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Diversity of Butterflies (Lepidoptera: Rhopalocera) of Jhargram District, West Bengal, India

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***Abstract*-- Butterflies are the most attractive insects in the world due to its coloration, thus also one of the most-known groups. Present study shows that butterfly diversity of Jhargram district for first time by providing annotate checklist of butterflies with scientific name. Study represents a total number of 132 butterfly species including 84 genera and 6 families. Out of these 6 families Lycaenidae is the most dominant including 42 species and 31 genus, followed by Nymphalidae comprising 38 species and 20 genus, Hesperidae consisting 19 species and 16 genus, Pieridae containing 18 species and 12 genus, Papilionidae 13 species and 4 genus, and Riodinidae with 2 species and single genus. During our exhaustive surveys we conclude that Grass Jewel (*Chilades trochylus*) and Blue Mormon (*Papilio polymnester*) is the smallest and largest butterfly respectively in Jhargram. All taxonomical data were collected by Pollard Walk (transect) method with regular intervals for 3 years by group surveys at different selected location of Jhargram district. Butterflies are very sensitive to ecological parameters, and well known for their ecological services, though some are pest of several plants. Rapid deforestation, urbanization and loss of sense of humor cause serious threats to the species and lead the species became extinct. Present paper contribute the first attempts for understand the butterfly diversity of Jhargram with their respective photographs, wingspan and abundance, diversity measuring indices, life cycle and ecological services.**

***Key words* - Jhargram district, Lycaenidae, Pollard Walk method, Ecological services, Deforestation.**

I. INTRODUCTION

Butterfly is an abundant and diverse group of insects in the terrestrial ecosystem of the world. They are very attractive due to their coloration, as well as they are good bio-indicator. Their population is seasonally fluctuating rapidly due to climatic variation and also environmental degradation. Various indices are used to measure the richness and evenness of butterfly, such of them are 1. Shannon Weiner Index (H'= -Σpi lnpi), where, H'= Shanon-Weiner diversity index, pi = Relative abundance of each species, calculated as (n/N), n= the number of individuals of a species, N= Total number of individuals in the sample, ln= Log normal, and 2. Pielou's evenness index (J'=H'/Hmax), where, H' is the number derived from Shannon-Weiner index and H'max is the maximum possible value of H'. The ecological data was manipulated and analysed by PALSTAT (paleontological statistic) software.

Butterfly used as biological model in study of insect-plant interaction and in other conservation tools. They are good pollinator of various nectar plants such as Cabbage white butterfly (*Pieris canidia*) is a useful pollinator of bitter gourd, *Momordica charantia* (Cucurbitaceae). They are sometime act as pest in flowering plants as for example abundant of milkweed butterfly, *Danaus* spp. in paddy field. Their abundance and evenness indicates the health of an ecosystem thus they are important for habitat conservation strategies (Dwari et al, 2017).

During the lifespan, a butterfly undergoes complete metamorphosis (i,e Holometabolus). Life cycle consisting of four distinct stages; egg, caterpillar, pupae and adult. After internal fertilization female find ideal food plants to lay eggs, some species lays eggs individually (*Atrophaneura aristolochiae*) while some lay in cluster (*Acraea terpsicore*). Protective egg shell contains chitin. Eggs hatch out and

caterpillar emerges, their first food is empty eggshell or chorion. Caterpillar generally shaped like a cigar. They eat and grow very rapidly, and are restless. Some caterpillar is plain smooth (ex. *Danaus chrysippus*) while some are bulbous, spiny and plumose (ex. *Euthalia aconthea*). They face various natural enemies and predators and finally cease feeding and settle down as pupae. They anchor themselves on a twig or stones by last pair of sucker legs and sometimes by silken threads. Pupae finally turn into crystalline structure and stouter before emergence as adult. The duration of each developmental stages is varies on species, environmental condition especially humidity, quality and quantity of food etc. We studied few life cycles, of which Common mormon (*Papilio polytes*) is well studied. Duration from egg lay to various developmental modifications is given: up to hatch is 3.6 days, up to first instar 5.9 days, up to fifth instar 32.7 days, up to pupate 13.8 days and from egg lay to adult required about 35 days.

