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STUDIES ON THE DIVERSITY OF SELECTED GROUP OF INSECTS IN THE PARAMBIKULAM WILDLIFE SANCTUARY

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ABSTRACT

The study was carried out in the Parambikulam Wildlife Sanctuary, in Kerala. during 1994-97 with an objective to prepare an inventory of insects belonging to Hymenoptera (limited to macro forms) and Lepidoptera in the different forest types and to estimate the insect diversity.

Altogether 1049 species of insects belonging to 13 orders and 106 families were collected from the study area. Of these 636 species belonging to 13 orders and 106 families were identified. Out of the 484 species of lepidopterans collected, 401 species belonging to 31 families were identifed. which include 124 butterflies and 277 moths. Among the 105 species of macro hymenopterans collected 84 species belonging to 16 families were identified.

The overall diversity index for the study area was 4.763. The overall insect diversity index was significantly higher in the moist deciduous forest (4.835) than that in the teak plantations (4.318). The diversity index for evergreen based on ten months data was 4.509. The overall diversity index varied significantly between years in the study area.

Species richness index for evergreen was the highest (6.82) suggesting the highest diversity in the evergreen. Species richness index for moist deciduous was 5.37 as against 4.5 for teak plantations.

Coleoptera was the most dominant group in the moist deciduous forest as well as in the teak plantation. In the evergreen, the most dominant group was Lepidoptera.

The dominant butterfly families recorded in the Sanctuary are Nymphalidae, Pieridae, Lycaenidae, Satyridae and Papilionidae followed by Hesperidae and Danaidae. The evergreen forest contained the highest number of species (117) compared to moist deciduous forest (95) and teak plantation (57). Of the 26 rare species identified from the sanctuary, 11 are protected species. Twenty three endemic species are also present of which 10 are narrow endemic to Western Ghats.

The dominant moth families are Noctuidae, Geometridae, Pyralidae and Arctidae which contained the maximum number of species. Of the 277 species of moths identified, five species were exclusively present in the evergreen forest and two species were exclusively present in the moist deciduous forest.

The dominant macro hymenopteran families were Formicidae, Sphecidae, Pompilidae and Apidae which contained the maximum number of species. The highest number of species were recorded from the evergreen forests (85). followed by moist deciduous forests (77), teak plantation (62) and dry deciduous forests (39).

1. INTRODUCTION

A great deal of attention has been focused on biodiversity over the past several years. Biological diversity, the result of about four billions of years of evolution, is the natural wealth of the world and its conservation is important for maintaining the overall ecological balance of the planet.

According to a report by the FAO, of the total forest cover of 3624.7 million hectares on the globe, 1714.8 million hectares are tropical forests. Compared to the temperate forests, a large proportion of worlds biological diversity is contained in the tropical forests (Stork, 1988). However, due to large scale destruction of tropical forests for human needs biological diversity is constantly being subjected to considerable reduction. Although biodiversity is renewable, they are being exploited at an unprecedented and unsustainable manner. The clearing of land for agriculture, logging operations for fuel and commercial timber, indiscriminate use of pesticides etc are some of the causes of destruction of our biological wealth. It has already been reported that many plants and animals have become extinct in the recent past. According to Wilkinson (1982), 76 species of vertebrates have become extinct in the last 50 years. Now 276 mammals, 345 birds, 136 amphibians and reptiles, 99 fishes and 2000 plants are threatened.

Insects which account for over half of all living described organisms (Wilson, 1988)have a very significant role in the ecosystem by affecting the diversity, abundance and distribution of plant communities. Many insects are economically important as pollinators and agents of plant dispersal and in the maintenance of soil structure and soil fertility. Many are also useful as predators and parasites of insect pests of various crops. Their diversity and composition is largely dependent on vegetation and any change in the habitat is likely to have an impact on their distribution and relative abundance. Insects also serve as a tool in monitoring environmental changes. Butterflies and moths are highly host specific and their faunal composition reflects the vegetation types. There are characteristic indicator species for each habitat and moth sampling has been reported to be useful in monitoring environmental changes in the forest (Holloway, 1977).

Eventhough a general statement of the insect number is as high as 30 billion (WWF) there is no realistic estimate on the insect communities of tropical forests. Most of the insect records available at present are results of taxonomic studies carried out in the past in which estimation of abundance and diversity was not a major objective.

Studies on forest insect diversity in India

So far, about 67,000 species of insects have been recorded from various ecosystems in India. Of these, 16,000 species are specifically recorded from the forests (Beeson, 1941; Nair and Mathew, 1993). However, this estimate may not hold true considering the fact that many species found in other ecosystems also occur in the forests. India has over 62.2 million ha under forests which range from the snow-clad boreal forests of Himalayas to the wet evergreen forests of the Western Ghats. Insect fauna of many parts of these forests are still not explored.

Faunal studies in the Kerala part of Western Ghats

Kerala, (Fig.1) with its variety of ecosystems ranging from the high mountains supporting thick tropical evergreen forests, coastal plains, riverine and mangrove vegetation is known for its rich diversity. Although most of the faunal surveys were carried out in the north and north-eastern parts of India, the publications of earlier workers like Sir George Hampson (Lepidoptera), Guy Marshall (Coleoptera), Maulik Coleoptera), De niceville (Butterflies) and Bingham (Hymenoptera) contain references to species found in Kerala.

More recent works on insect diversity in the Kerala part of Western Ghats include, recording of 242 species of insects from Silent Valley during 1979-1980 by Zoological Survey of India (ZSI, 1986), a detailed study on the butterflies of the Nilgiri mountains by Larsen (1987,1988); recording of 208 species of insects mostly dipterans from the hydal areas of Idukki forests (Cherian, 1983), a study of insect fauna in the Malayattoor forests by Mathew (1993), a study on the butterflies and moths of Silent Valley by Mathew and Rahamathulla (1993,1995);and a very recent study on insect diversity in Silent Valley, Sholayar and Nelliampathy forests (Mathew *et al.* 1998).

The significance of the present study

The objectives of the study were to prepare an inventory of insects with reference to two orders namely Hymenoptera (limited to macro forms) and Lepidoptera in the different forest types of the Parambikulam Wildlife Sanctuary, Kerala and to estmate their diversity.

The insect order Hymenoptera is an extremely diverse group and a major component of insect diversity. There are currently over 1,15,000 described species (Lasalle and Gauld, 1993). The role of bees and wasps as agents of pollination in phanerogamic plants is well recognised. Each plant species is highly specialised in this regard and requires certain

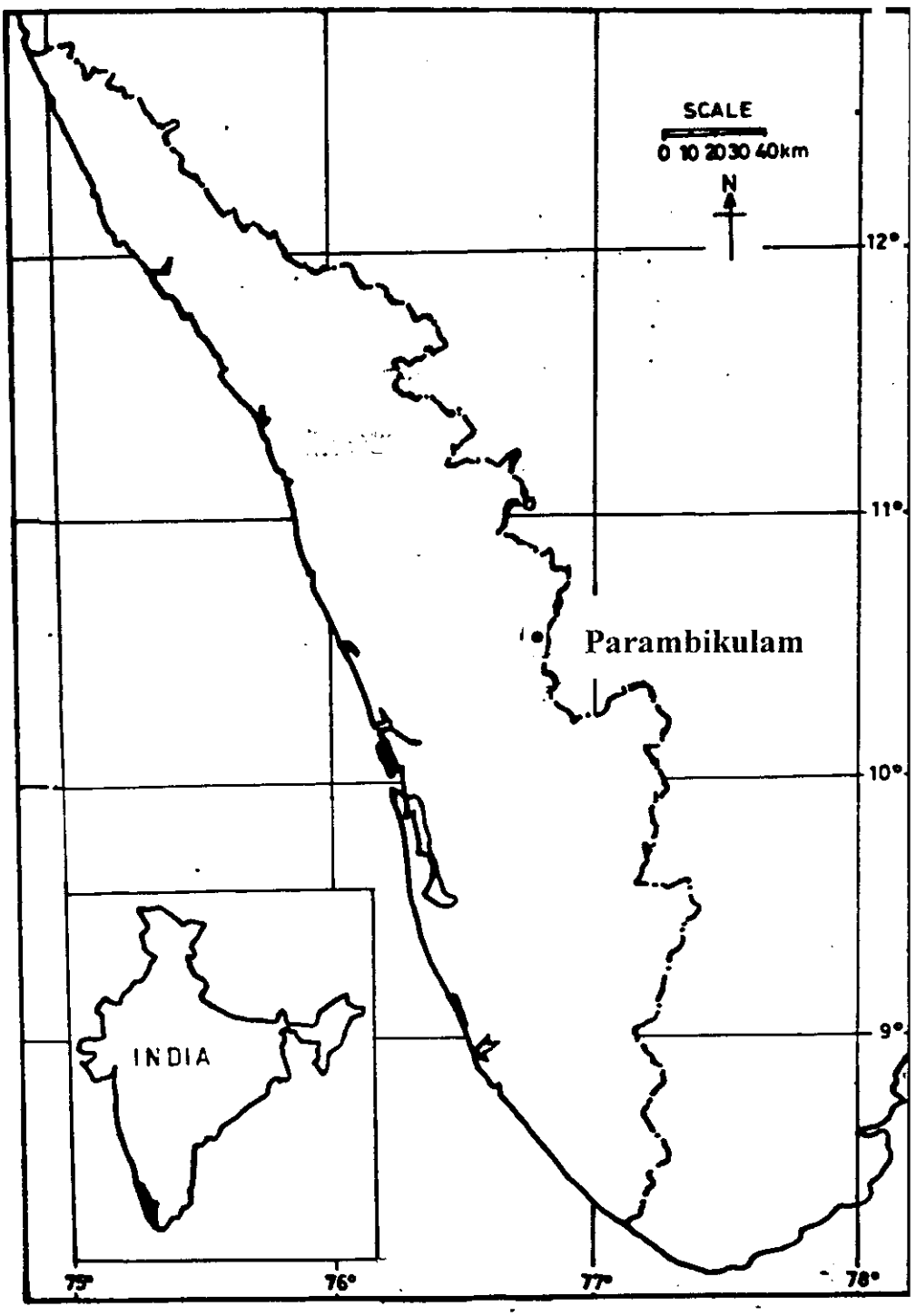


Fig. 1 Map of Kerala showing the study area

groups of insects for effecting cross pollination. Destruction of these insects may in the long run affect the forest structure. Parasitic and predatory forms have an important role in supressing insect pests. Many members of the families Chalcididae, Braconidae, Ichneumonidae etc. are utilised in biological controI of insect pests of agriculture and forestry crops. Similarly predatory ants are also known to regulate the population of other insects.

The lepidopterans, which include moths and butterflies, are also economically important as many of them are pests of a variety of crops. Information on their host range, habitat preferences, distribution etc., is very important in forest and agriculture canopy systems. Being closely associated with the vegetation, they are also important agents in nutrient cycling. The radiant energy trapped by plants is made available to the other organisms in the ecosystem through these insects. As a result they also form important links in the food webs. Because of their phytophagous habits, they have also been looked upon as important tools for monitoring changes taking place in terrestrial habitats.

2. STUDY SITE

The present study was carried out in one of the locations of the Western Ghats – Parambikulam Wildlife Sanctuary (Fig. 2).The Western Ghats which is the most imposing, but extremely threatened topographical, floristic and faunistic feature of the Indian sub continent, is one of the 18 biodiversity hotspots of the world. Spread over an area of 175,000 Sq. km in six States, this mountain range extends more or less parallel to the West Coast of Indian Peninsula from Kerala to Gujarat traversing a length of about 1600 km. Parts of this mountain range are also present in Tamil Nadu, Kamataka, Goa and Maharashtra.

The location and vegetation types of the study area are described below.

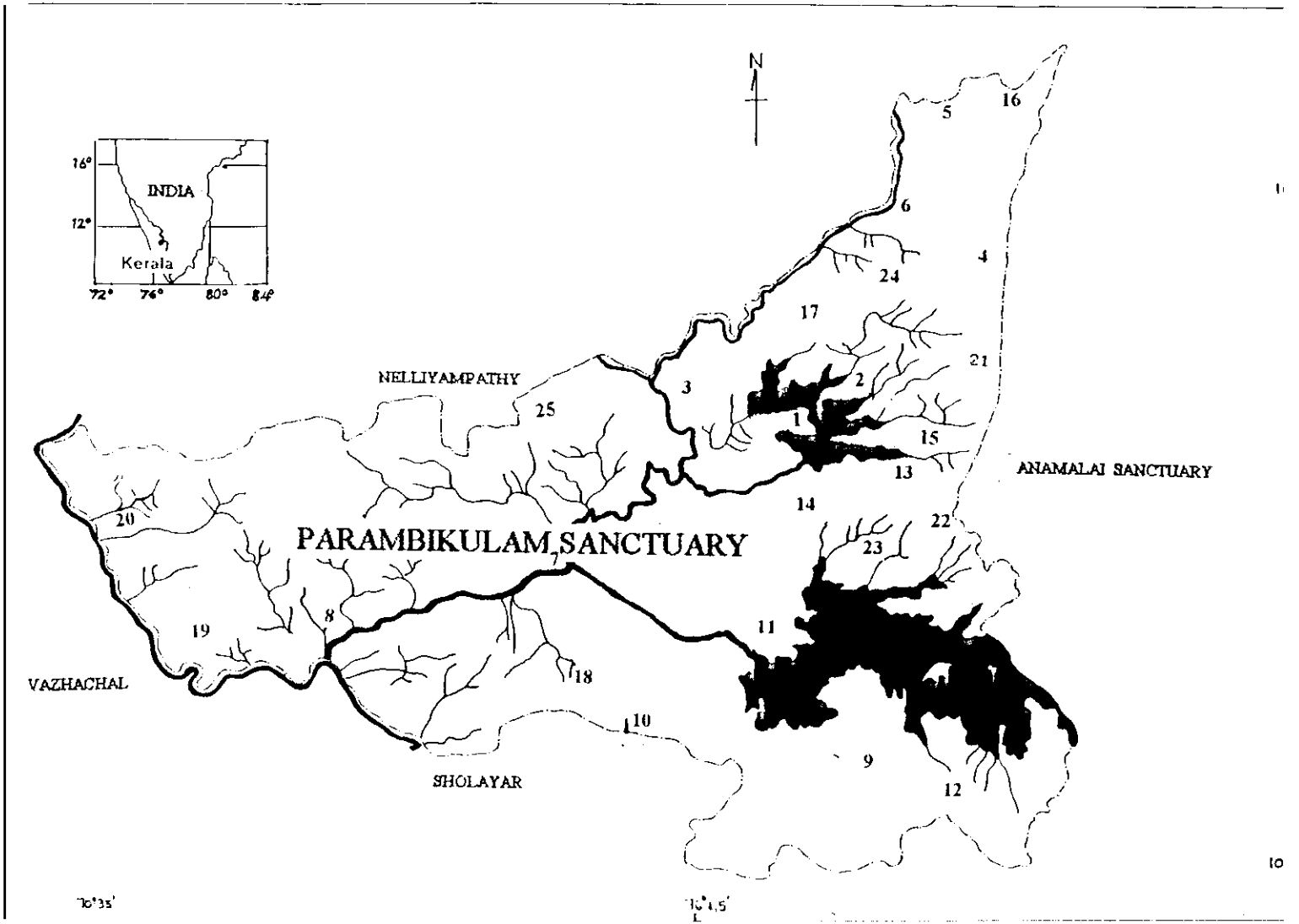
Location

The Parambikulam Wildlife Sanctuary (Fig.2) is located in the Palghat district of Kerala State and lies between 76° 35' and 76° 50' E and 10° 20' and 10° 26' N at an elevation of 600 m above sea level.

The Sanctuary came into existence in 1962 when an area of 69.8 km^2 of Sungam Range of Nemmara Forest Division was declared as a Sanctuary and later, in 1973 the Parambikulam Range was added to this. The Sanctuary as of now is formed in 1985, and has an area of 270 km^2. The boundaries include the Indira Gandhi Wildlife Sanctuary of Tamil Nadu on the east, the Nelliyampathy Reserve Forests on the northwest as well as the Vazhachal and Sholayar forests on the south. Many streams originate in this region which later merge to form the Karappara-Kuriarkutti river systems, which finally drain, into the Chalakudi river at Orukombankutty.

Topography

The Sanctuary exhibits hilly terrain with characteristic distribution of undulating plains interspersed with marshy fields in the valleys. The altitude varies between 300m and 1400m, and the highest peak is Karimalagopuram which has an elevation of 1438m. The mountain slopes are non-symmetrical and non-uniform, spread throughout the area in different directions. The mountain ridges, which have well defined valleys, slope down straightly to streams, which permit denser growth of vegetation in those regions. The ridges of the Sanctuary are of



1. Thunacadavu
2. Sungam
3. Thellickal
4. Karianshola
5. Thekkadi
6. Elathodu
7. Kuriarkutty
8. Orukombankutty
9. Poopara
10. Karimalagopuram
11. Parambikulam
12. Muduva colony
13. Vengolimala
14. Pillakkal
15. Seechalipallam
16. Keerappadi
17. Ponnamudi
18. Kottayali
19. Muthuvarachal
20. Puliyalapara
21. Anappady
22. Vengoli
23. Veyakkadamudi
24. Padippara
25. Thoothampara

Fig. 2 Map of the study area showing observation sites

sheet rock and are exposed at the top. Some of the hilltops have a thin crust of soil favoring stretches of grasslands.

