

## Diversity and community structure of butterfly of Arignar Anna Zoological Park, Chennai, Tamil Nadu

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### Abstract

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Investigation was carried out on the diversity of butterfly fauna in selected localities of conservation and breeding center of Arignar Anna Zoological Park (AAZP), Chennai, Tamil Nadu. A total of 56 species were recorded, 15 of them belonged to Pieridae, 12 Nymphalidae, 9 Satyridae, 8 Papilionidae, 7 Danaidae, 3 Lycaenidae and 1 species each belonged to the families Acraeidae and Hesperidae. Qualitatively and quantitatively Pieridae family were comparatively dominant than that of other families. The notable addition to the 25 more species listed during this observation were compared to previous field survey. Comparison of butterfly species distribution between the different localities revealed that butterfly species richness was higher at mountain region with 52 species and lowest of 25 species at public visiting areas. Visitor's activities may be that reason for effects on butterfly distribution and lack of vegetation. Each five endemic and protected species (*i.e.* endangered) listed under the Wildlife (Protection) Act were highlighted greater conservation importances of the AAZP. It is suggest that butterfly species diversity generally increase with increase in vegetation and declines with the increase in disturbance.

### Key words

Butterfly diversity, Zoo visitors, Zoological park

### Introduction

In terrestrial ecosystem, insect fauna represent more than 70% and also play an important role in food chain for the natural balance. Insects are extremely important components of the bioindicators of the world (Chakaravarthy *et al.*, 1997; Jana *et al.*, 2009). Butterflies are potentially useful ecological indicators of urbanization because they are ready surveyed, and they are sensitive to changes in microclimate, temperature, solar radiation, and the availability of host plants for ovipositing and larval development (Thomas *et al.*, 1998; Fordyce and Nice, 2003). Increased urban features, including roads, buildings and moved lawns, correspond with decreases in butterfly species richness, diversity and abundance (Blair and Launer, 1997; Stefanescu *et al.*, 2004; Clark *et al.*, 2007; Pocewicz *et al.*, 2009). Urbanization also is associated with habitat degradation including decreased

plant species diversity, reduced water quality, and increased air and soil pollutions (Bastin, 1999; Hall *et al.*, 1999; McKinney, 2002; Singh *et al.*, 2009; Garg *et al.*, 2009). The reductions in amount and quality of natural habitat associate with urban development negatively affect nature biodiversity (Malagrino *et al.*, 2008).

In India pioneering work in butterfly studies dates back to the 19<sup>th</sup> Century (Wood-Mason and De-Niceville, 1887; Gaonkar, 1996). Since, there have been many studies on butterflies from different parts of the India (Fergusson, 1891; Gaonkar, 1996; Larsen, 1989; Mathew *et al.*, 2000; Sudheendrakumar *et al.*, 2000; Roy *et al.*, 2010). The number of Indian butterflies amount to one fifth of the world of butterfly species (Kunte, 2000). The total number of species of butterflies recorded from the Indian region is about 1501 species (Gaonkar, 1996), of which peninsular India hosts 350, 331 species from Western Ghats, and 313 species of butterflies from South India

(Gaonkar, 1996), of which 42 species are endemic to south India. The butterfly fauna of the southern part of the India peninsular is very rich and diverse compared to the other parts of the peninsular due to the availability of diverse habitats, a wide range of altitudinal gradients and associated microclimatic regimes. Information pertaining to migration of number of butterflies in India has been given by Williams (1938). Recently, Bharos (2000) and Palot *et al.* (2002) have been found on the migration of butterflies from different parts of India.

Butterflies serve as important plant pollinators in the local environment, and help to pollinate more than 50 economically important plant crops (Borges *et al.*, 2003). However, a contemporary discourse regarding butterfly conservation and its importance is lacking amongst the public. In most of the landscapes in India, two factors caused by human beings influence the species diversity and composition of flora and fauna. The tropical region have a rich and diverse the insect fauna, unfortunately, data on the insect of both natural and man made habitats are very poor, especially for the Indian region.

