



## RESEARCH ARTICLE

# BUTTERFLY DIVERSITY (LEPIDOPTERA: RHOPALOCERA) FROM THREE ROAD SIDE SITES AT DIFFERENT ELEVATIONS OF SESHACHALAM, NALLAMALA HILLS - EASTERN GHATS - ANDHRA PRADESH - INDIA

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### ABSTRACT

Human activities disturb the diversity and distribution of all creatures in any region. The main aim of this study is to know the effects of human activities on the diversity of butterflies in three of the main sites of Seshachalam hills and Nallamala hills in Eastern Ghats, Andhra Pradesh, India. The diversity and composition of butterflies varied in all the three study sites showing the effect of temperature and disturbances associated with other climatic and ecological parameters. In the present study, a total of 564 individuals belonging to 82 species of five families were identified. Among which Nymphalids was found to be the most dominant family with 223 individuals and constituting 39.13% of the total abundance and the most dominant family in terms of species richness having 58 species. Shannon wiener diversity index, abundance and species richness were found to be maximum for the undisturbed site and minimum for the disturbed area.

**Key words:** Butterfly Diversity, Lepidoptera, Seshachalam hills, Nallamala hills, Eastern Ghats, Shannon wiener diversity index.

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### INTRODUCTION

India is a large country with different types of physical features and contrasting climate zones from deserts to wet places on earth and from tropical hot deserts to cold alpine regions. Butterflies (Lepidoptera: Rhopalocera) are the attractive and beautiful insects provide economic and ecological benefits to the human society, very few studies have been done on the butterfly diversity in Andhra Pradesh. Butterflies are the messengers of nature not only adding brilliance to their surroundings but also pollinating flowers and revealing the healthiness of our communities. Diversity of Butterflies in India varies in different parts like 89 species from Nagarjuna Tiger Reserve forest (Rao *et al.*, 2004), 52 species from Amravati (Tiple *et al.*, 2007), 103 species from Pune (Kunte, 1997), 300 species from Nilgiri Mountains (Larsen, 1988) 86 species from Metropolitan Delhi (Larsen, 2002), and 84 species from southern Andhra Pradesh (Prasanna *et al.*, 2013). Butterflies are considered as indicators of ecosystem change and are used to predict various environmental alterations (Chettri 2010a; Rakosy and Schmit 2011).

Due to their specificity in ecological requirements such as temperature, humidity, food plants and egg-laying habitats, they are most likely to get affected by global climate change (Forster and Shapiro 2003; Gonzalez-Megias *et al.*, 2008). No information was available on butterflies of Seshachalam hills and Nallamala hills in general and studied sites in particular. Therefore, here an attempt was made to understand how the distribution and variation in butterfly diversity changes in heterogeneous habitats with different ecological parameters in various sites in the Seshachalam hills and Nallamala hill region.

### MATERIALS AND METHODS

The present study was carried out from August 2016 to January 2017 in Seshachalam hills, Nallamala Hills of the Eastern Ghats situated at height of 600m (2000 ft) from above the sea level. The data was collected in and around Tirupati (13.6288° N and 79.4192° E), Kadapa (14.4674° N and 78.8241°E) and Srisailem town (16°06' 46.64" N and 78°49'16.23" E). (Fig. 1).

