Biolife 1(4):251-260
AN INTERNATIONAL QUARTERLY JOURNAL OF BIOLOGY & LIFE SCIENCES
ISSN (online): 2320-4257
www.biolifejournals.com
BIOLIFE ORIGINAL ARTICLE

AN ENTOMOLOGICAL STUDY ON *ANOPHELES STEPHENSI*, *CULEX QUINQUEFASCIATUS* AND *AEDES AEGYPTI* FAUNA POTENTIALITY IN THE URBAN AREA OF AUTONAGAR, VIJAYAWADA (KRISHNA DISTRICT, ANDHRA PRADESH)

Jayadev. D. J[1] and Viveka Vardhani. V[2*]

[1,2]Department Zoology & Aquaculture, Acharya Nagarjuna University, Nagarjunanagar-522 510

E-mail: vadlamudi_vv@yahoo.co.in

ABSTRACT

Different species of mosquitoes (pathogen carrying vectors) prevail in different regions of the world. Population density, sanitation and personal hygiene, economic status and topography have been known to be the contributory factors for the growing of the fauna. A study has been conducted in the Autonagar area of Vijayawada city, Andhra Pradesh for a period of one year; 3 selected localities were categorized into 3 Slum areas (low income group). Sanath nagar area situated near by the Autonagar bus stand, which includes 1785 families (6229 population). Municipal quarters are located at beside Gurunanak colony which is present in Autonagar area includes 1325 of families (5307 population) and Rellies huts includes 1219 families (4769 population). The three areas consist of 4329 families (16305 population). The prevalence of the three mosquito fauna has shown vide variation based on the topography and socio-economic status. All the 3 slum areas have shown high incidence of *Culex quinquefasciatus* and lowest incidence of *Anopheles stephensi*; incidence of *Aedes aegypti* in found to be moderate.

Key words : Epidemiology, Prevalence, Mosquitoes, Vijayawada

.

INTRODUCTION

Mosquitoes are the most important group of insects well-known for the public health importance, and act as vectors for many tropical and subtropical diseases such as dengue fever, yellow fever, malaria, filariasis and encephalitis of different types including Japanese encephalitis, (Service, 1983). *Anopheles stephensi*,*Aedes aegypti* and *Culex quinquefasciatus* are the major urban vectors of malaria, dengue and lymphatic filariasis respectively (Tiwary *et al.*, 2007). Malaria is a major public health problem, effecting over 200 million peoples world wide. In India malaria is a major serious parasitic disease, where every year at least 2 million cases are reported from endemic areas. Worldwide 1.52 – 2.7 million deaths occur annually, endemic in 91 countries and 40% of the world population is at risk. Malaria is dreadful disease of the poor countries and included under "Tropical Disease" (WHO, 1996). It is estimated that each year 50 million dengue infections occur, with 5 lakhs of cases dengue haemorrhagic fever and at least 12,000 deaths, mainly among children, (WHO, Geneva 2002). During 2006, there was a large outbreak of chikungunya in India, with 1.39 million officially reported cases spread over 16 states, attack rates were estimated as 45% in some

areas. The out breaks were first noticed in Andhra Pradesh and it subsequently spread to Tamilnadu (Park, 2009). Filariasis is estimated at about 600 million people, living in areas endemic for lymphatic filariasis in SEAR. There are about 60 million people infected and about 31 million people have clinical manifestation of the disease (WHO, 1999).

