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## DIVERSITY AND ENDEMISM OF BUTTERFLIES OF MONTANE FORESTS OF ERAVIKULAM NATIONAL PARK IN THE WESTERN GHATS, INDIA

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**Abstract:** In a study on the diversity and abundance of butterflies of montane forests of Eravikulam National Park in the Western Ghats, southern India, 85 species of butterflies belonging to six families were recorded. This include eight species of butterflies that are endemic to the Western Ghats and one Near-Threatened species according to IUCN Red List of Threatened Species. The family Nymphalidae, the brush-footed butterflies, was the major group of butterflies seen in the montane forests of Eravikulam National Park.

**Keywords:** Biodiversity hotspot, conservation, Hesperidae, IUCN, Lycaenidae, Nymphalidae, Papilionidae, Pieridae, Riodinidae.

The Western Ghats is one of the biodiversity hot spots of the world (Myers et al. 2000). This region is rich in endemism including butterflies and has been of great interest for biogeography. The natural habitats in the Western Ghats is under tremendous pressure from the biotic influences (Jha et al. 2000; Mittermeier et al. 1998). Butterflies are suitable for biodiversity studies, because their taxonomy and geographic distribution are better understood compared to many other taxonomic groups (Pandhye et al. 2012). Butterflies are also

regarded as good indicators of habitat quality as many species exhibit habitat preferences and seasonality (Larsen 1988; Kunte 1997). Butterflies are sensitive biota, which get severely affected by environmental variations and changes in forest structure (Pollard 1991). India has around 1,501 species of butterflies, out of which 336 species have been reported from the Western Ghats (Kunte et al. 2018). Of the 336 species of butterflies of the Western Ghats, 316 species have been reported from Kerala (Palot et al. 2012).

Although quite a few studies have been done on the butterflies of the Western Ghats (Gaonkar 1996; Kunte 2000, 2008; Kehimkar 2008; Padhye et al. 2012), very little is known about the butterflies of the montane habitats of the southern Western Ghats. Some of the earlier documentation on butterfly fauna from the Western Ghats include—100 species from Silent Valley National Park (Mathew & Rahamathulla 1993), 124 species from Parambikulam Wildlife Sanctuary (Sudheendrakumar et al. 2000), 75 species from Siruvani Reserve Forests (Arun

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**Competing interests:** The authors declare no competing interests.

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2003), 73 species from Shendurney Wildlife Sanctuary (Mathew et al. 2004), 74 species from Peechi-Vazhani Wildlife Sanctuary (Mathew et al. 2005), 24 species from Kalakkad-Mundanthurai Tiger Reserve (Ambrose & Raj 2005), 75 species from Anaikatty Reserve Forests (Eswaran & Pramod 2005), 53 species from Neyyar Wildlife Sanctuary (Mathew et al. 2007), and 282 species from the Kerala part of Nilgiri Biosphere Reserve (Mathew 2016). A checklist of butterflies of Western Ghats reported 834 species of plants as larval host plants of 320 butterflies (Nitin et al. 2018). In this paper we give an account of the butterfly fauna of the montane forests of Eravikulam National Park, based on a four-month long study done in 2014.

### STUDY AREA

Eravikulam National Park (ENP) (Fig. 1) is located between 10.08333–10.33333 °N & 77.00–77.16 °E in Idukki District of Kerala. The ENP forms part of the Munnar Hills, a part of the High Ranges of Western Ghats, which has six protected areas, viz., Anamudi Shola National Park, Pampadum Shola National Park, Mathikettan Shola National Park, Chinnar Wildlife Sanctuary, Kurinjimala Wildlife Sanctuary, and ENP; it is contiguous with the Palni Hills and Anamalai Hills. The ENP has an extent of 97km<sup>2</sup> and the terrain is undulating with grassland and shola, the stunted high altitude evergreen forests, as the dominant vegetation.

Climate: Eravikulam has a tropical montane climate.

The average annual rainfall is about 5,000–6,500 mm. The area receives both south-west as well as north-east monsoons. The mean monthly minimum temperature is 11.9°C, while the mean monthly maximum temperature is 22.5°C. The altitude of ENP ranges from 1,800–2,695 m, typical of a montane landscape and the highest peak is Anamudi (2,695m).

