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T. Mariappan
Centre for Research in Medical Entomology (ICMR), No.4. Sarojini Street, Chinna Chokkikulam, Madurai – 625 002, Tamil Nadu, India.

V. Thenmozhi
Centre for Research in Medical Entomology (ICMR), No.4. Sarojini Street, Chinna Chokkikulam, Madurai – 625 002, Tamil Nadu, India.

P. Udayakumar
Deputy Directorate of Health Services Ramanathapuram, Tamil Nadu.

V. Bhavaniumadevi
Deputy Directorate of Health Services Ramanathapuram, Tamil Nadu.

B.K. Tyagi
Centre for Research in Medical Entomology (ICMR), No.4. Sarojini Street, Chinna Chokkikulam, Madurai – 625 002, Tamil Nadu, India.

For Correspondence:
B.K. Tyagi
Centre for Research in Medical Entomology (ICMR), No.4. Sarojini Street, Chinna Chokkikulam, Madurai – 625 002, Tamil Nadu, India.

An observation on breeding behaviour of three different vector species (*Aedes aegypti* Linnaeus 1762, *Anopheles stephensi* Liston 1901 and *Culex quinquefasciatus* Say 1823) in wells in the coastal region of Ramanathapuram district, Tamil Nadu, India

T. Mariappan, V. Thenmozhi, P. Udayakumar, V. Bhavaniumadevi, B.K. Tyagi

Abstract
Mosquito-borne diseases are major public health problem in many parts of our country due to various ecology, vector bionomics, economic, socio-cultural and behavioral factors. In Ramanathapuram district of Tamil Nadu, is endemic for malaria having more than 10% *Plasmodium falciparum (Pf)* and the rest are *P. vivax (Pv)* infections and the same area is also reported for dengue/chikungunya. Vectors of malaria and dengue namely *Anopheles stephensi* and *Aedes aegypti* breeding in domestic wells reported separately elsewhere. The observation of the present study encountered, both the species found breeding together along with *Cx. quinquefasciatus* in wells in Regunathapuram, Ramanathapuram district where more cases of dengue reported in May 2014. The result of the survey, container index (CI) was found to vary between 1.09 (plastic container) and 16.67 (grinding stone) in Chinnamaya kulam whereas 3.03 (discarded container) and 20.83 (cement tank) in Regunathapuram. The overall CI values for the respective villages were not found to be statistically significant ($P > 0.05$). On the other hand, the CI values of well in Chinnamaya kulam recorded 2.78 whereas 3.85 in Regunathapuram respectively. Also, the stegomyia indices recorded in both the villages are more or less similar (i.e. House Index (HI) and Breteau Index (BI) in the respective areas (i.e. Chinnamaya kulam 16 and 16; Regunathapuram 13.11 and 16.39). The record is tinted that the adaptive capacity of *Ae. aegypti* along with other vectors of malaria and lymphatic filariasis is due to forcible behavioural change and also forecast the potential risk of epidemiological implications.

Keywords: Breeding behaviour, *Aedes aegypti, Anopheles stephensi,* Tamil Nadu

1. Introduction
Vector-borne diseases (VBDs) continue to be the major public health importance worldwide. India has the highest burden of VBDs among the Southeast Asian (SEA) countries. Malaria is endemic in different parts of the country with about 80.5% of India's population resides in malaria-endemic areas and has highly complex epidemiology. The burden of malaria disease has increased periodically at an interval of 5-10 years around the country as a result of effects of geo-climatic changes and human behavior.

Mosquito breeding behaviour has been extensively studied from different parts of the world including India. Earlier studies, demonstrated that the resting and breeding of *An. stephensi* [1-2] and *Aedes aegypti* [3-4] in wells but lack of studies have found on sharing the same ecological niche by both the vector mosquitoes. An entomological observation was made in Ramanathapuram district of Tamil Nadu during a dengue outbreak in 2014 to understand the ecological situations that promote the increasing trend of disease burden. The pilgrimage spot of India is well-known endemic region of malaria plus frequent outbreaks of dengue/chikungunya for the past several years [5]. The present communication highlights the observation on breeding behaviour of sharing of vector mosquitoes in the same ecological niche is reported.

2. Materials and methods

2.1 Study area

Ramanathapuram district is one of the coastal region of Tamil Nadu, located between 9.16ºN latitude and 77.26ºE longitudes, in which, Rameswaram is located and known pilgrimage place of nation. Major occupations in the study region includes fishing, tourism associated economic activities and labour migration in and out of the nation.

2.2 Entomological Observation

The statistics of dengue affected region in the study area during 2014 was obtained and Chinnamaya kulam and Regunathapuram were selected. An entomological investigation including identification of domestic and peridomestic larval breeding habitats of *Aedes* mosquitoes was carried out in May 20014. The immatures of mosquitoes from both indoor and outdoor sources including used and unused wells was done and brought to the laboratory of CRME for identification of species by using standard mosquito identification [6- 7].

