Research Paper

Volume : 3 | Issue : 9 | September 2014 • ISSN No 2277 - 8179

A Study on Diversity of Tree-Hole Mosquitoes in Kolli Hills, Eastern Ghats, Tamil Nadu, India

Zoology

KEYWORDS : Diversity, tree hole mosquitoes, Kolli hills, Eastern Ghats.

*** Makesh Kumar C** — Ph.D Research Scholar, Division of Vector Biology, Department of Zoology Annamalai University, Annamalai Nagar Chidambaram– 608002, Tamil Nadu, India.
* Corresponding Author

Jebanesan A — Professor, Department of Zoology Annamalai University, Annamalai Nagar Chidambaram – 608002, Tamil Nadu, India.

ABSTRACT

Tree holes are host for a variety of organisms specially mosquitoes. Tree hole breeding mosquito survey was conducted from January 2013 to December 2013 in three different places at Kolli hills, Eastern Ghats, Tamil Nadu, India. A total of 3646 mosquito larvae, pupae and adults were collected during the survey. 11 species representing 5 genera were recorded in three stations. The mosquitoes collected were Culex uniformis (14.61), Aedesaegypti (12.86), Aedes albopictus (11.76), Orthopodomyia anopheloides (10.28), Ochlerostatus greenivarkanaranus (8.28), Culex quinquefasciatus (7.84), Aedes luteocephalus (7.40), Toxorhynchites viridibasis (7.15), Aedes stokesi (6.80), Toxorhynchites splendens (6.77) and Culex decans(6.19). The highest number of larvae, pupae, and adults were found in Solakkadu (1305), followed by Semmedu (1198) and least in Othakadai (1143). The collected mosquito diversity was studied by Simpson's Index and Simpson's Reciprocal Index1 / D. Most comprehensive account on bioecology, ecophysiology and ethology of the mosquitoes of the tree hole of Kolli hills has been considered as a most fundamental prerequisite for launching any attempt on the etiology of vector borne diseases prevalent in rural parts of Southern India.

Introduction

Mosquitoes are of great economic impact because they are vector for a number of diseases, such as dengue, filariasis chickungunya, malaria, yellow fever etc. and their bites are annoying and may cause allergies[1].They are found to exist and breed in a variety of habitats in almost all parts of India excluding some high altitude areas. The Eastern Ghats, Western Ghats, Himalayas, North- Eastern hills and Andamans constitutes important biodiversity areas of India[2].The Eastern Ghats of Kolli hills having high hilly terrains, foothills, deep forestation, high rainfall, high humidity, and cold climate in high altitudes are the main ecological components of this region. This region is very rich in mosquito fauna. Many areas of this region are endemic for different mosquito borne diseases like malaria, filariasis, JE, dengue in last few decades. So, the extensive survey in need for planning vector control in Kolli hills region. Insects show greater diversity due to their ability to adapt the changes in the environment. The highly adaptable insects continue to coexist with man and transmit many diseases to more than 700 million people annually [3]. Mosquitoes breed in water and a variety of habitats support their growth. However, the preference of habitats depends on the species, some mosquitoes breed in small container type breeding sites, like flower vases, discarded bottles, cans, water storage containers, disposed tyres, coconut shells, bamboo stumps, and especially in tree hole water.

Tree holes are small detritus rich aquatic habitat in the tree cavities that can be readily used as breeding sites. They provide several niches for flora, fauna and microbes, as they trap considerable amounts of organic matter [4]. Dengue, chikungunya, malaria and filariasis are of great concern to public health in India. Every year, thousands of individuals are affected and contribute to the burden of health care. Chikungunya outbreaks started in the 1960sand dwindled to sporadic cases until resurgence in 2006.Based on the data of National Vector Borne Disease Control Program (NVBDCP)[5] the number of cases reported in 2013 was about 74,454 for dengue with 167 deaths and 18,639for chickungunya. There have been few studies in India related to the species diversity and abundance of tree hole mosquitoes [6, 7,8,9]. However, no systematic studies have been conducted in the state of Tamil nadu to document the breeding of these mosquitoes. Hence a study was planned to survey tree holes in three localities in Kolli hills. *Viz*, Othakadai, Solakkadu, Semmedu. The study was conducted from January 2013 to December 2013.

Materials and Methods

The study site is situated in the Kolli hills (11 10'-11 30' N lat and 78 15'-78 30'E long) of the Eastern Ghats. The Kolli hills are covering an area of 282.99km2consists of heterogeneous vegetation, along an elevation gradient. The Kolli hills forest covered by lot of trees like, *Delonix regia, Jacaranda mimosifolia*, *Ficus benjamina,*etc with tree holes. The study was carried out in three places of forests in Kolli hills like Othakadai, Semmedu and Solakkadu.

Collection of adult mosquitoes

The mosquitoes collected from the each tree hole of the study area determined and counted for identification. The total number of mosquitoes collected from each tree hole and month in which collected was noted. The larvae were collected easily by means of small sieve, siphon or by a rubber suction tube to remove the water from the tree hole. A rubber tube about one and a half inch diameter and three feet in length with an eight inch piece of glass tubing inserted makes a satisfactory siphon [10]. Adult mosquitoes were collected by using suction-tube.

