



Lepidopteran fauna of Agri-Horticultural ecosystem in Karaikal region

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ABSTRACT

The lepidopteran fauna in the Karaikal region was recorded from December 2003-November 2004. The lepidopterans collected were categorized into 36 butterflies and 95 moths. The family diversity index H' , was higher during the rainy periods (August-November) for both butterflies and moths. The diversity index α was lower during February-April in case of butterflies and in respect of moths, there was higher diversification during June (South West Monsoon). The evenness index (E) was more or less similar in case of butterfly families, which indicated less evenness of the families, whereas in case of moth families, more evenness was found during November, October, September, August and December with minimum number of families.

Key words: Agri-Horti ecosystem, lepidopteran fauna, diversity, crop pest

INTRODUCTION

The tropical regions are known for their richness of species diversity (Mathew and Rahamathulla, 1993). The role of insects in the maintenance of essential life support systems in natural habitats is well recognized (Wells *et al.*, 1983). Our knowledge on the insect fauna of Indian region is based on the studies of pioneer workers like Hampson (1891), Lefroy (1909) and Mathew and Rahamathulla (1995). At present about 80 per cent of the world's known animals are insects, and lepidopterans accounts for 112,000 species, which include both butterflies and moths (Hutchins, 1972; Gunathilagaraj *et al.*, 1998; Nair, 2001 and 2002). Lepidopteran insects are of diversified nature and they occur both as crop pests and pollinators. Lefroy (1909) had enumerated 10,000 species of lepidopterans of which 8,000 species were moths and 1,500 species were butterflies described in Hampson's (1894) paper of fauna of India.

Biodiversity is a function of the number of any taxon present, the evenness with which the taxons are distributed among these taxons (species evenness or family evenness) and the interaction component of richness and evenness i.e., heterogeneity (diversity) (Ludwig and Reynolds, 1988). Higher biodiversity confers stability (Levin and Wilson, 1980). Hence understanding the functional role of lepidopteran insects in agri-horticultural ecosystem in this region will have a great relevance in assessing the status of lepidopteran pests and their habitat. Therefore a study was taken up to account the lepidoteran fauna of agri-horticultural ecosystem of Karaikal region for documentation.

MATERIALS AND METHODS

Karaikal is one among the four regions in the Union Territory of Puducherry, located 140 km away from Puducherry under the tail end of Cauvery deltaic region. Karaikal is situated between 10°49' to 11°01' N latitude and 78°43' to 79°52' E longitude at an altitude of 4 m from mean sea level. This region is bounded by the Nagapattinam district of Tamil Nadu on three sides and the eastern side by the Bay of Bengal. This region consists of six communes *viz.*, Karaikal, Thirunallar, Nedungadu, Kottucherry, Neravy and Thirumalairayanpattinam. The total area under this region is 161 sq.km. Karaikal region comes under the eleventh agro climatic zone of India and is classified as PC 2-coastal deltaic alluvial plain zone.

Study details

A survey for lepidopterans were made from December 2003 to November 2004 in Karaikal region in all cropped ecosystem, fallow lands *etc.* During the survey, collection was made by using sweep nets, larval collection and rearing and also by visual observation from the cropped areas at weekly intervals and daily collection from light traps and those attracted to the lights of residential buildings. The day flying lepidopterans *viz.*, butterflies and some sphingids like *Macroglossum* sp. which visit flowers were collected using sweep nets in various habitats (Rao *et al.*, 2004). The Robinson light trap model with 100 watts sodium vapour lamp was set up in the farm of Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal which was operated overnight from 6.00 pm to 6.00 am. Those lepidopterans attracted to

light trap were collected in the next day morning (Mathew and Rahamathulla, 1995). The adult lepidopteran representatives of different species attracted to the lights of residing area were also collected using sweep nets (Kirti and Sodhi, 2003).

The larva of lepidopterans was collected from various crop plants, weeds and they were reared on their same host plants to emerge as adults and to record their possible hosts (Nair, 2002). Traps with different available pheromone lures @12 per ha (*viz.*, Spodolure and Helilure) were installed in the farms to collect the attracted moths. Visual observations were made during the survey especially for diurnal lepidopterans during day hours (Nair, 2002 and Baskaran and Solaiappan, 2002). The collected specimens were killed using ethyl acetate vapours and also in killing jar with cyanide (Kirti and Sodhi, 2003). The dead specimens were set neatly and preserved in insect boxes made of wood.

