



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2017; 5(4): 1361-1368

© 2017 JEZS

Received: 25-05-2017

Accepted: 26-06-2017

D Evangeline

Department of Zoology, Queen Mary's College (Autonomous), University of Madras, Chennai, Tamil Nadu, India

S Santhi

Department of Zoology, Queen Mary's College (Autonomous), University of Madras, Chennai, Tamil Nadu, India

Butterfly diversity at Guindy National Park in Metropolitan City of Chennai Tamil Nadu South India

D Evangeline and S Santhi

Abstract

The present investigation conducted to study the Butterfly Diversity at Guindy National Park in Metropolitan City of Chennai, Tamil Nadu, South India from February 2016 to July 2016. A total 90 species of butterflies were identified belonging to 5 families and 16 sub families were recorded with eleven species of host plants. The highest numbers of species were documented in family Lycaenidae (27 species), followed by Nymphalidae (26 species), Pieridae (17 species), Hesperidae (10 species) and Papilionidae (10 species). The butterfly's status was categorized as Common (C), Occasional (O), Rare (R) and Very rare (VR). Month wise diversity of butterflies was estimated using Shannon Weiner Index (3.054), Simpson Index (9.9637) and Species Richness (73) which showed maximum diversity in the month of July. Among the 90 species observed seven species of butterflies are listed as scheduled species under Indian Wildlife (Protection) Act, 1972.

Keywords: Guindy National Park, tropical dry evergreen forest, coromandel cirar coastal plain, Metropolitan city

1. Introduction

Butterflies are the sensitive insects which react quickly to any kind of disturbances like changes in the habitat quality and environmental variation. Apart from pollinators they play a major key role in food chain, being prey for birds, reptiles, spiders and predatory insects [1]. Many species of butterflies are strictly seasonal in their occurrence and prefer a particular set of habitats and host plants for their survival [2]. Notably these beautiful insects are slowly disappearing due to changes in land pattern and habitat as they are closely dependent on plants [3] [4]. The Indian sub continent has about 1439 species of butterflies, out of which 100 species are endemic to it and 26 taxa are today globally threatened as per the IUCN 1990 Red List of threatened animals and insects. In the past few decades the Chennai city has developed in an unstoppable manner and many green cover areas were converted into buildings. As a result the native forest cover is disappearing gradually. Guindy National Park is the only protected forest oasis holding good tropical dry evergreen forest vegetation sheltering many wild fauna and flora amidst the city. There are very few studies done earlier on various aspects of Ecology Conservation and Management [5], Habitat assessment [6], Vegetation [7], Black buck [8, 9], Spotted deer [10, 11], Birds [12, 13], Jackal [14] and Butterflies [15]. The record of research in the city national park did not have a continuation. On this contrary, it has become imperative to evolve the conservation and management of local extinction. The objective of the present study was to investigate the distribution and diversity of butterflies through different habitats, specifically, dry evergreen scrub, thorn forest, grasslands with tropical dissymmetric climate.

2. Materials and methods

2.1. Study Area

Guindy National Park is situated inside the Chennai city covering an area of 2.70 km² (13° 0' 29" N, 80° 13' 9" E). It was declared as Reserve forest in 1978 and is the last remnants natural habitat of the Coromandel Cirar Coastal plain in the northeastern Tamil Nadu. The park comprises of Scrub Jungle, Tropical Dry Ever Green Forest [9]. The park has dissymmetric climate and the temperature ranges from maximum 32.9°C to minimum 24.3°C and the annual rainfall received is 1,215 mm. There are over 350 species of plants, 14 species of mammals, more than 150 species of birds recorded from literature and unpublished documentation from forest department, Government of Tamil Nadu.

Correspondence

D Evangeline

Department of Zoology, Queen Mary's College (Autonomous), University of Madras, Chennai, Tamil Nadu, India

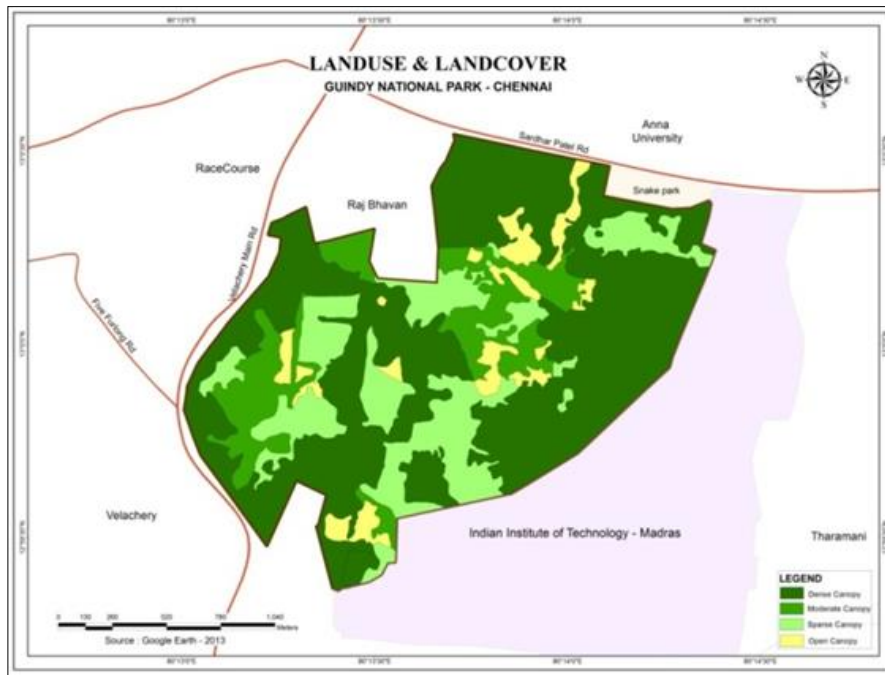


Plate 1: Guindy National Park located in Chennai, Tamil Nadu, Southern India.