Female *Anopheles*, *A. aegypti* and *C. quinquefasciatus* mosquitoes were acting as vectors to transmit malaria, dengue, chikungunya and filarial parasites from one person to another. There are approximately 3,500 species of mosquitoes grouped into 41 genera. Human malaria is transmitted only by females of the genus *Anopheles*. Of the approximately 430 *Anopheles* species, only 30-40 transmit malaria in nature. *A. aegypti* is the principal vector for dengue, chikungunya and yellow fever. *C. quinquefasciatus*, C. *fatigan* and *C. vishnui* are the major vectors for transmitting the filarial disease in India (Centers for Disease Control and Prevention, 2004). In India, there are 9 Anopheles mosquito species responsible for transmission of malaria. They are: 1. *Anopheles culicifacies*, 2. *Anopheles stephensi*, 3. *Anopheles fluviatilis*, 4. *Anopheles minimus*, 5. *Anopheles balabacensis*, 6.*Anopheles philippinensis*, 7. *Anopheles annularis*, 8. *Anopheles dirus* and 9. *Anopheles sundaicus* (Ramachandra Rao, 1984). Among the 9 mosquito species *A. culicifacies*, *A. fluviatilis* and *A. stephensi* are reported to be the successful vectors in Andhra Pradesh. In rural areas, malaria is found to be transmitted by *A. culicifacies* where as in urban areas it is by *A. stephensi* and in forest hilly areas by *A. fluviatilis*. Along with *A. fluviatilis*, *A. stephensi*, *C. quinquefasciatus* and *A. aegypti* are the successesful vectors in urban areas.

Vijayawada city in Krishna District of Andhra Pradesh is having a history of mosquito borne diseases like malaria, filariasis, dengue, Japanese encephalitis and chikungunya. Of all the vector borne diseases, malaria, dengue and filariasis is found to be dreadful epidemic diseases. Hence, a new vista has been opened to study the occurrence of *A. stephensi*, *C. quinquefasciatus* and *A. aegypti* fauna in the urban area of Autonagar, Vijayawada, Krishna District, Andhra Pradesh.

MATERIAL AND METHODS

The present survey has been conducted in 3 selected localities of autonagar. Sanath nagar area is situated near Autonagar bus stand, (1785 families 6229 population). Municipal quarters are located at beside Gurnanak colony (1325 families 5307 population) and Rellies huts are located at 100 feet's road end (1219 families - 4769 population). Of all the three low income groups, the total number of families residing are 4329 (population of 16305). The demographic details of the study area and income levels of the sampled inhabitants are as presented in table-1

Adult and larval collection of vectors was made from fixed and random catching stations at monthly intervals. The climate of this region is

Table-1. The demographic details of the study area and income levels of the sampled inhabitants

Area	Locality	No. of families	Total population	Income levels (₹)
Sanath nagar	Beside Autonagar Bus Station	1785	6229	65,000 to 75,000
Municipal quarters	Beside Gurunanak colony	1325	5307	80,000 to 1,20,000
Rellies huts	100 feet's Road end	1219	4769	18,000 to 50,000
	Total	4329	16305	

hot and humid during the sampling period, the temperature ranged from 16.5ºC to 38ºC and the relative humidity ranged between 60 to 88%.

Sampling:
Adult *Anopheles* and *Culex* mosquitoes were collected from both fixed and random catching stations during night hours (6:00 pm to 11:00 pm). *Aedes* mosquitoes were collected during day time (6:00 am to 8:00 am) and in the evening (4:00 pm to 6:00 pm). Aspirators and flash lights were used during night hours. Adult mosquitoes were collected thrice a week every month so as to cover 24 catching stations each day in two areas. Collected mosquitoes were brought to the laboratory, anesthetized and identified upto species level following standard identification keys (Barred, 1934; Das and Kaul, 1998).

Larval collection:
The potential breeding habitats in the study area (in each locality) were screened every month as per the guidelines given by the WHO (1975). Flash light, wide mouthed pipettes, larval dippers of 300ml capacity; well nets were used to collect the larval. The data of larvae survey was analyzed and calculated in terms of Container Index, House Index, Breteau Index and Breeding Preference Ratio (BPR) as per the guidelines given in the manual (Service, 1976).

RESULTS AND DISCUSSION

Results are shown in tables 2 to 12. The tremendous ecological changes led to drastic changes in vector densities as well as species distribution; some of the parasitic larvae shifted their habitat to water reservoirs. Exploitation of natural resources, unplanned rapid urbanization, deforestation, human activities etc. altered the ecosystem and behaviour of vectors affecting malaria transmission. Increased population in urban area has major implication for malaria epidemiology both in terms of vector density and host-vector contact resulting in malaria transmission. The housing and clothing pattern of people living in urban area are conducive. Inadequate epidemiological surveillance and/or incomplete treatment are some of the major constraints for reducing and/or eliminating the disease.