Worldwide, more than 28,000 species of butterflies present, of which about 80 percent found in tropical regions (Saha, 2017). The Indian subcontinent is home of about 1,504 species of butterflies (Saha, 2017) and West Bengal contain is about 452 species (Dwari et al, 2017). As butterflies is being an effective pollinator and ecosystem health indicator, exploration of butterfly fauna thus becomes important in recognizing and preserving potential habitats under threats.

A. Eggs

B. 5th instar larva

C. Starting Pupate

D. Adult emergence.

Figure1. (A-D) Sequences of developmental events in Common mormon (*Papilio polytes*) butterfly.

Jhargram is a newly born district, apart from Paschim Medinipur on 4th April, 2017 as 22nd district of West Bengal. It comprises natural beauties, various tourist spots, as well as mythical place. It is a elevated slopes of Chota Nagpur plateau, on north it bounded geographically by Bankura and Purulia districts, on south it covered by Odisha boarder after Dantan, on east it cover by the Paschim Medinipur district, river Kangsabati and partly by Subernarekha, and on west it bordered by Jharkhand state after Chakulia and Gidhni.

Present study represents a checklist of butterfly for first time from Jhargram which comprises total 132 species, 84 genus and 6 families and mentioning their occurrence at different season, also represent interesting photographs taken during our field surveys. It might be helpful for future researcher to formulate the effective strategies for conservation of this interesting group of insects as well as their natural habitats.

II. MATERIALS & METHODOLOGY

To understood the butterfly diversity of Jhargram we follows various techniques such as prepare study team, data sampling protocol, selection of study areas and various instruments and guidance used etc., which are describe below.

Sampling Method

During the survey of three years we follow Pollard Walk (transect) method to estimate the species composition of butterfly. Randomly we select some straight routes along the forest floor, mid slope, low vegetation area and riverbank side etc. within our mentioned study sites. Five study teams record butterfly by help of binoculars, digital cameras and mobile cameras during slow and steady pace walking and monitoring both side of the routes. Species identifies visually or rarely may it require captured by butterfly net and release unharmed after proper identification and imaging. We divides our study day time within several periods, like early morning, morning, post morning, pre-noon, noon, afternoon and evening (time duration are depends on seasons), and monitored the species in different season at a different day interval. Record the species by putting the data in butterfly transect data form (Pollard, 1977) and follow maximum rule of the standard Pollard Walk method. After the daytime surveys, during night we collect all the data form from five study teams and conclude the data and identify the species properly by using field guides, supplied documents and various suggestions from butterfly experts.

Study Sites

Pioneer to our exhaustive survey we select five study sites as well as five regarding survey teams. Five study sites roughly cover the Jhargram district as a whole and chosen as butterfly hotspot sites. These five study sites were; **1**. Jhargram town outskirt (N 22.45^0 & E 86.98^0), **2**. Chilkigarh Kanak Durga Temple, Jamboni (N 22.45^0 & E 86.88^0), **3**. Ex-Situ Conservation Site of Medicinal Plants, Amlachati (N 22.38^0 & E 87.04^0), **4**. Binpur-I which situated near Tarafeni and Kangsabati river basin (N 22.59^0 & E 86.92^0) and **5**. Gopiballavpur I which situated near Subarnarekha river basin (N 22.20^0 & E 86.88^0). Routine survey for three years (from April, 2016 to March, 2019) on these sites maximally covered up the butterfly diversity.

Instruments Used

Nikon ACULON A211-10-22 × 50 8252 Binocular is used for clear observation from long range, and Canon EOS 3000D 24.1 Digital SLR Camera with EF S18-55 II lens, Canon EOS 80D and Canon Powershot A490 is used for proper photography. Several mobile cameras have been used like, Oppo A3s (CPH1803), Realme xt (RMX1921) and Redme

during group surveys. 4A Garmin GPS machine was used to track the forest region and different coordinates of study sites.