2.2. Survey and Identification

The butterfly survey was conducted for a period of six months from February 2016 to July 2016 at Guindy National Park. A total of 11 line transects of 200 m were surveyed. The survey was done once in a week from 7am to 1pm and 3pm to 5pm. Photographic documentation was done using DSLR camera D5600 Nikon attached with 18-55mm and 70-300mm lens. Identification and classification of butterfly species and scientific names was done using Field guide [16] and available literatures [17, 18]. Butterflies which were difficult to identify were caught using hand net, photographed and then through expert the butterflies were identified. Environmental parameters such as temperature, humidity, rain fall and wind speed data were also recorded [19].

2.3. Statistical Analysis

The status of the butterfly species were based on the number of sightings which was categorized into Common (< 50 sightings), Occasional (15-49 sightings), Rare (2-14 sightings) and Very Rare (1 sightings) [20, 21]. The percentage compositions of butterfly family, subfamily, status, variation of butterfly abundance in relation to temperature, humidity, rainfall and wind speed are graphically plotted. The diversity indices such as Shannon- Wiener Diversity Index (H), Simpson Dominance Index (D), Shannon Evenness Index and Species Richness were used to analyze the data. The diversity indices were calculated using SPSS software.

1. Simpson's Index (D) measures the probability that two individuals randomly selected from a sample will belong to the same species (or some category other than species). The value of D ranges between 0 and 1. With this index, 0 represents infinite diversity and 1 represents no diversity. That is the bigger the value of D, the lower the diversity.

$$D = \frac{En(n-1)}{N(N-1)} \quad \text{or} \quad D = \frac{\Sigma(n/N)^2}{N}$$

Where "n" is the total number of organisms of a particular species and "N" is total number of organisms of all species.

2. Shannon - Wiener Diversity Index (H): It states the number of species within the site with relative abundance of each species.

$$H = -\sum (P_i \ln[P_i])$$

Where Sum = summation, "P_i" is the proportion of the ith species in the total sample.

3. Evenness Index: Equitability assumes a value between 0 and 1 with 1 being complete evenness according to Hill (1973) [22].

$$E = H/\ln S$$

Where H = index of diversity, lnS is the total number of species.

4. Species Richness: The number of species per sample is a measure of richness. The more species present in a sample, the 'richer' the sample.

The species Richness Index (D) was calculated following the formula (Menhinick, 1964) [23].

$$D = S/\text{Square root of } N,$$

where 'S' equals the number of different species represented in the sample, and 'N' equals the total number of individual organisms in the sample.

3. Results and Discussions

Guindy National Park with its unique habitat has revealed that the occurrence of 90 species of butterflies belonging to 5 families and 16 sub families, wherein 21 species of Polyommatainae, 13 species of Pierinae, 10 species of Papilioninae, 9 species of Nymphalinae, 8 species of Danainae, 5 species of Hesperinae, 4 species of Coliadinae and Theclinae 3 species of Coeliadinae and Satyrinae, 2 species of each Biblidinae, Heliconiinae, Limenitinae and Pyrginae, and 1 species of Curetinae Sunbeam and Miletinae

were recorded (Fig. 3). Percentage of 5 families was noted where Lycaenidae (30%) recorded the highest number of butterfly species followed by Nymphalidae (28.8%), Pieridae (19%), Hesperidae and Papilionidae (11.1%) (Fig.4). There is not much difference comparing the percentage of family dominance. In the study Lycaenidae showed the maximum number of species but there are many studies which have recorded Nymphalidae as dominant family in different parts of the country [24, 25, 26, 27, 21]. The percentage of butterfly status of presence and absence were recorded as Common (C), Occasional (O), Rare (R) and Very Rare (VR) where Common species (48%) were higher followed by Occasional (23.3%), Rare (18.7) and Very Rare (10%) (Fig.2). Similar studies on butterfly diversity at Guindy National Park were done by Rajasekhar, (1995) [15] who recorded 37 species only

and after eighteen years, Thangapandian *et al.*, (2014) [1] had recorded 46 species of butterflies throughout Chennai city including Guindy National park. The diversity of butterfly recorded shows a massive increase (2.43 times) from 1995 to 2016. The rainfall in November, 2015 (1144.8 mm) and December 2015 (345 mm) lead to heavy flood in Chennai which might have also influenced the increase in the number of species and also lack of continued research in Guindy National Park may also be a reason for increase in diversity. Seven species of butterflies *Appiasalbina* (Boisduval), *Castaliusrosimon* (Fabricius) *Euchrysopsnejeus* (Fabricius) *Euploea core* (Cramer), *Hypolimnasmismissippus* (Linnaeus), *Lampidesboeticus* (Linnaeus) and *Pachliopta hector* (Fabricius) recorded from this region are scheduled species under the Indian Wildlife Protection Act 1972 [28] (Table.1).

Table 1: Checklist of Butterfly species observed in Guindy National Park from February 2016 - July 2016.

