

The assessments of florestic diversity and their host butterfly Nectar Plants of Pachamalai Hills of Eastern Ghats towards biodiversity conservation

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Abstract

In this paper, we present present investigation has been carried out to enumerate the butterfly diversity greatly depends on the availability of host plants. The study has been carried from January 2023 – October 2023 in Pachamalai hills of Eastern Ghats in Tamilnadu. In the ecological site that has been observed in the native plant species of the Eastern Ghats especially in *Vitex negundo*, *Ehretia pubescens*, *Premna serrati folia* and *Pavetta indica* as well as observed in *Prosopis juliflora*, an invasive plant species. This study reveals that some of the native nectar host plants play a vital role in attracting butterflies and increasing the diversity of butterflies. *Vitex negundo*, which acts as a primary nectar host plant for a variety of species is studied in detail.

Keywords: Nectar plants, Pachamalai Hills, butterfly

Introduction

Butterflies are a crucial component of the food chain and are prey for birds, bats, and other insectivorous animals. Butterflies serve as indicators of a healthy ecology and habitat. They show a huge variety among other invertebrates. More than 19,000 butterfly species have been reported from all over the world. India has 1,501 species of butterflies and India hosts one of the richest and most diverse butterfly faunas in the world (Kehimkar, 2008). The diversity of butterflies depends on different factors. One of the most important factors is the plant diversity of the area. The diversity of plants and butterflies are favorably correlated (Leps and Spitzer, 1990) ^[13]; thus, a shift in butterfly diversity might result from a change in vegetation structure. The study of larval host plants of Indian butterflies was well documented by T.R. Bell (1909–1927). The study of butterflies and their host plants in the districts of Bankura and Purulia is notable in the present years. Some remarkable study has been carried out in these two districts of West Bengal. A new larval host plant of *Papilio crino* (Fabricius) was reported by Mukherjee and Ghosh (2018). Red Helen *Papilio helenus* (Linnaeus) was reported for the first time from Bankura district by Mukherjee (2019) ^[16]. A checklist of 117 butterfly species was established by Mukherjee and Mondal (2020) and new larval host plants for three butterflies were reported by Mukherjee (2021) ^[17]. Recently, new larval host plants of *Virachola isocrates* (Fabricius) and *Junonia orithya* (Linnaeus) were reported by Mukherjee (2022a), two new larval host plant of *Leptosia nina* (Fabricius) and *Rapala manea* (Hewitson) were reported by Mukherjee (2022b), and three new larval host plants were newly reported by Banerjee et al. (2023) from Bankura district. On the other side, a preliminary checklist of butterflies of Baghmundi in Purulia was reported by Samanta et al. (2017). In addition, some exclusive species,

including Anomalous nawab *Charaxes agrarius* (C. Swinhoe), were reported from Purulia for the first time by Samanta et al. (2019) ^[22], Blackvein sergeant *Athyma ranga* (Moore) was reported from Baghmundi by Mukherjee (2021), Color sergeant *Athyma nefta* (Cramer) was reported from Purulia by Mahato et al. (2022), the first photographic documentation of Large-spotted oakblue *Arhopala nicevillei* (Bethune-Baker) from Purulia was provided by Kuiry et al. (2022), and Variable Malayan *Megisba malaya* (Horsfield) was reported from Purulia district by Samanta et al. (2022).

Study area

The present study was undertaken in the Pachamalai Hills, located between the districts of Tiruchirappalli and Perambalur and Salem, Tamil Nadu, India. The hill is situated 1500 to 3000 feet above mean sea level and lies between 11o 28' N latitude and 78o 31' E longitude with an area covered with 14,122 sq. km. The mean annual rainfall ranges between 110 -150 cm's and maximum amount of rainfall was received during northeast monsoon. Pachamalai hill is a part of Eastern Ghats.

Materials and methods

A random sampling was carried out with special reference to the nectar host plants. The butterflies were observed during sunny day hours (08:00-16:00 hr.). In additional several field trips were carried out from January 2023 – October 2023 in the study area. The species of butterflies were identified by referring with the help of the book of Indian Butterflies, Butterflies of Peninsular India and checklists ^[9, 10, 11]. Nine common species were continuously monitored for the feeding behavior on *Vitex negundo*. Numbers of visits of each species at various timings was recorded and mean values were taken.