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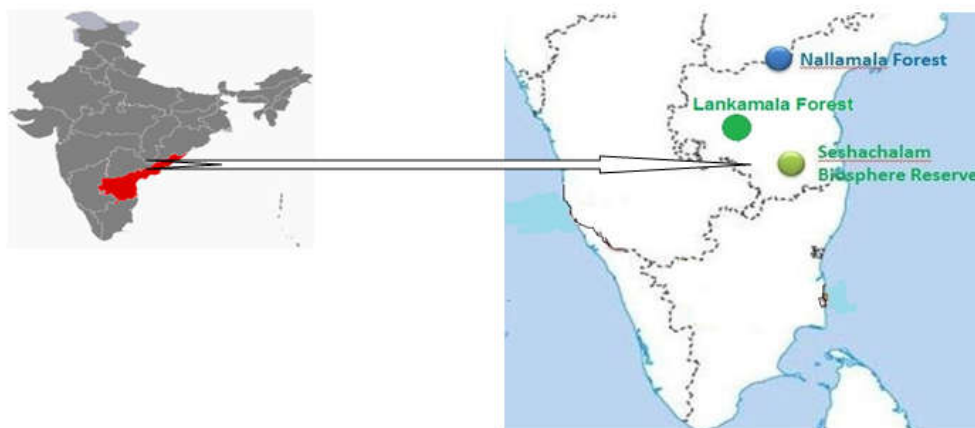


Fig 1. Study Area

Table 1. Month wise difference in temperature and humidity during the study period (Aug 2016 – Jan 2017)

S. No	Month	Site 1 (Srisaillam)		Site 2 (Kadapa)		Site 3 (Tirupati)	
		T	H	T	H	T	H
1	Aug - 16	27	65	26	72	31	56
2	Sep - 16	27	74	27	73	31	62
3	Oct - 16	28	58	27	71	32	50
4	Nov - 16	26	55	26	70	29	57
5	Dec - 16	25	57	23	69	26	69
6	Jan - 17	25	52	23	65	26	69

### Collection of insect samples and Preservation

#### Transects and butterfly data

The entomological collection, occasional rearing of larval and field observations were made during Aug 2016 to Jan 2017. The counts were conducted along fixed transects of about 1000 meters, consisting of smaller sections (200 meters), each with a homogeneous habitat type. Each transect was observed 3 times and the number of individuals per species as recorded from all the five segments (Van Swaay CAM, 2002). The more dominant butterflies were observed directly and unfamiliar species were collected for the identification and the voucher specimens were deposited at Entomology Research Lab, Yogi Vemana University, Kadapa. The collected butterflies were transferred into bottles containing ethyl acetate soaked cotton. All the specimens were brought to the laboratory for further studies. The specimens were stretched, pinned and oven dried at 60°C for 72 hours and then set into wooden boxes and labeled.

#### Measuring diversity of Butterflies

The butterflies' data collected in the field over the study period was examined and charted for species richness (the number of species), abundance (the number of individuals), and equitability (Evenness). Using Shannon's wiener diversity index ( $H'$ ) the species diversity of butterflies was calculated as follows:

$$H' = - \sum_{i=1}^s p_i \log p_i$$

Evenness (E) was measured as:

$$E = H' / H'_{\max}$$

Where,

$\sum$  = Summation

$p_i$  = Number of individuals of species  $i$ /total number of samples

S = Number of species or species richness

$H'_{\max}$  = Maximum diversity possible

E = Evenness =  $H' / H'_{\max}$

## RESULTS AND DISCUSSION

### Temperature

The maximum temperature was recorded in the month of October in all study sites whereas minimum temperature was recorded in the month of January. The data has been presented in Table 01.

### Humidity

The maximum humidity was recorded in the month of September (74%) in site – 1 and 2, whereas it was recorded minimum in the month of October (50%) in site 3. The detailed data has been presented in Table -1. Fig: 2 As shown in Table 2, a total of 32 common species were reported from all the study sites including *Eurema hecabe*, *Anaphaeis aurota*, *Catopsilia pomona*, *Cepora nerissa*, *Delias eucharis*, *Ixias pyrene*, *Colotis danae*, *Colotis etrida*, *Hasora chromus*, *Pelopidas mathias*, *Tagia-des japetus ravi*, *Caprona ransonnettii*, *Pachliopta aristolochiae*, *Papilio polymnestor*, *P. crino*, *Graphium agamemnon*, *G. doson*, *Euploea core*, *Danaus chrysippus*, *Tirumala limniace*, *Melantis leda*, *Hypolimnas bolina*, *Byblia ilithyia*, *Phalanta phalantha*, *Junonia hierta*, *Junonia lemonias*, *Palantha alcippe*, *Chilades lajus*, *Chilades parrhasius*, *Castalius rosimon*, *Euchrysops cnejus* and *Lampides boeticus*. A total of 82 species were recorded from all the three study sites. A maximum of 72 species was reported from site 1 and followed by site 2 and a minimum of 56 species was reported from site 3.

