

# ADDITIONAL DATA TO SEASONALITY OF BUTTERFLIES (RHOPALOCERA: LEPIDOPTERA) FROM NALLAMALA HILLS, SOUTHERN ANDHRA PRADESH, EASTERN GHATS, INDIA.

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## ABSTRACT:

A study was carried out during the period of January 2016 to December 2016. The butterflies were collected from different altitudes of Nallamala hills (Dornala, Velugodu, Atmakur, Yerragundapalem, Pullala Cheruvu, Sundipenta and Srisailam), Eastern Ghats of Southern Andhra Pradesh, India. Ninety-four species of butterflies from 56 genera, 15 subfamilies under five families were documented. The highest numbers of species were recorded from the family Nymphalidae (32%) followed by Pieridae (30%), Lycaenidae (15%), Papilionidae (13%), and least number of species were recorded from Hesperidae (10%). The present study also deals with species dominance, evenness, and diversity variations and observations that were made on the basis of different seasonal occurrence & altitudes and later. We also documented the rare butterflies in the study area, which acknowledges the value of this region for conservation.

**Key words:** Andhra Pradesh, Butterflies, Diversity, Eastern Ghats, Seshachalam hills, Nallamala hills.

## INTRODUCTION

Butterflies are an abundant and diverse group of animals and a conspicuous part of virtually all the world's terrestrial ecosystem, important components of biodiversity, and are ecologically important due to the role they play in the food chain of a forest ecosystem (Singh, 2011). The need for conservation of insects is increasing with each year and the butterflies are considered to be the important flagships for insect conservation (New *et al.*, 1995; Smetacek, 1996; Venkata Ramana, 2010 & 2011). In the past few decades, butterfly populations in India have declined (Grewal, 1996), and it is often suggested that captive rearing/breeding and releasing of butterflies in the wild will help restock at-risk populations and serve as a means of conservation (Nicholls & Pullin, 2000; Mathew, 2001; Crone *et al.*, 2007; Schultz *et al.*, 2008). The Eastern Ghats is a series of low hills, which run parallel to the east coast of India. The series of isolated hills runs from Orissa (south of the Mahanadi) southwards through Andhra Pradesh to central Tamil Nadu (Kehimkar, 2008). The vegetation in the study area has deciduous forests with patches of moist deciduous and evergreen to semi evergreen forests (Prasanna Kumar *et al.*, 2011, 2013). In the past 89 species were recorded/identified in Nallamala study region (Thulasi Rao *et al.*, 2004).