S.no.	Scientific Name	Common Name	Status			
			Common	Occasional	Rare	Very Rare
I	Family:Hesperidae					
1	<i>Badamiaexclamationis</i> (Fabricius, 1775)	Brown Awl		O		
2	<i>Borbocinnara</i> (Wallace, 1866)	Rice swift				VR
3	<i>Coladeniaandrani</i> (Moore, 1865)	Tricoloured Flat			R	
4	<i>Gomaliaelma</i> (Trimen, 1862)	African Marbled Skipper				VR
5	<i>Hasorachromus</i> (Cramer, 1782)	Common banded awl	C			
6	<i>Hasorataminatus</i> (Hubner, 1818)	White Banded Awl			R	
7	<i>Iambrixsalsala</i> (Moore, 1865)	Chestnut bob	C			
8	<i>Parnaraguttatus</i> (Bremer & Grey, 1852)	Straight swift	C			
9	<i>Pelopidasmathias</i> (Fabricius, 1798)	Small branded swift			R	
10	<i>Suastusgremius</i> (Fabricius, 1798)	Indian palm bob	C			
II	Family: Lycaenidae					
11	<i>Anthenelycaenina</i> (Felder, 1868)	Pointed ciliate blue			R	
12	<i>Arhopalaamantes</i> (Hewitson, 1862)	Large Oak Blue		O		
13	<i>Azananajesus</i> (Guerin Meneville, 1849)	African babul blue		O		
14	<i>Castaliusrosimon</i> (Fabricius, 1775) *	Common pierrot	C			
15	<i>Catochrysopsstrabo</i> (Fabricius, 1793)	Oriental forget me not		O		
16	<i>Chiladeslajus</i> (Stoll, 1780)	Lime blue	C			
17	<i>Chiladespandava</i> (Horsefield, 1829)	Plains cupid		O		
18	<i>Chiladesparrhasius</i> (Fabricius, 1793)	Small cupid		O		
19	<i>Curetisthetis</i> (Drury, 1773)	Indian sunbeam		O		
20	<i>Euchrysopsnejeus</i> (Fabricius, 1798) *	Gram blue	C			
21	<i>Freyeriaputli</i> (Kollar, 1844)	Oriental grass jewel	C			
22	<i>Jamidesbochus</i> (Stoll, 1782)	Dark Cerulean				VR
23	<i>Jamidesceleno</i> (Cramer, 1775)	Common cerulean	C			
24	<i>Lampidesboeticus</i> (Linnaeus, 1767) *	Pea Blue			R	
25	<i>Leptotesplinius</i> (Fabricius, 1793)	Zebra blue	C			
26	<i>Nacadubaberoe</i> (Felder & Felder, 1865)	Opaque Six Line Blue				VR
27	<i>Prosotasdubiosaindica</i> (Evans, 1925)	Indian Tailless line blue		O		
28	<i>Prosotasnora</i> (C. Felder, 1860)	Indian Common line blue	C			
29	<i>Pseudozizeerimaha</i> (Kollar, 1844)	Pale grass blue		O		
30	<i>Rapalalarbus</i> (Fabricius, 1787)	Indian Red Flash			R	
31	<i>Rathindaamor</i> (Fabricius, 1775)	Monkey puzzle	C			
32	<i>Spalgisepius</i> (Westwood, 1851)	Apefly			R	
33	<i>Spindasisictis</i> (Hewitson, 1865)	Common Shot silverline				VR
34	<i>Viracholaisocrates</i> (Fabricius, 1793)	Common guava blue		O		
35	<i>Zizeeriakarsandra</i> (Moore, 1865)	Dark grass blue	C			
36	<i>Zizinaotis</i> (Fabricius, 1787)	Lesser grass blue	C			
37	<i>Zizulahylax</i> (Fabricius, 1775)	Tiny grass blue	C			
III	Family: Papilionidae					
38	<i>Chilasaclytia</i> (Linnaeus, 1758)	Common Mime				VR
39	<i>Graphiumchironides</i> (Honrath, 1884)	Tailed jay	C			
40	<i>Graphiumdoson</i> (C. &R.Felder, 1864)	Common jay		O		
41	<i>Graphiumnomius</i> (Esper, 1798)	Spot sword tail			R	
42	<i>Graphiumteredon</i> (Felder& Felder, 1864)	Narrow banded blue bottle				VR
43	<i>Pachlioptaaristolochiae</i> (Linnaeus, 1775)	Common rose		O		
44	<i>Pachliopta hector</i> (Linnaeus, 1758) *	Crimson rose	C			
45	<i>Papiliodemoleus</i> (Linnaeus, 1758)	Common lime butterfly	C			
46	<i>Papiliopolymnestor</i> (Cramer, 1775)	Blue Mormon			R	
47	<i>Papiliopolytes</i> (Linnaeus, 1758)	Common Mormon	C			

