International Journal of Mosquito Research

ISSN: **2348-5906**
CODEN: **IJMRK2**
IJMR 2016; 3(6): 40-44

Received: 08-09-2016
Accepted: 09-10-2016

LJ Kanhekar
Centre for Medical Entomology & Vector Management, National Centre for Disease Control, 22-Sham Nath Marg, Delhi, India

R Ravikumar
Centre for Medical Entomology & Vector Management, National Centre for Disease Control, 22-Sham Nath Marg, Delhi, India

RK Meena
Centre for Medical Entomology & Vector Management, National Centre for Disease Control, 22-Sham Nath Marg, Delhi, India

RS Sharma
Centre for Medical Entomology & Vector Management, National Centre for Disease Control, 22-Sham Nath Marg, Delhi, India

AK Sharma
Centre for Medical Entomology & Vector Management, National Centre for Disease Control, 22-Sham Nath Marg, Delhi, India

SV Enkatesh
Centre for Medical Entomology & Vector Management, National Centre for Disease Control, 22-Sham Nath Marg, Delhi, India

Correspondence
R Ravikumar
Centre for Medical Entomology & Vector Management, National Centre for Disease Control, 22-Sham Nath Marg, Delhi, India

Population dynamics of *Aedes aegypti* and *Aedes albopictus* in Jagdalpur city, Bastar district of Chhattisgarh state, India

LJ Kanhekar, R Ravikumar, RK Meena, RS Sharma, AK Sharma and SV Enkatesh

Abstract
Aedes immatures were collected from four randomly selected municipal wards viz. Rajendra Nagar, Pravirchand, Sanjay Gandhi and Santhoshi of Jagdalpur, Bastar district, Chhattisgarh State during September 2013 to August 2014, using standard collection methods in order to see the population dynamics. The higher densities i.e. House, Container and Breteau indices were recorded in the month of August as House index =1.66, CI=3.39 and September Breutau index = 2.80. A total of 267 immature mosquitoes were collected from various breeding sources and allowed to emerge into adult under laboratory conditions. Aedes mosquitoes container preference was found high in the tyre (4.8%) followed by plastic (1.86), earthen pot (1.4%), cemented tanks (1.2%) and coolers (0.0%). The emerged adult mosquitoes identified up to species level as *Aedes aegypti*, *Aedes albopictus* and *Culex quinquefasciatus*. There was a significant relationship observed among the seasons i.e. June month (Pre-monsoon) having zero vector occurrence while in August (Post-monsoon) shows the maximum level. *Aedes aegypti*, the primary vector of dengue fever was recorded throughout the year except in the month of June. The secondary vector, *Aedes albopictus* occurrence was higher than *Aedes aegypti* due to congenial climatic factors and the very similar nature of peripheral forest topography prevailing in the study areas. The *Aedes aegypti* and the *Aedes. albopictus* were observed throughout the year hence there the chance of transmission of *Aedes* mosquito-borne diseases are more at Jagdalpur.

Keywords: Immatures, *Aedes aegypti*, *Aedes albopictus*, topography, population dynamics

1. Introduction
During the last two decades, there has been global increase in the frequency of Dengue/Dengue hemorrhagic fever epidemics with a concomitant disease incidence and about 2.5 billion people are at risk of tropical, subtropical and temperate areas of the world [1-3]. Repeated outbreaks are occurring in the various parts of the Indian sub-continent, especially from the Chhattisgarh state for many decades and *Aedes aegypti* are the only species incriminated as a vector and *Ae. albopictus* known to be prevalent in peri-urban and rural areas [4]. Chinery [5], Abdalmagid [6] and Russell [7, 8] have observed that the *Aedes aegypti* distribution and its density were affected by a range of limiting factors like latitude, altitude, temperature, rainfall, humidity, season, habitat and dispersal.
Many factors are attributed for the breeding of vector species and the resurgence of dengue fever and Chikungunya viz. population growth, cultural and social behavior of human being, non-planned urbanization, inadequate waste management, water supply mismanagement, water storage practices, influence of migratory laborers, increased densities and vast area distribution of vector mosquitoes, lack of effective mosquito control measures have increased the spread of dengue viruses and development of hyper-endemicity and deterioration in public health infrastructure [4, 9-11].
Chhattisgarh is an endemic state for Dengue and/Chikungunya but the available information on distribution and bio-diversity of *Stegomyia* species in Raipur region is fragmentary and needs a detailed investigation. As the *Aedes aegypti* breeding is more common in urban areas with concomitant disease transmission. However, the *Aedes aegypti* container breeding preference is changing with manmade ecology and has resulted in invasion of *Ae. aegypti* mosquitoes into the rural areas too. Current study was undertaken to forecast any disease outbreak in the changing demography scenario.

