuffin*	<i>Appias indra</i> Moore
19	Common Gull*	<i>Cepora nerissa</i> Fabricius
20	Common Jezebel	<i>Delias eucharis</i> Drury
21	Pioneer	<i>Belenois aurota</i> Fabricius
III. Family: NYMPHALIDAE		
Subfamily 1: Danainae		
22	Blue Tiger	<i>Tirumala limniace</i> Cramer
23	Dark Blue Tiger	<i>Tirumala septentrionis</i> Butler
24	Striped Tiger	<i>Danaus genutia</i> Cramer
25	Plain Tiger	<i>Danaus chrysippus</i> Linnaeus
26	Glassy Tiger	<i>Parantica aglea</i> Stoll
27	Common Indian Crow*	<i>Euploea core</i> Cramer
Subfamily 2: Charaxinae		
28	Common Nawab	<i>Polyura athamas</i> Drury
29	Black Rajah	<i>Charaxes solon</i> Fabricius
Subfamily 3: Satyrinae		
30	Common Evening Brown	<i>Melanitis leda</i> Linnaeus
31	Common Bush Brown	<i>Mycalasis perseus</i> Fabricius
32	Common Three Ring	<i>Ypthima asterope</i> Klug
33	Common Five Ring	<i>Ypthima baldus</i> Fabricius
34	Common Four Ring	<i>Ypthima huebneri</i> Kirby
Subfamily 4: Heliconiinae		
35	Tawny Coster	<i>Acraea violae</i> Fabricius
36	Common Leopard	<i>Phalanta phalantha</i> Drury
Subfamily 5: Limenitinae		
37	Chestnut Streaked Sailer*	<i>Neptis jumbah</i> Moore
38	Common Sailer	<i>Neptis hylas</i> Linnaeus
Subfamily 6: Cyrestinae		
39	Common Map	<i>Cyrestis thyodamas</i> Boisduval
Subfamily 7: Biblidinae		
40	Angled Castor	<i>Ariadne ariadne</i> Linnaeus
41	Common Castor	<i>Ariadne merione</i> Cramer
42	Joker	<i>Byblia ilithyia</i> Drury
Subfamily 8: Nymphalinae		
43	Painted Lady	<i>Vanessa cardui</i> Linnaeus
44	Blue Pansy	<i>Junonia orithiya</i> Linnaeus
45	Yellow Pansy	<i>Junonia hierta</i> Fabricius
46	Chocolate Pansy	<i>Junonia iphita</i> Cramer

Table-2 cont..

47	Grey Pansy	<i>Junonia atlites</i> Linnaeus
48	Peacock Pansy	<i>Junonia almana</i> Linnaeus
49	Lemon Pansy	<i>Junonia lemonias</i> Linnaeus
50	Great Eggfly	<i>Hypolimnas bolina</i> Linnaeus
51	Danaid Eggfly*	<i>Hypolimnas misippus</i> Linnaeus
IV. Family: LYCAENIDAE		
Subfamily 1: Curetinae		
52	Indian Sunbeam	<i>Curetis thetis</i> Drury
Subfamily 2: Theclinae		
53	Silver Streak Blue	<i>Iraota timoleon</i> Stoll
54	Large Guava Blue	<i>Deudorix perse</i> Hewitson
Subfamily 3: Polyommatainae		
55	Angled Pierrot	<i>Caleta caleta</i> Hewitson
56	Banded Blue Pierrot	<i>Discolampa ethion</i> Westwood
57	Common Pierrot*	<i>Castalius rosimon</i> Fabricius
58	Zebra Blue	<i>Leptotes plinius</i> Fabricius
59	Tailless Lineblue	<i>Prosotas dubiosa</i> indica Evans
60	Dark Cerulean	<i>Jamides bochus</i> Cramer
61	Common Cerulean	<i>Jamides celeno</i> Cramer
62	Metallic Cerulean*	<i>Jamides alecto</i> C- & R- Felder
63	Forget-me-not	<i>Catochrysops strabo</i> Fabricius
64	Pea Blue*	<i>Lampides boeticus</i> Linnaeus
65	Dark Grass Blue	<i>Zizeeria karsandra</i> Moore
66	Lesser Grass Blue	<i>Zizina otis</i> Fabricius
67	Tiny Grass Blue	<i>Zizula hylax</i> Fabricius
68	Red Pierrot	<i>Talicauda nyseus</i> Guerin -Meneville
69	Common Hedge Blue*	<i>Acytolepis puspa</i> Horsfield
70	Lime Blue	<i>Chilades laius</i> Stoll
Subfamily 4: Riodininae		
71	Plum Judy	<i>Abisara echerius</i> Stoll
Suborder : Grypocera		
V. Family: HESPERIIDAE		
Subfamily 1: Coeliadinae		
72	Common Banded Awl	<i>Hasora chromus</i> Cramer
Subfamily 2: Pyrginae		
73	Malabar Spotted Flat	<i>Celaenorrhinus ambareesa</i> Moore
74	Common Spotted Flat	<i>Celaenorrhinus leucocera</i> Kollar
75	Common Small Flat	<i>Sarangesa dasahara</i> Moore
76	Fulvous Pied Flat	<i>Pseudocoladenia dan</i> Fabricius
77	Tricoloured Pied Flat	<i>Coladenia Indrani</i> Moore
Subfamily 3: Hesperinae		
78	Dark Palm Dart	<i>Telicota ancilla</i> Herrich-Schaffer
79	Pale palm Dart	<i>Telicota colon</i> Fabricius
80	Rice Swift	<i>Borbo cinnara</i> Wallace
81	Small Branded Swift	<i>Pelopidas mathias</i> Fabricius
82	Conjoined Swift	<i>Pelopidas conjuncta</i> Herrich-Schaffer
83	Vindhyan Bob	<i>Arnetta vindhiana</i> Moore
84	Indian Palm Bob	<i>Suastus gremius</i> Fabricius
85	Chestnut Bob	<i>Iambrix salsala</i> Moore