IV	Family: Peridae					
48	<i>Appiasalbina</i> (Boisduval, 1836)*	Common albatross			R	
49	<i>Appiaslibythea</i> (Fabricius, 1775)	Striped albatross			R	
50	<i>Appiaslyncida</i> (Cramer, 1779)	Chocolate Albatross				V R
51	<i>Belenoisaurora</i> (Fabricius, 1793)	Pioneer		O		
52	<i>Catopsiliapomona</i> (Fabricius, 1775)	Common emigrant	C			
53	<i>Catopsiliapyranthe</i> (Linnaeus, 1758)	Mottled emigrant	C			
54	<i>Ceporanerissa</i> (Fabricius, 1775)	Common gull	C			
55	<i>Colotisamata</i> (Fabricius, 1775)	Small salmon Arab		O		
56	<i>Colotisamata</i> (Fabricius, 1775)	Common Wanderer	C			
57	<i>Colotisdanae</i> (Fabricius, 1775)	Crimson Tip			R	
58	<i>Colotis eucharis</i> (Fabricius, 1775)	Plain Orange Tip			R	
59	<i>Euremabrigitta</i> (Cramer, 1780)	Small grass yellow	C			
60	<i>GraphiumSarpedon</i> (Linnaeus, 1758)	Common grass yellow	C			
61	<i>Hebomoiaglaucippe</i> (Linnaeus, 1758)	Great Orange Tip			R	
62	<i>Ixias marianne</i> (Cramer, 1779)	White Orange Tip				V R
63	<i>Ixias pyrene</i> (Linnaeus, 1764)	Yellow orange tip	C			
64	<i>Leptosianina</i> (Fabricius, 1793)	Psyche	C			
V	Family: Nymphalidae					
65	<i>Acraeaviolae</i> (Fabricius, 1793)	Tawny coster	C			
66	<i>Ariadneariadne</i> (Linnaeus, 1763)	Angled castor	C			
67	<i>Bybliailithya</i> (Drury, 1773)	Joker			R	
68	<i>Charaxes solon</i> (Fabricius, 1793)	Black rajah		O		
69	<i>Danauschrysippus</i> (Linnaeus, 1758)	Plain tiger	C			
70	<i>Danausgenutia</i> (Cramer, 1779)	Striped tiger	C			
71	<i>Euploea core</i> (Cramer, 1780) *	Common crow	C			
72	<i>Euploeaklugii</i> (Moore&Horsefeild, 1857)	Brown king crow			R	
73	<i>Euploea Sylvester</i> (Fabricius, 1793)	Double branded crow		O		
74	<i>Hypolimnasbolina</i> (Linnaeus, 1758)	Great eggfly	C			
75	<i>Hypolimnasmisippus</i> (Linnaeus, 1764) *	Dannaideggfly	C			
76	<i>Junoniaatlites</i> (Linnaeus, 1763)	Grey Pansy		O		
77	<i>Junonialemonias</i> (Linnaeus, 1758)	Lemon pansy	C			
78	<i>Junoniaalmanac</i> (Linnaeus, 1758)	Peacock pansy		O		
79	<i>Junoniahierta</i> (Fabricius, 1798)	Yellow pansy		O		
80	<i>Junoniaiphita</i> (Cramer, 1782)	Chocolate pansy	C			
81	<i>Junoniaorithiya</i> (Linnaeus, 1764)	Blue pansy	C			
82	<i>Melanitisleda</i> (Linnaeus, 1758)	Common evening brown	C			
83	<i>Mycalasisperseus</i> (Fabricius, 1775)	Common bush brown	C			
84	<i>Mycalasisubdita</i> (Moore, 1892)	Tamil bush brown		O		
85	<i>Neptishylas</i> (Linnaeus, 1758)	Common sailer	C			
86	<i>Neptisjumbah</i> (Moore, 1857)	Chestnut streaked sailer	C			
87	<i>Phalantaphalantha</i> (Drury, 1773)	Common leopard	C			
88	<i>Tirumalalimniace</i> (Cramer, 1775)	Blue tiger	C			
89	<i>Tirumalaseptentrionis</i> (Butler, 1874)	Dark blue tiger		O		
90	<i>Vanessa cardui</i> (Linnaeus, 1758)	Painted Lady			R	

Common (<50 sightings), Occasional (15-49 sightings), Rare (2-14 sightings) and Very Rare (1 sightings) and star (*)

highlights scheduled species under the Indian Wildlife Protection Act 1972.

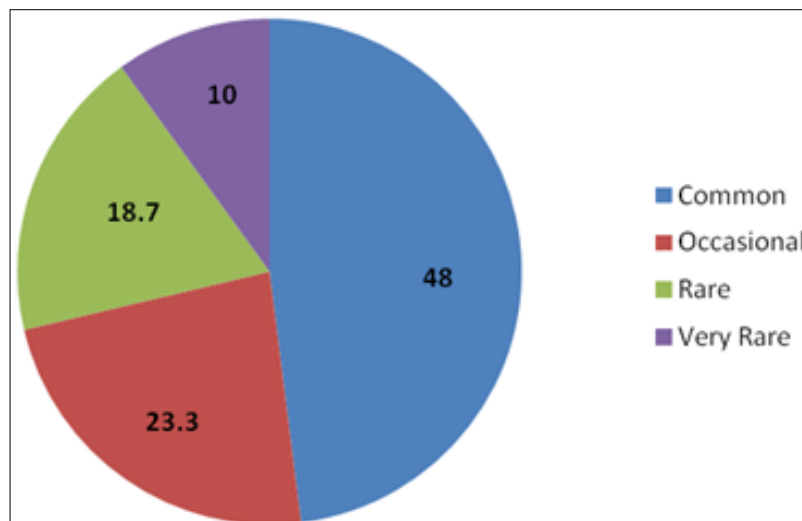


Fig 1: Percentage of Butterflies observed in Guindy National Park from February 2016-July 2016.

