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Preliminary checklist of moths (Lepidoptera: Glossata) of Annamalai Nagar, Tamil Nadu

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Abstract
The present research was carried out to document the moth fauna of Annamalai Nagar during December, 2015 to November, 2016 comprising four seasons for a period of one year, from agriculture and horticulture ecosystems using light traps and host rearing methods. The sheet method was used to record moth insects individually without any damage. Any moths that alight on the screen were recorded in jars just after sunset between 18.00 – 23.00 hr. A total of 2,679 moths were recorded using all the three types of methods employed in the study. Out of which, light trap was found with maximum of 2,253 moths followed by manual collection (369) and host rearing (57) from four different sites of observation. Among the sites, light trapping of moths were observed maximum (656) in Orchard followed by Experimental farm with 629 numbers. The diversity of moths was observed in the study area of Annamalai Nagar indicated the presence of 70 genera and 56 species identified under nine superfamilies of Clades *viz.,* Obtectomera (Pyraloidea and Thyridoidea) Macroheterocera (Noctuoidea, Bombycoidea, Geometroidea, Lasiocampoidea) Apoditrysia (Pterophoroidea and Cossoidea) Ditrysia (Tineoidea). The families namely Crambidae, Erebidae, Noctuidae, Sphingidae, Bombycidae, Uraniidae, Thyrididae, Eupterotidae, Geometridae, Pterophoridae, Lasiocampidae, Cossidae and Psychidae were observed in the study area. Out of which, the family Erebidae alone had 28 genera and 25 species and found to be the superior family. From the results, it was clear that light trapping was superior in collection of moths during night times.

Keywords: Checklist, Diversity, Fauna, Light trap, Moths

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INTRODUCTION

More than half of the world's known animal species are insects (Wilson, 1992) in which Lepidoptera is the second largest and the most diverse order of the class Insecta (Benton, 1995). The present total number of Lepidopteran named species approaches nearly 1,74,250, with butterflies and skippers estimated to comprise around 17,950, and moths making up the rest (Mallet, 2007). In India, estimated moth species were 11,300 according to Peter Smetacek (2011). Earlier, the order Lepidoptera was divided in to two suborders *viz*., Rhaphalocera and Heterocera. The moths, which have important role in forest ecosystems as herbivores and as food for various predatory and parasitic organisms. Moths are commonly nocturnal, holometabolous and phytophagous insects. They occur in all kinds of habitats including natural forests, grasslands, agro-horticulture fields and crop plantations. The moths are very familiar to mankind on account of their beautiful appearance, dark coloration, size and plant relationship. The dense covering of scales on the wings not only gives the order its scientific name, but also forms the basis for the attractive colour patterns present in many species (Kristensen, 2007). Moths are cosmopolitan in distribution occurring in every conceivable habitat from plains to deserts, forest, valley and mountains (Gurule *et al*., 2011). A combination of features has conspired to render the Lepidoptera as one of the most studied groups of organisms.

The moths provide valuable ecosystem services such as pollination of crepuscular and night blooming flowering plants and their role as prey in

food chain. These insects are often considered as bio - indicators in biological studies because they are sensitive to habitat change, whose function, population, or status can reveal the qualitative status of the environment. Being primary herbivorous insects, they help in natural control of weeds in an agro-ecosystem. The larvae of moths are active devourer of the tender parts of host plants hence, they are often recognized as pests of variety of crops, vegetables and forest plantations. Therefore, they are treated as economically important insects (Shah and Mitra, 2015). Many investigators have used Lepidoptera as model to assess the impact of disturbance and management practices on various ecosystems (Brehm, 2005).

The current knowledge on the insect fauna of moths is largely based on earlier studies by pioneer workers like Hampson (1892). A series of revisionary studies have been subsequently carried out from different geographical regions. The moths available in Mumbai, Pune and other localities in western India have been largely worked by Cotes and Col.C. Swinhoe followed by Gardner who reported immature stages of Indian Lepidopterans especially Noctuidae, Hypsidae *etc.* Research on moths of different regions was mostly carried out before 1950 (De Niceville and Marshall (1990), Bingham (1905, 1907), Bell (1919), Bell and Scot (1937), Mani (1986) and Talbot (2013). Extensive faunistic surveys, along with proper identification and documentation, at least to species level, provide the most reliable data for conservation and management of different habitats. No such survey has so far been done in coastal areas of Tamil Nadu related to diversity and population abundance of moths. Hence, understanding the functional role of the indicator groups like moth insects of this region will have a great relevance in assessing the status of ecosystems in the environment. Therefore, a study was undertaken to account the moth fauna and to prepare a checklist of moths of Annamalai Nagar, Tamil Nadu.

