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Butterfly diversity of Satara Tehsil, District Satara Maharashtra

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ABSTRACT

Butterflies and moths belong to the order Lepidoptera (scaly winged insects) The butterfly species of family Nymphalidae were identified as indicators of disturbance in any area. In the present study a total of 52 individuals belonging to 9 sub families 28 genera were identified and were recorded. Among which Limenitidiae was found to be the most dominant subfamily followed bySatyrinae. The area of study having rich diversity of butterflies, therefore this study may be of great importance for the conservation ofbutterflies. This study being the pioneer study in the area is of immense importance.

Keywords: Satara Tehsil, butterfly diversity, Abundance, Biodiversity,conservation.

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)

The butterflies are very well known for their beauty as they bear beautiful wings of various colours .The degree of diversity depends upon the adaptability of aspecies to a particular micro habitat. The Indian subcontinent (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. Recent data indicates 1318 species in India according to Varshney and Smetacek (2015)

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) In this study an attempt is made to understand how the distribution and variation in butterfly diversity changes with habitats in various sites in the Northern Western Ghats. An area rich in biodiversity is of great importance for conservation.

Butterflies are highly reactive and respond to slightest changes in their habitat. Hence the conservation of habitats and butterflies must be given priority (Sidhu;2011) .
The forests are lost at higher rate in Asia (Sodhi et al., 2010) due tologging (Lambert & Collar, 2002) agricultural (Koh&Wilcove, 2008) even endemic regions (Sodhi et al., 2010) . Effects in diversity if vertebrates (e.g., Chiarello, 1999; Stouffer et al., 2006) to smaller ratio on insects (e.g.,Didham et al., 1996) .

In Maharashtra various workers like Kunte (1997) , (2001) .Rane&Ranade (2004) ,Padhye et al. (2006) , (2009) Tiple et al. (2009) , (Margules&Pressey 2000) ,.

Nymphalidae contains around 6000 species (Nieukerken et al.,2011) , largest family of true butterflies. The family originated around 94 MYA in the mid Cretaceous. Diversifica- tion of the group began in the Late Cretaceous (current subfamilies) appeared shortly after the Cretaceous-Paleogene (K-Pg) boundary(Heikkilä et al. 2012) .One of the best studied family.27% ofNymphalid butterfly species in Himalaya are endemic (Evans, 1932; Saikia, 2008) .

Study Area

The present study was carried out at Satara Thesil during the calendar year 2013 to 2016. Satara Thesil lies between (170.5’ to 18^0.1’ N latitude and073^0 33' 74.76'E longitude) is located on the Western Ghats of India in the State of Maharashtra. Satara is located about 110 km away from Pune City in a south-westerly direction. The family Nymphalidae was studied so as to study the diversity in detail. The study area was regularly searched during the morning and evening hrs for the activity of (Image 1) .

The flora of Satara is endemic as it is a part of the Northern Western Ghats. The average annual rainfall for the year 2014—2016 as provided by the Regional Meteorological Centre, Mahableshwar .

The Arabian Sea brings in the mansoon rain 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 climatic seasons viz. pre-monsoon, monsoon, post-monsoon and winter could be considered. The variations in seasons have been seen in last few years.

Material and Method

Biodiversity of butterfly family Nymphalidae had beensurveyed opportunistically Butterflies were identified directly in the field visually with the help of field guides. Collection was restricted to those specimens that could not be identified directly. All the scientific names follow Varshney, R K &Smetacek P (2015) A Synoptic Catalogue of the Butterflies of India and common English names follow Wynter-Blyth .Benthum&Hooker (1862) system of classification is followed for plants. The study area was fully explored during the period from March 2014 to January 2016 (Image no. 1).The study area was visited twice in each season during above period.