* Scheduled Species.

Table 3: Seasonal Observations of Butterfly Species from Maval Tahsil

S.No.	Common Name	Scientific Name	Seasonal Sightings				Status	Biotope	Human Impact Gradient
			Pre Monsoon	Monsoon	Post Monsoon	Total			
Suborder : Rhopalocera									
I. Family: PAPILIONIDAE									
Subfamily 1: Papilioninae									
1	Common Bluebottle	<i>Graphium sarpedon</i> Linnaeus	10	28	12	50	C	BPF	AD
2	Common Jay	<i>Graphium doson</i> C & R Felder	0	20	5	25	R	FP	AV
3	Tailed Jay	<i>Graphium agamemnon</i> Linnaeus	15	35	20	70	C	BGP	AD
4	Common Mormon	<i>Papilio polytes</i> Linnaeus	18	42	25	85	VC	BFGP	AD
5	Red Helen	<i>Papilio helenus</i> Linnaeus	0	15	11	26	NR	FP	AV
6	Blue Mormon	<i>Papilio polymnestor</i> Cramer	1	14	10	25	NR	BFP	AV
7	Lime Butterfly	<i>Papilio demoleus</i> Linnaeus	5	30	25	60	C	BFGPS	AD
8	Common Rose	<i>Pachliopta aristolochiae</i> Fabricius	7	28	16	51	C	BFGPS	AV
9	Crimson Rose*	<i>Pachliopta hector</i> Linnaeus	6	29	15	50	C	BFPS	AV
II. Family: PIERIDAE									
Subfamily 1: Coliadinae									
10	Small Grass Yellow	<i>Eurema brigitta</i> Cramer	18	50	28	96	VC	BFGPS	AD
11	Common Grass Yellow	<i>Eurema hecabe</i> Linnaeus	27	48	22	97	VC	BFGPS	AD
12	Spotless Grass Yellow	<i>Eurema laeta</i> Boisduval	10	30	15	55	C	FGPS	AD
13	Common Emigrant	<i>Catopsilia pomona</i> Fabricius	19	45	35	99	VC	BFGPS	AD
14	Lemon Emigrant	<i>Catopsilia crocale</i> Cramer	4	29	19	52	C	FGPS	AD
15	Mottled Emigrant	<i>Catopsilia pyranthe</i> Linnaeus	12	42	24	78	VC	BFGPS	AD
Subfamily 2: Pierinae									
16	White Orange Tip	<i>Ixias marianne</i> Cramer	15	17	30	62	C	BFPS	AD
17	Common Wanderer*	<i>Pareronia valeria</i> Cramer	10	33	28	71	C	BFPS	AD
18	PlainPuffin*	<i>Appais indra</i> Moore	0	15	12	27	NR	P	AV
19	Common Gull*	<i>Cepora nerissa</i> Fabricius	15	35	25	75	C	FGPS	AV
20	Common Jezebel	<i>Delias eucharis</i> Drury	8	25	20	53	C	FPS	AD
21	Pioneer	<i>Belenois aurota</i> Fabricius	19	39	37	95	VC	BFGPS	AD

Table-3 cont..