Table 2. Species richness at study areas

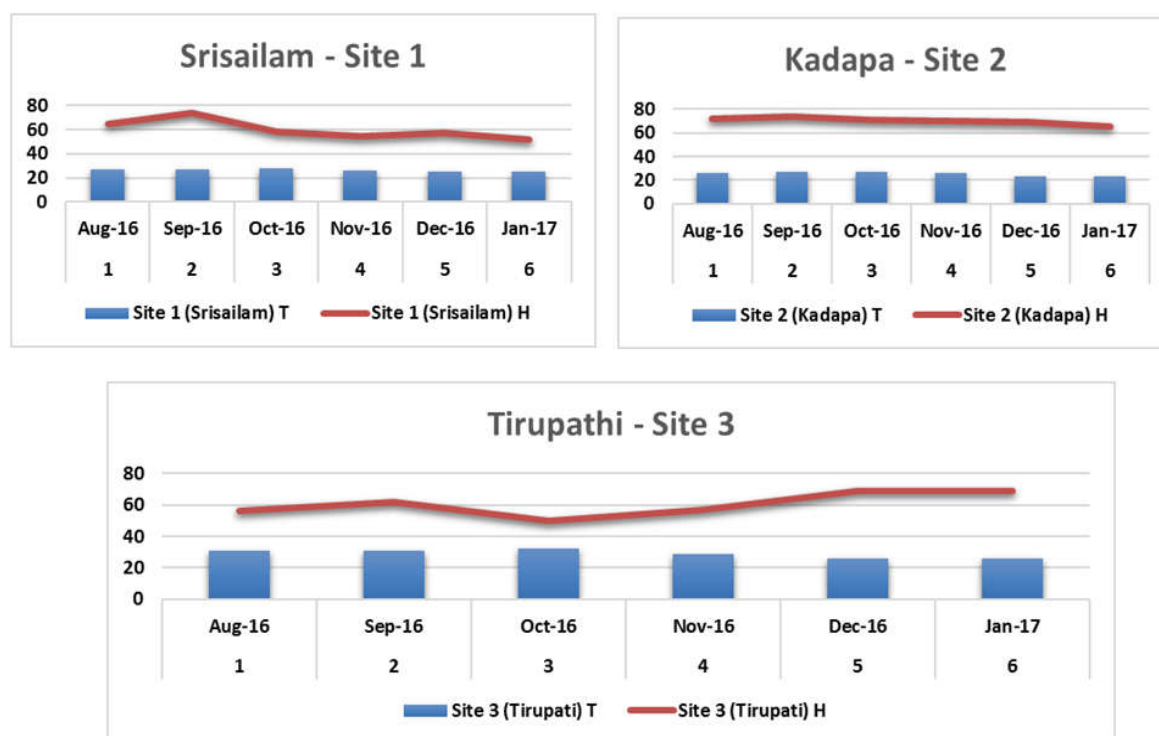
S. No	Scientific Name	Common Name	Site 1 (Srisailam)	Site 2 (Kadapa)	Site 3 (Tirupati)
Family: Pieridae					
1	<i>Eurema hecabe</i> (Linnaeus, 1758)	Common grass yellow	+	+	+
2	<i>Eurema brigitta</i> , (Cramer, 1780)	Small grass yellow	-	+	+
3	<i>Eurema blanda</i> , (Boisduval, 1836)	Three - spot grass yellow	+	-	-
4	<i>Anaphaeis aurota</i> , (Fabricius, 1793)	Pioneer	+	+	+
5	<i>Appias lalage</i> , (Doubleday, 1842)	Spot-puffin	+	+	-
6	<i>Catopsilia pomona</i> , (Fabricius, 1775)	Lemon emigrant	+	+	+
7	<i>Catopsilia pyranthe</i> , (Linnaeus, 1758)	Mottled emigrant	-	+	+
8	<i>Catopsilia Scylla</i> (Linnaeus, 1763)	Orange Emigrant	+	-	-
9	<i>Cepora nerissa</i> (Fabricius, 1775)	Common gull	+	+	+
10	<i>Cepora nadina</i> (Lucas, 1852)	Lesser gull	+	-	+
11	<i>Delias eucharis</i> (Drury, 1773)	Common jezebel	+	+	+
12	<i>Leptosia nina</i> (Fabricius 1793)	Psyche	+	+	-
13	<i>Pieris canidia</i> , (Sparman, 1768)	Indian Cabbage white	+	-	+
14	<i>Ixias pyrene</i> , (Linnaeus, 1764)	Yellow orange -tip	+	+	+
15	<i>Colotis danae</i> (Fabricius, 1775)	Crimson -tip	+	+	+
16	<i>Colotis aurora</i> (Crammer, 1780)	Plain orange- tip	+	+	-
17	<i>Colotis fausta</i> (Oliver, 1804)	Large salmon arab	-	+	+
18	<i>Colotis etrida</i> (Boisduval, 1836)	Small orange -tip	+	+	+
Family: Hesperidae					
19	<i>Hasora badra badra</i> (Moore, 1857)	Common Awl	+	+	-
20	<i>Hasora chromus</i> (Cramer, 1782)	Common banded Awl	+	+	+
21	<i>Pelopidas mathias</i> (Fabricius, 1798)	Small branded swift	+	+	+
22	<i>Caltoris kumara</i> (Moore, 1878)	Blank swift	-	+	+
23	<i>Udaspes folus</i> (Cramer, 1775)	Grass Demon	+	+	-
24	<i>Spialia galba fabricius</i> (Fabricius, 1793)	Indian skipper	+	+	-
25	<i>Tagia-des japetus ravi</i> (Stoll, 1781 )	Common snow flat	+	+	+
26	<i>Suastus gremius</i> (Fabricius, 1798)	Indian Palm Bob	+	-	+
27	<i>Oriens gola pseudolus</i> (Moore, 1877)	Common Dartlet	-	-	-
28	<i>Borbo cinnara</i> (Wallace, 1866)	Rice swift	+	+	-
29	<i>Caprona ransonnettii</i> (Felder, 1868)	Golden Angle	+	+	+
30	<i>Badamia exclamationis</i> (Fabricius, 1775)	Brown Awl	+	-	+
Family: Papilionidae					
31	<i>Pachliopta aristolochiae</i> (Fabricius, 1775)	Common rose	+	+	+
32	<i>P. hector</i> (Linnaeus, 1758)	Crimson rose	-	+	+
33	<i>Papilio polymnestor</i> (Cramer, 1775)	Blue mormon	+	+	+
34	<i>P. polytes</i> (Linnaeus, 1758)	Common mormon	+	+	-
35	<i>P. liomedon</i> (Moore, 1874)	Malabar banded wallowtail	+	-	+
36	<i>P. crino</i> (Fabricius, 1792)	Common banded peacock	+	+	+
37	<i>Papilio demoleus</i> (Linnaeus, 1758)	Lime butterfly	+	+	-
38	<i>Graphium agamemnon</i> (Linnaeus, 1758)	Tailed jay	+	+	+
39	<i>G. doson</i> (Felder & Felder, 1864)	Common jay	+	+	+