2. Materials and Methods

2.1 Study Area

Jagdalpur is an administrative head quarter of Bastar district of Chhattisgarh State. Earlier it was the capital of erstwhile princely state of Bastar and it is located at 19º 4' N: 82º 2' E. It has an average elevation of 552 meters above mean sea level and located on the south bank of Indrāvati River. The city demography is changing rapidly with the fastest growing population and becoming industrial hub. Peoples Conglomerated in the urbanized Jagdalpur city is surrounded by dense forests, lush Green Mountain and deep valleys are the most congenial for the persistence of *Aedes* mosquitoes and remain as dengue fever endemicity. In order to find the population dynamics of *Aedes* mosquitoes, entomological survey was carried out from randomly selected four wards Rajendra Nagar, Pravirchand, Sanjay Gandhi and Santhoshi having wide geographic range and endemic for Dengue fever.
Typical monsoon climate prevails in the study area which is characterized by hot and dry summer seasons from March to mid-June, dry and winter seasons from November to February and rainfall generally falls during the months of monsoon i.e. from mid-June to October. In winter season temperature ranges between 9-24 ºC and in summer it ranges from 26-40 ºC.

2.2 Entomological Study

Aedes mosquito immature collected from four wards using WHO [12] standard methods at monthly intervals for over a period of 12 months i.e. September 2013 to August 2014 in 25 houses each from every ward. The main breeding sources searched were grinding stones, cemented tanks, overhead tanks, discarded tins, earthen pots, plastic containers, coconut shells, unused tyres, tree holes, axils of leaves, water-logging pits of riversides. The collected larva and pupa live specimens were transported to the laboratory and allowed them to emerge into adult stage. The emerged adult mosquitoes were killed with chloroform soaked cotton swabs and pinned in stage-tube then it was identified up to the species level with the help of mosquito identification key books [13] Simultaneously, the larval indices like house index, container index and Breteau index was calculated to identify the critical level density and breeding potentiality of *Aedes* mosquitoes.