The butterflies collected were identified and described following the guidelines of Gunathilagaraj *et al.* (1998) and Gay *et al.* (1992) and moths were identified following the guidelines of Lefroy (1909) to the lowest possible taxon. The Diversity indices and Evenness index were worked out following Simpson (1949), Shannon-Weiner (1949) and Pielou (1977) methodology.

Statistical analysis

The diversity indices and evenness index for the families were calculated using the Shannon Weiner, Simpson diversity indices, evenness index given by Pielou (1975) and Anne Magurran (1988).

RESULTS AND DISCUSSION

Karaikal enjoys a tropical climate and receives an average rainfall of 1388.27 mm. The beneficial monsoon is North-East monsoon, which accounts for 900.5 mm rainfall, received during October-December. The South-West monsoon contributes 347.4 mm during June-September. Winter rain (January-February) accounts for 66.5 mm while summer rain (March-May) accounts for 68.4 mm of rainfall. The normal cropping system was rice (Kuruvai / Kharif)-rice (late Samba / Rabi)-rice fallow crops (pulses / cotton / gingelly). Other vegetable crops like bhendi, brinjal, raddish, tomato and greens are usually sown during August (Adipattam) and January (Thaipattam) in this region. Fruit tree crops like mango, sapota, annona, guava, amla, papaya, coconut and tamarind are being maintained in this region. The climate of Karaikal region is humid throughout the year except December and January, which are the coolest months. The maximum and minimum temperatures recorded in this region are 33.38° C and 24.63° C respectively.

Butterflies recorded from Karaikal region

Out of 131 lepidopteran species recorded, 36 species belong to butterflies (Rhopalocera) comprising eight families such as Acraeidae, Danaidae, Hesperidae, Lycaenidae, Nymphalidae, Papilionidae, Pieridae and Satyridae. The family Acraeidae constituted a single species, and the family Danaidae and Papilionidae with four species, Hesperidae and Pieridae with five species, Lycaenidae with eight species, Nymphalidae with seven species and family Satyridae with two species. The species collected are furnished in Table 1.

Moths recorded from Karaikal region

A total of 95 species belonging to Heterocera was recorded out of 131 species of lepidopterans from Karaikal region. They belong to 17 families *viz.*, Pyralidae (20 species), Noctuidae (30 species), Arctiidae (6 species), Lymantridae (8 species), Eupterotidae (2 species), Sphingidae (7 species), Hypsidae (3 species) and Geometridae (4 species). The families Pterophoridae, Saturniidae, Hyblaeidae, Agaristidae, Phycitidae, Cossidae, Notodontidae, Syntomidae / Amatidae, Crambidae recorded with single species each (Table 2). There were four species unidentified and two species *viz.*, *Clinabasalis*, *Bomolocha vestita* not grouped under any family due to the overlapping characters.

The collected lepidopterans were categorized according to their ecosystem and results show that 19.08 per cent population was from agricultural ecosystem, 12.98 per cent was from horticultural ecosystem and 9.92 per cent was from agricultural cum Horticultural Ecosystem. However, a major share (45.04%) was belonging to non categorized group. Most of the lepidopterans, especially the moths, are crop pests in their larval stage. The food plants of moths and butterflies larvae are furnished in tables 1 and 2. None of the moth collected was recorded as a pollinator. However, a few species under butterfly group are involved in pollination but their role is not of any economic importance. The moths, in their adult stage, are almost positively phototrophic and hence the species that were collected in light traps and light sources are also indicated in tables 1 and 2. Pheromones were also used to study the occurrence of *Helicoverpa armigera* and *Spodoptera litura*.