Biological diversity is now increasingly recognized as a vital parameter to assess global and local environmental changes and sustainability of developmental activities. However, a systematic study of invertebrates particularly butterflies has not been carried out from most of the wildlife reserves and zoological park in Tamil Nadu. Asaithambi *et al.* (1995) reported 31 butterfly species from Arignar Anna Zoological Park, but there is no report on the diversity and status of butterfly species in visitor's restricted areas in AAZP. Therefore, in the present investigation an attempt has been made to study the diversity and status of butterfly fauna in some selected habitats in Arignar Anna Zoological Park (AAZP), Vandalur, Chennai, Tamil Nadu.

### Materials and Methods

**Study site:** This study was conducted in the conservation and breeding center of Arignar Anna Zoological Park (AAZP) (13°16'S and 79°54'E at an altitude of MSL + 10m to 100m), Vandalur, Chennai, Tamil Nadu, India. Chennai has the distinction of having the first zoo in India, which was started in 1855 in Chennai. In, 1976 it's shifted to Vandalur Reserve Forest, an area of about 510 ha at the out skirt of near Chennai. The habitat of AAZP comes under tropical evergreen scrub, a degraded forest consisting of mostly thorny bushes. Average annual rainfall is about 250 mm. Annual average temperatures is 26°C. The annual average of the people visited to the zoological park is about 6 to 7 lakhs. Original vegetation of the area was of sparse scrub jungle consisting of species such as *Carissa sp.*, *Gmelina sp.*, *Eugenia sp.*, *Acacia sp.*, *Instia sp.* and few other species of dry evergreen forest type.

**Data collection:** A preliminary survey was carried out in different habitats of AAZP viz., low part of hills (1), fodder bank (2), orchard-planted mango, banana and guava (3), water reservoir (4), rescue center (5), public visiting areas i.e. zoo visitors (6) and butterfly farm (7) during April 2005 to March 2006 (Fig. 1). Data on butterfly

fauna, its abundance and seasonality is based on observation from 07.00 to 11.00 hr and 14.00 to 18.00 hr. Collection of specimen was avoided to the extent possible. Mostly photographic documentation was done. When identification was not possible through photographs only then we followed All-out search (i.e. physically collection) method for collecting the individuals of butterfly species by hand net and identified up to the species and released (Gadagkar *et al.*, 1990). The butterflies were identified by using various field guides and other available literature (Sathyamurthy, 1994; Kunte, 2000; Antram, 2002). Species classification and scientific names are given as per Varshney (1994, 1997).

Butterflies were categorised into four groups based on their occurrence during the period of study. Accordingly those species observed 80-100% of the survey days were categorised as abundant, 60-80% as common, 40-60% as occasional and 20-40% as rare.

### Results and Discussion

Arignar Anna Zoological Park provides diverse habitat to various butterfly species. The study revealed the occurrence of 56 species of butterflies belonged to the 32 genera and 8 families were found, of these 15 species belonged to the family Pieridae, 12 species belonged to the family Nymphalidae, 9 species belonged to the family Satyridae, 8 species belonged to the family Papilionidae, 7 species belonged to the family Danaidae, 3 species belonged to the family Lycaenidae and 1 species each belonged to the families Acraeidae and Hesperidae (Table 1). Comparison of butterfly species distribution between the different habitats revealed that butterfly species diversity was high at Mountain region (52 species) followed by fodder bank (46 species), rescue center (35 species), water reservoir (42 species), orchard (32 species), butterfly farm (30 species) and zoo visitor visiting areas (25 species) (Table 2). Relatively high butterfly species richness was recorded in three study sites with dense vegetation and low level disturbance in the mountain region, water reservoir and fodder bank. Sunil Kumar *et al.* (1997) reported that the monoculture plantation showed fewer number of ant diversity. Similarly, butterfly species richness was low in the orchard, visitors regions and butterfly farm, its might be due to lack of vegetation or monoculture plantation and high-level disturbance. Kunte (1997) reported that high influence of human interferences, which was relatively reducing the butterfly diversity.