3. Results and Discussion

In Regunathapuram, mixed breeding was observed in an unused well. The mean per dip density of immatures (both larvae and pupae) from well (bucket) were 112. The emergence was recorded as common vector mosquitoes known as *Ae. aegypti* (11 males and 5 females), *An. stephensi* (7 males and 4 females) and *Cx. quinquefasciatus* (16 males and 14 females) from the samples obtained from the unused well. The various habitats recorded from both the villages are presented in Table 1.

Table 1: Number of breeding habitats and positive for *Ae. aegypti* immatures during the survey at Ramanathapuram district.

		Chinnamaya kulam			Regunathapuram		
S. No	**Containers**	**No. Surveyed**	**No. Positive**	**Container Index (CI)**	**No. Surveyed**	**No. Positive**	**Container Index (CI)**
1	Bottle	6	0	0.00	1	0	0.00
2	Coconut shell	30	0	0.00	65	0	0.00
3	Cement cistern	4	0	0.00	21	0	0.00
4	Cement tank	25	3	12.00	24	5	20.83
5	Dis. Containers	22	1	4.55	33	1	3.03
6	Defrost water collection tray in Refrigerator	0	0	0.00	1	0	0.00
7	Flower pot	7	1	14.29	7	0	0.00
8	Grinding stone	6	1	16.67	18	1	5.56
9	Metal drum	12	0	0.00	33	0	0.00
10	Metal container	76	0	0.00	72	0	0.00
11	Plastic drum	14	0	0.00	16	0	0.00
12	Plastic container	92	1	1.09	70	0	0.00
13	Tree hole	7	0	0.00	0	0	0.00
14	Tyre	3	0	0.00	4	0	0.00
15	Well	36	1	2.78	26	1	3.85
16	Mud pot	17	0	0.00	47	2	4.26
17	Washing machine	0	0	0.00	6	0	0.00
18	Sintex tank	2	0	0.00	0	0	0.00
Total		**359**	**8**	**2.228**	**449**	**10**	**2.227**

The container index (CI) was found to vary between 1.09 (plastic container) and 16.67 (grinding stone) in Chinnamaya kulam whereas 3.03 (discarded container) and 20.83 (cement tank) in Regunathapuram. The results of the overall CI values for both the villages were not found statistically significant ($P > 0.05$). The value of CI for well in Chinnamaya kulam recorded 2.78 and 3.85 in Regunathapuram respectively. However, the stegomyia indices recorded in both the villages are relatively similar (i.e. House Index (HI) and Breteau Index (BI) include 16 and 16 in Chinnamaya kulam whereas 13.11 and 16.39 in Regunathapuram The indices have further confirmed that the areas are vulnerable for reporting more number of dengue cases. The sharing of the same niche by various vector mosquitoes based on initially due to the oviposition behavior which varied from species to species. In the case of *Anopheles* mosquito lay single eggs directly on the water surface of clean water while *Aedes* deposit eggs on peripheral regions of the respective habitats instead of placing on water surface especially on the wet surface of the habitat. *Cx. quinquefasciatus* lay egg rafts most preferably on the polluted water surface rather than clean / fresh water. In the present observation the unused well in Regunathapuram where falling of leaves promoted the enrichment of organic matter lead to turbid nature facilitated the breeding of *Cx. quinquefasciatus*. In those domestic wells with cemented rings water level increase or decrease depends upon the tidal waves of the sea has facilitated females of *Ae. aegypti* to deposit eggs on the wet surface of cemented portion. The deposited eggs lead to proliferate in the absence of most of the rain water habitats as well as other water stored habitats in the peridomestic regions. Also, the environmental conditions make easy for *Ae. aegypti* mosquitoes to rest inside well due to relatively the more cooling nature to avoid the hot sun in day time. As far as *An. stephensi* directly drop eggs on the water surface and breeds in wells are well documented. This particular habitat, immatures could be controlled by the stocking of larvivorous fishes alone. By introducing fishes into wells, immatures of all three different vector species immature population could be reduced drastically in order to avoid any epidemic of dengue/chikungunya. Fishes as biological control agents are well documented and practiced in control of vector breeding in India for the past several decades [8]. The various studies reported that females of *Ae. aegypti* shows a preference for laying their eggs in domestic containers as well as rainwater-accumulating containers present in the immediate peridomestic environments [9-11], however the present observation of sharing of all three vector species in the same habitat is first report from this region. Thereby the

opportunities for outbreak of any vector borne diseases depend upon the respective parasitic load available in the community.

4. Conclusion

In the present communication, all 3 vector species exploited habitat well due to scarcity of non-availability of more number of water stored habitats and disperse rain. The observation highlighted that the adaptive capacity of *Ae. aegypti* along with other vectors of malaria and lymphatic filariasis is due to necessitated behaviour and also forecast the potential risk of epidemiological implications. Novel strategies to eliminate prolific breeding of all vector species need to be developed besides, strengthening the source reduction methods involving community to control future outbreaks of vector borne diseases.

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