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

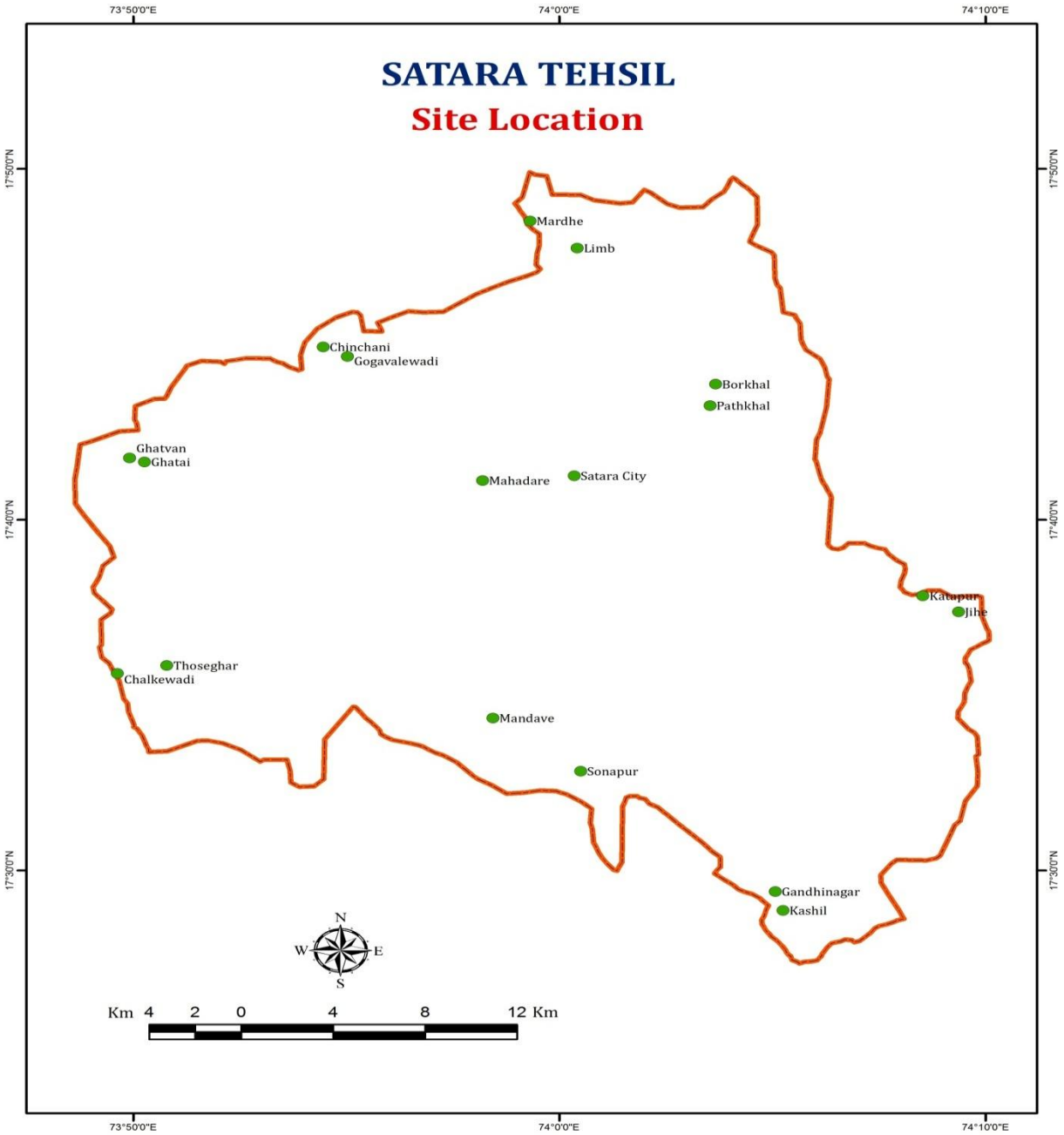

Image: 1 showing the sites where butterfly diversity was studied in Satara Tehsil.

Table no. 1. Site locations.

Sr. No	Site Location	Assigned Name
01	Chinchani-Gogavalewadi	A
02	Mahadare-Satara City	B
03	Chalkewadi-Thoseghar	C
04	Mandave-Sonapur	D
05	Ghatvan-Ghatai	E
06	Jihe-Katapur	F
07	Pathkal-Borkhal	G
08	Mardhe-Limb	H
09	Kashil-Gandhinagar	I

Results and Observation

The family Nymphalidae is well distributed in the Satara tehsilwith 52species. Three species are endemic to the Western Ghats, 6 species have shared endemism of Peninsular India and 2 are endangered.

During the course of study, 52 species of butterflies belonging to the family Nymphalidae were recorded in Satara Tehsil as recorded in (table no 3) In the present study a total of 52 individuals belonging to 11 sub families were identified and 28 genera were recorded.(table no 3) Among which Limenitidiae was found to be the most dominant sub family followed by Satyrinae. The area of study having rich diversity of host plants being a part of Western Ghats following are the species recorded.