Eventhough, the family Pieridae and Nymphalidae exhibited the maximum species diversity compared to other families. Balasubramanian *et al.* (2001) reported the dominance of the plants belonging to the genus *Capparis*, *Cassia*, *Bauhinia* and *Albizia* in the study area which are the food plants of pierid butterflies. One species, Common gull (*Cepora nerissa*) makes all the difference in diversity patterns for Pieridae. According to earlier reports of Mathew and Rahamathulla (1993) the family Nymphalidae was most predominant in the moist deciduous and evergreen forest. The reason for this extraordinary abundance of Pieridae and Nymphalidae butterflies in the study area can be ascribed to the dominance of their larval food plants in the region. Representation



**Fig. 1:** AAZP showing butterfly collection localities: (1) Lower part of hill, (2) Fodder bank, (3) Orchard, (4) Water reservoir, (5) Rescue center, (6) Butterfly farm, (7) Public visiting areas

**Table - 1:** List of butterfly fauna in Arignar Anna Zoological Park (AAZP) during 2005 to 2006

S.No.	Common name	Scientific name	Occurrence	Observed in months
<b>Family: Nymphalidae</b>				
1	Yellow Pansy	<i>Precis hierta hierta</i> (Fabricius)	Occasional	Aug, Sep, Dec, Jan
2	Lemon Pansy	<i>Precis lemonias vaisya</i> (Fruhstorfer)	Abundant	All months
3	Blue Pansy	<i>Precis orithya</i> (Linnaeus)	Abundant	Except Dec, Apr-July
4	Peacock Pansy	<i>Precis almana almana</i> (Linnaeus)	Occasional	Aug-Feb
5	Chocolate Pansy	<i>Precis iphita iphita</i> (Cramer)	Common	Except Apr- July
6	Common Sailor	<i>Neptis hylas varmon</i> (Moore)	Rare	Nov-Dec
7	Chestnut- Streaked Sailer	<i>Neptis jumbah</i> (Moore)	Common	Except Mar-July
8	Common Leopard	<i>Atella phalanta</i> (Drury)	Common	Sep-Feb
9	Common Castor	<i>Ergolis merione merione</i> (Cramer)	Common	All months
10	Great Eggfly	<i>Hypolimnas bolina</i> (Linnaeus)	Rare	Except Mar-Sep
11	Danaid Eggfly***1	<i>Hypolimnas missipus</i> (Linnaeus)	Rare	Aug - Feb
12	Aright Babul Blue	<i>Azonus ubaldus</i> (Cramer)	Occasional	Oct, Nov, Feb, Mar
<b>Family: Papilionidae</b>				
13	Blue Mormon <sup>1</sup>	<i>Papilio polymnestor polymnestor</i> (Cramer)	Occasional	Oct-Dec
14	Lime Butterfly	<i>Papilio demoleus</i> (Linnaeus)	Occasional	All months
15	Red Helen	<i>Papilio helenus</i> (Linnaeus)	Common	Apr.-July
16	Common Mormon	<i>Papilio polytes romulus</i> (Cramer)	Common	Apr-June
17	Common Rose	<i>Pachilocta aristoochia</i> (Fabricius)	Occasional	Aug-Feb
18	Crimson Rose*2	<i>Pachilocta hector</i> (Linnaeus)	Rare	Except Nov, Dec, Apr-July
19	Firebar Swordtail	<i>Graphium antiphates naira</i> (Moore)	Rare	Except Nov, Dec, Apr-July
20	Tailed Jay	<i>Graphium agammemnon menides</i> (Fruhstorfer)	Rare	Aug-Oct
<b>Family: Pieridae</b>				
21	Common Albatross**	<i>Appias albinas darada</i> (Felder and Felder)	Rare	June-July
