



SURVEY OF MOSQUITO SPECIES, COMPOSITION AND BREEDING HABITATS IN FOUR COMMUNITIES OF KADUNA METROPOLIS, NIGERIA

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ABSTRACT:

A survey on the species composition and breeding habitats of mosquitoes was conducted in four communities of Kaduna metropolis (Nariya, Tudun Wada, Kabala Doki and Sabon Tasha) through intensive bi-weekly sampling collection of larvae for a period of three months. All the randomly selected sampling points were categorized into three habitat types; Domestic Container (DC), Temporary Ground Pool (TGP) and Man-made Reservoir (MMR). All 3rd and 4th instar larvae were harvested and identified using taxonomic keys by Gillies and Coetzee. A total of 6,803 larvae samples were encountered and identified across the four communities. There were thirteen species which fall within the three common genera comprised of *Culex* species (94.19%), *Aedes* species (4.8%) and *Anopheles* (0.10%). Of the thirteen species identified, *Culex quinquefasciatus* Say, 1823 (72.8%) was significantly high ($p < 0.05$), then *Culex toroensis* Edwards (12.05%) and *Aedes aegypti* Linnaeus (4.8%). Temporary ground pool (61.7%) harbored more mosquito larvae; however there was no significant difference ($p > 0.05$) in distribution of mosquitoes among the three habitat types sampled; The study identified medically important mosquito species in the four communities and recommends integrated control measures for these vectors especially in line with National Malaria Control strategy 2016 - 2030 for global reduction of malaria disease.

Keyword: Kaduna Metropolis, *Culex quinquefasciatus*.

INTRODUCTION

Mosquitoes are long legged slender insect with a long proboscis and clothing of scales on most part of their body parts (Patel, 2016). A few species are harmless, but most are considered a nuisance (Simon-Oke and Ayeni, 2015). They are among the most medically important insect group for mankind due to their ability to transmit pathogen causing diseases to man, they are also known for being irritating biting insect. The females species are blood feeders through which they transmit harmful pathogens like *Plasmodium* parasites transmitted by *Anopheles* mosquitoes to humans and livestock, causing diseases such as, Malaria Yellow fever, Dengue fever, Lymphatic filariasis amongst others, (WHO, 2019). About 2.4 billion people globally are at the risk of malaria infection with transmission occurring in 97 countries which is heavily concentrated in the tropical and sub-tropical regions of the world. Africa holds the highest disease burden with 81% infection rate and about 655,000 to 1.2 million deaths occurring annually from malaria caused by *Anopheles* mosquito, (WHO, 2019).

In Nigeria, malaria is a major public health problem where it accounts for more cases and deaths which equivalent of 30% of the population were tested positive for the disease in 2015, which accounts for 60% of hospital outpatient visits and maternal mortality annually (Nigeria Malaria Fact Sheet, 2017). According to the Federal Ministry of Health, (FMOH, 2009), Nigeria is ranked the second highest with Lymphatic Filariasis in the global statistics. Many households and families in the country spend a part of their income on direct and indirect prevention and treatment of malaria, (Olayemi and Ande,

2008). Kaduna state is holoendemic for malaria and it is the commonest reason for hospital outpatient attendance in most health facilities across the state (Malaria Consortium Reports, 2017).

Due to the high menace of mosquitoes and the disease burden, the world health organization recommends a package of proven prevention approaches, including insecticide treated nets, spraying indoor walls with insecticides and preventive medicines for the most vulnerable groups: pregnant women, under-fives and infants (WHO, 2017). These, therefore suggests that an effective and integrated control measures such as investigating the composition and mosquito species controlling the mosquitoes as effective vectors is necessary in averting the disease burden. In other to achieve this, Mgbemena and Ebe (2012), opined that the correct identification of these local vectors was necessary so that effective control could be employed. This research is therefore, aimed at providing an update to the robust information on mosquito fauna in Kaduna metropolis.