3. Results and Discussion

The entomological indices (Table 3.1) recorded a house Index of 1.66 in the month of August, container index of 3.39 in August and Breutau index of 2.80 in the September. In the month of June, the house index, container index and Breteau index was found to be zero. The container Index (CI) level lies between the range of 2.5 and 3.5; house index was less than 1.5 throughout the year except in the month of August. The Breteau index was observed to be very high in the August (2.0) and September (2.8) (Figure 3.1) than the other seasons. This can be concluded that owing to the rain in the June-July the index seems to be increased in the post monsoon months.
Table 3.2 shows the different types of containers searched and found positive for larvae and pupae i.e. plastic (1231/23), earthen Pots (1019/14), cemented tanks (767/09), tyres (165/08), coolers (126/0) and others (21/0) were searched for the immature collection. There was a significant relationship observed among the seasons i.e. June (Pre monsoon) having zero vector occurrence while in August (Post monsoon) shows the occurrence was maximum level. Figure 3.2 shows the container preference by the *Aedes* mosquitoes; plastic containers found more followed by earthen pot, cemented tanks, coolers, tyres and others. *Aedes* mosquitoes container preference was found high in tyre 4.8% followed by plastic 1.86, earthen pot 1.4%, cemented tanks 1.2%, and coolers 0.0%.
Table 3.3 showing the data of total immature collection and adult emergence: 267 larva and pupa were emerged into adult, out of which 92 were male and 175 female. The emerged adult mosquitoes identified up to species level, *Aedes albopictus* (163) *Aedes aegypti* (71) and *Culex quinquefasciatus* (23). Fig.3 shows the month wise prevalence details: *Aedes albopictus* species found more number throughout the year than *Aedes aegypti* and later one found in the post monsoon season only. No *Aedes* species was found in the month of November and December (Winter Season). While, *Culex quinquefasciatus* could be collected from the study area, throughout the year.
The vector surveillance plays an important role in determining the seasonal population trends, transmission dynamics, transmission risks and control measures. Also, a clear understanding of the population dynamics and mapping of vector bionomics in a given geographic region would be of great help in framing appropriate vector control strategies. The commonly-used larval indices are house, container and Breteau useful for determining general distribution, seasonal changes of density pattern and principal larval habitats, as well as for evaluating the environmental sanitation programs as a whole we can say that population dynamics and these having direct relevance to the dynamics of disease transmission. *Aedes aegypti* and *Aedes albopictus*, the vectors of dengue fever, was recorded throughout the year in the present study. The recorded entomological indices were maximum in the month of August as House Index=1.66; Container Index=3.39; Breteau Index=2.80. Since, HI $\leq$ 1% or BI $\leq$ 5% are the indices critical level proposed to curtail the Dengue fever transmission [14]. There was a significant occurrence of *Aedes* species breeding between the months i.e. June having zero vectors while in August showed above the critical level. de Moura Rodrigues *et al* [15] have observed that the female mosquito density is directly proportional to the number of people residing in the houses. The current study data reveals the same i.e. comparatively more number of female *Aedes* mosquitoes has been collected 92 Male and 175 females (Table-3) from the highly migrated population of Jagdalpur city.
In general, the *Ae. aegypti* has been incriminated as the principal vector and *Aedes albopictus* has been given the status of secondary, responsible for maintenance and transmit the virus. *Aedes albopictus,* being highly adaptive, invasive and flexible in its behavior, effectively transmits dengue virus even in the absence or insignificant presence of principal vector *Ae. aegypti*. High density prevalence of *Aedes albopictus* may be due to the city having similar nature of peripheral forest topography. Hence it can be concluded that there will be more chance of transmission of *Aedes* borne diseases in the study area.
Distribution of high density *Ae. aegypti* mosquito during August-October months and *Ae albopictus* present throughout the year except November-December. Since both the major vectors were found throughout the year, there would be a

chance of high risk for Dengue/Chikungunya transmission. Migration of secondary vector i.e. *Ae. albopictus* towards the study area and presence of both major vectors poses threat and the control measures should be adopted. Further, detection/isolation of virus from the collected mosquito's specimen would infer the transmission potential of disease.

Framing an appropriate vector control strategy in selected geographic area can be achieved only by a clear understanding of vector population dynamics [16]. Singh *et al* [10] have suggested adopting the preventive strategy like bottom up the containers, changing of water storage practice, enforcement of laws and educate the community through IEC. Kumar *et al* [9] also proposed the warrant intensification of vector surveillance activities in regular intervals along with source reduction by changing the water storage practices. Abdalmagid *et al* [6] have proposed that systematic and sustained vector control programme and IEC should be adopted to reduce *Aedes aegypti* populations to reduce dengue transmission thresholds. Leda Regis *et al* [17] concluded the community involvement is the only solution to contain the *Aedes* breeding.

Table 3.1: Entomological indices of immature in 2013-14.

