

Diversity and Abundance of Butterfly (*Lepidoptera*) Fauna in Kalaimahal College Campus, Sembanarkoil, Tranqubar Taluk, Tamil Nadu

Joothi Pillai Paramanandham^{a*}, Kaliyamoorthy Krishnappa^b, Kannan Kabilan^c, and Selvaraj Sathishkumar^d

Department of Zoology and Wildlife Biology, A.V.C College (Autonomous)
Mannampandal-609 305 Tamil Nadu

^{a,*}paramusacon2010@gmail.com; ^bkrishnappaprofessor@gmail.com; ^ckkabilan116@gmail.com; ^dksathish605@gmail.com

Keywords: Lepidoptera, Butterfly, Institutional campus, Diversity indices and Pollinator

Abstract. 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. It is one of the most important assemblages of insects that act as biodiversity indicators as well as nature's gardeners. The objective of the present survey is focussed on the assessment of the diversity and abundance of butterfly conservation priorities in the study area. A total of 33 species of butterflies under 5 families and 26 genera were recorded during from December 2017 to February 2018 in the Kalimahahal College campus, Sembarnarkoil, Tharangambadi Taluk. Nymphalidae was recorded as the most dominant family in terms of number of species (13) and number of genera (9), followed by Pieridae 8 species (6 genera), Lycaenidae 6 species (5 genera), Hesperidae 3 species (3 genera), and Papilionidae 3 species (2 genera). Species richness (25), Simpson diversity index (0.7206) and Shannon 'H' index (1.783) were high in the month of December 2017. Simultaneously the Dominance index (0.6634) and Species Evenness (0.2871) were high in the month of February 2018. The outcomes of the present study highlight the importance of institutional campuses as a preferred habitat for butterflies. If the landscaping and maintenance of gardens are cautiously planned, the diversity of butterflies may increase in college campus providing a rich ground for butterfly conservation as well as for research.

Introduction

Insects have a significant role to play in conservation assessments because of their dominance in terrestrial ecosystems [1], their short generation times that can result in rapid population response to disturbance, and their wide range of life styles that make them sensitive to changes in the biotic and abiotic environments [2]. It contributes to more than half of all the species on the planet [3]. Among the insects, butterflies are scaled wing insects belonging to the order Lepidoptera, which constitutes visually appealing insect [4]. In India, a rich butterfly fauna comprising of 1501 species out of 16,823 species recorded from all over the world [5]. Butterflies and their larvae play important roles in ecosystem functioning, including nutrients cycle and pollination [6-7]. Butterflies are moral indicators of environmental alterations as they are sensitive and are directly affected by changes in the habitats, atmosphere, temperature and the weather conditions [8-9]. In flowering plants, sexual reproduction is mainly mediated by animal pollinators such as butterflies and in many out-crossing plant species nectar is the principal floral prize. Butterflies are one of the important food chain components of the birds, reptiles, amphibians, spiders and predatory insects [10]. They have a useful role to play in ecological impact assessments, and in continued monitoring of ecological health. They would also be very suitable organisms for studying the effect of forest management.

Seasonal fluctuations of butterflies covering a particular area are influenced by environmental factors viz., temperature, photoperiod, rainfall, humidity and availability of food resources, types of vegetation viz., herbs, shrubs and trees [11-13]. In the present investigation was carried out,

abundance and diversity of butterflies in Kalaimahal College Campus, to access the species composition and species richness of the butterflies, to compare the butterfly abundance and diversity in month wise during the study period.

Materials and Methods

The study was conducted in Kalaimahal College Campus (N 11.11° & E 79.75°) which is located at Sembanarkoil, Tharangambadi Taluk, Nagapattinam District, Tamil Nadu. The campus is spread an area of 7.43 Hectares and it covers a garden, banana orchard, shrubs and trees. The study was carried out from December 2017 to February 2018 and observation made through walking transect method [14] modified as per the Kunte [15]. In every day of study period 1000 meter was walked (100m each transects) and each transects were slowly traversed at a uniform pace for 15 min at each transect from 07:00 am to 10:00 am during good weather period (no heavy rain or strong winds) and 3 min intervals in between the transects. The individuals of butterfly were counted and the photographs were taken in the field and later identified with the help of references books [9], relevant publications [16] and standard guidelines [17]. Moreover, the independent factor like temperature and humidity were measured by thermometer and Hygrometer respectively. The data were entered and documentation done by MS Office and analyzed by PAST software.

Results

Abundance of Butterfly

A total 874 individuals of 33 butterfly species belongs to five families were recorded during study period from December 2017 and February 2018 in the Kalaimahal College Campus, Sembanarkoil, Tharangapadi Taluk, Nagapattinam District. Among the various species of butterflies recorded, *Acraea violae* was the high abundance with 67.85% followed by *Delias eucharis* and *Eurema hecabe* with 9.95% and 4.00% respectively (Table 1).