Floristic Diversity

According to the classification of Champion and Seth (1968), vegetation in Eastern Ghats can be broadly classified into (1) Evergreen forests. (2) Tropical semi-evergreen forests. (3) Tropical moist deciduous forests. (4) Southern tropical dry deciduous forests. (5) Northern mixed dry deciduous forests. (6) Dry Savannah forests. (7) Scrub forests (8) Tropical dry evergreen forests and (9) Tropical dry evergreen Scrub. The vegetation type of Pachamalai hill vegetation is mixed Scrub jungle, evergreen forest to moist deciduous having rich amount of highly valuable medicinal plants. The importance of traditional knowledge is now being increasingly realized world over. So there is great scope for new drug discoveries based on traditional plant use. Keeping the above facts in mind, an attempt has been made to identify all potential medicinal plants that have been found integrated with traditional medicine and therapies in the study areas. The data were collected from the tribals through the questionnaire and also interview by mouth words and recording by video for the folklore.

Results

In this study, the authors found 223 plant species from 52 plant families, which were used by 124 butterflies (Table 1). The greatest number of plants were used by Nymphalidae and Lycaenidae, followed by Hesperidae, Pieridae, Papilionidae, and Riodinidae (Fig. 5). Nymphalidae used 30 families of plants, but Lycaenidae used 29 families. We found that there was a significant positive correlation between Nymphalidae and Hesperidae ($r=0.59$, $p<0.0001$) and Lycaenidae and Pieridae ($r=0.52$, $p<0.0001$) in terms of plant family and species usage. PCA analysis of butterfly families showed 53.57% variance in principal component 1 (PC1) (eigenvalue 7.87) and 25.82% variance in principal component 2 (PC2) (eigenvalue 3.79) (Fig. 6). Lycaenidae showed the strongest positive correlation (0.93) with PC1 followed by Pieridae (0.62), Nymphalidae (0.57), and Hesperidae (0.50). However, Nymphalidae displayed a strong positive correlation with PC2, followed by Hesperidae (0.60). From the biplot (Fig. 6), it can be seen that Nymphalidae and Hesperidae show similar plant utilization; Lycaenidae and Pieridae also exhibit an alike pattern.

Two-way ANOVA results suggest that there are significant differences in terms of plant uses among butterfly families ($F=7.85$, $df=5$, $p=0.0001$) and vice versa ($F=2.18$, $df=51$, $p=0.0001$). We found the plant family Zingiberaceae was exclusively used by Hesperidae. The following plant families were solely used by the butterfly family Lycaenidae: Verbenaceae, Ulmaceae, Sapindaceae, Smilacaceae, Myrtaceae, Oleaceae, Oxalidaceae, Lythraceae, Loganiaceae, Lamiaceae, Cycadaceae, and Boraginaceae. The butterfly family Nymphalidae used host plants from the Cannabaceae, Convulaceae, Ebenaceae, Melastomataceae, Papaveraceae, Portulacaceae, Salicaceae, Solanaceae, Urticaceae, and Violaceae plant families, which were not used by other butterfly families. Capparaceae, Cleomaceae, and Brassicaceae plant families were exclusively used by Pieridae. The Aristolochiaceae and Lauraceae plant families were only utilized by Papilionidae. Riodinidae only used the plant family Primulaceae. The Annonaceae family was mainly used by Papilionidae, except for one species used by the Tawny rajah of the Nymphalidae family. Aristolochiaceae, Lauraceae, along

