Role of Butterflies as Pollinators in Maruthamalai Hills of Southern Western Ghats

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Abstract: The present study was carried out in Maruthamalai Hills of Southern Western Ghats during September 2012- February 2013, to study the role of butterflies as pollinators and floral attributes which influence nectar feeding butterflies. During the study period, 27 species of butterflies were collected as flower visitors on 36 species of flowering plants. Among the life habits, the herbs are the dominant species (19), followed by shrubs (7), trees (6) and under-shrubs (4). Out of 27 butterfly species, 12 species belong to the family Nymphalidae, 7 species belong to the family Pieridae, 5 species belong to the family Lycaenidae and 3 species belong to the family Papilionidae. The following butterfly species, Junonia orithiya L. Melanitis leda and Acytolepis puspa Hors. shows mud-puddling behaviour. A very little information is available on butterfly species and their nectar host plant relationships. The present study is an essential factor for pollination process and provides preliminary information on the relationship between plants and butterflies. It is suggested that an adequate care should be taken to conserve both flora and fauna for the sustainable utilization of our bioresources.

Key words: Flora • Flower visitors • Pollination process • Eco-econo-benefits • Human society

INTRODUCTION

India, being a vast country with wide contrasts in physical features, climate and vegetation, possesses one of the richest and most varied flora and fauna in the world. There are approximately 45,000 plant species of which about 20,000 species are flowering plants. The Western Ghats is an area of exceptional biological diversity and conservation interest and are “one of the major tropical evergreen forest regions in India” [1]. This region shows high species diversity as well as high levels of endemism. Though the ideal climatic conditions prevailing in this region, their populations is rapidly declining due to various factors such as habitat degradation, fragmentation of populations, lack of specific pollinating agents, poor fruit set, improper seed dispersal, other reproductive problems etc [2].

The global concern about the deforestation and degradation of ecological communities makes a subject of Plant-Animal interactions. Much recent attention has focused on the importance of pollinators, especially insects, in the production of food crops for human consumption [3]. Certain groups of plants are particularly at risk notably of medicinal importance [4]. An estimated 62% of all flowering plants may be suffering reduced regeneration from seeds as a result of Pollinator scarcity [5]. Study on pollination of threatened and economically important species would be valuable to conserve the concerned species. Careful observation of flowers and flower visitors can yield information on the role of visits in pollination. Insects are excellent organisms for community and ecosystem studies as they occupy many niches and tropics levels [6, 7].

A significant majority of insects have strong interactions with plants and other biotic components of any ecosystem [8, 9]. Whenever, insect species evolved to exploit a new source of food, they became a resource for parasite, parasitoid or predator species than might have coevolved to exploit it [10]. Organisms that visit flowers for nectar or pollen may or may not pollinate the plant species. Butterflies are monitored to indicate climatic change and environmental degradation. Some ecological factors such as temperature, availability of food and suitability of habitat have an impact on the lifespan of an adult butterfly.
Butterflies (Lepidoptera) are very important group of insects because they take part in the key stone ecological process of pollination [11]. There are about 18,000 species of butterflies in the world. India has 1,501 species, of which 321 are Skippers, 107 Swallowtails, 109 Whites and Yellows, 521 Brush-footed butterflies and 443 Blues [12]. Butterfly migrations are known to take place mainly due to day length, rainfall, temperature changes or shortage of food plants. Monitoring the butterflies has proven useful in the evaluation of terrestrial landscape for biological resource conservation.

The butterflies are the best indicator of these changes and can be used as surrogate to assess the conservation threat to the biodiversity. It is hence encouraging that butterflies are now being included in biodiversity studies and biodiversity conservation prioritization programmes. Many of butterfly species are strictly seasonal and prefer only a particular set of habitats [13] and they are good indicators in terms of anthropogenic disturbance and habitat quality [14]. Being good indicators of climatic conditions as well as seasonal and ecological changes they can serve in formulating strategies for conservation. Hence the present study is an attempt to analyze the interaction between plants and insects (Family, species level analysis) and to access the relationship between insects and plants based on colour and size of the flower.