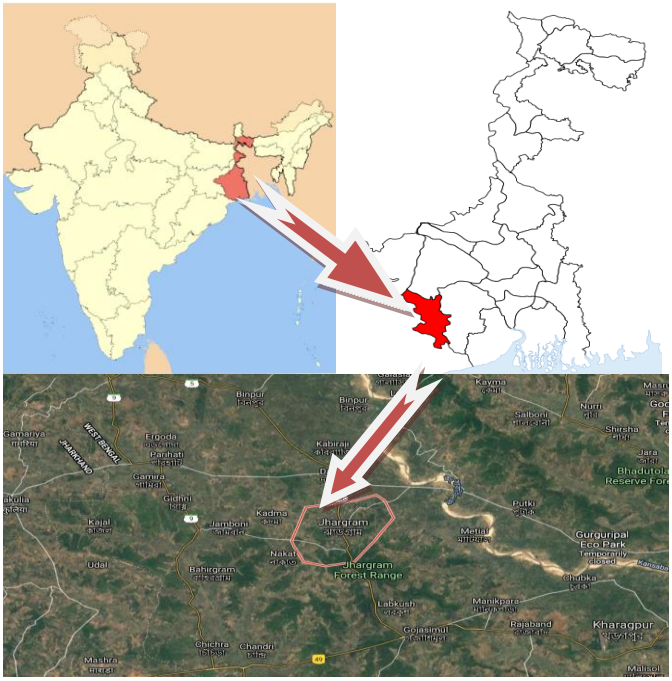

Figure 2. Study area, **I**-India, **II**-West Bengal and **III**-Google satellite image of Jhargram.

Field Guides Used

Mainly three guide books were used to identify the butterfly during field surveys and analysis of prominent photographs as named, "The Text Book of Indian Butterflies" by Issac Kehimker, BNHS publication, "Butterfly of India" by Arun Pratap Singh, Om Book International Publication and "Butterflies of Peninsular India" by Krushnamegh Kunte, University Press (India) Private Limited.

III. Results

Butterflies are insects in the Macro-lepidopteran clade Rhopalocera from the order Lepidoptera (scaly wing insect), which also includes moths.

Kingdom- Animalia
Phylum- Arthropoda
Class- Insecta
Order- Lepidoptera
Sub-order- Rhopalocera

The Suborder Rhopalocera divided into two Super-family; 1) Hesperioidea (Skippers) 2) Papilionoidea (True butterflies). Our three year's (from April, 2016 to March, 2019) survey to Jhargram convey a total 132 butterfly species within 84 genera and six families for first time. It represent their abundance (abbreviated in the table as VC, very common, LC, less common, C, common and R, rare) in study site on basis of frequency of sighting, and also wingspans (after Wynter-Blyth, 1957 and ifoundbutterflies.org). The largest and smallest butterfly of Jhargram is Blue Mormon (*Papilio polymnester*, wingspan 120-150 mm) and Grass Jewel (*Chilades trochylus*, wingspan 8-12 mm) respectively and also in West Bengal. While in India the largest butterfly is Southern Birdwing (*Troides minos*, wingspan 140-190 mm) and smallest is Grass Jewel (*Chilades trochylus*, wingspan 8-12 mm), and in the world, the largest butterfly is Queen Alexandra's Birdwing (*Ornithoptera alexandrae*, wingspan 250-300 mm) and smallest is Western Pygmy Blue (*Brephedium exilis*, wingspan 7-11 mm). The following article also illustrates some interesting colorful picture of butterflies that captured during surveys. Our study concludes that the Lycaenidae is most dominant family comprises 31.3% while Riodinidae is least dominant comprises 1.5% of total species. Common Pierrot (*Castalius rosimon*), Common Crow (*Euploea cora*), Common Redeye (*Matapa aria*), Common Grass Yellow (*Eurema* hecaba), Common Rose (*Atrophaneura aristolochiae*) and Plum Judy (*Abisara echerius*) are most commonly found to Jhargram district, respective to the family Lycaenidae (31.3%), Nymphalidae (29%), Hesperidae (14.5%), Pieridae (13.7%), Papillionidae (9.9%) and Riodinidae (1.5%).