Table 1. Abundance of Butterfly fauna in Kalaimahal College Campus (n=874)

Sl. No	Species	No. of individuals	Percentage (%)
1	<i>Acraea violae</i>	593	67.85
2	<i>Delias eucharis</i>	87	9.95
3	<i>Eurema hecabe</i>	35	4.00
4	<i>Pachliopta aristolochiae</i>	25	2.86
5	<i>Danaus chrysippus</i>	21	2.40
6	<i>Tirumala limniace</i>	19	2.17
7	<i>Leptosia nina</i>	14	1.60
8	<i>Pachliopta hector</i>	14	1.60
9	<i>Ariadne ariadne</i>	10	1.14
10	<i>Danaus genutia</i>	7	0.80
11	<i>Castalius rosimon</i>	6	0.69
12	<i>Euploea core</i>	6	0.69
13	<i>Zizeeria karsandra</i>	5	0.57
14	<i>Papilio polytes</i>	4	0.46
15	<i>Junonia lemonias</i>	3	0.34
16	<i>Ariadne merione</i>	2	0.23
17	<i>Borbo cinnara</i>	2	0.23
18	<i>Catopsilia pyranthe</i>	2	0.23
19	<i>Hebomoia glaucippe</i>	2	0.23
20	<i>Junonia iphita</i>	2	0.23
21	<i>Mycalesis perseus</i>	2	0.23

22	<i>Pelopidas conjuncta</i>	2	0.23
23	<i>Azanus Jesous</i>	1	0.11
24	<i>Azanus ubaldus</i>	1	0.11
25	<i>Catopsilia pomona</i>	1	0.11
26	<i>Cepora nerissa</i>	1	0.11
27	<i>Euema hecabe</i>	1	0.11
28	<i>Jamides celeno</i>	1	0.11
29	<i>Lampides boeticus</i>	1	0.11
30	<i>Melanitis leda</i>	1	0.11
31	<i>Mycalesis mineus</i>	1	0.11
32	<i>Neptis hylas</i>	1	0.11
33	<i>Pseudoborbo bevani</i>	1	0.11

Among the five families, family Nymphalidae (76.43%) represented by 9 genera and 13 species were the most dominant followed by 6 genera, 8 species in Pieridae (16.36%), 5 genera, 8 species in Lycaenidae (1.72%), 3 genera, 3 species in Hesperidae (0.57%) and 2 genera, 3 species in Papilionidae (4.92%) (Table 2).

Table 2. Family wise abundance of butterfly fauna in Kalimahal College campus

Sl. No	Families	Frequency	Percentage (%)
1	Nymphalidae	457	70.52
2	Pieridae	128	19.75
3	Papilionidae	44	6.79
4	Lycaenidae	14	2.16
5	Hesperidae	5	0.77

Local status recorded by using observation which has very low sighting coming under very rare species, and low sighting were rare species, moderate sighting were occasional species and frequently sighting were considered as common species. In the present investigation, 16 species of butterflies showed rarely (50%) distribution followed by 6 species were common (19%), 5 species were occasional (16%) and 5 species were very rare (15%) (Table 3).

Table 3. Local status of Butterfly observed in Kalaimahal College Campus

S. No.	Scientific name	Family	Common	Occasional	Rare	Very Rare
1	<i>Borbo cinnara</i>	Hesperidae			✓	
2	<i>Pelopidas conjuncta</i>				✓	
3	<i>Pseudoborbo bevani</i>				✓	
4	<i>Azanus Jesous</i>	Lycaenidae				✓
5	<i>Azanus ubaldus</i>				✓	
6	<i>Castalius rosimon</i>				✓	
7	<i>Jamides celeno</i>					✓
8	<i>Lampides boeticus</i>					✓
9	<i>Zizeeria karsandra</i>				✓	
10	<i>Acraea violae</i>	Nymphalidae	✓			
11	<i>Ariadne ariadne</i>		✓			
12	<i>Ariadne merione</i>		✓			
13	<i>Danaus chrysippus</i>		✓			

14	<i>Danaus genutia</i>		✓			
15	<i>Euploea core</i>				✓	
16	<i>Junonia iphita</i>				✓	
17	<i>Junonia lemonias</i>				✓	
18	<i>Melanitis leda</i>				✓	
19	<i>Mycalesis mineus</i>				✓	
20	<i>Mycalesis perseus</i>				✓	
21	<i>Neptis hylas</i>				✓	
22	<i>Tirumala limniace</i>			✓		
23	<i>Pachliopta aristolochiae</i>	Papilionidae		✓		
24	<i>Pachliopta hector</i>			✓		
25	<i>Papilio polytes</i>			✓		
26	<i>Catopsilia pomona</i>				✓	
27	<i>Catopsilia pyranthe</i>	Pieridae		✓		
28	<i>Cepora nerissa</i>					✓
29	<i>Delias eucharis</i>		✓			
30	<i>Pseudoborbo bevani</i>				✓	
31	<i>Euema hecabe</i>					
32	<i>Hebomoia glaucippe</i>					✓
33	<i>Leptosia nina</i>				✓	

Diversity Indices of Butterfly

There was a significant difference in number of species between different months. A total 33 species of butterflies observed during from December 2017 to February 2018. The diversity indices were a significantly different in number of species between different months.