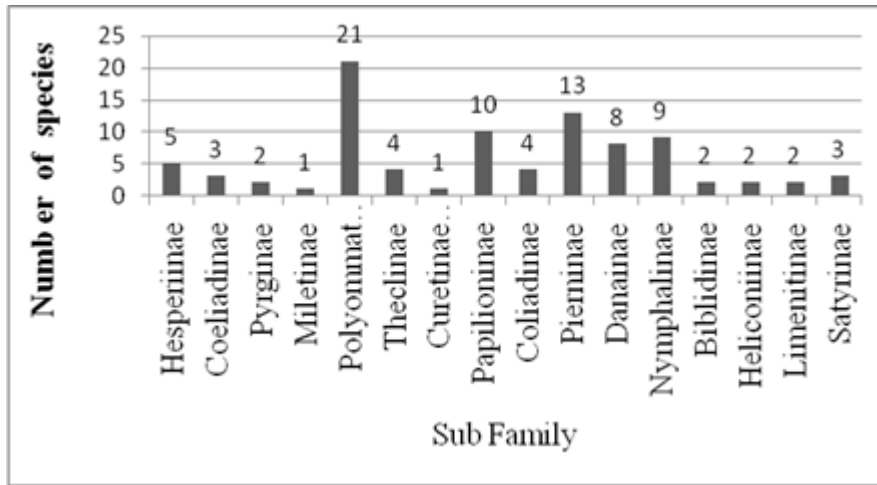


Fig 2: Number of Butterfly species observed in each subfamily in Guindy National Park during February 2016-July 2016.

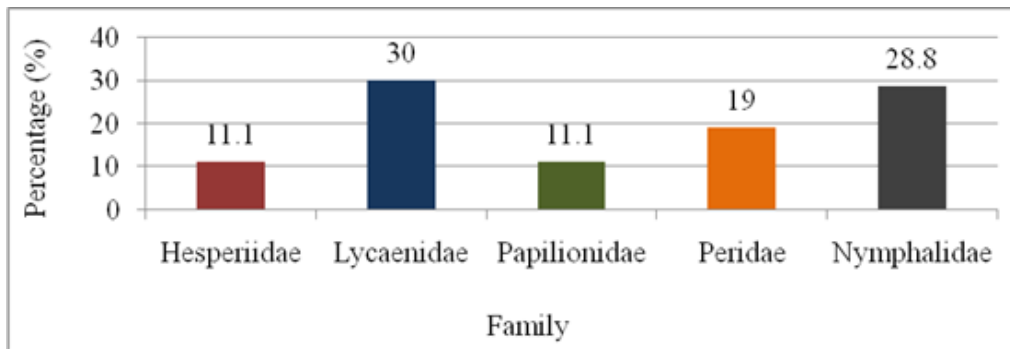


Fig 3: Percentage of butterfly Families Observed in Guindy National Park during February 2016- July 2016.

Table 2: Diversity Indices of Butterflies recorded in Guindy National Park from February 2016 – July 2016.

Month	Abundance	Simpson Index	Shannon Wiener Index	Variance H	Evenness	Species Richness
February	1574	9.9811	2.905	0.001	0.646	45
March	1918	8.5341	2.845	0.001	0.633	58
April	1208	4.3994	2.330	0.002	0.518	39
May	752	4.2084	2.069	0.003	0.460	22
June	2611	9.2726	2.944	0.001	0.655	72
July	3216	9.9637	3.054	0.001	0.680	73

3.1. Diversity Indices

The diversity indices of the study area were calculated month wise (Table 2). A total of 11279 individual species of butterflies were recorded during the study period. Monthly variation in abundance, species richness and evenness varied in each month. The maximum number of abundance was observed during July (3216) followed by June (2611), March (1918), February (1574), April (1208) and the least was recorded in May (752). Similar increase in abundance at early monsoon was recorded by A.D. Tiple during 2009 [12]. Family Peridae recorded the highest number of individuals (5676) and the lowest number of individual was from Hesperidae family (473) throughout the study period. Diversity Indices such as Simpson Index D was calculated and the value ranged from 9.9637 to 4.2084. The maximum was recorded during the month of July and the lowest being in May. Similarly, Shannon Wiener Index recorded the maximum diversity in July (H = 3.054) and least in May (H = 2.069). Shannon Evenness Index ranged from 0.460 to 0.680, where the maximum was observed in July (0.680) and minimum in May (0.460). More number of species were recorded in the month of July (73) followed by June (72), March (58), February (45), April (39) and May (22). The study recorded maximum diversity in short period when compared to other research in and around Chennai [29, 30, 31, 32].

3.2. Abundance in Relation with Weather Parameters

Distribution of butterfly’s abundance was correlated with Mean Temperature, Humidity, Rainfall and Wind speed. Temperature increase has resulted in the decrease of butterfly species. The maximum temperature was recorded in the month of May, 34°C, being the hottest weather, shows a decline in the abundance of the species (752), Fig 6. The butterflies prefer moist places than dry habitat [12]. The onset of North East monsoon begins during late June lasts till September. The abundance was higher in July (3216) as the temperature declined to 33 °C. Anupa *et al.*, (2016) [20] and Arya *et al.*, (2014) [35, 36] reported a similar trend and the species abundance increases from the beginning of monsoon. The humidity ranged from 61% to 71 %. Higher abundance was recorded in the month of July where the humidity was 61% Fig 7. Rainfall recorded the lowest in the month of February (0.59 mm), March (0.1mm) and April (0.1mm). The summer rain in the month of May recorded 261.15mm and the monsoon rain recorded maximum in the month of June (130.15 mm) and July (115.79 mm). As the summer rain did not last for more than 9 days the forest experienced very dry habitat with increase in temperature and the increase in rainfall has showed decrease in abundance whereas moderate rainfall, humidity, wind speed with moderate temperature has shown greater abundance in July. The abundance with

environmental parameters has shown minor variations (Fig. 4, 5, 6 and 7) and, therefore, long term assessment and monitoring of both butterfly abundance alongwith

environmental parameters are warranted to achieve better understanding and to arrive at factors responsible for abundance.

