

ROLE OF BUTTERFLY GARDENS IN PROMOTING BIODIVERSITY CONSERVATION AND ECOTOURISM

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ABSTRACT

The role of butterfly gardens as conservation-cum-ecotourism ventures was evaluated in a model garden established in a 0.5 ha patch of degraded moist deciduous forest in the KFRI Campus at Peechi (Kerala, India). As a result of the introduction of host plants and habitat management, there was a tremendous increase in the butterfly population, with 4509 sightings of butterflies belonging to 43 species during the first half of the project (after the first 15 months) and 5993 sightings of butterflies belonging to 50 species during the second half (from the 16th month to the 30th month). Altogether, 10,502 sightings of butterflies belonging to 56 species were recorded during the 30-month study period. These included nine species that are endemic to the Western Ghats and 10 species having a protected status under the Indian Wildlife Act, compared with about a dozen species recorded from the area before the garden was set up. The butterfly garden set up at Peechi formed a major tourist attraction, with over 11,483 visitors during the period from April 2004 to March 2009, not including the number of visitors at the facility during the Open House event, which drew several thousand visitors.

INTRODUCTION

The establishment of butterfly gardens helps maximize butterfly diversity and abundance in urban and suburban areas, conserving species that might otherwise become rare or even disappear. It was in this context that the present investigations on the in situ conservation of butterflies through butterfly gardening were undertaken and a prototype garden was set up in a 0.5 ha patch of degraded forest in the KFRI (Kerala Forest Research Institute) campus at Peechi, mainly to standardize methodologies for establishing such gardens in the conditions prevailing in Kerala (Mathew, 2001).

MATERIALS AND METHODS

SITE SELECTION

The site selected for establishing the garden was a patch of highly degraded moist deciduous forest within the KFRI campus, which has been under protection since 1975. The terrain is undulating and hilly in nature, with steep slopes and a more or less plain ridge. The vegetation of this area included a few *Bombax malabaricum*, *Ailanthus triphysa*, *Tectona grandis*, *Grewia tiliaefolia* and *Terminalia bellerica* trees along the slopes and ground vegetation, comprising mostly weeds such as *Lantana camara* and *Chromolaena odoratum*.

LANDSCAPING AND INTRODUCTION OF HOST PLANTS TO RECREATE BUTTERFLY HABITATS

The basic design of the garden was prepared based on the terrain and geographical features of the area as well as the behavioural characteristics of butterflies since foraging and breeding are the important activities of butterflies.

As far as possible, the existing vegetation was retained, and native plants were preferred for introduction. Selection of host plants for introduction was based on data already available on the host plant preferences of various butterflies present in the area. The plants were introduced in a phased manner. Data pertaining to the butterfly host plants already present in the study area and those subsequently introduced are given in Appendix 1.

Since environmental education of the public was the main target of this programme, care was taken to make an exhibit of butterflies in a special area of the garden. For this, an area along the entrance was developed as the 'Butterfly Exhibit Area' around a circular canal 0.5 m wide and 60 cm deep (Figs. 1 & 2). This area was planted with butterfly aggregation plants such as *Heliotropium keralense* and *Crotalaria retusa* to facilitate roosting of danaid butterflies. Other plants introduced in this area included *Cycas*, ornamental palms, *Cuphea*, *Cassia tora*, *Jatropha podagrica*, *Kalanchoe blossfeldiana* and *K. pinnata*. The remaining area of the garden was planted with plants such as *Wattakaka volubilis*, *Thottea siliquosa*, *Tylophora indica*, *T. camosa*, *Asclepias* sp., *Calotropis giganteum*, *Carissa carandas*, *Ruta graveolens*, *Aegle marmelos*, *Albizia lebbeck*, *Cassia* spp., *Citrus* spp., *Murraya koenigii*, *Mussaenda luteola*, *M. laxa*, *Ixora* spp., *Kalanchoe blossfeldiana* and *K. pinnata*. All these species are known to support a variety of lycaenid, pierid, satyrid and nymphalid butterflies.

Figure 1.



View of butterfly exhibit area with the circular canal prior to introduction of host plants.

Figure 2.



A view of the butterfly exhibit area after landscaping and introduction of host plants.