Materials and Methods

The Study Area

The geographical entity known as Kaduna is the capital of Kaduna State in the North Western region of Nigeria in Sub Saharan Africa. Kaduna metropolis is located between Latitude 10°20'N of the equator and Longitude 7° 45'E in the North Western Nigeria high plains of the Greenwich Meridian, (Fig. 1). Kaduna is approximately 162km away from Abuja, the capital city of Nigeria. The town made up of about four different

local government areas (Kaduna North, South, Chikun & Igabi) is centrally located at the epicenter of the northern region notably between the ancient city of Kano and Abuja (Saleh, 2015). Kaduna Metropolis covers an area span of a distance of about 25km long from Kawo in north to the oil refinery in the south up to an average width of 8-10km (Max Lock Group, 2008). The climate of Kaduna is the tropical type, which has distinct wet and dry seasons. Annual rainfall is ranging between 1000 – 1500mm, it occurs between early April and early

October. The Guinea Savannah woodland which may attain a height of about 10 to 15m when fully developed and may be dense enough to suppress the growth of grasses (Olaniyan, *et al.*, 2013). Dry season farming is all about irrigation. Irrigation activities on the farm are continuous practice which usually climax especially in the dry season period between November and March. The source of irrigation water is River Kaduna (Olaniyan *et al.*, 2013).

