



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2019; 7(3): 324-326

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Received: 14-03-2019

Accepted: 18-04-2019

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Species diversity of tree hole breeding mosquitoes (Diptera: Culicidae) in Wayanad district, Kerala

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Abstract

A survey of tree holes in Wayanad district of Kerala was conducted from June 2017 to November 2018. Out of 112 tree holes encountered during the survey 55 (49.1%) were with rain water. All the 55 tree holes were positive for mosquito breeding. A total of 7 species of mosquitoes under five genera viz., *Aedes albopictus*, *Aedes chrysolineatus*, *Armigeres subalbatus*, *Culex brevipalpis*, *Culex quinquefasciatus*, *Heizmannia chandi* and *Toxorhynchites splendens* were obtained from these habitats. *Culex brevipalpis* was found breeding in 50 sites (90.9%), *Aedes chrysolineatus* in 43 sites (78.2%), *Aedes albopictus* in 41 sites (74.5%); *Heizmannia chandi* in 30 sites (54.55%), *Armigeres subalbatus* in 23 sites (41.8%), *Culex quinquefasciatus* in 10 sites (18.2%) and *Toxorhynchites splendens* in 2 sites (3.6%). Co-breeding of 2 to 5 species were observed in 53 habitats. The breeding of *Aedes albopictus*, the vector of Dengue and Chikungunya in the tree holes calls for serious attention from the Public Health authorities.

Keywords: mosquito diversity, tree hole, dengue, chikungunya, wayanad

1. Introduction

Phytotelmata or water filled cavities in a terrestrial plant supports a unique community of flora and fauna including mosquitoes^[1]. Tree holes, leaf axils, pitchers of carnivorous plants, and bamboo internodes are some of the important categories of phytotelmata^[2]. Among them tree holes are the most important breeding habitats of mosquitoes. There is a large body of literature on mosquitoes breeding in tree holes around the world, especially from tropical countries^[3]. In an extensive study in the Western Ghats of Kerala, Tamil Nadu and Karnataka from July 2010 to October 2013 Munirathinam *et al.* observed 11 phytotelmata habitats and 124 species of mosquitoes breeding in them^[4]. Among them tree holes with 99 species had supported maximum number of species. There are a few more studies on tree hole breeding mosquitoes from various parts of India including Kerala^[5-11]. One of the common features of tree hole mosquito fauna is the presence of the genus *Aedes*, especially, *Aedes albopictus*, the vector of Dengue, Chikungunya and Zika viruses. The breeding of *Aedes aegypti* was also observed in Pondicherry^[5]. Since the state of Kerala in South India is endemic to dengue and chikungunya, the knowledge on the status of mosquito diversity in tree holes assumes strategic importance for the control of these diseases. Against this backdrop a survey of tree holes in Wayanad district of the state was carried out from June 2017 to November 2018. The selection of Wayanad district was done deliberately as 74.18 % geographical area of this district is covered by forests as per 2017 estimate, which is the highest in the state (Source: ENVIS, Kerala).

2. Materials and Methods

Study area: Wayanad district is located in the North-Eastern side of Kerala state and is bordered by Karnataka to north and north-east, Tamil Nadu to south-east, Malappuram district of Kerala to south, Kozhikode district to south-west and Kannur district to north-west. It has a total area of 2132 square kilometers of which 74.18% is covered by different kinds of forests. According to 2011 census it has a population of 817420. It is set high on the Western Ghats with altitudes ranging from 700 to 2100. Surveys were done in 16 localities viz., Chembilode, Kattikulam, Kainatty, Madakkimala, Mananthavadi, Koyileri, Kakkavayal, Meenangadi, Muttill, Nadavayal, Kenichira, Marankav, Kalpetta, Pulppally, Ambalavayal and Sulthan Batheri. Care was taken to ensure representation from all geographically distinct areas of the district. All the areas selected were human settlements.

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Mosquito survey: Mosquito surveys were conducted randomly throughout the district. Tree holes from the ground level to a maximum 10 feet were selected for the study. Immature stages of mosquitoes from shallow holes were collected by droppers. For collecting from deep tree holes siphoning method was used. For this purpose one meter long flexible plastic tubes were used. The samples were transported to the laboratory in plastic containers on the same day of collection.

Rearing: The immature stages were transferred to culture bowls for rearing. The larvae were fed on dog biscuit powder.

Identification: The adult mosquitoes emerged from the samples were identified using standard dichotomous key [11, 12].

3. Results and Discussion

Species diversity: A total of 112 tree holes on 18 species of trees were encountered during the survey. 55 of these (49.1%) contained rain water. All the 55 tree holes were positive for mosquito breeding. Seven species of mosquitoes under five genera viz., *Aedes albopictus*, *Aedes chrysolineatus*, *Armigeres subalbatus*, *Culex brevipalpis*, *Culex quinquefasciatus*, *Heizmannia chandi* and *Toxorhynchites splendens* emerged from the samples (Table-1). *Culex brevipalpis* was found breeding in 50 sites (90.9%), *Aedes chrysolineatus* in 43 sites (78.2%); *Aedes albopictus* in 41 sites (74.5%); *Heizmannia chandi* in 30 sites (54.55%); *Armigeres subalbatus* in 23 sites (41.8%); *Culex quinquefasciatus* in 10 sites (18.2%) and *Toxorhynchites splendens* in 2 sites (3.6%). (Table-1).