III. Family: NYMPHALIDAE									
Subfamily 1: Danainae									
22	Blue Tiger	<i>Tirumala limniace</i> Cramer	6	35	25	66	C	FPS	AD
23	Dark Blue Tiger	<i>Tirumala septentrionis</i> Butler	2	21	12	35	NR	FP	AV
24	Striped Tiger	<i>Danaus genutia</i> Cramer	8	25	35	68	C	FGPS	AV
25	Plain Tiger	<i>Danaus chrysippus</i> Linnaeus	25	40	35	100	VC	BFGPS	AD
26	Glassy bTiger	<i>Parantica aglea</i> Stoll	5	26	20	51	C	FGPS	AD
27	Common Indian Crow*	<i>Euploea core</i> Cramer	20	37	24	81	VC	BFGPS	AD
Subfamily 2: Charaxinae									
28	Common Nawab	<i>Polyura athamas</i> Drury	2	10	6	18	R	FPS	AV
29	Black Rajah	<i>Charaxes solon</i> Fabricius	3	12	7	22	R	FPS	AV
Subfamily 3: Satyrinae									
30	Common Evening Brown	<i>Melanitis leda</i> Linnaeus	11	43	32	86	VC	BFGPS	AD
31	Common Bush Brown	<i>Mycalesis perseus</i> Fabricius	9	31	28	68	C	FGPS	AV
32	Common Three Ring	<i>Ypthima asterope</i> Klug	4	17	9	30	NR	FGS	AV
33	Common Five Ring	<i>Ypthima baldus</i> Fabricius	5	21	9	35	NR	FS	AV
34	Common Four Ring	<i>Ypthima huebneri</i> Kirby	6	12	7	25	R	FS	AV
Subfamily 4: Heliconiinae									
35	Tawny Coster	<i>Acraea violae</i> Fabricius	14	33	25	72	C	BGPS	AD
36	Common Leopard	<i>Phalanta phalantha</i> Drury	26	38	26	90	VC	FGPS	AD
Subfamily 5: Limenitinae									
37	Chestnut Streaked Sailer*	<i>Neptis jumbah</i> Moore	7	18	9	34	NR	FPS	AV
38	Common Sailer	<i>Neptis hylas</i> Linnaeus	14	28	21	63	C	FGS	AD
Subfamily 6: Cyrestinae									
39	Common Map	<i>Cyrestis thyodamas</i> Boisduval	4	15	8	27	NR	FS	AV
Subfamily 7: Biblidinae									
40	Angled Castor	<i>Ariadne ariadne</i> Linnaeus	13	40	31	84	VC	BGPS	AD
41	Common Castor	<i>Ariadne merione</i> Cramer	12	29	17	58	C	BGPS	AD
42	Joker	<i>Byblia ilithyia</i> Drury	9	17	12	38	NR	FGS	AV
Subfamily 8: Nymphalinae									
43	Painted Lady	<i>Vanessa cardui</i> Linnaeus	7	29	25	61	C	GPS	AD
44	Blue Pansy	<i>Junonia orithiya</i> Linnaeus	17	27	21	65	C	FGPS	AD
45	Yellow Pansy	<i>Junonia hierta</i> Fabricius	10	24	19	53	C	FGPS	AD

Table-3 cont..

46	Chocolate Pansy	<i>Junonia iphita</i> Cramer	8	32	16	56	C	BFGPS	AD
47	Grey Pansy	<i>Junonia atlites</i> Linnaeus	8	18	24	50	C	BFPS	AV
48	Peacock Pansy	<i>Junonia almana</i> Linnaeus	7	17	11	35	NR	BFGPS	AD
49	Lemon Pansy	<i>Junonia lemonias</i> Linnaeus	22	48	30	100	VC	BFGPS	AD
50	Great Eggfly	<i>Hypolimnas bolina</i> Linnaeus	18	36	28	82	VC	BFPS	AD
51	Danaid Eggfly*	<i>Hypolimnas misippus</i> Linnaeus	7	44	25	76	VC	BFPS	AD
IV. Family: LYCAENIDAE									
Subfamily 1: Curetinae									
52	Indian Sunbeam	<i>Curetis thetis</i> Drury	0	16	12	28	NR	FP	AV
Subfamily 2: Theclinae									
53	Silver Streak Blue	<i>Iraota timoleon</i> Stoll	5	16	7	28	NR	FP	AV
54	Large Guava Blue	<i>Deudorix perse</i> Hewitson	6	11	8	25	NR	FP	AV
Subfamily 3: Polyommatae									
55	Angled Pierrot	<i>Caleta caleta</i> Hewitson	0	20	10	30	NR	F	AV
56	Banded Blue Pierrot	<i>Discolampa ethion</i> Westwood	0	16	12	28	NR	FPS	AV
57	Common Pierrot*	<i>Castalius rosimon</i> Fabricius	8	15	9	32	NR	FGPS	AD
58	Zebra Blue	<i>Leptotes plinius</i> Fabricius	4	31	19	54	C	FGPS	AD
59	Tailless Lineblue	<i>Prosotas dubiosa</i> indica Evans	0	40	19	59	C	FGS	AV
60	Dark Cerulean	<i>Jamides bochus</i> Cramer	7	23	19	49	NR	FP	AD
61	Common Cerulean	<i>Jamides celeno</i> Cramer	20	34	25	79	VC	FP	AD
62	Metallic Cerulean*	<i>Jamides alecto</i> C & R Felder	7	32	21	60	C	FGS	AV
63	Forget-me-not	<i>Catochrysops strabo</i> Fabricius	6	13	9	28	NR	FPS	AV
64	Pea Blue*	<i>Lampides boeticus</i> Linnaeus	18	20	30	68	C	BFGS	AD
65	Dark Grass Blue	<i>Zizeeria karsandra</i> Moore	7	20	14	41	NR	FGPS	AD
66	Lesser Grass Blue	<i>Zizinia otis</i> Fabricius	5	16	4	25	R	GS	AD
67	Tiny Grass Blue	<i>Zizula hylax</i> Fabricius	15	37	20	72	C	BFGPS	AD
68	Red Pierrot	<i>Talicauda nyseus</i> Guerin-Meneville	10	21	14	45	NR	BPS	AD
69	Common Hedge Blue*	<i>Acytolepis puspa</i> Horsfield	5	32	19	56	C	FPS	AV
70	Lime Blue	<i>Chilades laius</i> Stoll	10	36	25	71	C	BP	AV
Subfamily 4: Riodininae									
71	Plum Judy	<i>Abisara echerius</i> Stoll	10	19	29	58	C	FPS	AV
Suborder : Grypocera									

