

## RESEARCH NOTE

# MEDICALLY IMPORTANT MOSQUITOES IN THE RUBBER PLANTATION BELT OF CENTRAL KERALA, INDIA

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**Abstract.** Entomological surveys were carried out in the rubber plantation belt of Kerala to record mosquito fauna. Samples were collected from 23 randomly selected localities using standard methods for a period of three years, from February 2008 to January 2011. Thirty-two species belonging to nine genera: *Aedes*, *Anopheles*, *Armigeres*, *Coquillettidia*, *Culex*, *Heizmannia*, *Mansonia*, *Toxorhynchites*, and *Uranotaenia* were recorded. Many of the recorded species were medically important as potential vectors of dengue fever, chikungunya, Japanese encephalitis, malaria and filariasis.

**Keywords:** mosquito fauna, breeding habitat, plantation, India

### INTRODUCTION

Central Kerala (comprised of Kottayam, Ernakulam, Idukki, and Pathanamthitta districts) is considered to be the rubber center of India. Rubber trees are extensively cultivated in the mid-land and lower elevation of high-land areas of central Kerala. Mosquito-borne diseases such as dengue fever (DF) and chikungunya (CG) have caused serious public health problems in the rubber plantation area.

In Kerala, DF was first reported from the rubber plantation area of central Kerala in 1997 (Tyagi *et al*, 2002). Since then, DF cases have been routinely reported from that area. Chikungunya, which appeared

in epidemic form in 2006, added a new dimension to the entire scenario of mosquito-borne diseases in the plantation belt of Kerala. Central Kerala was the worst affected with CG in Kerala (Kannan *et al*, 2009; DHSK, 2011). Japanese encephalitis, malaria and filariasis have also been reported from the area (DHSK, 2011).

Little is known about the mosquito vectors in the rubber plantation belt of central Kerala. The main objective of the present study was to record the mosquito fauna, especially vectors, in the rubber plantation belt of central Kerala.

### MATERIALS AND METHODS

The rubber plantation belt of Kottayam and Idukki districts of central Kerala was selected for the survey. The study area is situated between latitude 9° 15' and 10° 21', and longitude 76° 22' and 77° 25', and naturally divided into mid-land and

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mid-upland/high land areas, respectively.

Agriculture is the livelihood of the majority in the area, and rubber is the major crop cultivated. Paddy, coconut, tapioca, pineapple, plantain, ginger, tubers, vegetables, pepper, coffee, coco, areca nut, and so forth are cultivated marginally in the study belt (Idukki District, 2012; Kottayam District, 2012). The study area has a tropical climate with an average annual rainfall of 3,664 mm, temperature ranging from 23°C to 32°C, and relative humidity ranging from 73% to 88%, during the study period.

The present study was conducted by sample surveys for a period of three years, from February 2008 to January 2011. Adult mosquitoes were collected from 23 randomly selected localities by expending 92 manhours per year. Samples were collected from indoors and outdoors of human dwellings and animal sheds using an aspirator and flashlight from 6 PM to 9 PM and 7 AM to 11 AM (WHO, 1975). Adult specimens were narcotized with petroleum ether and identified using relevant taxonomic references (Barraud, 1934; Sirivanakarn, 1976; Das *et al.*, 1990; Reuben *et al.*, 1994; Reinert, 2000). Along with adult collection, immature samples were also collected from their natural breeding habitat using dippers and pipettes (WHO, 1975; Service, 1993). Collected immatures were allowed to emerge for easy identification.

## RESULTS

Thirty-two species belonging to nine genera: *Aedes*, *Anopheles*, *Armigeres*, *Coquillettidia*, *Culex*, *Heizmannia*, *Mansonia*, *Toxorhynchites*, and *Uranotaenia* were recorded from the study area (Table 1). Genus *Culex* was predominant with a maximum of 14 species followed by *Aedes* (6), *Anopheles* (4) and *Mansonia* (3). Genus *Armigeres*,

*Coquillettidia*, *Heizmannia*, *Toxorhynchites* and *Uranotaenia* were represented by one species each.