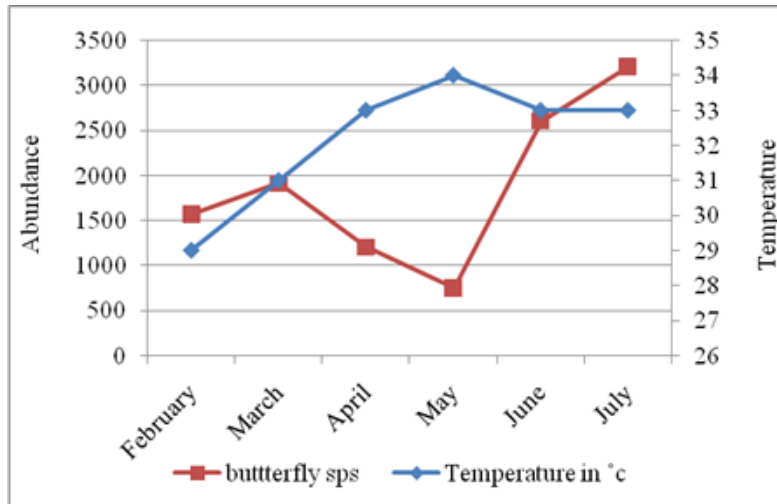


Fig 4: Relationship between butterflies abundance and temperature at Guindy National Park from February 2016 – July 2016.

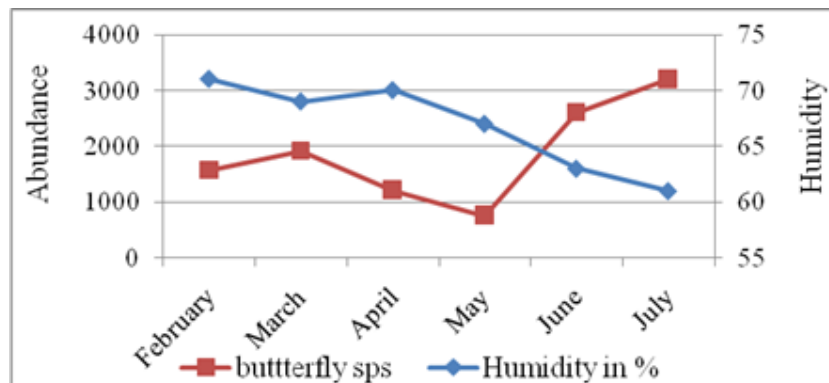


Fig 5: Relationship between butterflies abundance and humidity at Guindy National Park from February 2016 – July 2016.

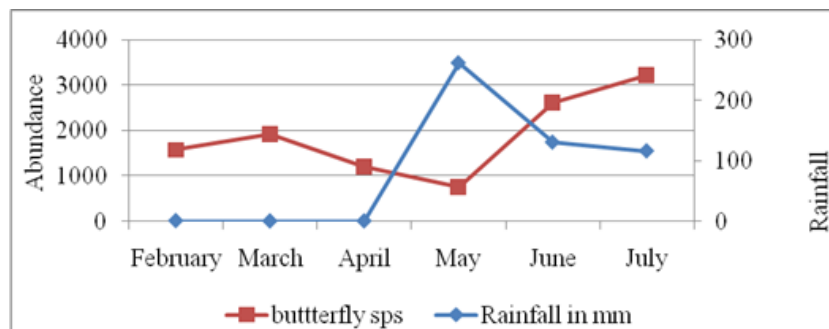


Fig 6: Relationship between butterflies abundance and rainfall at Guindy National Park from February 2016 – July 2016

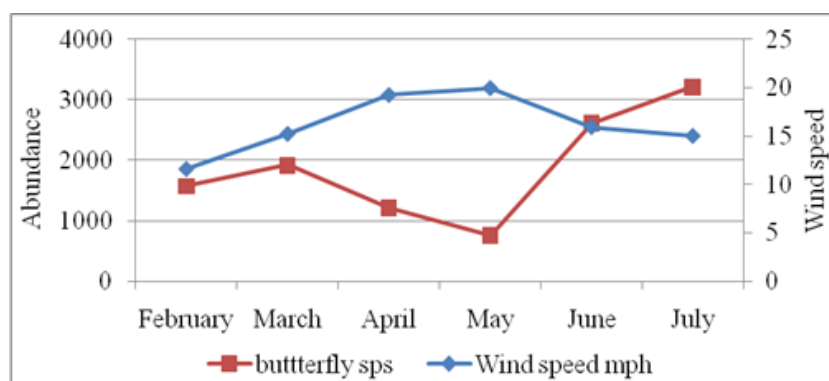


Fig.7: Relationship between butterflies abundance and wind speed at Guindy National Park from February 2016 – July 2016.

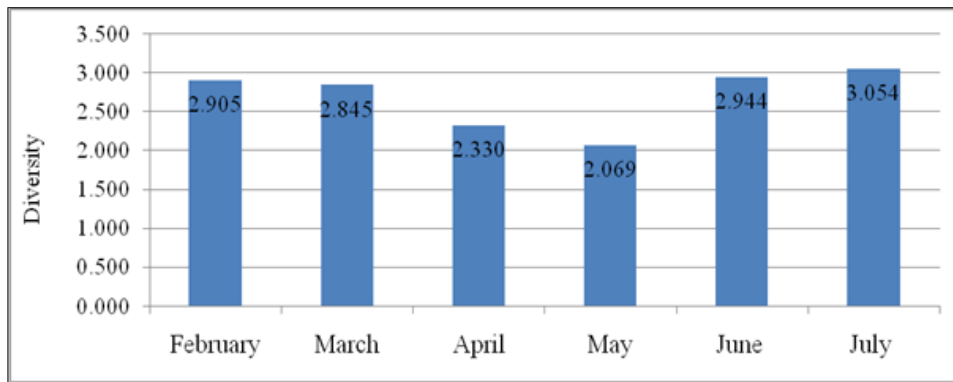


Fig 8: Monthly variation of the species diversity of butterflies recorded from the study area from February 2016 – July 2016.