Month/Year	House Index			Container Index			Breutau Index
	THS	+ve H	HI	TCS	+ve C	CI	
Sept.2013	500	07	1.40	537	14	2.60	2.80
Oct.2013	650	02	0.30	361	05	1.38	0.76
Nov.2013	550	02	0.36	282	02	0.70	0.36
Dec.2013	450	03	0.66	172	03	1.72	0.66
Jan.2014	550	01	0.18	152	01	0.65	0.18
Feb.2014	500	02	0.40	185	03	1.62	0.60
Mar.2014	650	04	0.61	255	05	1.96	0.76
April2014	700	02	0.28	237	02	0.84	0.28
May2014	700	01	0.14	268	01	0.37	0.14
June2014	350	-	0.00	195	-	0.00	0.00
July2014	600	04	0.66	331	06	1.81	1.00
Aug.2014	600	10	1.66	353	12	3.39	2.00

Note: THS=Total House Searched; +ve H=Positive Houses; HI=House Index; TCS=Total Container Searched; +ve C=Positive Containers; CI= Container Index

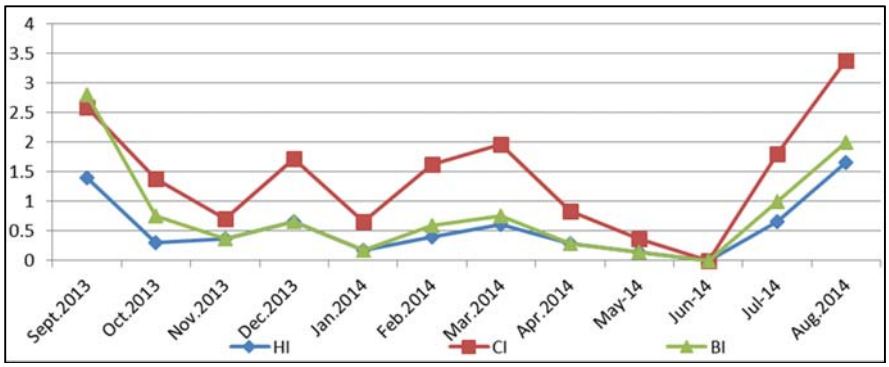

Fig 3.1: Prevelance of *Aedes* in 2013-14.
Note: HI=House Index; CI=Container Index; BI=Breteua Index

Table 3.2: Month wise data of containers searched for *Aedes* immature.

Month/Year	Aedes mosquitoes breeding in different containers											
	Plastic		Earthen		Cemented tank		Coolers		Tyres		Others	
	S	+ve	S	+ve	S	+ve	S	+ve	S	+ve	S	+ve
Sept.2013	220	08	186	02	101	01	-	-	30	03	-	-
Oct.2013	159	05	109	-	72	-	-	-	21	-	-	-
Nov.2013	126	01	91	-	65	01	-	-	-	-	-	-
Dec.2013	67	02	57	-	48	01	-	-	-	-	-	-
Jan.2014	60	-	46	-	46	01	-	-	-	-	-	-
Feb.2014	72	02	65	-	48	01	-	-	-	-	-	-
Mar.2014	106	-	71	03	68	02	10	-	-	-	-	-
April2014	70	01	79	-	56	01	20	-	12	-	-	-
May2014	79	-	74	-	64	01	35	-	16	-	-	-
June2014	51	-	44	-	35	-	33	-	27	-	05	-
July2014	106	02	86	01	79	-	23	-	24	03	13	-
Aug.2014	115	02	111	08	84	-	05	-	35	02	3	-
Total	1231	23	1019	14	767	09	126	-	165	08	21	-

Note: S=Searched; +ve=Positive; THS=Total House Searched; HI=House Index; TCS=Total Container Searched; CI= Container Index