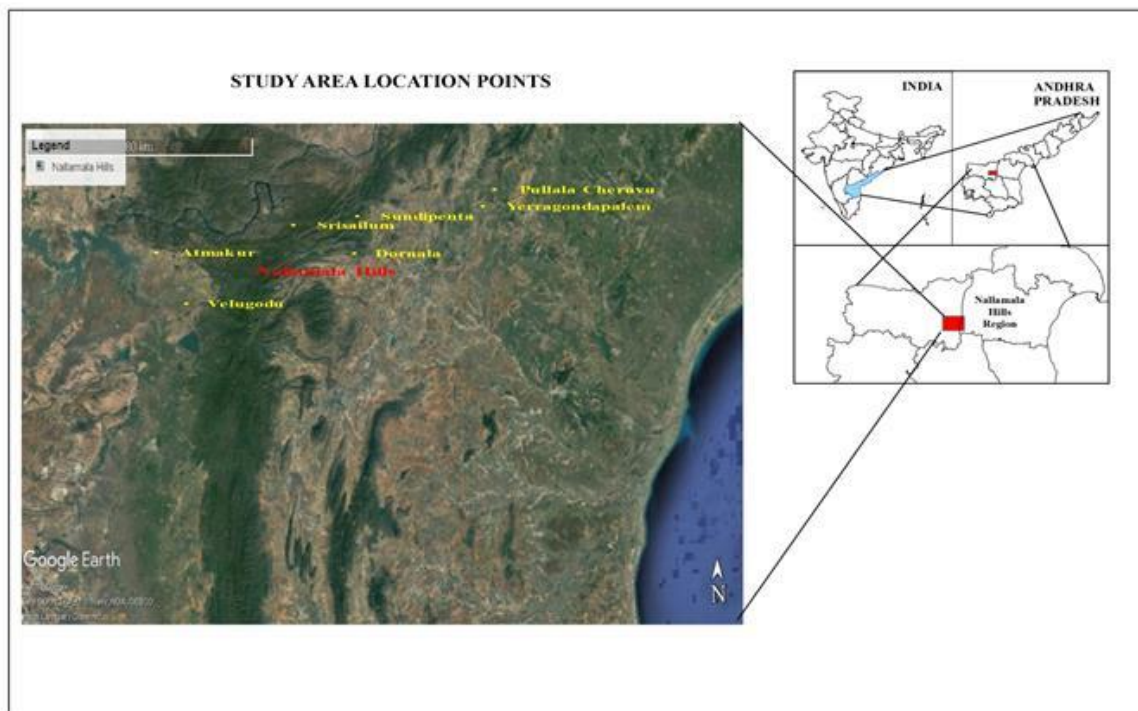
The Nallamalas ( $15^{\circ}20' - 16^{\circ} 31''\text{N}$ ;  $78^{\circ} 30' - 80^{\circ} 10''\text{E}$ ) is the group of low hill ranges in the central part of Eastern Ghats. It is an unbroken chain of rugged hills spread over  $7,640 \text{ Km}^2$  (Srinivasulu & Nagulu, 2002). The Nallamalas is a section of the Eastern Ghats which stretch primarily over Kurnool, Nellore, Guntur, Prakasam, Kadapa and Chittoor districts of the state of Andhra Pradesh and Mahabubnagar, Nalgonda districts of the state of Telangana, in India. They run in a nearly north-south alignment, parallel to the Coromandel Coast for close to 430 km between the rivers, Krishna and Pennar. The flat Palnadu basin marks its northern boundaries while in the South; it merges with the Tirupati hills. An extremely old system, the hills have extensively weathered and eroded over the years. The average elevation today is about 520 m, which reach 1100 m at Bhairani Konda and 1048 m at Gundla Brahmeswara. Both of these peaks are in a northwesterly direction from the town of Cumbum.

There are also many other peaks above 1100 m. The present study aims to assess the diversity and record the list of butterfly fauna in Nallamala hills from January 2016 to December 2016.

## MATERIALS AND METHODS

### Study area:

The present study was conducted in different regions of Nallamala hills of Eastern Ghats. The Nallamala Forests are probably the largest stretch of undisturbed forest in south India apart from the large part of the forest is a part of the Nagarjunsagar - Srisailem Tiger Reserve that has a viable tiger population (Mohammed *et al*, 2011). They are considered an important biodiversity area of four country Dornala [ $15^{\circ}53' 58.77''\text{N}$ ;  $79^{\circ} 05' 53.07''\text{E}$ ], Velugodu [ $15^{\circ}43' 06.20''\text{N}$ ;  $78^{\circ}34' 14.84''\text{E}$ ], Yerragundapalem [ $16^{\circ} 02' 34.34''\text{N}$  ;  $79^{\circ}18' 21.88''\text{E}$ ], Atmakur [ $15^{\circ}52' 21.53''\text{N}$ ;  $78^{\circ}35'19.10'' \text{E}$ ], Pullala Cheruvu [ $16^{\circ}09' 11.28''\text{N}$ ;  $79^{\circ}25' 49.09''\text{E}$ ], Sundipenta [ $16^{\circ}05' 05.69''\text{N}$   $78^{\circ}53' 56.56''\text{E}$ ], and Srisailem [ $16^{\circ}06' 46.64''\text{N}$ ;  $78^{\circ}49' 16.23''\text{E}$ ]. (Fig.-1)