MATERIALS AND METHODS

The present research was carried out in the Department of Entomology, Faculty of Agriculture, Annamalai University, Annamalai Nagar. The study area, Annamalai Nagar is located at 11.39°N 79.71°E and 4.680 mts. MSL in Cuddalore district of Tamil Nadu state. It has a tropical climate and an average temperature ranges between 25^0C to 35^0C during summer (March to May). Winters are very cool with maximum temperature of about 30^0C and a minimum of about 22^0C. The moth insects were recorded from the experimental farm, garden land, orchard and new area of Annamalai Nagar during December, 2015 to November, 2016 comprising four seasons and for a period of one year. For manual collection, the moths were also recorded from light source during night times in possible residential places of Annamalai Nagar.

The sheet method was used to record moth insects individually without any damage. A white cloth sheet (10'×6') was hung between two vertical poles in such a way that it was just above (half foot) the surface and extended forward over the ground slightly away from direct source of light placed at such a point that the whole sheet from edge to edge brightly reflected the light. A 100 watt Tungsten lamp was used as a light source (Chandra and Sambath, 2013). Any moths that alight on the screen were recorded in jars just after sunset between 18.00 – 23.00 hr. The light trap was operated twice a week in the locality and the moths alight on the screen were recorded. Single specimens from each species were collected and identified in the laboratory. The location of the light trap was changed from time to time within the ecosystem. Only one light trap was used to document the moth's diversity in each ecosystem. In host rearing method, the larvae of moths collected from the field and orchards were reared with their respective food material. The dried leaves were replaced with fresh ones frequently and waste bits and pieces were removed. For soil pupating caterpillars, soil was put into the rearing polythene cover. After adult emergence, they were collected and preserved for identification.

The adults were caught in the insect cover with a piece of cotton dipped in ethyl acetate or chloroform or the captured specimens were introduced into killing bottle. The specimens were pinned using entomological pins (Size 000/001/002/003) obtained from Rescholar Equipments, Haryana. Setting boards were used to spread the wings of specimen in the correct position, until the body is thoroughly dry. A permanent data label (20 x 10 mm or 15 x 10 mm) showing the precise locality, the date of capture and the collector's name was attached to every specimen. The data was printed neatly on archival white card. After pinning, spreading, drying and labeling; the specimens were placed permanently in the store boxes and kept in entomological cabinets at Lepidoptera Research Laboratory, Department of Entomology, Annamalai University. The collected moth specimens were diagnosed after clearing the wings using the procedure given by Triplehorn (1989), following the key characters of Hampson (1892, 1893, 1894, 1895, 1896) and Holloway (1989), their current nomenclature based on LEPINDEX (Beccaloni *et al.,* 2003). The hierarchy of different families of moths was based on the classification by Nieukerken Van *et al*. (2011).

RESULTS AND DISCUSSION

The results revealed that a total of 2,679 moths were recorded from the study area in both agriculture and horticulture ecosystems during December 2015 to November 2016. The moths were

Table 1. Moths recorded in Annamalai Nagar during December 2015 to November 2016 by using various methods.

S.N.	Methods	Total Numbers
1	Light trap	2,253
2	Host rearing	57
3	Manual collection	369
	Total	**2,679**

Table 2. Moths recorded at different sites in Annamalai Nagar using light trap during December 2015 to November 2016.

S.N.	Sites of observation	Total numbers
1	Experimental Farm	629
2	Garden land	541
3	Orchard	656
4	New area	427
	Total	**2,253**

Table 3. Preliminary check list of moth fauna of Annamalai Nagar during December 2015 to November 2016.