Vegetation: The major plant communities found within ENP are grasslands, shrub lands, and forests. The terrain above 2,000m is covered primarily by grasslands (~60%), about 25% by shola forests, 8% by southern sub-tropical hill forest, and 7% by shrubs (Menon 2001).

### METHODS

The study was conducted from September 2014 to December 2014. The whole of the study area was divided into nine blocks based on topography and drainage (Table 1) and five days each were spent on each of these blocks. At each basecamp two to three hour long transects were walked in the morning from 10:00–13:00 hr. No afternoon transects could be done because of the unfavourable weather conditions, such as mist, cloud and northeastern monsoon rains. During these transect walks, the butterflies were identified to the species level and the number of individuals were counted. Attempt was also made to photo-document every species of butterflies sighted. The butterflies were identified using the field guides of Kunte (2000) and Kehimkar (2008), and for taxonomy and nomenclature,

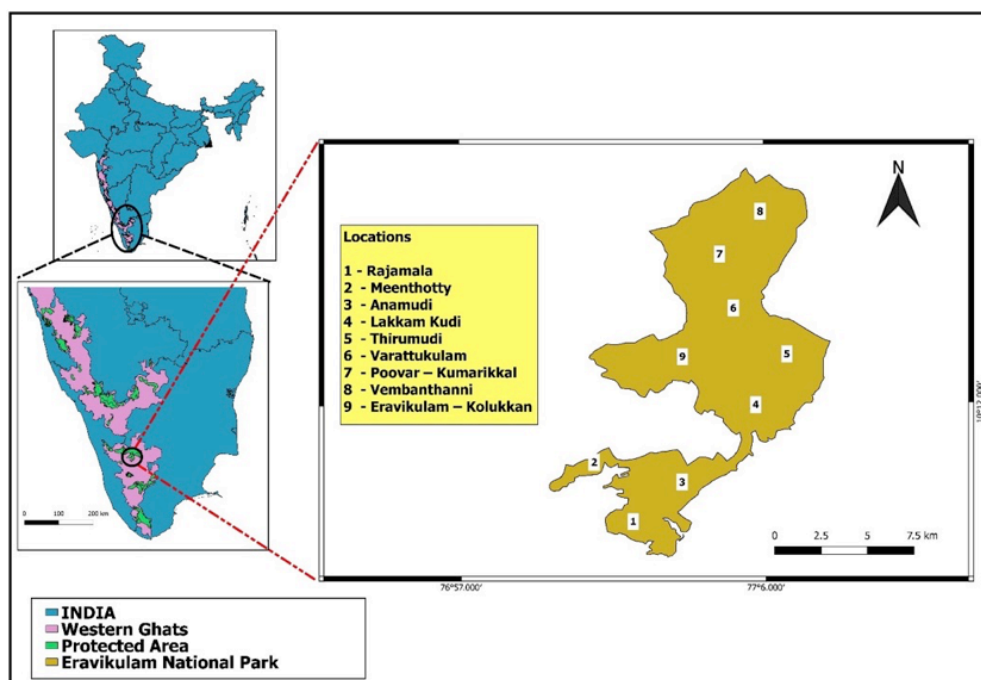


Figure 1. Location map of Eravikulam National Park

**Table 1.** Basecamp details of the study locations at Eravikulam National Park (modified after Praveen & Nameer 2015)

Camps	Altitude (m)	Habitats
Rajamala	1,750	Shola, grasslands, rocky out-crops and shrubs, adjacent to tea plantations
Meenthotty	1,950	Shola, grasslands, rocky out-crops, adjacent to tea plantations and tribal settlements
Anamudi	2,150	Shola, grasslands, adjacent to tea plantations
Lakkam Kudi	1,450	Shola, grasslands, adjacent to tea plantations, coffee plantation and tribal settlements
Thirumudi	1,625	Shola, grasslands, adjacent to tribal settlements
Varattukulam	2,100	Shola, grasslands, adjacent to degraded grasslands
Poovar - Kumarikkal	2,125	Shola, grasslands
Vembanthanni	2,125	Shola, grasslands
Eravikulam - Kolukkan	2,180	Shola, grasslands

we followed Kunte et al. (2018).

The abundance of the butterflies was calculated using the following method, species observed 80–100 % of the survey days were categorized as very common (VC), 60–80 % as common (C), 40–60 % as occasional (O), 20–40 % as rare (R) and below 20% as very rare (VR) (after Aneesh et al. 2013).