**Figure 1:** Nallamala Hills

## Datacollection

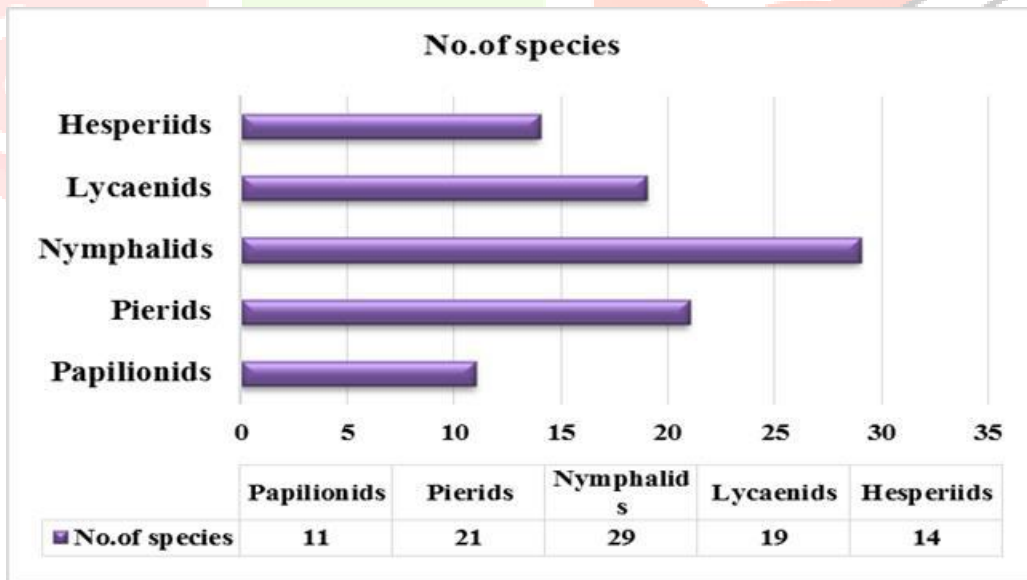
The butterfly data was collected using “Pollard walk” method (Pollard 1977; Pollard *et al.*, 1993). Regular sampling was conducted thrice a month in each study zone from January 2016 to December 2016. Sampling was carried out in suitable weather conditions, from 08.00hrs – 16.00hrs. We applied line transects of about 1000 meter in length which was divided into five segments of 200 meters. Each transect was observed 3 times and the number of individuals per species was recorded from all the five segments. Altogether 94 species were recorded within 12 months and the butterfly data was collected in every month of the year.