with Annonaceae, formed a clade that was mainly used by Papilionidae. Asteraceae, Lecythidaceae, and Passifloraceae constructed a clade as the butterfly families Lycaenidae and Nymphalidae used them in an exactly similar way. Phyllanthaceae was closely associated with this clade. Verbenaceae, Ulmaceae, Smilacaceae, Myrtaceae, Oleaceae, Loganiaceae, Lamiaceae, Cycadaceae, and Boraginaceae were taken by Lycaenidae exclusively, so they clustered together in the dendrogram (Fig. 8). The clade of Oxalidaceae and Lythraceae was built due to their use pattern by Lycaenidae. Amaranthaceae, Anacardiaceae, and Rubiaceae made a cluster depending on their utilization by Lycaenidae and Nymphalidae. Cannabaceae, Convulaceae, Portulacaceae, and Salicaceae and Ebenaceae, Melastomataceae, Papaveraceae, Solanaceae, Urticaceae, and Violaceae made two sister clades because of their use pattern by Nymphalidae. Capparaceae closely branched with the Cleomaceae and Brassicaceae clade as they were exclusively used by Pieridae. The highest number of plant species (34) was used in the family Fabaceae by four butterfly families (Hesperidae, Lycaenidae, Nymphalidae, and Pieridae). As Primulaceae was solely used by Riodinidae, it positioned singly outside all clusters (Fig. 8).

Discussion

The observed butterfly number accorded well with previous research (Mukherjee and Mondal, 2020). Almost all plant species mentioned here were previously reported from the area (Malick, 1966; Sanyal, 1994). Nymphalidae and Hesperidae are largely found in herb-rich areas but Papilionidae, Lycaenidae, and Pieridae preferred shrub and tree-enriched areas (Mukherjee and Mondal, 2020). The consequences for the ecological and evolutionary processes of insect-plant interactions are poorly understood. In their larval stage, the majority of butterfly species only feed on a small number of plant species, forming strong relationships with their host plants. The availability of similar plant chemical defenses (Schoonhoven et al., 2005) in a certain geographic area is assumed to account, at least in part, for the emergence of these ecological connections between butterflies and their hosts (Figs. 9 and 10). However, ANOVA results also suggest their guild level separations are significant enough so that their cooccurrence is quite natural in the studied area. Lycaenidae and Pieridae larva feast largely on the family Fabaceae. Hesperidae and Nymphalidae both interact with host plants of Poaceae but they are considered as generalist feeders. The chemical compound genistein is specific to host plants of Lycaenidae butterflies and skimmianine attracts Papilionidae butterflies and may be found in the Rutaceae plant family (Muto-Fujita et al., 2017). Most of the used plant species were from the families *Fabaceae* and *Poaceae* because these families do not retain toxic compounds, and these less toxic plant species may help the resiliency of butterflies to switch on to new host plants because the butterflies are able to use their existing detoxification mechanisms to acclimatize to these plants.

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Table 1: Checklist of larval host plants of butterfly species in Pachamalai Hills of Eastern Ghats arranged by butterfly family.

