

Seasonal Diversity and Distribution of Butterflies in G.Venkataswamy Naidu College Campus, Kovilpatti, Tuticorin District, Tamil Nadu

Kumar P^{1,*}, Makesh Kumar B²

¹Department of Zoology, G. Venkataswamy Naidu College (Autonomous), Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India

²Department of Botany, G. Venkataswamy Naidu College (Autonomous), Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India

Received October 20, 2020; Revised July 2, 2021; Accepted July 19, 2021

Cite This Paper in the following Citation Styles

(a): [1] Kumar P, Makesh Kumar. B , "Seasonal Diversity and Distribution of Butterflies in G.Venkataswamy Naidu College Campus, Kovilpatti, Tuticorin District, Tamil Nadu," *Advances in Zoology and Botany*, Vol. 9, No. 5, pp. 91 - 99, 2021. DOI: 10.13189/azb.2021.090501.

(b): Kumar P, Makesh Kumar. B (2021). *Seasonal Diversity and Distribution of Butterflies in G.Venkataswamy Naidu College Campus, Kovilpatti, Tuticorin District, Tamil Nadu. Advances in Zoology and Botany*, 9(5), 91 - 99. DOI: 10.13189/azb.2021.090501.

Copyright©2021 by authors, all rights reserved. Authors agree that this article remains permanently open access under the terms of the Creative Commons Attribution License 4.0 International License

Abstract This study was conducted to prepare a baseline inventory, seasonal population trends and status of butterfly inhabiting the campus of G. Venkataswamy Naidu College, Kovilpatti, Tuticorin. The survey yielded 309 individuals of 48 butterfly species, belonging to the families Nymphalidae, Pieridae, Lycaenidae, Papilionidae and Hesperidae. Nymphalidae were found to be the dominant family during all seasons. Species abundance was highest during the northeast monsoon and winter periods. The maximum number of 163 individuals was sampled during the NE monsoons followed by winter 109 individuals and SW Monsoon showed 23 individuals. The summer showed least skewed 15 individuals were recorded. The butterfly species composition and relative abundance belonged to the families Nymphalidae (17 Species; 35.42%), Pieridae (11 species; 25.00%), Lycaenidae (7 Species; 14.58%), Papilionidae (8 Species; 16.67%) and Hesperidae (4 Species; 8.33%). The maximum number of butterfly species and maximum number of individuals were sampled during the monsoons, indicating that, the southern plains area of India butterflies prefer cool seasons for breeding and emergence. Three endemic species like *Cepora nerissa*, *Troides minos* and *Atrophaneura hector* and seven protected species like *Euploea core*, *Cepora nerissa*, *Appias albino*, *Castalius rosimon*, *Euchrysops cnejus*, *Troides minos* and *Atrophaneura hector* were listed

under the Wildlife Protection Act 1972. These species highlighted greater importance of conservation in college campus. A checklist of butterfly species is also provided. The observation will support the detailed study of ecologically important local butterfly fauna of the college campus in Kovilpatti which provide a valuable resource to nature.

Keywords Butterfly, Diversity, Abundance, College Campus, Conservation

1. Introduction

Butterflies are one of the most conspicuous species of Earth's biodiversity [1]. Butterflies are generally regarded as the best taxonomically studied groups of insects due to their great aesthetic value owing to bright colors, interesting behaviors and daytime activity periods [2]. Butterflies are extremely important components of the bioindicators [3]. It is often used as bio-indicators of ecosystem health and as surrogates for overall biodiversity [4] and are widely used as sensitive indicators of environmental change, temperature and humidity caused by disturbances in its habitats [5]. Institutional

campuses with undisturbed vegetation and seasonal flowering provide potential habitat for butterfly population [6]. Food of butterfly plays an important role in determining their distribution, abundance and movement [7]. Positive relationships have been found between butterfly diversity and plant diversity [8]. A large proportion of the plant species including many trees depends on insects to pollinate their flowers (9). Totally, 252 wild and planted species of flora were recorded in G.V.N. College Campus [10].

Conservationist, mainly focus on vertebrates but many invertebrate species are at risk. [11]. The immediate steps need to be taken to protect invertebrates and restore invertebrate diversity and habitat. Moreover, the information available is mostly restricted to some protected areas and there is a need to study these organisms particularly at institutional campuses. Hence, the objective of this study is to create baseline information on diversity and distribution pattern of lepidopteron fauna communities present at G.V.N. College campus, Kovilpatti.