TABLE 1
Family wise Checklist of Reported Butterflies

Sl. No.	Common Name	Scientific Name	Wingspan (in mm)	Abundance
A. Family- Lycaenidae (Blues butterflies): 31.3 %				
1	Indian Oakblue	*Arhopala atrax*	30 to 40	C
2	Large Oakblue	*Arhopala amantes*	45 to 57	C
3	Falcate Oakblue	*Mahathala ameria*	38 to 42	R
4	Lime Blue	*Chiladis lajus*	26 to 30	C
5	Common Lineblue	*Prosotas nora*	18 to 25	C
6	Tailless Lineblue	*Prosotas dubiosa*	22 to 26	LC
7	Gram Blue	*Euchrysops cnejus*	25 to 33	C
8	Zebra Blue	*Leptotis plinius*	22 to 30	LC
9	Tiny Grass Blue	*Zizula hylax*	16 to 24	C
10	Dark Grass Blue	*Zizeeria karsandra*	18 to 24	C
11	Pale Grass Blue	*Pseudozizeeria maha*	26 to 30	C
12	Common Hedge Blue	*Acytolepis puspa*	28 to 35	R
13	Mandarin Blue	*Charana mandarinus*	36 to 38	LC
14	Common Guava Blue	*Virachola isocrates*	35 to 40	C
15	Common Acacia Blue	*Surendra quercetorum*	28 to 32	LC
16	Pea Blue	*Lampides boeticus*	22 to 28	LC
17	Silver Streak Blue	*Iraota timoleon*	40 to 48	C
18	Common Ciliate Blue	*Anthene emolus*	28 to 35	C
19	Pointed Ciliate Blue	*Anthene lycaenina*	24 to 29	C
20	Purple Leaf Blue	*Amblypodia anita*	85 to 110	C
21	Common Silverline	*Spindasis vulcanus*	26 to 34	VC
22	Long-Banded Silverline	*Spindasis lohita*	30 to 42	C
23	Common Pierrot	*Castalius rosimon*	24 to 34	VC
24	Rounded Pierrot	*Tarucus extricatus*	23 to 28	C