Diversity

The families Noctuidae (30) and Pyralidae (20) followed by Lymantridae (8) constituted maximum number of species in case of moths and maximum number of species were recorded by Lycaenids (8) followed by Nymphalids (7) in case of butterflies. Similar results with maximum number of species with respect to moths belonging to the family

Table 1. Butterfly fauna recorded from Karaikal region during December 2003-November 2004 and their period of activity with host plants

Scientific Name	Common Name	Family	Period of Activity	Food PLANT
<i>Acraea violae</i> (Fabr.)	Tawny coster	Acraeidae (1)	December-November	<i>Tridax procumbens</i>
<i>Euploea core core</i> (Cramer)	Common Crow	Danaidae (4)	December-February, April, June -November	<i>Nerium oleander</i> <i>Calotropis gigantea</i>
<i>Danaus chrysippus chrysippus</i> (Linn.)	Plain Tiger		December-November	
<i>D. genutia genutia</i> (Cr.)	Striped Tiger		December-March, May-November	
<i>Tirumala linniaae exotica</i> (Gmelin)	Blue Tiger	Hesperiidae (5)	July-November	
<i>Telipotia ancilla bambusae</i> (Moore)	Dark Palm Dart		April-July, September-October	
<i>Spialia galba galba</i> (Fabr.)	Indian Skipper		July-October	
<i>Hasora chromus chromus</i> (Cr.)	Common Banded Awl		December-November	Rice
<i>Pelopidas mathias mathias</i> (Fabr.)*	Small Banded Swift		December-November	Rice
<i>Parnara guttatus guttatus</i> (Brem.)*	Rice Skipper		May-July, September-November	
<i>Castalius rosomon rosomon</i> (Fabr.)	Common Pierrot	Lycaenidae (8)	December, February-March, May-November	
<i>Everes lacturnus syntala</i> (Candle)*	Indian Cupid			
<i>Zizeeria maha ossa</i> (Swinhoe)*	Pale Grass Blue			
<i>Syntarucus plinius</i> (Fabr.)	Zebra Blue		September-November	Guava
<i>Virachola isocrates</i> (Fabr.)	Anar Butterfly		September-November	Guava
<i>Rapala varuna</i> (Cramer)	Indigo Flash	Lycaenidae	December, February	Pods of Pulses, <i>Crotalaria</i> spp and Pillepesara
<i>Lampides boeticus</i> (Linn.)	Pea Blue		December, February -November	Pods of Pulses, <i>Crotalaria</i> spp and Pillepesara
<i>Euchrypsops cnejus</i> (Fabr.)*	Gram Blue		March-November	
<i>Precis orithya</i> (Linn.)	Blue Pansy	Nymphalidae (7)	December, March, June, November	Castor
<i>P. iphita iphita</i> (Cramer)*	Chocolate Pansy		February - November	
<i>Ariadne merione merione</i> (Cramer)	Common Castor		December, June, August, October-November	
<i>Hypolimnas misippus</i> (Linn.)	Danaid Eggfly		December, February-March, May-November	
<i>P. lemonias lemonias</i> *	Lemon Pansy		February -March, June-October	
<i>P. almana almana</i>	Peacock Pansy		May-November	
<i>P. hierta hierta</i>	Yellow Pansy		December, March-May, July-November	
<i>Papilio polytes polytes</i> (Linn.)	Common Mormon	Papilionidae (4)	December-November	
<i>P. demoleus</i> (Linn.) Lime Butterfly	Papilionidae		December, February- November	
<i>Pachitopa hector</i> (Linn.)	Crimson Rose		December, March-November	
<i>P. aristolochiae aristolochiae</i> (Fabr.)	Common Rose		December-November	
<i>Eurema hecabe simulata</i> (Moore)	Common Grass Yellow	Pieridae (5)	March-April, July	Daincha, Agathi, Kolingi
<i>Cepora nerissa nerissa</i> (Fabr.)	Common Gull		December-January, March-November	<i>Loranthus dendrophthoe</i>
<i>Delias eucharis</i> (Drury)	Common Jezebel		May-June	<i>Cassia siamea, C. hybrida</i>
<i>Colotis danae danae</i> (Fabr.)	Crimson Tip		December-November	
<i>Catopsilia pyranthe</i> (Linn.)	Mottled Emigrant		December-March, June-November	
<i>Melanitis leda leda</i> (Drury)*	Common Evening Brown	Satyridae (2)	February-March, June-November	Rice
<i>Mycalasis subdita</i> (Moore)*	Tamil Bush Brown			

Figures in parentheses denote number of species

* Attracted to light trap and light source

Table 2. Moths recorded in Karaikal between December 2003 and November 2004 and their period of activity with host plants