40	<i>Graphium nomius</i> (Esper, 1793)	Spot sword tail	+	-	+
Family: Nymphalidae					
41	<i>Euploea core</i> , (Cramer, 1780)	Common crow	+	+	+
42	<i>Euploea sylvester</i> (Fabricius, 1793)	Double-branded crow	+	+	-
43	<i>Euploea klugii</i> (Moore, 1858)	Brown king crow	-	-	+
44	<i>Danaus chrysippus</i> (Linnaeus, 1758)	Plain tiger	+	+	+
45	<i>Tirumala limniace</i> (Cramer, 1775)	Blue tiger	+	+	+
46	<i>Melantis leda</i> (Linnaeus, 1758)	Common evening brown	+	+	+
47	<i>Melantis phedima</i> (Cramer, 1780)	Dark evening brown	+	+	-
48	<i>Parantica aglea</i> (Stoll, 1782)	Glassy Tiger	+	+	-
49	<i>Elymnia-hypermnestra</i> (Linnaeus, 1763)	Common palm-fly	+	+	+
50	<i>Enispe cycnus</i> (Westwood, 1851)	Blue Caliph	+	+	-
51	<i>Hypolimnas bolina</i> (Linnaeus, 1758)	Great egg-fly	+	+	+
52	<i>Hypolimnas misippus</i> (Linnaeus, 1764)	Danaid egg-fly	+	+	-
53	<i>Mycalasis visala</i> (Moore, 1858)	Tamil bush - brown	-	-	+
54	<i>Ariadne merione</i> (Cramer, 1777)	Common castor	+	-	+
55	<i>Byblia ilithyia</i> (Drury, 1773)	Joker	+	+	+
56	<i>Euthalia aconthea</i> (Hewiston, 1874)	Baron	+	-	+
57	<i>Euthalia nais</i> (Forster, 1771)	Baronet	-	-	+
58	<i>Neptis hylas</i> (Linnaeus, 1758)	Common sailer	+	+	-
59	<i>Phalanta phalantha</i> (Drury, 1773)	Common leopard	+	+	+
60	<i>Vindula erota</i> (Fabricius, 1793)	Cruiser	+	-	-
61	<i>Junonia almanae</i> (Linnaeus, 1758)	Peacock pansy	+	+	-
62	<i>Junonia hierta</i> (Fabricius, 1798)	Yellow pansy	+	+	+
63	<i>Junonia lemonias</i> (Linnaeus, 1758)	Lemon pansy	+	+	+
64	<i>Junonia orithyia</i> (Linnaeus, 1758)	Blue pansy	+	-	+
65	<i>Junonian iphita</i> (Cramer, 1779)	Chocolate pansy	+	+	-
66	<i>Palantha alcippe</i> (Stoll, 1782)	Small Leopard	+	+	+
67	<i>Acraea terpsicore</i> (Linnaeus, 1758)	Tawny coster	+	-	-
Family: Lycaenidae					
68	<i>Chilades pandava</i> (Horsfield, 1829)	Plains cupid	+	-	+
69	<i>Chilades lajus</i> (Stoll, 1780)	Lime blue	+	+	+
70	<i>Chilades parrhasius</i> (Fabricius, 1793)	small cupid	+	+	+
71	<i>Castalius rosimon</i> (Fabricius, 1775)	Common pierrot	+	+	+
72	<i>Tarucus nara</i> (Kollar, 1848)	Rounded pierrot	-	+	-
73	<i>Euchrysops cnejus</i> (Fabricius, 1798 )	Gram blue	+	+	+
74	<i>Zizeeria karsandra</i> (Moore, 1865)	Dark grass blue	+	-	+
75	<i>Pratapa deva</i> (Moore, 1857)	White Tufted Royal	+	+	-
76	<i>Rathinda amor</i> (Fabricius, 1775)	Monkey puzzle	-	-	+
77	<i>Curetis thetis</i> (Drury, 1773)	Indian Sunbeam	+	+	+
78	<i>Lampides boeticus</i> (Linnaeus, 1767)	Pea Blue	+	+	+
79	<i>Jamide sceleto</i> (Cramer, 1775)	Common cerulean	+	+	+
80	<i>Prosotas dubiosa</i> (Semper, 1879)	Tailless line blue	+	+	-
81	<i>Rapala airbus</i> (Fabricius, 1787)	Indian red flash	+	-	+
82	<i>Spindasis vulcanus</i> (Fabricius, 1775)	Common silver-line	+	+	-
Total			72	59	56