In Sanath nagar, the occurrence of *C. quinquefasciatus* female mosquitoes was found to be highest (2407) (Table 2). 1454 female *Aedes* mosquitoes and 1265 female *Anopheles* mosquitoes were found. In municipal quarters, the incidence of *Culex* was highest (1701) and that of *Anopheles* was lowest (1411). In Rellis huts, the female mosquitoes of *Culex* were found to be 2140, *Anopheles* were 1025 and *Aedes* were 1195. Among of all the three selected areas, the highest incidence of mosquitoes population recorded was 6248 (*Culex*), and the least mosquito population was 3707 (*Anopheles*). The total number of *Aedes* species was found to be 4224. The highest breeding percentage was found in containers like waste tyres (20.6%), cement tubs (15.9%) and lowest breeding % was observed in discarded buckets (2 .1%). The highest larval breeding percentage of *Culex* mosquitoes population was found in waste tyres (34.2%). The second place of larval density was found in ditches in rainy season (19.6%) and the lowest larval breeding was found in 19 traditional mortars (0.7%). A total 10537 of *Culex* larvae were found in 2607 positive larval containers. The highest breeding preference ratio was found to be 2.06 in municipal drains and 1.85 in discarded buckets and 0.25 in over head tanks (Table 3).

Abundant larval forms were found in 1182 containers (20.6%) and the lowest breeding was recorded in 122 discarded buckets (2.1%) (Table 3). Among all the 2474 positive containers, the highest % of *Aedes* larvae was found in cement tubs (23.2%), followed by waste tyres with (20.4%). The lowest container breeding was identified in traditional mortars (0.3%). The highest number of (943) larval forms of *Aedes* were observed in over head tanks and this in followed by the cement tubs (902). The lowest number of larval forms was collected in discarded earthen pots (114). The highest breeding preference ratio was found to be 1.87 in flower pots, followed by 1.38, 1.37 discarded buckets (1.38) and over head tanks (1.37) and

Table-2. Area wise and species wise male and female mosquitoes population

Area	*Anopheles*		*Aedes*		*Culex*	
	M	**F**	**M**	**F**	**M**	**F**
Sanath nagar	702	1265	857	1454	799	2407
Municipal quarters	813	1411	942	1575	578	1701
Rellis huts	382	1025	819	1195	914	2140
Male + Female mosquitoes total	1897	3707	2618	4224	2291	6248
Total	5598		6842		8539	

M = Male; F = Female

Table 3. Relative abundance of *Culex quinquefasciatus* larvae in different containers and the breeding preference

Sl. No	Type of Container	No. of Containers With Water			Breeding Preference Ratio BPR (Y/X)
		Examined (X) (%)	With *Culex* Larvae(Y) (%)	Total No. of Larvae	
1	Municipal drains	177 (3.0)	164 (6.2)	6022	2.06
2	Over head tanks	322 (5.6)	38 (1.4)	158	0.25
3	Desert water coolers	220 (3.8)	134 (5.1)	234	1.34
4	Flower pots	272 (4.7)	79 (3.0)	89	0.63
5	Ditches in rainy season	619 (10.8)	512 (19.6)	622	0.18
6	Cement tubs	911 (15.9)	217 (8.3)	219	0.52
7	Water drums	721 (12.6)	159 (6.0)	254	0.47
8	Waste tyres	1182 (20.6)	892 (34.2)	2017	1.66
9	Discarded buckets	122 (2.1)	102 (3.9)	212	1.85
10	Discarded earthen pots	614 (10.7)	139 (5.3)	339	0.49
11	Traditional mortars	242 (4.2)	19 (0.7)	112	0.16
12	Coconut shells	317 (5.5)	152 (5.8)	259	1.05
	Total	5719	2607	10537	

Note: Figures shown in the parentheses are percentages

the lowest BPR was observed in discarded earthen pots and traditional mortars (0.07).