The Sub family Danainae has five species belonging to two tribes and two genera.The Tribe danainihas Genus Danaus (Kluk,1780) represented by *Danaus.chrysippus.chrysippus* Plain tiger, *(Danaus.genutia. genutia)* Common tiger, (*Parantica .aglea.aglea)* Glassy tiger, *(Tirumala.liminace.exociticus)* Blue tiger .TheTribeEuploeini Genus Euploea *(Euploea. core.core*) Common Crow.

The sub family Charaxinae is represented by one tribe Charaxin and two genera.The Genus Polyura*(Polyura.agraria.agraria)* Anomalous *Nawab (Polyura. athamas.athamas.)* Common NawabThe Genus Charaxes is represented by *(Charaxes .psaphon.imna)* Plain Tawny Rajah and *(Charaxes .solon.solon)* Black Rajah.

The sub family Satyrinae is the second largest sub family represented by two tribes and four genera.The tribe Tribeni and Melanitini are represented by four genera Elymnias, Melanitini, Lethe,Ypthima Genus Elymnias *(Elymniashypermnestra.caudata)* Common Palmfly Tribe Melanitini Genus Melanitis *(Melanitis.leda.ledaenus)* Common Evening Brown *(Melanitis.phedima.varaha)* Dark Evening Brown,Genus Lethe *(Lethe.europa.ragalav)* Bamboo Tree Brown, *(Lethe.rohria. neelgheriensis)* Common Treebrown(*Mycalesis .perseus*)Common Bushbrown Genus Ypthima *(Ypthima .asterope. maahratta)* Common Threering *(Ypthima .baldus.madrasa)* Common Fivering(Ypthima .huebneri. huebneri) Common Fourring*(Ypthima .philomela.tabella)* Baby Fivering.

The sub family Limenitidina is the largest sub family has a single Tribe limenitidinihaving seven genera Genus Neptis(*Neptis.hylas.varmona)* CommomnSailer, *(Neptis.jumbha .jumbha)* Chestnut-Streaked Sailer.GenusPantoporia *(Pantoporia.hordonia.hordonia)* Common Lascar(*Pantoporia. sandaca. davidsoni.)* Extra Lascar Genus Athyma *(Athyma.nefte.inara)* Colour Sergeant, *(Athyma.perius.perius.)* Common Sergeant.GenusModuza.*(Moduza .procris.undifragus.)* Commander, Genus Cynitia *(Cynitia.lepideamiyana.)* Grey Count .Genus Euthalia *(Euthaliaaconthea.anagama.)* Common Baron *(Euthaliaaconthea,meridionalis)* CommoBaron *(Euthalialubentina.arasada)* Gaudy Baron *(Euthalia. lubentina. lubentina)* Gaudy BaronGenus *(SymphaedraSymphaedranasi)* Baronate.

The sub family Heliconiinae is represented by Tribe HrliconiiniGenus Phalanta*(Phalanta.phalanta.phalanta)* Common Leopard,GenusCupha*(Cupha .erymanthis.maja.)* Rustic.

The Sub family Biblidinae consist of the Tribe BiblidiniGenus Ariadne*(Ariadne. ariadne. indica)* Angled Castor, *(Ariadne.merione.merione)* Common Castor,GenusByblia*(Byblia.ilithyia)* Joker.

Sub family Apaturinae Tribe Apaturini Genus Rohana(Rohana.parisatis .atacinus) Black Prince, Genus Euripus (Euripus.consimilis.meridionalis) Painted Courteasan .

Sub family Cyrestinae Tribe *Cyrestini* Genus Cyrestis *(Cyrestis.thyodamanas.indica)*Common Map.

Sub family Nymphalinae Tribe NymphaliniGenus Venessa*(Venessa .cardui.cardui.)* Painted Lady,TribeJunoniini Genus Junonia *(Junonia.almana almanac)* Peacock Pansy, *(Junonia .iphita. pulviatalis)* Chocolate Pansy,*(Junonia .lemonias.vaisya)* Lemon Pansy, *(Junonia orithya.swinhoei.)*

Blue Pansy*(Junonia.hierta.hierta)* Yellow Pansy(Junonia .atlites,atlites) Grey Pansy Tribe Kallimini Genus Hypolimnas*(Hypolimnas.bolina,jacintha)* Great Eggfly,*(Hypolimnas.misippus.)* DanaidEggfly, Genus Kallima*(Kallimahorsfieldi)* Southern Blue Oakleaf,The sub family Acraeinae represents Tribe AcraeiniGenusAcraea *(Acraea.violae)* Tawny Coster.The sub family Libytheinae Genus Libythea *(Libythea.myrrha.rama)* Club Beak.(table no 3)

Table no 2. Site wise distribution of species (site names as per table no 1).

