EXCELLENT PUBLISHERS

International Journal of Current Research and Academic Review

ISSN: 2347-3215 Volume 2 Number 4 (April-2014) pp. 43-49

www.ijcrar.com

Bioecology and Vectorial Capacity of Aedes mosquitoes (Diptera: Culicidae) in Irinjalakuda Municipality, Kerala, India in Relation to Disease Transmission

K.Misvar Ali, A.V.Asha and E.M.Aneesh*

Communicable Disease Research Laboratory, St. Joseph's College, Irinjalakuda, Kerala, India-680121

***Corresponding author**

KEYWORDS

Mosquito,
Aedes,
Habitat,
Vector,
Disease,
Dengue,
Irinjalakuda

A B S T R A C T

The larval habitats of mosquitoes were investigated in Irinjalakuda, Thrissur in order to determine the breeding sites of the existing mosquito fauna belong to *Aedes* and its possible public health implications on the residents of the Municipality. It has been officially reported that the study area is a disease prone zone having affected by 117 Chickunguniya, 779 Dengue, and 1419 Malaria cases for the last eight years. Thirty habitat spots were randomly selected and sampled using plankton nets, dippers, and pippets. Eight species of *Aedes* mosquitoes were encountered namely *Ae. scatophagoides, Ae. pseudotoeniatus, Ae. longerostris, Ae. eagypti, Ae. vittatus, Ae, albopictus, Ae. Walbus* and *Ae. Vexanus.* Out of these, *Ae. eagypti, Ae. vittatus, Ae, albopictus,* and *Ae. Vexans* are potential vectors of communicable diseases. The study site provided diverse habitats to *Aedes* species such as tree hole, cemented tanks, stream pools, fountains, ditches, mud pot, plastic containers, tyers, plant pot, rocky pool, pods, nuts, tin, flower bracts, internodes, latex collecting containers, bowls, duck weed ponds, coconut shell, leaf axils, temporary pools, fish ponds, bamboo and containers. Progressing history of disease outbreak by *Aedes* species in the study area inspire an intensification of the vector surveillance activities.

Introduction

Mosquito-borne diseases remain a major problem in the world, particularly in tropical and subtropical regions. These diseases contribute significantly to disease burden, death, poverty, and social debility in tropical countries (Young-Su *et al.*, 2002). Mosquitoes are the carrier of a number of vector-borne diseases, such as malaria, filariasis, yellow fever, brain fever, dengue fever, etc. (Jaswanth *et al.*, 2002).

Among the thirteen genera of the family Culicidae, genus *Aedes* is considered dangerous because of their significant public health threat all over the world (Rajesh *et al.*, 2013). *Aedes* species are important vectors of yellow fever, dengue, encephalitis viruses and many other arboviruses, and in a few restricted areas they are also vectors of *W. bancrofti* and *B. malayi* (Kandaswamy *et al.*, 2012). In recent years the average annual incidence of dengue-related serious disease in many tropical countries has been rising dramatically, with the infection becoming endemic in areas where its occurrence was once sporadic (Surya *et al.*, 2007). In India, Dengue fever and Dengue Hemorrhagic Fever has been documented in different parts of the country including southern India **(**Kabilan *et al.*, 2003). The population of *Aedes* species fluctuates with temperature, rainfall and humidity. Dengue infections were generally encountered during or after rainfall, as an outcome of rise in vector population (Pandya, 1982). An explosive outbreak due to an arthropod-borne virus, chikungunya virus (CHIKV), affected for the first time in 2005– 2006 numerous islands in the Indian Ocean and notably La Reunion Island where one third of the population was infected (Renault *et al.*, 2007).

Biological control at the larval stage of development of mosquitoes is one of the techniques which affords a cheap, easy to use, and environment friendly method of disease control. These disease situations can be best tackled by improving the knowledge about the vectors. The information could aid in the risk assessment of diseases transmitted, and the planning of control measures in support of disease control programmes. Since good health is a prerequisite to economic development, there is the need to focus on these vectors in order to put them in the right perspective. In the light of their economic importance, this study was undertaken to assess the mosquito species types in the study area, their vectorial capacity, and the habitat characteristics that offer them proper breeding environment.