## Transects and butterfly data

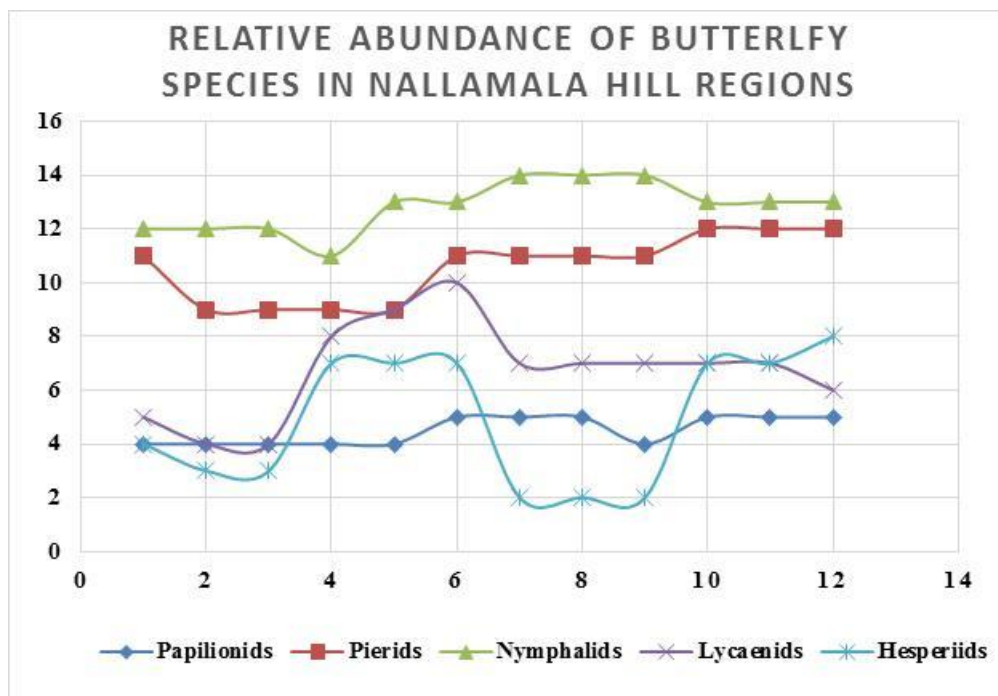
The entomological collection, occasional rearing of larval and field observations were made during January 2016 to December 2016. The counts were conducted along fixed transects of about 1000 meters, consisting of smaller sections (200 meters), each with a homogeneous habitat type. In the field work, a record of all butterflies in an imaginary box 2.5 meters to their left, 2.5 meters to their right, 5 meters above them and 5 meters ahead of them (Van Swaay CAM, 2002). The more dominant butterflies were observed directly and recorded in the field but cryptic species were photographed and identified later on by using specific guide books (Wynter- Blyth, 1957; Kunte 2000a; Kehimkar 2008) and in consultation with the Envi. - Zoological Survey of India (ENVIZSI). - If required.

## Diversity calculation:

The total number of individuals collected under each identified species in different habitats was recorded and diversity indices namely dominance index, Shannon’s diversity indices ( $H'$ ), and evenness index ( $e^{H'/S}$ ) were calculated using PAST software (PAST; version= 2.02).



**Figure 2:** Family wise richness in the Butterflies of Nallamala Hills



**Figure 3:** Month wise Relative abundance of butterfly species in the vegetation's of Nallamala hill Regions of The Eastern Ghats during January 2016 to December 2016.

#### Diversity Indices:

Diversity, Dominance and Evenness values are collated (Table 1.). The maximum value of Shannon's diversity index (H1) was recorded in December (1.539) and June (1.559); a minimum value was recorded in March (1.415) and February (1.429). The maximum value of Simpson diversity was recorded in the month of December (0.7714) and June (0.7691) and the minimum value was recorded in March (0.7215) and February (0.7269). Maximum evenness value was recorded in the month of December (0.9317) and minimum evenness value was recorded in the month of March (0.8236). The maximum Menhinick value was recorded in the month of March & May (0.8575) and the minimum value was recorded in November (0.6804) and December (0.6934). Maximum Margalef value was recorded in the month of March & May (1.134) and the minimum value was recorded in November (1.003) and December (1.012). Larsen (1998) and Sparrow *et al.* (1994) had reported a maximum number of species from low and semi-elevated regions. Coinciding with the earlier reports, in our study, diversity of butterfly was high in lower elevation when compared to higher elevated regions. This could be due to the favorable microenvironment for their living associated with cattle grazing, agro-based human activities, dampness in rocks, sand and mud along the banks of a river etc. In addition, the lower part of the forest has more gaps for light than high altitudes with a thick canopy. Wynter-Blyth (1957) had identified two seasons, March-April, and October-November as the peak periods in India for the species diversity and abundance. We also observed maximum species diversity and abundance in the months of March-May and October-November, and there was a gradual increase during the early summer from the month of March and it reached a maximum in the month of May; a second peak was recorded in the month of October and November. Species abundance and diversity declined in two seasons, one in December-January due to extreme cold and withering of flowers (nectar source) and again in late summer, June-July due to non-availability of nectar source, over heat, and scarcity of water. In the present study, butterfly communities did show a significant variation based on the altitudes. Increasing forest fragmentation also resulted in decline in diversity of the butterflies in the study area. Hence the selected area considered the importance of conservation measures.