Sr no	Scientific name	Common Name	A	B	C	D	E	F	G	H	I
1)	***Genus (kluk,1780) Danaus.chrysippus***	Plain tiger	+	+	+	+	+	+	+	+	+
2)	***Danaus.genutia***	Common tiger	+	+	+	+	+	+	+	+	+
3)	***Parantica .aglea***	Glassy tiger	+	+	+	+	+	+	+	+	+
4)	***Tirumala.liminace***	Blue tiger	+	+	+	+	+	+	+	+	+
5)	***Genus Idea Idea.malabarica.kanarensis***	Malbar Tree Nymph			+		+				
6)	***Genus Euploea Euploea .core.core***	Common Crow	+	+	+	+	+	+	+	+	+
7)	***Euploea .sylvester.coreta***	Double-branded crow			+		+				
8)	***Genus Polyura Polyura.agraria.agraria***	Anomalous Nawab			+		+				
9)	***Polyura.athamas.athamas..***	Common Nawab	+	+	+		+				
10	***Genus Charaxes Charaxes .psaphon.imna***	Plain Tawny Rajah			+		+				
11	***Charaxes .solon.solon***	Black Rajah	+	+	+		+				
12	***Genus Elymnias Elymniashypermnestra.caudata***	Common Palmfly		+			+				
13	***Genus Melanitis Melanitis.leda.ledaenus***	Common Evening Brown	+	+	+	+	+	+	+	+	+
14	***Melanitis.phedima.varaha***	Dark Evening Brown			+		+				
15	***Genus Lethe Lethe .europa.ragalava***	Bamboo Tree Brown			+		+				
16	***Lethe .rohria.neelgheriensis .***	Common Treebrown	+	+	+	+	+	+	+	+	+
17	***Mycalesis .perseus.tabitha***	Common Bushbrown	+	+	+	+	+	+	+	+	+
18	***Mycalesis .mineus.polydecta***	Dark brand Bushbrown			+	+		+			
19	***Genus Ypthima Ypthima .asterope.maahratta***	Common Threering			+	+		+			
20	***Ypthima .baldus.madrasa***	Common Fivering	+	+	+	+	+	+	+	+	+
21	***Ypthima .huebneri.huebneri***	Common Fourring	+	+	+	+	+	+	+	+	+
22	***Ypthima .philomela.tabella***	Baby Fivering		+	+		+				
23	***Genus Neptis Neptis.hylas.varmona***	C ommon Sailer	+	+	+	+	+	+	+	+	+
24	***Neptis.jumbha.jumbha***	Chestnut-Streaked Sailer		+	+		+				
25	***Genus Pantoporia Pantoporia,hordonia.hordonia***	CommonLascar		+	+		+				
26	***Pantoporia.sandaca.davidsoni.***	Extra Lascar		+	+		+				

27	***Genus Athyma Athyma.nefte.inara***	Colour Sergeant			+		+				
28	***Athyma.perius.perius.***	Common Sergeant		+	+	+	+				
29	***Genus Moduza Moduza .procris.undifragus.***	Comman-der		+	+		+				
30	***Genus Cynitia Cynitia.lepideamiyana.***	Grey Count			+		+				
31	***Genus Euthalia Euthaliaaconthea.anagama.***	Common Baron	+	+	+	+	+	+	+	+	+
32	***Euthalia.lubentina.lubentina***	Gaudy Baron		+	+	+	+	+			
33	***Genus Symphaedra Symphaedranasi.***	Baronate	+	+							
34	***Genus Phalanta Phalanta.phalanta.phalanta***	Common Leopard	+	+	+	+	+				
35	***Genus Cupha Cupha .erymanthis.maja.***	Rustic		+	+	+	+				
36	***Genus Ariadne Ariadne.ariadne.indica***	Angled Castor		+	+		+				
37	***Ariadne.merione.merione***	Common Castor	+	+	+	+	+	+	+	+	+
38	***Genus Byblia Byblia.ilithyia***	Joker	+	+	+	+	+	+	+	+	
39	***Genus Rohana Rohana.parisatis .atacinus***	Black Prince		+	+		+				
40	***Genus Cyrestis Cyrestis.thyodamanas .indica***	Common Map	+	+	+	+	+	+	+	+	+
41	***Genus Venessa Venessa .cardui***	Painted Lady	+	+	+	+	+	+	+	+	+
42	***Genus Junonia Junonia.almana almanac***	Peacock Pansy	+	+	+	+	+	+	+	+	+
43	***Junonia .iphita.pulviatalis***	Chocolate Pansy	+	+	+	+	+	+	+	+	+
44	***Junonia .lemonias.vaisya***	Lemon Pansy	+	+	+	+	+	+	+	+	+
45	***Junoniaorithya.swinhoei.***	Blue Pansy	+	+	+	+	+	+	+	+	+
46	***Junonia.hierta.hierta***	Yellow Pansy	+	+	+	+	+	+	+	+	+
47	***Juznonia .atlites,atlites***	Grey Pansy	+	+	+	+	+	+	+	+	+
48	***Genus Hypolimnas Hypolimnas.bolina,jacintha***	Great Eggfly	+	+	+	+	+	+	+	+	+
49	***Hypolimnas.misippus***	Danaid Eggfly	+	+	+	+	+	+	+	+	+
50	***Genus Kallima Kallimahorsfieldi***	Southern Blue Oakleaf		+	+		+				
51	***Genus Acraea Acraea.violae***	Tawny Coster		+	+	+					
52	***Genus Libythea Libythea .lepita.lepitoides***	Club Beak		+	+	+					