In the month December 2017 has a high species richness (25) followed by January and February 2018 with 15 and 8 respectively (Fig. 4). The dominance was maximum recorded in February 2018 (0.66) followed by January 2017 (0.65) and minimum dominance was recorded December 2017 (0.27) (Fig. 5).

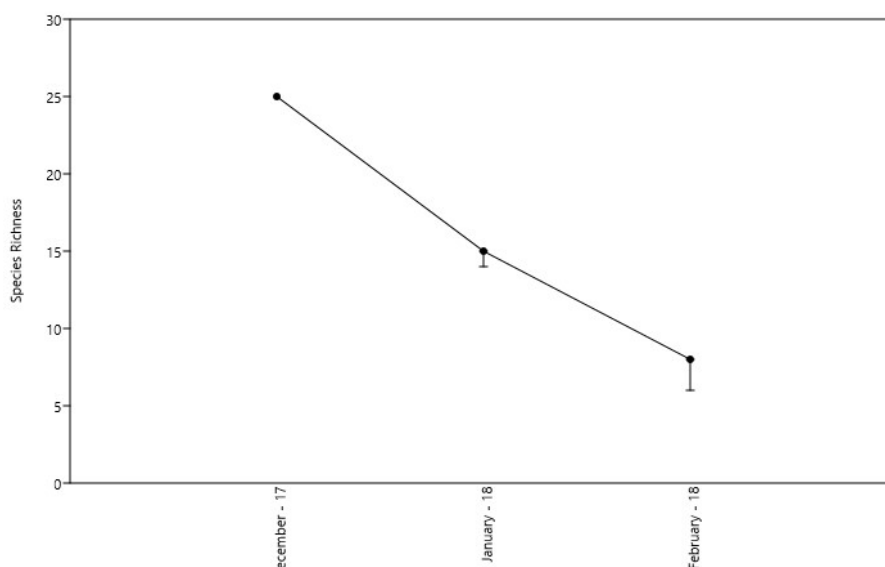


Fig. 4. Species richness of Butterfly fauna in different month (n=3)

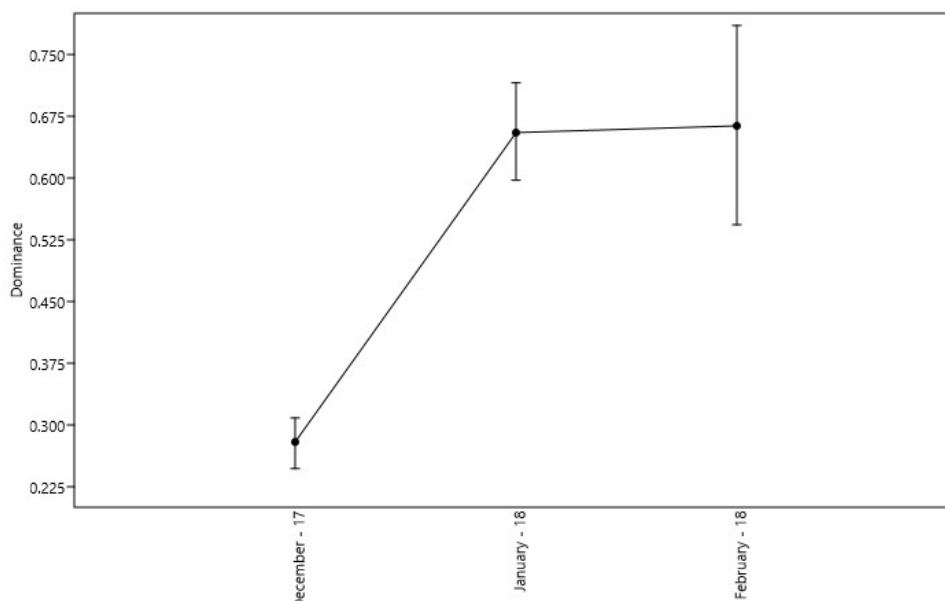


Fig. 5. Dominance index of Butterfly fauna in different month (n=3)

Simpson diversity was recorded maximum in the month of December 2017 (0.7206) and minimum was observed in the month of February 2018 (0.3366) (Fig. 6). Shannon wiener index was maximum in December 2017 (1.783) and minimum was recorded February 2018 (0.8317) (Fig. 7). The maximum evenness observed during February 2018 (0.2871) and minimum was in January 2018 (Fig. 8).