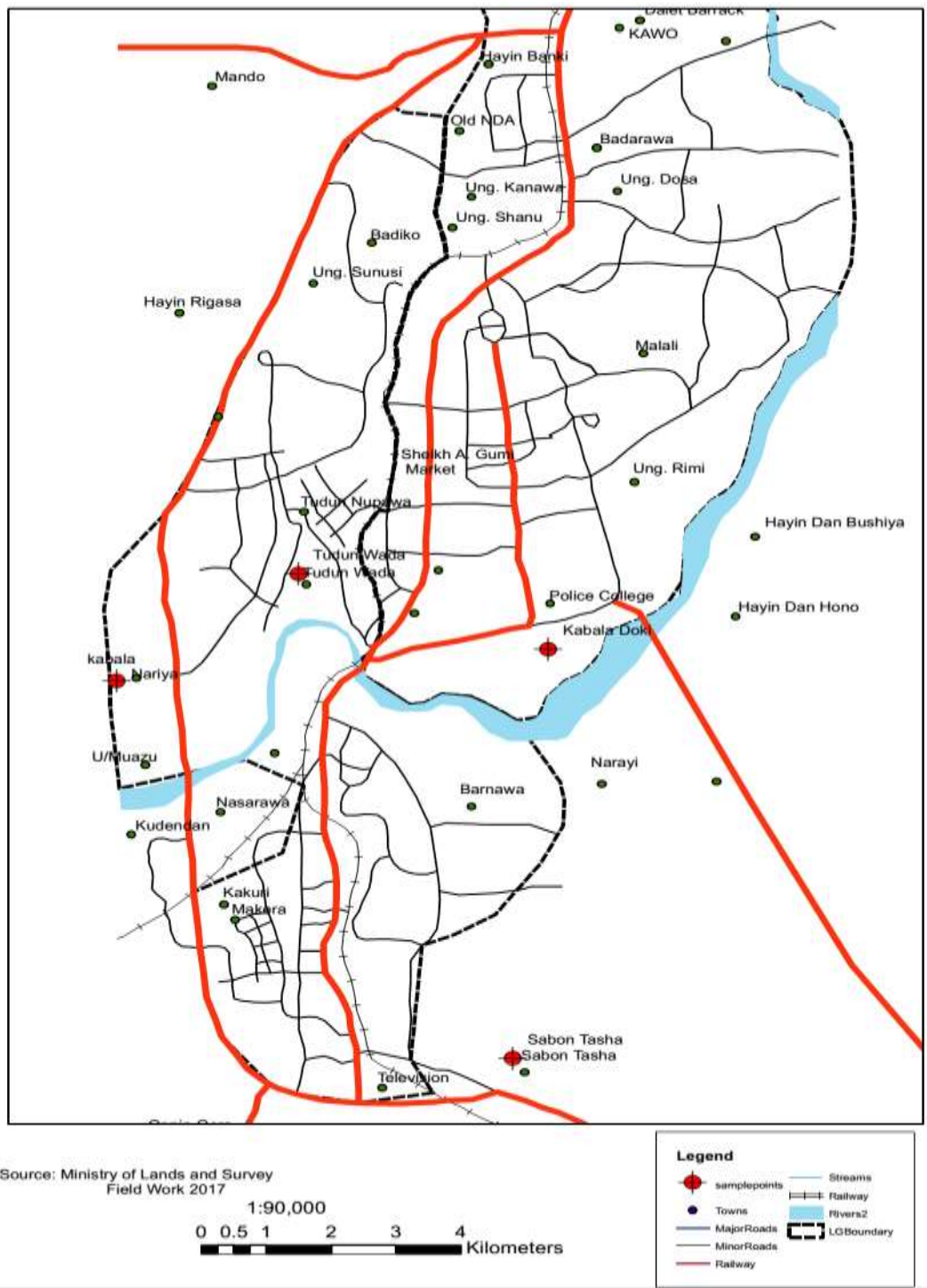


Fig 1. Kaduna Metropolis showing sampling locations (communities) within the four L.G.As

Source: Kaduna State Ministry of Lands and Survey, Field Work, 2017.

Selection of sampling communities

Four communities with high anthropogenic activities were selected which comprise of Nariya in Igabi local government, Tudun Wada, in Kaduna south local government, Sabon tasha, in chikun local government and Kabala doki, in Kaduna north local government area of Kaduna metropolis.

Sampling sites

The sampling sites in each community were categorized into groups based on habitat types which include the following; Domestic Containers (cans, plastic bottles, tyres, household water storage containers etc); Temporary Ground Pools (puddles, rocks pools, tyre tracks, ditches, domestic run-offs,

etc); Man-made Reservoirs (Overhead tanks and water storage drums) as described by (Olayemi and Ande, 2008).

Collection of Larvae

Intensive mosquito larval sampling was conducted twice weekly from September, 2016 to December, 2016 within the four Communities. The larval breeding habitats which comprise of Domestic Containers (DC), Temporary Ground Pools (TGP) and Man-made Reservoirs (MMR). Forty (40) locations were sampled, ten (10) from each community. Sampling was done in aquatic habitats using dipper of 175ml and 10 dips of water were collected at each sampling point for standardization (Service, 1993). All samples were carefully transported in plastic containers to the zoology laboratory in the Department of Biological science, Kaduna State University. Mosquito larvae were sorted at their 3rd and 4th instars and were preserved in 96% ethanol. The immature stages (pupae) were reared in mosquito cage where they were fed with yeast until they emerged as adults. The larvae and emerged adults were identified microscopically using the simple Olympus light

microscope and with the aid of Mosquitoes taxonomic keys of Hopkins, (1952) and Gillies and Coetzee (1987) to genera and species level.