2. Materials and Methods

i) Inventory of Fauna

The inventory of lepidopteran faunal diversity in G. Venkataswamy Naidu College, Kovilpatti, Tuticorin ($9^{\circ}11'45.35N$ $77^{\circ}50'04.29E$) is a 6E, Deccan Peninsula Deccan South. This study was conducted in the college campus with several line transect of Kovilpatti, Tuticorin district of Tamil Nadu (Figure 1). The work was carried out over a one year period (September 2018- August

2019). The procedure involved field survey of handful charismatic taxa of butterflies. Identification of butterflies was achieved through photographic evidence. Confirmation of species status was done using identification [12,13]. The butterflies were observed and photographed during the survey period (Plate 1).

ii) Methodology for Butterflies

Sampling was carried out in different seasons South West Monsoon (SWM), North East Monsoon (NEM), Winter and Summer during September 2018-May 2019 covering an entire campus area of about 105ha. A slight modification of the conventional line transect count [14] was adapted to determine butterfly richness and abundance. In this method, six permanent 200m line transects were setup in college campus. The transects were slowly traversed for approximately 10 minute in each transect from 08.00hrs to 09.30hrs during the good weather period (no heavy rain or strong wind). Butterfly species were recorded around a radius of 5 meter from the observer covering all sides laterally and above. This is a suitable method for surveying butterflies in a wide range of habitats all individuals were identified in the field using standard guides [12, 13]. No specimen was collected during the study period. Photograph was taken during the field visit using Nikon D 3400.

The interpretation of data was carried out to assess the relative abundance of the butterfly populations. The clustering of species was based on their presence and absence during different seasons was compared by using Bray Curtis similarity matrix (Cluster analysis) were calculated using Biodiversity Pro Version 2 [15].

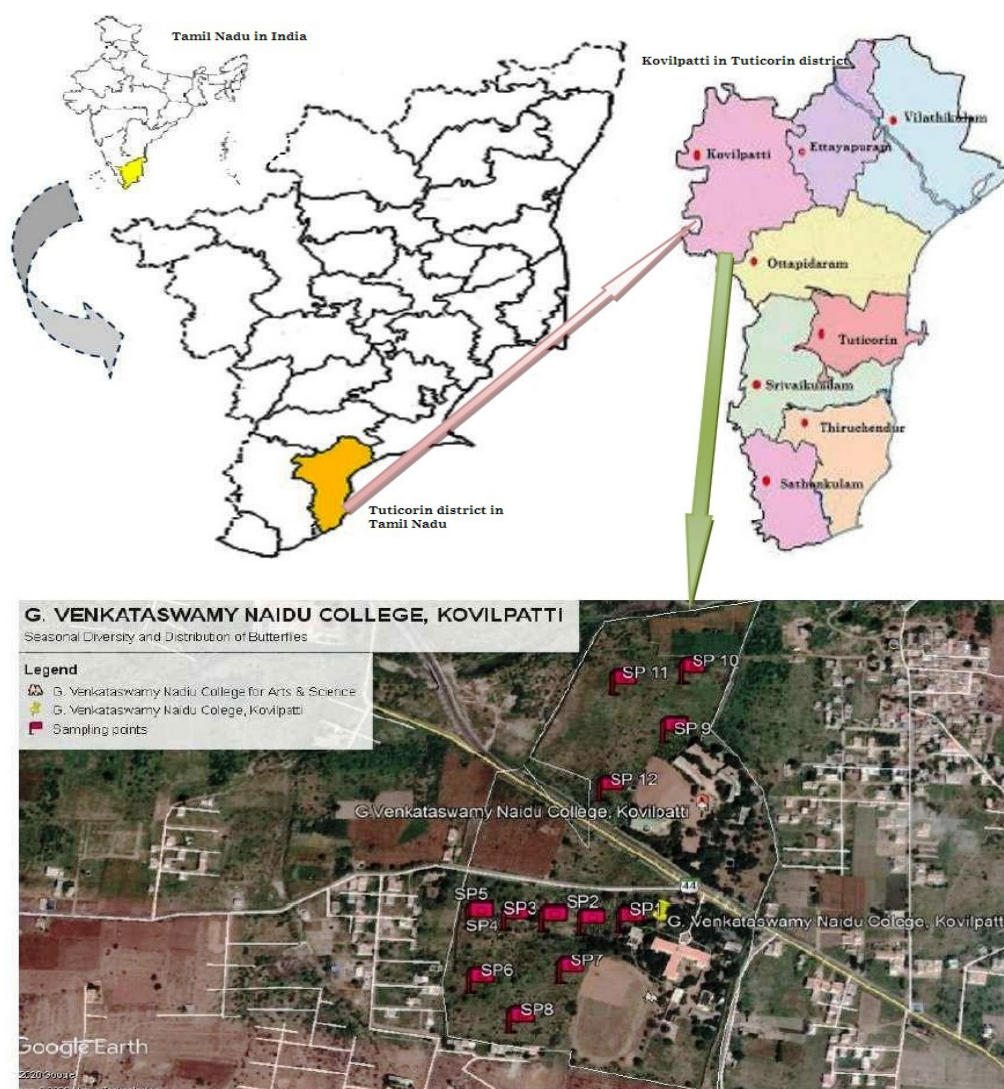


Figure 1. Location and sampling points at G. Venkataswamy Naidu College, Kovilpatti

3. Result

The study revealed that, total of 309 individuals comprising 36 genera and 48 species of butterflies around the campus of G.V.N College, Kovilpatti (Table 1 & Figure 6). The overall occurrence of maximum number of species in the family Nymphalidae, Pieridae and Lycaenidae were in the study area. Nymphalidae is the dominant family in terms of species composition and abundance with (17 species and 35.42%), Pieridae (11 species, 25.00%), Papilionidae (8 species and 16.67%), Lycaenidae (7 species, 14.58%) and Hesperidae (4 species, 8.33%). The study revealed the occurrence of 48 species of butterflies belonged to the 36 genera and 5 familie (Table 2).