The tall trees present in the garden offered a very good habitat for many swift-flying butterflies, especially papilionids, and the area where they were located was developed into a butterfly forage area (Figs. 3 & 4) through the introduction of host plants suitable for large butterflies. For this, nectar plants such as *Clerodendrum capitatum*, *Cassia* spp. and *Lantana camara* and larval food plants such as *Michelia champaca* (food plant of *Graphium doson* and *G. agamemnon*), *Zinnamom zeylanicum* (food plant of *Chilasa clytia*), *Zanthoxylum rhetsa* (food plant of *Papilio helenus* and *P. crino*), *Aegle marmelos* (food plant of *Papilio demoleus* and *P. polytes*) and *Citrus aurantia* (food plant of *Papilio polytes* and *P. polymnestor*) were introduced. Care was also taken to retain the ground vegetation and to leave the accumulated dry leaves and other debris undisturbed in order to offer suitable habitats for satyrid butterflies. Thickets of palms, *Heliconia* and ornamental varieties of *Musa* were introduced to develop dense vegetation conducive to the breeding of satyrid butterflies (Mathew, 2001).

The garden was fenced using pre-fabricated steel frames over which creepers such as *Passiflora edulis*, *Aristolochia indica*, *Ipomoea* sp. and *Wattakaka volubilis* were grown. Along the sides of the nature trail as well as in open areas present in the garden, nectar plants such as *Ixora* spp., *Cassia* spp., *Allamanda cathartica*, *Hibiscus rosa-sinensis*, *Cuphea miniata*, *Zinnia haageana*, Marigold, *Clerodendrum capitatum* and *Lantana camara* were introduced. Because of the mixed assemblage of a variety of larval and adult host plants, a number of butterflies belonging to diverse groups became general visitors to this area.

MONITORING AND RECORDING BUTTERFLY POPULATION TRENDS

In order to evaluate the effect of habitat enrichment, regular monitoring of the fauna was carried out by making daily transect counts and recording the numbers, for the entire study period, from June 1998 to November 2000, along a 175 m long, 1.5 m wide line transect traversing the garden. Along this transect, two fixed locations were selected for sampling—one in the garden area and the other in the area containing wild nectar sources. A 10-minute visual survey was done during each sampling period. Two transect counts, viz., a forenoon count, between 10.30 hrs and 11.30 hrs, and an afternoon count, between 14.30 hrs and 15.30 hrs were made at the two locations (Yamamoto, 1975).

ANALYSIS OF DATA

Seasonal index

For comparing butterfly population trends, the seasonal index for each month was calculated using the following formula:

$$\text{Seasonal index} = \frac{\text{Month-wise mean}}{\text{Overall mean}} \times 100,$$

where, the month-wise mean is the mean number of butterflies for a given family sighted during a month and the overall mean is the mean of all the month-wise means. By calculating the seasonal index, it was possible to interpret the mean/percentage of occurrence of butterflies in a given month in relation to the overall mean of monthly sightings.

2.4.2. Role of butterfly gardens in promoting ecotourism: Trends in visitor turnout

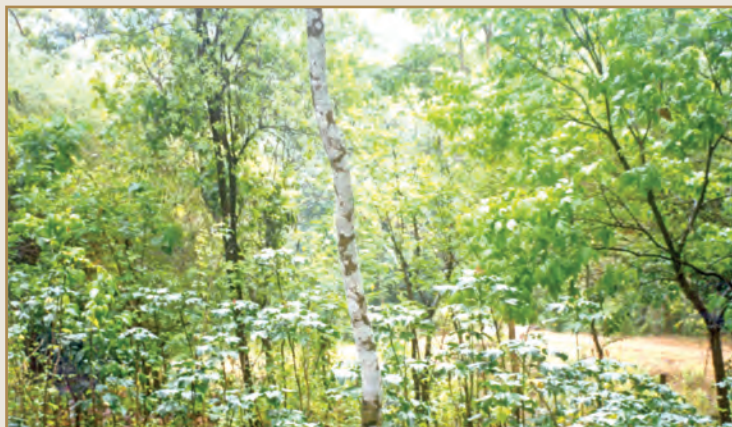
In order to evaluate the role of butterfly gardens in promoting ecotourism, the trends in visitation with respect to season, geographical region and educational background of visitors were recorded and analysed.

RESULTS

BUTTERFLY FAUNA

Prior to landscaping and introduction of host plants, about a dozen species were recorded in the study area, most of which were represented by only a few individuals. Following the introduction of appropriate larval and adult host plants, there was a sharp increase in the number of butterflies visiting the area, in terms of both individuals and species. During the first half of this study (after the first 15 months), there were 4509 sightings of individuals belonging to 43 species, and in the second half (from the 16th month to the 30th month), 5993 sightings of individuals belonging to 50 species were recorded (Appendix 2). After 30 months of monitoring, a total of 10,502 sightings of individuals belonging to 56 species were recorded. Continuous monitoring has shown a steady increase in the number of sightings, with 73 species of butterfly being recorded in the study area, including eight species that are Western Ghats endemics and 10 species that have a protected status under the Wildlife (Protection) Act, Government of India (Gol, 1972).