22	Common Jezaebal <sup>1</sup>	<i>Delias eucharis</i> (Drury)	Common	Aug-Feb
23	Chocholate Albatrass	<i>Appias lyncida latifsaciata</i> (Moore)	Common	Aug-Feb
24	Indian Cabbage White	<i>Pieris canidia canis</i> (Evans)	Common	All months
25	Yellow Orange Tip	<i>Ixias pyrene sesia</i> (Fabricius)	Occasional	May-July
26	White Orange	<i>Ixias marianne</i> (Cramer)	Occasional	Apr-Aug
27	Large Salmon Arab	<i>Colotis fausta fulvia</i> (Wallace)	Abundant	All months
28	The Mottled Emigrant	<i>Catopsilia pyranthe</i> (Linnaeus)	Common	Aug, Dec-Mar
29	Common Grass Yellow	<i>Eurema hecabe hecabe</i> (Linnaeus)	Common	All months
30	Plain Orange	<i>Colotis eucharis euchar</i> (Fabricius)	Common	Except Nov, Dec, Apr-July
31	Lemon Emigrant	<i>Catopsilia Pomona</i> (Fabricius)	Abundant	July-Dec
32	Common Emigrant	<i>Catopsilia crocale</i> (Cramer)	Abundant	All months
33	Psyche	<i>Leptosia nina nina</i> (Fabricius)	Rare	Oct-Jan
34	Great Orange Tip	<i>Hebomoia glaucippe australis</i> (Butler)	Common	Except Apr-July
35	Common Gull**	<i>Cepora nerissa phryne</i> (Fabricius)	Abundant	Aug-Mar
<b>Family: Danaidae</b>				
36	Double-Branded Crow	<i>Euploea coreta coreta</i> (Godart)	Occasional	Oct-Dec
37	Indian Common Crow****	<i>Euploea core core</i> (Cramer)	Common	All months
38	Blue Tiger	<i>Danaus limniaca mutina</i> (Fruhstorfer)	Rare	Except Apr-July
39	Plain Tiger	<i>Danaus chrysippus chrysippus</i> (Linnaeus)	Common	Apr-Sep
40	Dark Blue Tiger	<i>Danaus melissa</i> (Cramer)	Occasional	Oct-Dec
41	Striped Tiger	<i>Danaus genutia genutia</i> (Cramer)	Common	All months
42	Chestnut Tiger	<i>Parantica site site</i> (Kollar)	Occasional	Sep-Nov
<b>Family: Satyridae</b>				
43	Common Evening Brown	<i>Melanitis leda leda</i> (Drury)	Abundant	Sep-Dec
44	Dark Evening Brown	<i>Melanitis phedima varaha</i> (Moore)	Abundant	Oct-Jan
45	The Nigger	<i>Orsotrioena medus medus</i> (Fabricius)	Common	Except Dec, Jan, Apr-July
46	Common Bush Brown	<i>Mycalesis perseus typhlus</i> (Fruhstorfer)	Common	Oct-Nov
47	Common Palm Fly	<i>Elymnias hypermnestra caudate</i> (Butler)	Rare	Aug-Jan
48	Palni Fourring <sup>3</sup>	<i>Ypthima ypthimoides</i> (Moore)	Common	All months

49	Baby Fivering	<i>Ypthima philomela tabella</i> (Marshall)	Common	Oct-Nov
50	Tamil Bush Brown	<i>Mycalesis subdita</i> (Moore)	Occasional	Sep-Jan
51	White-Bar Bush Brown	<i>Mycalesis anaxias</i> (Hewitson)	Occasional	Except Apr-Aug
<b>Family: Lycaenidae</b>				
52	Common Pierrot	<i>Castalius rosimon rosimon</i> (Fabricius)	Occasional	Sep-Feb
53	Forget-Me-Not	<i>Catochrysops strabo</i> (Fabricius)	Occasional	Oct-Dec
54	The White-Tipped Line Blue	<i>Nacadula noreia hampsonia</i> (De-Niceville)	Rare	Except Apr-Aug
<b>Family: Acraeidae</b>				
55	Tawny Castro	<i>Telchinia violae</i> (Fabricius)	Rare	Oct-Feb
<b>Family: Hesperidae</b>				
56	Indian Skipper	<i>Syrictus galba</i> (Fabricius)	Rare	Aug-Jan