Inside the Sanctuary, three dams were constructed in the year 1960 - Parambikulam, Thunacadavu, and Peruvarippalam - as part of Parambikulam - Aliyar project. The total water- spread area of these three dams comes around 29 km^2 of which Parambikulam is the largest (21.22 km^2).

Climate

The climate in general is pleasant. The maximum temperature ranges between 24°C to 33C and minimum 20°C to 25°C. The average annual precipitation is 1800 mm varying between 1200 mm to 2300 mm. The area gets both the south - west and north - east monsoons, the south - west monsoon being more active. When compared to the eastern portion, western parts of the sanctuary receive higher precipitation. Monsoons last from June to December and as such, two seasons could be distinguished in the area- dry and wet. January to May with low or no rainfall is considered as *dry* and the remaining months of the year as wet. February to April is the hottest months and the Sanctuary becomes dry and fire prone during these months.

Habitats and Vegetation

The Parambikulam Wildlife Sanctuary has a variety of habitats, both natural and man-made. Natural habitats include moist deciduous forests to tropical wet evergreen rain forests. Semi-evergreen forests appear where moist deciduous forests merge into evergreen forests. Grasslands are seen on the upper reaches of Karimalagopuram and Vengoli hills above 1000 m. The man made habitats are chiefly teak plantations, which have an extent of about 90 km^2, and were first introduced in the year 1912. In addition to this, a small area of the Sanctuary bordering Tamil Nadu is planted with eucalyptus (Uniyal, 1987). Based on Champion and Seth (1968),the natural vegetation is classified broadly as West-Coast tropical evergreen (55 km^2), West-Coast semi evergreen (20 km^2), the South Indian moist deciduous (65 km^2), and the South Indian dry deciduous (15 km^2) forests. Besides small patches of bamboo and reed are also present in certain areas.

Vegetation type of the study area

Moist deciduous forests (MDF)

In the sanctuary this type of forests cover 65km^2 area. They are mostly encountered along the ridges and lower slopes. Trees such as *Terminalia spp., Lagerstroemia microcarpa, Xylia* xylocarpa and *Tectona grandis* dominate this habitat. The understorey is a combination of shrubs like *Sida* sp., *Hibiscus* sp., *Helicteres isora, Glycosmis pentaphylla* and herbs like *Synedrella nodiflora, Smithia geminiflora, Centella asiatica* and *Globba marantiana.*

Teak plantation area

About 90 km^2 area of the sanctuary is under teak which are in a state of regeneration. Deciduous species like *Cassia fistula, Cordia dichotoma, Butea monosperma, Grewia tillifolia* and *Randia* spp. are seen intermingled with teak trees in the plantations. The raising of teak plantations after clear-felling of natural forests is the major disturbance to the natural ecosystem. However, being a wildlife sanctuary, the plantations are left without any weeding or extraction of miscellaneous tree species as a result of which some areas have developed into mixed stands. The forests adjacent to teak plantations are mainly moist deciduous.

Evergreen forests

In Parambikulam, such forests are distributed in higher slopes above 800m msl. They exhibit luxuriant vegetation and are mostly found in Karianshola,Vengolimalai,and Karimalagopuram. Most of the streams and rivers that drain the Parambikulam Valley originate from these forests. The total extent of these forests in the sanctuary is about 55km2. The general floristics of these forests are given below. Upper canopy species include *Palaquium ellipticum, Cullenia exarillata, Mesua ferrea, Calophyllum tomentosum, Hopea parviflora, Polyalthia fragrans, Dipterocarpus indicus, Dysoqlum malabaricum, Myristica malabarica, Vateria indica* and Syzygium *cumini.* Lower canopy species include *Aporosalind leyana, Canarium strictum, Elaeocarpus serratus, Evodia roxburghiana, Hydnocarpus wightiana, Mallotus philippensis* and *Holigarna arnottiana.* The under growth species are *Antidesma* spp., *Calamus hookerianus, Glycosmis pentaphylla, Ixora spp., Laportea crenulata, Murraya exotica, Ochlandra wightii, Curcuma spp., Strobilanthus spp., Elettaria cardamomum.* are the species of ground vegetation.

Vayals

Vayals or marshy lands are generally low lying depressions with a high content of clay in the soil. They accumulate runnig water during monsoon and this becomes stagnant as the *dry* season approaches. Most of the vayals are so interspersed with the teak plantations that they create effective edges. *Tectona grandis* , *Lagerstroemia microcarpa*, *Randia* sp., *Ziziphus, Butea monosperma,* etc., grow in the fringes. Polygonums (Polygonaceae), sedges (Cyperaceae), grasses, etc., grow profusely in these marshy areas. They used to contain water throughout the year in the past. However, now they turn *dry* during March-April and soil appears cracked. In many such areas weeds like *Cassia tora* ,and *Lantana camara* have invaded and occupied the fringes. These marshlands are interspersed within the sanctuary in more than 30 places occupying 150 ha.

3. MATERIALS AND METHODS

The study was carried out during January 1994 - December 1997 and the systematic sampling was done during 1995 to 1997. Details of the methodology followed are given below.

Insect sampling

Sampling methods

Light trap sampling : Light traps have been successfully used by various workers for sampling insects. It is a useful tool particularly to collect moths and beetles in addition to several other nocturnal insects. In the present study, sampling of insects was done using a battery operated light trap specially fitted with a switching device to facilitate self operation at specified hours (Mathew and Rahamathulla, 1995).The trap was operated alternately between plots in the teak plantation and moist deciduous forest i.e., if the trap was operated initially in plot 1 in the teak plantation area, the next day, it was operated in the plot 1 of the moist deciduous forest area and then in plot ***2*** of the plantation area and so on, in order to avoid the influence of lunar phase on insect catches. Due to operational difficulties, light trap catches in the evergreen area was made only once in a month, for a period of one year during 1996-97. The insects collected were sorted out to species and the number of individuals for each species was recorded on data sheets for estimating the diversity. As spot identification could not be made in all cases, code numbers were assigned to the various species, which were later labeled after establishing their correct identity.

Hand net sampling : Direct catching of insects using handnet is often required for collecting various insects like, bees, wasps etc. Using this method collections were also made during day times (8a.m to 1 p.m). Altogether 25 locations distributed over the sanctuary area representing different habitats were covered in this study (Fig 2).

Ecological studies

In addition to studying the fauna, attempts were also made to gather information on their ecology. Data on habitat association of the insects particularly Lepidoptera and Hymenoptera were gathered. Systematic collection of butterflies was carried out from different habitats during 1995-1997. Intensive sampling by laying belt transects was made in

Karianshola (evergreen forests), Aamakundu (moist deciduous forests), Thekkady-Keerappady (dry deciduous forests) and Thunacadavu (teak plantations) areas during June 1996 to May 1997. These sites were chosen to be representative of the habitat types present throughout the study area. Each site was sampled as thoroughly as possible on each visit and field notes were taken concerning the habitats of each butterfly species encountered at every site. As the forest canopy could be only poorly sampled by this method, supplementary point observations of forest canopy were repeatedly performed in different habitats. Each transect was covered twice in a month during the morning hours between 8 a.m and 2 p.m. Occasional collections made from other parts of the sanctuary like Poopara, Orukombankutty, Kuriarkutty, Velayudhankayi, Seechali and Thellikkal provided complementary information. Based on the occurrence of butterflies in different habitats in the sanctuary, they were generally categorized as follows. (1)Common (C) - Present in 4 or more habitats (2)Uncommon (UC) - Present in 2 - 3 habitats (3) Rare (R) - Present only in 1habitat

A separate attempt was also made to record insects in the "vayal".Due to operational difficulties, light trap sampling could be made in this habitat only for a shorter period of four months from June - September, 1997.

Insect identification

The insects collected under this study were subsequently identified either by the investigators or by comparing with the identified specimens in the national collections like IARI, New Delhi and ZSI, Calcutta or by referring to experts in other institutions. Wynter-Blyth (1957)and De Abrera (1982,1985,1986) served as useful literature for the identification of butterflies.

Insect diversity studies

Representative plots in three habitats namely, teak plantation, moist deciduous forest (Both at Thunacadavu) and evergreen forest (at Karianshola) were established for systematic collection of the insects. Except in the evergreen forest, at each location, four plots of 25m x 25m were laid out. The plots were separated by a distance of 25m. Due to operational difficulties, only a single plot of 625m^2 was laid out in the evergreen patch . Data on insects were collected from the plots in each habitat and from this indices of insect diversity, dominance, evenness, species richness etc., were computed. The values for different habitats were pooled for deriving the overall values for the study area.

Diversity index

The quantification of diversity must address two statistical properties common to any mixture of different objects. The first property is the number of different classes or types of objects *i.e.*, species, genera, families, different habitats and so on. The second property is the distribution of objects among classes such as the relative abundance of individuals of different taxa or the relative area of the habitat that falls into different habitat types. In this study, only species diversity was studied. For this, the Shannon-Weiner diversity index (H) was used (Margalef,1968):

$$H = -\sum_{i} P_i \log_e (P_i)$$

where 'H' is the Shannon's index of species diversity and P_i is the proportion of individuals in the 'i' th species.

In order to find out whether any significant difference existed in the insect diversity between the two localities or between the disturbed and undisturbed areas within a locality, a 't' test was done (Magurran, 1988) using the following formula:

$$t = \frac{H1-H2}{(\text{var}(H_1) + \text{var}(H_2))^{1/2}}$$

where 'H1' and 'H2' are diversity indices of first and second locality, and var (H1) and var (H2) are their variances. Variance of diversity index (Magurran, 1988)is defined as follows

$$\text{Var}(H) = \frac{\sum_i (Pi (\log_e (Pi))^2 - (\sum_i (Pi \log_e (pi))^2}{N} - \frac{S-1}{2N^2}$$

Dominance index

Patterns of relative abundance of species determine the dominance component of diversity. In this study, the relative dominance of each insect order in a locality was determined by calculating the dominance index using the following formula:

$$\text{Relative dominance} = \frac{ni \times 100}{N}$$

Where ni = no. of insects in the 'i' th order, and N = the total number of insects in all the orders collected during the study period.

Evenness or equitability index

This index which measures the evenness of species abundance is complimentary to the diversity index concept and it indicates how the individuals of various species are distributed in the community.

For estimating evenness, Shannon's evenness index was calculated (Pielou, 1975). Mathematically, the evenness of frequency distribution of species abundance in a community with 's' component species, is the degree to which it approximates the uniform distribution for 's' species i.e., equal abundance of all species in the sample or community (Pielou, 1977).

In a collection or in a community with 's' component species, diversity wil1 be greater if all 's' species are well represented. In this condition, there is high evenness and low dominance. On the contrary, if a few of the species, say 't' are very common and the rest (s-t) are very rare, then it is a case of low evenness and high dominance.

The Shannon's evenness index of the community (E) was calculated following Pielou (1975):

$$E = H/\log_e(s)$$

where 's' is the number of species recorded and 'H is the Shannon-Weiner index of diversity.

Species richness

In the ecological literature the number of species at a site, in a region or in a collection is called species richness, which is the simplest and most useful measure of species diversity. In this study, the total number of insect species collected in each month from each locality was considered as species richness.

Species richness index

The index of species richness (d) was calculated using the formula given by Menhinick (1964):

$$d = s / \sqrt{n}$$

where 's' is the number of species recorded and 'n' is the total number of individuals summed over all species.

4. RESULTS AND DISCUSSION

Insect records

1049 species of insects belonging to 13 orders and 106 families were collected from the Parambikulam Wildlife Sanctuary area (Table 1). Of the species collected 636 species belonging to 10 orders and 106 families were identified and 413 species remain unidentified.

Lepidopterans

Of the 484 species of lepidopterans collected 401 species belonging to 31 families were identified. This include 124 butterflies and 277 moths.

Hymenopterans

Among the 105 species of macro hymenopterans collected 84 species belonging to 16 families were identified.

Table 1: Consolidated account of insect species recorded from Parambikulam Wildlife Sanctuary

Order	No. of families	Identified species	Unidentified species	Total species
Lepidoptera	31	401	83	484
Hymenoptera	16	84	21	105
Homoptera	8	26	31	57
Heteroptera	7	24	50	74
Orthoptera	2	11	20	31
Dictyoptera	2	3	8	11
Neuroptera	1	1	12	13
Coleoptera	29	78	135	213
Odonata	2	7	10	17
Diptera	5	1	35	36
Trichoptera	1		4	4
Ephemeroptera	1		2	2
Isoptera	1		2	2
Total	106	636	413	1049

Insect Diversity

Species Richness

The seasonal pattern of the number of species.of insects collected during the period December 1995-August 1997 using light trap with respect to the *two* habitats namely, teak plantation and moist deciduous forest(MDF) is presented below (Table 2)

Table 2. Seasonal trend of species richness in the two habitats at Parambikulam (Teak plantation and Moist Deciduous forest) during 1995-1997 (Pooled data)

Habitat	Number of species collected in different months												
Teak Plantation	82	113	97	124	121	104	83	81	45	33	44	82	353
Moist Deciduous forest	107	154	156	106	94	96	131	101	64	69	61	106	436

The total number of species recorded was more in the MDF (436) than in the teak plantation (353). As per the pooled data for the period1995-1997, the species recorded from the study area was found to increase in the teak plantations from November to May and later showing a decreasing trend. In the MDF the species increase was noted during December – March with a decline thereafter until July. The number of species again decreased during the period from August to December. The seasonal pattern of species composition was found different in the two habitats studied. It was found that there was significant difference in the insect species richness between the teak plantations (x^2=120.34) and the MDF (x^2=104.07).

Data collected from evergreen plot for a period of ten months (January - April and July –December) in 96-97 showed that the maximum number of insects was recorded during December – January (Table 3). Out of the 184 species, the highest number of species was recorded in December (62) followed by January (46).

Species richness index

Species richness index showed higher value of 5.37 for MDF as against 4.5 for teak plantations. Though the data is limited, species richness index for evergreen was the highest (6.82) suggesting the highest diversity in the evergreen.

Table 3. Seasonal trend of species richness in the evergreen forest at Parambikulam in the year 1997

Number of species collected in different months											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
46	18	32	33	*	*	29	13	16	18	23	62

* Data not available

Species abundance

The number of insects collected during different months from the teak plantations and the MDF is presented in Table.4, and the overall trend is shown in the Fig.4. A total of 6602 insects were recorded from the MDF as against 6040 insects from the teak plots suggesting that the number of insect species recorded in different months in the MDF is significantly more (x^2=1549)than in the teak plantations ((x^2=3469)In the MDF the number of insects varied from 148-1008. In the teak plots, it ranged from 86- 1507. The maximum number of insects was recorded during April irrespective of the habitats. The overall seasonal trend of the species abundance in the study area is presented in Fig.4. The trend indicates that there is an increase in the number of species from December to April and a decline in the number thereafter. As far as insect species abundance is concerned September-November appeared to be the dull period.

Dominance index

The dominance indices for various insect groups at Parambikulam are given in Table 5. Data for the period 95-97 indicated that Coleoptera is the most dominant group (53.8) followed by Hymenoptera (15.6)in the teak plantation. The dominant group in the MDF was Coleoptera (39.6) followed by Lepidoptera (14.2) and Diptera (13.5). The pooled data indicated that in Parambikulam, Coleoptera is the most dominant group followed by Hymenoptera.

Table. 4. Seasonal trend of Insect abundance (number of insects) in the teak plantation and moist deciduous forest during 1995-97-

Habitat	Number of insects collected in different months												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Teak Plant-ation	404	799	550	1507	790	616	339	428	150	86	112	259	6040
Moist Deciduous forest	701	779	837	1008	720	491	463	601	187	167	148	500	6602

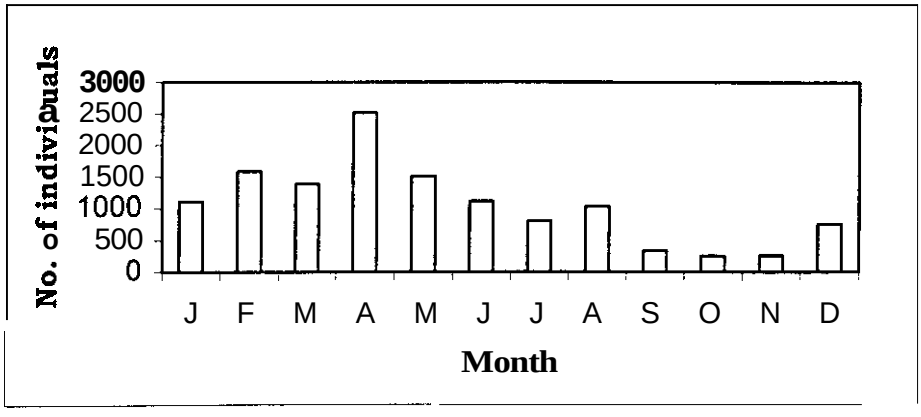


Fig. 3. Overall seasonal trend of the number of insects recorded in the study area during 1995-97

The percentage of insect species belonging to various groups in the teak plantations and in the MDF are shown in Fig.4 and Fig.5 respectively. In the teak plantation as well as in the MDF the maximum number of species collected belonged to Coleoptera (38.5% and 38.8% respectively) followed by Lepidoptera (23.8 % and 23.4% respectively. However the Hymenoptera stood as third in teak plantation and as fourth in the MDF.