Seven thousand sixty-six adult mosquitoes were collected during the study. Genus *Culex* alone constituted 40.69% of the total, followed by *Aedes* (29.48%), *Armigeres* (20.35%), and others (9.48%).

Larval habitats of 27 species of mosquitoes were also detected during the study. Major habitats were the rubber latex collecting containers, discarded coconut shells, various types of containers, and tree holes. Breeding was also observed in drains, ground pools, rock pools, canals, paddy fields, tanks, and other minor habitats.

Many species were found to exploit different types of breeding habitat. Dominant species such as *Ae. albopictus* Skuse, *Ar. subalbatus* (Coquillett) and *Cx. quinquefasciatus* Say were found in more than 10 habitats during the present study. Twelve species each were observed in rubber latex collecting containers and discarded coconut shells.

## DISCUSSION

A detailed study of the mosquito fauna of rubber plantations of central Kerala had not been undertaken before, except for some surveys conducted in search of dengue vectors at the time of disease outbreaks. The area had a rich and diversified mosquito fauna with 32 species (Table 1). *Ae. albopictus* was the most predominant species with 1,478 mosquitoes (20.92%), followed by *Ar. subalbatus* with 1,438 mosquitoes (20.35%), *Cx. tritaeniorhynchus* Giles with 839 mosquitoes (11.87%), and *Cx. quinquefasciatus* with 616 mosquitoes (8.72%). These four species together constituted 61.86% of the total, and the remaining 28 species constituted only

Table 1  
Mosquito species composition and relative abundance.

Mosquito species	Immature mosquitoes collected	Adult mosquitoes collected	%
<i>Aedes (Stegomyia) aegypti</i> Linnaeus	-	2	0.03
<i>Aedes (Stegomyia) albopictus</i> Skuse	+	1,478	20.92
<i>Aedes (Finlaya) chrysolineatus</i> Theobald	+	221	3.13
<i>Aedes (Finlaya) niveus</i> Ludlow	+	24	0.34
<i>Aedes (Aedimorphus) vexans</i> Meigen	+	181	2.56
<i>Aedes (Fredwardsius) vittatus</i> Bigot	+	177	2.50
<i>Anopheles (Anopheles) barbirostris</i> Van der Wulp	+	5	0.07
<i>Anopheles (Anopheles) nigerrimus</i> Giles	+	4	0.06
<i>Anopheles (Cellia) subpictus</i> Grassi	+	9	0.13
<i>Anopheles (Cellia) vagus</i> Doenitz	-	8	0.11
<i>Armigeres (Armigeres) subalbatus</i> Coquillett	+	1,438	20.35
<i>Coquillettidia (Coquillettidia) crassipes</i> Van der Wulp	-	22	0.31
<i>Culex (Culex) bitaeniorhynchus</i> Giles	+	384	5.43
<i>Culex (Eumelanomyia) brevipalpis</i> Giles	+	153	2.17
<i>Culex (Lutzia) fuscans</i> Wiedemann	+	23	0.33
<i>Culex (Culex) fuscocephala</i> Theobald	-	4	0.06
<i>Culex (Culex) gelidus</i> Theobald	+	215	3.04
<i>Culex (Lophoceratomyia) minutissimus</i> Theobald	+	3	0.04
<i>Culex (Culiciomyia) pallidothorax</i> Theobald	+	193	2.73
<i>Culex (Culex) pseudovishnui</i> Colless	+	72	1.02
<i>Culex (Culex) quinquefasciatus</i> Say	+	616	8.72
<i>Culex (Culex) tritaeniorhynchus</i> Giles	+	839	11.87
<i>Culex (Lophoceratomyia) uniformis</i> Theobald	+	230	3.26
<i>Culex (Culex) univittatus</i> Theobald	+	32	0.45
<i>Culex (Culex) vishnui</i> Theobald	+	45	0.64
<i>Culex (Culex) whitmorei</i> Giles	+	66	0.93
<i>Heizmannia (Heizmannia) chandi</i> Edwards	+	17	0.24
<i>Mansonia (Mansonioides) annulifera</i> Theobald	-	30	0.42
<i>Mansonia (Mansonioides) indiana</i> Edwards	+	80	1.13
<i>Mansonia (Mansonioides) uniformis</i> Theobald	+	446	6.31
<i>Toxorhynchites (Toxorhynchites) splendens</i> Wiedemann	+	34	0.48
<i>Uranotaenia (Pseudoficalbia) novobscura</i> Barraud	+	15	0.21
Total		7,066	100.00

38.14% of the total catches (Table 1).