Table-3 cont..

V. Family: HESPERIIDAE									
Subfamily 1: Coeliadinae									
72	Common Banded Awl	<i>Hasora chromus</i> Cramer	2	18	8	28	NR	FPS	AV
Subfamily 2: Pyrginae									
73	Malabar Spotted Flat	<i>Celaenorrhinus ambareesa</i> Moore	4	17	9	30	NR	FP	AV
74	Common Spotted Flat	<i>Celaenorrhinus leucocera</i> Kollar	2	16	8	26	NR	FP	AV
75	Common Small Flat	<i>Sarangesa dasahara</i> Moore	16	32	18	66	C	FGP	AD
76	Fulvous Pied Flat	<i>Pseudocoladenia dan</i> Fabricius	7	29	17	53	C	FP	AV
77	Tricoloured Pied Flat	<i>Coladenia Indrani</i> Moore	0	7	4	11	R	FP	AV
Subfamily 3: Hesperinae									
78	Dark Palm Dart	<i>Telicota ancilla</i> Herrich-Schaffer	2	17	7	26	NR	FS	AV
79	Pale palm Dart	<i>Telicota colon</i> Fabricius	0	19	6	25	NR	FS	AV
80	Rice Swift	<i>Borbo cinnara</i> Wallace	4	31	19	54	C	FPS	AD
81	Small Branded Swift	<i>Pelopidas mathias</i> Fabricius	5	13	9	27	NR	FPS	AV
82	Conjoined Swift	<i>Pelopidas conjuncta</i> Herrich-Schaffer	1	8	5	14	R	FP	AV
83	Vindhyan Bob	<i>Arnetta vindhiana</i> Moore	0	17	8	25	R	FP	AD
84	Indian Palm Bob	<i>Suastus gremius</i> Fabricius	1	5	3	9	R	FP	AV
85	Chestnut Bob	<i>Iambrix salsala</i> Moore	5	22	23	50	NR	FP	AV

Table 4: Nectar Food Plants and Other Food Sources of Butterfly Species Observed from Maval Tahsil

S. No.	Common Name of Butterfly	Scientific Name of Butterfly	Scientific Name of Plant / Other Food Source
Suborder: Rhopalocera			
I. Family: PAPILIONIDAE 1. Subfamily: Papilioninae			
1	Common Bluebottle	<i>Graphium sarpedon</i> Linnaeus	<i>Cosmos bipinnatus</i> , <i>Zinnia elegans</i> and Mud-puddling.
2	Common Jay	<i>Graphium doson</i> C. & R. Felder	<i>Pentas karmesiana</i> .
3	Tailed Jay	<i>Graphium agamemnon</i> Linnaeus	<i>Cussia siemia</i> , <i>Lantana camara</i> , <i>Moringa oleifera</i> , <i>Pentas karmesiana</i> , <i>Tagetis erecta</i> and Mud-puddling.
4	Common Mormon	<i>Papilio polytes</i> Linnaeus	<i>Cosmos bipinnatus</i> , <i>Cussia siemia</i> , <i>Lantana camara</i> , <i>Zinnia elegans</i> and Mud-puddling.
5	Red Helen	<i>Papilio helenus</i> Linnaeus	<i>Pentas karmesiana</i> .
6	Blue Mormon	<i>Papilio polymnestor</i> Cramer	<i>Lantana camara</i> and Mud-puddling.
7	Lime Butterfly	<i>Papilio demoleus</i> Linnaeus	<i>Lantana camara</i> , <i>Moringa oleifera</i> , <i>Tephrosia purpurea</i> , <i>Trichodesma indicum</i> and <i>Tridax procumbens</i> .
8	Common Rose	<i>Pachliopta aristolochiae</i> Fabricius	<i>Alstonia scholaris</i> , <i>Cussia siemia</i> , <i>Tagetis erecta</i> and <i>Trichodesma indicum</i> .
9	Crimson Rose	<i>Pachliopta hector</i> Linnaeus	<i>Tridax procumbens</i> .