The North East Monsoon revealed that highest number of species, Nymphalidae showed (15 species 38.46%), followed by Pieridae (10 species 25.64%), Lycaenidae (7 species 17.54%), Papilionidae (4 species; 10.25%) and Hesperidae (3 species; 7.69%). Winter season showed Nymphalidae showed (13 species 36.11%), followed by Pieridae (10 species 27.77%), Lycaenidae (6 species 16.66%), Papilionidae (4 species; 11.11%) and Hesperidae (3 species; 8.33%). South West Monsoon showed Nymphalidae showed (6 species 50.00%), followed by Pieridae (3 species 25.00%) and Papilionidae (3 species; 25.00%). Summer seasons showed Nymphalidae showed (2 species 40.00%), followed by Pieridae (1 species 20.00%) and and Papilionidae (2 species; 40.00%) figure 2.

Table 1. List of butterflies present in G.V.N College campus, Kovilpatti

S.No	Family	Scientific Name	Common Name
1	Nymphalidae	<i>Acraea terpsicore</i> (Linnaeus, 1758)	Tawny Caster
2	„	<i>Ariadne ariadne</i> (Linnaeus, 1763)	Angled Castor
3	„	<i>Ariadne merione</i> (Cramer, 1777)	Common Caster
4	„	<i>Danaus chrysippus</i> (Linnaeus, 1758)	Plain Tiger
5	„	<i>Danaus genutia</i> (Cramer, 1779)	Striped Tiger
6	„	<i>Euploea core</i> (Cramer, 1780)	Common Indian Crow
7	„	<i>Euthalia nais</i> (Forrstar, 1771)	Baronet
8	„	<i>Hypolimnas bolina</i> (Linnaeus, 1758)	Great Egg Fly
9	„	<i>Junonia almana</i> (Linnaeus, 1758)	Peacock Pansy
10	„	<i>Junonia hierta</i> (Fabricius, 1798)	Yellow Pansy
11	„	<i>Junonia iphita</i> (Cramer, 1779)	Chocolate Pansy
12	„	<i>Junonia lemonias</i> (Linnaeus, 1758)	Lemon Pansy
13	„	<i>Junonia orithya</i> (Linnaeus, 1758)	Blue Pansy
14	„	<i>Melanitis leda</i> (Linnaeus, 1758)	Common Evening Brown
15	„	<i>Neptis hylas</i> (Linnaeus, 1758)*	Common Sailor
16	„	<i>Phalanta phalantha</i> (Drury, 1773)	Common Leopard
17	„	<i>Tirumala limniace</i> (Cramer, 1775)	Blue Tiger
18	Pieridae	<i>Appias albino</i> (Boisduval, 1836)	Common Albatross
19	„	<i>Belenois aurota</i> (Fabricius, 1793)	Pioneer
20	„	<i>Ixias marianne</i> (Cramer, 1779)*	White Orange Tip
21	„	<i>Catopsilia pomona</i> (Fabricius, 1775)	Common Emigrant
22	„	<i>Catopsilia pyranthe</i> (Linnaeus, 1758)	Mottled Emigrant
23	„	<i>Cepora nerissa</i> (Fabricius, 1775)	Common Gull
24	„	<i>Colisa croceus</i> (Geoffroy, 1785)	Dark Clouded Yellow
25	„	<i>Colotis danae</i> (Fabricius, 1775)	Crimson Tip
26	„	<i>Colotis etrida</i> (Boisduval, 1836)	Small Orange Tip
27	„	<i>Eurema hecabe</i> (Linnaeus, 1758)	Common Grass Yellow
28	„	<i>Delias eucharis</i> (Drury, 1773)	Common Jezebel
29	„	<i>Leptosia nina</i> (Fabricius, 1793)	Psyche
30	Lycaenidae	<i>Castalius rosimon</i> (Fabricius, 1775)	Common Pierrot
31	„	<i>Chilades parthasius</i> (Fabricius, 1793)	Indian Cupid
32	„	<i>Euchrysops cnejus</i> (Fabricius, 1798)	Gram Blue
33	„	<i>Freyeria trochylus</i> (Freyer, 1845)	Grass Jewel
34	„	<i>Jamides celeno</i> (Grammer, 1775)	Common Cerulin
35	„	<i>Zizeeria knysna</i> (Trimen, 1862)	Tiny Grass Blue
36	„	<i>Zizina otis</i> (Fabricius, 1787)	Lesser Grass Blue
37	Papilionidae	<i>Atrophaneura aristolochiae</i> (Linnaeus, 1758)	Common Rose
38	„	<i>Atrophaneura hector</i> (Linnaeus, 1758)	Crimson Rose
39	„	<i>Graphium agamemnon</i> (Linnaeus, 1758)*	Tailed Jay
40	„	<i>Graphium sarpedon</i> (Linnaeus, 1758)*	Common Bluebottle
41	„	<i>Papilio demoleus</i> (Linnaeus, 1758)	Lime Butterflies
42	„	<i>Papilio polytes</i> (Linnaeus, 1758)	Common Mormon
43	„	<i>Papilio polymnestor</i> (Cramer, 1775)*	Blue Mormon
44	„	<i>Troides minos</i> (Cramer, 1779)*	Southern Bird Wing
45	Hesperiidae	<i>Borbo cinnara</i> (Wallace, 1866)	Rice Swift
46	„	<i>Sarangesa purendra</i> (Moore, 1882)	Spotted Small Flat
47	„	<i>Spialia galba</i> (Fabricius, 1793)	Indian Skipper
48	„	<i>Suastus gremius</i> (Fabricius, 1798)	Indian Palm Bob