25	Plains Cupid	*Chilades pandava*	25 to 35	C
26	Indian Cupid	*Everes lacturnus*	20 to 25	C
27	Forget me not	*Catochrysops strabo*	25 to 35	LC
28	Common Cerulean	*Jamides celeno*	27 to 40	C
29	Yamfly	*Loxura atymnas*	36 to 40	R
30	Slate Flash	*Rapala manea*	30 to 33	LC
31	Common Red Flash	*Rapala iarbus*	32 to 37	C
32	Indigo Flash	*Rapala varuna*	29 to 35	LC
33	Monkey Puzzle	*Rathinda amor*	26 to 28	LC
34	Indian Sunbeam	*Curetis thetis*	40 to 50	LC
35	Angled Sunbeam	*Curetis acuta*	35 to 45	LC
36	Plains Blue Royal	*Tajuria jehana*	130 to 190	LC
37	Dark Blue Royal	*Pratapa icetas*	120 to 130	LC
38	Peacock Royal	*Tajuria cippus*	33 to 40	LC
39	Chocolate Royal	*Remelana jangala*	31 to 35	LC
40	Grass Jewel	*Chilades trochylus*	8 to 12	LC
41	Quaker	*Neopithecops zalmora*	20 to 22	R
42	Apefly	*Spalgis epius*	10 to 14	LC
B. Family- Nymphalidae (Brush-footed butterflies): 29 %				
1	Common Crow	*Euploea cora*	85 to 95	VC
2	Double banded crow	*Euploea sylvester*	95 to 105	C
3	Brown King Crow	*Euploea klugii*	85 to 100	VC
4	Blue Pansy	*Juninio orithya*	45 to 60	C
5	Grey Pansy	*Junonio atlites*	55 to 65	VC
6	Peacock Pansy	*Junonio almana*	60 to 65	VC
7	Yellow Pansy	*Junonia hierta*	45 to 60	LC
8	Chocolate Pansy	*Junonia iphita*	50 to 80	C
9	Lemon Pansy	*Junonia lemonias*	40 to 60	C
10	Common Sailer	*Neptis hylas*	50 to 60	VC
11	Chestnut-Streaked Sailer	*Neptis jumbah*	60 to 70	C
12	Yellow Sailer	*Neptis ananta*	56 to 68	C
13	Baronet	*Euthalia nais*	60 to 70	VC
14	Monarch butterfly	*Danaus plexippus*	80 to 90	LC
15	Common Palmfly	*Elymnias hypermnestra*	60 to 80	VC
16	Common Castor	*Ariadne merione*	45 to 60	VC
17	Angel Castor	*Ariadne ariadne*	45 to 60	C
18	Tawny Coster	*Acraea terpsicore*	50 to 65	VC
19	Common Bushbrown	*Mycalesis perseus*	38 to 55	VC
20	Common Eveningbrown	*Melanitis leda*	60 to 80	VC
21	Dark Eveningbrown	*Melanitis phedima*	60 to 85	VC
22	Bamboo Treebrown	*Letha europa*	65 to 75	C
23	Common Four-ring	*Yapthima huebneri*	30 to 35	C
24	Common Five-ring	*Yapthima baldus*	30 to 40	VC
25	Great Eggfly	*Hypolimnas bolina*	70 to 110	VC
26	Danaid Eggfly	*Hypolimnus misippus*	55 to 90	LC
27	Plain Tiger	*Danaus chrysippus*	70 to 80	VC
28	Stripped Tiger	*Danaus genutia*	72 to 100	C
29	Blue Tiger	*Tirumala limniace*	90 to 100	C
30	Common Leopard	*Phalanta phalantha*	50 to 60	C
31	Black Rajah	*Charaxes solon*	70 to 80	LC
32	Tawny Rajah	*Charaxes bernardus*	85 to 110	LC
33	Common Baron	*Euthalia aconthea*	55 to 80	C
34	Gaudy Baron	*Euthalia lubentina*	60 to 80	LC
35	Commander	*Moduza procris*	60 to 75	LC
36	Orange Oakleaf	*Kallima inachus*	85 to 110	R
37	Common Duffer	*Discophora sondaica*	80 to 90	R
38	Painted Courtesan	*Euripus consimilis*	70 to 88	R
C. Family- Hesperidae (Skippers): 14.5 %				
1	Common Redeye	*Matapa aria*	45 to 50	VC
2	Rounded Palm-redeye.	*Erionota torus*	65 to 70	C
3	Conjoined Swift	*Pelopidas conjuncta*	45 to 52	VC
4	Straight Swift	*Parnara guttatus*	32 to 38	C
5	African Straight Swift	*Parnara bada*	30 to 40	LC
6	Paintbrush Swift	*Baoris farri*	43 to 48	C
7	Rice Swift	*Borbo cinnara*	60 to 70	C
8	Grass Demon	*Udaspes folus*	40 to 48	LC
9	Indian Palm Bob	*Suastus gremius*	32 to 45	C
10	Chestnut Bob	*Lambrix salsala*	23 to 27	LC
11	Indian Skipper	*Spialia galba*	24 to 27	C
12	Grass Skipper	*Hesperia comma*	20 to 30	C
13	Dark Palm Dart	*Telicota ancilla*	33 to 36	LC
14	Pale Palm Dart	*Telicota colon*	30 to 40	LC
15	Common Snow Flats	*Tagiades japetus*	38 to 45	R
16	Ultra Snowflat	*Tagiades ultra*	37 to 43	R
17	Tree Flitter	*Hyarotis adrastus*	38 to 48	LC
18	Lesser Dart	*Potanthus omaha*	18 to 24	C
19	Smaller Dartlet	*Oriens goloides*	22 to 27	C
D. Family- Pieridae (White and Yellows butterflies): 13.7 %				
1	Common Grass Yellow	*Eurema hecaba*	40 to 50	VC
2	One Spot Grass Yellow	*Eurema andersoni*	38 to 45	C
3	Three Spot Grass Yellow	*Eurema blanda*	40 to 45	VC
4	Tree Yellow	*Gandaca harina*	44 to 46	C
5	Common Albatross	*Appias albina*	60 to 75	C
6	Chocolate Albatross	*Appias lyncida*	55 to 70	C
7	Stripped Albatross	*Appias libythea*	50 to 60	LC
8	Common Wanderer	*Pareronia valeria*	65 to 80	VC
9	Common Jezebel	*Delius eucharis*	66 to 83	VC
10	Painted Jezebel	*Delias hypareta*	72 to 88	C
11	Common Gull	*Cepora nerissa*	40 to 65	VC
12	Common Emigrant	*Catopsilia pomona*	50 to 80	VC
13	Mottled Emigrant	*Catopsilia pyranthe*	50 to 70	C
14	Psyche	*Leptosia nina*	35 to 50	C
15	Pioneer	*Belonois aurota*	40 to 45	C
16	Yellow Orange Tip	*Ixias pyrene.*	50 to 70	C