Table-4 cont..

II. Family: PIERIDAE 1. Subfamily: Coliadinae			
10	Small Grass Yellow	<i>Eurema brigitta</i> Cramer	<i>Lantana camara, Urena lobata</i> and <i>Zinnia elegans</i> .
11	Common Grass Yellow	<i>Eurema hecabe</i> Linnaeus	<i>Celosia argenta, Lantana camara, Tephrosia purpurea, Tribulus terrestris, Tridax procumbens</i> and <i>Zizyphus mauritiana</i> .
12	Spotless Grass Yellow	<i>Eurema laeta</i> Boisduval	<i>Celosia argenta, Lantana camara, Trichodesma indicum</i> and <i>Tridax procumbens</i> .
13	Common Emigrant	<i>Catopsilia pomona</i> Fabricius	<i>Cassia auriculata, Lantana camara, Tephrosia purpurea</i> and <i>Tridax procumbens</i> .
14	Lemon Emigrant	<i>Catopsilia crocale</i> Cramer	<i>Catharanthus roseus, Cussia siemia, Lantana camara, Sida acuta, Tephrosia purpurea</i> and <i>Tridax procumbens</i> .
15	Mottled Emigrant	<i>Catopsilia pyranthe</i> Linnaeus	<i>Catharanthus roseus, Cussia siemia, Lantana camara, Sida acuta, Tridax procumbens</i> and <i>Zizyphus mauritiana</i> .
2. Subfamily: Pierinae			
16	White Orange Tip	<i>Ixias marianne</i> Cramer	<i>Calotropis gigantea, Lantana camara</i> and <i>Tridax procumbens</i> .
17	Common Wanderer	<i>Pareronia valeria</i> Cramer	<i>Bauhinia purpurea</i> and <i>Tagetis erecta</i> .
18	Plain Puffin	<i>Appias indra</i> Moore	<i>Cosmos bipinnatus</i> and <i>Lantana camara</i> .
19	Common Gull	<i>Cepora nerissa</i> Fabricius	<i>Asclepias curassavica, Lantana camara, Tagetis erecta</i> and <i>Tridax procumbens</i> .
20	Common Jezebel	<i>Delias eucharis</i> Drury	<i>Celosia argenta</i> and <i>Lantana camara</i> .
21	Pioneer	<i>Belenois aurata</i> Fabricius	<i>Calotropis gigantea, Lantana camara</i> and <i>Tridax procumbens</i> .
III. Family: NYMPHALIDAE 1. Subfamily: Danainae			
22	Blue Tiger	<i>Tirumala limniace</i> Cramer	<i>Crotalaria juncea, Lantana camara, Tagetis erecta, Trichodesma indicum, Trichodesma zeylanica</i> and <i>Tridax procumbens</i> .
23	Dark Blue Tiger	<i>Tirumala septentrionis</i> Butler	<i>Crotalaria juncea, Lantana camara, Tagetis erecta, Trichodesma zeylanica</i> and <i>Tridax procumbens</i> .
24	Striped Tiger	<i>Danaus genutia</i> Cramer	<i>Celosia argentea, Crotalaria juncea, Lantana camara, Sencio bombayensis, Tridax procumbens</i> and Mud-puddling.
25	Plain Tiger	<i>Danaus chrysippus</i> Linnaeus	<i>Catharanthus roseus, Celosia argentea, Crotalaria juncea, Gaillardia picta, Lantana camara, Trichodesma indicum, Tridax procumbens, Vitex negundo, Zinnia elegans</i> and Mud-puddling.
26	Glassy Tiger	<i>Parantica aglea</i> Stoll	<i>Crotalaria juncea, Lantana camara, Zinnia elegans</i> and Mud-puddling.
27	Common Indian Crow	<i>Euploea core</i> Cramer	<i>Celosia argentea, Cosmos bipinnatus, Lagasca mollis, Lantana camara, Tridax procumbens, Zinnia elegans</i> .
2. Subfamily: Charaxinae			
28	Common Nawab	<i>Polyura athamas</i> Drury	Mud-puddling and Animal Droppings
29	Black Rajah	<i>Charaxes solon</i> Fabricius	Mud-puddling, Rotting Fruits, Animal Dropping and Tree Sap.
3. Subfamily: Satyrinae			
30	Common Evening Brown	<i>Melanitis leda</i> Linnaeus	<i>Tridax procumbens, Rotting Fruits, Tree Sap</i> and Mud-puddling.
31	Common Bush Brown	<i>Mycalesis perseus</i> Fabricius	<i>Tagetis erecta</i> and Mud-puddling.
32	Common Three Ring	<i>Ypthima asterope</i> Klug	<i>Celosia argentea, Tagetis erecta, Tridax procumbens</i> and Mud-puddling.