Scientific Name	Common Name	Family	Period of Activity	Food Plant
<i>Cnaphalocrocis medinalis</i> (Guenee)*	Rice Leaf folder	Pyralidae (20)	December-February, August-November	Rice
<i>Marasmia patnalis</i> (Bradley)*	Cotton Leaf roller		December, February-November	Rice
<i>Sylepta derogata</i> (Fabr.)	Jasmine Leaf roller		December-January	Cotton, Bhendi, Hibiscus
<i>Glyphodes unionalis</i> (Fabr.)*	TMC Leaf roller		December-January, August-November	TMC (<i>Tabernaemontana</i>)
<i>Glyphodes glauculalis</i> (Gr.)*	Moringa Leaf webber		December-January, August-November	Moringa
<i>Noorda blitealis</i> (Wlk.)*	Rice yellow stem borer		December-November	Rice
<i>Scirpophaga incertulas</i> (Wlk.)*	Stem Borer		October-November	
<i>Scirpophaga innotata</i> *	Brinjal shoot and fruit borer		February-May, August-November	Brinjal, <i>S. tarvum</i>
<i>Leucinodes orbonalis</i> (Guenee)*	Sesame leaf webber		March-May, September-November	Sesamum
<i>Antigastra calalaunalis</i> (Duponchel)*	Rice Caseworm		January	Rice
<i>Nymphula depunctalis</i> (Gn.)*	Caseworm	Pyralidae	December-March, June	Rice
<i>N. fluctuosalis</i> (Zell.)*	Amaranthus leaf webber		January, May-October	Amaranth, Saranai, <i>A. viridis</i>
<i>Hymenia (=Spolodea) recurvalis</i> (Fabr.)*			December-February	Flower buds of redgram, Sesbania spp, Pods of cowpea and blackgram, Pillepesara.
<i>Maruca testulalis</i> (Geyer.)*	Spotted pod borer		August-November	Pumpkin, cucumber, water melon
<i>Diaphania (=Eudiotpes indicus) (Saunders) *</i>	Pumpkin Caterpillar		August	
<i>Omphisa anastomosalis</i> (D.)*	Sweet potato stem borer		December-February	
Unidentified 1*			December	
Unidentified 2*			October-November	
Unidentified 3*				
Unidentified 4*				
<i>Spodoptera litura</i> (Fabr.).	Tobacco cutworm	Noctuidae (30)	December-April, August-November	Cowpea, Castor, <i>A. viridis</i> , Bhendi
<i>Helicoverpa armigera</i> (Hubn.)* .	Gram caterpillar		January-April, June, September-October	Cotton, Sunflower, <i>Gaillardia puichella</i> (Blanket flower)
<i>Earias vittella</i> (Fabr.)*	Spotted bollworm		February-June, October-November	Cotton, Bhendi, <i>Abutilon indicum</i> capsules
<i>Anticarsia irrotata</i> (B.)*	Pulse leaf roller		December-January, August-September	Cowpea leaves
<i>Acontia (=Xanthodes) graellsii</i> (Faith.)*	Cotton/Bhendi semilooper		December-January, June	
<i>A. intersepta</i> (Guen.)*			December, July	