**Table 1:** Diversity calculation of Butterflies from Nallamala hills, Southern Andhra Pradesh, India**RESULTS AND DISCUSSION****Species composition**

In the present study, we recorded 94 species of butterflies belonging to 56 genera, 15 subfamilies distributed over five families (Table-2). Family Nymphalidae contributed a maximum number of species (29 species) followed by Pieridae (21 species), Lycaenidae (19 species), Hesperidae (14 species) and Papilionidae (11

Month / Year	Individual	Dominance (D)	Simpson_1-D	Shannon_H	Evenness_e^H/S	Menhinick	Margale	Equitability_J
Jan	44	0.2386	0.7614	1.515	0.91	0.7538	1.057	0.9414
Feb	36	0.2731	0.7269	1.429	0.8352	0.8333	1.116	0.8881
Mar	34	0.2785	0.7215	1.415	0.8236	0.8575	1.134	0.8794
Apr	36	0.2454	0.7546	1.492	0.8889	0.8333	1.116	0.9268
May	34	0.2439	0.7561	1.497	0.8938	0.8575	1.134	0.9302
Jun	43	0.2309	0.7691	1.535	0.9279	0.7625	1.063	0.9535
Jul	47	0.2331	0.7669	1.529	0.9228	0.7293	1.039	0.9501
Aug	50	0.2597	0.7456	1.465	0.8657	0.7071	1.022	0.9104
Sep	47	0.2531	0.7469	1.469	0.8688	0.7293	1.039	0.9126
Oct	50	0.2432	0.7568	1.504	0.8999	0.7071	1.022	0.9345
Nov	54	0.2394	0.7606	1.514	0.9089	0.6804	1.003	0.9406
Dec	52	0.2286	0.7714	1.539	0.9317	0.6934	1.012	0.956

species), respectively (Fig. 2 & 3). Majority number of butterflies was seen in the months of October, November. The species like *Pachliopta aristolochiae*, *Eurema hecabe*, *Euploea core*, *Jamides celeno*, *Pelopidas mathias* and *Borbocinnara* to mention a few were commonly seen, while *Papilio polytes*, *Appias albino*, *Euthalia aconthea*, *Talica danyseus*, *Hasorabadra* were found to be seasonal. Species like *Curetisthetis*, *Rathinda amor*, *Leptosianina* were occurs rarely while *Vanessa*

*indica*, *Oriensgoloides* were very rare in this study. Nymphalidae outnumbered the other families with maximum species throughout the study; this could be because of their ecological adaptation (Jigginset al. 1996), speciation and high dispersal ability (Adler et al., 1996). Similar findings were reported by Mathew and Rahamathulla (1993) and Sudeendrakumaret al. (2000) in Silent Valley in India.

**CONCLUSION**

Earlier a study from Thulasirao et al., (2007) on butterflies of Nallamala recorded 89 butterflies under 64 genera, 13 subfamilies, 05 families, Our studies, supplement 94 species under 56 genera 15 Subfamilies under five families to the butterflies at Nallamala study area. The presence of 94 Lepidoptera species, 550 and above recognized faunal species states Nallamala as one of the biodiversity rich area in the Eastern Ghats. In the present research work we have studied butterfly biodiversity and also prepared its checklist in the study areas and we observed that Family-Nymphalidae carries the highest number of species than other families and greater

diversity occurs in lower elevation compared to higher elevation due to the favorable microenvironment for their living associated with cattle grazing, agro-based human activities, dampness in rocks, sand and mud along the banks of a river etc. The result of this study can also be used to make steps on the conservation of natural habitat for lepidopteron diversity. Hence, through surveys with long term monitoring programmes will help to categorize the status of the species with the help of IUCN categories for the conservation and management of biodiversity.