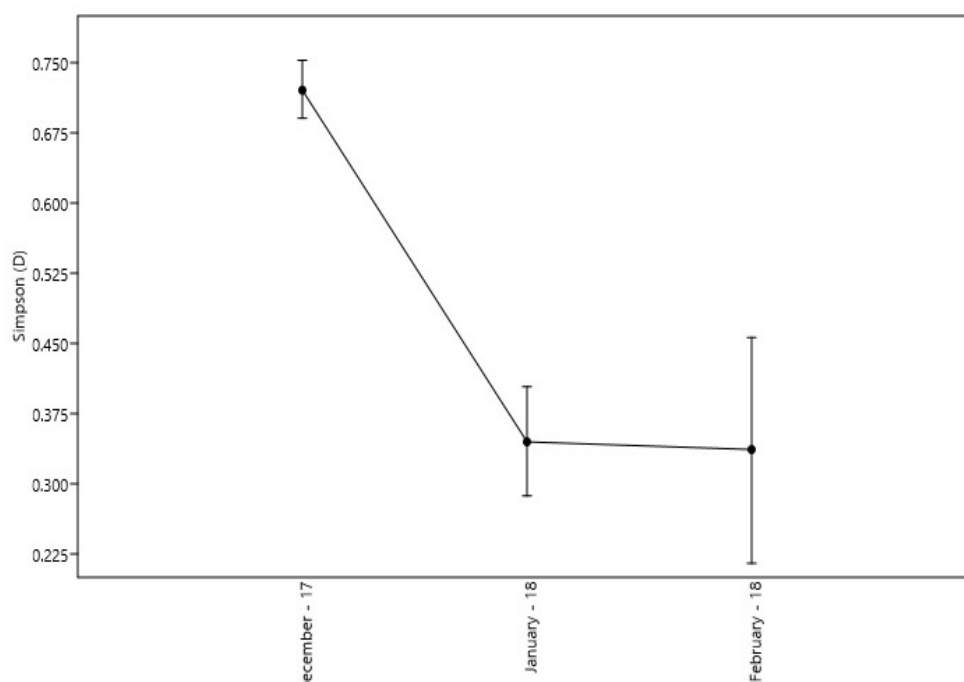


Fig. 6. Simpson diversity index of Butterfly fauna in different month (n=3)

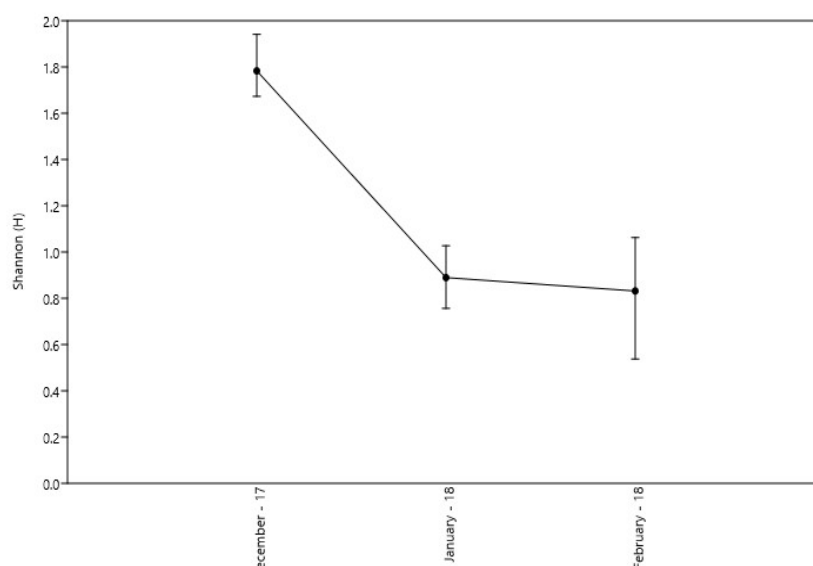


Fig. 7. Shannon wiener diversity index of Butterfly fauna in different month (n=3)

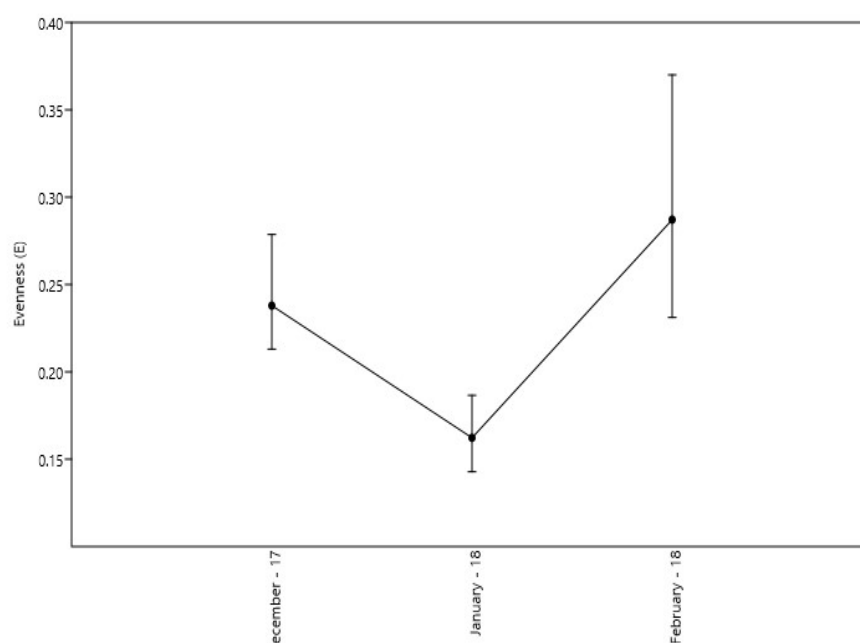


Fig. 8. Evenness of Butterfly fauna in different month (n=3)

Activity budget of Butterfly

Three hours were observed in every day during study period, maximum sighting was between 07:50 and 08:20 hrs (Fig. 9). At the sighting time the butterflies were flying activity was high followed by resting, siting and basking (Fig. 10). Correlation showed the high percentage humidity was reflecting the more number of individuals' sightings and low percentage was directly affecting the sightings of the butterfly fauna. Likewise the low temperature is directly related with high abundance of butterfly fauna and high temperature is affecting the sightings (Fig. 11 and 12).