<i>Achaea janata</i> (Linn.)* <i>Euphorbia</i> <i>Achaea</i> sp.* <i>Othreis materna</i> (Linn.)* <i>O. fullonica</i> (Cramer)* <i>O. ancilla</i> (Cramer)* <i>Sesamia inferens</i> (Walker)* <i>Anomis flava</i> (F.) <i>Antoba</i> (= <i>Eublemma</i>) <i>olivacea</i> (Walker) <i>Eublemma hemirrhoda</i> (W.)* <i>Agrotis segetum</i> (D&S)* <i>Perigea capensis</i> (= <i>Prospalta capensis</i>) A.* <i>Parallelia algira</i> (L.)* <i>Trigonodes hyppasia</i> (Cram.)* <i>Grammodes stolidia</i> (F.)* <i>Tarache nitidula</i> (Fabr.) <i>Zalissa venosa</i> * <i>Plusia orichalcea</i> (F.)* <i>Pericyma glaucinans</i> (G.)* <i>Eupithecia amulata</i> * <i>Remigia undata</i> * Unidentified 5 * Unidentified 6 * Unidentified 7 * Unidentified 8 *	Castor semi looper Fruit sucking moths Pink stem borer Cotton semi looper Brinjal leaf folder Pulse flower webber Cutworm Safflower shoot caterpillar Castor semi looper Cotton semi looper Daincha semi looper	Noctuidae Noctuidae	December, September-November December, September-November December-January and November February-March, June, October-November December-January, September-November December, February-September December, June-July January-April, August-November January, October-November January-March, July August October-November December, October-November December, July-November September-November July-November July May-November August August-September October-November	Castor, Rose, <i>hirta</i> Ragi, Sorghum Cotton, Bhendi Brinjal Flower buds of pulses
<i>Pericallia ricini</i> (Fabr.)* <i>Cretonotus gangis</i> (L.)* <i>Utethesia pulchella</i> (L.)* <i>C. interruptus</i> (Gmelin) <i>Rajendra irregularis</i> * <i>Rhodogastria astreas</i> (Dr.)* <i>Psalis pennatula</i> (F.)* <i>Porthesia</i> sp.* <i>Euproctis</i> sp.*	Woolly bear Hairy caterpillar Sunhemp hairy caterpillar Rice yellow hairy caterpillar	Noctuidae Arctiidae (6) Lymantridae (8)	October-November December-January, March-April, June-November December-January, July-August December-January, November December-January December-January, March-April, August September-November December, May, August-November December, October-November December-January	Banana, Cluster bean, Horsegram, Labalab Sunhemp Rice, <i>Echinochloa</i> sp., <i>Cyperus</i> sp

<i>Notolephus posticus</i> (W.)*	Lymantiridae		October-November, September	
<i>Laelia exclamatoris</i> (= <i>L. adalia</i>)*			December-January, September-November	
<i>Chaerotracha decussata</i> *			August-November, May-July	
<i>P. xanthorrhoea</i> (Kollar)*			December-February, May-June, August-November	
Unidentified 9*			December-February, May-September	
<i>Eupterote mollifera</i> (Walker)*	Moringa hairy caterpillar	Eupterotidae (2)	December, May-November	Moringa, <i>Thespesia purpurea</i>
<i>E. undata</i> (Blanch.)*	Hairy caterpillar		December, October-November, August-September	
<i>Exelastis atomosa</i> (W.)*	Redgram plume moth	Pterophoridae (1)	December-January, July-November	Red gram pods
<i>Macroglossum particolor</i> *	Nuna sphingid	Sphingidae (7)	December-January, April-November	Nuna
<i>Herse</i> (= <i>Agrius</i>) <i>convolvuli</i> (Linn.)*	Pulse horn worm		December-January, June-November	Cowpea, <i>Pillepesara Boerhavia diffusa</i> (weed)
<i>Hippotion celerio</i> (Linn.)*	Grapevine sphingid		December	
<i>Theretra gnoma</i> (Fabr.)*	Sphinx moth		September-November	
<i>Ambulyx pagana</i> *	Pungam sphingid		December-November	
<i>Cephonodes hylax</i> (Linn.)*	Humming Bird hawk moth		March-April, July-September, November	
<i>Acherontia styx</i> (Westwood)*	Sesamum horn worm		December-January, April-November	
<i>Actias selene</i> (Hb.)*	Moon moth	Saturniidae (1)	September-November	Sesamum, Brinjal
<i>Hypsa.ficus</i> (F.)*	Fig moth	Hypsidae (3)	December, July-November	
<i>Argina cribraria</i> (C.)*	Hairy caterpillars (Crotolaria)			
<i>A. syringa</i> *		Hypsidae	December, July-September	<i>Crotolaria</i> spp
<i>Hyblaea puera</i> (Cr.)*	Teak defoliator		July-October	<i>Crotolaria</i> spp
<i>Aegocera venulia</i> (Cr.)*		Hyblaeidae (1)	December, June-September, November	Teak
<i>Nephopteryx eugraphella</i> (Rag.)	Chickoo moth	Agaristidae (1)	December, June-September, November	
<i>Azygophleps scalaris</i> (F.)*	Sebania stem borer	Phycitidae (1)	July-August	Sapota (New flush)
<i>Stauropus alternus</i> (Wlk.)*	Lobster caterpillar	Cossidae (1)	July-September	Agathi stems
<i>Macaria fasciata</i> (Fabr.)*		Notodontidae (1)	August-September	
<i>Thalassodius quadraria</i> (Guen.)*	Brown looper	Geometridae (4)	June, August-November	
<i>Semiothisa pervolgata</i> (W.) *	Green looper		December-January, May-November	
<i>Gnamptoloma aventiaria</i> *	Wasp moth		June-November	
<i>Syntomis</i> (= <i>Amata</i>) <i>thoracica</i>		Syntomidae/Amatidae (1)	June-November	
<i>Chilo</i> sp*	Stem borer	Crambidae (1)	December-February, August, October-November	
<i>Clina basalis</i> *		Unidentified	July-August	
<i>Bomolocha vestita</i> *		Unidentified	December-January, March-August	
Unidentified 10*			August-September	
Unidentified 11*			September	
Unidentified 12*			August-September	
Unidentified 13*			July-August	