*observed only during inventory period, hence not included in data

Table 2. Species, general and individuals relative abundance of butterflies in G.V.N. College campus

S. No	Family	No. of Genera	No. of Species	No. of Individuals
1	Nymphalidae	11 (30.56%)	17 (35.42%)	91 (29.45%)
2	Pieridae	10 (27.78%)	11 (25.00%)	106 (34.30%)
3	Lycaenidae	7 (19.44%)	7 (14.58%)	73 (23.95%)
4	Papilionidae	4 (11.11%)	8 (16.67%)	27 (8.74%)
5	Hesperiidae	4 (11.11%)	4 (8.33%)	11 (3.56%)
Total	5 Family	36 Genera	48 Species	309 individuals

The butterfly abundance during different seasons showed that more number of butterflies were observed during the periods of North East Monsoon followed by Winter Figure 3. The NEM showed more number (159 individuals; 51.45%) followed by winter (89 individuals; 28.80%); summer (35 individuals; 11.32%) and SEM (26 individuals; 8.41%).

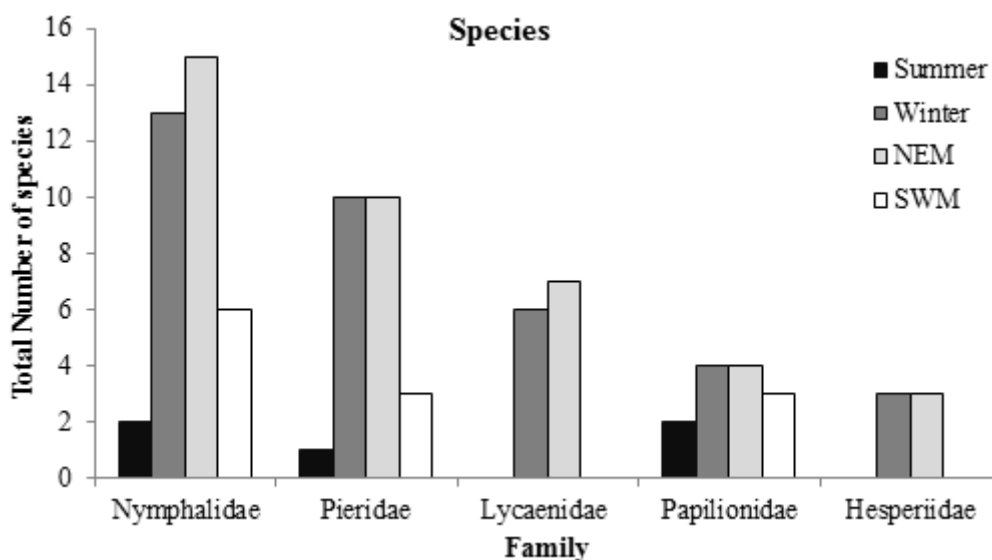


Figure 2. Number of species of butterflies sampled in G.V.N College during different seasons of the year September 2018- August 2019