S.N.	Family	Sub family	Common name	Scientific name
I	**Crambidae**			
1		Acentropinae	Rice case worm	*Parapoynx stagnalis* (Zeller)
2		Pyraustinae	Snout moth	*Isocentris* sp.
3		Schoenobiinae	Rice stem borer	*Scirpophaga incertulas* (Walker)
4		Spilomelinae	Swan plant moth	*Boccchoris onychinalis* (Guenee)
5			Rice leaf folder	*Cnaphalocrocis medinalis* (Guenee)
6			Cucumber moth	*Diaphania indica* (Saunders)
7			Shoot and fruit borer	*Leucinodes orbonalis* (Guenee)
8			Bean pod borer	*Maruca vitrata* (Fabricius)
9			Bean leaf roller	*Omiodes* sp.
10			Sweet potato vine borer	*Omphisa* sp.
11			Green moth	*Parotis* sp.
12			Green moth	*Parotis* sp.
13			Banded pearl	*Sameodes cancellalis* (Zeller)
14			Beet webworm moth	*Spoladea recurvalis* (Fabricius)
II	**Erebidae**			
15		Aganainae	Tropical tiger moth	*Asota caricae* (Fabricius)
16		Anobinae		*Plecoptera* sp.
17		Arctiinae	Fly like moth	*Amata* sp.
18			Tiger moth	*Amerila astrea* (Drury)
19			Yellow peach moth	*Argina astrea* (Drury)
20			Hairy caterpillar	*Creatonotes gangis* (Linnaeus)
21			Lichen moths	*Lyclene* sp.
22			Hairy caterpillar	*Olepa ricini* (Fabricius)
23				*Rajendra vittata* (Moore)
24			Salt and pepper moth	*Utetheisa lotrix* (Cramer)
25		Calpinae	Fruit sucking moth	*Eudocima homaena* (Hubner)
26			Fruit sucking moth	*Eudocima materna* (Linnaeus)
27			Fruit sucking moth	*Eudocima phalonia* (Linnaeus)
28			Fruit piercing moth	*Thyas coronata* (Hubner)
29		Catocalinae	Cotton semi looper	*Anomis flava* (Fabricius)
30			Owl moth	*Anticarsia irrorata* (Fabricius)
31		Erebinae	Fruit piercing moth	*Achaea serva* (Fabricius)
32			Jig saw moth	*Bastilla torrida* (Guenee)
33			Triangular striped moth	*Chalciope mygdon* (Cramer)
34			Black triangle moth	*Grammodes geometrica* (Fabricius)
35				*Hypena* sp.
36			Noctuid moth	*Hypopyra verspertilio* (Fabricius)
37			Sugarcane looper	*Mocis frugalis* (Fabricius)
38			Brown striped semi-looper	*Mocis undata* (Fabricius)
39			Indian owlet moth	*Spirama retorta* (Clerck)
40		Lymantriinae	Tussock caterpillar	*Artaxa guttata* (Walker)
41			Tussock moth	*Calliteara grotei* (Moore)
42			Yellow tail	*Euproctis* sp.
43			Tussock moth	*Euprotis* sp.
44			Brown tussock moth	*Olene mendosa* (Hubner)
45			Clearing tussock moth	*Perina nuda* (Fabricius)
46				*Somena* sp.

Contd.....

III	**Noctuidae**			
47		Acontiinae		*Acontia crocata* (Guenee)
48		Eariadinae	Shoot and fruit borer	*Earias vittella* (Fabricius)
49		Heliothinae	American bollworm	*Helicoverpa armigera* (Hubner)
50		Noctuinae	Army worm	*Mythimna loreyi* (Duponchel)
51			Tobacco caterpillar	*Spodoptera litura* (Walker)
52			Swarming caterpillar	*Spodpotera mauritia* (*Boisduval)*
IV	**Sphingidae**			
53		Macroglossinae	Common bumble bee hawk moth	*Cephonodes hylas* (Linnaeus)
54			Oleandar hawk moth	*Daphnis nerii* (Linnaeus)
55			Impatiens hawk moth	*Hippotion* sp.
56			Tersa sphinx moth	*Hippotion* sp.
57			Humming bird hawk moth	*Macroglossum* sp.
58		Smerinthinae	Velvet hawk moth	*Clanis* sp.
59		Sphinginae	Greater death' s head hawk moth	*Acherontia lachesis* (Fabricius)
60			Lesser death' s head hawk moth	*Acherontia styx* (West wood)
61			Convolvulus hawk moth	*Agrius convolvuli* (Linnaeus)
V	**Bombycidae**			
62		Bombycinae	Silk moth	*Bombyx mori* (Linnaeus)
63				*Trilocha* sp.
VI	**Uraniidae**			
64		Microniinae	Spotted swallow tail moth	*Micronia aculeta* (Guenee)
VII	**Thyrididae**			
65		Striglininae	Sapodilla borer	*Banisia myrsusalis* (Walker)
VIII	**Geometridae**			
66		Ennominae	Geometrid moth	*Chiasmia eleonora* (Hubner)
67			Tussock moth	*Eucyclodes* sp.
68			Black looper	*Hyposidra talaca* (Walker)
69			Pale oak beauty	*Hypomecis punctinalis* (Scopoli)
70		Geometrinae	Plae green moth	*Nemoria* sp.
71		Sterrhinae	Riband wave	*Idaea aversata* (Linnaeus)
72			Flower webber	*Eublemma* sp.
73			Cream wave moth	*Scopula floslactata* (Haworth)
IX	**Pterophoridae**			
74		Pterophorinae	Plume moth	*Exelastis atomosa* (Walsingham)
X	**Lasiocampidae**			
75		Pinarinae	Jamun lappet moth	*Metanastria* sp.
XI	**Eupterotidae**			
76		Eupterotinae	Hairy caterpillar	*Eupterote mollifera* (Moore)
XII	**Cossidae**			
77		Metarbelinae	Bark borer	*Indarbela tetraonis* (Moore)
XIII	**Psychidae**			
78		Oiketicinae	Bagworm moth	*Eumeta* sp.