Figure 3.



*View of butterfly forage area
before establishment of host
plants*

Figure 4.



*View of butterfly forage area
after establishment of host
plants*

Figure 5.

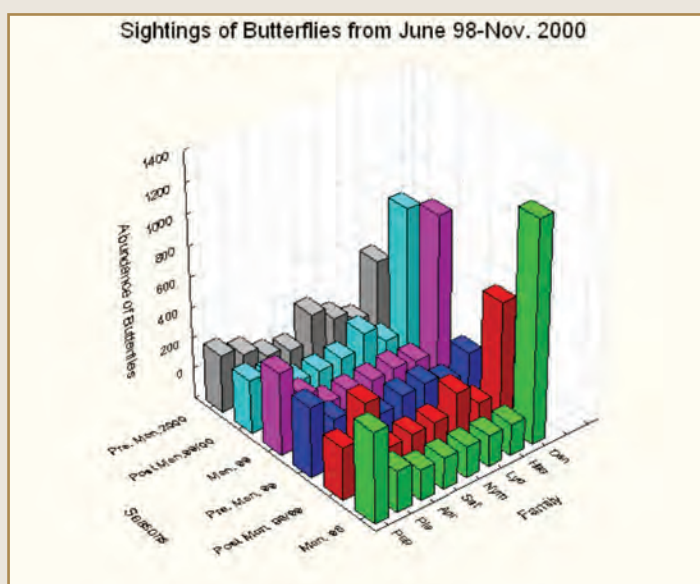


*Aggregation of Blue Tiger on
Crotalaria retusa in the Butterfly
Garden at KFRl*

SEASONAL POPULATION TRENDS OF BUTTERFLIES IN THE GARDEN

Data generated by pooling the sightings of all groups of butterflies during the period from June 1998 to May 2000 showed that the families Papilionidae, Pieridae and Danaidae, which were able to efficiently exploit the available resources, had the highest numbers in the garden (Figs. 5 & 6). It was also observed that while several butterflies of the families Papilionidae and Pieridae showed a more or less continuous population trend for most part of the year, with a resident population in the study area, others of the families Danaidae, Lycaenidae, Satyridae, Nymphalidae and Hesperidae were mostly seasonal. *Chilasa clytia* (Papilionidae); *Acraea violae* (Acraeidae); *Elymnias caudata* (Satyridae); *Talica nyseus*, *Rathinda amor* (Lycaenidae); *Parantica aglea*, *Tirumala septentrionis* (Danaidae); and *Gangara thyrus* (Hesperidae) were some of the butterflies that have colonized the area following habitat enrichment and host plant introduction.

Figure 6.



Overall seasonal population trends of various groups of butterflies in the garden.

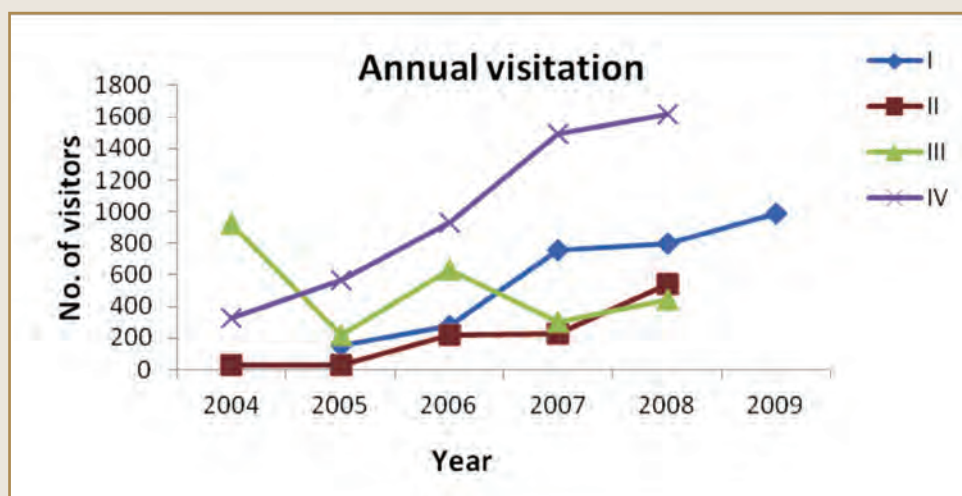
ROLE OF BUTTERFLY GARDENS AS ECOTOURISM VENTURES