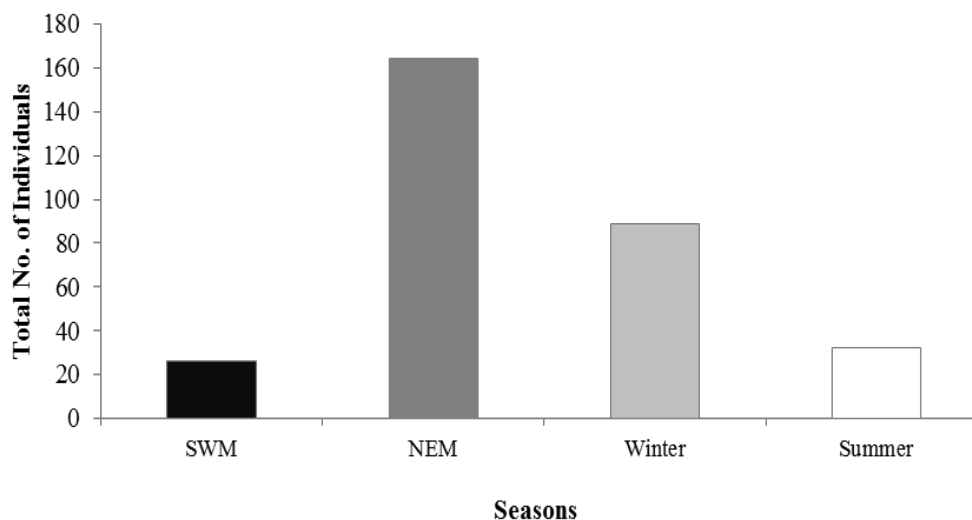


Figure 3. Seasonal abundance of butterfly species in G.V.N. College campus

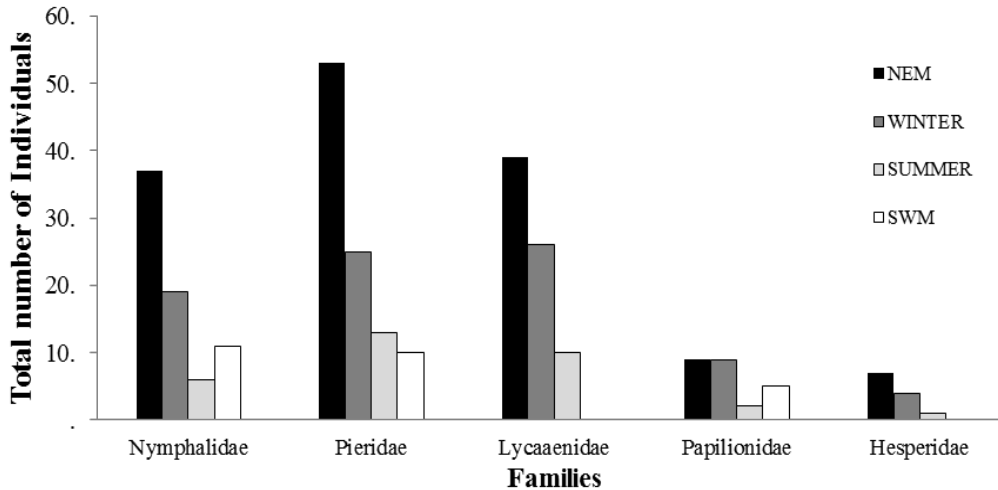


Figure 4. Total number of individual population of butterfly in different seasons

Figure 4 describes butterfly individual patterns during different seasons. More number of adult butterflies were observed during the periods of NEM and winter followed by SWM and summer. Interestingly, North East Monsoon, Pieridae showed 53 individuals (42.3%) followed by Lycaenidae 39 individuals (22.03%) and Nymphalidae 30 individuals (25.51%). The greatest number of 26 individuals (31.32%) observed in winter season followed by Pieridae 25 individuals (30.12%) and Nymphalidae 19 individuals (22.89%). The South West monsoon showed highest number of individuals was observed in Nymphalidae, 11 individuals (42.30%) followed by Pieridae 10 individuals (38.46%). The summer seasons, Pieridae showed 13 individuals (40.62%) followed by Lycaenidae 10 individuals. Papilionidae and Hesperidae lead to substantial decline to complete dwindling of the butterfly individuals and species in all four seasons.

seasons has also been presented in Figure. 5. The similarity matrix from the quantitative data showed that taxonomic composition of butterflies was much similar in the NEM and Winter formed a single cluster group with a similarity index value of 60.52%, it indicated that both periods have the similar species composition. The insignificant variability was observed in SWM and summer; it showed that 18-30% similarity. The overall observations made in the present study suggest that seasonal complexity and distribution of butterflies associated with each seasons might act as major drivers and determinants of the patterns of butterfly assemblages in college campus.

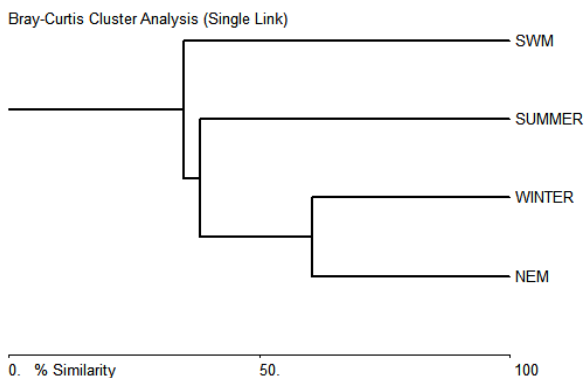


Figure 5. Bray Curtis similarity matrix comparing different seasons of butterflies

The similarity of species composition among different

Table 3. List of butterflies with status

S.No	Common Name	WPA 1972	Endemic to
1	Common Indian Crow	Sch IV	-
2	Common Gull	Sch II	SL
3	Common Albatross	Sch II	-
4	Common Pierrot	Sch I	-
5	Gram Blue	Sch II	-
6	Southern Bird Wing	Sch I	SI
7	Crimson Rose	Sch I	SI & SL

SI- Southern India SL- Sri Lanka

A total of three species of endemic (*Cepora nerissa*, *Troides minos* and *Atrophaneura hector* and seven scheduled species (*Euploea core*, *Cepora nerissa*, *Appias albino*, *Castalius rosomon*, *Troides minos*, *Euchrysops cnejus* and *Atrophaneura hector* listed under the Wildlife Protection Act. These species highlighted greater conservation importance table 3.