Table-4 cont..

33	Common Five Ring	<i>Ypthima baldus</i> Fabricius	<i>Tridax procumbens</i> and Mud-puddling.
34	Common Four Ring	<i>Ypthima huebneri</i> Kirby	<i>Celosia argentea</i> , <i>Tridax procumbens</i> and Mud-puddling.
4. Subfamily: Heliconiinae			
35	Tawny Coster	<i>Acraea violae</i> Fabricius	<i>Lagasca mollis</i> , <i>Lantana camara</i> , <i>Tridax procumbens</i> and <i>Vitex negundo</i> .
36	Common Leopard	<i>Phalanta phalantha</i> Drury	<i>Celosia argentea</i> , <i>Gaillardia picta</i> , <i>Lantana camara</i> , <i>Tridax procumbens</i> , <i>Xanthium indicum</i> and Mud-puddling.
5. Subfamily: Limenitinae			
37	Chestnut Streaked Sailer	<i>Neptis jumbah</i> Moore	<i>Tridax procumbens</i> and Mud-puddling.
38	Common Sailer	<i>Neptis hylas</i> Linnaeus	<i>Tridax procumbens</i> and Mud-puddling.
6. Subfamily: Cyrestinae			
39	Common Map	<i>Cyrestis thyodamas</i> Boisduval	Mud-puddling.
7. Subfamily: Biblidinae			
40	Angled Castor	<i>Ariadne ariadne</i> Linnaeus	<i>Lantana camara</i> , <i>Tagetis erecta</i> and <i>Tridax procumbens</i> .
41	Common Castor	<i>Ariadne merione</i> Cramer	<i>Lantana camara</i> , <i>Tagetis erecta</i> , <i>Tridax procumbens</i> and Mud-puddling.
42	Joker	<i>Byblia ilithyia</i> Drury	<i>Lantana camara</i> and <i>Tridax procumbens</i> .
8. Subfamily: Nymphalinae			
43	Painted Lady	<i>Vanessa cardui</i> Linnaeus	<i>Carissa congesta</i> , <i>Gnidia glauca</i> , <i>Lantana camara</i> and <i>Tridax procumbens</i> .
44	Blue Pansy	<i>Junonia orithiya</i> Linnaeus	<i>Celosia argentea</i> , <i>Lantana camara</i> , <i>Trichodesma indicum</i> and <i>Tridax procumbens</i> .
45	Yellow Pansy	<i>Junonia hierta</i> Fabricius	<i>Celosia argentea</i> , <i>Lantana camara</i> , <i>Tephrosia purpurea</i> , <i>Tridax procumbens</i> and Mud-puddling.
46	Chocolate Pansy	<i>Junonia iphita</i> Cramer	<i>Tephrosia purpurea</i> .
47	Grey Pansy	<i>Junonia atlites</i> Linnaeus	<i>Celosia argentea</i> , <i>Cosmos bipinnatus</i> , <i>Tridax procumbens</i> and Mud-puddling.
48	Peacock Pansy	<i>Junonia almana</i> Linnaeus	<i>Celosia argentea</i> .
49	Lemon Pansy	<i>Junonia lemonias</i> Linnaeus	<i>Asclepias curassavica</i> , <i>Celosia argentea</i> , <i>Tephrosia purpurea</i> and <i>Tridax procumbens</i> .
50	Great Eggfly	<i>Hypolimnas bolina</i> Linnaeus	<i>Bauhinia purpurea</i> , <i>Celosia argentea</i> , <i>Lantana camara</i> and Mud-puddling.
51	Danaid Eggfly	<i>Hypolimnas misippus</i> Linnaeus	<i>Asclepias curassavica</i> , <i>Celosia argentea</i> , <i>Lantana camara</i> , <i>Zinnia elegans</i> and Mud-puddling.
IV. Family: LYCAENIDAE 1. Subfamily: Curetinae			
52	Indian Sunbeam	<i>Curetis thetis</i> Drury	Animal Dropping and Mud-puddling.
2. Subfamily: Theclinae			
53	Silver Streak Blue	<i>Iraota timoleon</i> Stoll	Mud-puddling.
54	Large Guava Blue	<i>Deudorix perse</i> Hewitson	Mud-puddling.
3. Subfamily: Polyommatae			
55	Angled Pierrot	<i>Caleta caleta</i> Hewitson	<i>Lantana camara</i> , Animal Dropping and Mud-puddling.
56	Banded Blue Pierrot	<i>Discolampa ethion</i> Westwood	<i>Lantana camara</i> , Animal Dropping and Mud-puddling.
57	Common Pierrot	<i>Castalius rosimon</i> Fabricius	<i>Sida acuta</i> and <i>Tridax procumbens</i> .
58	Zebra Blue	<i>Leptotes plinius</i> Fabricius	<i>Celosia argentea</i> , <i>Lantana camara</i> , <i>Tephrosia purpurea</i> , <i>Tridax procumbens</i> and <i>Zizyphus mauritiana</i> .
59	Tailless Lineblue	<i>Prosotas dubiosa indica</i> Evans	<i>Celosia argentea</i> .