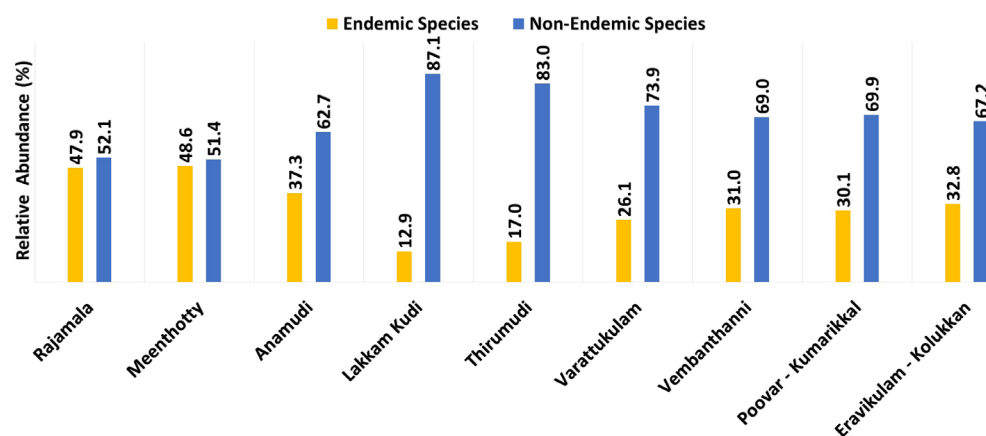
## RESULTS

A total of 85 species of butterflies belonging to six families such as, Papilionidae (10 species), Pieridae (15), Nymphalidae (36), Riodinidae (1), Lycaenidae (9), and Hesperidae (14) (Table 2) were identified from the montane habitat of ENP. This included eight species that are endemic to the Western Ghats. They are

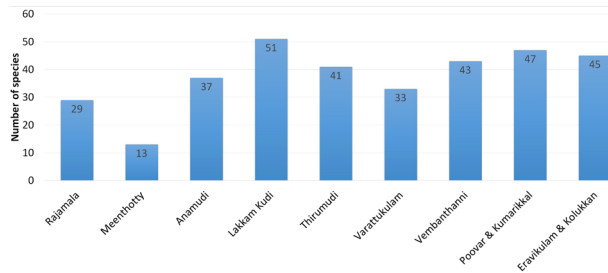
Sahyadri Birdwing *Troides minos*, Nilgiri Clouded Yellow *Colias nilagiriensis*, Red-disc Bushbrown *Heteropsis oculus*, Nilgiri Four-ring *Ypthima chenui*, Palni Four-ring *Ypthima ypthimoides*, Palni Fritillary *Argynnis castetsi*, Nilgiri Tiger *Parantica nilgiriensis* and Striped Hedge Hopper *Baracus subditus*. The proportion between the endemic and non-endemic species of butterflies in the different basecamps are given in Fig 2. The basecamps such as Meenthotty, Rajamala, Anamudi and Eravikulam-Kolukkan recorded the greatest proportion of the endemic butterflies at ENP, while the Lakkam Kudi basecamp recorded the greatest proportion of the non-endemic species of butterflies. While the basecamps that recorded the greatest proportion of endemic butterflies were all within the core zone of the ENP, the Lakkam Kudi basecamp is very close to human habitation and the elevation is also the lowest. The Palni Four-ring found to be the most abundant species among endemic species was found in ENP.

Highest species diversity was observed in Lakkam Kudi area (51 species), followed by Poovar-Kumarikkal (47), Eravikulam-Kolukkan (45), Vembanthanni (43), Thirumudi (41), Anamudi (37), Varattukulam (33), Rajamala (29) and Meenthotty (13) (Fig. 3). The relative abundance of the butterflies was highest in the family Nymphalidae (57.6%), followed by Pieridae (25%) and Papilionidae (10.4%). The other three butterfly families account for the remaining 7% of the butterflies of ENP (Fig. 4).