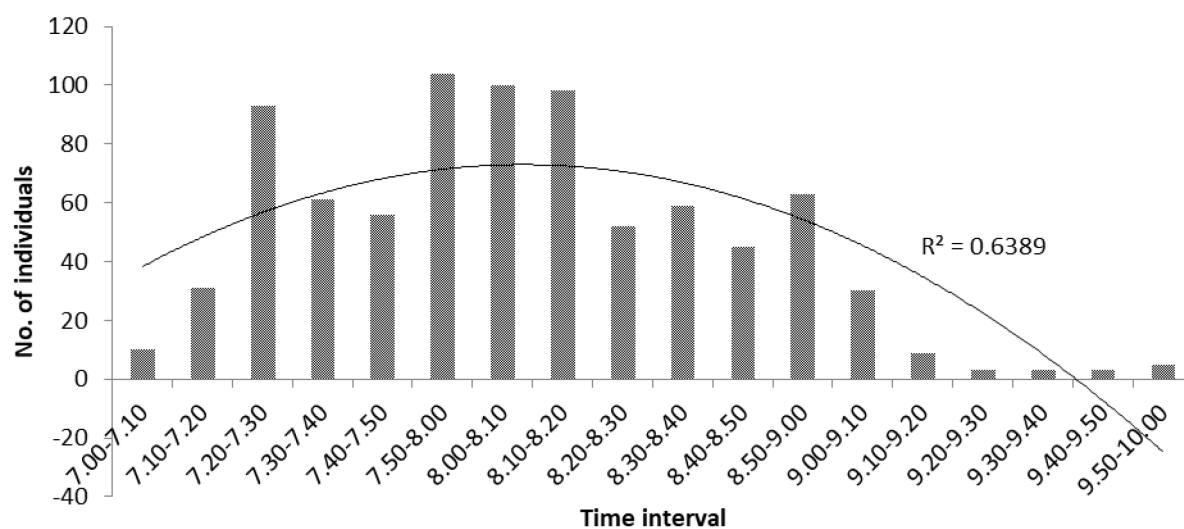


Fig. 9. Occurrence of individuals in relation with sighting time in study area (n=874)

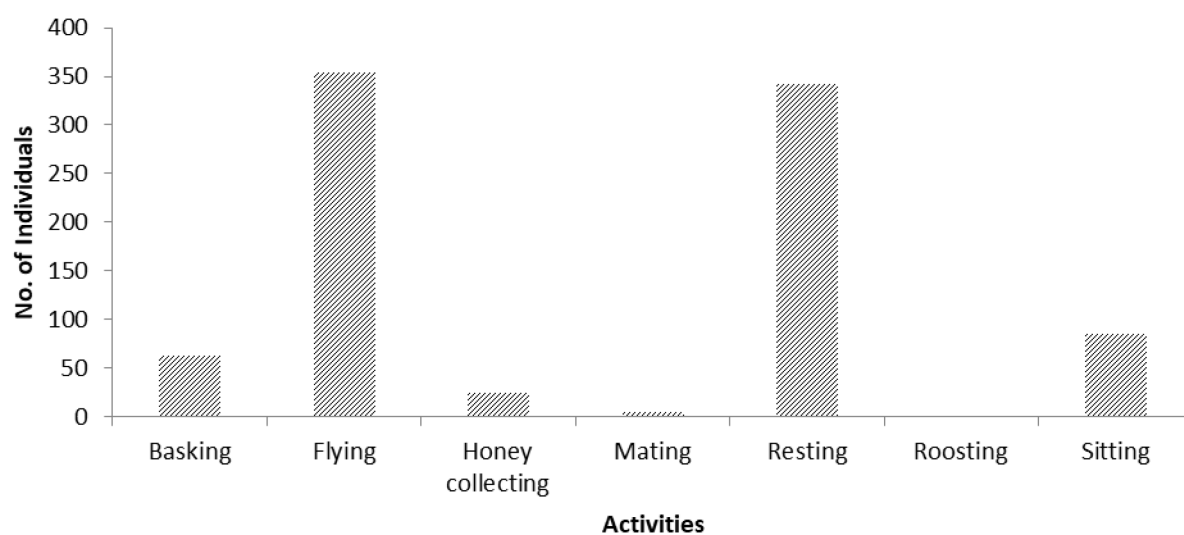


Fig. 10. Activities of butterflies during study period (n=874)