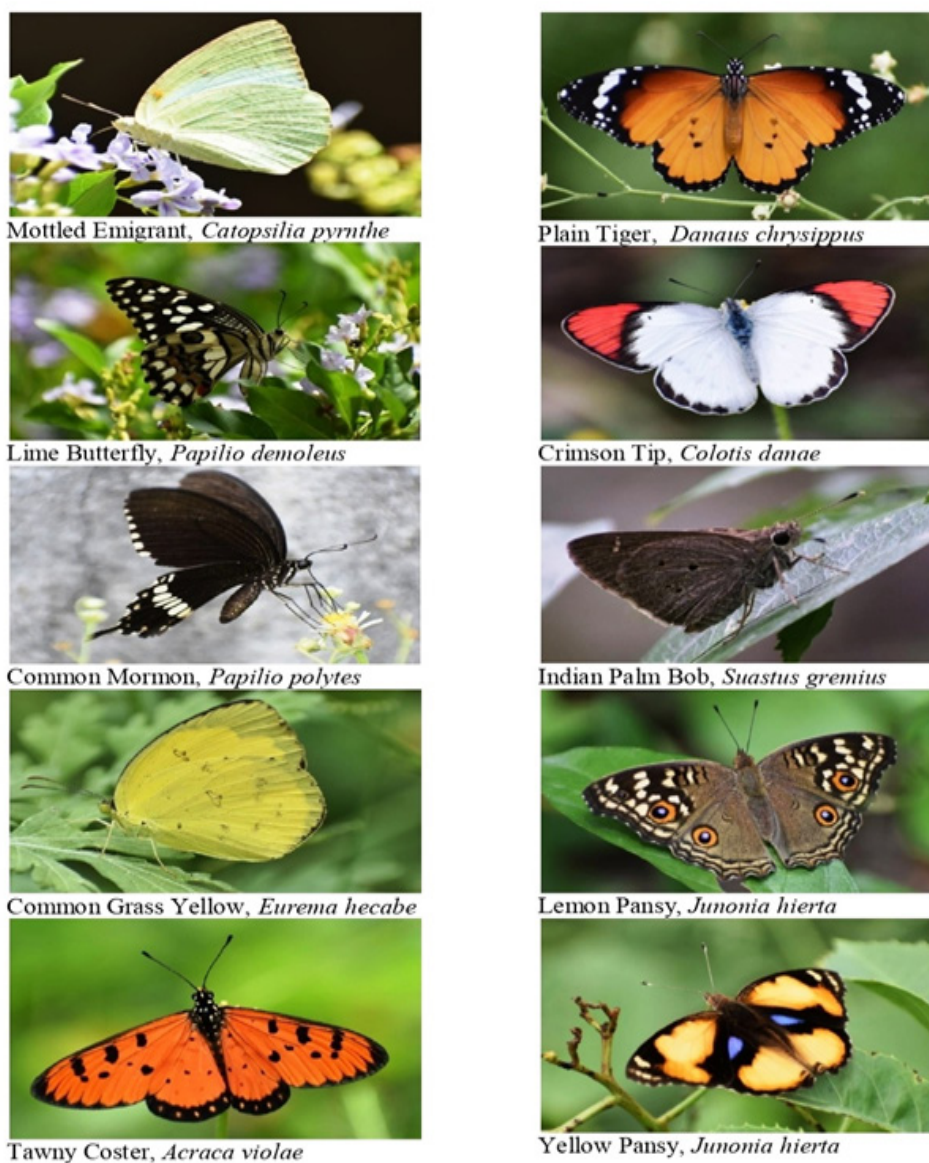


Plate 1. Common butterflies recorded in G.V.N College campus study area

4. Discussion

The present study revealed that highest number of individuals in North East Monsoon followed by Winter, Summer and South West Monsoon. Nymphalidae were the most common with 17 species, followed by the Pieridae (11 species), Papilionidae (8 species) Lycaenidae (7 species), and the least number of species was observed in Hesperidae only 4 species. The same pattern of predominance of nymphalidae was reported by different researchers (Eswaran and Pramod, 2005 and Pramod *et al.*, 2007) (16,17). The reason for the extraordinary abundance of pieridae butterfly in the study area can be achieved to the dominance of their larval food plants in the region (Balasubramaniam *et al.* 2001) [18] and the butterfly diversity in various institutional campuses and research institutes showed a similar pattern of predominance of