Figures in parentheses denote number of species, * Attracted to light trap and light source., Attracted to pheromone trap

Noctuidae and Pyralidae was reported by Mathew and Rahamathulla (1995) from Silent Valley National park, Kerala and maximum number of butterfly species collected belong to the family Nymphalidae (Mathew and Rahamathulla, 1993) from Silent Valley National Park, Kerala. Nymphalidae followed by Lycaenidae reported by Bhalodia *et al.* (2002a and 2002b) from Vansda National Park and Ratanmahal Wildlife Sanctuary, Gujarat

Crop pests

Among the 131 species recorded, eight species of butterflies were pest on agricultural crops *viz.*, three Hesperids and one Satyrid on rice, one Pierid on green manure and one Nymphalid on oilseed crop (castor), two Lycaenids on pulses. Four species were recorded as pests of horticulture crop *viz.*, two Papilionids on citrus and curry leaf and two Lycaenids on guava, whereas the others were found to feed on weed plants and others were collected by sweep nets. The Pyralids recorded from the study area have been reported to infest field crops. Among which six species were observed to be the pest of rice, one each on cotton, sesame, pulse, amaranth, moringa, jasmine, cucurbits, sweet potato, brinjal and *Tabernaemontanae*, which were also reported to occur in Kerala as observed by Mathew and Menon (1984).

Among the 30 Noctuids recorded, many of them were found to infest more than a single crop *i.e.*, seven species common to both cotton and bhendi. *S. inferens* found to damage rice and other millets, which was also reported by Pathak (1968) and Ragini *et al.* (2000). Two species *viz.*, *A. irrotata* and *E. hemirrhoda* occurred on pulse, two species *viz.*, *A. janata* and *P. algira* found to damage castor was also reported by Sevastopulo (1940b) and one species *A. olivacea* infested brinjal, also reported by Sevastopulo (1946b) and *P. glaucinans* on green manure. Similar findings were also reported by Sevastopulo (1940b). Among the Arctiids, *C. gangis* is a pest of rice, which is confirmed by the record made by Rao *et al.* (1969) and *U. pulchella* on sunhemp confirmed by the report of Trehan (1957). Among the Lymantrids, *P. pennatula* was a pest of rice also reported by Rao *et al.* (1969). *Laelia exclamationis* and *P. xanthorrhoea* also rarely damage rice crop and the same was reported by Rao *et al.* (1969). *E. mollifera*, the moringa hairy caterpillar is a defoliating pest, the Pterophorid *E. atomosa* is a pest of redgram and *H. convolvuli* is a Sphingid pest of pulse, is in accordance with the earlier findings of Sevastopulo (1942). *A. styx* is a pest of brinjal and sesame. This pest has already been reported by Sevastopulo (1946a) on sesame and pulses. The Hypsids, *A. syringa* and *A. cribraria* are pests of crotolaria, also reported by Sevastopulo (1978).

The chikoo moth, *N. eugraphella* is a specific pest of sapota and *A. scalaris* (cossid) is a pest of *S. grandiflora*, which were also reported by Gardner (1945). The other species recorded were pest of trees and weeds.