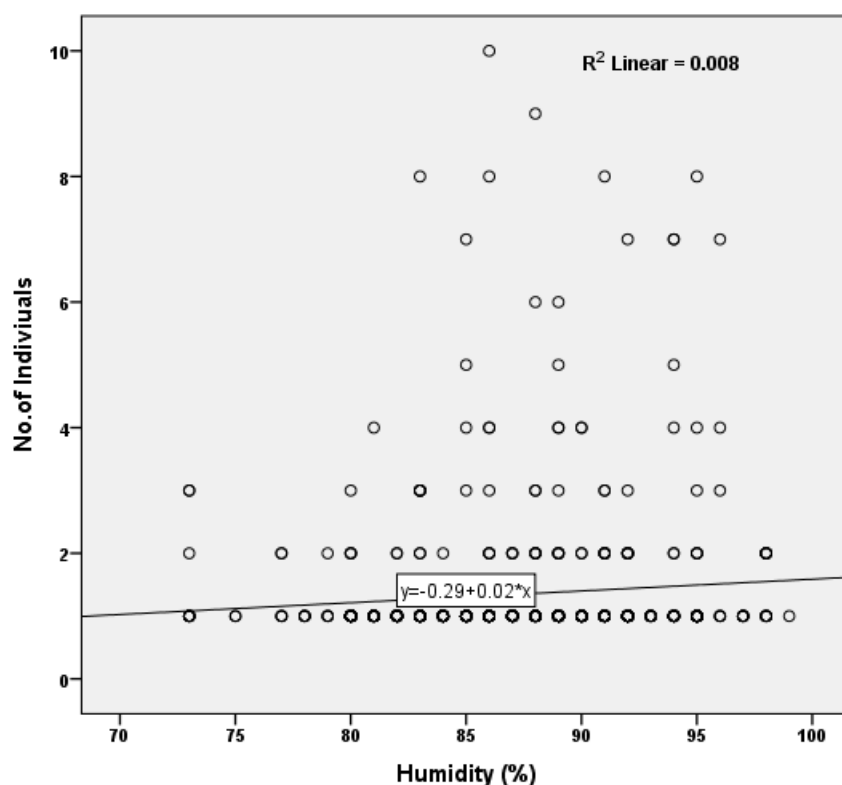


Fig. 11. Correlation matrix between humidity and number of individuals during study period

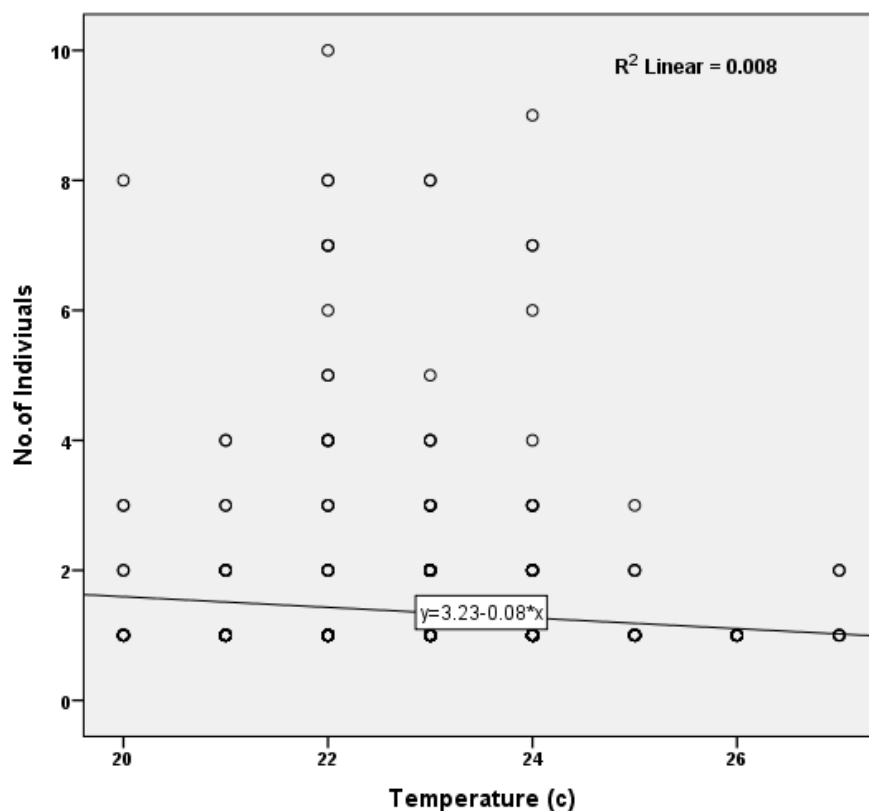


Fig. 12. Correlation matrix between temperature and number of individuals during study period