Co-breeding: Except in 2 tree holes co-breeding of 2 to 5 species were observed in all tree-holes. Combination of 2-5 species was observed in 94.6% of tree-holes. Combination of 2 species was found in 18.2% of tree holes; 3 species in 29.1%; 4 species in 10.9% and 5 species in 38.2% tree holes. *Aedes chrysolineatus*, *Aedes albopictus*, *Culex brevipalpis*, *Heizmannia chandi* and *Armigeres subalbatus* co-bred on maximum occasions (29.1%) followed by *Aedes chrysolineatus*, *Culex brevipalpis* and *Heizmannia chandi* (14.5%).

The results amply prove the importance of tree holes as a major breeding habitat of mosquitoes in Wayanad as breeding was encountered in 49.1% of the tree holes surveyed. Among

the species emerged *Aedes albopictus* is a major vector of Dengue and Chikungunya. The high frequency of its breeding (74.5%) indicates its preference for tree holes. *Culex quinquefasciatus* is the primary vector of *Wuchereria bancrofti*, the nematode parasite causing Lymphatic filariasis in the state. Since this species breeds in large densities in larger habitats with polluted water tree holes cannot be considered as an important habitat. *Armigeres subalbatus* is a suspected vector of *Wuchereria bancrofti* and Japanese Encephalitis [13-14]. However, similar to *Cx. quinquefasciatus* the contribution of tree holes for the proliferation of this species is also not significant. Surveys in tree holes of three North Kerala districts in 2010 generated similar results except that breeding of *Aedes chrysolineatus* and *Culex quinquefasciatus* was not encountered⁹. Tewari and Hiriyani (1992) described a new species of mosquito viz., *Aedes rubenae* which was collected from tree holes in Wayanad [10]. However, this specimen species was not found during the present study. In an earlier study Munirathinam *et al.* reported as many as 98 species of mosquitoes from tree holes in the hill ranges of Western Ghats spanning three southern states [4]. The low count of species in the present study could be due to the smaller geographical area and also the low density and diversity of trees compared to the forest areas in which the above studies were conducted.

Co-breeding of mosquitoes to the extent of 5 species in a single hole indicates the nutrient richness of this habitat. Tewari and Hiriyani also reported co-breeding of species but there is no data on the species supported by a single hole¹⁰. The observation that *Aedes chrysolineatus* has a slight edge over *Aedes albopictus* in the frequency of breeding (78.2% and 74.5% respectively) is a unique finding. Though Munirathinam *et al.* also reported breeding of *Aedes chrysolineatus* it was only approximately 12% as that of *Aedes albopictus*. Hence, this phenomenon can be considered unique to Wayanad and calls for detailed studies. If the former species has a numerical upper hand in terms of successful emergence, it could be considered as a candidate for the competitive suppression of the latter species as the former is not a disease vector.

The fact that tree holes provide a suitable niche for the proliferation of *Aedes albopictus*, the vector of Dengue and Chikungunya necessitates specific attention from Public Health authorities while planning strategies for the control of the above diseases.

Table 1: Mosquitoes breeding in tree-holes of Wayanad district

S. No.	Mosquito species	Number of tree holes (%)
1	<i>Culex brevipalpis</i>	2 (3.6)
2	<i>Culex brevipalpis</i> , <i>Toxorhynchites splendens</i>	2 (3.6)
3	<i>Aedes albopictus</i> , <i>Culex brevipalpis</i>	2 (3.6)
4	<i>Aedes albopictus</i> , <i>Culex quinquefasciatus</i>	2 (3.6)
5	<i>Aedes albopictus</i> , <i>Armigeres subalbatus</i>	1 (1.8)
6	<i>Aedes chrysolineatus</i> , <i>Culex quinquefasciatus</i>	1 (1.8)
7	<i>Aedes albopictus</i> , <i>Heizmannia chandi</i>	1 (1.8)
8	<i>Aedes chrysolineatus</i> , <i>Culex brevipalpis</i>	1 (1.8)
9	<i>Aedes albopictus</i> , <i>Culex brevipalpis</i> , <i>Culex quinquefasciatus</i>	2 (3.6)
10	<i>Aedes chrysolineatus</i> , <i>Culex brevipalpis</i> , <i>Heizmannia chandi</i>	8 (14.5)
11	<i>Aedes chrysolineatus</i> , <i>Aedes albopictus</i> , <i>Culex brevipalpis</i>	6 (10.9)
12	<i>Aedes chrysolineatus</i> , <i>Aedes albopictus</i> , <i>Culex brevipalpis</i> , <i>Armigeres subalbatus</i>	6 (10.9)
13	<i>Aedes chrysolineatus</i> , <i>Aedes albopictus</i> , <i>Culex brevipalpis</i> , <i>Heizmannia chandi</i> , <i>Armigeres subalbatus</i>	16 (29.1)
14	<i>Aedes chrysolineatus</i> , <i>Aedes albopictus</i> , <i>Culex brevipalpis</i> , <i>Culex quinquefasciatus</i> , <i>Heizmannia chandi</i>	5 (9.1)
	Total	55

4. Conclusion

This study has brought out the significance of tree holes as an important breeding habitat for mosquitoes in Wayanad District, especially *Aedes albopictus*, the vector of Dengue and Chikungunya. The observation of *Ae. chrysolineatus* as a competitor species to *Aedes albopictus* is another important outcome of this study that requires further probing.

5. Acknowledgement

The authors wish to acknowledge the facilities provided by the Principal, Government College, Madappally to carry out this work.

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