Materials and Method

Mosquito Larvae were collected from 30 different habitats both natural and artificial using plankton nets, dippers, and pippets. Dippers and plankton nets were used in open sources and pippets in tree holes for sampling. All the sampling sites were visited periodically. Collections from each site were maintained separately in suitable containers and allowed them to emerge. Adult specimens were narcotized with petroleum ether following identification using systematic keys and catalogues of Barraud (1934) and Christophers (1933), catalogue of Stone and Knight (1959 and Rao (1981).

Result and Discussion

Mosquito larvae were collected from 30 selected spots in Irinjalakuda municipal area during the study period. A total of eight species belong to genus *Aedes* were identified and recorded. *scatophagoides, pseudotoeniatus, longerostris, eagypti, vittatus, albopictus, walbus, vexanus* were the representing species of *Aedes*. The *Aedes* species were preferred different habitats which offered them apt microenvironment for better proliferation.

Among the eight collected species of *Aedes* mosquitoes, four species were known to have vector status. These species include *Aedes aegypti, Ae. albopictus, Ae. vittatus* and *Ae. vexans. Ae. aegypti* is the primary vector of Dengue and Chikungunya. They are also reported having potential ability to spread Yellow fever and West Nile Virus. *Ae. albopictus* is the secondary vector of

Dengue and transmit Chikungunya in Asia, Africa and Europe and also transmit West Nile Virus. *Ae. vittatus* is a vector of Chickungunia and Yellow fever. *Ae. vexans* is a major vector of Rift Valley Fever Virus and West Nile Virus.

In the past eight years there has been at least eleven officially recorded human death caused due to mosquito born diseases in and around the study area. Cases of major mosquito born diseases recorded include 117 chickunguniya, 779 dengue and 1419 Malaria. The pattern of outbreak of these diseases shows variation in the past years. While taking two widely spread diseases, Dengue and Malaria, the *Aedes* born Dengue shows progressive outbreak against *Anopheles* born Malaria which is having invariable occurrence in the past eight years.

Aedes aegypti is the primary vector of yellow fever (YF) and dengue fever (DF) flaviviruses worldwide (William, *et al.*, 2002). In 1998 Vincent, *et al*., suggested that Dengue viruses are transmitted principally by *Aedes aegypti* that breeds in stagnant water in all forms of receptacles in urban areas. In 1998, Zdenek and Jiri, demonstrated Transovarial transmission of the West Nile Virus by *Aedes aegypti*. In 2013, Rajesh, *et al*., reported that *Aedes vittatus* is a container breeding dengue vector, one of the dominant species in Tiruchirappalli district, Tamil Nadu, India. *Ae. vittatus* facilitate circulation of Chikungunya virus (Mawlouth Diallo, 1999). *Aedes albopictus* can carry and transmit dengue virus acting as an important dengue vector in rural areas (Vincent *et al.*, 1998). According to Michel, *et al.*, in 2002, *Aedes albopictus* is susceptible to WNV. *Ae. albopictus* is a competent experimental vector of seven Alphaviruses: Chikungunya, eastern equine encephalitis (EEE), Mayaro, Ross River, western equine encephalitis, Venezuelan equine encephalitis, and Sindbis viruses (Chester and Carl, 1997). In 2003, Cancrini, *et al.,* suggested *Ae. albopictus* as a natural vector of *D. immitis* nematodes in Italy. In 2002, Laura *et al.*, reported that *Ae. vexans* exhibited moderate infection and transmission rates for WNV. According to Fontenille, *et al.,* 1998, *Ae. vexans* is the chief enzootic vector of RVF virus.

Agro-industrial modifications of habitats of mosquitoes along with climatic variations influence outbreak of these diseases by mosquito species as vectors in the study area. Mosquitoes utilize a great variety of water sources for breeding. These include ground pools, water in artificial containers, water holding tree holes and leaf axils. Depending upon the species involved, the distance of dispersal from breeding areas varies from a few meters to many kilometers. As a result, mosquito larvae are found in different habitats (Service, 1976). Important habitats chosen by *Aedes* species in the study area include tree hole, cemented tanks, stream pools, fountains, ditches, mud pot, plastic containers, tyres, plant pot, rocky pool, pods, nuts, tin, flower bracts, internodes, latex collecting containers, bowls, duck weed ponds, coconut shell, leaf axils, temporary pools, fishponds, bamboo and containers (Table 2).