Table-4 cont..

60	Dark Cerulean	<i>Jamides bochus</i> Cramer	<i>Celosia argentea</i> and <i>Tridax procumbens</i> .
61	Common Cerulean	<i>Jamides celeno</i> Cramer	<i>Celosia argentea</i> , <i>Tephrosia purpurea</i> , <i>Tridax procumbens</i> and <i>Zizyphus mauritiana</i> .
62	Metallic Cerulean	<i>Jamides alecto</i> C- & R-Felder	<i>Lantana camara</i> and <i>Nothapodytes nimmoniana</i> .
63	Forget-me-not	<i>Catochrysops strabo</i> Fabricius	<i>Celosia argentea</i> .
64	Pea Blue	<i>Lampides boeticus</i> Linnaeus	<i>Celosia argentea</i> .
65	Dark Grass Blue	<i>Zizeeria karsandra</i> Moore	<i>Lantana camara</i> and <i>Tridax procumbens</i> .
66	Lesser Grass Blue	<i>Zizina otis</i> Fabricius	<i>Lantana camara</i> .
67	Tiny Grass Blue	<i>Zizula hylax</i> Fabricius	<i>Tridax procumbens</i> and <i>Zinnia elegans</i> .
68	Red Pierrot	<i>Talicauda nyseus</i> Guerin-Meneville	<i>Tridax procumbens</i> and <i>Zinnia elegans</i> .
69	Common Hedge Blue	<i>Acytolepis puspa</i> Horsfield	<i>Ageratum conyzoides</i> and Animal Dropping.
70	Lime Blue	<i>Chilades laius</i> Stoll	<i>Sida acuta</i> .
4. Subfamily: Riodininae			
71	Plum Judy	<i>Abisara echerius</i> Stoll	Mud-puddling.
Suborder : Grypcera			
V. Family: HESPERIIDAE 1. Subfamily: Coeliadinae			
72	Common Banded Awl	<i>Hasora chromus</i> Cramer	<i>Lantana camara</i> .
2. Subfamily: Pyrginae			
73	Malabar Spotted Flat	<i>Celaenorrhinus ambareesa</i> Moore	<i>Vitex negundo</i> and Mud-puddling.
74	Common Spotted Flat	<i>Celaenorrhinus leucocera</i> Kollar	<i>Celosia argentea</i> .
75	Common Small Flat	<i>Sarangesa dasahara</i> Moore	<i>Tridax procumbens</i> .
76	Fulvous Pied Flat	<i>Pseudocoladenia dan</i> Fabricius	<i>Lantana camara</i> , <i>Sida acuta</i> and Mud-puddling.
77	Tricoloured Pied Flat	<i>Coladenia Indrani</i> Moore	<i>Lantana camara</i> .
3. Subfamily: Hesperinae			
78	Dark Palm Dart	<i>Telicota ancilla</i> Herrich-Schaffer	<i>Lantana camara</i> and <i>Tridax procumbens</i> .
79	Pale palm Dart	<i>Telicota colon</i> Fabricius	<i>Lantana camara</i> .
80	Rice Swift	<i>Borbo cinnara</i> Wallace	<i>Lantana camara</i> , <i>Moringa oleifera</i> , <i>Tribulus terrestris</i> , <i>Tridax procumbens</i> and <i>Xanthium indicum</i> .
81	Small Branded Swift	<i>Pelopidas mathias</i> Fabricius	<i>Lantana camara</i> and <i>Tridax procumbens</i> .
82	Conjoined Swift	<i>Pelopidas conjuncta</i> Herrich-Schaffer	<i>Lantana camara</i> .
83	Vindhyan Bob	<i>Arnetta vindhiana</i> Moore	<i>Lantana camara</i> .
84	Indian Palm Bob	<i>Suastus gremius</i> Fabricius	<i>Lantana camara</i> .
85	Chestnut Bob	<i>Iambrix salsala</i> Moore	<i>Tridax procumbens</i> and <i>Zinnia elegans</i> .