The only threatened species of butterfly recorded as per the IUCN category was the Nilgiri Tiger *Parantica nilgiriensis*. It belonged to the Near Threatened category (Lepidoptera Specialist Group 1996). The relative abundance study revealed that 27.05% of species of butterflies belonged to very rare (VR) followed by



**Figure 2.** Percentage relative abundance of endemic and non-endemic species of butterflies in different study locations of Eravikulam National Park



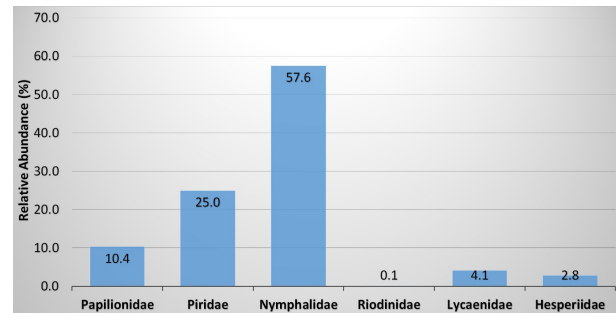
**Figure 3. Species richness of butterflies in different study locations of Eravikulam National Park**

28.24% of species that were rare (R) (Table 2).

This is the first ever documentation of the butterflies of a montane habitat in the Western Ghats, which highlights the significance of these habitats on the conservation of high altitude, endemic butterflies of the Western Ghats.

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**Figure 4. Relative abundance of families of butterflies in Eravikulam National Park**

[RLTS.T16151A5439571.en](https://doi.org/10.11609/JoTT.ZPJ.1312.2100-7)

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Table 2. Checklist of butterflies of Eravikulam National Park

Common English name/Family	Scientific name	Species authority	Image number	Abundance
<b>Family Papilionidae</b>				
Sahyadri Birdwing*	<i>Troides minos</i>	Cramer, 1779	1	O
Common Rose	<i>Pachliopta aristolochiae</i>	Fabricius, 1775	2	VR
Crimson Rose	<i>Pachliopta hector</i>	Linnaeus, 1758	3	O
Common Bluebottle	<i>Graphium sarpedon</i>	Linnaeus, 1758	4	VC
Tailed Jay	<i>Graphium agamemnon</i>	Linnaeus, 1758	5	R
Lime Swallowtail	<i>Papilio demoleus</i>	Linnaeus, 1758	6	O
Red Helen	<i>Papilio helenus</i>	Linnaeus, 1758	7	C
Common Mormon	<i>Papilio polytes</i>	Linnaeus, 1758	8	C
Blue Mormon	<i>Papilio polymnestor</i>	Cramer, 1775	9	C
Paris Peacock	<i>Papilio paris</i>	Linnaeus, 1758	10	O
<b>Family Pieridae</b>				
Lemon Emigrant	<i>Catopsilia pomona</i>	Fabricius, 1775	11	C
Mottled Emigrant	<i>Catopsilia pyranthe</i>	Linnaeus, 1758	12	O
Spotless Grass Yellow	<i>Eurema laeta</i>	Boisduval, 1836	13	VC
One-spot Grass Yellow	<i>Eurema andersoni</i>	Moore, 1886	14	VR
Common Grass Yellow	<i>Eurema hecabe</i>	Linnaeus, 1758	15	O
Three-spot Grass Yellow	<i>Eurema blanda</i>	Boisduval, 1836	16	R
Nilgiri Clouded Yellow*	<i>Colias nilagiriensis</i>	Felder & Felder, 1859		VR
Indian Jezebel	<i>Delias eucharis</i>	Drury, 1773	17	R
Asian Cabbage White	<i>Pieris canidia</i>	Linnaeus, 1768	18	VC
Common Gull	<i>Cepora nerissa</i>	Fabricius, 1775	19	R
Lesser Gull	<i>Cepora nadina</i>	Lucas, 1852		VR
Pioneer	<i>Belenois aurota</i>	Fabricius, 1793	20	C
Common Albatross	<i>Appias albina</i>	Boisduval, 1836	21	C
Yellow Orange-tip	<i>Ixias pyrene</i>	Linnaeus, 1764	22	O
Great Orange-tip	<i>Hebomoia glaucippe</i>	Linnaeus, 1758		C
<b>Family Nymphalidae</b>				
Common Evening Brown	<i>Melanitis leda</i>	Linnaeus, 1758	23	VR
Common Treebrown	<i>Lethe rohria</i>	Fabricius, 1787	24	R
Tamil Bushbrown	<i>Mycalesis subdita</i>	Moore, 1892	25	R
Red-disc Bushbrown*	<i>Telinga oculus</i>	Marshall, 1880	26	VC
Common Four-ring	<i>Ypthima huebneri</i>	Kirby, 1871	27	O
Common Five-ring	<i>Ypthima baldus</i>	Fabricius, 1775	28	C
Nilgiri Four-ring*	<i>Ypthima chenu</i>	Guérin-Ménéville, 1843	29	R
Palni Four-ring*	<i>Ypthima ypthimoides</i>	Moore, 1881	30	VC
Tawny Coster	<i>Acraea terpsicore</i>	Linnaeus, 1758	31	O
Rustic	<i>Cupha erymanthis</i>	Drury, 1773	32	R
Common Leopard	<i>Phalanta phalantha</i>	Drury, 1773	33	R
Palni Fritillary*	<i>Argynnis castetsi</i>	Oberthür, 1891	34	R
Common Sailer	<i>Neptis hylas</i>	Linnaeus, 1758	35	O
Commander	<i>Moduza procris</i>	Cramer, 1777	36	VR
Clipper	<i>Parthenos sylvia</i>	Cramer, 1775	37	VR
Angled Castor	<i>Ariadne ariadne</i>	Linnaeus, 1763	38	O
Common Castor	<i>Ariadne merione</i>	Cramer, 1777		VR