Table 5. Dominance indices of insects

Dominance index				
Sl. No.	Order	Habitats		Pooled value
		Teak	MDF	
1	Coleoptera	53.8	39.6	45.7
2	Hymenoptera	15.6	10.4	13.0
3	Diptera	12.0	13.5	12.8
4	Lepidoptera	7.5	14.2	10.9
5	Heteroptera	4.1	6.0	5.4
6	Homoptera	3.4	6.2	5.2
7	Isoptera	2.1	8.1	5.2
8	Orthoptera	0.6	1.0	0.9
9	Dictyoptera	0.6	0.4	0.5
10	Trichoptera	0.2	0.3	0.2
11	Ephimeroptera	0.1	0.2	0.2
12	Odonata	0	0.04	0.02

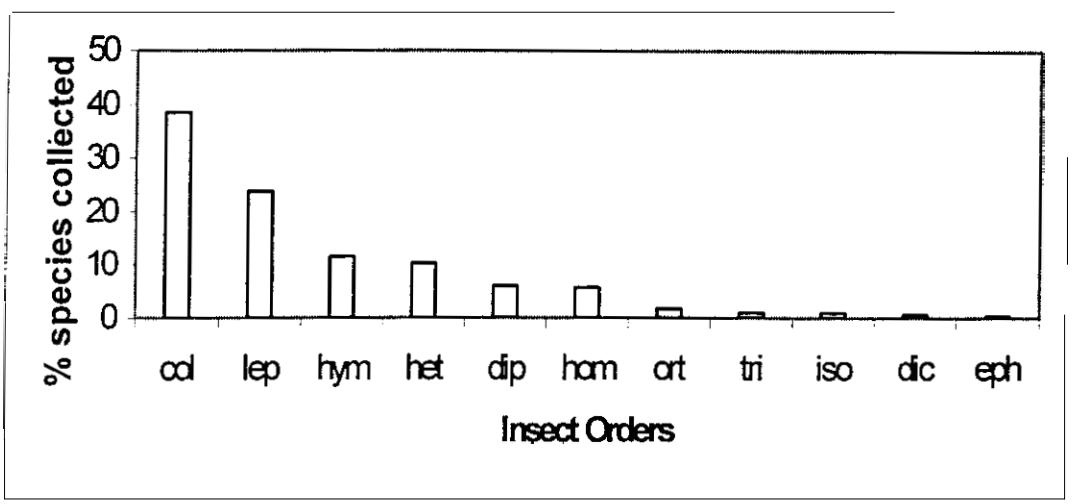


Fig. 4. Representation of percentage of insect species belonging To various groups in Parambikulam (teak plantation) during 1995-97. (col- Coleoptera; lep- Lepidoptera; Hym- Hymenoptera; het- Heteroptera; dip- Diptera; hom- Homoptera; ort- Orthoptera; iso- Isoptera; tric- Trichoptera; dic- Dictyoptera; Eph-

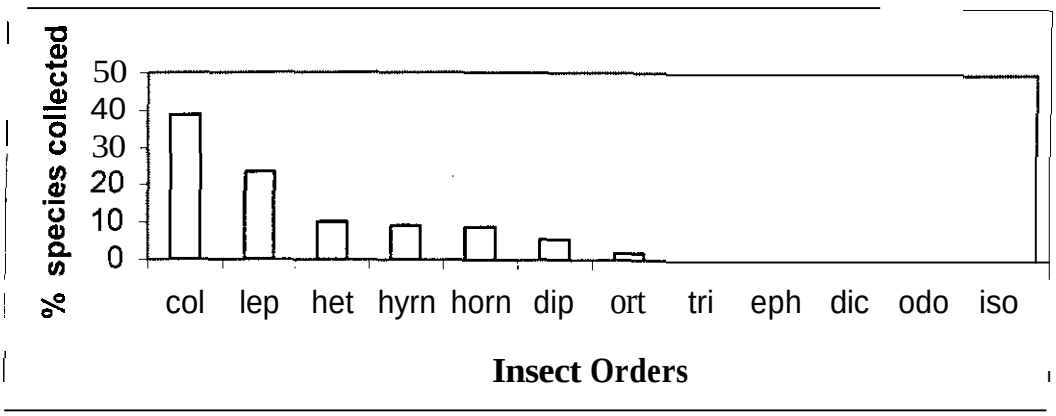


Fig. 5. Representation of percentage of insect species belonging to various groups in Parambikulam (moist deciduous forest) during 1995-97. [Abbreviations : col - Coleoptera; lep- Lepidoptera; hym- Hymenoptera; het- Heteroptera; dip- Diptera; hom- Homoptera; ort- Orthoptera; tric- Trichoptera; eph- Ephimeroptera; dic- Dictyoptera; ado - Odonata ; iso- Isoptera;

Dominance index of insects in the evergreenforest

In the evergreen, the most dominant group was Lepidoptera (28.03) followed by Hymenoptera (24.3I), Coleoptera (20.88), and Diptera (13.19). Of the species collected maximum number belonged to Coleoptera (36%) followed by Lepidoptera (28%) and Hymenoptera (12.5%).

Species diversity index

Shannon's index of diversity was calculated month-wise for various habitats studied.

The diversity index of insects in teak plantation in the first year of study (95-96) was 3.987 as against 4.643 in MDF. The t value of 11.98 indicated significant difference in the diversity between the two habitats. Similarly in the second year the diversity index in teak plots and the MDF was 4.40 and 4.51 with the t value being 2.74. The data indicates that significant difference in the diversity between the two habitats within a particular year.

Based on the pooled data for each year the overall diversity index for 95-96 was 4.501 as against 4.677 of 96-97. The overall diversity index varied significantly between years (t= 4.274) in the study area. Significant changes in the diversity was evident between years (95-96

and 96-97) in teak plantations as well as in MDF (t values 9.78 and 3.14 respectively).

The overall insect diversity index for the study period in the teak plantations (4.318) was found to be significantly lower than that in the MDF (4.835) (t value = 17.56). The overall diversity index for the study area was 4.763 (Table 6).

Diversity index of insects in the evergreen forest

As the diversity index of insects in the evergreen forest was based on ten months data it is dealt separately here. The diversity was found to be 4.509, which is lower than that for MDF (4.835) as well as the overall value for the study site (4.763) (Table 7) and higher than that of teak plantation (4.318).

Evenness of equitability index

Based on the pooled data for the study period, the Shannon's evenness indices for Evergreen forests, MDF and teak plantations were 0.864, 0.795 and 0.736 respectively which indicated more evenness of species abundance in the evergreen forest followed by MDF and teak plantation.

Table 6. Species diversity index for insects collected from (Pooled data for 95-97)

Month	Habitats		Pooled value
	Teak	MDF	
Jan	3.781	3.570	3.855
Feb	3.447	4.302	4.070
Mar	3.402	3.961	4.026
Apr	2.731	3.033	3.335
May	3.446	3.860	3.919
Jun	3.235	3.977	3.943
Jul	3.674	4.192	4.279
Aug	3.128	3.779	3.807
Sep	3.167	3.779	3.881
Oct	3.396	3.900	4.111
Nov	3.471	3.820	4.171
Dec	4.029	3.456	3.928
Total	**4.318**	4.835	**4.763**

Table 7. Species diversity indices for insects in the evergreen forest

Month	Diversity index
January	3.364
February	2.632
March	3.211
April	3.270
May	*
June	*
July	2.566
August	2.327
September	1.400
October	2.751
November	2.947
December	3.832

* No data availaIe

Macro hymenopteran fauna

Altogether 105 species of hymenopterans were collected, of which 84 species were identified. The species names and their habitat associations are listed in the Table 8. They belong *to* 47 genera and 16 families. Maximum number of species recorded belonged to the families Formicidae, Sphecidae, Pompilidae, and Apidae.

With regard to the habitats studied, the highest number of species were recorded from the evergreen forests (85sp). Moist deciduous forests (77 sp.) and dry deciduous forests (39 sp.) showed some remarkable difference in the species composition. Teak plantation (62 sp.) showed close affinity to the moist deciduous forests probably due to recolonisation by different plant species in these areas.

The dominance of the families Apidae, Anthophoridae, Megachilidae, and Xylocopidae was noted in all the habitats. While *Apis dorsata,* A. *indica,* A. *florea, Xylocopa verticalis, X. dissimilus* were found in abundance in all the habitats, *Mutilla semiaurata* Smith, *Mutilla* sp., *Sphex praedator leutipennis, Camponotus* spp., *Crematogaster* sp., and *Dorylus* sp. were recorded exclusively from the evergreen areas. *Scale carbonaria, Megascolia* sp., *Dorylus* sp., *Pseudagenia blanda, Sphex argentatus, Heals feai,* and *Platythyrea* sp. were

observed only in the moist deciduous and evergreen areas. Some species like *Eumenes conica, Trypoxylon errans* were not very common in the evergreen forests.

Table 8. List of macrohymenoptera recorded from different habitats

FAMILY/ SPECIES	EVG	MDF	DDF	PLN
APIDAE				
Apis dorsata Fb.	+	+	+	+
A. indica Fb.	+	+	+	+
A. florea Fb.	+	+	+	+
Coelioxys cuneatus Smith	+	+	-	+
Thyreus sp.				
Thyreus ramosa Lepel	+	+	-	-
Thyreus sp.	+	+	+	+
Nomia ellioti Smith	+	+	-	+
N.thoracica Smith	+	+	+	+
Psithyrus sp.	+	+	-	-
XYLOCOPIDAE				
Xylocopa dissimilus Lepel	+	+	+	+
Xylocopa verticallis Lepel	+	+	+	+
EUMENIDAE				
Eumenes conica Fb.	+	+	+	+
E. flavopicta Blanch	+	+	+	+
Odynerus fragilis Smith	+	+	-	+
Rhynchium brunneum (Fb.)	+	+	+	+
SCOLIIDAE				
Megascolia sp.	+	+	-	-
Scolia carbonaria Saus.	+	+	-	-
S. aureipennis Lepel	+	+	-	+
SPHECIDAE				
Ammophila laevigata Smith	+	+	+	+
A. atripes Smith	+	+	-	+
Chalybion bengalense (Dahlbom)	+	+	+	+
Chlorion lobatum Fb.	+	+	-	+
Cerceris sp.	+	+	+	+
Sceliphron javanum Lepel	+	+	-	-
S. coromandelicum	+	+	-	+
S. madraspatanam madraspatnam Fb.	+	+	-	+
Sphex argentatus Fb.	+	+	-	-
S. praedator leutipennis Mocsary	+	-	-	-
Sphex sp. nr. nigripes	+	+	+	+
S. sericius Fb.	+	+	+	+
Trirhogma caerulea Westwood	+	+	-	-
Trypoxylon errans Saussure	+	+	+	+
CHRYSIDIDAE				

Stilbum cyanarum Forster	+	+	+	+
Trichrysis lusca	+	+	+	+
VESPIDAE				
Vespa sp. nr. cincta Fb.	+	+	+	+
Rhopalidia sp.	+	+	-	+
Polistes sp.	+	+	-	+
FORMICIDAE				
Camponotus sp.	+	+	+	+
Camponotus sp.	+	+	+	+
Camponotus sp.	+	-	-	-
Camponotus sp.	+	+	+	+
Camponotus sp.	+	-	-	-
Crematagaster sp.	+	-	-	-
Dorylus sp.	+	-	-	-
Harpegnathos saltator Jerd.	+	+	-	-
Leptogenys sp.	+	+	-	-
Leptogenys sp.	+	+	-	-
Leptogenys sp.	+	+	+	+
Myrmicaria sp.	+	+	+	+
Oecophylla smaragdina Fb.	+	+	+	+
Pheidologeton diversus Jerd.	+	+	-	+
Pheidologeton sp.	+	+	-	+
Plagiolepis longipes Jer.	+	+	+	+
P. rothneyi Forel	+	+	-	-
Platythyrea sp.	+	+	-	-
Polyrhachis sp.	+	+	-	+
*Polyrhachis illaudata*Wlk.	+	+	-	+
Tetraponera sp.	+	+	+	+
BRACONIDAE				
Cardiochile sp.	+	+	+	+
EVANIIDAE				
Evania sp.	+	+	-	+
ICHNEUMONIDAE				
Enicospilus sp.	+	+	-	+
MUTILLIDAE				
Mutilla semiaurata Smith	+	-	-	-
Mutilla sp.	+	-	-	-
COLLETIDAE				
Hylaeus feai (Vachal)	+	+	-	-
Anthophora niveocincta Smith	+	+	+	+
A. zonata (Lin.)	+	+	-	+
A. confusa Smith	+	+	+	+
MEGACHILIDAE				
Magachile lanata Fb.	+	+	+	+
M. carbonaria Smith	+	+	+	+
M. quartinae Gribodo	+	+	-	+
POMPILIDAE				
Ceropales sp.	+	+	-	+
Ceropales sp.	+	+	+	+

Ceropales sp.	+	+	+	+
Pompilus sp.	+	+	+	+
Pompilus sp.	+	+	+	+
Pseudagenia blanda Guer.	+	+	-	-
Salius fulvipennis Fb.	+	+	-	-
S. perplexus Smith	+	+	+	+
S. praestabilis Binham	+	+	+	+
S. caeruleopennis Saus.	+	+	-	+
Salius sp.	+	+	+	+
Salius sp.	+	+	-	+
Salius sp.	+	+	-	+

Abbreviatons :

+ - species present

- - species absent

EVG - evergreen; MDF- moist deciduous;

DDF - dry deciduous; PLN- teak plantation.

Lepidopteran fauna

Altogether 484 species of lepidopterans have been collected in this study. The identity of 116 species of butterflies and 277 species of moths could be confirmed and the remaining is in the process of confirmation. Details of the lepidopterans recorded are given in Table 9.

Butterflies

Habitat associations

Butterfly associations in different habitats in the study area are discussed below. A list of species with their habitat associations are given in Table 8. The 124 species of butterflies collected belonged to Nymphalids (28 species), Pierids (22 species), Lycaenids (20 species), Satyrids (16 species) and Papilionids (15 species).

Tropical evergreen forests

In Parambikulam such forests are seen in Karianshola, Pulikkal, Karappara and Orukomban areas. Small patches of evergreen forests also occur at Karimalagopuram and Shettiwaramalai. Butterflies like *Papilio buddha, Papilio paris tamilana, Graphium antipathes alcibiades., Idea rnalabarica malabarica, Vindula erota saloma., Parthenos sylvia virens* etc. are present in the forest canopies of this habitat. The understoreys were occupied mostly by shade loving species who are excellent mimics of their surroundings like *Lethe rohria neelgheriensis, Ypthima* spp. and *Melanitis* spp. are common here. Species like *Cethosia nietneri mahratta, Cupha erymanthis maja, Catopsilia spp., Papilio*

helenus, Tagiades litigiosa and *ambareesa* were found to prefer forest clearings formed as a result of tree falls.