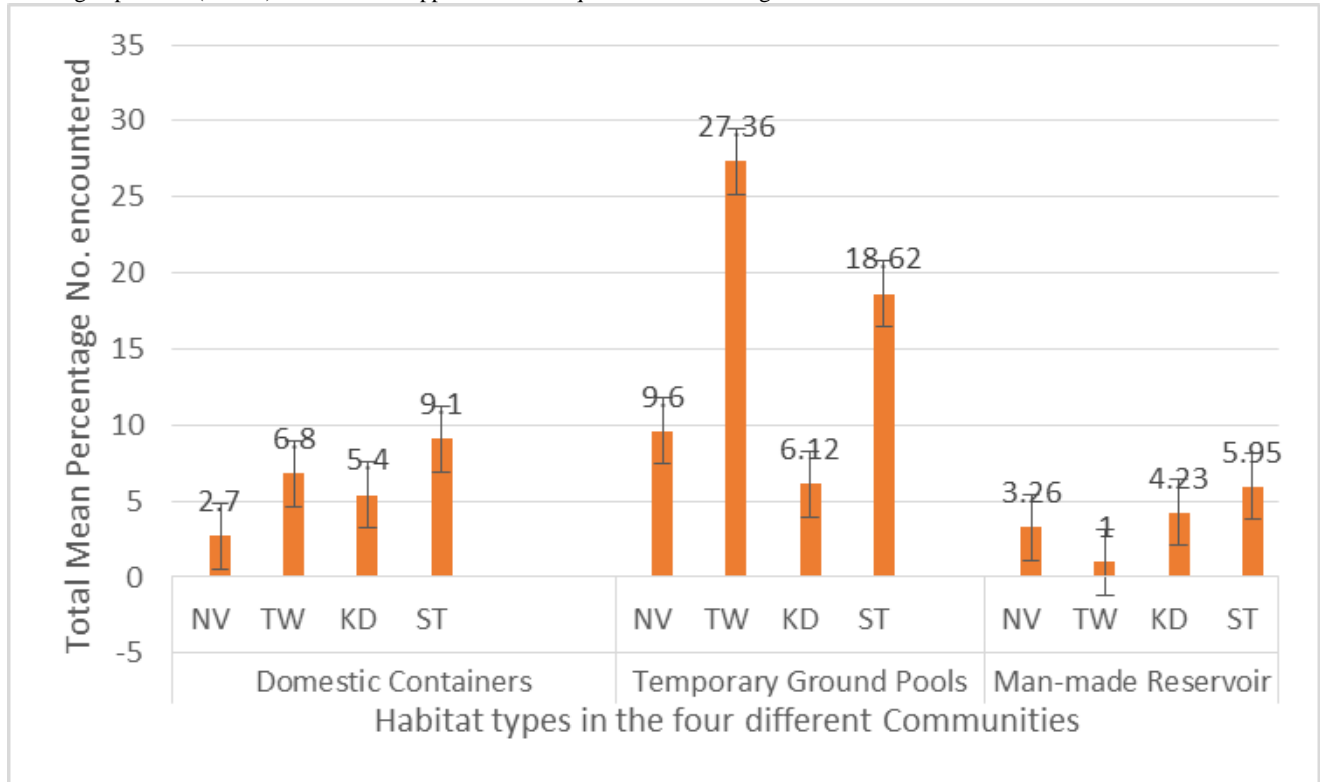
RESULTS

A total of 6803 mosquito larvae were sampled from four communities of Kaduna metropolis. Culicine consists of eleven species; with *Culex quinquefasciatus* 72.8%, being the highest while *Aedes aegypti* and *Anopheles gambiae* of consists of single species each at 4.8% and 0.98% respectively, (Table 1). The species composition within the four communities is significantly ($p < 0.05$) different; Nariya village (a suburban community) had ten mosquito species represented. Tudun wada and Sabon tasha had the highest total number of mosquito abundance. The distribution of the species showed that four out of the 13 species had the highest number in all settlement areas that were sampled. Out of the populations; *Culex quinquefasciatus* and *Culex toroensis* were exceptionally high in all the sampled areas, while *Culex univittatus* (0.01%) was least encountered, (Table 1).

Table 1: Composition and Abundance of Mosquito Species in Nariya, Tudun Wada, Kabala Doki and Sabon Tasha of Kaduna

S/NO	Mosquito species	Locations				Number caught	Percentage abundance
		N/V	T/W	K/D	S/T		
1	<i>Culex quinquefasciatus</i>	387(36.5%)	1976(82.6)	855(79.8%)	1,733(75.5)	4951	72.8%
2	<i>Culex toroensis</i>	304(28.7%)	212(9.2%)	9(0.8%)	295(12.9)	820	12.1%
3	<i>Culex tritaeniorynchus</i>	113(10.6%)	0(0.00%)	85(7.9%)	10(0.44%)	208	3.1%
4	<i>Culex whitmorei</i>	34(3.2%)	0(0.00%)	0(0.00%)	0(0.00)	34	0.5%
5	<i>Culex univittatus</i>	1(0.09%)	0(0.00%)	0(0.00%)	0(0.00)	1	0.01%
6	<i>Culex pipiens</i>	205(19%)	29(1.2%)	64(6.0%)	0(0.00)	298	4.4%
7	<i>Culex simpsoni</i>	2(0.18%)	0(0.00%)	0(0.00%)	0(0.00)	2	0.03%
8	<i>Culex poicilices</i>	7(0.6%)	0(0.00%)	0(0.00%)	0(0.00)	7	0.10%
9	<i>Aedes aegypti</i>	3(0.3%)	88(3.6%)	27(2.5%)	210(9.18)	328	4.8%
10	<i>Culex andersoni</i>	2(0.2%)	5(0.2%)	9(0.8%)	21(0.92%)	37	0.5%
11	<i>Culex dutoni</i>	0(0.00)	4(0.1%)	23(2.1)	19(0.83%)	46	0.7%
12	<i>Culex jacksoni</i>	0(0.00)	4(0.1%)	0(0.00)	0(0.00)	4	0.06%
13	<i>Anopheles species</i>	0(0.00)	67(2.8%)	0(0.00)	0(0.00)	67	0.98%
	TOTAL	1058(100%)	2390(100%)	1072(100%)	2288(100%)	6,803	