Discussion

The results of the present study were *Nymphalidae* dominant family followed by *Pieridae*, *Lycaenidae* and *Hesperiidae*. More or similar results have been reported by Adiroubane and Kuppamal [18] in Karaikal agro ecosystem. Present study revealed that, family *Acraeidae*

constituted a single species, and the family Danaidae and Papilionidae with four species, Hesperidae and Pieridae with five species, Lycaenidae with eight species, Nymphalidae with seven species and family Satyridae with two species. Prapakaran et al. [8] also recorded a total of 63 genera and 97 species belonging to 5 families in Thiruvalluvar District. Out of these, individuals of the family Nymphalidae were found to be dominant with 31 species under 19 genus followed by the family Hesperidae with 25 species under 18 genus, the family Pieridae with 20 species under 12 genus, the family Lycaenidae with 14 species under 11 genus and the family Papilionidae with 7 species under 3 genus. Evangeline and Santhi [10] have been recorded butterfly diversity in 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 Polyommata, 13 species of Pierinae, 10 species of Papilioninae, 9 species of Nymphalinae, 8 species of Danae, 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. 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%). Bora and Meitei [19] have noted that, a total of 96 species of butterflies belonging to 68 genera and five families were recorded during the study period, of which 13 species were under the rare category (included 9 rare* and 4 very rare**). During the course of the present studies it was observed that the family Nymphalidae represented by 23 genera and 34 species was the most dominant followed by Lycaenidae (19 genera, 20 species), Hesperidae (13 genera, 15 species), Pieridae (9 genera, 14 species) and Papilionidae (4 genera, 13 species).

Sharma et al. [20] discussed a total of 63 species of butterflies belonging to the five families were recorded and during the survey and Nymphalidae were the most commonly recorded, accounting for 44% of total species recorded followed by Lycaenidae 17%, Pieridae 16% and Papilionidae 14% of total species and minimum was recorded for Hesperidae 8% (n=5). Maximum 51 species were recorded in the forest patches followed by home garden (46), road side plantation (44) and minimum in open grassland (36). The diversity was found high in the forest patch ($H=3.76$) followed by roadside plantation ($H=3.68$), home garden ($H=3.65$) and open grassland ($H=3.39$). Khyade and Jagtap [21] reported a total of 96 species of butterflies belonging to 68 genera and five families were recorded during the study period, of which 13 species were under the rare category. It was also observed that the family Nymphalidae represented by 23 genera and 34 species was the most dominant followed by Lycaenidae 20 species, Hesperidae 5 species, Pieridae 14 species and Papilionidae 13 species. Also Evangeline and Santhi [10] revealed that, there is not much difference the dominance. The predominance of Nymphalidae over other butterfly groups in Western Ghats has earlier been reported by many workers [15, 22-25]. Adiroubane and Kuppammal [18] have been revealed that the same trend of evenness among the month of the study period. The families showed least diversification during the month of February, followed by April, May, March which indicated that the evenness of species in the families. Similar results have been observed in near town Karaikal and the climate of region is humid throughout the year except December and January, which are the coolest months. The maximum and minimum temperatures recorded in this region are 33.38°C and 24.63°C respectively. Evangeline and Sandhi [10] have been reported that, least number of species recorded during minimum and maximum temperature in Guindy National Park, Chennai and moderate temperature enrich the species diversity. Climatic factors such as humidity, rainfall, temperature and wind speed influence the activity of butterfly in terms of seasonal reproduction and dormancy [26-27]. Some other studies also showed similar kind of results, the pre monsoon (June-July) and post monsoon (August-November) showed good number of species where as peak summer (May) and winter (December) showed less number of species [17, 28].

Conclusion

Butterflies are the sensitive insects which react quickly to any kind of disturbances like changes in the habitat quality and environmental variation. Butterflies and their larvae play an important role in ecosystem functioning, including nutrient cycling and pollination. The study concluded that, A total 33 species of butterfly species identified from the study period of area. It shows great diversity of Lepitoptera fauna in the study area. Further it is suggested the still extensive study is repeated in this area to bring about interning information about the butterfly species. This study will also add to our future attempts in understanding the complex nature of mutualistic interaction between butterflies and flowering plants that is essential for continuity of ecosystem services. This is the first effort in exploring the butterfly wealth of Kalaimahal College Campus. The present list of butterfly species is not conclusive and exhaustive and future exploration will be continued to update this checklist.

Conflict of Interest

The author(s) declare(s) that there is no conflict of interest.”

Acknowledgements

The authors are thankful to Principal and Head of the Department of Zoology, AVC College (Autonomous), Mannampandal and The Principal, Kalaimahal College of Arts and Science, Sembanarkoil for permitting to do the work successfully.