Disscusion

The Diversity pattern and faunal composition differ significantly between seasons

Species diversity was consistently higher during the monsoon season. There are some species found in close vicinity of the study area but not in the study area. The reason may be the humidity as the

habitats and host plants are available in the study area yet the butterflies are absent. The highest diversity was recorded at the sites B and C (table no 1).The species are restricted to certain areas they have geographical and climatic needs and hence are of conservation value (Thomas 1991; Vane-Wright et al. 1991; Kakati 2006).

The microhabitat and the availability of the host plant are directly related to the butterfly diversity. The abundance and distribution is completely in the hands of climatic conditions like rainfall,temperature and humidity(Hill et al. 2003; Shubhalakshmi&Chaturvedi, 1999) . This emphasizes the need for biodiversity assessments to cover sufficiently long period to account for seasonal variation in species abundance in different habitats. The species like the Common Sergeant (***Athyma.perius.perius***), Colour Sergeant. (***Athyma. nefte.inara***),Common Lascar (***Pantoporia,hordonia.hordonia***),Tawny Rajah (***Charaxes.psaphon.imna***) were recorded at high altitudinal sites and not observed in the low lying areas.(table no 2)

The species like Sailers,Leopards,Commanders,Extra laskars Chestnut Streaked Sailer(***Neptis.jumbha.jumbha***),CommonSailer (***Neptis.hylas. varmona)*** CommonLeopard (***Phalanta.phalanta.phalanta)*** Commander (***Moduza .procris. undifragus***) Extra Lascar (***Pantoporia.sandaca. davidsoni)*** were common and abundant (table no 2)

Our study reveals that there were butterflies which have been able to accept alternative host plants, butterflies which were capable of changing the host plant due to attitudinal variations .Based on the positive findings we have suggest that there is need for revision study.

Distributional status of the butterflies states that there were areas with high altitude where many sub families were abundant whereas there were areas where only one family was abundant.(table no 2). Some sites along the river bank sites indicated average abundance with no prominent sub family but equally scattered sub families. The status of a sub family cannot be stated in such a small scale.

A temporal and spatial study is required for the proper assessment of diversity for a long time scale. The seasonality of some species may be related toits host plant availability and dry weather condition. During winter season majority of the host plant become defoliated or no new foliages are appearing.

The seasonal patterns in tropical butterflies is unknown to correlate it with host plants (Wolda 1989) .The patterns of butterfly abundance may be a result of seasonal leaf sprouting, larval mortility, host plants in different microhabitats.(D' Amico & Elkington 1995) .

The study is concerned to butterfly diversity which are identified as indicators of ecosystem, slightest change in the habitat may lead to evolution or replacement of species (Wilson 1987; Liow et al. 2001) . Diversity assessments techniques are required to study the impact of habitat and seasonal variation. (Hamer et al. 2005) .

Conclusion

There is no work being done in Satara Thesil on butterfly diversity and if it is done it is not yet published hence this work is a pioneer work on butterflies of Satara Thesil. The purpose of generation of a authentic checklist of butterflies of family Nymphalidae has been done successfully .There are about 52 butterflies of the family Nymphalidae belonging to the Satara Thesil. The family Nymphalidae is a diverse one and most abundant among all other families.