The purpose of vector surveys was to assess the potential for disease outbreak and the risk to public health. Of the 32 species of mosquitoes collected, 19 have been found to be vectors of various diseases in many parts of the world. Of the

14 *Culex* species collected during the study, 9 are known vectors in India. *Cx. vishnu* Theobald, *Cx. pseudovishnui* Colless, and *Cx. tritaeniorhynchus* are the common vectors of JE in different parts of the country (Reuben *et al*, 1994). *Cx. gelidus* Theobald *Cx. quinquefasciatus*, *Cx. whitmorei* Giles,

*Cx. bitaeniorhynchus* Giles, *Cx. fuscocephala* Theobald and *Cx. fuscans* Wiedemann have also found to be vectors of JE (Mourya *et al*, 1989; Dhanda *et al*, 1997). *Cx. tritaeniorhynchus* is identified as the primary JE vector in Kerala (Arunachalam *et al*, 2004). *Cx. quinquefasciatus* is a primary vector for bancroftian filariasis and suspected vector of JE (Mourya *et al*, 1989).

Of the six *Aedes* species recorded, *Ae. aegypti* (L.) is the well-known primary vector of DF and CG. In Kerala, *Ae. albopictus* is recognized as the primary vector and plays a significant role in transmission of DF and CG (Thenmozhi *et al*, 2007; Kanann *et al*, 2009). *Ae. niveus* Ludlow has been incriminated as secondary vector of DF in some parts of the world (Huang, 1979). *Ae. vittatus* Bigot and *Ae. aegypti* have been identified as the main vectors of yellow fever in many parts of the world (Bruce, 2005).

Genus *Mansonia* was represented by three species. *Ma. annulifera* Theobald, *Ma. indiana* Edwards, and *Ma. uniformis* Theobald have been incriminated as secondary vectors of JE in Kerala (Dhanda *et al*, 1997; Arunachalam *et al*, 2004). They have also been implicated as vectors of brugian filariasis in the former Travancore area of Kerala as early as 1932 (Iyengar, 1938).

No primary vector of malaria was detected from the study area. However, *An. subpictus* Grassi is a suspected vector for malaria in India, and *An. barbirostris* Van der Wulp is a vector for malaria in Indonesia (Wattal and Kalra, 1961). *An. barbirostris*, *An. nigerrimus* Giles, and *An. subpictus* are vectors of human filariasis in India (Nagpal and Sharma, 1995). JE virus was isolated from *An. subpictus* during the JE outbreak in Kerala in 1996 (Dhanda *et al*, 1997).

Almiron and Brewer (1996) pointed out that the type of habitat is the main

characteristic that explains the observed variations among mosquito species. Many types of habitats were noted during the survey, and many species exhibited a high degree of adaptive flexibility to diverse breeding habitats. Major species such as *Ae. albopictus*, *Ar. subalbatus*, and *Cx. quinquefasciatus* had wider breeding habitat preferences. This breeding adaptability might be the one possible reason for their abundance in the study area. Latex collecting cups were a readily available habitat for the breeding of many species during rainy season.

Agro-climatic conditions of the study area support a rich and diversified mosquito fauna. High relative humidity, moderate temperature, and high rainfall, along with crops such as rubber, coco, pineapple, coconut, paddy, and areca nut make suitable conditions for mosquito breeding and proliferation. Source reduction through modification or eradication of habitat with the participation of community and local governments is recommended for the control of mosquitoes and subsequently the mosquito borne-diseases.

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