The habitat preference by *Aedes* species has found to be similar as described by earlier studies. The major breeding habitats of *Aedes* mosquitoes are both natural and artificial containers such as temporary pools, cemented tanks, stream pools, tyres, tree holes, buckets, trashcans, planter dishes and traps (Gautam, *et al.,* 2006).

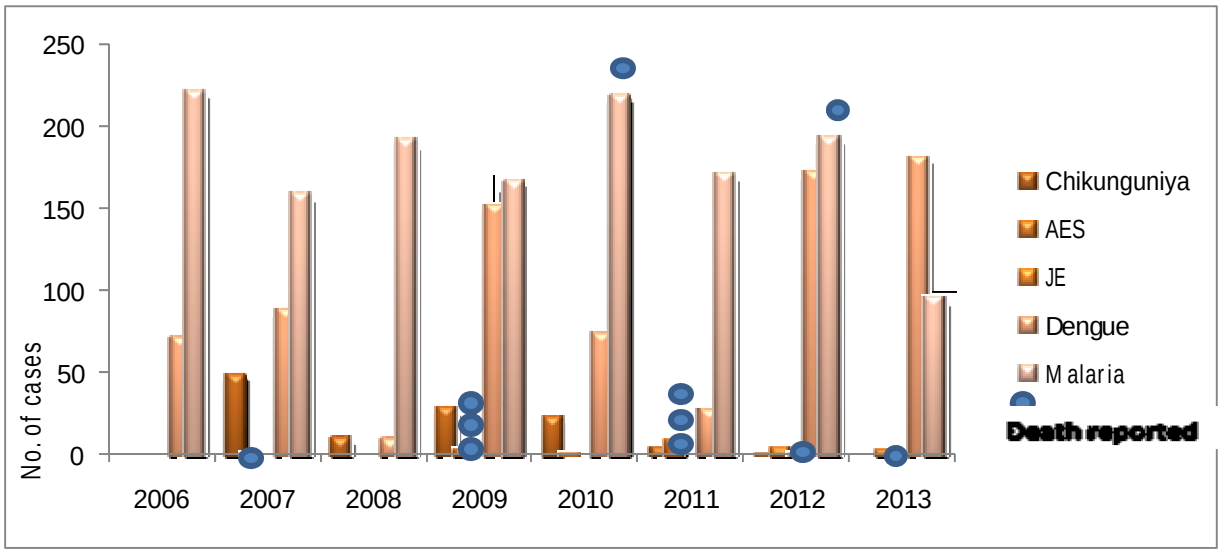
Table.1 List of collected *Aedes* species and their vector status.

Mosquito species	**Vector status**
Ae. aegypti	West Nile virus, Dengue, Yellow fever, Chikungunya
Ae. pseudotoeniatus	
Ae. longirostris	
Ae. scatophagoides	
Ae. vittatus	Chikungunya, Yellow fever
Ae. albopictus	WNV, Dengue
Ae. walbus	
Ae. vexans	Rift Valley Fever Virus, WNV

Table.2 Habitat preferences of different *Aedes* species in the study area.

Habitat	*Ae. scatophagoides*	*Ae. pseudotoeniatus*	*Ae. longirostris*	*Ae. aegypti*	*Ae. Vittatus*	*Ae. albopictus*	*Ae. walbus*	*Ae. vexans*
Tree hole		+		+	+	+		
Cemented tanks				+		+	+	
Stream pools				+		+	+	
Ditches	+							
Mud pot				+	+			
Plastic containers				+	+			
Tyers				+		+		
Plant pot				+	+			
Rocky pool					+			
Pods		+						
Nuts		+		+				
Tin						+		
flower bracts		+						
internodes		+						
latex collecting containers					+			
Bowls				+		+		
duck weed ponds			+					
coconut shell				+	+			
Leaf axils		+				+		
Temporary pools							+	+
fishponds	+		+					
bamboo						+		
containers				+		+		

Figure.1 A comparison of different mosquito borne disease cases and death reported in and around the study area for the last eight years.