Common English name/Family	Scientific name	Species authority	Image number	Abundance
Map Butterfly	<i>Cyrestis thyodamas</i>	Doyère, 1840	39	R
Common Beak	<i>Libythea lepita</i>	Moore, 1857	40	O
Yellow Pansy	<i>Junonia hierta</i>	Fabricius, 1798	41	O
Lemon Pansy	<i>Junonia lemonias</i>	Linnaeus, 1758	42	R
Chocolate Pansy	<i>Junonia iphita</i>	Cramer, 1779	43	R
Painted Lady	<i>Vanessa cardui</i>	Linnaeus, 1758	44	R
Indian Red Admiral	<i>Vanessa indica</i>	Herbst, 1794	45	VR
Blue Admiral	<i>Kaniska canace</i>	Linnaeus, 1763	46	R
Great Eggfly	<i>Hypolimnas bolina</i>	Linnaeus, 1758	47	O
Danaid Eggfly	<i>Hypolimnas misippus</i>	Linnaeus, 1764	48	VR
Glassy Tiger	<i>Parantica aglea</i>	Stoll, 1782	49	R
Nilgiri Tiger*	<i>Parantica nilgiriensis</i>	Moore, 1877	50	VC
Blue Tiger	<i>Tirumala limniace</i>	Cramer, 1775	51	VC
Dark Blue Tiger	<i>Tirumala septentrionis</i>	Butler, 1874	52	VC
Plain Tiger	<i>Danaus chrysippus</i>	Linnaeus, 1758	53	R
Striped Tiger	<i>Danaus genutia</i>	Cramer 1779	54	R
Common Crow	<i>Euploea core</i>	Cramer, 1780	55	C
Double-branded Crow	<i>Euploea sylvester</i>	Fabricius, 1793	56	O
King Crow	<i>Euploea klugii</i>	Moore, 1857	57	O
<b>Family Riodinidae</b>				
Double-banded Judy	<i>Abisara bifasciata</i>	Moore, 1877	58	VR
<b>Family Lycaenidae</b>				
White Hedge Blue	<i>Udara akasa</i>	Horsfield, 1828	59	C
Common Hedge Blue	<i>Acytolepis puspa</i>	Horsfield, 1828	60	VR
Pale Grass Blue	<i>Pseudozizeeria maha</i>	Kollar, 1844	61	R
Tiny Grass Blue	<i>Zizula hylax</i>	Fabricius, 1775	62	VR
Oriental Grass Jewel	<i>Freyeria putli</i>	Kollar, 1844		VR
Forget-me-not	<i>Catochrysops strabo</i>	Fabricius, 1793	63	R
Pea Blue	<i>Lampides boeticus</i>	Linnaeus, 1767	64	C
Common Cerulean	<i>Jamides celeno</i>	Cramer, 1775	65	R
Common Lineblue	<i>Prosotas nora</i>	Felder, 1860	66	VR
<b>Family Hesperidae</b>				
Common Banded Awl	<i>Hasora chromus</i>	Cramer, 1780	67	VR
Common Awlking	<i>Choaspes benjaminii</i>	Guérin-Méneville, 1843		VR
Water Snow Flat	<i>Tagiades litigiosa</i>	Möschler, 1878	68	R
Common Yellow-breasted Flat	<i>Gerosis bhagava</i>	Moore, 1865	69	VR
Fulvous Pied Flat	<i>Pseudocoladenia dan</i>	Fabricius, 1787		VR
Dingy Scrub Hopper	<i>Aeromachus dubius</i>	Elwes & Edwards, 1897	70	C
Restricted Demon	<i>Notocrypta curvifascia</i>	Felder & Felder, 1862	71	VR
Striped Hedge Hopper*	<i>Baracus subditus</i>	Moore, [1884]	72	O
Giant Redeye	<i>Gangara thyrus</i>	Fabricius, 1775		VR
Rounded Palm-redeye	<i>Erionota torus</i>	Evans, 1941	73	VR
Tawny-spotted Grass Dart	<i>Taractroceras ceramas</i>	Hewitson, 1868	74	O
Dark Palm-Dart	<i>Telicota bambusae</i>	Moore, 1878	75	R
Oriental Variable Swift	<i>Parnara bada</i>	Moore, 1878		R
Blank Swift	<i>Caltoris kumara</i>	Moore, 1878	76	VR