Table 9. Distribution of butterflies in the various habitats

Family / Species	Habitats					Status
PAPILIONIDAE	EVG	SEV	MDF	DDF	PLN	
Graphium sarpedon teredon Felder	*	*	*	*	*	C
G. agamemnon Lin.	*	*	*	*	*	C
G. doson eleius Fruh.	*	*				UC
G. antipathes Fb.	*S					R
Pachliopta aristolochiae Lin.	*	*	*	*	*	C
P. hector Lin.	*	*	*	*	*	C
P. pandiyana Moore	*					R
Papilio polytes thesus Cram.	*	*	*	*	*	C
P. demoleus Lin.	*	*	*	*	*	C
P. paris tamilana Moore	*	*	*			UC
P. budha Westwood	*					R
P. helenus Lin.	*	*	*		*	C
P. polymnestor parinda Moore	*	*	*	*	*	C
P. dravidarum Wood-Mason	*	*				UC
Troides minos Cram.	*	*	*	S	*	C
NYMPHALIDAE						
Cethosia nietneri mahratta Felder	*	*	*			UC
Charaxes bernardus imna Butl.	*	*				UC
Cirrochroa thais thais Fb.	*	*	*			UC
Cupha erymanthis maja Fruh.	*	*	*			UC
Ariadne ariadne indica Moore	*	*	*	*	*	C
A. merione merione Cram.	*	*	*	*	*	C
Polyura athamas athamas Drury	*	*	*		*	C
Euthalia lubentina arasada Fruh.	*	*	*			UC
E. aconthea meridionalis Fruh.	*	*	*			UC
Hypolimnas bolina Lin.	*	*	*		*	C
H. misippus Lin.	*	*	*		*	C
Junonia orithya swinhoei Butl.	*	*	*		*	C
J. lemonias Lin.	*	*	*	*	*	C
J. hierta Fb.	*	*	*	*	*	C
J. almana Lin.	*	*	*		*	C
J. atlites Lin.	*	*	*		*	C
J. iphita pluvialis Fruh.	*	*	*	*	*	C
Kaniska canace viridis Evans	*	*	*			UC
Moduza procris Cram.	*	*	*		*	C
Neptis hylas varmona Moore	*	*	*	*	*	C
N. jumbah jumbah Moore.	*	*	*		*	C
Pantoporia hordonia Stoll	*	*	*			UC
P. ranga (Moore)	S					R

Parthenos sylvia virens Moore	*	*				UC
Phalanta phalanta Drury	*	*	*			UC
Tanaecia lepidea miyana Fruh.	*	*	*			UC
Vanessa cardui Lin.	*	*	*			UC
Vindula erota saloma Swinhoe	*	*	*		*	C
DANAIDAE						
Danaeus genutia genutia Cram.	*	*	*	*	*	C
D. chrysippus chrysippus Lin.	*	*	*	*	*	C
Euploea core core Cram.	*	*	*	*	*	C
Idea malabarica malabarica Moore	*	*				UC
Parantica aglea aglea Cram.	*	*	*	*	*	C
P. nilgiriensis Moore	*	*	*			UC
Tirumala limniace leopardus Butl.	*	*	*	*	*	C
T. septentrionis dravidarum Fruh.	*	*	*			UC
PIERIDAE						
Appias libythea libythea Fb.	*	*	*	*	*	C
A. lyncida latifascia Moore	*	*	*	*	*	C
A. albina darada Felder	*	*				UC
A. indra shiva Swinhoe	*	*	*			UC
Anaphaeis aurota Fb.	*	*	*		*	C
Catopsilia pomona pomona Fb.	*	*	*	*	*	C
C. pyranthe Lin.	*	*	*	*	*	C
Cepora nerissa phryne Fb.	*	*	*	*		C
C. nadina remba Moore	*	*				UC
Colotis fausta (Oliv.)				*		R
C. etrida Bois.				*		R
C. danae Fb.				*		R
Delias eucharis Drury	*	*	*	*	*	C
Eurema laete laeta Bois.	*	*	*	*	*	C
E. hecabe Lin.	*	*	*	*	*	C
E. blanda Bois.	*	*	*	*	*	C
E. brigitta rubella Wallace	*	*	*		*	C
Hebomoia glaucippe australis Butl.	*	*	*	*	*	C
Ixias pyrene sesia Lin.				*		R
I. marianne Cram.				*		R
Leptosia nina nina Fb.			*	*		UC
Pareronia valeria hippia Fb.	S					R
SATYRIDAE						
Lethe rohria neelgheriensis Guerin	*	*	*		*	C
L. europa Fb.	*	*				UC
Melanitis leda leda Drury	*	*	*		*	C
M. phedima varaha Moore	*	*	*		*	C
Mycalesis anaxias anaxias Hewit.	*	*	*		*	C
M. igilia Fruh.	*	*	*			UC
M. patnia junonia Butl.	*	*	*			UC
M. perseus Fb.	*	*	*			UC
M. mineus polydecta Cram.	*	*	*		*	C
M. visala Moore	*	*	*			UC
Orsotriaena medus mandata Moore	*	*	*			UC

Ypthima ceylonica ceylonica Hewit.				*		R
Y. baldus madrasa Evans	*	*	*	*	*	C
Y. philomela Lin.	*	*	*			UC
Y. huebneri Kirby	*	*	*	*	*	C
Zipoetis saitis Hewit.	*					R
HESPERIDAE						
Badamia exclamationis Fb.	*	*	*			UC
Celaenorrhinus leucocera Kollar	*	*				UC
C. ambareesa Moore	*	*	*		*	C
Hasora chromus chromus Cram.	*	*	*			UC
Iambrix salsala luteipennis Plotz	*	*	*			UC
Oriens concinna El.	*					R
Odontoptilum angulata Feld.	*	*	*			UC
Potanthus pava pava Koll.	*	*	*			UC
Pelopidas subochracea subochracea Moore	*	*				UC
Spialia galba Fb.	*	*	*			UC
Tagiades litigiosa Moschler	*	*	*		*	C
Taractrocera ceramas ceramas Hewit.	*	*	*			UC
Telicota ancilla bambusae Moore	*	*	*		*	C
LYCAENIDAE						
Caleta caleta Hewit.	*	*	*		*	C
Castalius rosimon (Fb.)	*	*	*	*	*	C
Celastrina lavendularis Moore	*	*	*			UC
Cheritra freja (Fb.)	*	*	*			UC
Chilades pandava pandava Hors.	*	*	*			UC
Curetis dentata dentata Moore	*	*	*			UC
Discolampa ethion vavasanus Fruh.	*	*	*		*	C
Euchrysops cnejus cnejus Fb.	*	*	*		*	C
Jamides alecto (Feld.)	*	*	*		*	C
J. celeno (Cram.)	*	*	*	*	*	C
J. bochus bochus Cram.	*	*				UC
Loxura atymnus Cram.	*	*	*			UC
Neopithecops zalmora dharma Moore	*	*				UC
Spindasis vulcanus vulcanus Fb.	*	*	*			UC
S. schistacea schistacea Moore	*	*	*			UC
Talicada nyseus nyseus Guerin.	*	*				UC
Udara akasa Horsfield	*	*	*			UC
Virachola perse ghela Fruh.	S					R
Zezius chrysomallus Hub.	S					R
Zizina otis decreta Butl.	*	*	*		*	C
ACRAEIDAE						
Acraea terpsicore Lin.	*	*	*	S		C
AMATHUSIIDAE						
Discophora lepida lepida Moore	*	*				UC

EVG – Evergreen ; SEV – Semi Evergreen Forest; MDF – Moist Deciduous Forest ; DDF – Dry deciduous Forest ; PLN – Teak plantation : S – Sighted only ones

Semi evergreen forests

Butterflies present here are common to both evergreen and moist deciduous forests. Species like *Papilio helenus, Charaxes bemardus imna, Cirrochroa thais thais, Tanaecia lepidea miyana, Polyura athamas athamas, Phalanta phalantha , Hypolimnas* spp., *Neptis* spp. and *Junonia* spp. are commonly found here. Besides a stray species of *Papilio paris tamilana, Vindula erota saloma* and *Parthenos sylvia virens* were also occasionally sighted. The understorey species are more or less same as in the evergreen forest habitat.

Moist deciduous forests

Several species of butterflies which are generally common in the study area like *Neptis hylas varmona, Ariadne ariadne indica, Papilio demoleus, Euploea core core, Tirumala Iimniace Ieopardus, Junonia* spp., *Pachliopta* spp. Etc are encountered in this habitat. Species like *Charaxes bemardus imna, Polyura athamas athamas, Appias lyncida latifascia,* and *Tanaecia lepidea miyana* are occasionally sighted here during the wetter months.

The forest understorey species show remarkable seasonal variation in this habitat. Species like *Eurema hecabe, E.blanda, Ypthima baldus madrasa* and *Y. huebneri* are seen throughout the year. During wetter months species like Gelatins lead, *M. phedima varaha, Mycalesis igilia, M.patniajunonia, M. perseus* can also be sighted.

Dry deciduous forests

Although these forests are seen only in a small patch, the butterfly fauna here is unique and varied. Canopy species include *Danaus chrysippus, Hebomoia glaucippe australis* and *Cepora nerissa phryne* along with *Catopsilia* spp., *Junonia* spp. and *Appias* spp. During the study period a single specimen of *Troides minos* was also sighted here in the month of January.

This habitat harbours the most characteristic understorey fauna in the sanctuary. Species like *Ixias marianne, I. pyrene sesia, Colotisfausta, C. danae, C. etrida* and *Yphthima ceylonica ceylonica* are confined only to this habitat. Species like *Leptosia nina nina, Yphthima baldus rnadrasa, Y. huebneri* and *Eurema* spp. are also common.

Teak plantations

Butterfly community is a mosaic here with species from moist deciduous and semi evergreen forests dominating. Species like *Neptis jumbah jumbah, Vindula erota saloma, ,Papilio helenus, Tanaecia lepidea miyana* were also recorded during the wet months. Understorey fauna also showed similar afffinity to moist deciduous forests with species like

Melanitis leda leda, Mycalesis mineus polydecta, Yphthima spp. and Eurema spp.

Vayals' or marshy lands

Butterflies which prefer bright sunlight and open areas inhabit this area. Danaid butteflies like Tirumala Iimniace leopardus, T. sepentrionis dravidamm, Parantica aglea aglea, P. nilgiriensis and Nymphalids like Junonia atlites, J. iphita pluvialis, Euploea core core and Pierids like Eurema spp. and Appias spp. are common here. Aggregation of mud puddling butterflies of the species Appias indra shiva, A. libythea libythea, Cepora nadina remba, Graphium sarpedon teredon and Jamides spp. are characteristic for this habitat. Small scale population buildup of Tirumala limniace leopardus, T.sepentrionis dravidarum, Parantica aglea, Danaus chrysippus, D. genutia genutia and Euploea core core were also observed here during the summer months.

Banks of rivers and streams

Species like Kaniska canace viridis, Graphium sarpedon teredon, Caleta caleta, Castalius rosimon, Discolampa ethion vavasanus and Jamides spp. were recorded from the banks of rivers and streams.

Protected and endemic butterflies

Eighteen species recorded in this study have protected status of which the papilionid, Pachliopta hector and the lycaenid, Castalius rosimon rosimon come under Schedule I of the Indian Wildlife Act of 1972 (Table 10). Further monitoring of these species along with studies on other ecological aspects are essential for their effective conservation. Twenty three species were found endemic to different biogeographic regions. Out of this 10 species are narrow endemics of Western Ghats, another 10 are endemic to South India and Sri Lanka while the remaining three are endemic to Sri Lanka and the Indian Sub Continent. The species which were found to be rare in the study area include the papilionid, Troides minos, Papilio dravidarum, the danaid, Parantica nilgiriensis, Idea malabarica, the lycaeinids, Zesius chysomallus and the satyrid, Mycalesis igilia.

Characteristics of the butterfly fauna

Most butterflies showed wide habitat preferences being found in several habitats recognised in this study. Several species of papilionid like Graphium sarpedon teredon, G. agamemnon, Pachliopta, aristlachiae, Papilio polytes thesus. P. polytes romulus, P. demoleus, P. polymnester parinda, and Troides minos ; the nymphalid Eriodes ariadne, Euploea core core, Junonia lemonias, J. atlites, J. stygia, Neptis hylas varmona ; the danaids, Daneus genitalia genitalia, D. chrysippus, Parantica aglea,

Tirumala limniace leopardus ; the pierids, Catopsilla pomona pomona, C. pyranthe, Delias eucharis, Eurema hecabe and E. blanda ; the lycaenids, Castalius rosimon, Jamides alecto and J. celeno. It is of interest that most of these butterflies are very colourful and large sized. The lycaeinid, Castalius rosimon which is a protected species under the Indian Wildlife Act recorded from all the habitats studied indicates that the fauna is well preserved in the sanctuary.

With regard to distribution, evergreen forest is the most species rich habitat harbouring 117 species. This was followed by semi evergreen forests (108 species) and moist deciduous forests (95 species). Teak plantations were found to be utilized by 57 species, which means that there is substantial reduction in butterfly diversity in this altered environment. Dry deciduous forest habitat, which cover only 5.26 % of the total area of the sanctuary, harbours the least number of species (41 species). Holloway *et al.* (1992) observed that conversion of forests to plantation and other man induced disturbances leads to reduction in the diversity of lepidopterans, both in species richness and in taxonomic and biogeographic quality.

Table 10. List of rare and endemic butterflies

FAMILY/SPECIES	STATUS	ENDEMISM
Papilionidae		
Troides minos Cram.	Rare	Western Ghats
Pachliopta hector Lin.	Protected, Schedule I	South India & Sri Lanka
P.Pandiyana Moore		Western Ghats
Papilio budha Westwood	Protected, Schedule II.	Western Ghats
P. dravidarum Wood-Mason	Very rare	Western Ghats
P. polymnestorparinda Moore		Peninsular India & Sri Lanka
Pieridae		
Appias libythea libythea Fb.	Protected, Schedule IV	
Appias lyncida latifascia Moore	Protected, Schedule II	
A. albinadarada Felder	Protected, Schedule II	Western Ghats

A. indra shiva Swinhoe	Protected, Schedule.II	
Cepora nadina remba Moore	Wettest rainforests	
Delias eucharis Drury		South India & Sri Lanka
Lycaenidae		
Castalius rosimon rosimon Fb	Protected, Schedule I	
Euchrysops cnejus cnejus Fb.	Protected, Schedule.II	
Spindasis vulcanus vulcanus Fb.		Sri Lanka & Indian sub continent
S. schistacea schistacea Moore		South India & Sri Lanka
Udara akasa Hors.		South India & Sri Lanka
Zesius chrysomallus Hub.	Very rare	Sri Lanka & Indian Sub continent
Danaidae		
Parantica nilgiriensis Moore	Rare	Western Ghats
Idea rnalabarica malabarica Moore	Rare	Westem Ghats
Satyridae		
Mycalesis anaxias anaxias Hewit.	Protected, Schedule II	
M. igilia Fruh. Rare		Western Ghats
M. patniajunonia Butler		South India & Sri Lanka
Ypthima ceylonica ceylonica Hewit.		South India & Sri Lanka
Zipoetis saitis Hewit.	Protected, Schedule II.	Western Ghats
Nymphalidae		
Cirrochora thais thais Fb.	Only in wettest rainforests	South India & Sri Lanka
Cethosia nietneri mahratta Feld.	Only in wettest rainforests	South India & Sri Lanka
Euthalia lubentina (Cram.)	Protected, Schedule IV	
Hypolimnas missipus Lin.	Protected, Schedule I	

Neptis jumbah jumbah Moore	Protected, Schedule II	
Parthenos sylvia Moore	Protected, Schedule II	
Tanaecia lepidea miyana Fruh.	Protected, Schedule.II	
Pantoporia ranga Moore	Protected, Schedule.II	
Hesperidae		
Odontoptilum angulata (Feld.)	Rare	
Oriens concinna Elwes	Protected, Schedu1e.IV	Western Ghats
Acraeidae		
Acraea terpsicore Lin.	Sri Lanka & Indian sub continent	
Amathusiidae		
Discophora lepida lepida Moore	Protected, Schedule. II	South India & Sri Lanka

The butterflies recorded from Parambikulam represent *all* the major butterfly families. The fauna includes some interesting and rare species such as *Discophora lepida lepida* , *Graphiurn antipathes alcibiades, Papilio buddha, Pantoporia ranga, Pareronia valeria hippia and Charaxes bemardus* imna. The only representative of Acraeidae in S.India, *Acraea terpiscore* is present in the Parambikulam forests. About ten species of butterflies such as *Troides minos, Papilio budha, P. dravidarum Pachliopta pandiyana Appias albina, Idea malbarica, Parantica nilgiriensis, Mycalesis igilia Zipoetis saitis, Oriens concinna* are endemic to the Western Ghats.

Of the various species recorded 33 species were common, which were present in all the habitats studied. Forty nine species are considered as uncommon as their distribution was limited to 2 or 3 habitats. The distribution of 15 species restricted to only a particular habitat are considered as rare which include 9 species observed exclusively from evergreen forests *viz., Papilio buddha, Graphiurn antiphates alcibiades, Pachliopta pandiyana, Pantoporia ranga, Pareronia valeria hippia, Zipoetis saitis, Oriens concinna, Virachola perse ghela* and *Zesius chrysomallus.* Dry deciduous habitat contain the remaining 6 species viz., Ixias *marianne, I. pyrene sesia, Colotis etrida, C. danae, C. fausta, Yphthima ceylonica ceylonica.* No species specificity was observed in any of the other habitats present in the sanctuary.

The distribution pattern of the butterflies observed indicates that the species found in the dry deciduous forests and teak plantations are relatively tough and adapted to dry condition. Whereas species found in the evergreen and moist deciduous forests are relatively fragile with narrow adaptation for wide habitat variation.

Significant variation in the forest understorey and forest canopy butterfly species was also observed in differnt habitats. Forest understorey species *(Lethe rohria, Ypthima ceylonica, Ixias pyrene, Colotis fausta)* showed remarkable habitat specificity when compared to forest canopy species *(Cirrochroa thais thais, Papilio demoleus, Delias eucharis, Hebomoia glaucippe*). This may be the reason for canopy butterflies (barring a few species) having a higher degree of distribution in various habitats inside the sanctuary.

Moths

277 species of moths species were identified eventhough some of them could be identified only to the generic level (Table 11). The families Noctuidae, Geometridae, Pyralidae and Arctidae contained maximum number of species. These families are of interest that they contain insects that develop on arboreal and shruby vegetation and some are already well known as pests of various cultivated plants (Table 10). These include the cutworm, *Prodenia litura* (Noctuidae), the castor hairy caterpillar, *Pericallia ricini* (Arctidae), the wheat shoot borer, Chilo *partellus,* the castor fruit borer *Dichocrosis punctiferalis* the wax moth, *Galleria mellonella,* the brinjal fruit borer, *Leucinodes orbonalis,* the pod borer of pea, Maruca testulalis, the bhindi leaf webber Sylepta derogata (Pyralidae).

Pests associated with trees were also recorded which include the teak defoliator, *Hyblaea puera* (Hyblaeidae), the eucalyptus leaf webber, *Archips sucaceana* (Tortricidae) ; the *Ailanthus* shoot webber, *Atteva fabriciella* (Yponomeutidae) as well as the teak trunk borer, *Cossus cadambae* (Cossidae).