3.3. Species Diversity

Most of the butterflies are seasonal and they have different requirements for different habitat types for performing their basic life processes like mating, breeding and foraging [31]. Fig.8 shows the seasonal pattern of species diversity for each

month. The diversity of butterfly was recorded maximum in the month of July followed by June, February, March, April and the lowest species diversity was observed in May. A similar change in species richness was also observed [33, 34, 35, 36].

Table 3: List of Butterfly larval host plants recorded in Guindy National Park.

S. No	Family	Species	Plant Common Name	Butterfly Species	Plant Type
1	Acanthaceae	<i>Hygrophila auriculata</i>	Marsh barbel	Blue Pansy, Chocolate Pansy, Grey Pansy, Peacock Pansy, Tiny grass blue	Herb
2	Annoaceae	<i>Polyathia longifolia</i>	False ashoka	Common jay, Common blue bottle, Tailed jay	Tree
3	Annoaceae	<i>Annona reticulata</i>	Custard apple tree	Lime butterfly	Tree
4	Arecaceae	<i>Cocos nusifera</i>	Coconut	Indian palm bob	Tree
5	Capparaceae	<i>Capparis spinosa</i>	Common caper bush	Common gull, Pioneer, Psyche	Shrub
6	Combretaceae	<i>Terminalia catappa</i>	Malabar almond	Line blue	Tree
7	Fabaceae	<i>Cassia fistula</i>	Golden shower tree	Common emigrant, Common grass yellow, Mottled emigrant	Tree
8	Malvaceae	<i>Abutilon indicum</i>	Indian mallow	African malabar skipper	Shrub
9	Mimosaceae	<i>Xylia xylocarpa</i>	Burma Ironwood	Common cerulean, Common sailor, Tricoloured flat	Tree
10	Passifloraceae	<i>Turnera ulmifolia</i>	Yellow alder	Twanycostor	Herbacious shrub
11	Rutaceae	<i>Glycosmis pentaphylla</i>	Gin Berry	Common mime, Lime butterfly, Common Mormon	Shrub

3.4. Host Plant

A total of 11 species of larval host plants as tree, shrub and herb was recorded from 10 families. *Hygrophila auriculata* plant hosted maximum number of butterfly species (5) followed by *Xylia xylocarpa*, *Cassia fistula* and *Capparis spinosa*, *Polyathia longifolia* and *Glycosmis pentaphylla* hosted 3 different species of butterflies, *Abutilon indicum* hosted 2 different species of butterflies whereas *Cocos nusifera*, *Annona reticulata*, *Terminalia catappa*, and *Turnera ulmifolia* hosted only one species of butterfly (Table-3).

4. Conclusion

The present study revealed the existence of 90 species of butterflies belonging to 5 families. This indicates that the possibility of surviving butterflies in urban cities have higher chances when the habitat is undisturbed. Further, systematic research is essential to understand the status of butterflies in mega metropolitan cities. This also underlies that the biodiversity existence in cities where conservation strategies is essential.

5. Acknowledgement

We express our special thanks to Vikas Madav and Dr. Prassana Shirya, Madras Naturalist's Society, Chennai, Dr. R. Banumathi, Naturalist and Managing Trustee of the Pavai Center for Puppeteers, Dr. S. Jayakumar, Assistant Professor,

A.V.C College, Mayiladurai for helping me to identify species and encouraged me to undertake the study on butterflies and host plants. Our sincere thanks to the Officials of Forest Department, Guindy National Park, Chennai, Tamil Nadu.

6. Reference

1. Thangapandian MA, Ganesh P, Ramaraj C, Selvakumar, Janarthan S. Diversity and Status of Butterflies in the city Chennai, Tamil Nadu. Hexapoda Insecta indica. 2014; 21:1-9.
2. Gaurav Sharma, Joshi PC. Diversity of Butterflies (Lepidoptera: Insecta) from Dholbaha dam (Distt. Hoshiarpur) in Punjab Shivalik, India, Biological Forum – An International Journal. 2009; 1(1):12-17.
3. Pollard E. Monitoring butterfly numbers. Monitoring for ecology and conservation, (Ed. by F.B. Goldsmith), Chapman & Hall, London. 1990. 87-111.
4. Blair RB. Birds and Butterflies along an urban gradient: surrogate taxa for assessing biodiversity, Ecological Applications. 1999; 9:164-170.
5. Chaudhuri KK. Management Plan for the Guindy National Park 1990-91 to 1994-95, Wildlife Warden, Madras. 1990.
6. Rajarathinum M. Preliminary report on Habitat Evaluation of the Guindy National park for conservation