The highest container positivity was observed in waste tyres 1182 (20.6 %) (Table 5). Cement tubs showed highest container positivity (911) (15.9 %) and municipal drains lowest container positivity (177) (3.0%). The highest number of *Anopheles* larvae was observed in waste tyres (419) (22.4%) the highest number of larvae was observed in over head tanks (2094), followed by flower pots (531) and traditional mortars (52) (lowest number). The number of larvae obtained in water drums was 282 (15.0%) and lowest number of larvae were found in municipal drains (16) (0.8%). The highest breeding preference ratio was found in over head tanks (2.30), followed by in discarded buckets (2.28) and traditional mortars (0.23) (the lowest BPR). Larvae of *Culex*, *Aedes* and *Anopheles* (21340) were found in different containers during rainy, winter and summer seasons. Highest number of

Table-4. Relative abundance of *Aedes* larvae in different containers and the breeding preference

Sl. No.	Type of Container	No. of Containers With Water			Breeding Preference Ratio
		Examined (X) (%)	With *Aedes* Larvae(Y) (%)	Total No. of Larvae	BPR (Y/X)
1	Municipal drains	177 (3.0)	142(5.7)	576	1.9
2	Over head tanks	322 (5.6)	184 (7.7)	943	1.37
3	Desert water coolers	220 (3.8)	122 (4.9)	241	1.28
4	Flower pots	272 (4.7)	218 (8.8)	208	1.87
5	Ditches in rainy season	619 (10.8)	284 (11.4)	384	1.05
6	Cement tubs	911 (15.9)	576(23.2)	902	1.45
7	Water drums	721 (12.6)	249 (10.0)	819	0.79
8	Waste tyres	1182 (20.6)	506 (20.4)	706	0.99
9	Discarded buckets	122 (2.1)	73 (2.9)	194	1.38
10	Discarded earthen pots	614 (10.7)	20 (0.8)	114	0.07
11	Traditional mortars	242 (4.2)	08 (0.3)	192	0.07
12	Coconut shells	317 (5.5)	92(3.7)	293	0.67
	Total	5719	2474	5518	

Note: Figures shown in the parentheses are percentages

Table 5. Relative abundance of *Anopheles* larvae in different containers and the breeding preference

Sl. No.	Type of Container	No. of Containers With Water			Breeding Preference Ratio
		Examined (X) (%)	With *Anopheles* Larvae(Y) (%)	Total No. of Larvae	BPR (Y/X)
1	Municipal drains	177 (3.0)	16 (0.8)	411	0.26
2	Over head tanks	322 (5.6)	242 (12.9)	2094	2.30
3	Desert water coolers	220 (3.8)	136 (7.2)	317	1.89
4	Flower pots	272 (4.7)	120 (6.4)	531	1.36
5	Ditches in rainy season	619 (10.8)	69 (3.6)	248	0.33
6	Cement tubs	911 (15.9)	255 (13.6)	416	0.85
7	Water drums	721 (12.6)	282 (15.0)	382	1.19
8	Waste tyres	1182 (20.6)	419 (22.4)	212	1.08
9	Discarded buckets	122 (2.1)	91 (4.8)	179	2.28
10	Discarded earthen pots	614 (10.7)	52 (2.7)	246	0.25
11	Traditional mortars	242 (4.2)	20 (1.0)	52	0.23
12	Coconut shells	317 (5.5)	168 (8.9)	197	1.61
	Total	5719	1870	5285	

Note: Figures shown in the parentheses are percentages

Table 6 Total number of larval forms *Culex quinquefasciatus*, *Aedes aegypti* and *Anopheles stephensi* species different containers

Sl. No.	Type of containers	Total no. of larval forms	*Culex*	*Aedes*	*Anopheles*
1	Municipal drains	7009	6022	576	411
2	Over head tanks	3195	158	943	2094
3	Water coolers	792	234	241	317
4	Flower pots	828	89	208	531
5	Ditches in rainy season	1254	622	384	248
6	Cement tubs	1537	219	902	416
7	Water drums	1455	254	819	382
8	Waste tyres	2935	2017	706	212
9	Discarded buckets	585	212	194	179
10	Discarded earthen pots	699	339	114	246
11	Traditional mortars	356	112	192	52
12	Coconut shells	695	259	293	197
	Total	21340	10537	5518	5285