The breeding habitats of *Ae. scatophagoides* are freshwater ponds and ditches (Derek, 2013). *Ae. eagypti* predominates in urban areas while *Ae. albopictus* predominates in rural areas. *Ae. aegypti* commonly breeds in artificial water containers than does *Ae. albopictus*, and it is hypothesized that during dry conditions, people may increase their use of rain water collection containers, providing areas for *Ae. aegypti* breeding (Poveda *et al.*, 1999). Pemola, *et al.*, in 2005, described *Ae. aegypti* is an urban mosquito that breed almost entirely in man-made containers found in and around households, construction sites, factories etc, and larval population has been recorded in drains, pits, streams, canals, containers, and tree holes.

Studies have shown that *Ae. albopictus* prefers to oviposit in open containers with leaf litter compared with closed containers. *Aedes albopictus* breeds in both man-made containers as well as in Natural containers such as bamboo, tree holes and leaf axils, larvae were recorded from tanks, pools, streams, containers, and tree holes (Pemola, *et al.*, 2005). *Aedes longorostris* mosquitoes mainly breed in shallow permanent pools include fishponds, duck weed ponds etc. The current study also could confirm the same preferences of habitat by *Aedes longorostris* while *Ae. vexans* prefers temporary fresh water pools . *Ae. Vittatus* prefers rock pools, tyres, coconut shell, latex collecting containers, mud pot, plant pot, plastic container, rocky pool, tank and tree hole/ tree stump (Jomon, 2009). Temporary pools, cemented tanks and stream pools are the preferred habitats of *Ae. walbus* (Gautam, *et al.*, 2006). *Ae. Pseudotoeniatus* prefers natural containers (plant origin) include tree holes, internodes, leaf axils, flower bracts, fronts, nuts and pods.

Conclusively, the presence of diverse habitats and water availability and the progressing history of disease outbreak by *Aedes* species in the study area inspire an intensification of the vector surveillance activities.

Acknowledgement

Authors are thankful to the UGC for the financial support and Principal, St. Joseph's College, Irinjalakuda for facility provided.

References

Barraud, P.J. 1934. The Fauna of British India, including Ceylon and Burma, Diptera. Vol. V. Family- Culicidae. Taylor and Francis, London.1-463.

Cancrini, A Frangipane di Regalbono, I Ricci et al., 2003. Aedes albopictus is a natural vector of Dirofilaria immitis in Italy. Veterinary Parasitology, 118: 195–202.

Chester G. and J. Carl, 1997. Aedes albopictus in the United States: Ten-Year Presence and Public Health Implications. Emerging Infectious Diseases. Vol. 3, No. 3, July–September 1997.

Christophers, S.R. 1933. The Fauna of British India, including Ceylon and Burma. v IV, Taylor and Francis, London. 1-360

Derek, J., A. Gracieta, Maria Manhaca et al., 2013. Population dynamics and spatial structure of human biting mosquitoes, inside and outside of houses, in the Chockwe irrigation scheme, southern Mozambique. Geospatial health, 7: 309-320

Fontenille, D., M. Traore-Lamizana and M. Diallo et al., 1998. New Vectors of Rift Valley Fever in West Africa, Emerging Infectious Diseases. Vol. 4, No. 2, April–June 1998.

Gautam, Aditya., K. Mihir, Premanik et al., 2006. Larval habitats and species composition of mosquitoes in Darjeeling Himalayas , India. J.Vect Borne dis, 43: 7-15.

Jaswanth, A., P. Ramanathan and K. Ruckmani, 2002. Evaluation of the mosquitocidal activity of Annona squamosa leaves against filarial vector mosquito, Culex quinquefasciatus Say. Indian J Exptl Biol, 40: 363-5.

Jomon, K. V., S. Sudharamini, and T. Thomas. 2009. Aedes mosquitoes in arboviral endemic prone area of Kottayam district, Kerala, India. ISSN: 0973-7464 vol XVI: No: 1&2 SB Academic Review:171-178.