A maximum number of species belonged to family Nymphalidae (58), Pieridae (42) followed by Lycaenidae (33), Hesperidae (27) and Papilionidae (25). A maximum number of individuals belonged to Family Nymphalidae (31.35%), Pieridae (22.70%) followed by Lycaenidae (17.83%), Hesperidae (14.59%) and Papilionidae (13.51%). A total of 564 Lepidopteron individuals were collected from all the study sites during the study period among which maximum number of individuals were collected from site 1 (232) followed by site 2 (167) and a minimum number of individuals were collected from site 3 (165). Overall maximum number of individuals belonged to Nymphalidae (223, 39.53%) followed by Pieridae (154, 27.30%), Lycaenidae (106, 18.79%), Hesperidae (45, 07.97%) and Papilionidae (36, 06.39%). The Shannon diversity (H) was found to be maximum in site 2 (1.562) followed by site 3 (1.559) and site 1 (1.549). A maximum number of individuals and species were recorded from site 1 as it was the least disturbed site which was followed by site 3 which has a moderate disturbance. Whereas, the minimum number of individuals, species, and decline in diversity was recorded in site 3 as it was the most disturbed site among the three study sites. They have been studied systematically since the early 18th century and about 19,238 species are documented worldwide by (Heppner, 1998). There are about 1,504 species of butterflies in Indian Subcontinent (Gaonkar, 1996; Smetacek, 1992; Kunte, 2009 and Roy *et al.*, 2010). 334 butterflies were reported from the Western Ghats, (Tiple and Khurad, 2009) and 150 from the Eastern Ghats (Gunathilagaraj *et al.*, 1998).