The host records of several other species could not be determined. Apart from their economic importance as pests of forest plants, certain moths were interesting because of their size and colour patterns. These include the atlas moth, *Attcus atlas* (Saturnidae), the Eupterotids, *Eupterote mollis,* the Syntomid, *Euchroma polymena* and the Geometrid, *Eumela rosalia.*

Among the moths recorded and identified, the Geometrid, *Naxa* textilis, the Eupterotids, Eupterote testaceae and *E. flavida,* the Saturnids, *Tropea luna (Actia selena*) *Loepa sikkima* were exclusively recorded from the evergreen forests. The Pyralids, and *Pygospila tyres* and

Filodes fulvidorsalis were found specifically associated with moist deciduous forests.

Table 11. Species of Moths recorded from Parambikulam

ORDER LEPIDOPTERA	
FAMILY NOCTUIDAE	*Hypospila sp.* nr.to *bolinoides Guen.*
Achaea sp.	*Ischyja sp. nr.to inferna*
Achaea janata Fb.	*Laphygma exigna* Hubn.
Anua coronata Fb.	*Maceda* sp. nr.to *mansueta* Wlk.
Asta quadrilinea Wlk.	*Maliattha* sp.
Blenina donans Wlk.	*Matapha* sp.
Bocana manifestalis Wlk.	*Mocis undata* Fb.
Callopistria sp.	*M. frugalis* Fb.
Callopistriapulcherilinia Wlk.	*Mythimna sp.* nr.to *vittata* Hamp.
Carea endophaea Hamp.	*Mythimna* sp.
Catephia leucomonalis Lin	*Nyctipao macrops* Lin.
Chalciope hyppasia Cram.	*Ophideres materna* Lin.
Chasmina rejecta Fb.	*Oxyodes scorbiculata* Fb.
Egnasia khasiana Moore	*Ozarba* sp.
Eumonodia sp. nr.to *vespertitia* Fb.	*Ozarba sp.* nr.to *punctigera* Wlk.
Erebus sp.	*Parallelia* sp.
Erebus ephesperis ephesperis Hubn.	*Parallelia arcuata* Moore
Ericeia sp. nr.to *inangulata* Guenee	*Pericyma* sp.
Ericeia sp.	*Polytela gloriosae* Fb.
Ericeia sp.	*Prodenia litura* Fb.
Fodina stola Guenee	*Rhynchina curvilinea* Hamp.
Helicoverpa obsolata	*Rhytia hypermnestra* Stoll.
Hypocala deflorata Fb.	*Spiredonia retorta* Cram.

Spiredonia sp. nr.to *alix* Guenee	*Dirades* sp.
Spodoptera litura (Fb.)	*Eumelea rosalia* Cram.
S. mauritia Boisd.	*Eumelea* sp.
Strictopera cuculleoides Guenee	*Ecliptoptera dissecta* Moore
Tiracola sp. nr.to *plagiata* Wlk.	*Ecliptoptera sp.* nr. to *fulvotincta* Hamp.
Tinolius eburneigutta Wlk.	*Ectropis* sp.
Westermannia superba Hubn.	*Euschema percota* Swinh.
Xanthodes graellsii Feisth.	*Fascellina* sp.
FAMILY GEOMETRIDAE	*Hemithea* sp.
Abraxas sp.	*Heterostegane* sp.
Acropteris ciniferaria Wlk.	*Heterostegane subtessalata* Wlk.
Agathia laetata Fb.	*Hypochrosis sp.* nr to *abstractaria* Wlk.
Agathia lycaenaria Koll	*Hypomecis* sp.
Anisephyra ocularia Fb.	*H. pallida* Hamp.
Anisodes sp. 1	*Hypomecis sp.* nr.to *dentigerata* Warren
Anisodes sp. *2*	*Menophra* sp.
Anisodes sp. nr.to *apogona* Prout	*Menophra sp.* nr.to *inouei* Sato
Anisozyga sp.	*Naxa sp.* nr.to *textilis* Wlk.
Boarmia infixaria Wlk.	*Naxa* sp.
Borbacha sp. nr. to *pardaria* Guenee	*Noveia* sp.
Cleora sp. nr.to , *alienaria* Wlk.	*Ourapteryx marginata* Hamp.
Combiaena inductaria Guenee	*Pinaasa ruainaria*
Cusiala sp. nr.to *raptaria* Wlk.	*Polynesia sunandava* Wlk.

Pseudornicroniapluviosa Guenee	*Asura arcuata* Moore
Racotis sp.	*A. syringa* Cram.
Scopula sp.	*Asura conferta* Wlk.
Scopulapulchellata Fb.	*Asura metamelus* Hamp
Semiothisa opicata Fb.	*Asura rubricosa* Moore
Semothisa sp. nr. to *triangulata* Hamp.	*Asura sp.* nr. to *obsoleta* Moore
Semiothisa. sp. nr. to *quadraria* Moore	*Asura* sp. 1
S.honaria Hamp.	*Asura* sp. *2*
Semiothisa sp. nr. to *epicharis*	*Asura* sp. 3
S.cleonara Stoll	*Asura* sp.4
Serniothisa nr. to *khasiana* Moore	*Asura* sp.5
Serniothisa sp. nr. to *nora* Wlk.	*Asura* sp.6
Serniothisa sp. nr. to *rnyandaria* Wlk.	*Characorna* sp.
Sornatina sp. nr. to *anthophilata* Guenee	*Characorna sp.* nr.to *nilotica* Rog.
Symmacra solidaria Guenee	*Cyana indonesia* Roester & Kuppers
Thalassodes sp.	*Cyana sp.* nr.to *perornata* Wlk.
Timandra sp. nr.to *nelsoni Prout*	*Creatonotus gangis* Lin.
Traminda sp.	C. *transiens* Wlk.
Uliocnemisbiplagiata Moore	*Digama sp.* nr.to *rnarchalli* Guerin
Zamrada exica Hamp.	*Eilema* sp. nr.to *tumida* Wlk.
FAMILY ARCTIIDAE	*Eilema tetragona* Wlk.
Argina cribaria Clerk	*Eligma narcissus* Cram.
A.argus Koll	*Estigmene perotetti*

Eugoa sp. nr.to *bipunctata* Wlk.	*Dichocrocis euaxalis* Wlk.
Hypsa alciphron Cram.	*D. plutusalis* Wlk.
Macotasa sp. nr. to *nubecula* Moore	*D. punctiferalis* Guenee
Nyctemera baulus Boisd.	*D. surusalis* Wlk.
N coleta Cram.	*Epicrocis lateritialis* Wlk.
Oeoristis sp.	*E. aegnusalis* Wlk.
Pericallia ricini Fb.	*Ercta* sp. nr.to *ornatalis* DUD.
Rhesala sp.?	*Eurrhyparodes tricoloralis* Zell.
Rhodogastria astreas Drury	*Eutectona machaelaris* Wlk.
Siccia taprobanis Wlk.	*Filodes fulvidorsalis* Hubn.
Spilosoma sp.	*Galleria mellonella* Lin.
Utethesia pulchellale Wlk.	*Glyphodes glauculalis* Guenee
FAMILY PYRALIDAE	*G. indica* Saund.
Acigona sp.	*G. stolalis* Guenee
Agrotera sp.	*G. vertumnalis* Guenee
Agrotera basinotata Hamp.	*G. bicolor* Swains
Autocharis sp. nr.to *amethystina* Swinh.	*G. marinata* Moore
Botyodes asialis Guenee	*Hellula undalis* Fb.
Bocchoris onychinalis Guenee	*Herculia marthalis* Wlk.
B. inspersalis Zell.	*Hyalobathra ophetesalis* Wlk.
Bostra vibicalis Led.	*Hymenia recurvalis* Cram.
Chilo sp. nr.to *partellus* Butl.	*Lamprosema sp.*
Cnaphalocrosis medinalis Guenee	*Lepyrodes.sp.* nr.to *geometralis* Guenee
Crocidolomia pavonana Fb.	*L. neptis* Cram.

Leucinodes orbonalis Guenee	*Scirpophaga* sp.
Lygropia amyntusalis Wlk.	*Sylepta derogota* Fb.
L. obrinusa1is Wlk.	*S. lunalis* Guenee
Mecyna gilvata Fb.	*S. balteata* Moore
Marasmia venilalis Wlk.	*Sylepta sp.* nr. to *quadrimaculalis* Koll.
Maruca testulalis Geyer	*Syngamia abruptalis* Wlk.
?Myelois sp.	*S. flondalis* Zell
Nephoteryx atrisquamella Hamp.	*S. latimarginata* Wlk.
Nymphula depunctalis Guenee	*Talanga* sp.
N. fluctuosalis Zell	*Talanga sexpunctalis* Moore
Omphisa repetitalis Snell.	*Tryporiza incertulas* Wlk.
Paauda traducalis Zell.	*Vitessa suradeva* Moore
Patissa sp. nr. to *fulvosparsa* Butl.	**FAMILY HYBLAEIDAE**
Phluctaenia flavofimbriata Moore	*Hyblaeapuera* Cram.
Phryganodes unitalis Guenee	**FAMILY NOTODONTIDAE**
Psara sp.	*Spatiala argentifera* Wlk.
Psara bipunctalis Fb.	**FAMILY TINIIDAE**
Psara sp. *nr.cynaralis* Wlk.	*Setomorpha rutella* Zell.
Pycnarmon sp.	**FAMILY COSSIDAE**
Pygospila tyres Cram	*Alcterogystia cadambae* (Moore)
Pyralis manihotalis Guenee	*Xyleutes strix* Lin.
Pyrausta sp. nr. to *signatalis* Wlk.	*X. anceps* Snellen
Pyrausta tetraplagialis Hamp.	**FAMILY IMMIDAE**
Schoenobius minutellus Zell.	*Imma flaviceps* Felder
S.immeritalis Wlk.	**FAMILY SATURNIDAE**
Scirpophaga sp.	*Loepantheraea sp. nr. rosieri* Toxopeus

Tropea luna Lin.(=Actiasselena)	*Adoxophyes revoluta* Meyrick
Loepa sikkirna Moore	**FAMILY EPIBLEMIDAE**
Attacus atlas Lin.	*Phalacra* sp.
FAMILY LIMACODIDAE	**FAMILY SPHINGIDAE**
Miresa sp.	*Agrius sp.nr.toconvolvuli* Lin.
Scopelodes velutina Koll.	*Daphnis hypothous* Cram.
Scopelodes sp.	*Hippotion celerio* Lin.
Susica sp. nr.to *hirnalayana* Holloway	*Macroglossurn aquila* Boisd.
Parasa lepida Cram	*M. corythus luteatum* Butl.
Miresa albipuncta Herr.	*Meganoton sp.*
FAMILY EUPTEROTIDAE	*Megacorma sp.* nr.to *obliqua* Wlk.
Eupterote mollis Moore	*Theretra boisduvali* Bugnion
E. testacea Wlk.	*T. nessus* Drury
E. flavida Moore	*Phalera* sp.
E. hibisci Fb.	**FAMILY YPONOMEUTIDAE**
E. fabia Cram.	*Atteva fabriciella* Swed.
FAMILY AMATIDAE (SYNTOMIDAE)	**FAMILY LYMANTRIIDAE**
Euchromia polyrnene Lin.	*Euproctis fratema* Moore
Arnata extensa Wlk.	*E. icilia* Stoll
Eressa confinis Wlk.	*E. diaramma* Guenee
E. aperiens Wlk.	*E . scintillans* Wlk.
FAMILY BOMBICIDAE	*E. sp.* nr.to *percnogaster* Collenette
Penicillifera sp. nr to *apicalis* Wlk	*Euproctis* sp.
FAMILY TOTRICIDAE	*Euproctis sp.*
Archips rnicaccana Wlk.	*Aroa* sp.

FAMILY LYMANTRIIDAE (Contd..)	
Euproctis bipunctapex Hamp.	D. bhana Moore
Teldinia sp.	Dasychira sp.
Redoa sp.	Orygia sp.
Dasychira mendosa Hb.	Lymantria sp.

Other groups of insects

Other than Lepidoptera and Hymenoptera, reported above, 460 species of insects belonging 11 orders and 59 families were collected in this study of which 144 species belonging to 8 orders 49 families were identified and listed (Table 12). Of these Coleoptera, Hemiptera and Homoptera were the most dominant orders followed by Orthoptera and Odonata.

The bugs and hoppers are important in forest ecosystem in that they cause injury to plants by sucking sap from them. They also act as agents for transmission of various plant diseases. Of the 10 hoppers recorded in this study, none are known to have pest status. The bugs recorded include the giant waterbug, Belostorna indicurn which is usually found in fresh water streams. The pyrhocorid bug Disdercus cingulatus commonly known as cottonbug causes damage to the seeds and shoots of Bombax malabarica. Among the bugs and hoppers present in the sanctuary the most interesting were the five species of cicadas.

The beetles collected were of different types - leaf eating, wood boring etc. The leaf eaters mostly belonged to the families Chrysomelidae, Cassididae etc. Some of the beetles recorded are known to be pests of agricultural and forestry crops. They include the gmelina defoliator, Calopepla leayana and the pumpkin beetle, Aulacophora unicolor. Basilepta fulvicornis is known to carve the mesophyll tissues of various plants particularly the weeds. Certain weevils like Indomias hispidulus and Myllocerus viridanus occasionally cause severe damage to foliage. The tree boring beetles include the buperstid beetles, Chysochroa sp. and Sphenoptera cyaniceps which cause injury to saplings of several species of forest trees. Certain small borers like Synoxylon anale, Scolytomimus assamensis and Xyleborus formicatus are usually found attacking dead twigs and stored wood. X. formicatus causes die-back in crops like coffee and mango. The cerambicid, Batocera rufomaculata is a borer of several tree species like mango. The dung beetles are ecologically important as they bury the dung found on forest in the subsoil. Holotrichia fessa, H. serrata, Mimela sp., Anomala ruficapilla etc., are primarily associated with dung of bovine herbivores. Of these H. fessa and H. serrata are also economically important as pests as they feed on roots of seedlings and saplings of forest tree species.

Table 12. List of insects other than Lepidopterans and Hymenopterans

ORDER HOMOPTERA	FAMILY COREIDAE
FAMILY CICADIDAE	*Antiliochus russus* Stal.
Cryptotympana varicolor Dist.	*Serenthia auger*
Platylomia sp. nr.larus Wlk.	*Macropes* sp.
P. amicta Dist.	*Anoplocnemis* near to *curvipes*
Pycna repanda Lin.	*Acanthocoris scabrator* Fb.
Platypleura sp.	*A. strucornis* Scott
FAMILY CICADELLIDAE	*Notobitus* sp.
Petalocephala nilgirilinea Walk.	**FAMILY REDUVIIDAE**
Krishna strigicollis Spinola	*Triatoma* sp.
Orosis albicinctus Dist.	**FAMILY CYDNIDAE**
Ledropsis sp.	*Cyclopelta siccifolia* (Westwood)
Iassus indicus Leth.	*Chilocoris piccus* Signoret
Cicadella spectra Dist.	*Cydnus* sp.
Bothrogonia ferruginea Fb.	*Geotomus* sp.
FAMILY FLATTIDAE	**FAMILY PENTATOMIDAE**
Pochazia fuscata Fb.	*Catacanthus incarnatus Drury*
Flata sp.	*Plautia fimbriata* Fb.
Ricania marginalis Wlk.	*Plaecosternum* sp.
Flata ocellata Fb?.	*Tipulparra trivandera producta* Ghaur.
FAMILY CERCOPIDAE	**FAMILY SCUTELLERIDAE**
Cosmoscarta relata Dist.	*Chrysocoris purpureus* Westwood
Ptyelus sp.	*Chrysocoris* sp.?
FAMILY FULGORIDAE	**ORDER ORTHOPTERA**
Kalidasa lanata Drury	**FAMILY ACRIDIDAE**
FAMILY MEMBRACIDAE	*Catantops henryi* Bor.
Tricentrus sp.	*Oedalus abruptus* (Thunb.)
FAMILY DICTYOPHARIDAE	*Catantops* sp.
Dictyophara viridissima Melich.	*Aularches miliaris*
Putala maculata Dist.	*Cyrtacanthacris tatarica* (L)
Paranda sp.	*Pternoscirta bimaculata* (Thumn.)
FAMILY EURYBRACHIDAE	*Chondracris rosea* (Gerr.)
Eurybrachis sp.	*Meclasumma sorar* Chop.
Eurybrachis sp.	*Hieroglyphus banian*
Messena sp.	**FAMILY TETTIGONIDAE**
ORDER HETEROPTERA	*Onomarchus* sp.
FAMILY BELOSTOMATIDAE	*Onomarchus* sp.
Belostoma indicum Lep.&Serv.	**ORDER DICTYOPTERA**
FAMILY COREIDAE	**FAMILY BLATTIDAE**
Melamphaus fulvomarginalis Dohrn.	*Rhabdoblattia* sp.
Dindymus sanguineus Fb.	*Thorax porcellana* Sauss.
Odontopus nigricornis Stal.	