Sl no.	Common name	Scientific name	Host plant	Family	References
1	Hesperiidae Chestnut bob	Iambrixsalsala (Moore)	Bambusavulgaris (Schrad. ExJ. C. Wendl.)	Poaceae	Robinsonetal.,2010; Nitinetal.,2018
2	Indian palm bob	Suastusgremius (Moore)	Borassus flabellifer (L.); Arecacatechu (L.); Calamus rotang (L.); Calamus pseudofeanus (Becc); Rhapsisexcelsa (Thunb.) A. Henry; Caryotaurens (L.); Phoenixsylvestris (L.) Roxb. Tamarindusindica (L.)	Arecaceae	Robinsonetal.,2010; Nitinetal.,2018
3	Common red eye	Gaggarathyrasis (Fabricius)	Bambusavulgaris	Poaceae	Robinsonetal.,2010; Nitinetal.,2018
4	Common red eye	Gangarathyrasis (Fabricius)	Bambusavulgaris; Oryzasativa (L.)`	Poaceae	Wynter-Blyth,1957; Kunte, 2000; Nitinetal., 2018
5	Rice swift	Borbocinnara (Wallace)	Imperata cylindrica (L.) P. Beauv.; Oryzasativa; Setariabarbata (Lam.) Kunth; Setaria pumila (Poir.) Roem. and Schult.; Phragmites karka (Retz.) Trin. ExSteud	Poaceae	Davidson et al., 1898; Pantand Chatterjee,1950; Robisonetal.,2010; Nitinetal.,2018; Dey,2020
6	Brown awl	Badamiaexclamationis	Terminaliabellirica (Gaertn) Roxb. Combretaceae		Kehimkar,2008
7	Grass demon	Udaspesfolus (Cramer)	Curcumalonga (L.); Curcuma decipiens (Dalzell); Zingiberofficinale (Roscoe); Costusspeciosus (J. KoenigexRetz.) Sm	Zingiberaceae	Kehimkar, 2008; Nitinetal.,2018
8	Common small flat	Sarangesadesahara (Moore)	Blepharissp. Asystasiasp	Acanthaceae	Bell,1924; Kehimkar,2008
9	Common grass dart	Taractroceramaevius	Imperatacylindrica; Oryzasativa	Poaceae	Nitinetal.,2018
10	Complete paint-brush swift	Baorisfarri (Moore)	Bambusavulgaris; Oryzasativaandothergrasses	Poaceae	Nitinetal.,2018
11	Common banded awl	Hasorachromus (Cramer)	Ricinuscommunis (L.) Pongamiapinnata (L.) Pierre	Euphorbiaceae Fabaceae Fabaceae	Nitinetal.,2018
12	Tree flitter	Hyarotisadrastus (Cramer)	Phoenixsylvestris; Calamusrotang; Calamuspseudofeanus	Arecaceae	Wynter-Blyth, 1957; Robinsonetal
13	Common leopard	Phalantaphalantha (Drury)	Flacourtiaindica (Burm. f.) Merr.	Salicaceae	Bell, 1910b; Wynter-Blyth,1957; Kunte, 2000; Kunte,2006; Robinsonetal.,2010
14	Chocolate pansy	Junoniaiphita (Cramer)	Barleriacrystata; Barleriaprionitis (L.); Ruelliatuberosa; Justiciaprocumbens (L.); Dipteracanthusprostrate	Acanthaceae	Winter-Blyth,1957; Kunte,2000; Nitinetal.,2018
15	Yellow pansy	Junoniahierta	Barleriacrystata; Barleriaprionitis; Hygrophilauriculata	Acanthaceae	Winter-blyth1957; Kunte2000; Robinson Et al.,2010
16	Acanthaceae	Junoniaatlites (L)	Hygrophilauriculata; Dipteracanthus prostrate; Ruelliatuberosa; Barleriacrystata; Barleriaprionitis	Acanthaceae	Winter-Blyth,1957; Kunte, 2000; Robinson, et al.,2010
17	Blue pansy	Junoniaorithya (L.)	Hygrophila auriculata; Barleriacrystata; Barleriaprionitis Evolvulusnumularis, Ipomeabatatas	Acanthaceae Convolvulaceae	Winter-Blyth,1957; Kunte,2000; Ro10 Mukherjee2022
18	Lemon pansy`	Junonialemonias (L.)	Hygrophilauriculata; Barleriacrystata; Barleriaprionitis; Ruellia tuberosa; Justiciaprocumbens; Dipteracanthusprostrate	Acanthaceae	Winter-Blyth,1957; Kunte,2000; Robinson Et al.,2012
19	Spot swordtail	Graphiumnomius	Polyalthialongifolia; Miliusa tomentosa	Annonaceae	Wynter-Blyth,1957; Kunte, 2000; Robinsonetal.,2010
20	Common banded peacock	Papiliocrino (Fabricius)	Citruslimon	Rutaceae	MukherjeeandGhosh,2018
21	Psyche	Leptosianina (Fabricius)	Capparis baducca; Capparis zeylanica (L.); Capparisspinosa (L.); Cratevareligiosa (G. Forst.) Cleome viscosa (L.); Cleomerutidosperma (DC.)	Capparaceae Cleomaceae	Wynter-Blyth,1957; Kunte,2000; Kunte,2006; Robinson etal.,2010; Mukherjee,2022