17	Indian Cabbage White	*Pieris canidia*	45 to 60	VC
18	Small Salmon Arab	*Colotis amata*	35 to 50	C
E. Family- Papilionidae (Swallowtails butterflies): 9.9 %				
1	Blue Mormon	*Papilio polymnester*	120 to 150	C
2	Common Mormon	*Papilio polytes*	90 to 100	VC
3	Great Mormon	*Papilio memnon*	120 to 150	LC
4	Crimson Rose	*Pachliopta hector*	90 to 120	LC
5	Common Rose	*Atrophaneura aristolochiae*	80 to 110	C
6	Common Mime	*Papilio clytia*	90 to 100	VC
7	Lime Butterfly	*Papilio demoleus*	80 to 110	VC
8	Red Helen	*Papilio helenus*	100 to 120	LC
9	Common Banded Peacock	*Papilio crino*	110 to 130	C
10	Common Jay	*Graphium doson*	70 to 80	VC
11	Tailed Jay	*Graphium agamemnon*	85 to 100	C
12	Spot Sword Tail	*Graphium nomius*	75 to 90	C
13	Common Bluebottle	*Graphium sarpedon*	80 to 90	C
F. Family- Riodinidae (Metalmark butterflies or Punches and Judies): 1.5%				
1	Plum Judy	*Abisara echerius*	41 to 52	LC
2	Double-banded Plum Judy	*Abisara bifasciata*	40 to 50	R

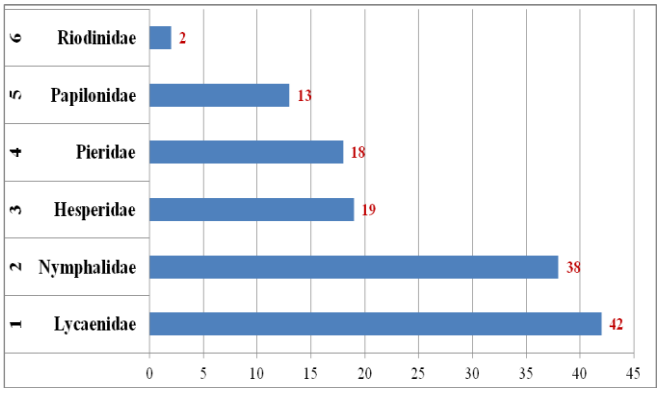

Figure 3: Bar diagram show the no. of butterfly species reported in Jhargram district