Table 5: Descriptive statistics of the occurrence of butterfly species with seasonal variation

Season	Mean Individuals	Total Individuals	Total Species	Minimum	Maximum
Pre Monsoon	16.6	1411	83	0	37
Monsoon	10.929	929	77	0	42
Post Monsoon	24.365	2071	85	5	50

DISCUSSION AND CONCLUSIONS

The species abundance rose from the beginning of monsoon, from the months June to July and reached a peak in the months from August to November. A decline in species abundance was observed from the months December to January and continued up to the end of May. Earlier observations made by Wynter -Blyth [21] had identified two seasons as peaks, March – April and October for Butterfly abundance in India. However, our finding observed peak period in the months from August to November, in line with the findings of Kunte [8]. Bhusal and Khanal [3] reported that there is a significant correlation between species diversity and spring season, indicating the abundances of diverse species was positively affected by approaching warmer days, high relative humidity and more rainfall. These factors help to flourish diverse vegetations, which are vital food sources for many Butterfly species. Gutierrez & Mendez [6] reported that the abundance of Butterflies is not affected by altitudes but it is more related to the availability of food plants. A similar seasonal variation in species abundance was observed by Prajapati [14] in Daman of Makawanpur District of Central Nepal. Plants have importance in increasing the Butterfly diversity and their abundance in the area. In study area, maximum species of Butterflies were recorded in forest biotope than followed by plantation, scrub, grassland and boticanal garden biotope. However, grassland and botanical garden are not observed as rich biotopes; heavy grazing pressure on grassland and use of pesticides in gardens has adversely affected diversity of Butterflies in these biotopes. Nimbalkar [11] reported 64 butterfly species from Bhor Tahsil and 58 species on plantation biotope; however, forest biotope is rich in butterfly diversity in Maval Tahsil. The nectar flowering plants visited by Butterflies, as observed in our findings, namely *Alstonia scholaris*, *Ageratum conyzoides*, *Nothapodytes nimmoniana*, *Carissa congesta*, *Asclepias curassavica*, *Calotropis gigantea*, *Senecio bombayensis*, *Zinnia elegans*, *Cassia auriculata*, *Urena lobata*, *Pentas karmesiana*, *Gnidia glauca* and *Vitex negundo* are not reported by Tiple [18, 19] in their study area of Amravati University Campus and Nagpur, Central India, respectively. Nimbalkar [11] reported 19 nectar food plants belonging to ten plant families from Bhor Tahsil of Pune District. Maval Tahsil is rich in floral diversity as compared to earlier reports from Amravati University Campus, Nagpur and Bhor Tahsil. The herbs from study area namely *Celosia argentea* and *Tridax procumbens* are more used by the Butterflies, probably due to long flowering period. The shrub *Lantana camara* is having flowering period throughout the year, so it is more used by Butterflies as their food plant. A few species of Butterflies were observed feeding on either animal droppings or on ripe fruits or while mud puddling (Table 4). Mud puddling is usually observed in males, but in our findings females of *Hypolimnas bolina* & *Hypolimnas misippus* Butterfly species were observed doing mud puddling. Mathew and Binoy [10] reported that females of *Appias albina darada* were found to be very much active in mud puddling. The requirement of more water & salt could be the reason for this. Among the insects, Butterflies occupy a vital position in ecosystems and their occurrence and diversity are considered as good indicators of the health any given terrestrial biotope [1, 8, 17]. In study area, events like grazing pressure, influx of tourist, construction of highway, use of pesticides and change in land use pattern, are mainly responsible for diversity loss of both Butterflies and plants. Members from family Lycaenidae largely feed on grasses and cattle grazing affected their diversity and abundance. In the United Kingdom grazing by cattle and sheep has been practiced as a management tool [13] and there is ample scope for such practices in India. A total of nine species of Butterflies from study area are designated as Rare while describing their status and justifies its inclusion in Scheduled List suggesting the need for its strict conservation measures (Table 2). As reported by Kunte [8], an objective revision of the Scheduled List will be very useful in providing appropriate and adequate legal protection to Indian Butterflies. Details of habitat used by Indian Butterflies are not known. Fresh information on the habitat and microhabitats of Butterflies will be very useful in all the regions of India [8]. These findings will prove to have their own importance to fill the lacunae on seasonal abundance, biotopes and nectar food plants of butterflies from study area, as depleting biodiversity, unlike any other environmental threat, is irreversible.

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