identified belonging to the order Lepidoptera as their body, wings and appendages were densely clothed with overlapping scales. Further, they were classified under the suborder Glossata because of the presence of coiled tongue (haustellum) for sucking nectar and absence of mandibulate mouth parts in adults. The suborder Glossata was further identified to clades *viz.,* Obtectomera, Macroheterocera, Apoditrysia and Ditrysia. The moths recorded were further categorized under nine superfamilies and 13 families based on Nieukerken Van *et al*. (2011) classification. The results of moths recorded from the study area of Annamalai Nagar during December 2015 to November 2016 using various methods are furnished in Table 1. A total of 2,679 moths were recorded using all the three types of methods employed in the study. Among various methods, light trap method could help to collect maximum of 2,253 moths followed by manual collection (369) and host rearing (57). It indicated that a share of 84% moth observed only through light trapping (Fig. 1). From the results, it is clear that light trap was superior in collection of moths during night times. Similar findings were reported by Chandra and Sambath (2013) who found that light trap is an efficient method to attract nocturnal moths. The same results were also obtained by Gadhikar *et al.* (2013) who found that moths were effectively collected during night times with the help of light

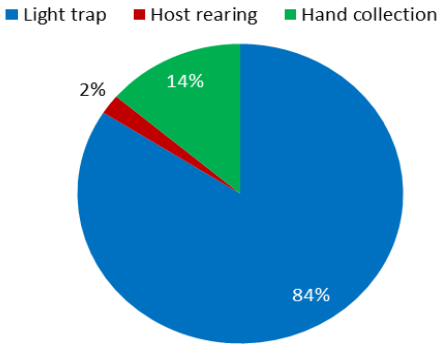

Fig.1. *Moths recorded in Annamalai Nagar using various methods during December 2015 to November 2016.*

trap erected in the collection area. The results are in tune with the findings of Fry and Waring (1996) that have collected noctuid moths with the help of light traps fitted at different places during night time.

The results of the moths recorded from the study area during December 2015 to November 2016 using light trap were witnessed maximum (656) in Orchard followed by Experimental farm with 629 numbers among the four sites of collection. The other sites like garden land and new area were found to contain suit 541 and 427 numbers respectively during all the four seasons (Table 2). This might be due to continuous presence of vegetable crops and also fruit tree crops in the locality; and also weed plants around the orchard. The results corroborate with the findings of the Pavithradharani (2016) who found that light trapping was suitable for collection of moths in orchards and also in hilly tracts. The other methods like host rearing will be useful only for certain available species in the vicinity whereas the manual collection will yield only limited species only when it is abundant.

The diversity of moths was observed in the study area of Annamalai Nagar during 2015 to 2016 indicated the presence of 70 genera and 56 species identified under nine superfamilies of Clades *viz.,* Obtectomera (Pyraloidea and Thyridoidea) Macroheterocera (Noctuoidea, Bombycoidea, Geometroidea, Lasiocampoidea) Apoditrysia (Pterophoroidea and Cossoidea) Ditrysia (Tineoidea) and 13 families namely Crambidae, Erebidae, Noctuidae, Sphingidae, Bombycidae, Uraniidae, Thyrididae, Eupterotidae, Geometridae, Pterophoridae, Lasiocampidae, Cossidae and Psychidae were observed in the study area (Table 3). Out of which, the family Erebidae alone had 28 genera and 25 species and thus was found to be the superior family followed by Crambidae (13), Sphingidae (07) and Noctuidae (05). This may be due to the least number of cropping and less rain fall in the study area lead to lack of crops in both the ecosystems. Similar results were obtained by Gurule *et al.* (2013) that Eribidae was the dominant family out of the five families recorded under the super family Noctuoidae. The results are different from that reported by Chandra and Sambath (2013) who found that out of 250 morpho- species of moths collected in the Tawang District of Arunachala Pradesh, in which 102 species and 81 genera were under 12 diversified families. The family Geometridae dominated with 48% of total species recorded followed by Erebidae (26%).

Conclusion

A total of 70 genera and 56 species were identified from the study area, out of which the family Erebidae alone had 28 genera and 25 species and found to be the superior family. Among the methods employed for observation, light trap was found to be the best than other methods. However, an extensive survey with other sampling methods including, crepuscular netting, baiting, larval searching, diurnal nectaring and malaise trapping may yield new record to get a detailed periodic estimate of the faunal diversity of moths in this area.

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