Table 7. Seasonal Variation of *Culex quinquefasciatus* larval density in house index and container index in different localities

Month & Year	Sanath Nagar		Municipal Quarters		Rellis Huts	
	HI (1785)	CI (2217)	HI (1325)	CI (1982)	HI (1219)	CI (1520)
In rainy season:						
July 2009	23	223	19	117	13	91
August 2009	42	307	37	246	31	159
September 2009	67	457	42	384	39	342
October 2009	82	741	57	562	52	362
In winter season:						
November 2009	112	627	89	467	80	270
December 2009	98	512	71	413	73	311
January 2010	92	482	78	393	74	317
February 2010	86	457	61	352	54	287
In summer season:						
March 2010	57	276	42	194	38	177
April 2010	26	227	21	137	20	99
May 2010	22	102	15	82	09	46
June 2010	19	117	11	109	07	92
Total	726	4528	543	3456	490	2553

HI = House Index; CI = Container Index

Table 8. Seasonal Variation of *Aedes* Larval density in house index and container index in different localities

Month & Year	Sanath Nagar		Municipal Quarters		Rellis Huts	
	HI (1785)	CI (2217)	HI (1325)	CI (1982)	HI (1219)	CI (1520)
In rainy season:						
July 2009	23	121	19	149	13	94
August 2009	42	132	37	153	31	114
September 2009	67	157	42	188	39	197
October 2009	82	237	57	349	52	213
In winter season:						
November 2009	112	209	89	351	80	192
December 2009	98	241	71	257	73	189
January 2010	92	198	78	247	74	143
February 2010	86	147	61	182	54	124
In summer season:						
March 2010	57	92	42	174	38	99
April 2010	26	78	21	112	20	34
May 2010	22	42	15	54	09	21
June 2010	19	97	11	59	07	72
Total	726	1751	543	2275	490	1492

HI = House Index; CI = Container Index

Culex larvae was observed in municipal drains (6022) and 2017 larvae were found in waste tyres and least number in flower pots (89) (Table 6). Large number of *Aedes* larvae were found in over head tanks (943) followed by 902 larvae in cement tubs and the lowest number of *Aedes* larvae (114) in discarded earthen pots. In case of *Anopheline* larvae, the highest number were found in overhead tanks 2094, followed by 531 larvae in flower pots and the lowest number of 52 larvae in traditional mortars.

The larval density of *C. quinquefasciatus* was high in house and container index of Sanath nagar, Municipal quarters and Rellis huts in rainy, winter and summer seasons (Table 7). This study revealed that the three different localities like Sanath nagar (741), Municipal quarters (562) and Rellis huts (362) showed highest larval density in of October in rainy season but the house index showed highest incidence of larval breeding in November in Sanath nagar (112), Municipal quarters (89) and Rellis Huts (80).

Aedes larval density was highest (112) in November. Out of 726 houses, 241 container positivity was observed in December. Out of 1751, the lowest larval density was observed in Sanath nagar in June. The house index was found to be 19 (out of 726 positive houses). The lowest container positivity (42) was found in May. In municipal quarters the highest house index and container index were found to be 89 and 351in November. The lowest house index (11) in June and container index (54) in May were observed in the municipal quarters. Rellis huts showed highest house index (80) and container index (192) in November. The lowest house index (07) was observed in June and the lowest container positivity (21) was found in May (out of 1492 containers).

Table 9. Seasonal Variation of *Anopheles* Larval density in house index and container index in different localities

Month & Year	Sanath Nagar		Municipal Quarters		Rellis Huts	
	HI (1785)	CI (2217)	HI (1325)	CI (1982)	HI (1219)	CI (1520)
In rainy season:						
July 2009	23	117	19	131	13	64
August 2009	42	179	37	212	31	127
September 2009	67	237	42	289	39	211
October 2009	82	332	57	399	52	306
In winter season:						
November 2009	112	214	89	387	80	237
December 2009	98	163	71	246	73	178
January 2010	92	140	78	208	74	139
February 2010	86	117	61	131	54	110
In summers season:						
March 2010	57	61	42	69	38	57
April 2010	26	33	21	34	20	19
May 2010	22	0	15	9	09	0
June 2010	19	32	11	63	07	34
Total	726	1625	543	2178	490	1482

HI = House Index; CI = Container Index

Table 10. Details of the factors contributing to the growth of *Culex quinquefasciatus sps*.