Identification of mosquitoes

The numbers of mosquitoes collected from each tree hole were counted. They emerged adults were collected and stored in vials and all the collected mosquitoes photographed in a magnified form and then identified by using standard keys [11, 12, 13]. Again the microscope was used for further identification with particular reference to the thorax, wings and hind legs**.** The voucher specimens are present in the Department of Zoology, Annamalai University, Chidambaram.

Simpson's Diversity Index (D) is used to measure the species richness and evenness in Kolli hills by using the following formula, Simpson's Index (D) measures the probability that two individuals randomly selected from a sample will belong to the same species [14]. In ecology, it is often used to quantify the biodiversity of a habitat. It takes into account the number of species present, as well as the abundance of each species. Environmental scientists use a variety of different methods to compare diversity in different ecosystems and to monitor the progress of conservation measures. One of the most popular methods is to use the relative abundance of different species to calculate Simpson's Index of Diversity. So, we have chosen Simpson's index.

$$D = \frac{\sum n (n-1)}{N (N-1)}$$

n = the total number of organisms of a particular species.
N = the total number of organisms of all species.

Simpson's Index of Diversity 1 - D

The value of this index also ranges between 0 and 1 the greater the value, the greater the sample diversity. The index represents the probability that two individuals randomly selected from a sample will belong to different species.

Simpson's Reciprocal Index 1 / D

The value of this index starts with 1 as the lowest possible. The higher the value, the greater the diversity.

Results and Discussion

Table 1. Abundance of mosquitoes in natural tree holes encountered during the study period.

Mosquito species	Othakadai			Semmedu			Solakkadu			Percentage%
	Adult	Larva	Total	Adult	Larva	Total	Adult	Larva	Total	
Aedes aegypti	78	93	171	70	86	156	63	79	142	12.86
Aedes albopictus	64	86	150	68	80	148	60	71	131	11.76
Aedes stokesi	32	58	90	30	49	79	29	50	79	6.80
Aedes luteocephalus	31	42	73	39	55	94	49	54	103	7.40
Culex uniformis	80	108	188	68	98	166	83	96	179	14.61
Culex quinquefasciatus	20	30	50	50	62	112	55	69	124	7.84
Orthopodomyia Anopheloides	46	79	125	39	70	109	60	81	141	10.28
Ochleorostatus greenivarkanaranus	38	69	107	29	48	77	50	68	118	8.28
Culex decens	18	22	40	44	53	97	39	50	89	6.19
Toxorhynchites viridibasis	40	53	93	28	49	77	38	53	91	7.15
Toxorhynchites splendens	18	38	56	33	50	83	48	60	108	6.77
Total	1143			1198			1305			100

Table 2.Diversity Index values of tree hole mosquitoes in selected places of Kolli hills.

Diversity Index	Othakadai	Semmedu	Solakadu
Simpson's Index of Diversity 1 – D	0.8910	0.9022	0.9049
Simpson's Reciprocal Index 1 / D	9.1790	10.2327	10.5152

11 species of mosquitoes belonging to five genera were encountered and recorded in tree holes of selected places like Othakadai, Semmedu and Solakkadu at Kolli hills. These species include Aedes aegypti, Ae. albopictus, Ae.stokesi, Ae. luteocephalus, Culex uniformis, Culex quinquefasciatus, Orthopodomyia anopheloides, Ochleorostatus greenivarkanaranus, Culex decens, Txorhynchites viridibasis and Toxorhynchites splendens. Observations of the monthly abundance of mosquitoes revealed that Culex uniformis is the dominant species followed by Ae. aegypti and Orthopodomyia anopheloides (Table 1). Culex uniformis had the highest relative abundance (14.61) followed by Aedes aegypti (12.86) Orthopodomyia anopheloides (10.28) and Culex uniformis (6.19). These mosquito species prefer tree holes, water for their larval development [15]. Tree holes trapping water are reported from many parts of the world. In Western Europe, most of the species of deciduous tree species have been reported to develop holes, and water- filled tree holes are important aquatic environment for insects and many other organisms [16]. In the tropics, the tree holes offer an excellent opportunity to breed mosquitoes in forest areas. Ae. aegypti breed in bamboo stumps and tree holes[17]and found in both natural and artificial container in Philippines[18].Tree hole inhabitants of the genus Culex and Aedes are generally plankton feeders. The presence of Toxorhynchites splendensis a positive sign for mosquito breeding as it is known as a predator for some other mosquito larvae [19].The highest number of mosquitoes is collected in Solakkadu. Based on the Simpson's index and Simpson's reciprocal index values are represented as 1-D = 0.9049and 10.5152 respectively in Solakkadu. Lowest mosquito species are collected from Othakadai the index values are 0.8910 and 9.1790. From the index it is concluded that Solakkadu is more endemic for the mosquito vector borne diseases in Kolli hills when compared with Semmedu and Othakadai. The biodiversity index values indicate that the closest categories in their species composition and diversity of tree hole mosquitoes in the study area. Hence, Simpson index and Simpson's reciprocal index clearly indicate Solakkadu having more vector mosquito species and we suggest to a public health organization for necessary planning vector control strategies. Human intervention in the form of forestation for cultivation and construction of buildings for tourists and others facilitated more breeding for mosquito species in the study area. Addition to decaying leaves from the neighboring trees produce chemical condition which is favorable for mosquito breeding in tree holes [20, 21]. These observations bring to light certain more fundamental aspects of mosquito ecology that may serve