Nymphalidae followed by Pieridae, Lycaenidae, Papilionidae and Hesperidae were also reported by different researchers [17,18,19,20,21]. (19,20,21,22, 23)

The dominance of Nymphalidae species may be attributed to their ability to forage on various kinds of plants, being a polyphagous species and many species of this family are active fliers and thus forage wide areas it is one of the important ecological advantages. Similar patterns of observation recorded in [Majumder *et al.*, 2013] (24). This is consistent with Nymphalidae being the largest butterfly family, accounting for one third of known species worldwide (Tiple, 2011). (25)

However, in the present study, Lycaenidae and Hesperidae were poorly represented in the study area, which reported members of Hesperidae to be least represented. One of the possible reasons for this difference could be due to the difficulties in observing

Hesperiidae butterflies because of their dull color. Lycaenidae also very less species and individual abundance due to the foraging herb absent in the Summer and South West Monsoon.

The abundance of species and individuals were high during North East Monsoon 39 species and 163 individuals, whereas 36 species, 109 individuals were observed only from winter. The same pattern of increasing species abundance and individual abundance from the beginning of the monsoon till early winter and decline in species abundance from late winter to the end of summer have also been reported by Tiple et al. (2007) [26] and Tiple & Khurad (2009) [27].

Majority of species and individuals were observed, the possible reasons include increased availability and variety of host plants. The distribution and diversity of butterflies varies depends upon the seasons. They are abundant in some months and absent during months (Kunte 2000) (7). This has been reported in other studies (Qureshi et al. 2013) (28). The greatest number butterflies in the study area might be the adequate distribution of larval host plants and nectar [24] (29) and vegetation cover and good food sources for many butterfly species [25] (30).

A total of three species of endemic and seven species of butterflies from the study area are designated as Wildlife Protection Act (WPA 1972) while describing their status and justifies its inclusion in scheduled list suggesting the need for strict conservation measures. The objective revision of the scheduled list will be very useful in providing appropriate and adequate legal protection to Indian [7]. Nine species are accorded highest protection under the Indian Wildlife Act, 1972 [31] (Anonymous 1972)

5. Conclusion

This study reveals that to enrich the information and knowledge available on the butterflies of G. Venkataswamy Naidu College campus. The maximum number of butterfly species and maximum number of individuals were sampled during the monsoons, indicating that in the southern plains area of India butterflies prefer cool seasons for breeding and emergence. The rich diversity of butterflies, especially the nymphalids, pieridae and lycaenidae in the study area indicates a varied assemblage of floral species. The butterflies sampled resemble that of the Western Ghats and other regions of India in two ways 1) dominance of nymphalids and 2) peak abundance during wet seasons. The finding of the present study is to recommend the importance of institutional campuses as a preferred habitat for butterflies like endemic and protected species. This information will help in future research work on butterflies larval host plants preference for launching conservation strategies. It will helpful to owing carefully planned in larval host

plants maintenance in gardens, the diversity of butterflies may increase in the college campus providing excellent knowledge for butterfly conservation as well as for future research.

Acknowledgements

Authors are thankful to the Secretary and Principal, G.Venkataswamy Naidu College, Kovilpatti for the continuous encouragement and support for this work.

REFERENCES

- [1] Brereton, T., Roy, D.B., Middlebrook, I., Botham, M. and Warren, M. (2011). The development of butterfly indicators in the United Kingdom and assessments in 2010, *Journal of Insect Conservation*, 15(1):139-151.
- [2] Robbins, R.K. and Opler, P.A. (1997). Butterfly diversity and a preliminary comparison with bird and mammal diversity. In: *Biodiversity II. Understanding and Protecting our Biological Resources*. Pp69-82.
- [3] Chakaravathy, A.K., Rajagopal, D. and Jagannatha, R. (1997). Insects as bio indicators of conservation in the tropics. *Zoo's Print Journal*, 12: 21-25.
- [4] Saikia, M.K., Kalita, J. and Saikia, P.K. (2009). Ecology and conservation needs of nymphalid butterflies in disturbed tropical forest of Eastern Himalayan biodiversity hotspot, Assam, India. *International Journal of Biodiversity and Conservation*, 1(7): 231-250.
- [5] Thomas, J.A. (2005). Monitoring change in the abundance and distribution of insects using butterflies and other indicator groups. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 360:339-357.
- [6] Tiple, A.D., Deshmukh, V.P. and Dennis, R.L.H. (2006). Factors influencing nectar plant resource visits by butterflies on a university campus: implications for conservation. *Nota Lepidopterologica*. 28: 213-224.
- [7] Kunte, K. (2000). *Butterflies of Peninsular India*. Universities Press Limited, Hyderabad, India, Pp.254.
- [8] Leps, J. and Spitzer, K. 1990. Ecological determinants of butterfly communities (Lepidoptera, Papilionidae) in the Tam Dao Mountains, Vietnam. *Acta Entomol Bohemoslov*, 87: 182-194.
- [9] Ramesh, T., Hussain, K. J., Selvanayagam, M., Satpathy, K. K. and Prasad, M.V.R. (2010) Patterns of Diversity, Abundance and Habitat Association of Butterflies Communities in Heterogeneous Landscapes of Department Atomic Energy (DAE) Campus at Kalpakkam, South India. *International Journal of Biodiversity and Conservation*, 2, 75-85.
- [10] Makesh Kumar, B., Stephan, J. and Pandiarajan, G. 2012. *Flora of G.V.N College*, Pp128.
- [11] International Union for the Conservation of Nature and