Locality	FACTORS * CONTRIBUTING TO THE GROWTH OF MOSQUITOES LARVAL FORMS											
	1	2	3	4	5	6	7	8	9	10	11	12
Sanath Nagar	+	X	+	X	+	+	X	+	+	+	X	+
Municipal Quarters	+	X	+	+	+	+	X	X	+	X	+	+
Rellis Huts	+	X	X	X	+	+	+	+	+	+	+	X
Total	3	0	2	1	3	3	1	2	3	2	2	2

*1 = Municipal drains; 2= Overhead tanks; 3 = Desert water coolers; 4 = flower pots;
5 = Ditches in rainy season; 6 = Cement tubs; 7 = Water drums; 8= Waste tyres;
9 = Discarded buckets; 10 = Discarded earthen pots; 11 = Traditional mortars;
12 = Coconut shells

'+' Positive; 'x' Negative

Table 11. Details of the factors contributing to the growth of *Aedes aegypti sps*.

Locality	FACTORS * CONTRIBUTING TO THE GROWTH OF MOSQUITOES LARVAL FORMS											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Sanath Nagar	X	+	+	+	+	+	+	+	X	X	X	X
Municipal Quarters	X	+	+	+	+	+	+	+	X	X	X	+
Rellis Huts	+	X	X	+	X	+	+	+	+	+	+	X
Total	1	2	2	3	1	3	3	3	1	1	1	1

*1 = Municipal drains; 2= Overhead tanks; 3 = Desert water coolers; 4 = flower pots;
5 = Ditches in rainy season; 6 = Cement tubs; 7 = Water drums; 8= Waste tyres;
9 = Discarded buckets; 10 = Discarded earthen pots; 11 = Traditional mortars;
12 = Coconut shells
'+' Positive; 'x' Negative

Table 12. Details of the factors contributing to the growth *of Anopheles stephensi sps*.

Locality	FACTORS * CONTRIBUTING TO THE GROWTH OF MOSQUITOES LARVAL FORMS											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Sanath Nagar	+	+	+	+	X	+	+	+	+	X	+	+
Municipal Quarters	X	+	+	+	X	+	+	X	+	X	+	+
Rellis Huts	X	+	+	+	X	+	+	+	+	+	+	+
Total	1	3	3	3	0	3	3	2	3	1	3	3

*1 = Municipal drains; 2= Overhead tanks; 3 = Desert water coolers; 4 = flower pots;
5 = Ditches in rainy season; 6 = Cement tubs; 7 = Water drums; 8= Waste tyres;
9 = Discarded buckets; 10 = Discarded earthen pots; 11 = Traditional mortars;
12 = Coconut shells

'+' Positive; 'x' Negative

Seasonal variation of *Anopheles* larval density (in house index and container index) revealed of 332 in Sanath nagar, 399 in Municipal quarters in November and 306 in Rellis huts in October. The highest house index was found to be 112, 89 and 80 in Sanath nagar, Municipal quarters and Rellis huts respectively in November. Zero larval density was observed in summer May 2010 in Sanath nagar and Rellis huts. The container index was found to be 9 in Municipal quarters. The lowest house index of 7 was found in Rellis huts, 11 in Municipal quarters and 19 in Sanath nagar in June 2010 (among 4329 families in16,305 population).

The present entomological investigation reveal that *C. quinque fasciatus* is well established in the urban area of Vijayawada city; al the 3 localities showed high adult and larvae indices which may be the probable reason for the

incidence of *C. quinquefasciatus* in this area. These results compare well which those of Rajagopal et al., (2010) who also found high density *C. quinquefasciatus* in the urban area of Vellore, Tamilnadu.