### ACKNOWLEDGMENTS

Authors are grateful to all members of the Eastern Ghats Biodiversity network for their local support. We are indebted to Dr. S. P. VenkataRamana for their support and encouragement. We thank the Ministry of Environment and Forest, Government of India and the local forest department officials for their continued cooperation. Finally DST – INSPIRE New Delhi is acknowledged for providing flexible financial support.



**Table 2:** Relative abundance and seasonality of butterfly species in Nallamala hill regions of Southern Andhra Pradesh during January 2016 to December 2016.

S.No	Family/ Sub Family	Genus	Scientific name	Common name	Seasonality
	<b>Papilionidae</b>				
1	A. Papilioninae	Graphium	<i>Graphiumagamemnon</i> (Linnaeus, 1758)	Tailed jay	1-12
2		Graphium	<i>G. doson</i> Felder & Felder, 1864	Common jay	5-10
3		Graphium	<i>Graphiumnomius</i> (Esper, 1799)	Spot sword tail	6-7
4		Pachliopta	<i>Pachlioptaaristolocheiae</i> (Fabricius, 1775)	Common rose	1-12
5		Pachliopta	<i>P. hector</i> (Linnacus, 1758), Schedule I, Part II	Crimson rose	1-12
6		Papilio	<i>Papiliopolymnestor</i> Cramer, 1775	Blue mormon	10-3
7		Papilio	<i>P. polytes</i> Linnaeus, 1758	Common mormon	5-8
8		Papilio	<i>P.helenus</i> Linnaeus, 1758	Red helen	8-9
9		Papilio	<i>P. liomedon</i> Moore, 1874	Malabar banded swallowtail	1-3
10		Papilio	<i>P. crino</i> Fabricius, 1792	Common banded peacock	5-8
11		Papilio	<i>Papiliodemoleus</i> Linnaeus, 1758	Lime butterfly	3-11
	<b>Pieridae</b>				
12	A. Pierinae	Belenois	<i>Anaphaeisaurota</i> (Fabricius, 1793)	Pioneer	1-12
13		Appias	<i>Appiaslalage</i> (Doubleday, 1842)	Spot-puffin	7-2
14		Appias	<i>Appiasalbina</i> (Boisduval, 1836)	Common albatross	12-4
15		Colotis	<i>Colotisdanae</i> (Fabricius, 1775)	Crimson- tip	1-12
16		Colotis	<i>Colotis aurora</i> (Crammer, 1780)	Plain orange- tip	1-12
17		Colotis	<i>Colotisfausta</i> (Oliver, 1804)	Large salmon arab	6-11
18		Colotis	<i>Colotisamata</i> (Fabricius, 1775)	Small salmon arab	8-12
19		Colotis	<i>Colotisetrida</i> (Boisduval, 1836)	Small orange- tip	8-12
20		Cepora	<i>Ceporanerissa</i> (Fabricius,1775) Schedule II, Part I	Common gull	1-12