- Natural Resources. 2000. The 2000 IUCN red list of threatened species.
- [12] Gunathilagaraj, K., Perumal, T.N.A., Jayaram, K. and Kumar, M.G. (1998). Some South Indian butterflies, Nilgiri Wildlife and Environmental Association, Nilgiri, Tamilnadu, Pp.274.
- [13] Kunte, K. (2000). India, a Lifescape Butterflies of Peninsular India, Indian Academy of Sciences, University Press. Pp. 243.
- [14] Kunte, K. (1997). Seasonal patterns in butterfly abundance and species diversity in four tropical habitats in the northern Western Ghats. *Journal of Bioscience*, 22: 593-603.
- [15] Neli Mc Alece, N., Lambshead, P.J.D. and Paterson, P.L.J. (1997). Biodiversity Pro (Version 2). The Natural History Museum, London.
- [16] Eswaran, R. and Pramod, P. (2005). Structure of butterfly community of Anaikatty hills, Western Ghats. *Zoos' Print Journal*, 20(8): 1939-1942.
- [17] Pramod, K.M.P.M., Hosetti, B.B., Poomesha, H.C., Raghavendra, G.H.T. (2007). Butterflies of the tiger lion safari, Thyavarekoppa, Shioga, Karnataka. *Zoo's print. Journal*. 22(8): 2805.
- [18] Balasubramanian, P., Mahendramani, P and Padmapriya, K (2001). Comparison of plant biodiversity pattern of variously disturbed habitat of Moongilpallam area in the western ghats. *Salim Ali Centre for ornithology and Natural History, Coimbatore*.
- [19] Daniel, J.A., Sankararaman, H. and Hegde, D.R. (2018). Butterfly diversity in Tamil Nadu agricultural university campus, Coimbatore, Tamil Nadu, India. *Journal of Entomology and Zoology Studies*, 6(4):1354-1361.
- [20] Kumar, P., Ramarajan, S. and Murugesan, A.G. (2017). 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): 1125-1134.
- [21] Sagar, S.C. and Antoney, P.U. (2015). Diversity of Butterflies in Christ University Campus, Bangalore, India *Zoology for Future Education and Research*, 111-118.
- [22] Jahir, H.K., Satpathy, K.K., Prasad, M.V.R., Sridharan, V.T., Ramesh, T. and Selvanayagam, M. (2008). Faunal Diversity Assessment at Department of Atomic Energy (DAE) Campus, Kalpakkam. Pp.268.
- [23] Harsh, S. (2014). Butterfly Diversity of Indian Institute of Forest Management, Bhopal, Madhya Pradesh, India. *Journal of Insects*, 1-4.
- [24] Majumder, J., Lodh, R. and Agarwala, B.K. (2013). Butterfly species richness and diversity in the Trishna Wildlife Sanctuary in South Asia. *Journal of Insect Science*, 13: 79.
- [25] Tiple, A.D. (2011). Butterflies of Vidarbha region, Maharashtra State, central India. *Journal of Threatened Taxa*, 3(1): 1469-1477.
- [26] Tiple, A.D., Khurad, A.M. and Dennis, R.L.H. (2007). Butterfly diversity in relation to a human-impact gradient on an Indian university campus. *Nota Lepidopterologica*, 30 (1): 179-188.
- [27] Tiple, A.D. and Khurad, A.M. (2009). Butterfly diversity of reserve forest area (Seminary hill) with in Nagpur city, central India. *Hislopia Journal*, 1(1): 35-41.
- [28] Qureshi, A.A., Rayees, A.D., Shaheen, I.T. and Bhagat, R.C. (2013). Butterfly-fauna of Gulmarg, Kashmir, J&K State. *Journal of Agriculture and Veterinary Science* 2(5): 40-45.
- [29] Brown, K.S. and Freitas, A. (2000). Atlantic forest butterflies: indicators for landscape conservation. *Biotropica*, 32(4b): 934-956.
- [30] Wood, B. and Gillman, M.P. (1998). The effects of disturbance on forest butterflies using two methods of sampling in Trinidad. *Biodiversity and Conservation*, 7(5): 597-616.
- [31] Anonymous. (1972). The Indian Wildlife (Protection) Act, 1972 Ministry of Environment & Forests, Government of India, New Delhi.