Butterfly exhibition and butterfly farming have already gained the status of a booming business in many countries such as Australia, Singapore, Malaysia, Papua New Guinea, the UK and Canada (Pyle, 1995). According to an estimate made in 1987, Britain has 50 to 60 butterfly houses, attracting 5 million visitors annually, with the gate collections exceeding 5 million pounds (Collins, 1987). In North America, more than a dozen major exhibits are already operating, and many units are under construction. Similarly, the Niagara Parks Commission's Butterfly Garden in Ontario, which is a 15 million dollar facility, attracts about 20,000 visitors during weekends (Mathew, 2006). India, with its rich butterfly fauna, has great potential for alternative income production as well as rural employment opportunities by incorporating butterfly exhibition in ecotourism enterprises. Already, several villages in the north-eastern states have gone ahead with the production of butterfly curios as a cottage industry. Khoshoo (1984) has suggested that there is good scope for such enterprises in biodiversity-rich areas such as the north-eastern states, the Himalaya and the Western Ghats.

TRENDS IN VISITATION BY THE PUBLIC

During the period from April 2004 to March 2009, altogether 11,483 visitors visited the park. This number, however, does not include the number of visitors at the facility during the Open House, which was several thousands. The visitor turnout during specific periods/quarters is presented for convenience of interpretation. During the first quarter, comprising the months from January to March, an upward trend in visitation rates was observed in successive years. A total of 2973 persons visited the garden, and the average of all the years for this period was 594.7. The second quarter (April to June) had the lowest visitation rates (total, 1048; average, 209.6). The next quarter (July to September) showed a fluctuating trend, which were attributed to unpredictable rains during this period. The total number of visitors during this quarter in the 5 year period was 2519, and the average was 503.8. Similarly, the last quarter of the year (October to December) showed the highest visitor turnout, with a total of 4943 and an average of 988.6. This quarter showed a remarkable increase in visitors during the 5 year study period (Fig. 7).

Figure 7.



Quarter-wise annual visitation to KFRI Butterfly Garden (2004–2009)

CONCLUSIONS

Because of habitat enrichment and the introduction of suitable host plants, there was a marked increase in the number of butterflies visiting the garden, in terms of both individuals and species. *Pachliopta hector*, *Papilio polymnestor* (Papilionidae); *Catopsilia pomona*, *Catopsilia pyranthe* (Pieridae); *Moduza procris* (Nymphalidae); *Elymnias caudata* (Satyridae); *Talica dana*, *Rathinda amor* (Lycaenidae); and *Danaus genutia*, *Danaus chrysippus*, *Tirumala septentrionis*, *Tirumala limniace*, *Parantica aglea* and *Euploea core* (Danaidae) were some of the species that showed a population increase in the garden. Even more interesting was the appearance of certain rare species such as *Papilio crino* (Papilionidae); *Appias* sp. (Pieridae); *Junonia orithya* (Nymphalidae); *Spalgis epius*, *Badamia exclamationalis* and *Potanthus* sp. (Hesperiidae), which were observed visiting the garden. Several species of butterfly have also started to colonise the area, setting up local populations.

The positive impact of the nature experiences at the KFRI butterfly garden has resulted in the setting up of butterfly gardens by various individuals, schools, colleges and business concerns. The fact that almost 90% of the visitors were school and college students highlights the immense potential of this programme in reaching out to the future citizens of the country. Setting up thematic museums and interactive exhibits will help increase the appeal of the facility to the student population. Some of the facilities established as a result of the success of this venture include the Butterfly Safari at Thenmala, which is Asia's largest butterfly park, and the butterfly garden set up in the Bioresources Nature Park at Nilambur. Butterfly parks are also being set up at Pathiramanal (Tourism Department project) and at the Indian Oil Corporation outlet at Koratty, Kerala. The results obtained in this study indicate the effectiveness of butterfly gardens in biodiversity conservation and in promoting ecotourism.

ACKNOWLEDGEMENTS

This study was funded by the Ministry of Environment and Forests (MoEF), New Delhi. We are thankful to Dr. K.S.S. Nair (erstwhile Director) and Dr. J.K. Sharma (Director) for their encouragement and interest in this study.

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APPENDIX I

Data on plants initially present in the study area and those subsequently introduced.