MATERIALS AND METHODS

Angiosperm Plants Recorded During the Study Period:
The present investigation was undertaken with a view to list out the plant-Insect interaction in Coimbatore district, Tamilnadu. Intensive field visits were undertaken in Maruthamalai Hills during the study period, at twice in a day. The entire area is covered at different seasons during the year 2012 (September) - 2013 (February). The plants collected were given with field numbers, identified with the help of Flora of the Presidency of Madras [15], Flora of Tamilnadu Carnatic [16], Flora of Tamilnadu (Analysis) [17, 18], Flora of Coimbatore [19] and comparing authenticated specimens available in the Madras Herbarium, Botanical survey of India (BSI), Southern circle, Coimbatore. A few of the listed plants along with insects were photographed in colour and incorporated in the appropriate plates. The species were arranged according to Bentham and Hooker’s system of Classification. Brief taxonomic descriptions are provided.

Fig. 1: Study area map
Fig. 2: Interaction of butterflies with respect to different flower colour

based on the critical observation made in the field. Herbarium specimens have been deposited in the Herbarium of the Department of Botany, Bharathiar University (BUH).

Insect Diversity Study: Present studies were conducted regarding different flowering plants visited by butterflies, their foraging activity and abundance at different locations. The key characters used for identification were colour pattern, wing span, mode of flight etc. during the study, flight patterns, activity patterns and behaviours were also noted. Observations were made between 9 a.m. to 5 p.m. These observation were made for a period of 6 months from September (2012) to February (2013). All observations were made on clear, warm (20°-27°C) days, when winds were calm. In addition to this the photographic documentation is also used. The insects were identified by using various field guides and other available literatures [20-23]. Species classification and scientific names are as per Isaac Kehimkar.

Study Area: The study area Maruthamalai Hills consists of an environment of moist dry deciduous type of forest at an altitude of 426.72m above MSL, 11.04°E 07 longitude and 76.93°N latitude. The area has a predominant red, black soil types impregnated with organic matter, granite, bed rock is overlaid with shallow, sandy loam and glacial soils are moderate to well drained. The maximum and minimum temperature of this area varies from 41°C and 16°C respectively. The temperature in a year is varying between 17°C and 38°C and annual rainfall is around 450 mm. Although this rainfall is not enough to sustain the needs of the city for the year, small rivers like Siruvani and Athikadavu which fulfill the city’s water needs. (Fig. 1).

RESULTS AND DISCUSSION

A total of 27 butterfly individuals were recorded on 36 plant species. The community of butterflies was composed of 27 species of butterfly, 12 species of butterflies belong to the family Nymphalidae, 7 species belong to the family Pieridae, 5 species belong to the family Lycaenidae and 3 species belong to the family Papilionidae (Table 1) (Fig. 3-6). Among 27 species of butterflies, three species such as Junonia orithiya Linnaeus, Melanitis leda Linnaeus and Acytolepis puspa Horsfield shows this mud puddling behaviour. The butterfly species recorded in this study have already been reported from different regions of India and to provinces of Pakistan [24, 25].

Among the 36 plants studied 19 plant species found to be herbaceous, 4 species comes in the category of under shrubs, 7 plant species were found to be shrubs and 6 plant species are trees. Composition of herbaceous plant species in an ecosystem may bring an importance on butterfly species richness and vegetation types can contribute disproportionately high numbers of butterfly species compared to dominant vegetation type of the single species of plant [26]. Woody plant species richness may not good predictor for butterfly species richness [27]. During the study flowering plant-butterfly interaction is more frequent in January to March and gradually decreased until November to December. Sajjad et al. [28] also observed that the abundance and richness of butterflies and flowering plants sharply increased from January to March and then gradually decreased until December. The variation in abundance and richness of butterflies followed the variation in the availability of floral resources and exhibited a positive relationship with temperature and negative relationship with relative humidity.