FAMILY MANTIDAE	*Platycorinus* sp.
Hierodula sp.	*Basilepta fulvicornis* Jac.
ORDER NEUROPTERA	**FAMILY CERAMBYCIDAE**
FAMILY MANTISPIDAE	*Logaeus subopacus* Wat.
Humbertiella indica (Sauss.)	*Xystrocera globosa* Oliv.
ORDER COLEOPTERA	*Cercosterna scabrator* (Fb.)
FAMILY LANGURIDAE	*Batocera rufomaculata* Ger.
Tetraglenes sp.	*Desisa* sp.
FAMILY PASSALIDAE	*Oberea lateapicalis* Pic.
Pleurarina brachyphyllus Stal.	*Nupserha madurensis* Pic.
FAMILY ANOBIDAE	*N.malabarensis* Pic.
Ptilinus binodulus Motsch.	*Niphona sp* nr. to *andamanica* Breun.
FAMILY BUPRESTIDAE	*Acanthophorus serraticornis* (Oliv.)
Sphenoptera cyaniceps Kerr.	**FAMILY SCARABAEIDAE**
Chrysochroa sp.	*Heliocopris dominus* Bates
Sternocera sp.	*Catharsius* sp.
FAMILY TENEBRIONIDAE	*Onitis* sp.
Lyprops curticollis Fairm.	*Copris* sp.
Strongylium macrops (Wied.)	*G. sinuates* (Oliv.)
Platybolium alvearium Blair	**FAMILY RUTELIDAE**
Alphitobius laevigatus (Fb.)	*Holotrichia serrata* (Fb.)
Tribolium castaneum Herbst.	*H. fessa*
FAMILY MELOIDAE	*H.rufoflava* Brenske
Eletica testacea Oliv.	*Mimela* sp.
Epicauta sp.	*Anomala ruficapilla* Barmeister
FAMILY CASSIDIDAE	*Anomala* sp.
Aspidomorpha sp.	*Brahmina* sp.
FAMILY HISPIDAE	**FAMILY SCOLYTIDAE**
Hispa armigera Oliv.	*Scolytomimus assamensis* Schedt
FAMILY BOSTRYCHIDAE	*Xyleborus fornicatus* Eichh.
Sinoxylon atratum Lesn.	**FAMILY CETONIDAE**
FAMILY ELATERIDAE	*Heterorrhina* sp.
Silesis sp.	**FAMILY COCCINELLIDAE**
Agrypnus near toholocericeus	*Epilachna vigintioctopuntata* (Fb.)
FAMILY THROSCIDAE	*Coelophora sp.* near to *inacquila* Fb.
Lissomus mastrucatus Gerst	*Catana parcesetosa* (Sicard)
FAMILY CHRYSOMELIDAE	**FAMILY SILVANIDAE**
Calopepla leyana Latr.	*Oryzaephilus mercator*
Ceratobasis near to *nair* Lacord	**FAMILY PASSANDRIDAE**
Corynodes peregrinus (Fuessly.)	*Laemonetus insignis* Grour

FAMILY CICINDELIDAE	*Lixus truncatulus* Fb.
Neocollyris **sp.**	*Myllocerus viridanus* Fb.
FAMILY CARABIDAE	*M.dorsatus* (Fb.)
Omphra **sp.**	*Sternochetus mangiferae* Fb.
Chlaenius nr.to *tenuilimbatus* Ballion	**FAMILY PLATYPODIDAE**
FAMILY DYTISCIDAE	*Platypus latifinis* Walk.
Hydaticus leechi Sato	P. *cavus* Strohm
FAMILY STAPHYLINIDIDAE	**ORDER ODONATA**
Borolinus minutes Cast.	**FAMILY LIBELLULIDAE**
Priochirus sp.	*Orthretum pruinosum negletum* (Ram.)
FAMILY HISTERIDAE	*Macromia* sp.
Teretriosoma sp.	*Nemothemis fulvia* Drury
FAMILY ANTHRIBIDAE	*N.intermedia* (Ramb.)
Araecerus fasciculatus (Deg.)	*Palpopleura sexmaculata* Drury
FAMILY CURCULIONIDAE	*Trithemis aurora* (Burn.)
Desmidophorus celatus Karsch	*T. festiva* (Ramb.)
Peltotrachilus cognatus Mshl.	**ORDER DIPTERA**
Indomias hispidulus Mshl.	**FAMILY ASILIDAE**
I. frater (Mshl.)	*Microstylum* sp.
Episomius lacerta Fb.	

The odonates recorded include several colourful and interesting species like Nernothemis fulvia, N. intermedia and Orthretum pruinosum.

The dipterans were not well covered in the study and only one species of the family Asilidae, Microstylum sp. was identifed.

Insect fauna of vayals

A total of 299 specimens belonging to 54 species were collected using Light trap during the four months period from June – September 1997. The diversity index was estimated to be 3.57. This value was found to be lower than the pooled value for Parambikulam (MDF + Teak) for the same period (4.30).

General sampling indicated that butterflies like Tirumala limniace, Parentica aglea, Junonia atlites, Euploea core, Eurema spp., Papilio polytes and Mylabris (Fam: Meloidae) beetles were very common in these areas. The most abundant buttererfly in rainy season was J. atlites. Waterbeetles like Dytiscids, Hydrophilids and Hydrometrid bugs were also common during rainy seasons. Cydnus sp. (Cydnidae: Heteroptera),

Xyleborus fomicatus (Bostrychidae: Coleoptera), Catharsius sp. (Scarabaeidae: Coleoptera) , Orosius albicinctus (Jassidae: Homoptera), Euproctis percnogaster (Lymantriidae: Lepidoptera), many species of small moths of the families Pyralidae, Geometridae, Tiniidae, grasshoppers of the families Tettigonidae and Acrididae are among other common insects found. Honeybees like Apis dorsata, A. indica and A. florea were abundantly seen during flowering season of herbs and shurbs. Termite and ant mounds are common in the fringes between vayals and teak plantations. Since most of the vayals are sorrounded by teak plantations, the insect fauna there in general resembles that of teak plantations.

Habitat specificity of insects as evident from light trap studies

Analysis of light trap data from different habitats indicated many species to be habitat specific.

Evergreen

Five species of moths and three species of beetles specifically recorded from evergreen forests are listed in Table 13.

Apart from the above species, 14 unidentified species one each belonging to the families Tenebrionidae, Elateridae, Rutelidae Chrysomelidae, Vespidae, Sphingidae Cerambicdae, Saturnidae, three species of Scarabaedae and three species of microlepidopterans recorded from the evergreen plot were not recorded from the other habitats.

Moist Deciduous Forest

Species specific to moist deciduous forest included two species of bugs, one species of coleoptera and two species of moths which are listed in Table 14. Apart from the listed species several unidentified species belonging to Lepidoptera (9 sp.), microlepidoptera (22 sp.), Heteroptera (13 sp.), Coleoptera 21 sp.) Hymenoptera (1sp) Diptera (3sp,) and Ephimeroptera (1 sp.) were also recorded exclusively from this habitat.

Table 13. Insects specifically recorded from evergreen forest

Order	Family	Species
Lepidoptera	Geometridae	Naza textilis Wlk.
„	Eupterotidae	Eupterote testaceae
„	Eupterotidae	E. flavidae
››	Satumidae	Tropea luna (=Actiasselena)
ı,	Satumidae	Loepa sikkima
Coleoptera	Amobidae	Ptilium binodulus
„	Rutelidae	Holotrichia serrata
,,	Scarbaeidae	Catharsius sp

Table 14. Species exclusively present in the moist deciduous forest

Order	Family	Species
Homoptera	Flattidae	Ricinia marginalis
Coleoptera	Cerambicidae	Batocera rufomaculata
Lepidoptera	Pyralidae	Fpgospyla tyres
Lepidoptera	Pyralidae	Filodes fulvidorsalis
Heteroptera	Scutelleridae	Tetranthria variegata

Teak plantation

Species exclusively recorded from the teak plantations includes, the teak defoliator, Hyblaea puera (Lepidoptera, Hyblaeidae) and Cusiala sp. near raptoria (Lepidoptera, Geometridae). Unidentified species exclusively recorded also includes Coleoptera (4 sp.), Heteroptera (2 sp.), Lepidoptera (7 sp.), Hymenoptera 5 sp.), Diptera (1 sp.) and Trichoptera (1 sp.).

General distribution and host records of insects

As part of this study a literature survey was carried out to gather information on general distribution and plant host records of the insects collected and identified in this study . Though information pertaining to all the species could not be collected or found, the available information for 299 species have been assembled and presented in the Appendix 1 .

5. GENERAL DISCUSSION

Insect Diversity

The study has generated data on the insect diversity in the Parambikulam Wildlife Sanctuary. The overall diversity index for the study area is estimated as 4.763, the indices for the moist deciduous forest (MDF) and the teak plantations being 4.835 and 4.318 respectively. The moist deciduous forest is comparatively an undisturbed habitat in comparison with the highly disturbed teak patch. As reported in earlier studies (Mathew *et al.,* 1998), the insect fauna in MDF appears to be more diverse than that in the the disturbed teak plantations. The data for evergreen forests though not exhaustive indicated high insect diversity there (4.509)but slightly lower than that in MDF.

Insect diversity indices are available for only very few localities in Kerala. It is interesting to find that the diversity index of Parambikulam (4.76)is similar to that of Sholayar, which is 4.74. However, this is lower than that of Silent Valley (4.83) and much lower than that of Nelliampathy (5.13).

Changes in the insect diversity in the study area between years were evident from the data. This phenomenon was similar for both the habitats – MDF and Teak plantations from where data were gathered exhaustively. The reason for such variation could be several including changes in the weather parameters, floral structure etc.

Insect records and characteristics of the insect fauna of Parambikulam

A total of number of 636 species belonging to 10 orders and 106 families were identified which include 84 species of hymenopterans and 401 species of lepidopterans. The next important group of insects was coleopteran with 78 species. Although a total of 1049 species could be collected, the identity of all of them could not be established for various technical reasons including non-availability of literature and specific expertise.

Hymenopteran fauna

Though a serious attempt has not been made in the past to record species belonging to this group of insects from Parambikulam, the literature survey revealed some micro hymenopteran records which include seven species belonging to the family Chalcididae (Narendran, 1989) and seven species belonging to the family Torymidae (Narendran, 1994).

The macrohymenopterans recorded under this study include all the three major groups, bees, wasps and ants. They belonged to the families Apidae, Xylocopidae, Eumenidae, Sphecidae, Chrysididae, Vespidae, Formicidae, Braconidae, Colletidae, Megachilidae and Pompilidae. Of the 84 species identified 38 were found represented in all the four habitats and the remaining species were collected from some specific habitats. Many species of hymenopterans recorded from all the four habitats like, Ammophila laevigata, Chalybion bengalense, Sceliphron madraspatanam, Typoxylon errans are also known from non-forest habitat. Species like Sphex argentatus, Sceliphron javanum were collected from evergreen forests and MDF and Sphex paedator leutipennis was collected exclusively from evergreen forest. However it is interesting to note that such species have been reported earlier from non forest habitats (Sudheendrakumar and Narendran, 1989). The habitat associations of many such species appears to be not exclusive. Species which were not common to all habitats include Thyreus sp. and Psithyrus sp, (Apidae); Mergascolia sp. and Scolia carbonaria (Scoliidae), Harpegnathos saltator and Platythyrea *sp,* (Formicidae); Hylaeus feai (Colletidae), Pseudagenia blanda and Salius fulvipennis (Pompilidae) recorded from evergreen forests as well as from the MDF. Among the species identified, Mutilla semiaurata was recorded only from the evergreen forest. In general, the observations on the habitat associations of the macrohymenopterans recorded in this study leaves some doubt whether such habitat association of the above mentioned species are exclusive and true.

As the micro hymenopterans were not included, the records made in this study reveals only a part of the whole hymenopteran treasure present in the Parambikulam forests. Further studies are hence suggested for a better understanding of other group of insects.

Lepidopteran fauna

The butterfly fauna of India is quite well known (Talbot, (1939,1947); Wynter-Blyth, (1957); Larsen (1987,1988)). However only very few studies were conducted with reference to Kerala part of the Western Ghats (Fergusson, (1891); Fraser, (1930); Mathew and Rahmathulla, (1993); Palot *et al.* (1997)).

In the present study 124 species of butterflies belonging to 76 genera and 9 families were collected and identified. Most of the butterflies collected belonged to Nymphalids (28 species), Pierids (22 species), Lycaenids (20 species), Satyrids (16 species) and Papilionids (15 species). The study revealed presence of 18 species which are having protected status under the Indian Wild Life Act, 1972 (Anon., 1990). Twenty three endemic species were also recorded of which 10 are narrow endemic to Western Ghats. Apart from the recording of some of the interesting species such as Discophora lepida lepida , Papilio davidarum, Pantoporia ranga, Pareronia valeria hippia and Charaxes bernardus imna, the only representative of Acraeidae in India, Acraea terpiscore could also be collected from the Parambikulam forests.

Parambikulam consists a number of different habitats and climatic zones. This may be one of the reasons for the area exhibiting a high degree of species richness for butterflies. Tropical wet evergreen forests possessed the greatest butterfly diversity in Parambikulam followed by semi evergreen and moist deciduous habitats. Significant reduction in butterfly diversity was observed in both dry deciduous habitats and teak plantations.

The butterfly fauna of Parambikulam consisting of 124 identified species is comparable with that in Silent Valley with a record of 100 species (Mathew and Rahmathulla, 1993) and in Periyar Tiger Reserve with a record of 119 species (Palot *et al.*, 1997). Endemism in the fauna seems to be higher in Parambikulam (23 species) than in Silent Valley (13 species) and Periyar (19 species).

The study indicated presence of a variety of moths in the study area. It is interesting to note that many of them have a pest status. Certain moths were interesting because of their size and colour patterns. These include the atlas moth, Attcus atlas (Saturnidae), the eupterotids, Eupterote mollis, the syntomid, Euchroma polymena and the geometrid, Eumela rosalia. Species like , Naxa textilis, Eupterote testaceae and E. flavida, Tropea luna (=Actia selena), Loepa sikkima were found to be specifically associated with evergreen forests. Similarly the pyralids, and Pygospila tyres and Filodes fulvidorsalis were found specifically associated with moist deciduous forests.

Studies conducted elsewhere (Holloway, 1977) has indicated that the species composition of moths is of indicative value in monitoring changes taking place in the environment. In a recent study, Mathew *et al.* (1998) have shown that the arboreal feeding forms of the families, Geometridae, Satumidae etc. are charcteristics of the undisturbed forest patches while the species preferring shrubby vegetation (Pyralidae, Noctuidae etc.) are characteristic of disturbed forest patches .

Eventhough the major objective of this study was to generate information on Hymenoptera and Lepidoptera, data on other insect groups were also gathered to some extend which indicates that Parambikulam forests are very rich as far the insect fauna in general is

concerned. The record of 460 species of such insects indicates that the insect fauna of Parambikulam is very rich. The presence of endemic and rare species of butterflies, colurful and attractive moths, several species of predatory wasps etc. adds to the insect species richness in the Parambikulam Wildlife Sanctuary.

The species diversity of the insect fauna of Parambikulam Wildlife Sanctuary as evident from this study indicates that conserving the present structure of the natural forest habitats of this sanctuary is very much required to conserve the valuable insect fauna existing there.

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APPENDIX 1

General distribution and host records of insects

INSECT SPECIES	DISTRIBUTION	HOST RECORDS*
Abraxes poliaria Swinhoe	Nilgiri plateau.	
Acanthophorus serraticomis Oliv	Madras, Mysore, Trivandrum.	*Bombax malabaricum, Mangifera indica, Morus alba, Shorea robusta.*
Achaea janata Lin.	Australia, India, Malaysia, Pakistan, New Guinea.	*Albizia falcata, Dalbergia latifolia, Palaquium gutta, Shorea robusta, Xylia xylocarpa.*
Acraea violae (Fb.)	India, Sri Lanka.	Cucurbitacea and Passifloraceae plants.
Agathia laetata Fb.	Siberia,Japan,India, Sri Lanka, Myanmar, Borneo, Australia.	
Agathia lycaenoria Koll	China, Throught India, Sri Lanka, Java Borneo, Penang,	*Holarrhena antidysenterica.*
Agrotera basinotata Hamp.	South-East Asia.	*Lagerstroemia parvifolia, Syzygium cumini, Eugenia operculata, Pavetta indica,* Beetroot, Cabbage, etc.
Alcterogystia cadambae Moore	S. India.	*Tectona grandis.*
Alphitobius laevigatus Fb.	India	*Dipterocarpus* sp., *Melanorrhoea* sp., *Shorea*
Amate extensa Wlk.	Nilgiris, Bombay, Mahabaleshwara.	
Ammophila atripes Smith	Oriental region, Mainland Asia.	