- strategies. Madras Naturalists Society. 1990, 37:38-42.
7. Rajasekhar B. Observations on the Vegetation of Guindy National Park. Blackbuck. 1992; 8(2):38-42.
 8. Selvakumar R. On the Ecology and Ethology of Blackbuck Antelope *Cervicapra* (Linnaeus) and the Chital *Axis axis* (Erxleben) at the Guindy Deer Sanctuary. Unpublished M.Sc dissertation Madras Christian College, Tambaram. Madras. 1979.
 9. Shankar Raman TR, Menon RKG, Sukumar R. Ecology and Management of Chital and Blackbuck in Guindy National Park, Madras. Journal of Bombay Natural History Society. 1996, 93.
 10. Miura S. Social behavior of the *Axis axis* Deer during the dry season in Guindy Sanctuary, Madras. Journal of Bombay Natural History Society. 1981; 18:125-138.
 11. Menon RK. Observation on Cheetal at Guindy National Park. Cheetal. 1982; 24(1):37-40.
 12. Santharam V. Birds of the Guindy National Park. Blackbuck. 1986; 2(1):22-26.
 13. Selvakumar RR, Sukumar V, Narayanaswamy, Baskaran ST. A checklist of Birds Guindy Deer Park. Newsletter for Birdwatchers. 1981; 21(8):3-6.
 14. Menon RK. The Hunting Dogs and the Deer population at Guindy National Park. Blackbuck. 1987; 3(2): 13-15.
 15. Rajasekhar B. A study on butterfly populations at Guindy national park, Madras. Journal, Bombay Natural Hist. Society. 1995; 92:275-276.
 16. Kehimkar I. The book of Indian Butterflies. BNHS, Oxford University Press, Mumbai. 2008, 497.
 17. Monsoon Jyoti Gogoi. On the identification of Indian butterflies in the book on Butterflies of the Garo Hills. Journal of Threatened Taxa. 2013; 5(15):5016-5018.
 18. Krushnamegh Kunte, Gaurav Agavekar, Sanjay Sondhi, Rohan Lovalekar, Kedar Tokekar. On the identification and misidentification of butterflies of the Garo Hills. Journal of Threatened Taxa. 2013; 5(11):4616-4620.
 19. <https://www.worldweatheronline.com/chennai-weather-averages/tamil-nadu/in.aspx>. February, 2016.
 20. Anupa KA, Prasad G, Kalesh S. Diversity and Abundance of Butterflies of Kerala University Campus, Kariavattom Thiruvanthapuram, Journal of Entomology and Zoology Studies. 2016; 4(5):1074-1081.
 21. Shankar Raman TR, Menon RKG, Sukumar R. Ecology and Management of Chital and Blackbuck in Guindy National Park, Madras. Journal of Bombay Natural History Society. 1996, 93.
 22. Hill MO. Diversity and Evenness: A Unifying Notation and Its Consequences. Ecology. 1973; 54:427-432.
 23. Menhinick EF. A Comparison of Some Species-Individuals Diversity Indices Applied to Samples of Field Insects.
 24. Farzana Haroon P. Diversity of Butterflies Fauna in Tehsil Tangi, Khyber Pakhtunkhwa, Pakistan. World Journal of Zoology. 2015; 10(4):302-309.
 25. Kumar S, Khamashon L, Pandey P, Chaudhary R, Nath P, Awasthi S *et al.* Community Composition and Species Diversity of Butterfly Fauna with in Gurukula Kangri Vishwavidyalaya Campus, Journal of Entomology and Zoology Studies. 2013; 1(6):66-69.
 26. Tshering Nidup, Tshering Dorji, Ugyen Tshering. Taxon diversity of butterflies in different habitat types in Royal Manas National Park. Journal of Entomology and Zoology Studies. 2014; 2(6):292-298.
 27. Veronica F, Salvatore S, Salvatore A, Barbara M. Seasonal patterns in butterfly abundance and species diversity in five characteristic habitats in Sites of Community Importance in Sicily (Italy), Bulletin of Insectology. 2015; 68(1):91-102.
 28. Priyamvada, Animesh Kumar Mohapatra. A preliminary study on diversity of butterflies (Lepidoptera: Macrolepidoptera) in Regional Institute of Education campus, Bhubaneswar, Odisha, India. Journal of Entomology and Zoology Studies. 2016; 4(2):489-496.
 29. Ashish DT, Arun MK. Butterfly Species Diversity, Habitats and Seasonal Distribution in and Around Nagpur City, Central India. World Journal of Zoology. 2009; 4(3):153-162.
 30. Prabakaran S, Chezian Y, Evangelin G, John William S. Diversity of Butterflies (Lepidoptera: Rhopalocera) in Tiruvallur District, Tamilnadu, India. Biolife. 2014; 2(3):769-778.
 31. Rajagopal T, Sekar M, Archunan G. Diversity and community structure of butterfly of Arignar Anna Zoological Park, Chennai, Tamil Nadu. Journal of Environmental Biology. 2011; 32:201-207.
 32. Singh AP, Pandey R. A model for estimating butterfly species richness of areas across the Indian sub- continent: species proportion of Papilionidae as an Indicator. Journal Bombay Natural History Society Bombay. 2004; 101:79-89.
 33. Kumar P, Ramarajan S, Murugesan AG. Diversity of butterflies in relation to climatic factors in environmental centre campus of Manonmaniam Sundaranar University, Tamil Nadu India, Journal of Entomology and Zoology Studies. 2017; 5(2):1125-1134.
 34. Krushnamegh JK. Seasonal patterns in butterfly abundance and species diversity in four tropical habitats in northern Western Ghats. Journal of Bio-science. 1997; 22(5):593-603.
 35. Arya MK, Dayakrishna, Chaudhary R. Species richness and diversity of Butterflies in and around Kumaun University, Nainital, Uttarakhand, India, Journal of Entomology and Zoology Studies. 2014; 2(3):153-159.
 36. Jahir HK, Ramesh T, Satpathy KK, Selvanayagam M. Seasonal dynamics of butterfly population in DAE Campus, Kalpakkam, Tamil Nadu, India. Journal of Threatened Taxa. 2011; 3(1):1401-1414.