Plant species	No. of plants at the beginning of the study	No. of saplings introduced
<i>Acestatia</i> sp. *	-	8
<i>Aegle marmelos</i> +	-	9
<i>Albizia lebbbeck</i> +	-	525
<i>Albizia odoratissima</i> + *	3	5
<i>Allamanda cathartica</i>	-	5
<i>Angelonia biflora</i>	-	2
<i>Aristolochia indica</i> +	24	75
<i>Aristolochia grandiflora</i> +	-	5
<i>Bauhinia racemosa</i>	-	1
<i>Begonia</i> spp *	-	30
<i>Bombax</i> sp. +	-	5
<i>Bryophyllum bipinnata</i> +	-	57
<i>Caesalpinia pulcherima</i> *	-	20
<i>Calliandra inequalifolia</i>	-	1
<i>Calotropis gigantean</i> +	-	6
<i>Cananga odorata</i>	-	3
<i>Carissa carandus</i> + *	-	17
<i>Cassia biflora</i> + *	25	7
<i>Cassia fistula</i> + *	2	13
<i>Cassia occidentalis</i> + *	-	34
<i>Cassia tora</i> + *	-	23
<i>Cassia</i> sp.	-	8
<i>Catheranthus roseus</i>	-	2
<i>Centranthera</i> sp.	-	2
<i>Chrysanthemum morifolium</i> *	-	25
<i>Citrus aurantia</i> +	-	10
<i>Citrus aurantifolia</i> +	-	12
<i>Citrus limon</i> +	14	37
<i>Citrus medica</i> +	-	8
<i>Clerodendrum paniculatum</i> *	75	250
<i>Clitoria ternatea</i> *	-	4
<i>Copsia fruiticosa</i>	-	1
<i>Cosmos bipinnatus</i>	-	2
<i>Crotalaria pallida</i>	-	5
<i>Crotalaria retusa</i>	-	25
<i>Cuphea hyssopifolia</i> *	-	25

<i>Cuphea miniata</i> *	-	300
<i>Cycas circinalis</i> +	-	2
<i>Doxantha unguis-cati</i> *	-	8
<i>Duranta plumerii</i>	-	1
<i>Euphorbia</i> sp.	-	2
<i>Ficus racemosa</i> +	2	3
<i>Ficus religiosa</i> +	-	16
<i>Evolvulus</i> sp.	-	2
<i>Gardenia</i> sp. *	-	10
<i>Gloriosa superba</i>	-	4
<i>Gomphrena globosa</i> *	-	150
<i>Heliotropium keralense</i>	-	5
<i>Hemidesmus indicus</i> +	38	55
<i>Hibiscus rosa-sinensis</i> *	-	12
<i>Holostemma annulare</i> +	-	15
<i>Hydnocarpus pentandra</i>	-	2
<i>Impatiens</i> sp.	-	1
<i>Ixora chinensis</i> *	2	8
<i>Ixora coccinea</i> *	1	35
<i>Ixora parviflora</i> *	5	120
<i>Ixora macrothyrsa</i> + *	3	34
<i>Jasminum grandiflorum</i>	-	5
<i>Jasminum pubescens</i> *	-	3
<i>Jatropha podagrica</i> *	1	2
<i>Kalanchoe pinnata</i> + *	-	5
<i>Kalanchoe suarezensis</i> + *	-	5
<i>Lantana camara</i> *	25	35
<i>Lantana sellowiana</i> *	-	4
<i>Michelia champaka</i>	-	2
<i>Mirabilis jalapa</i>	-	2
<i>Murraya exotica</i> +	-	18
<i>Murraya koenigii</i> +	9	15
<i>Mussaenda erythrophylla</i> *	-	2
<i>Mussaenda incana</i>	-	2
<i>Mussaenda laxa</i> + *	-	14
<i>Mussaenda luteola</i> *	-	2
<i>Nyctanthus arbor-tristis</i>	-	
<i>Ocimum gratissimum</i>	-	2
<i>Ocimum tenuifolium</i>	-	2
<i>Passiflora edulis</i> +	-	8
<i>Pentas lanceolata</i> *	-	5
<i>Plumeria alba</i>	-	5
<i>Plumeria rubra</i> *	-	10
<i>Pseudocalyma atata</i>	-	2
<i>Pyrostegia venusta</i>	-	2