Image 1. Sahyadri Birdwing *Troides minos*

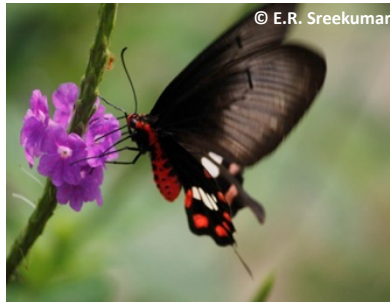


Image 2. Common Rose *Pachliopta aristolochiae*



Image 3. Crimson Rose *Pachliopta hector*



Image 4. Common Bluebottle *Graphium sarpedon*



Image 5. Tailed Jay *Graphium agamemnon*



Image 6. Lime Swallowtail *Papilio demoleus*



Image 7. Red Helen *Papilio helenus*



Image 8. Common Mormon *Papilio polytes*

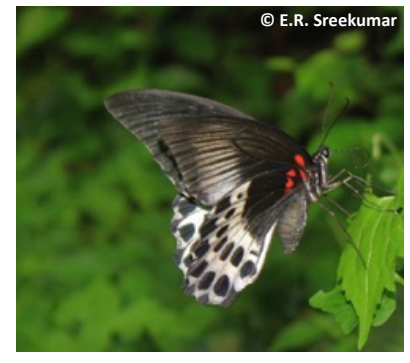


Image 9. Blue Mormon *Papilio polymnestor*



Image 10. Paris Peacock *Papilio paris*



Image 11. Lemon Emigrant *Catopsilia pomona*



Image 12. Mottled Emigrant *Catopsilia pyranthe*



Image 13. Spotless Grass Yellow *Eurema laeta*



Image 14. One-spot Grass Yellow *Eurema andersoni*



Image 15. Common Grass Yellow *Eurema hecabe*

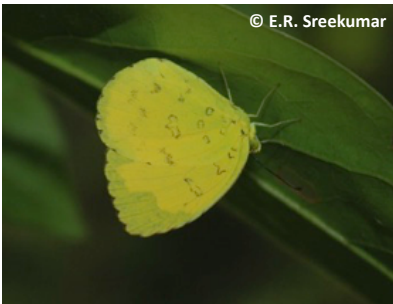


Image 16. Three-spot Grass Yellow *Eurema blanda*



Image 18. Indian Jezebel *Delias eucharis*



Image 18. Asian Cabbage White *Pieris canidia*



Image 19. Common Gull *Cepora nerissa*



Image 20. Pioneer *Belenois aurota*



Image 21. Common Albatross *Appias albina*



Image 22. Yellow Orange-tip *Ixias pyrene*



Image 23. Common Evening Brown *Melanitis leda*



Image 24. Common Treebrown *Lethe rohria*



Image 25. Tamil Bushbrown *Mycalesis subdita*



Image 26. Red-disc Bushbrown *Telinga oculus*



Image 27. Common Four-ring *Ypthima huebneri*



Image 28. Common Five-ring *Ypthima baldus*



Image 29. Nilgiri Four-ring *Ypthima chenu*



Image 30. Palni Four-ring *Ypthima ypthimoides*



Image 31. Tawny Coster *Acraea terpsicore*



Image 32. Rustic *Cupha erymanthis*



Image 33. Common Leopard *Phalanta phalantha*



Image 34. Palni Fritillary *Argynnis castetsi*



Image 35. Common Sailer *Neptis hylas*

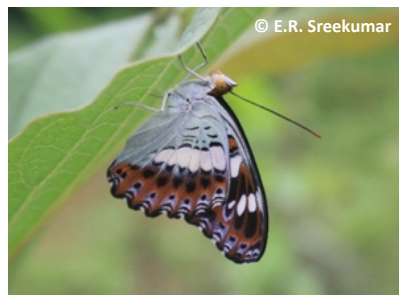


Image 36. Commander *Moduza procris*



Image 37. Clipper *Parthenos sylvia*



Image 38. Angled Castor *Ariadne ariadne*