IV. Discussion

Jhargram is biodiversity rich region due to its humid temperate climate and dense vegetation, low human population density and lack of industrialization and urbanization also play important roles to maintain it. Butterfly is a well studied insect group (hexapods having three pair of thoracic legs) due to its attractive coloration and recreation values. Earlier several authors represent a variable number of species and genus from several part of West Bengal [61 genera from West Bengal State University Campus[23] by Saha et al., 75 genera and 106 species from Howrah district[9] by Dwari et al., 54 genera and 69 species from Singur [8] by Dey et al. and 82 species from Medinipur Urban area by Biswas et al., 2019]. This paper represents a total 132 species and 84 genera from Jhargram for first time which may helpful the future researchers especially entomologist and environmentalists. There was no previous survey on butterflies, so every species are newly reported from that region and extend the geographical range of some rare species. This region contain huge butterfly diversity due to suitable environment, abundance of host plant (members of the family Apocynaceae, Acanthaceae, Verbenaceae, Dipterocarpaceae, Poaceae and Malvaceae etc.), low human interference and less pollution etc. Though each butterfly species are resident of very specific host plant, some have a wider range. Few are mention **1**) Plain tiger (*Danaus chrysippus*) live on *Caltropis gigantea* (Apocynaceae), **2**) Common mormon (*Papilio polytes*) and Red helen (*Papilio helenus*) live on members of Rutaceae, *Murray koengil* and *Citrus lemon* respectively, **3**) *Michalea champaca* (Magnoliaceae) is a good host for common mime (*Papilio clytia*) butterfly, **4**) Tailed jay (*Graphium agamemnon*) live on *Saraca asoca* (Detaroideae), **5**) Blue tiger (*Tirumala limniace*) live on *Ixora coccinea* (Rubiaceae), **6**) Tawny coster (*Acraea terpsicore*) feed on yellow alder plant (*Turnera* ulmifolia) of family Passifloraceae and **7**) *Lantana camara* (Verbenaceae) is a ideal host for both Common castor (*Ariadne merione*) and Angle castor (*Ariadne ariadne*) butterflies (Fig.4-9). There are several risks during survey to rural forest areas, such as chase of Asian elephant as it is a corridor for them, communicate with tribal and sub-tribal peoples (lodha, munda, savar, santal etc.), very uncertain natural calamities like heavy rain and storm, etc. Our futures works to measure richness, abundance and dominance of butterfly species by help of bio-statistical tools. It may also help for ecological modeling and conservation of nature. We hope more exhaustive monitoring in future may report more butterfly species from that area.

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Large Oakblue


Hedge Blue


Yamfly


Monkey Puzzle


Common Cerulean


Common Pierrot


Asian Zebrablue


Apefly


Forget me not


Guava Blue


Indian Cupid


Indian Quaker


Leaf Blue


Lime Blue


Long-banded Silverline


Pale Grass Blue


Pea Blue


Plain Cupid


Pointed Ciliate Blue


Slate Flash

Fig. 4. Lycaenidae family Butterflies


Tawny Coster


Commander


Common Leopard


Tawny Rajah


Painted Courtesan


Gaudy Baron


Common Baron


Blue Tiger


Angle Castor


Baronet


Chestnut Streaked Sailor


Common Evening Brown


Common Castor


Common Crow


Common Palmfly


Orange Oakleaf

Fig.5. Nymphallidae family butterflies


Three spot Grass Yellow


Common Grass Yellow


Common Emigrant


Mottled Emigrant


Common Gull


Psyche


Pioneer


Common Wanderer

Fig.6. Pieridae family butterflies

Common banded Peacock

Common Rose

Indian Spot Swordtail

Tailed Jay

Red Helen

Blue Mormon

Common Lime

Common Mime

Fig.7. Papilionidae family butterflies

Grass Demon

Indian Skipper

Lesser Dart

Pale Palm Dart

Ultra Snow flats

African Straight Swift

Rice Swift

Indian Palm Bob

Small Dartlet

Tree Flitter

Red Eye

Fig.8. Hesperidae family butterflies

Plum Judy

Fig.9. Riodinidae family butterflies

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