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Checklist

Sr no	Sub Family	Tribe	Scientific name	Common name
1	Dyainae-	danaini	***Genus (kluk,1780) Danaus.chrysippus***	Plain tiger
2			***Danaus.genutia***	Common tiger
3			***Parantica .aglea***	Glassy tiger
4			***Tirumala.liminace***	Blue tiger
5		Euploeini	***Genus Idea Idea.malabarica.kanarensis***	Malbar Tree Nymph
6	Charaxinae	Charaxin	***Genus Euploea Euploea .core.core***	Common Crow
7			***Euploea .sylvester.coreta***	Double-branded crow
8			***Genus Polyura Polyura.agraria.agraria***	Anomalous Nawab
9			***Polyura.athamas.athamas..***	Common Nawab
10	Satyrinae	Tribeni	***Genus Charaxes Charaxes .psaphon.imna***	Plain Tawny Rajah
11		Melanitini	***Charaxes .solon.solon***	Black Rajah
12			***Genus Elymnias Elymniashypermnestra.caudata***	Common Palmfly
13			***Genus Melanitis Melanitis.leda.ledaenus***	Common Evening Brown
14			***Melanitis.phedima.varaha***	Dark Evening Brown
15			***Genus Lethe Lethe .europa.ragalava***	Bamboo Tree Brown
16			***Lethe .rohria.neelgheriensis .***	Common Treebrown
17			***Mycalesis .perseus.tabitha***	Common Bushbrown
18			***Mycalesis .mineus.polydecta***	Dark brand Bushbrown
19			***Genus Ypthima Ypthima .asterope.maahratta***	Common Threering
20	Limenitidina	Tribe limenitidini	***Ypthima .baldus.madrasa***	Common Fivering
21			***Ypthima .huebneri.huebneri***	CommonFourring
22			***Ypthima .philomela.tabella***	Baby Fivering
23			***Genus Neptis Neptis.hylas.varmona***	CommomnSailer
24			***Neptis.jumbha.jumbha***	Chestnut-Streaked Sailer
25			***Genus Pantoporia Pantoporia,hordonia.hordonia***	CommonLascar
26			***Pantoporia.sandaca.davidsoni.***	Extra Lascar
27			***Genus Athyma Athyma.nefte.inara***	Colour Sergeant
28			***Athyma.perius.perius.***	Common Sergeant
29			***Genus Moduza Moduza .procris.undifragus.***	Commander
30			***Genus Cynitia Cynitia.lepideamiyana.***	Grey Count
31			***Genus Euthalia***	Common Baron

			Euthaliaaconthea.anagama.	
32			***Euthalia.lubentina.lubentina***	Gaudy Baron
33	Heliconiinae	Tribe Hrliconiini	***Genus Symphaedra Symphaedranasi.***	Baronate
34			***Genus Phalanta Phalanta.phalanta.phalanta***	Common Leopard
35	Biblidinae	Tribe Biblidini	***Genus Cupha Cupha .erymanthis.maja.***	Rustic
36			***Genus Ariadne Ariadne.ariadne.indica***	Angled Castor
37			***Ariadne.merione.merione***	Common Castor
38	Apaturinae	Tribe Apaturini	***Genus Byblia Byblia.ilithyia***	Joker
39			***Genus Rohana Rohana.parisatis .atacinus***	Black Prince
40	Cyrestinae	Tribe Cyrestini	***Genus Cyrestis Cyrestis.thyodamanas .indica***	Common Map
41	Nymphalinae	Tribe Nymphalini	***Genus Venessa Venessa .cardui***	Painted Lady
42		Tribe Junoniini	***Genus Junonia Junonia.almana almanac***	Peacock Pansy
43			***Junonia .iphita.pulviatalis***	Chocolate Pansy
44			***Junonia .lemonias.vaisya***	Lemon Pansy
45			***Junoniaorithya.swinhoei.***	Blue Pansy
46			***Junonia.hierta.hierta***	Yellow Pansy
47			***Juznonia .atlites,atlites***	Grey Pansy
48		Tribe Kallimini	***Genus Hypolimnas Hypolimnas.bolina,jacintha***	Great Eggfly
49			***Hypolimnas.misippus***	DanaidEggfly
50			***Genus Kallima Kallimahorsfieldi***	Southern Blue Oakleaf
51	Acraeinae	Tribe Acraeini	***Genus Acraea Acraea.violae***	Tawny Coster
52	Libytheinae		***Genus Libythea Libythea .lepita.lepitoides***	Club Beak
				Total =52

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