<i>Rosa</i> sp.	-	2
<i>Ruellia affinis</i>	-	2
<i>Ruta graveolens</i> +	-	5
<i>Salvia splendens</i> *	-	10
<i>Spilanthes</i> sp.		
<i>Stachytarpheta mutabilis</i> *	-	15
<i>Strobilanthus lawsonii</i>	-	1
<i>Tabernaemontana coronaria</i>	-	2
<i>Tacca</i> sp.	-	2
<i>Tagetes erecta</i>	-	5
<i>Thottea barberi</i> +	-	3
<i>Thottea siliquosa</i> +	-	3
<i>Thunbergia erecta</i> *	-	20
<i>Thunbergia grandiflora</i>	-	5
<i>Tithonia diversifolia</i> *	-	3
<i>Turnera ulmifolia</i> *	-	4
<i>Tylophora indica</i> +	3	27
<i>Vinca rosea</i> *	-	15
<i>Wattakaka</i> sp. +	-	24
<i>Wattakaka volubilis</i> +	-	28
<i>Zanthoxylum rhetsa</i> +	20	15
<i>Zinnia haageana</i> *	-	20

* Nectar plants.

+ Larval host plants.

- nil.

APPENDIX II

Butterflies sighted in the area during the period of study (June 1998 to November 2000)

Butterfly family/species		No. of sightings		Total
		First half	Second half	
	Papilionidae			
1	<i>Chilasa clytia</i>	81	15	96
2	<i>Graphium agamemnon</i>	5	5	10
3	<i>G. antiphates</i>	19	13	32
4	<i>G. sarpedon</i>	7	5	12
5	<i>Pachliopta aristolochiae</i>	191	175	366
6	<i>P. hector</i>	24	45	69
7	<i>P. pandiyana</i>	50	57	107
8	<i>Papilio buddha</i>	39	17	56
9	<i>P. crino</i>	0	2	2
10	<i>P. demoleus</i>	2	14	16
11	<i>P. helenus</i>	43	52	95
12	<i>P. liomedon</i>	1	2	3

13	<i>Papilio paris</i>	4	1	5
14	<i>P. polymnestor</i>	141	69	210
15	<i>P. polytes</i>	217	139	356
16	<i>Troides minos</i>	226	159	385
	Pieridae			
17	<i>Appias sp.</i>	1	7	8
18	<i>Catopsilia sp.</i>	154	93	247
19	<i>Delias eucharis</i>	24	10	34
20	<i>Eurema sp.</i>	399	288	687
21	<i>Leptosia nina</i>	1	3	4
	Acraeidae			
22	<i>Acraea violae</i>	0	32	32
	Satyridae			
23	<i>Melanitis leda</i>	17	0	17
24	<i>Orsotriaena medus</i>	1	0	1
25	<i>Ypthima huebneri</i>	1	4	5
	Nymphalidae			
26	<i>Cupha erymanthis</i>	5	3	8
27	<i>Ariadne merione</i>	0	3	3
28	<i>Junonia atlites</i>	25	36	61
29	<i>J. hierta</i>	0	3	3
30	<i>J. iphita</i>	36	38	74
31	<i>J. lemonias</i>	1	112	113
32	<i>J. orithya</i>	0	1	1
33	<i>Hypolimnias bolina</i>	0	21	21
34	<i>H. misippus</i>	1	11	12
35	<i>Moduza procris</i>	0	2	2
36	<i>Neptis hylas</i>	14	6	20
37	<i>Phalanta phalantha</i>	0	2	2
	Lycaenidae			
38	<i>Arhopala pseudocentaurus</i>	1	0	1
39	<i>Castalius rosimon</i>	5	0	5
40	<i>Jamides sp.</i>	202	315	517
41	<i>Rathinda amor</i>	0	6	6
42	<i>Spalgis epius</i>	0	3	3
43	<i>Talicauda nyseus</i>	0	129	129
	Hesperiidae			
44	<i>Badamia exclamationis</i>	0	3	3
45	<i>Celaenorrhinus leucocera</i>	2	0	2
46	<i>Tagiades litigiosa</i>	1	4	5
47	<i>Pelopidas mathias</i>	2	1	3
48	<i>Potanthus sp.</i>	0	3	3
49	<i>Taractrocera sp.</i>	3	0	3
50	<i>Udaspes folus</i>	1	1	2

	<i>Danaidae</i>			
51	<i>Danaus genutia</i>	484	453	937
52	<i>D. chrysippus</i>	13	48	61
53	<i>Euploea core</i>	789	1186	1975
54	<i>Parantica aglea</i>	224	424	648
55	<i>Tirumala limniace</i>	359	382	741
56	<i>T. septentrionis</i>	693	1590	2283
	Grand total	4509	5993	10,502