22	Pioneer	Belenoisaurora	Capparissepiaria (L.); Capparizylandica; Capparisspinosa	Capparaceae	Wynter-Blyth, 1957; NOT COMPLETED
23	Striped albatross	Appiasolferna (C. Swinhoe)	Cratevareligiosa; Crateva adansonii (DC.); Capparissepiaria	Capparaceae Cleomaceae	Wynter-Blyth,1957; Kunte,2000; Kunte,2006; Robinson et al.,2010; Mukherjee,2022
24	Chocolate albatross	Appiasyncida (Cramer)	Bombax ceibaCappariz baducca; Capparizylandica; Capparisspinosa; Crateva religiosa	Capparaceae	Wynter-Blyth,1957; Kunte,2000; Robinsonetal.,2010
25	Common jezebel	Deliasucharis	Butea monosperma Dendrophthoe falcata; Loranthuslongiflorus; Loranthus ordifolius	Loranthaceae Fabaceae	Wynter-Blyth, 1957; Kunte, 2000; Robinsonetal.,2010
26	Yellow orange tip	Ixias pyrene (L.)	Cappariz sepia; Capparizylandica	Capparaceae	Wynter-Blyth, 1957; Robinsonetal.,2
27	White-orange tip	IxiasMarianne (Cramer)	Cappariz sepia; Capparizylandica	Capparaceae	Wynter-Blyth, 1957; Robinsonetal.,2010
28	Common gull	CeporaNerissa (Fabricius)	Cappariz sepia; Capparizylandica; Capparisspinosa	Capparaceae	Wynter-Blyth, 1957; Robinsonetal.,2
29	Common emigrant	CatopsiliaPomona (Fabricius)	Bauhinia racemosa; Cassia fistula; Senna tora (L.) Roxb; Sennasiamea; Sennaoccidentalis (L.) Link; Buteamonosperma	Fabaceae	Wynter-Blyth, 1957; Robinsonetal.,2010
30	Mottled emigrant	Catopsiliapyranthe (L.)	Bauhinia racemosa; Buteamonosperma; Cassia fistula; Cassia javanica (L.); Senna tora; Senna siamea; Sennaoccidentalis; Senna alata (L.) Roxb.; Senna	Fabaceae	Wynter-Blyth,1957; Kunte, 2000; Nitinetal., 2018
31	Common grass yellow	Euremahecabe (L.)	Albizialebbeck; Caesalpinia pulcherrima (L.) Sw.; Cassiafistula; Mimosa pudica; Senna tora; Sesbania sesban (L.) Merr.; Smithiasensitiva (Aiton); Peltophorumpterocarpum (DC.) K. Heyne	Fabaceae	Wynter-Blyth,1957; Kunte,2000; Nitinetal., 2018
32	Three spot grass yellow	Euremablanda (Boisduval)	Albizia lebbeck; Cassia fistula; Cassia javanica; Delonix regia (Bojer ex Hook.) Raf.; Pithecellobiumdulce	Fabaceae	Robinson et al., 2010; Wynter-Blyth, 1957; Kunte,2000
33	Spotless grass 12 yellow	Euremablanda (Boisduval)	Cassia fistula	Fabaceae	ButterfliesofIndia,2022
34	Small grass yellow	Euremabrigitta (Stoll)	Smithiasensitiva (Aiton)	Fabaceae	Nitin et al., 2018; Author'spers. obs
35	One spot grass yellow	Euremaandersonii (Moore)	Ventilagodenticulate (Willd.)	Rhamnaceae	Author'spers. obs
36	Indiacabagewhite	Pieriscandia (L.)	Brassica oleracea var. capitata (L.); Brassica oleracea var. botrytis (L.); Sinapis arvensis (L.)	Brassicaceae	Wynter-Blyth,1957; Kunte, 2000; Robinsonetal.,2010
<i>Riodinidae</i>					
37	Double banded Judy	abisarabifasciata (Moore)	Ardiasolanacea (Roxb.); Embeliatsjeriam-cottam (Roem. andSchult.) A. DC.	Primulaceae	Davidson and Aitken, 1890; Moore, 1901; Pant and Chatterjee,1950; Wynter- Blyth,1957