Among 36 plants, the Asteraceae (4-species) was the most specious family followed by Euphorbiaceae, Rubiaceae, Verbenaceae (3-species each), Malvaceae, Fabaceae and Boraginaceae (2-species each) families during the study period which may be due to the availability of host plant. Thakur and Mattu [29] also observed that the family Asteraceae is the most attracted by different butterfly species.
Table 1: List of butterflies and larval food plants recorded from the study area.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Abundance</th>
<th>Larval Food Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Papilionidae</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Common mormon</td>
<td><em>Papilio polytes</em> Linnaeus</td>
<td>Very rare</td>
<td><em>Parthenium hysterophorus</em> L.</td>
</tr>
<tr>
<td><em>PIERIDAE</em></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>4. Pioneer</td>
<td><em>Belenois aurota</em> Fabricius</td>
<td>Rare</td>
<td><em>Tridax procumbens</em> L.</td>
</tr>
<tr>
<td>6. Common emigrant</td>
<td><em>Catopsilia pomona</em> Fabricius</td>
<td>Rare</td>
<td><em>Tribulus terrestris</em> L. <em>Hamelia patens</em> Jacq.</td>
</tr>
<tr>
<td>8. Common jezebel</td>
<td><em>Delias eucharis</em> Drury</td>
<td>Rare</td>
<td><em>Chromolaena odorata</em> (L.) King and Robins. <em>Tridax procumbens</em> L.</td>
</tr>
<tr>
<td>10. Chocolate grass yellow</td>
<td><em>Eurema sari</em> Horsfield</td>
<td>Rare</td>
<td><em>Acalypha indica</em> L.</td>
</tr>
<tr>
<td><em>LYCAENIDAE</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Common hedge blue</td>
<td><em>Acytolepis puepa</em> Horsfield</td>
<td>Very rare</td>
<td><em>Mudpuddling</em></td>
</tr>
<tr>
<td>12. Common pierrot</td>
<td><em>Castalius rosimon</em> Fabricius</td>
<td>Rare</td>
<td><em>Vernonia cinerea</em> (L.) Less.</td>
</tr>
<tr>
<td>14. Grass jewel</td>
<td><em>Freyeria trochylus</em> Freyer</td>
<td>Rare</td>
<td><em>Tridax procumbens</em> L.</td>
</tr>
<tr>
<td><em>NYMPHALIDAE</em></td>
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</tr>
<tr>
<td>17. Angled castor</td>
<td><em>Ariadne ariadne</em> Linnaeus</td>
<td>Rare</td>
<td><em>Trichodesma zeylanica</em> (Burm.) R. Br.</td>
</tr>
<tr>
<td>Common Name</td>
<td>Scientific Name</td>
<td>Abundance</td>
<td>Larval Food Plant</td>
</tr>
<tr>
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<tr>
<td>21. Yellow pansy</td>
<td>Junonia hierta Fabricius</td>
<td>Common</td>
<td>Abutilon indicum (L.) Sweet</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Hedyotis corymbosa (L.) Lam.</td>
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<td>Chromolaena odorata (L.) King and Robins.</td>
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<td>Tridax procumbens L.</td>
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<td>Tribulus terrestris L.</td>
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<td>Tridax procumbens L.</td>
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<td>Parthenium hysterophorus L.</td>
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<td>Gomphrena celosioides Mart.</td>
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<td></td>
<td></td>
<td></td>
<td>Tribulus terrestris L.</td>
</tr>
<tr>
<td>23. Blue pansy</td>
<td>Junonia orithiya Linnaeus</td>
<td>Very rare</td>
<td>Mudpuddling</td>
</tr>
<tr>
<td>26. White four ring</td>
<td>Ypthima ceylonica Hewitson</td>
<td>Common</td>
<td>Tridax procumbens L.</td>
</tr>
<tr>
<td>27. Large three ring</td>
<td>Ypthima nareda Kollar</td>
<td>Rare</td>
<td>Hedyotis corymbosa (L.) Lam.</td>
</tr>
</tbody>
</table>

Fig. 3: Foraging activity of pollinators in plants of the study.
Fig. 4: Foraging activity of pollinators in plants of the studt.

Fig. 5: Foraging activity of pollinators in plants of the studt.
Fig. 6: Foraging activity of pollinators in plants of the studt.

Hamelia patens, Hedyotis corymbosa, Crotalaria verrucosa, Leucas aspera, Lantana camara, Murraya koenigii, Tephrosia purpurea, Justicia tranquebariensis, Vernonía cinerea, Gomphrena celosoides, Heteropogon contortus, Corchorus trilocularis, Mangifera indica, Pithecellobium dulce, Ziziphus mauritiana, Boerhavia diffusa, Trichodesma zeylanica, Waltheria indica, phyllanthus madraspatensis, Tecoma stans, Turnera subulata, Morinda pubescens, Acalypha indica, Azadirachta indica, Duranta erecta, Pavonia zeylanica and Trichodesma indicum were visited by minimum number of butterflies. *Tridax procumbens* was the most preferred plant species. It has a tubular flower (tube length 10-15 mm) and such flowers exhibited typical butterfly pollination syndromes [30]. Floral preference in pollinators may vary from species to species. Most of the species are highly generalized while a few of them are highly specialized feeders [31].