21		Cepora	<i>Ceporanadina</i> (Lucas, 1852)	Lesser gull	9-12
22		Delias	<i>Delias eucharis</i> (Drury, 1773)	Common jezebel	9-12
23		Leptosia	<i>Leptosianina</i> (Fabricius, 1793)	Psyche	1-3
24		Pareronia	<i>Pareroniahippia</i> (Fabricius, 1787)	Common wanderer	1-4
25		Pieris	<i>Pieriscanidia</i> , (Linnaeus, 1768)	Indian cabbage white	1-5
26		Ixias	<i>Ixias pyrene</i> , Linnaeus, 1764	Yellow orange -tip	5-12
27	B. Coliadinae	Catopsilia	<i>Catopsiliapomona</i> , Fabricius, 1775	Lemon emigrant	6-10
28		Catopsilia	<i>Catopsiliapyranthe</i> , (Linnaeus, 1758)	Mottled emigrant	1-12
29		Catopsilia	<i>Catopsiliascylla</i> (Linnaeus, 1763)	Orange emigrant	5-6
30		Eurema	<i>Euremahecabe</i> (Linnaeus, 1758)	Common grass yellow	1-12
31		Eurema	<i>Euremabrigitta</i> , (Cramer, [1780])	Small grass yellow	1-12
32		Eurema	<i>Euremablanda</i> Boisduval, 1836	Three - spot grass yellow	9-4
		<b>Nymphalidae</b>			
33	A. Danainae	Danaus	<i>Danauschrysippus</i> (Linnaeus, 1758)	Plain tiger	1-12
34		Tirumala	<i>Tirumalalimniace</i> (Cramer, 1775)	Blue tiger	10-4
35		Euploea	<i>Euploea core</i> , (Cramer, 1780) Schedule IV	Common crow	1-12
36		Euploea	<i>Euploeasylvester</i> (Fabricius, 1793)	Double-branded crow	2-4
37		Euploea	<i>Euploeaklugii</i> Moore, 1858	Brown king crow	4-5
38		Parantica	<i>Paranticaaglea</i> (Stoll, 1782)	Glassy tiger	9-11
39	B. Satyrinae	Elymnias	<i>Elymnias hypermnestra</i> (Linnaeus, 1763)	Common palm-fly	9-3
40		Enispe	<i>Enispecycnus</i> (Westwood, 1851)	Blue caliph	8-9
41		Melanitis	<i>Melanitisleda</i> (Linnaeus, 1758)	Common evening brown	9-5
42		Melanitis	<i>Melanitisphedima</i> (Cramer, [1780])	Dark evening brown	9-11
43		Mycalesis	<i>Mycalesisvisala</i> Moore, [1858]	Tamil bush brown	1-3



44	C. Biblidinae	Ariadne	<i>Ariadne merione</i> (Cramer, 1777)	Common castor	1-12
45		Byblia	<i>Bybliailithya</i> (Drury, 1773)	Joker	3-7
46	D. Limenitidinae	Euthalia	<i>Euthaliaaconthea</i> (Hewiston, 1874)	Baron	5-8
47		Euthalia	<i>Euthalianais</i> (Forster,1771)	Baronet	6-10
48		Neptis	<i>Neptishylas</i> (Linnaeus, 1758)	Common sailer	6-12
49	E. Nymphalinae	Hypolimn as	<i>Hypolimnasbolina</i> (Linnaeus, 1758) Schedule I, Part II	Great egg fly	6-10
50		Hypolimn as	<i>Hypolimnasmisippus</i> (Linnaeus, 1764)	Danaid egg fly	7-3
51		Junonia	<i>Junoniaalmanae</i> (Linnaeus, 1758)	Peacock pansy	7-12
52		Junonia	<i>Junoniahierta</i> (Fabricius, 1798)	Yellow pansy	6-12
53		Junonia	<i>Junonialemonias</i> (Linnaeus, 1758)	Lemon pansy	1-12
54		Junonia	<i>Junoniaorithya</i> (Linnaeus, 1758)	Blue pansy	7-12
55		Junonia	<i>Junoniaiphita</i> (Cramer, 1779)	Chocolate pansy	6-12
56		Vanessa	<i>Vanessa indica</i> (Herbst, 1794)	Indian red admiral	4-5
57	F. Heliconiinae	Phalantha	<i>Phalantaphalantha</i> (Drury, [1773])	Common leopard	1-12
58		Vindula	<i>Vindulaerota</i> (Fabricius, 1793)	Cruiser	9-11
59		Phalantha	<i>Phalanthaalcippe</i> (Stoll, [1782])	Small leopard	2-4
60		Acraea	<i>Acraeaterpsicore</i> (Linnaeus, 1758)	Tawny coster	1-12
61		Cupha	<i>Cuphaerymanthis</i> (Drury, 1773)	Rustic	7-11
	<b>Lycaenidae</b>				
62	A. Polyommatainae	Castalis	<i>Castaliusrosimon</i> (Fabricius, 1775) Schedule I, Part IV	Common pierrot	1-12
63		Caleta	<i>Caletadecidia</i> (Hewitson, 1876)	Angled pierrot	4-9
64		Tarucus	<i>Tarucusnara</i> (Kollar,1848)	Rounded pierrot	2-5
65		Euchrysop s	<i>Euchrysopsnejus</i> (Fabricius, 1798 ) Schedule II, Part II	Gram blue	1-12
66		Zizeeria	<i>Zizeeriakarsandra</i>	Dark grass blue	4-6