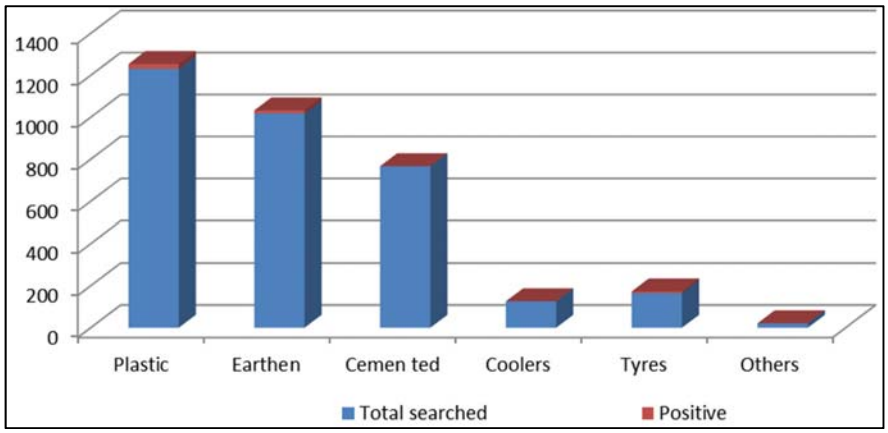

Fig 3.2: Breeding container preference by *Aedes* mosquito.

Table 3.3: Month-wise emergence of adult *Aedes* mosquitoes.

Month/Year	Total emerged adult mosquitoes			Identified Adult Aedes and other Mosquitoes species		
	Male	Female	Total	*Aedes aegypti*	*Ae. albopictus*	*Culex quinquefasciatus*
Sept.2013	34	23	57	47	10	00
Oct.2013	02	10	12	06	06	00
Nov.2013	00	12	12	00	00	12
Dec.2013	00	11	11	00	00	11
Jan.2014	00	07	07	00	07	00
Feb.2014	02	10	12	00	12	00
Mar.2014	06	24	30	00	30	00
April2014	03	03	06	00	06	00
May2014	00	03	03	00	03	00
June2014	00	00	00	00	00	00
July2014	16	24	40	16	24	00
Aug.2014	29	48	77	12	65	00
Total	92	175	267	71	163	23

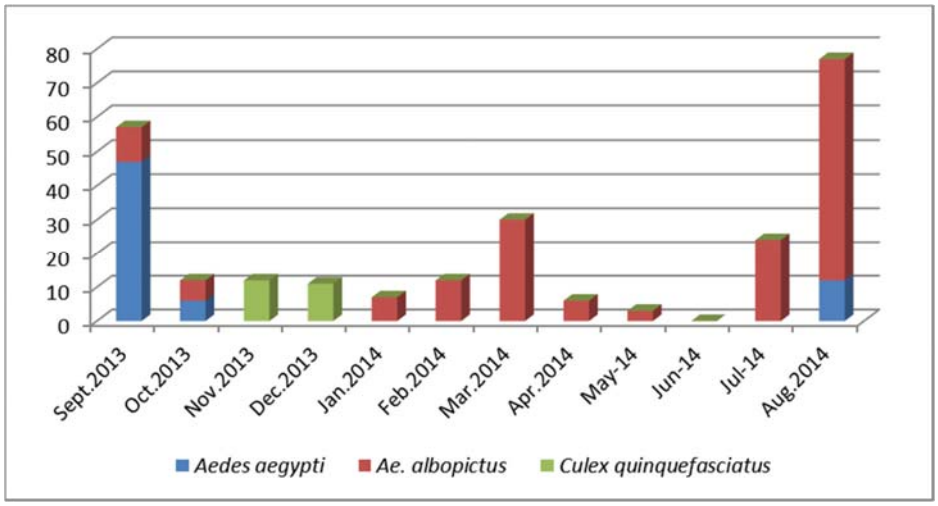

Fig 3.3: Month-wise mosquito species prevalence.

4. Conclusion

From the study it was observed that the in the study area *Aedes aegypti*, *Aedes albopictus* and *Culex quinquefasciatus* mosquitoes were observed. However the dengue vectors *Aedes aegypti*, *Aedes albopictus* were observed to be present throughout the year (except in cold seasons) in the study area. The study indicates that the *Aedes albopictus* found to be present in the study area more in abundance than *the Aedes aegypti* indicating the changing pattern of mosquito prevalence.

5. Acknowledgement

The authors are very much thankful to the staff of Jagadalpur NCDC branch for their dedicated field survey and cooperation to conduct entire study.