The present study observed that the colour of the flower is an important factor for plant-butterfly interaction. Among 27-butterfly varieties, maximum number of butterfly visited cream colour (14-varieties) followed by White colour (10-varieties) and Bluish-mauve (8-varieties). Orange-red, Whitish pink, Blackish brown, Bluish white, Green, Greenish yellow, Pale-yellow, Pinkish-purple and Purplish white visited by only one or two butterfly varieties only (Fig. 2).

Leppik [32] reported that the foragers should recognize the appearance of the flowers not just by their colours or by odour alone but by all essential characteristics of flowers such as size, colour, number of flower parts, symmetry and odour. The present study also observed that the butterflies are attracted to the flower initially based on their attractive colour. After that only they realized the presence or absence of nectar in their respective flowers. This was supported by some of the earlier workers [33].
Dave Goulson [34] found that no relationship between size and visitation. A majority of studies have found that insect foragers exhibit higher rates of visitation to larger flowers [35-42]. Flower size is correlated with production of pollen or nectar [43-46]. It has been shown that butterflies remember and associate certain stimuli like the preferred taste of nectar with the shape and colour of the flowers and then choose flowers of similar features [47, 48].

The Nymphalidae (12-species) was the most specious family in the study area, which accounted for around 44% of the species richness and the abundance species richness more in Nymphalidae (12), Pieridae (7), Lycaenidae (5) and Papilionidae (3) families during the study period which may be due to the availability of host plants. The different butterfly families are found in different food and feeding association with the plant species. But the Nymphalidae are associated with fruits and feeding on even human droppings. Availability and dominance of flowering wild plants are influence on the butterfly number richness.

Butterflies have evidential capabilities to recognize the plant source of food. For the reason, it is important to note that each of the vegetation type can make unique contribution to the measured butterfly diversity and the butterflies for the plant diversity [49, 50].

Previously most of the work has been done on distribution and taxonomy of butterflies [51, 52] and there was no information available on floral host plant range, floral host preferences, seasonal fluctuation in population, relationship with abiotic and biotic factors. The present study gives a baseline for future plant-floral visitor relationships in the region.

Butterflies have traditionally been viewed as an excellent group of bioindicators mainly due to complexity of ecological management required by many species [53, 54] and more recently to their great ability to act as indicators of climate changes [55]. The present study concluded that among insects, butterflies are suitable for ecological studies, as the taxonomy, geographic distribution and status of many species is relatively well known. Schultz and Dlugosch [56] suggested that restoration of the degraded habitat by augmenting food resources for adult butterflies will play an important role in managing populations of those insects.

CONCLUSION

The flowering plants and butterfly interaction study was carried out from September 2012 - February 2013, resulted in collection of 36 species of flowering plants drawn from 34 genera belongs to 24 families. 27 species of butterflies were found belongs to 4 families viz. Nymphalidae, Pieridae, Lycaenidae, Papilionidae. 17 flower colours were found in 36 plants. Cream colour flower was found common and the flower size ranges from 3mm to 130mm. Most of the butterfly species visited cream colour flower. It is found that plant-insect interaction is influenced by various factors like flower colour, size of the flower, presence of a nectar secretion cells etc.

The present study mainly focalized on plant-insect interaction and how it affects pollen biology and plant breeding. Due to lack of suitable management, unsustainable utilization of natural resources, deforestation and urbanization, uncontrolled use of pesticides and in-organic manures, environmental pollution may adversely affect the existence of both insects and floral diversity of the area. The knowledge of pollination biology is a pre-requisite in a plant breeding and for obtaining better yield of plants. It is concluded that, the plant-insect interaction is an essential factor for pollination process and better yield in both wild and crop plants. So an adequate care should be taken to conserve both flora and fauna of our nature for future generation.

REFERENCES