Food plants of Moths

Pyralidae

C. medinalis and *M. patnalis* larvae were recorded on rice which was also confirmed by the report of Rao *et al.* (1969) and Mathew and Menon (1984) from Kerala. The leaf roller *S. derogata* was recorded on cotton, bhendi and hibiscus, which was also reported on bhendi and balsa trees (Mathew and Menon, 1984) and cotton and Malvaceae plants (Sevastopulo, 1946a) which confirms the report of the present study *i.e.*, larvae are feeding on Hibiscus leaves. *G. glauculalis* larvae were found feeding on the leaves of *Tabernaemontanae* which was confirmed as its food plant from the report of Mathew and Menon (1984) from Kerala. Similarly the food plant of *N. blitealis* was confirmed as moringa by the report of Mathew and Menon (1984). *S. incertulas*, a major pest of rice is in agreement with the reports of Mathew and Menon (1984). *L. orbonalis* was recorded in *S. melongena* and *S. tarvum* while Lall (1964) and Das and Patnaik (1970) reported it on *S. melongena* as the host. *A. catalaunalis* and *H. recurvalis* recorded in gingelly and amaranth respectively which are in agreement with the report of Mathew and Menon (1984). The weed plants Saranai and *A. viridis* were found to be the hosts of *H. recurvalis* from the present study. *E. indicus* was found to feed on pumpkin, cucumber, watermelon, whereas cucumber was reported as food plant by Mathew and Menon (1984) (Table 1 and 2).

Noctuidae

S. litura was found feeding on cowpea, castor, amaranth, *A. viridis* and bhendi. This is in confirmation with the report of Sevastopulo (1956a) who described this insect as polyphagus. *E. vittella* recorded on host plant like cotton, bhendi and *Abutilon indicum* which is in agreement with the reports of Sevastopulo (1940b) and Cherian and Kylasam (1946) who reported the same genera *viz.*, *E. insulana* and *E. fabia* on the above hosts. *A. irrotata* was recorded on cowpea, *A. janata* larvae was found feeding on castor, rose and *E. hirta* which is in agreement with Sevastopulo (1956 b) who reported it on castor, Pruthi and Mani (1945) on Dudhi *E. hirta*, Banyan and Ber (Tables 1 and 2).

H. armigera was found on bolls of cotton, bhendi fruits, heads of sunflower and an ornamental flower *G. pulchella*. *S. inferens* a polyphagous Noctuid borer found to infest

millets and also rice. This is in agreement with the report of Pathak (1968) who stated it as polyphagous, whereas Ragini *et al.* (2000) recorded it on rice. *A. flava* recorded on bhendi and cotton, whereas it was reported on malvaceous plant *viz.*, Kasthuri bhendi by Rajashe karagouda *et al.* (1984). *A. olivacea* a specific pest of brinjal recorded in this region was in agreement with the report of Sevastopulo (1946b) (Table 2). *P. glaucinans* recorded on *Sesbania* spp whereas Sevastopulo (1940b) reported it on a leguminous tree and by Trehan (1957) on daincha.

Lepidopterans attracted to light

Among the butterflies two Satyrids *viz.*, *M. subdita* and *M. leda leda*. two Nymphalids *viz.*, *P. lemonias lemonias*, *P. iphita iphita*, two Hesperiid *P. mathias mathias*, *P. guttatus guttatus* and three Lycaenids *viz.*, *Z. maha ossa*, *E. lacturnus syntala*, *E. cnejus* were observed when they were attracted to lights (Table 1 and 2). This in accordance with Shull and Nadkerny (1964) who reported five species of Satyrids and one Lycaenid attracted to the mercury vapour lamp light at Surat Dangs, Gujarat. Nair (2001) has reported that *E. cnejus* was attracted to light at Aralam Wildlife Sanctuary, Kerala.

Among the moths 86 species were attracted to light, 18 were Pyralids, 27 were Noctuids, eight were Lymantrids, six were Arctiids, two were Eupteroptids, one species of each belonging to Pterophoridae, Saturniidae, Cossidae, Notodontidae, Crambidae, four were Geometrids, three Hyspids, six Sphingids and four were unidentified species (10,11,12,13) and two others were not grouped under any family *viz.*, *B. vestita* and *C. basalis* whereas Sevastopulo (1935) reported 91 species of Pyralids from Calcutta that were attracted to light and 15 moths were attracted to light at Gopalpur by Sevastopulo (1940a), whereas Mathew and Rahamathulla (1995) recorded 318 species belonging to the nineteen families from Silent Valley National Park, Kerala and Mathew and Menon (1984) reported that 108 species out of 155 species of Pyralid were attracted to light.