* Hosts of only phytophagus insects given

Ammophila laevigata Smith	India,Sri Lanka, Vietnam, Thailand.	
Anapheis aurata Fb.	India, Sri Lanka.	*Capparis aphylla, C.heyneana, Cadaba indica, pubescens, Maerua arenaria.*
Anomala ruficapilla Barm.	Bombay,Mysore, Sri Lanka.	
Anoplocnemis curvipes Fb.	Tropical Africa.	*Cassia sp., Ficus sp., Mangifera indica, Tectona grandis.*
Anthophora confusa Smith	India,Myanmar,	
Anthophora niveocincta Smith	India.	
Anthophora zonata (Lin.)	India, Myanmar, Sri Lanka, Tenasserim.	
Antiliochus russus Stal.	Sikkim, Bhutan, Assam, Margherita, Khasis.	
Apis dorsata Fb.	India, Myanmar, Tenasserim,Sri Lanka, China, Malava, Java.	
Apis florea Fb.	Kumaun, Sikkim, Bengal, Central India, Kerala, Sri Lanka.	
Apis indica Fb.	India, Madagascar Myanmar,Tenasserim, Sri Lanka,Malaysia.	
Appias libythea Fb.	India, Sri Lanka.	*Capparis sepiaria, Crataeua roxburghi.*
Appias lyncida (Cram.)	S. India, Sikkim to Assam and Myanmar. Lucknow, Orissa, Sri Lanka.	*Crataeva religiosa, Capparis roxburghii*

Araecerus fasciculatus Degeer	Cosmopolitan.	*Anona squamosa, Artocarpus hirsuta, Cassia occidentalis, Crotalaria striata, Leucaena glauca, Pentacme suavis, Tephrosia candida, Terminalia catappa.*
Argina argus Koll	Throught India, Sri Lanka, Myanmar.	
Argina cribraria Clerch.	India.	*Crotalaria sericea.*
Argina syringa Cram.	India (Uttarpradesh).	*Antirrhinurn majus, Banapsa sp., Crotalaria sericea.*
Asura conferta Walk.	India.	*Santalum album.*
Attacus atlus Lin.	Throught India,Malaysia Sri Lanka, Myanmar, Java.	*Aleurites montana, Cinnamomum zeylanicum, Lagerstroernia speciosa, Schleichera trijuga, Dillenia pentagyna, Clerodendron sp.*
Atteva fabriciella Swed.	India, Borneo.	*Ailanthus excelsa, Boswellia serrata, Santalurn album, Quassia sp.*
Aularches miliaris Lin.	Oriental region.	*Artocarpus integra, Butea monosperma, Colebrookia oppositfolia, Hevea brasiliensis, Mangifera indica, Tectona grandis, Erythrina sp., Flemingia sp.*
Basilepta fulvicomis Jac.	S. India, Nilgiris, Anaimalais.	
Batocera rufomaculata Degeer	Widely distributed in Oriental, Madagascan, Near East & Carribean regions.	*Adina cordifolia, Albizia lebbeck, Artocarpus hirsuta, Ceiba pentandra, Ficus glomerata, Hevea brasiliensis, Mangifera indica, Shorea robusta, Syzygium cumini, Sterculia*

Belostoma indicum Lep.&Serv.	Sind,Kerala, Sri Lanka,Malaysian peninsula, Philippins.	
Blenina donans Wlk.	Nilgiris, Sri Lanka, Andamans,New Guinea.	
Boarmia infixaria Wlk.	Sikkim, Bombay, Myanmar.	
Bocchoris inspersalis Zell.	Africa, Aden, Japan, China, Bhutan,Nilgiris, Myanmar,Java.	
Bocchoris onychinalis Guenee	W.Africa,Aden,India, Sri Lanka Myanmar, Borneo, Australia.	
Bostra vibicalis Leder.	India.	*Shorea robusta.*
Bothrogonia ferruginea Fb.	Oriental region.	*Mangifera indica.*
Botyodes asialis Guen.	Asia.	*Casearia graveolens, C.tomentosa, Diospyros tupru, Glycosmis pentaphylla, Urena lobata.*
Botyodes asialis Guenee	Baluchistan, India, Sri Lanka, Myanmar, Borneo.	
Calopepla leayana Latreille	India, E.Pakistan, Myanmar.	*Gmelina arborea, Cissampelospareira.*
Carea endophea Ham.	Throught India.	
Castalius rosimon (Fb.)	Sri Lanka, India, Myanmar.	*Zizyphus rugosa; Z. jujuba*
Catacanthus incartnatus Drury	India, Japan, Myanmar, throught Malay archipelago.	
Catopsilia florella Fb.	India, Africa.	*Cassia fistula, C.nodosa.*
Catopsilia pomona Fb.		*Cassia fistula, Brassica oleracea*

Catopsiliapyranthe Herbst.	Australia, Sri Lanka, India, Hongkong, Malaysia, Pakistan.	*Cassiafistula, C. auriculata, C.nodosa, Litsea chinensis, L. monopetala, Mallotus philippensis, Phoebe lanceolata.*
Celaenorrhinus ambareesa Moore	S.India..	*Strobilanthes callosus.*
Celaenorrhinus leucocera (Kollar)	S.India.	*Strobilanthes callosus*
Celostema scabrator Fb.	Western part of Oriental region.	*Acacia nilotica, Cassia siamea, Casuarina equisetifolia, Pithecellobium dulce, Shorea robusta, Tectona grandis, Terminalia chebula, Zizyphus rnauritiana. Eucalyptus spp.*
Ceratobasis nair Lacord	Bombay, Kerala, Nilgiris.	
Cethosia nietneri Moore	Western Ghats, Sri Lanka.	*Modecca palmata*
Chalibion bengalense Dahl.	Oriental reg., Australia, Mauritius Seychelles, Mozambique.	
Cheritra freja (Fb.)	Kumaon to Assam & Myanmar. Sri Lanka, W.Ghats.	*Xylia sp. Saraca indica, Cinnamon,* Ixora *sp.*
Chilo partellus Swinh.	Assam	Sugarcane, Maize, Ragi.
Chionoema peregrina Walker	Uttarpradesh.	*Dendrocalamus strictus, Derris dalbergioides, Shorea robusta, Tectona grandis.*
Chlorion lobatum Fb.	Oriental region.	
Chrysocoris purpureus Westwood	Banglore, Madras, Secundrabad, Bombay.	
Cirrochroa thais Fb.	Sri Lanka, S.India.	*Hydnocarpus wightiana*

Canphalocrosis medinalis Guen.	Bengal.	Found in nests of red ant , *Oecophylla smaragdina.*
Creatonotis gangis Lin	India, Myanmar.	*Toona ciliata, Ficus religiosa, Lantana camara var. aculeata.*
Coelioxys cunea Smith	Barrackpore, Tenasserim.	
Colasposoma rufipes Jac.	India.	
Colotis danae (Fb.)	Sri Lanka. Pen. India to Madhya Pradesh. Saurashtra to Baluchistan.	*Cadaba indica,Maeruae arenaria, Capparis sepiaria, C. divaricata*
Colotis etrida (Bois.)	Plains of India,except Bengal and Assam. Sri Lanka.	*Cadaba indica* (Capparidaceae)
Colotis fausta (Oliv.)	Baluchistan. NW. And central India. Sri Lanka Pen. India.	*Maerua arenaria* (Capparidaceae)
Corynodes peregrinus Hbst.	India.	*Tectona grandis.*
Cosmoscarta relata Dist.	India, Pakistan.	*Artocarpus integrifolia.*
Cossus cadambe Moore	Calcutta,Kerala.	
Crocidolomiapavonana Fb.	S.Africa, Oriental & Australian regions.	
Crocisa ramosa Lepel	Kumaun, Bombay, Madras, Sri Lanka, Myanmar.	
Cyptotymphana varicolor Dist.	Sri Lanka, Sumbava Isl.	
Cupha eymanthis (drury)	Sri Lanka,S. India. Mussoorie to Assam & Myanmar.	*Flacourtia ramontchi; F. Montana* (Bixaceae)
Curetis thetis Drury	Sri Lanka, Peninsular India.	*Pongamia glabra*
Cusiala raptaria Walker	India, Pakistan.	

Cyana bianea Wlk.	Sikkim, Cachur, Penang, Myanmar Andamans.	
Cyclopelta siccifolia Westw.	Sikkim,Khasis, Bengal, Bombay, Sri Lanka, Myanmar.	*Cajanus indicus, Erythrina indica, E.lithosperma, Moringa pterygospenna, Pongamia glabra, Sesbania aegyptiaca.*
Danais chrysippus (Lin.)	India,	*Holarrhena antidysenterica Calotropis gigantea.*
Dasychira bhana Moore	Sikkim,Nilgiris Plateau	
Dasychira mendosa Hubn.	South and East Asia to Australia.	*Cassiafistula,Cinnamomum zeylanicum, Dipterocarpus tuberculatus, Lagerstroemia speciosa, Mangifera indica, Santalum album, Tectona grandis.*
Delias eucharis Drury	India.	*Xeromphis uliginosa*
Dichocrocis punctiferalis Guenee	Japan, China, India, Malaysian subregion, Australian region.	*Ellettaria cardamomum, Ricinus communis, Garuga pinnata, Mallotus philippensis, Tectona grandis*
Dichocrocis euaxalis Wlk.	Bhutan, Khasis, Sri Lanka, Sumatra.	
Dichocrocis plutusalis Wlk.	Sikkim,Khasis, Andamans.	
Dichocrocis sursalis Wlk.	Japan, Sri Lanka, Borneo.	*Grewia microcos*
Dindymus sanguineus Fb.	Assam,Nagas, China, Myanmar, Hongkong.	
Dysdercus cinguiatus Fb.	Southern Asia , Australia, Papua & Solomon Islands.	*Abutilon indicum, Lantana* sp., *Bombax malabaricum, Hibiscus rosa-sinensis, Solanum sp.*
Egnasia khasiana Moore	Sylhet, Nagas, Nilgiris, Sri Lanka, Myanmar.	
Eligma narcisuss Cram.	India, Sri Lanka, China, Philippines.	Sugarcane, *Ailanthus* spp.

Epicrocis lateritialis Wlk.	The plains of India, Sri Lanka,Myanmar, Andamans.	
Epilachna viginti-octopunctata		*Adina cordifolia.*
Episomius lacerta Fb.	S.India Bengal,Belgaum, Nilgiris-4000', Anaimalais, Koorg.	*Acacia cyanophylla, Dalbergia paniculata, Erythrina indica, Tectona grandis.*
Ercta ornatalis Dup.	S.Nearctic, Neotropical,Oriental & Australian regions.	
Eressa aperiens Wlk.	Nilgiris 3000-7000'.	
Eressa confinis Wlk.	Almora, Kulu.	
Ergolis ariadne (Johanssen)	Sri Lanka, India.	*Ricinus communis, Tragia cannabina, T. involucrata.*
Ergolis merione Cram.	India, Sri Lanka.	*Tectona grandis*
Enboea athamas Drury	India. Pakistan.	*Acacia catechu, Albizia lebbeck. A.chinensis.*
Ericeia inangulata Guen.	Africa, India, Pakistan, Myanmar, Australia.	*Albizia falcata, Cassia fistula, Dalbergia latifolia, Xylia xylocarpa.*
Euchromia polymene Lin.	Plains of India, Kerala,Andamans Sri Lanka, Penang.	
Eugoa bipunctata Wlk.	Assam, Nilgiris, Sri Lanka, Myanmar, Borneo.	
Eumelia rosalia Cram.	China,India,Sri Lanka, Formosa, Austro-Malaysian regions.	
Eumenes conica Fb.	The plains of India, Myanmar, Sri Lanka, China,Malaysia.	

Eumenes flavopicta Blanch	Sikkim,Bengal, S.India, Sri Lanka, Myanmar	
Euploea core Cram. *Eupterote testacea* Walk.	Sri Lanka, India, Assam-China.	*Ficus* sp., *Holarrhena* sp., *Nerium* sp., *Streblus asper.* *Grsses, Loropetalum chinense, Dwarf bamboo.*
Euproctis bipunctapex Hamp.	India, Malaysia, Myanmar, Pakistan, Singapore.China.	*Aleurites fordii, Mangifera indica, Ougeinia oojeinensis, Tectona grandis, Terminaliapaniculata, Syzygium cumini, Glochidion velutinum, Eugenia jambolana.*
Euproctis digramma Guenee	Throught India, Sri Lanka, Myanmar, Java	
Euprterote fabia Cram.	Sikkim,Throught N.& S.India, Sri Lanka.	
Eupterote flavida Moore	N. Canara, Khandala,Nilgiris.	
Euproctis fratema Moore	Sri Lanka, India.	*Aleurites fordii, Mangifera indica, Ougeinia dalbergioides, Tectona grandis, Terminalia tomentosa, T.alata, Shorea robusta.*
Euproctis icilia Stoll	N.W. HiMalaysias, Throught S. India, Sri Lanka.	
Euproctis luscintillans Walk.	South Asia.	*Acacia nilotica, Aleurites montana, Cassia fistula, Ficus glomerata, Mangifera indica, Quercus incana, Terminalia bellerica, Tamarindus indica.*
Euproctis scintillens Wlk.	Throught India, Sri Lanka, Myanmar, Andamans.	
Eupterote testacea Wlk.	Cachar, Sylhet,Myanmar	

Eupterotefabia Cram.	Sri Lanka. India.	Michelia champaca, Eythrina indica.
Eupterote mollis Moore	Throught S. India and Sri Lanka.	
Eurema blanda Boisd.	Sri Lanka, India , Myanmar, Andamans.	Acrocatpusfraxinifolius, Albizia lebbeck, Cassiafistula, Xylia xylocarpa.
Eurerna hecabe Lin.	South Asia, Africa, Australia, Pacific Islands.	Albiziafalcata , Butea monosperma, Cassiafistula, Pithecellobium dulce, Schleichera oleosa.
Eurrhyparodes tricoloralis Zell	W.&S. Africa, Java, Punjab,Nilgiris, Sri Lanka, Australia.	
Euschema Percota Swin.	Western Ghats.	
Euthalia lubentina (Cram.)	India	Loranthus scurrula, *L. longiflorus*
Filodes fuluidoraliss Hubn.		Anogeissus latifolia, Cassia fistula, Holarrhena antidysenterica.
Fodina stola Guene	N.W.HiMalaysias, Sikkim, Bhutan, Sri Lanka.	Anogeissus latifolia, Cassiafistula, Holarrhena antidysenterica
Galleria rnellonella Lin.	South India.	Quercus sp.
Xyphodes bicolor Swains	Australia, Africa, Sri Lanka, India, Malaysia.	Holarrhena antidysenterica, Ougeinia dalbergioides, Tabernaemontana heyneana, Wrightia tinctoria.
Glyphodes celsalis Walk.		Olea dioica.
Glyphodes glauculalis Guen.		Momordica charantia.
Glyphodes marinata Moore	Sikkim, Calcutta, Cachur, Kerala Sri Lanka, Nicobar.	
Glyphodesstolalis Guen.	Africa to Pacific. **Sri** Lanka, Fiji, India, Seychelles.	Ficus glornerata, Ficus sp.

Glyphodes vertumnalis Guen.	India	*Shorea robusta.*
Graphium agamemnon Lin.	Australia, India, Malaysia, Papua, Solomon Islands.	*Michelia champaca, Polyalthia* sp., *Saccopetalum tomentosum.*
Graphium antiphates Cram.	Sri Lanka, Kerala, Sikkim to Assam and Myanmar.	*Anona lawii, A. Elegans, A. Sri Lankaica*
Graphium doson Felder	Sri Lanka. S.India.	*Cinnamomum sp., Michelia oblonga, Polyalthia* sp., *Saccopetalum tomentosum.*
Graphium sarpedon Lin.	Sri Lanka, India, Malaysia.	*Alseodaphne owdenii, Camphora officinalis, Cinnamomum* sp., *Litsea* sp., *Machilus odoratissima*
Gymnopleurus cyaneus Fb.	Kerala, Bengal, Bombay, Sri Lanka	
Harpegnathos saltator Jerd.	W.India, Mysore, Sri Lanka, China	
Hebomoia glaucippe Lin.	Asia.	*Crataeua religiosa.*
Heliocopris dominus Bates	Bengal, Assam, Siam,Malaysian peninsula.	
Heliothis obsoleta Fb.		*Cassia tora, Diospyros chloroxylon,* Agave.
Hispa armigera Oliv.	Kerala, Bengal, Nepal, Myanmar, Assam, Sumatra.	
Holotrichia serrata Fb.	India.	*Butea monosperma, Schleichera oleosa, Tectona grandis.*
Hyblaea puera Cram.	Australian and Oriental regions and Africa.	*Tectona grandis, Oroxylum indicum, Terminalia chebula, Ficus* sp., *Callicarpa arborea, Premna latifolia, Vitex negundo.*
Hylaeusfeai (Vachal)	Myanmar, Sikkim. Tenasserim,	

Hymenia recurvalis Fb.	S.India, Tithimatti.	*Celastrus paniculata.*
Hypocala deflorata Fb.	E.&S.Africa, N.W.HiMalaysia, Canara,Nilgiris.	
Hypochrosis abstractaria Wlk.	Sikkim, Khasis, Sri Lanka,Nilgiris.	
Hypolimnas missipus Lin.		*Portulaca oleracea(Portu1acaceae); Abutillon; Hibiscus*
Hypsa alciphron Cram.	Oriental region.	*Ficus glomerata, F. hispida, Mesua ferrea, Shorea robusta,* Tectona *grandis.*
Ixias marianna (Cram.)	Sri Lanka, Pen. India to Saurashtra, Punjab And Bengal.	*Capparis sepiaria; C. divaricata; C. aphylla C. Grandis*
Ixias pyrene Lin.	Sri Lanka, Peninsular India to Saurashtra and Bengal, Baluchistan, Assam and Myanmar.	*Capparis sepiaria*
Jamides alecto (Feld.)	Sri Lanka, S.India, Sikkim to Myanmar.	*Kaempferia pandurata; Elettaria cardamomum*
Jamides celeno cram.	Oriental region	*Butea monosperma, Pongamia pinnata.*
Junonia almana Lin.	Sri Lanka, Myanmar, India.	*Asteracantha longifolia; Hygrophila; Barleria, Osbeckia*
Junonia atlites Lin.	N.E. India, Wetter regions of Pen. India, Sri Lanka, Myanmar.	*Asteracantha longifolia; Barleria*
Junonia hierta (Fb.)	India, Sri Lanka, Myanmar.	*Asteracantha longifolia;* Barleria sp.
Junonia lemonias Fruh.	Sri Lanka, Kashmir, Assam, Bengal, south and central India, Myanmar.	*Nelsonia campestris, Asteracantha longifolia.* Also on jute and *Sida rhombifolia*