Butterfly Status (endangered):- IW (P) Act- Indian Wildlife (Protection) Act 1972: \* Schedule I, \*\* Schedule II, \*\*\* Schedule I & II, \*\*\*\* Schedule IV

<sup>1</sup>Endemic species found in the Peninsular India and Sri Lanka, <sup>2</sup>Endemic species found in the Western Ghats (South India), <sup>3</sup>Endemic species found in the Peninsular India

**Table - 2:** Butterfly distribution in different habitats in Arignar Anna Zoological Park (AAZP) during 2005 to 2006

Sl. No.	Habitats	Number of family	Number of genus	Number of species
1	Lower part of hill	8	32	52
2	Fodder bank	8	30	46
3	Orchard	6	17	32
4	Water reservoir	7	25	42
5	Rescue centre	6	20	35
6	Butterfly farm	4	15	30
7	Public visiting areas	4	15	25

**Table - 3:** Composition and Status of butterflies in Arignar Anna Zoological Park (AAZP) during 2005 to 2006

Sl. No.	Family	Number of genus	Number of species	Occurrence			
				Abundant	Common	Occasional	Rare
1	Nymphalidae	6	12	2	4	3	3
2	Pieridae	10	15	4	7	2	2
3	Satyridae	5	9	2	4	2	1
4	Danaidae	3	7	0	3	3	1
5	Papilionidae	3	8	0	2	3	3
6	Lycaenidae	3	3	0	0	2	1
7	Acraeidae	1	1	0	0	0	1
8	Hesperidae	1	1	0	0	0	1
	<b>Total</b>	<b>32</b>	<b>56</b>	<b>8</b>	<b>20</b>	<b>15</b>	<b>13</b>

from the families Hesperidae and Acraeidae was very less compared to the proportion of the other families. It is partly due to the sampling bias, since Hesperids exhibits crepuscular habit, i.e. they are active in the early morning and to a less extent in the evening. Kunte (2000) reported that they are also seen active in day time under the shade of jungle or out in the open during cloudy weather. In case of one of the Lycaenid, the populations were occurred at the time when the plants were in suitable phenophase for growth of the caterpillars (Kunte, 1997, 2009). However, the sample data reflects the same trends in composition of species in various families of butterflies of AAZP.

Arignar Anna Zoological Park harbours five endemic species of butterflies. The endemism level varies from southern India to the Indian sub-continent (Table 1). Gilbert and Singer (1975) have pointed out the availability of larval as well as adult food resources as a limiting factor in the occurrence and migration of butterflies. Five species are listed in the Wildlife (Protection) Act, 1972 (Anonymous, 1990) with each two species in Schedule I and II and one species in Schedule IV. Danaid eggfly (*Hypolimnys misippus*) is listed in Schedule I and II. Similar species also reported in the different places of southern India such as Thengumarahada, Nilgiri (Cyril Rufus and Sabarinathan, 2007), Government Arts College



Campus Kozhikode (Xavier, 2006) and Anaikatty hills, Western ghats (Eswaran and Pramod, 2005). Regarding the status of butterfly species in Arignar Anna Zoological Park, 10 species abundant, 22 species as common, 13 species as occasional and 11 species as rare (Table 3).