The mean occurrence of mosquito species in the different breeding habitats in Kaduna metropolis did not vary substantially ($P > 0.05$) and the species had their preferences (Fig 2). Mosquito larvae were majorly encountered in Temporal Ground Pools (TGP) in and around the settlement areas. The pooled mean and percentage distribution of mosquito larvae abundance in the breeding habitats revealed the frequency of larval occurrence in the positive habitats in the following order of decreasing abundance; Temporal ground pools (61.70%), Domestic house hold containers (24.90) Open Drainages / gutters classified as Man Made Reservoirs MMR (14.40%) while careful observation of other habitats, Low marsh land (0.00%) and road-side vehicle tyre markings / puddles (0.00%) were all not supportive of mosquito larval breedings.



Key: NV = Nariya Village; TW = Tudun Wada; KD = Kabala Doki; ST = Sabon Tasha.

Fig. 2: Mean and Percentage Distribution of Mosquito species in different breeding habitats sampled from four communities in Kaduna metropolis.

DISCUSSION

The result of this survey, revealed the species composition and breeding habitat of mosquitoes in four communities of Kaduna metropolis (Nariya, Tudun Wada, Kabala Doki and Sabon Tasha). Three genera of mosquitoes were investigated, *Culex*, *Aedes* and *Anopheles* which comprise of Thirteen species of mosquitoes; (Table 1) *Culex quinquefasciatus* is significantly high ($p < 0.05$) with (72.8%) *Culex toroensis* (12.05%), *Culex tritaeniorhynchus* (3.05%), *Culex whitmorei* (0.49%), *Culex univittatus* (0.01%), *Culex pipiens* (4.4%), *Culex simpsoni* (0.03%), *Culex poicilepes* (0.10%), *Aedes aegypti* (4.8%), *Culex andersoni* (0.54%), *Culex duttoni* (0.67%), *Culex jacksoni* (0.06%) and *Anopheles gambiae* (0.98%).

Among the four communities investigated, Sabon Tasha (33.6%) and Tudun Wada (35.1%) records the highest number of mosquito larvae collected during the findings. This could be due to the dense population of people, land use and human activities in those areas as corroborated by a similar researches (Simon Oke *et al.*, 2012; Yayock *et al.*, 2014). The preponderance of *Culex quinquefasciatus* also called the “common house mosquito” over *Anopheles species* which on the other hand was found only in a single community, (Tudun wada) which transmits *plasmodium* that causes malaria is not

surprising. This finding agrees with Amaechi *et al.*, (2014) in a study on the distribution and abundance of dry season indoor mosquitoes in an urban community. He reported high occurrence of *Culex* species and low occurrence of *Anopheles*. While *Culex* and *Aedes* are indiscriminate breeders, *Anopheles*, is an exception. The selected study areas are densely populated human settlements, thus high percentage of *Culex quinquefasciatus* as reported by (Mgbemena and Ebe, 2012), (Yayock *et al.*, 2014) and (Dalhatu *et al.*, 2016) who surveyed mosquito species in Imo, Kaduna and Bauchi states of Nigeria respectively.

The presence of *Culex toroensis* which is the second highest (12.20%) mosquito encountered in the genus culicine was discovered for the first time in the study area. This species were also found to be sparsely distributed which agrees with the finding of (Simon Oke *et al.*, 2012) who opined that difference in vegetation, social and anthropogenic activities play a vital role.

Figure 2 revealed the distribution of mosquito species across different breeding habitats which were categorized into Domestic Container (DC), Temporary Ground Pool (TGP) and Man-Made Reservoir (MMR). All the habitats investigated were found to be positive with mosquito larvae; this could be as

a result of dilapidated infrastructures and heavy anthropogenic activities in the study area such as domestic run offs, storage of water in containers for domestic uses and livestock uses as opined by (Adeleke *et al.*, 2013). Temporary ground pool was found to harbor more mosquito larvae (61.7%). However, statistical analysis of variance (ANOVA $P > 0.05$) showed no significant difference in the distribution of mosquito species among the habitat types.