Kabilan, L., S. Balasubramanian, S. M., Keshav, V. Thenmozhi, G. Sekar and S. C. Tewari, 2003. Dengue disease spectrum among infants in the 2001 dengue epidemic in Chennai, Tamil Nadu, India. Journal of Clinical Microbiology, 41:3919-21.

Kandaswamy Kalaivani, Sengottayan Senthil-Nathan and Arunachalam Ganesan Murugesan, 2012. Biological activity of selected Lamiaceae and Zingiberaceae plant essential oils against the dengue vector Aedes aegypti L. (Diptera: Culicidae). Parasitol Res, 110:1261–1268

Laura, B., E. Amy and K. William, 2002. Vector Competence of California Mosquitoes for West Nile virus Emerging Infectious Diseases , Vol. 8, No. 12, December 2002.

Mawlouth diallo, Jocelyn Thonnon, and Moumouni Traore-Lamizana, 1999. Vectors Of Chikungunya Virus In Senegal: Current Data And Transmission Cycles. Am. J. Trop. Med. Hyg., 60(2): 281–286

Michael J., J. David, and N. Christopher, 2008. Potential for North American Mosquitoes to Transmit Rift Valley Fever Virus. Journal of the American Mosquito Control Association 24(4):502-507.

Pandya, G., 1982. Prevalence of dengue infection in India, Defence Science Journal, 32:359-370.

Pemola Devi, N. and R. K. Jauhari. 2005. Habitat biodiversity of mosquito richness in certain parts of Garhwal (Uttaranchal), india. Southeast Asian J trop med public health. Vol 36. No:3

Poveda, G., N. E. Graham, P. R. Epstein,W. Rojas, I. D. Velez, M. L. Quinones, and P. Martens. 1999. Climate andENSOvariability associated to malaria and dengue fever in Colombia. In Proceedings of the 10th Symposium Global Change Studies. Boston: American Meteorological Society, 173–76.

Rajesh, K., D. Dhanasekaran and B. K. Tyagi, 2013. Survey of container breeding mosquito larvae (Dengue vector) in Tiruchirappalli district, Tamil Nadu, India. Journal of Entomology and Zoology Studies, 1 (6): 88-91

Rao, R. T. 1981. The Anophelines of India. Indian Council of Medical Research, New Delhi, 594.

Renault, P., J. L., Solet, D., Sissoko, E., Balleydier, and S., Larrieu, 2007. A major epidemic of chikungunya virus infection on Reunion Island, France, 2005–2006. Am J Trop Med Hyg, 77: 727–731.

Service, M. W.,1976. Mosquito Ecology Field Sampling Methods. Applied Science Publishers Limited, London .

Stone and Knight. 1959. Catalogue of World Mosquito. J. U Pub

Suaya J. et al., 2007. Dengue Burden of Disease and Cost of Illness. TDR/SWG/08.

Victor, T. J., M. Malathi, R. Asokan and P. Padmanaban, 2007. Laboratory-based dengue fever surveillance in Tamil Nadu, India. Indian Journal of Medical Research, 126:112-115.

Vincent, T. K., Y. C Chow, Chan, et al., 1998. Monitoring Of Dengue Viruses In Field-Caught Aedes Aegypti and Aedes Albopictus Mosquitoes By A Type-Specific Polymerase Chain Reaction And Cycle Sequencing. Am. J. Trop. Med. Hyg., 58(5): 578–586

William C. Black, Kristine E. Bennett, Norma Gorrochotegui-Escalante et al., 2002. Flavivirus Susceptibility in Aedes aegypti. Archives of Medical Research, 33: 379–388

Young-Su, J., K. Moo-Key and A. Young-Joon, 2002. Larvicidal activity of Brazilian plants against Aedes aegypti and Culex pipiens pallens (Diptera: Culicidae). Agric Chem Biotechnol., 45:131-4.

Zdenek Hubalek and Jiri Halouzka, 1999. West Nile Fever—a Reemerging Mosquito-Borne Viral Disease in Europe, Emerging Infectious Diseases Vol. 5, No. 5