Shannon-Weiner index

The diversity values of H' during December 2003 was 1.95 for butterfly families and which was lowered to 1.28 during January 2004. Then an increased trend was recorded for the month of February (1.98), which then showed a decreasing trend till May (1.94). Then there was a sudden increase during June with 1.96 and it showed a slight decrease of 0.01 during July. There was an increase during the month of August with 1.99. During September, October, February the diversity indices were 1.98, 1.96 and 1.98 respectively.

From the above result, it is inferred that the occurrence of species of different families were highly diversified during the month of August, followed by September, November, February, followed by October, June. The diversification of families had a similar trend during the months of December and July. The families showed least diversification during the month of February, followed by April, May, March which indicated that the evenness of species in the families.

The diversity index for the months December 2003- November 2004 were 1.73, 1.56, 1.37, 1.32, 1.35, 1.51, 1.71, 1.79, 1.89, 1.82, 1.71 and 1.73. Among which the extent of diversification was high during August (1.89) followed by September (1.82), July (1.79). Same extent of diversification was registered during December 2003 and November 2004. Least diversification was registered during March (1.32), followed by February and January. There was a decreasing trend from December to March, after which the diversified nature of the families were on the increasing trend up to August, followed by a decreasing trend till October. The overall index value of 'H' for the year was 1.89 ± 0.057 for the butterfly families and 1.62 ± 0.053 in case of the diversity of moth families which indicated the greater diversification of the butterfly families.

Simpson's index (α)

The Simpson's index (α) of diversity in respect of butterfly family was low during the month of January, which indicated the least diversification among the families. During May the Simpson's index (α) was 0.130 followed by October, June and July. During the months of November and December the diversified nature of the butterfly families recorded and the same trend (0.116) was observed during March, September and April. The high degree of diversification was noticed during August and February.

The moth families were with registered diversity index, wherein there was a decreasing trend of the index values from February to June and a constant increase in the values of diversity from July to October with a decline during August month. The highest diversification was registered during June. The diversification of families was low during February with an increase in diversification from February to June. During December, January and September diversification were higher than that compared to that of March and April. The overall index of ' α ' for the study period was 0.13 ± 0.009 for butterfly families and 0.29 ± 0.004 for moth families. The value of index is lower in case of butterfly families.

Evenness index (E)

The overall evenness (E) was 0.95 ± 0.004 and 0.72 ± 0.018 for butterfly and moth families. The less value registered by moth families is close to zero than the butterfly families which indicates higher degree of evenness in case of families of the Heterocerans.

The evenness index (E) of 0.96 was registered during the months of April, May and August, which indicated that there was no evenness in the butterfly families. The evenness of 0.95 was registered during February, September and November and 0.94 during December, June, July and October. The evenness was more during the month of January (0.92) and March (0.93). There was an increasing trend of evenness value from March to May and declined during June and then an increase from June to August. This indicated that the evenness of the families was on a decreasing trend from March to May and more evenness during June and decrease of evenness from June to August. From September till October there was an increasing nature of evenness.

The evenness of the moth families had a decreasing trend from December to April. Evenness during January, February, March were 0.71, 0.76, 0.82 respectively. Low degree of evenness was observed during April. There was a decreasing trend of evenness value from April to November, which indicated that evenness was less during April, and increasing trend of evenness of families up to November. The degree of evenness (E) of the moth families was high for the month of November. The evenness index (E) for May, June, July, August, September, October were 0.78, 0.74, 0.68, 0.67, 0.66, and 0.65 respectively. The overall index of evenness was 0.95 ± 0.004 and 0.72 ± 0.020 for the butterfly and moth families respectively. This indicated the evenness of the occurrence of moth families was more even than that of the butterfly families.

The Evenness index (E) of the families did not tend towards zero during any of the month, which indicated that there was no even occurrence of families. In case of family evenness of butterflies it was more or less similar during all the months ranging between 0.92-0.96, whereas in case of the moths, it ranged between 0.64-0.84. The least family evenness was observed during November, since a maximum number of families of moths were observed during the month of November, minimum number of families during the month of April. On comparing the evenness butterfly families exhibited less evenness than the moth families.

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