Junonia orithya (Lin.)	India,Sri Lanka, Myanmar.	*Justicia procumbens, J. rnicrantha, Lepidogathis prostrata*
Junonia stygia	Sri Lanka, south and central India as far west as Kashmir, NE. India, Myanmar	*Strobilanthus callosus, Justicia rnicrantha, Asteracantha longifolia*
Laphygma exigna Hubn.	India, Pakistan.	*Momordica charantia, M.dioica.*
Leptosia nina Fb.	India, Sri Lanka, Myanmar.	*Capparis heyneana, Crataeva religiosa*
Lepyrodes geornetralis Guenee	W.Africa,China, Formosa, India, Myanmar, Sri Lanka, Australia.	
Lepyrodes neptis Cram.	India, Sri Lanka, Myanmar, The Malaysian subregion,Austrlia.	
Leucinodes orbonalis Guen	India.	Pest of brinjal. *Dalbergia sissoo, Solanum xanthocarpum.*
Lixus truncatulus Fb.		*Amaranthus caudatus, A. gangeticus, A. spinosus, A.viridis.*
Loepantheraea rosieri Toxopeus	Malaysia, Sumatra, Borneo.	
Logaeus subopacus Wat.	Kerala, Nilgiris.	
Loxura atymnus (Cram.)	Sri Lanka, S,India, Orissa, Bihar, Madhyapradesh, Mussorie to Assam, Bengal, Myanmar.	*Dioscorea pentaphylla, Smilax sp.*
Lygropia amyntusalis Walk.	Myanmar, India, Java, Sri Lanka, Andamans.	
Lygropia obrinusalis Walk.	S.India .	*Grewia tiliifolia, G.elastica, Helicteres isora, Wrightia tinctoria.*

Lyprops curticollis Fairm.	Kerala.	Common in rubber plantation. Larval stages in vegetable refuse or in humus soil.
Macroglossum aquila Bois.	Java, Central India,	
Magachile lanata Fb.	India, Myanmar, Sri Lanka, Tenasserim.	
Magachile carbonaria Smith	N. India.	
Magachile quartinae Gribodo	Myanmar, Tenasserim, India.	
Marasmia venilalis Walk.	W.&S.Africa, India, Sri Lanka, Myanmar, Borneo, Australia,	
Maruca *testulalis* Geyer.	India.	*Albizia chinensis, Careya arborea, Syzygium cumini, Tectona grandis, Terminalia bellerica, Butea monosperma, Ficus bengalensis, Mangifera indica, Litsea monopetala , Mallotus philippensis, Xanthophllum 1imonella.*
Mecyna gilvata Fb.	S.&E.Europe, Syria, Punjab, Karachi, India (Nilgiris),Sri Lanka.	*Indigofera pulchella, Sophora griffithi, S.tomentosa*
Melamphaus fulvomarginalis Dohrn.	India (Trivandrum), Sri Lanka, Kandy,	
Melanitis ismene Cram.	India.	*Dalbergia latifolia, D.sissoo, D. volubilis.*
Melanitis leda Lin.	All India except the extreme Myanmar NW.Sri Lanka,	Grasses
Melanitis phedima Moore	Sri Lanka, Myanmar, S.India, Pachamarhi, Kashmir to Assam.	Grasses
Miresa albipuncta Herr	Throught India and Sri Lanka.	*Butea frondosa, Terminalia sp.*

Mocis undata Fb.	Ghana, India, Malaysia, Pakistan, Uganda.	Pest of citrus. Butea monosperma, Dalbergia latifolia, Ougeinia dalbergioides, Shorea robusta, Hevea brasiliensis.
Mutilla semiaurata Smith	India.	
Myllocerus dorsatus (Fb.)	S. &E.India, Nilgiris.	
Myllocems viridanus Fb.	S. India, Sri Lanka.	Anacardium occidentale, Tectona grandis, Tamarindus indica.
Naxa textilis Wlk.	Sikkim, Bhutan, India -Nilgiris, Sri Lanka, Myanmar.	
Neptis hylas Lin.	Oriental region.	Dalbergia sissoo.
Neptis jumbah Bingham.	Sri Lanka, S. India, Bengal, Myanmar.	Xylia; Pongamia glabra; Dalbergia sp., Hibiscus sp.. Grewia sp., Elaecarpus sp.,Zizyphus sp.
Nomia ellioti Smith	The plains of India, Myanmar, Tenasserim.	
Nomia thoracica Smith	Barrackpore, Myanmar, Tenasserim, China.	
Nyctemera coleta Cram.	Assam, Sri Lanka.	
Nyctipao macrops Lin.	Throught Africa, Madagascar, India, Sri Lanka, Myanmar.	
Nymphula depunctalis Guenee	S. Africa, India, Sri Lanka, Myanmar, Java, Australia.	
Nymphula fluctusalis Zell	Throught the tropical and Subtropical zones.	
Odontoptilum angulata (Feld.)		Allophylus cobbe

Odontopus nigricornis Stal.	Bombay, Borghat, Myanmar, Mandaly, Khandala.	
Odynereus fragilis Smith	Myanmar, Tenasserim, Borneo.	
Oecophylla smaragdina Fb.	India,Myanmar, Sri Lanka, Malaysian subregion to Australia, New Guinea.	
Oedalus *abruptus* Thunb.	India.	*Pinus* longifolia, Shorea robusta.
Oeonstis sp.	Myanmar, Malacca, Java, Ceram.	
Omphisa repetitalis Snell	Sikkim.	
Ophideres matema Lin.		*Tinospora* cordifolia.
Oxiodes scorbiculata Fb.	China, India, Sri Lanka, Myanmar, Java, Fiji.	
Pachliopta aristolochiae Fb.	India. Sri Lanka.	Acronychia pedunculata, Aegle marmelos, Glycosmis pentaphylla, Murraya koenigii, Ruta angustifolia, *Ziziphus mauritiana.*
Pagyda traducalis Zell	S.America, S.Africa, Aden, India, Sri Lanka, Myanmar, Syria.	
Papilio budha Westwood	Western ghats	Zanthoxylum rhesta
Papilio demoleus Lin.	Australia , Sri Lanka, Malaysia, Pakistan. Africa to Pacific, India.	Pest of citrus. Ruta angustifolia, Aegle marmelos, Murraya koenigii, Acronychia laurifolia, Zanthoxylum limonella.
Papilio dravidarum Wood-Mason	Western Ghats.	Glycosmis pentaphylla

Papilio paris tamilana Moore	*S.* India (W. Ghats & Nilgiris) Orissa, Kumaon to Sikkim, Assam, Myanmar.	*Evodia roxburghiana*
Papilio polymnester Moore	Sri Lanka, India	*Citrus decumana; Glycosmis pentaphylla, Atlantia* spp.
Papilio polytes Lin.	India, Sri Lanka.	*Ficus bengalensis, Ricinus communis, Bauhinia* sp., *Euphorbia sp., Ziziphus sp.*
Parasa lepida Cram.	Throught India and Sri Lanka, Java.	
Parasa lepida Cram.	Sri Lanka, S.India.	*Alurites montana, Artocarpus hirsuta, Butea frondosa, Careya arborea, Erythrina lithosperma, Eugenia sp., Ficus glomerata, Mangifera indica, Terminalia catappa, Vitex altissima, Sapindus trifoliatus.*
Parenonia ***valeria*** (Cram.)	India, Myanmar.	*Capparis heyneana* (Capparidaceae)
Parthenos sylvia Moore		*Modecca* sp. *Tinospora cordifolia*
Patissa fulvosparsa Butl.	Nilgiris, Sri Lanka.	
Pericallia ricini Fb.	India, Pakistan, Sri Lanka.	*Santalum album, Cassia tora, Ricinus communis, Zea mays, Lantana* sp.
Pheidologeton diversus Jerd.	India, Myanmar, Malaysian subregion.	
Phalantha phalantha Drury	India, Uganda.	*Populus* sp.
Phlyctaenia flavofimbriata Moore	India.	*Dendrocalamus strictus, Carissa spinarum, Flacourtia indica, Gymnospona champiani.*
Phryganodes unitalis Guenee	Sikkim,Khasis, Andamans, Ceram.	
Platylomia amicta Dist.	Karwar.	

Platylomia lams Walk.	Bombay, Nilgiris, Koonor, Sri Lanka.	
Plautia firnbriata Fb.	Sikkim,Khasis, Assam, Kanara, Kerala,Myanmar, Japan.	*Lantana* sp
Pleurarius brachyphyllus Stal.	S.India.	Makes deep galleries in wood that is often quite hard.
Pochazia fuscata Fb.	Madras, Malaysian, Peniensula, Java, Sumatra, Myanmar.	
Polynesia sunandava Wlk.	Sikkim, Kerala, Sri Lanka,Andamans.	
Polytela gloriosae Fb.	Throught india and Sri Lanka.	
Potanthus Sp. .	India,Sri Lanka.	Bamboos; Grasses
Prodenia litura Fb.	Australian and Oriental regions.	*Artocarpus integra, Casuarina equisetifolia, Mangifera indica, Moms alba, Tectona grandis, Terminalia tomentosa, Tristania conferta.*
Psara bipunctalis Fb.		*Achyranthes aspera, Boerhavia diffusa, Plectranthus incanus* , *Solanum torvum.*
Pseudagenia blanda Guer.	India, Myanmar, Sri Lanka extending to Malacca, Borneo and Celebes.	
Ptilinus binodulus Motsch.	India. Sri Lanka.	*Boswellia serrata, Canarium euphyllum, Ficus roxburghii, Grevillea robusta, Morus alba, Quercus incana, Sernecarpus anacardiurn, Spatholobus roxburghii, Sterculia companulata, Vateria indica.*
Putala maculata Dist.	Nilgiris, Udakamandalam.	
Pycna repanda Lin.	N.E India, Myanmar	

Pygospila tyres Cram.	Maharashtra	*Callicarpa arborea, Holarrhena antidysenteRIca, Rhynchosia albiflora, Wrightia tinctoria.*
Pyralismanihotalis Guenee	Neotropical, Oriental & Australian regions.	*Opuntia monocantha.*
Pyraustasignatalis Walk.	N.& W. HiMalaysias, Nilgiris, Sri Lanka, Java.	
Rhodogastriaastreas DRUry	India, Myanmar, Sri Lanka, China, Penang, Java.	
Rhynchium brunneum (Fb.)	India, Myanmar, Sri Lanka, Tenasserim extending to Malacca, Borneo to the south-east, Aghanistan,Persia to the northwest.	
Rhynchina curvilinea Ham.	Japan,China, India, Andamans, Java, Chusan Isl.	
Ricania marginalis Wlk.	Myanmar, Tavoy, Tenasserim,Borneo, Myitta.	
Salius caerulipennis Saus.	India.	
*Salius fulvipennis*Fb.	India, Sri Lanka, Myanmar.	
Salius perplexus Smith	India, Tenasserim.	
Salius praestabilis Binham	Pegu Yoma, Myanmar, Tenasserim.	
Sceliphronjavanum Lepel	Java, Borneo.	
Sceliphron madraspatnam madraspatnam Fb.	Maldives, Sri Lanka, Vietnam, Java, Borneo, Indonesia.	
Schoenobius minutellus Zell	Borneo, Sri Lanka Java,Myanmar, Culcutta, Sri Lanka	

Schoenobius immeritalis Walk.	Calcutta. Sri Lanka. Siam, Dharmasala.	
Scolia aureipennis Lepel	Sikkim,Kerala,Tenassrim,Java,Philippiens	
Scolia carbonaria Saus.	India.	
Semiothisa khasiana Moore	Sikkim,Khasis, Nilgiris,Bombay.	
Semiothisa myandaria Wlk.	N.India,Canara, Nilgiris.	
Semiothisa *nora* Wlk.	Throught India and Sri Lanka.	
Sinoxylon *atratum* Lesne.	Oriental region to Australia.	Artocarpus hirsuta, Santalum album.
Somatina anthophilata Guenee	Throught India, Sri L anka,Myanmar.	
Spatiala argentifera Wlk.	Sikkim,Canara, Banglore,Borneo.	
Spiredonia *alix* Guenee	HiMalaysias, Assam, Java, Andamans & Nicobar.	
Sphex argentatus Fb.	Oriental region to ne. Australia.	
Sphex praedator leutipennis Mocsary	Indonesia, Ambon, Moluccas, Buru.	
Sphex sericius Fb.	Indonesia, Flores, Sumbava, Bali,Java.	
Spodoptera mauritia Boisd.	Oriental, Australian, and Pacific regions.	Pest of paddy. Sugarcane, Casuarina equisetifolia, Acacia catechu, Cassia fistula, Albizia chinensis, Camellia theae, Mangifera indica, Ougeinia oojeinensis etc.

Sylepta derogata Fb.	Borneo, Sri Lanka, Malaysia, Uganda, Seychelles, Kenya, Ghana, India.	*Pest of cotton. Kydia calycina, Helicteres isora, Lantana camara, Ceiba pentandra, Sterculia villosa.*
Sylepta lunalis Guen.	India, Pakistan.	*Quercus incana, Vitis vinifera, Girardinia heterophylla, Helicteres isora, Leea aspera.*
Sylepte balteata Fb.	Europe, Africa, Asia.	*Anacardium occidentale, Boehmeria malabarica, Grewia tiliifolia, Garuga pinnata, Shorea robusta, Leea crispa.*
Syngamia abruptalis Wlk.	W.Africa, India, Java, Andamans, Sri Lanka, Myanmar, Australia.	
Syngamia floridalis Zell	Sri Lanka,.Myanmar, India, The Malaysian subregions.	
Syngamia latimarginata Walk.	Myanmar, Sri Lanka, W.&E.tropical regions, India.	
Tagiades litigiosa Mosch.	Sri Lanka, Pen. India, HiMalaysias as far west as Simla, Assam, Myanmar.	*Dioscorea oppositifolia,* Smilax sp.
Talanga sexpunctalis Moore	Sikkim, Bombay, Nilgiris, Andamans, New Britain,Sri Lanka.	
Taractrocera ceramas (Hewit.)	Western Ghats to Bombay. Hills of S. India, N. Myanmar.	Grasses
Tetronthna variegata Dahl.	Assam,Trivandrum, Malaysian peninsula, Philippiens, Sylhet.	
Timandra nelsoni Prout	Formosa, Myanmar, Sri Lanka,Australia, India.	

Tinolius eburneigutta Wlk.	Sikkim,Throught Pen. India, Sri Lanka, Myanmar, Andamans.	
Tiracola plagiata Walk.	Australian and Oriental regions.	*Pest* of banana, Tapioca, Castor, Coffee.
Tribolium castaneum Herb	Throughout India and East.	Manufactured wooden articles, bamboos, seeds, dried fruits etc.
Tnrogma caerulea Westwo	Oriental region.	
Troides *minos* Cram.	Sri Lanka. S. India.	Aristolchia indica, Bragantia wallichii
Typoryza incertulas Walk	India.	Sugarcane.
Typoxylon errans Saussu	Mauritius, Seychells.	
Udaspes folus Cram.	Uttarpradesh.	Magnolia pterocarpa, Michelia champaca, M.oblonga, Manglietia insignis, Talauma hodgsoni.
Uliocnemis biplagiata Moo	Sri Lanka.	
Utethesia pulchella lin.	S.India.	Girardinia heterophylla.
Vanessa cardui Lin.	India, Europe, N.America.	Artemesia vulgaris, Blumea sp., Coricus arvensis, Zornia diphylla.
Vespa cincta Fb.	The plains of India, Myanmar, Tenasserim, Sri Lanka, Malaysia.	
Vitessa suradeva Moore	Sikkim, Assam, Hills of S. India, Sri Lanka, Andamans.	
Xanthodes graellsii Fist.	S.India.	Abelmoschus esculentus, Hibiscus tiliaceus, Kydia calycina, Urena lobata.

Xyleborus fomicatus Eichhoff	Sri Lanka, Fiji, India, Malaysia, Hawaii, E.Pakistan & Papua.	*Albizia falcata, Grevillea robusta, Gmelina arborea, Ricinus communis, Schleichera oleosa.*
Xylocopa dissimilus Lepel	N. W.India, Sikkim, Ghorokhpur. Myanmar, Sri Lanka.	
Xylocopa verticalis Lepel.	ndia, Andamans, Malaysia.	*Duabanga sonneratioides, Michelia champaca, M.oblonga, Terminalia procera , bamboos. Morus laevigata,*
Xystrocera globosa Oliv.	Madagascar region, East and S.Asia, eastwards to Hawaii & Puerto Rico.	*Grewia tiliifolia, Xylia xylocarpa, Actocarpus frxinifolius, Albizia falcata, A.lebbeck, Bombax malabaricum, Acacia catechu, Bauhinia acuminata.*
Ypthima genus		Grasses
Zamrada exica Hamp.	Khasis, Nagas, Gunjam, Nilgiris, Sri anka, Myanmar.	

- plant hosts of only phytophagous insects given ; Blank columns indicates "no information"