Thulasi rao, I. Siva Rama Krishna (2003) reported 89 species belonging to 5 families of order Lepidoptera from Nagarjuna sagar, Srisailem Reserve forest. Prasanna kumar *et al.* (2013) has reported 78 species belonging to 5 families of this order from a plain and hill region of seshachalam reserve forest. S.P. Venkata Ramana (2010) and Harinath *et al.* (2013) reported 85 species of butterflies belonging to 5 families from Kadapa hills regions. Bubesh Gupta *et al.* (2012, 2014) reported 96 species of butterflies belonging to five families from Seshachalam Bio-reserve forest, Eastern Ghats, India. Suryanarayana *et al.* (2014) reported 75 species from 5 families and studied the effects of human land use and disturbance on butterfly communities in the cool temperate zone of seshachalam and reported that the butterfly communities in semi-natural (undisturbed) habitats had higher species richness and diversity than those in human-modified (highly disturbed) ones. Least number of species and individuals were recorded in site 3 (Tirupati). It has heavy traffic load as all the vehicles going up hills to Tirumala have to pass through this city; thus it is the most disturbed site among the three sites Temperature of site 3 was normally found to be always great than the other two sites this may also be a reason for the variation in the diversity and evenness of species. A maximum number of species i.e. species richness was found to the maximum in site 1 followed by site 2 and site 3. Thus the present study points out that that disturbance due to human activities and variation in temperature causes a great variation in the diversity, evenness, and richness of insect species (Table -3). These factors thus may also be causing biodiversity loss of the present study area.

**Table 3. Butterfly Community Structure during the Study period**

Site No	Diversity (H)	Abundance (N)	Evenness (E)	Richness (S)
Site 1	1.549	232	0.968	72
Site 2	1.562	167	0.953	59
Site 3	1.559	165	0.950	56



**Fig 2. Temperature & Humidity Variation at Study Areas**

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