Image 39. Map Butterfly *Cyrestis thyodamas*



Image 40. Common Beak *Libythea lepita*



Image 41. Yellow Pansy *Junonia hierta*



Image 42. Lemon Pansy *Junonia lemonias*



Image 43. Chocolate Pansy *Junonia iphita*

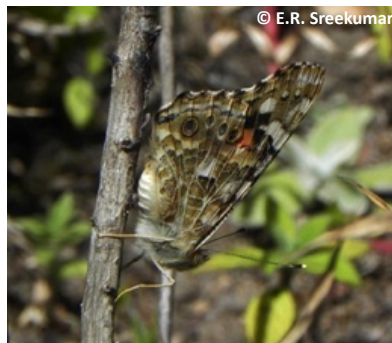


Image 44. Painted Lady *Vanessa cardui*



Image 45. Indian Red Admiral *Vanessa indica*



Image 46. Blue Admiral *Kaniska canace*



Image 47. Great Eggfly *Hypolimnas bolina*



Image 48. Danaid Eggfly *Hypolimnas misippus*



Image 49. Glassy Tiger *Parantica aglea*



Image 50. Nilgiri Tiger *Parantica nilgiriensis*



Image 51. Blue Tiger *Tirumala limniace*



Image 52. Dark Blue Tiger *Tirumala septentrionis*



Image 53. Plain Tiger *Danaus chrysippus*



Image 54. Striped Tiger *Danaus genutia*



Image 55. Common Crow *Euploea core*



Image 56. Double-branded Crow *Euploea sylvester*



Image 57. King Crow *Euploea klugii*

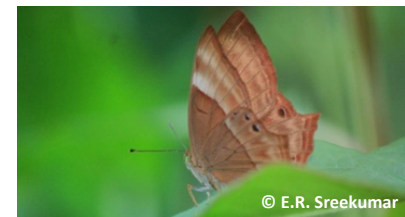


Image 58. Double-banded Judy *Abisara bifasciata*



Image 59. White Hedge Blue *Udara akasa*



Image 60. Common Hedge Blue *Acytolepis puspa*



Image 61. Pale Grass Blue *Pseudozizeeria maha*



Image 62. Tiny Grass Blue *Zizula hylax*



Image 63. Forget-me-not *Catochrysops strabo*



Image 64. Pea Blue *Lampides boeticus*



Image 65. Common Cerulean *Jamides celeno*



Image 66. Common Lineblue *Prosotas nora*



Image 67. Common Banded Awl *Hasora chromus*



Image 68. Water Snow Flat *Tagiades litigiosa*



Image 69. Common Yellow-breasted Flat *Gerosis bhagava*



Image 70. Dingy Scrub Hopper *Aeromachus dubius*



Image 71. Restricted Demon *Notocrypta curvifascia*



Image 72. Striped Hedge Hopper *Baracus subditus*



Image 73. Rounded Palm-redeye *Erionota torus*



Image 74. Tawny-spotted Grass Dart *Taractrocera ceramas*



Image 75. Dark Palm-Dart *Telicota bambusae*



Image 76. Blank Swift *Caltoris kumara*







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