as reliable background in estimating the vector potential of tree hole breeding mosquitoes of Kolli hills. Cx. uniforms and Aedes species are dominant species in Kolli hills, it is recommended that due consideration should be given for the control of mosquitoes in these less known breeding sites.

Acknowledgements
The authors are grateful to University Grants Commission for providing financial assistance and thankful to the Professor and Head, Department of Zoology, Annamalai University for the facilities provided.

REFERENCE

1. Jebanesan A, Rajasekar P, Shabir Ahmad Paul. Influence of climatic factors on the distribution of tree hole mosquitoes collected from Kashmir valley India. International Journal of Environmental Biology 2012; 2 (2); 92-96. | 2. Naeem S. Ecosystem Consequences of Biodiversity Loss: the evolution of a paradigm. Ecology 2002; 83: 1537-1552. | 3. Taubes G. A mosquito bites back. York Times magazine 1997; 24:40-46. | 4. Nadkarni NM, Mewin MC, et. al. Forest canopies, plant diversity – In: Encyclopedia of biodiversity 2001; 3: 27–40 New York. | 5. National Vector Borne Disease Control Programme. Dengue/ dengue haemorrhagic fever. 2013. http://www.nhp.gov.in/nvbdcp - accessed 16 March 2014. | | 6.Panicker KN, Rajagopalan PK. A note on tree hole breeding mosquitoes in Pondicherry Town. Indian Journal of Medical Research, 1978; 68: 610-613. | 7. Rajavel AR, Manirathinam A, Natarajan R, Vaidyanathan K. Species diversity of mosquitoes (Diptera; Culicadae) in Mangrove Ecosystem in South India. Entomon, 2001; 26: 271-277. | 8. Rajavel AR, Natarajan R, Vaidyanathan K. Mosquitoes of the mangrove forest of India, Part-I, Bhitarkanika, Orissa, Journal of the Amercian Mosquito Control Association, 2005; 21 (2): 131-135. | 9. Rajavel AR, Natarajan R, Vaidyanathan K. Mosquitoes of the mangrove forest of India, Part-IV Coringa, Andhrapradesh. Journal of the Amercian Mosquito Control Association, 2006; 21 (4): 579-581. | 10. Makesh Kumar C, Jebanesan A, Senthamarai Selvan P. Diversity and distribution of tree hole mosquitoes in Neyveli, Tamilnadu, India. Environment and Ecology 2014; 32 (2A): 794-796. | 11. Barraud PJ. The fauna of British India including Ceylon and Burma (Diptera; Culicidae). Taylor & Francis, London 1934; 5:1-463. | 12. Rao TR. The Anopheline of India (Revised edition) Malaria Research Institute, ICMR, Delhi. 1984: 1-518. | 13.Chloristopher SR. The fauna of British India including Ceylon and Burma (Diptera; Culicidae) vol IV. Tayler and Francis, London 1993; 1-360. | 14. Simpson, E. H. Measurement of diversity. Nature, 1949; 163- 688. | 15. Senthamarai Selvan P, and Jebanesan A. Survey and epidemiology of tree hole breeding mosquitoes in Annamalai University campus, Tamil Nadu, India. International journal of Current Research. 2014; 6: 6462-6465. | 16. Kitching, R. L. An ecological study water filled tree holes and their position in the woodland ecosystem. Journal of Animal Ecology. 1971; 40: 281- 302. | 17. Nasiruddin M. Mosquitoes breeding in tree holes and bamboo stumps in Dacca (East Pakistan). Pakistan. J, Hlth. 1952; 2. 110-112. | 18. Basio RG. The mosquito fauna of the Philippines (Diptera: Culicidae. Philipp. Nat. Mus. Mogr. 1971; 4.198. | 19.Furumizo RT, Rudnick A. Laboratory Studies of Toxyrhynchitessplendens (Diptera: Culicidae): Biological observations Annals of the Entomological Society of Amercia, 1978; 71(5): 670-673. | 20. Eritja RA, Escosa R, Lucientes J, Marque SE, Molina R, Roiz D, Ruiz S. World wide invansion of vector mosquito: Present European distribution and challenges for Spain. Biological Invasions 2005; 7(1): 87-97. | 21. Moore C.G. Aedes albopictus the United States: Current status and prospects for further spread. Journal of American Mosquito Control Association 1999; 15 (2): 221-227. |