The search of 4329 houses for mosquito (*Anopheles, Aedes and Culex*) breeding revealed the vector breeding in all 4329 houses. About 5719 containers were searched, out of which 1870 were found positive for *Anopheles*, 2474 for *Aedes* and 2607 for *Culex*. The overall house index (HI), container index (CI) and larval index were1759, 6951 and 21340 respectively.

The main factor contributing for the growth of *Culex* larvae is stagnated water in all the containers. In the Sanath nagar municipal drains, desert water coolers, ditches in rainy season, cement tubs, waste tyres, discarded buckets, discarded earthen pots and coconut shells factors are favorable for *Culex* breeding, In Municipal quarters, municipal drains, desert water coolers, flower pots, ditches in rainy season, cement tubs, discarded buckets, traditional mortars and coconut shells and in Rellis huts municipal drains, ditches in rainy season, cement tubs, water drums , waste tyres, discarded buckets, discarded earthen pots and traditional mortars factors are favorable for *Culex* breeding. In Sanath nagar overhead tanks, desert water coolers, flower pots, ditches in rainy season, cement tubs, water drums and waste tyres. In Municipal quarters overhead tanks, desert water coolers, flower pots, ditches in rainy season, cement tubs, water drums, waste tyres and coconut shells and in Rellis huts municipal drains, flower pots, cement tubs, water drums, waste tyres, discarded buckets, discarded earthen pots and traditional mortars are found to be the most favaourable sites for mosquito breeding (Table 11).

Anopheles species were found in Sanath nagar municipal drains, overhead tanks, desert water coolers, flower pots, cement tubs, water drums, waste tyres, discarded buckets, traditional mortars and coconut shells; in Municipal drains overhead tanks, desert water coolers, flower pots, cement tubs, water drums, discarded buckets, traditional mortars and coconut shells followed these two localities in Rellis hutsl overhead tanks, desert water coolers, flower pots, cement tubs, water drums, waste tyres, discarded buckets, discarded earthen pots, traditional mortars and coconut shells are the most favorable sites for mosquito breeding in the study area (Table 12).

REFERENCES

1. **CDCP (2004)**. Centre for Disease Control and Prevention, Department of Health and Human Services.
2. **Park, K. (2009)**. Park's text book of Preventive and Social Medicine 20th Edn.
3. **Rajagopal, V., Elango, S., Jeykumar, K., Madhavan, J., Alamelu, M. and Shanthi, S. (2010)**. A study on the resting preference of mosquito species in wells in Vellore in Tamilnadu, South India. **.** J. Comm. Dis. 42 (1): 27-31.
4. **Ramachandra Rao, T. (1984)**. The *Anophelines* of India, ICMR 22, Sham Nath Marg, Delhi Press, New Delhi, India.
5. **Service, M.W. (1976)**. Mosquito Ecology: Field sampling techniques. Halstead Press, New York, pp 583.
6. **Service, M.W. (1983)**. Management of vectors. In: Youdeowei A, Service MW, editors. Pest Vector Management in Tropics. pp 265–280.
7. **Tiwary, M., Naik, S.N., Dhanajjay Kumar Tewary, Mittal, P.K. and Yadav, S. (2007)**. Chemical composition and larvicidal activities of the essential oil of *Zanthoxylum armatum* DC (Rutaceae) against three mosquito vectors. J. Borne Dis., 44: 198-204.
8. **WHO (1975)**. Manual on practical Entomology in malaria Part II. Methods and Techniques.
9. **WHO (1999)**. Health situatin in the South – East Asia Region1994-1997, Regional Office for SEAR, New Delhi.
10. **WHO (2002)**. Weekly Empidemiological record, No. 6, 8th pp: 41-43.
11. **WHO Geneva (1996)**. World Health Organisation fact sheet NX 94 (Revised December- 1996), Malaria, WHO.

DOI:https://dx.doi.org/10.5281/zenodo.7194051
Received: 16 October 2013; Accepted; 30 November 2013; Available online : 8 December 2013