References

- [1] E.Q. Wilson, The little things that run the world (the importance and conservation of invertebrates). *Conservation Biology*. 1 (1987) 344-346.
- [2] C. Kremen, A.M. Merenlender, D.D. Murphy, Ecological monitoring: a vital need for integrated conservation and development programs in the tropics. *Conservation Biology*. 8 (1994) 388–97.
- [3] P.G. May, Flower selection and the dynamics of lipid reserves in two nectarivorous butterflies, *Ecology* 73 (1992) 2181- 2191.
- [4] P.J. Gullan, P.S. Cranston, *The Insects: An Outline of Entomology*, In the importance, diversity and conservation of insects. 3rd Edition (2009), John Wiley and Sons Publishers, pp.528.
- [5] H. Gaonkar, Butterflies of the Western Ghats, India, including Srilanka; A biodiversity assessment of a threatened mountain system. (1996) Center for Ecological Sciences, IISc. Bangalore and the Natural History Museum, London. pp. 51.
- [6] D.H. Janzen, Insect diversity of a Costa Rican dry forest; why keep it, and how? *Biological Journal of the Linnean Society*, 30 (1987). 343–356.
- [7] T.D. Schowalter, *Insect Ecology, an Ecosystem Approach*, 2nd edn. (2006). Academic Press, San Diego, California.
- [8] S. Prabakaran et al., Diversity of Butterflies (Lepidoptera: Rhopalocera) in Tiruvallur District, Tamil Nadu, India. *Bio life*. 2(3) (2014) 769-778.
- [9] K. Gunathilagaraj et al., Some South Indian butterflies: field guide. (1998) pp 274.
- [10] D. Evangeline, S. Santhi, Butterfly diversity at Guindy National Park in Metropolitan City of Chennai, Tamil Nadu, South India *Journal of Entomology and Zoology Studies*. 5(4) (2017) 1361-1368.

-
- [11] A. Anu, T.K. Sabu, P.J. Vineesh, Seasonality of litter insects and relationship with rainfall in a wet evergreen forest in south Western Ghats. *J Sect. Sci.* 9 (2009) 46.
 - [12] R. Shanthi, K.J. Hussain, K.P. Sanjayan, Influence of weather on the incidence of sucking pest complex on summer-irrigated cotton crops of Tamil Nadu. *Hexapoda.* 16(1)(2009) 89-92.
 - [13] A.D. Tiple, A.M. Khurad, R.L.H. Dennis, Butterfly diversity in relation to a human-impact gradient on an Indian university campus. *Nota lepidopterologica.* 30(1) (2007) 179-188.
 - [14] E. Pollard, A method for assessing changes in the abundance of butterflies. *Biol. Conserv.* (12) (1977) 115–153.
 - [15] K.J. Kunte, Seasonal patterns in butterfly abundance and species diversity in four tropical habitats in the northern Western Ghats. *J Biosci.* 22 (1997) 593 - 603.
 - [16] K.J. Kunte, Butterflies of peninsular India. University press (Hyderabad) and Indian Academy of Sciences (Bangalore) (2000) pp. 254.
 - [17] H.K. Jahir et al., Seasonal dynamics of butterfly population in DAE Campus, Kalpakkam, Tamil Nadu, India. *J Threatened Taxa.* 3(1) (2011) 1401-1414.
 - [18] D. Adiroubane, P. Kuppammal, Lepidopteron fauna of Agri-horticultural ecosystems in Karaikal region. *J Biol Pest* 3 (2010) 1-10.
 - [19] A. Bora, L.R. Meitei, Diversity of butterflies (Order: Lepidoptera) in Assam University Campus and its Vicinity, Cachar District, Assam, India. *Journal of Biodiversity and Environmental Sciences.* 5(3) (2014) 328-339.
 - [20] K. Sarma et al., Diversity and habitat association of butterfly species in foothills of Itanagar, Arunachal Pradesh, India. *CIBTech Journal of Zoology.* 1 (2013) 67-77.
 - [21] V.B. Khyade, S.G. Jagtap, Butterflies - Diversity in Mayureshwar Wildlife Sanctuary of Baramati Tehsil in Pune district (India). *Journal of Entomology and Zoology Studies.* 5(2) (2017) 443-457.
 - [22] P. Eswaran, P. Pramod, Structure of butterfly community of Anaikatty Hills, Western Ghats. *Zoo's Print J* 20 (2005) 1939-1942.
 - [23] K.A.D. Padhye et al., Season and Landscape wise distribution of butterflies in Tamhini, Northern, and Western Ghats, India. *Zoos Print J* 21 (3) (2006) 2175 - 2181.
 - [24] T. Ramesh et al., Patterns of diversity, abundance and habitat associations of butterfly communities in heterogeneous landscapes of the department of atomic energy (DAE) campus at Kalpakkam, South India. *Inter J Biodiver Conser.* 2(4) (2010) 75-85.
 - [25] N. Krishnakumar et al., Diversity of papilionid butterflies in the Indira Gandhi Wildlife Sanctuary, Western Ghats, Southern India. *Tiger Paper* 35 (1) (2008) 1-8.
 - [26] N.E. Alma et al., The species composition of butterflies (Lepidoptera: Rhopalocera) in Lipa city, Batangas, Philippines *Journal of Entomology and Zoology Studies.* 5(2) (2017) 531-536
 - [27] N. Ruchi, G. Nirjara, P. Sujatha, What determines the abundance of butterflies? - A short search. *Recent Research in Science and Technology.* 4(11) (2012) 28-33.
 - [28] P. Kumar, S. Ramarajan, A.G. Murugesan, 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.* 5(2) (2017) 1125-1134.