The larvae of *Culex quinquefasciatus* and *Aedes aegypti* were found in all habitats surveyed but large numbers were found in TGP which include polluted gutters behind house-holds, this could be due to preference of the species to breed in high organic rich habitat. This result agrees with findings of (Mgbemena and Ebe 2012) who found similar species in polluted water in Imo state *Anopheles species* (0.98%) was found in TGP and MMR which are less polluted habitats in Tudun Wada community. The findings of Afolabi *et al.*, (2010) and Aliyu, (2014) who studied the breeding characteristics of mosquitoes in Zaria and Katsina respectively. They all reported that *Anopheles* mosquitoes prefers breeding in natural or man-made non polluted habitats. It is worthy of note that while *Anopheles* species breeds conventionally in clean clear ground pools waters, Service, (1980); this was also the case in this study.

The larval habitats encountered during the period of sampling were minimal and not active in terms of production or yielding many mosquito species. The results suggests that larvae in the different breeding habitats were not varied substantially ($P > 0.05$) and mosquito bred majorly in temporary ground pools. This was also observed by Anyanwu, *et al.*, (1999) in Zaria and by Olayemi and Ande (2008) in Ilorin. This is connected to the fact that poor behavioral attitudes and sanitary conditions were observed within the sampling areas. Thus, the drainage is poor, temporal ground pools and stagnant gutters are formed which provides enabling environments for mosquito breeding. This situation was reported same by Anyanwu, *et al.*, (1999) in Zaria, Abdulkadir, (2001) in Kaduna; Okogun, *et al.*, (2005) in Abeokuta; and Aribodor, *et al.*, (2013) in Anambra.

The presence of these species poses a serious health challenge to the inhabitants of these communities. The outbreak of diseases such as Malaria, Dengue, Yellow fever and Filariasis are a possibility due to the presence of their vectors. *Anopheles gambiae* is known to transmit plasmodium which causes Malaria while *Aedes aegypti* transmits Dengue and Yellow fever. *Culex quinquefasciatus* and *Aedes aegypti* transmits Filarial worms (Borah *et al.*, 2010). A similar report by (El Hadji *et al.*, 2017) also found *Culex species* to transmit Rift Valley Fever Virus (RVFV) in Senegal.

Conclusion

Three categories of habitats investigated in Kaduna metropolis Anyanwu, I.N., Agbede, R.I.S., Ajanusi, O.J and Umuh, J.U were found to harbor thirteen species of mosquitoes. Temporary (1999): A Survey of Culicids (Mosquitoes) in a Northern ground pool particularly harbors the highest percentage of Guinea Savannah town of Zaria, Kaduna State. *The Nigeria* mosquito and it was found to be common in all communities *Journal of Parasitology*, Vol.20 pp.137-148 surveyed. The mosquito species that was found to be highest in Aribodor, D.N., Aribodor, O.B., Eneanya, C.I., Onyindo, A.E familiar habitat was *Culex quinquefasciatus* which was found in all (2013). Survey of Open Habitats of Mosquitoes in Four habitats but significantly high in TGP. *Anopheles gambiae* was Communities in Awka South Local Government Area, found in an unusual habitat while *Culex tritaeniorhynchus*, *Culex* Anambra State, Nigeria. *The Bioscientist*: Vol. 1(2):132-139. *toroensis*, *Culex jacksoni*, *Culex whitmorei* and *Culex simpsoni* Borah, R., Kalita, M.C., Kar, A., Talukdar, A.K (2010). were discovered for the first time in the study area. This Larvicidal efficacy of *Toddalia asiatica* (Linn) Lam against investigation suggests that a dense population, human activities and two mosquito vectors *Aedes aegypti* and *Culex* availability of breeding habitats in the communities in focus played *quinquefasciatus*. *African Journal of Biotechnology*, 9(16): a vital role in the composition of mosquitoes found therefore, 2527-2530.

suggests that an effective and integrated control measures such as controlling larval habitat is necessary in an attempt to avert the burden caused by these vectors. Also, for effective mosquito control there by leading to a reduction in malaria burden and cases in Kaduna metropolis, aggressive environmental sanitation program coupled with public enlightenment campaign to reverse the trend of poor drainage systems, stagnant gutters and unhealthy environment within the metropolis and its environs which provides conducive breeding sites for vectors of malaria and other associated diseases is strongly advised.

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