6. References

1. Halstead SB. Dengue hemorrhagic fever-a public health problem and a field for research. Bull World Health Organ. 1980; 58(1):1.
2. Gubler DJ. The changing epidemiology of yellow fever and dengue, 1900 to 2003: full circle? Comp Immunol Microbiol Infect Dis. 2004; 30:27(5):319-30.
3. Lam SK. Rapid dengue diagnosis and interpretation. Malays J Pathol. 1993; 15(1):9-12.
4. Das BP, Kabilan L, Sharma SN, Lal S, Regu K, Saxena VK. Detection of dengue virus in wild caught *Aedes albopictus* (Skuse) around Kozhikode airport, Malappuram district, Kerala, India. Dengue Bull. 2004; 28:210-2.
5. Chinery WA. A survey of mosquito breeding in Accra, Ghana, during a 2-Year period of larval mosquito control: The mosquito collected and their breeding places. Ghana Med J, 1969; 8:266-274.
6. Abdalmagid MA, Alhusein S. Entomological investigation of *Aedes aegypti* in Kassala and Elgadarief States, Sudan. Sudanese J Public Health. 2008; 3(2):77-805.
7. Russell RC, Whelan PI. Seasonal prevalence of adult mosquitoes at Casuarina and Leanyer, Darwin. Aust J Ecol. 1986; 11(2):99-1057.
8. Russell RC. Dispersal of the arbovirus vector' *Culex annulirostris'* Skuse (Diptera: Culicidae) in the Murray Valley of Victoria, Australia. General and Applied Entomology. 1986; 18:5-9.
9. Kumar RR, Kamal S, Patnaik SK, Sharma RC. Breeding habitats and larval indices of *Aedes aegypti* (L) in residential areas of Rajahmundry town, Andhra Pradesh. J Communicable Dis. 2002; 34(1):50-8.
10. Singh RK, Dhiman RC, Dua VK, Joshi BC. Entomological investigations during an outbreak of dengue fever in Lal Kuan town, Nainital district of Uttarakhand, India. J Vector Borne Dis. 2010; 47(3):189.
11. Balakrishnan N, Venkatesh S, Lal S. An entomological Study on the Dengue vectors during outbreak of Dengue in Tiruppur town and its surroundings, Tamil Nadu, India. J Communicable Dis. 2006; 38(2):164.
12. World Health Organization. Comprehensive Guidelines for Prevention and Control of Dengue and Dengue Hemorrhagic Fever: Revised and Expanded Edition. WHO Regional office for South East Asia, 2010.
13. Barraud PJ. The Fauna of British India, including Ceylon and Burma. Diptera. Vol. 5. Family Culieldae. Tribes Megarhinini and Culicini. The Fauna of British India, including Ceylon and Burma. Diptera. Vol. 5. Family Culieldae. Tribes Megarhinini and Culicini, 1934.
14. Vijayakumar K, Kumar TS, Nujum ZT, Umarul F, Kuriakose A. A study on container breeding mosquitoes with special reference to *Aedes* (*Stegomyia*) *aegypti* and *Aedes albopictus* in Thiruvananthapuram district, India. J Vector Borne Dis. 2014; 51(1):27.
15. De Moura Rodrigues M, Marques GR, Serpa LL, de Brito Arduino M, Voltolini JC, Barbosa GL *et al*. Density of *Aedes aegypti* and *Aedes albopictus* and its association with number of residents and meteorological variables in the home environment of dengue endemic area, São Paulo, Brazil. Parasit Vectors. 2015; 8(1):1.
16. Dixit V, Gupta AK, Kataria OM, Prasad GB. Population dynamics of *Culex quinquefasciatus* filaria vector in Raipur City of Chhattisgarh State. J Communicable Dis. 2002; 34(3):193-202.
17. Regis L, Souza WV, Furtado AF, Fonseca CD, Silveira Jr JC, Ribeiro Jr PJ *et al*. An entomological surveillance system based on open spatial information for participative dengue control. Anais da Academia Brasileira de Ciências. 2009; 81(4):655-62.