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Diversity of mosquito species in plantation areas of mananthavady, wayanad district of Kerala

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Abstract
A survey on the diversity of mosquito species in plantation areas of Mananthavady municipal area was conducted for six months from February- July 2016. Larvae and adults of the mosquitoes were collected and identified by running appropriate keys. A total of 17 mosquito species belonging to 6 Genera, namely, *Anopheles*, *Culex*, *Aedes*, *Armigeres*, *Uranotaenia* and *Tripteroides* were identified. *Aedes* (10) was the most dominant genus followed by *Culex* (3), *Anopheles* (1), *Uranotaenius* (1), *Tripteroides* (1) and *Armigeres* (1) respectively.

Keywords: Mosquito, plantation, *Aedes*, *Anopheles*, *Culex*, *Armigeres*, *Uranotaenia*, *Tripteroides*

1. Introduction
Diptera represents one of the largest orders of insects with more than 85,000 species including a large number of disease vectors [1]. Mosquitoes are prominent among these which are placed under the sub-order Nematocera and family Culicidae. Mosquitoes are found throughout the world except in places that are permanently frozen. Altogether 3150 species of mosquitoes have been reported globally [2, 3, 4]. Mosquitoes rank predominantly first as the most harmful hematophagous insects on earth. According to WHO, 1995, mosquitoes are recognized as vectors of several dreadful disease causing organisms from animals to man. In recent years, vector-borne diseases (VBD) have emerged as a serious public health problem in countries of the South-East Asia Region, including India because of unplanned urbanization, industrialization and excessive population growth coupled with rural to urban migration. Mosquitoes are found in all types of environments associated with lentic aquatic habitats forbreeding such as sewage water, stagnant water, septic tanks etc. [5] and natural and artificial containers such as pools, gutters, coconut shells, tree holes, bamboo stumps, leaf axils, water tanks and so on [6, 7]. The major roles as vectors have been recognized in the genera namely, *Culex*, *Anopheles* and *Aedes* with regard to human health.
Kerala has been abode to different species of mosquitoes, viz. *Aedes*, *Culex* and *Anopheles* which causes allergies, serious diseases and deaths at alarming rates. Apart from the role as vectors, many are a cause of serious concern to the general population owing to their blood feeding habit. Malaria, Filariasis, Japanese Encephalitis (JE), Dengue fever and Dengue haemorrhagic fever (DHF) are the major mosquito borne diseases in India. The problem of dengue has now been extended to newer areas including several rural areas. Wayanad district is notorious for dengue and there has been no systematic study of vector and non-vector mosquito fauna carried out. Hence, an attempt has been made to survey the mosquito species diversity in Mananthavady Muncipal area of Wayanad district

Methods
Study area
The current investigation was carried out at Mananthavady municipality of Wayanad District of Kerala, located at 4550 feet above sea level. The survey was done for duration of six months from February-July 2016. The area is semi terrestrial with vivid floral diversity including paddy, Coffee, Pepper, Banana, Areacnut, Cashew, Rubber, Tea, Cardamom, Ginger and Coco. The site equally harbours rich faunal diversity ranging from minute soil arthropods to large animals. The area was selected owing to the occurrence of mosquitoes outnumbering other forms of life.

The presence of ponds, stagnant water bodies associated with paddy fields and unhealthy disposal and dumping of wastes are few of the various reasons for the high species diversity of this area. Adult mosquitoes collected from various habitats in 15 selected spots of the study area, were, Mananthavady, Ambuthi, Vanjodu, Kanchirankad, Makkiyad, Paleri, Purinjimala, Kallodi, Periya, Kammana, Anchukunnu, Thonichal, 4th mile, Dwaraka and Kuttimoola.

Sample collection

The larvae of mosquitoes were collected mainly by dipping, using ladle and pipetting. The collected larvae were transferred to the labeled containers and kept for emergence. Adult collection was done using light traps, aspirator and sweep net. The mosquitoes were then transferred to labeled containers and preserved for taxonomic studies.

Results and Discussion

High species diversity and species richness of mosquitoes were recorded in the study area. Adult mosquitoes were collected from all the 15 selected spots of the study area. A total of 17 species belonging to 6 genera were identified and recorded. Of them, *Aedes* was the most predominant genus with 10 species followed by C*ulex* (3), *Anopheles* (1), *Uranotaenius* (1), *Tripteroides* (1), and *Armigeres* (1). In light trap collections majority were *Culex* and *Armigeres* (Table1). Most of the *Aedes*, *Armigeres* and *Uranotaenius* were collected by hand collection (Fig.1).

Genus *Aedes* represented by *Aedes albopictus*, *A. vittatus*, *A. aegypti*, *A. (Finlaya) macdougalli*, *A. (Finlaya) psuedotaeniatus*, *A. (Finlaya) cogilli*, *A. (Finlaya) chrysoleneatus*, *A. novalbopictus*, *A. pseudalbopictus* and *A. subalbopictus*. Genus *Culex* include *Culex quinquefasciatus*, *C. titaeneorhyncus* and *C. (lophoceratomya)* sp. While the other genera *Anopheles*, *Uranotaenius* and *Tripteroides* were represented by single species namely *A. elegans*, *U. stricklandi* and *T. affinis* respectively. Out of 867 specimen collected majority were *Aedes* (422) followed by *Armigeres* (258), *Culex* (162), *Tripteroides* (12), *Uranotaenia* (8), *Anopheles* (8) and in the descending order (Table 2).