Previous field studies in the AAZP revealed 31 species of butterflies (Asaithambi et al., 1995). The present observation compared with previous records, added 25 more species to the new list, making a total of 56 species from this park. The notable addition to the list is the Great Eggfly, *Hypolimnas bolina* (Linnaeus), Danaid Eggfly, *Hypolimnas missipus* (Linnaeus), Common Rose, *Pachilopta aristolochiae* Fabricius, Common Caster, *Ergolista merione merione* (Cramer), White Orange, *Ixias Marianne* (Cramer), Common Leopard, *Atella phalanta* (Drury), Large Salmon Arab, *Colotis fausta* (Wallace), Common Pierrot, *Castalius rosmon* (Fabricius), and Forget-Me-Not, *Catochrysops strabo* (Fabricius), were observed in large numbers along the mountain region. The Mottled Emigrant, *Catopsilia pyranthe* (Linnaeus), Common Emigrant, *Catopsilia crocale* (Cramer), Psyche, *Leptosia nina nina* (Fabricius), The Common Gull, *Cepora nerissa phryne* (Fabricius) and The White-Tipped Line Blue, *Nacadula noreia hamponia* De-Niceville were also observed in fairly good numbers in water reservoir. Aright Babul Blue, *Azanus ubaldus* Cramer, Tawny Castor, *Telchinia violce* (Fabricius), and Indian Skipper, *Syrictus galba* (Fabricius) were observed very rare abundant in rescue center. Peacock Pansy, *Precis almana* (Linnaeus), Chocolate Pansy, *Precis iphita* (Cramer), Common Grass Yellow, *Eurema hecabe hecabe* (Linnaeus), Plain Orange, *Colotis eucharis* (Fabricius), Great Orange Tip, *Hebomoia glaucippe australis* Butler, Plain Tiger, *Danaus chrysippus* (Linnaeus), Dark Blue Tiger, *Danaus Melissa* (Cramer) and Striped Tiger, *Danaus genutia genutia* (Cramer), were very common in fodder bank and could be seen on all days during the study periods. It should be noted that large number of butterflies migrates in this park. However, it is probable that the stimulation to migrate in vast number might be due to the availability of suitable larval host plants and adult nectar resources. The above finding was supported by Kunte (2000) and Subba Reddi et al. (2003).

Rainfall is largely determined the geography and the pattern of large air movement or weather system. In the present study, maximum number of butterfly species was seen in the month of August to February, immediately after rain whereas minimum during April to July. It was probably due to the availability of host plants. The similar observation was reported by Sunil Kumar et al. (1997) were the ant species richness generally increased with increase in vegetation. Subba Reddi et al. (2003) reported that the rainfall conditions greatly influence the butterfly numbers and species distributions. The butterflies tend to avoid dry habitat and prefer moist places. However, all of them may not survive if the natural vegetation likes mountain, fodder bank, orchard and water reservoir. Some of the species seen around human habitation have their food plants or source populations in such rescue center, butterfly farm

and zoo visitor visiting areas. Clark et al. (2007) reported that the increased human activities (i.e. urbanization) were associated with decreased butterfly species richness, and rare and specialized species were most affected.

Detection probability in butterfly survey is critical when providing sound-based information for biodiversity (including butterflies species) management. The finding of the present study indicate that the butterflies species diversity differs with different habitats and it's related with the dense vegetation, host plant appearance and low level of disturbance. Various studies have suggested that the visitor's (i.e. zoo visitors) could provide a unique and complex form of disturbance for many species of zoo animals (Mallapur et al., 2005; Well, 2005; Sekar et al., 2008). Based on the previous observations it may be possibility for the zoo visitors activities disturbing the butterflies diversity in the regions of zoo visitors visiting areas and butterfly farm. It indicates that disturbed localities show lower richness and diversity in their butterfly community. In fact, the study area harbours significant numbers of endemic and protected butterfly species also highlight greater conservation importance of the area. From the conservation point of view, some butterflies play a very important role in the ecological indicator and vital role of plant propagation through cross-pollination. Therefore, further research on the biodiversity of butterflies with special reference to their host plants and factors that affect their distribution, diversity and abundance will be rewarding experience.

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