			(Moore, 1865)		
67		Chilades	<i>Chiladespandava</i> (Horsfield, 1829)	Plains cupid	4-7
68		Chilades	<i>Chiladeslajus</i> (Stoll, 1780)	Lime blue	4-6
69		Chilades	<i>Chiladesparrhasius</i> (Fabricius, 1793)	Small cupid	3-10
70		Lampides	<i>Lampidesboeticus</i> (Linnaeus, 1767) Schedule II, Part II	Pea Blue	11-12
71		Talicada	<i>Talicadanyseus</i> (Guerin, 1843)	Red pierrot	4-6
72		Anthene	<i>Antheneemolus</i> (Godart, 1823)	Common ciliate blue	3-5
73		Jamides	<i>Jamidesceleno</i> (Cramer, 1775)	Common cerulean	1-12
74		Prosotas	<i>Prosotasdubiosa</i> (Semper, 1879)	Tailless line blue	5, 10-12
75	B. Theclinae	Rapala	<i>Rapalaiarbus</i> (Fabricius, 1787)	Indian red flash	5-7
76		Spindasis	<i>Spindasisvulcanus</i> (Fabricius, 1775)	Common silver line	6-10
77		Pratapa	<i>Pratapa deva</i> (Moore, 1857)	White tufted royal	12-3
78		Rathinda	<i>Rathindaamor</i> (Fabricius, 1775)	Monkey puzzle	1-12
79		Apharitis	<i>Apharitislilacinus</i> Moore, 1884	Lilac silver line	8-10
80	C. Curetinae	Curetis	<i>Curetisthetis</i> (Drury, [1773])	Indian Sunbeam	7-9
	<b>Hesperiidae</b>				
81	A. Hesperinae	Borbo	<i>Borbocinnara</i> (Wallace, 1866)	Rice swift	1-12
82		Pelopidas	<i>Pelopidas mathias</i> (Fabricius, 1798)	Small branded swift	1-12
83		Caltoris	<i>Caltoris kumara</i> (Moore, 1878)	Blank swift	6-11
84		Suastus	<i>Suastusgremius</i> (Fabricius, 1798)	Indian palm bob	9-10
85		Oriens	<i>Oriensgolapseudolus</i> (Moore, 1877)	Common dartlet	3-5, 10-12
86		Oriens	<i>Oriensgoloides</i> (Moore, 1881)	Small dartlet	11-12
87		Udaspes	<i>Udaspesfolus</i> (Cramer, 1775)	Grass demon	9-10
88	B. Pyrginae	Spialia	<i>Spialiaagalbafabricius</i> (Fabricius, 1793)	Indian skipper	5-11
89		Tagiades	<i>Tagiadesganaathos</i>	Suffused snow flat	3-5,10-12

			(Moore, 1865)		
90		Tagiades	<i>Tagia-des japetusravi</i> (Stoll, 1781)	Common snow flat	1-12
91		Caprona	<i>Capronaransonnnettii</i> (Felder, 1868)	Golden angle	3-5
92	C. Coeliadinae	Badamia	<i>Badamiaexclamationis</i> (Fabricius, 1775)	Brown Awl	3-5
93		Hasora	<i>Hasorabadrabadra</i> (Moore, 1857)	Common Awl	4-7
94		Hasora	<i>Hasorachromus</i> (Cramer, 1782)	Common banded Awl	2-8

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