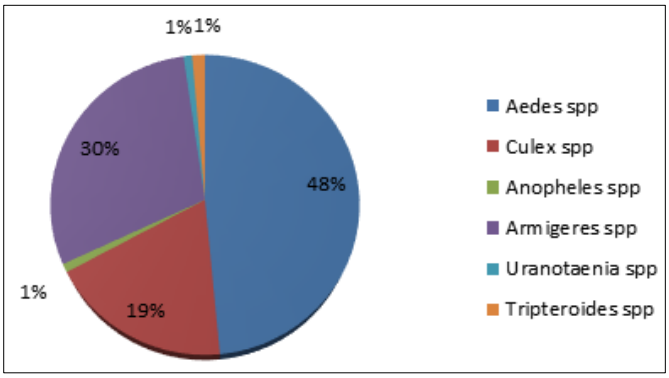

Fig 1: Mosquito species composition in the study area

Table 1: Species Composition of Collected Mosquitoes.

Sl. No.	Genus	No of species
1	*Aedes*	10
2	*Culex*	3
3	*Armigeres*	1
4	*Anopheles*	1
5	*Uranotaenia*	1
6	*Triperoides*	1

Table 2: List of mosquito species present in the study area.

Sl. No	Genus	Species	Number	Percentage
1	*Aedes*	*A. albopictus*	365	42
		A. aegypti	15	1.7
		A. vittatus	12	1.38
		A. pseudotaeneatus	8	0.92
		A. chrysolineatus	6	0.69
		A. macdougalli	4	0.46
		A. cogilli	5	0.58
		A. novalbopictus	2	0.23
		A. psuedoalbopictus	4	0.46
		A. subalbopictus	1	0.11
2	*Culex*	*B. quinquefasciatus*	136	15.68
		C. tritaeneorynchus	22	2.53
		D. lophoceratomyiaspp	4	0.46
3	*Anopheles*	*A. elegans*	5	0.57
4	*Uranotaenia*	*U. stricklandi*	8	0.92
5	*Tripteroides*	*T. affinis*	12	1.38
6	*Armigeres*	*A. sabalbatus*	258	29.76
		Total	867	100

According to White [8] mosquitoes are grouped on their preference to breeding habitats, which emphasized the ability of different species to select their breeding habitat. They are capable of occupying a wide variety of habitats, fresh water, brackish water, or any water (clear, turbid or polluted) except in marine habitats with high salt concentration. Majority of the mosquitoes collected in this study prefer fresh water for their breeding. *Aedes* mosquitoes, also known as floodwater mosquitoes, lay eggs on damp soils or in dry tree holes and containers rather than on standing water. Boorman [9] observed the appearance of pupae of *Aedes vittatus*in rock-pools four days after rain. Larval population of *Aedesa egypti* and *Aedes albopictus* has been recorded in rock pools, streams, canals, containers and tree holes which is in

agreement with the present study as these where the predominant breeding habitats of the study area.

*Armigeres subalbatus*is commonly found close to human dwellings especially in sub- urban areas with poor sanitation. According to Pramanic *et al*. [10], suitable breeding habitats for *Armigeres* are water bodies often polluted and closely associated with human habitation. Gautam, *et al*., [5] showed that cemented tank is one of the breeding habitats for *Armigeres subalbatus. Culex* mosquitoes prefer highly polluted habitat like drainsand larvae of this genus are found in habitats like artificial containers, flood pools, rock pools, irrigation ditches and stream margins.

Yadav, *et al.* [11] discussed that temporary (hoof print, riverbed pools), semi-permanent (small pools, paddy fields,irrigation canals and channels) andpermanent (pond, river, wells, andintra domestic sources) habitats are the majorbreeding sites of *Anopheles*mosquitoes. *Anopheles elegans* were seen in shady places associated with areacnut trees, since the area was rich with Areacnut plantations.

This study has provided information about diversity and breeding habitats of different mosquitoes in Mananthavady Municipal area. This would be helpful for the sustainableManagement of vector mosquitoes and to take precautionary measures against Mosquito borne diseases.

Conclusion

The current investigation was an attempt to unveil thespecies diversity, distribution and breeding grounds of mosquitoes in various plantations at Mananthavady Municipal area in Wayanad District of Kerala. Among the six genera collected, genus *Aedes* proved to be the most predominantwith highest species abundance in all the collections retrieved.Rainy season and pooling of water in the study area was one of the most decisive factorsthatadded to increase infecundity rateand promoted breeding of mosquitoes, especially *Aedes* spp. and *Culex* spp. In addition, factors like temperature, humidity and other related climatic attributes also exerted vital influence in the observed species variation. Further studies on this line are necessitated.

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