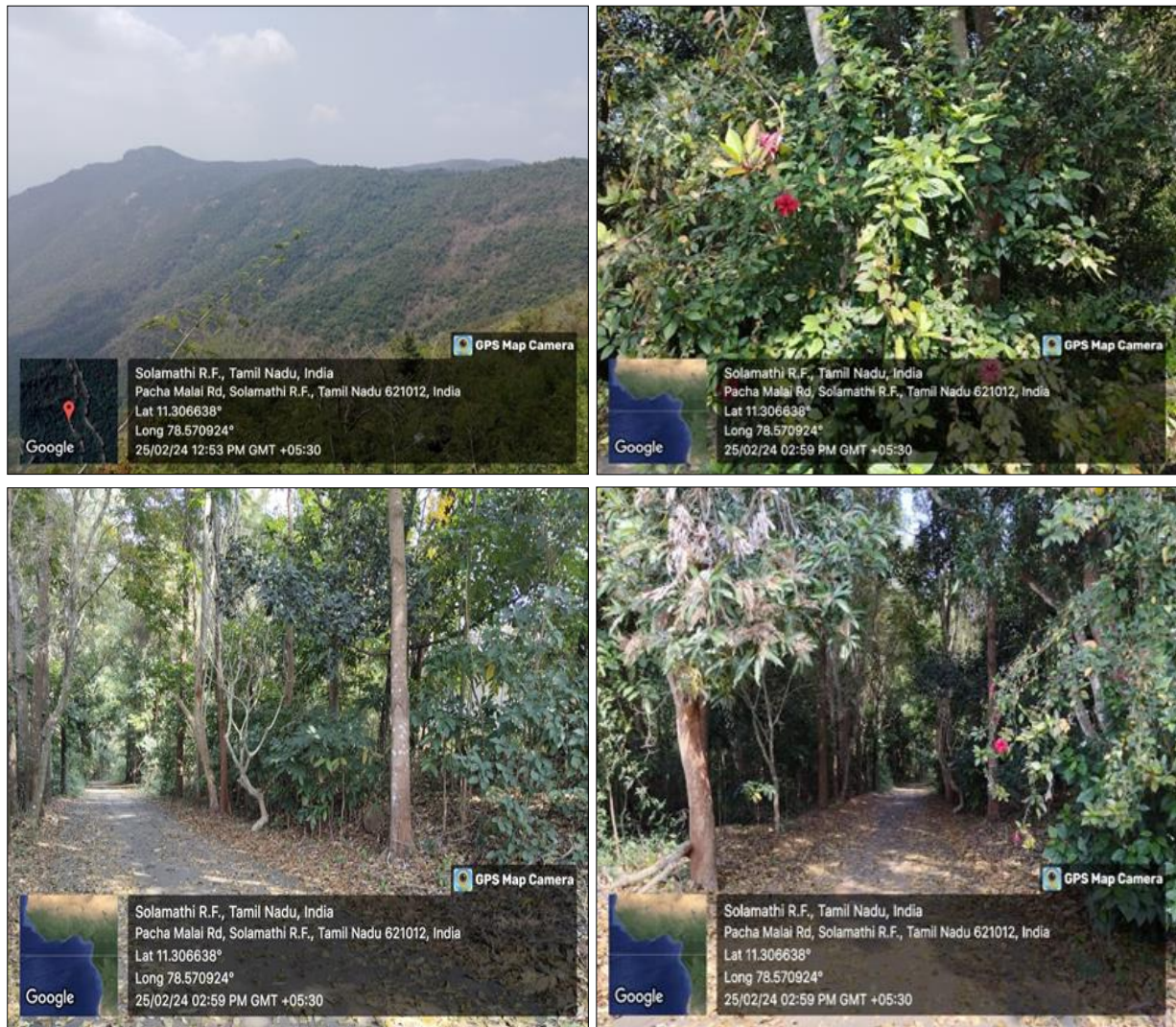


Fig 1: The Location of Pachamalai Hills of Eastern Ghats

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