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BREEDING SITES CHARACTERISTICS AND MOSQUITO ABUNDANCE IN SOME SELECTED LOCATIONS WITHIN JIMETA METROPOLIS

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ABSTRACT

Samples of water in the service of mosquito's breeding, in the tropical region supports their resting, swarming and mating activities. Samples were collected from breeding sites within some selected locations from January to June. One thousand, six hundred and twenty-two (1622) mosquito larvae belonging to 3 genera, Anopheles, Culex, and Aedes were collected and seven species of mosquitoes were identified comprising; Culex quinquefasciatus 410 (25.28%), Aedes aegypti 972(48.83%), Culex decens 42 (2.71%), Aedes vittatus 105 (6.56%), Culex tarsalis 44(2.71%), Culex pipiens 30 (1.85%) and Anopheles gambiae 19(1.17%). Aedes aegypti was common in all the locations. Water samples were collected from seven different major breeding sites such as clocked drainage 154(50.82%), abundant tyres 51(16.39%), Rice farms 45 (12.03%), Pools 19 (5.08%) ponds 42(11.23%), Plastic containers 44 (11.76%), and Metallic containers 19 (5.08%) totaling 374 sampled breeding sites. Out of the 374 selected sites, 251 sites were found positive for different species of mosquito larvae. Correlation analysis showed abundance of mosquitoes decreased with increase in physicochemical parameters. In conclusion, the Aedes aegypti was the most prevalent and present in all the breeding sites with the exception of rice fields; while the physico-chemical parameters were all within the favourable limits for mosquito breeding.

Keywords: Mosquito larvae, Abundance, Physio-chemical parameters, Breeding Sites

INTRODUCTION

Mosquitoes are serious nuisance as it causes so many people sleepless nights, and apart from nuisance from the noise, they also transmit several diseases through their blood feeding process. Generally, mosquitoes are seen as public health enemies (Li et al., 2021). Many mosquito's species are known as vectors for some diseases such as Zika virus, malaria, yellow fever, encephalitis, filariasis, dengue fever (WHO, 2018) in humans and they are also responsible for the transmission of animal diseases like heart worm diseases of dogs, the fowl pox of poultry, rift –valley fever of sheep and myxomatosis of rabbit (Adnan et al., 2021). In 2019, there were two hundred and twenty-eight (228000000) million cases of mosquito related diseases worldwide leading to an estimated 405,000 deaths (Hidayah, 2019). Almost, 93% of the infection and 94% of mortalities occurred in tropical regions. The estimated burden and result due to morbidity and deaths caused by these diseases transmitted by the mosquito and the cost of their treatments is up to US$12 billion each year (WHO, 2018). Their immature stages can survive in animal hoofs, rice fields, ditches, marshes, phytotelma, temporary rain pools, streams, fresh or salt water, clocked gutters (Grech et al., 2019). The farming and other anthropogenic activities, seriously affect physico-chemical parameters of their breeding sites (Olayemi et al., 2014). Ecological and environmental modifications so as to modify agricultural activities and urbanization have led to increase in insecticides resistance and resurgence in mosquitoes breeding species (Jeffrey et al., 2020). The strong matches of different mosquitos' larvae along with other insects and biotic organisms such as frogs and fish, form a community in the shared habitats (Afolabi et al., 2010). Physico-chemical parameters such as temperature, turbidity, conductivity, and pH have significant influence on mosquito larval abundance (David et al., 2021). Any form of water collection serves as an optimum habitat that supports their production, oviposition, and emergence, while savannah, grasslands or shady low woodlands supports their resting activities, swarming and mating (Mbanzulu et al., 2020).

MATERIALS AND METHODS

Study Locations

The study was carried out in Jimeta, Yola metropolis of Adamawa State. Jemeta is located on latitude 9.2717° N longitude 12. 4525°E. The study was conducted in selected locations within Jimeta, which include Bachure, Lugere, Jambutu and Wuro-jebe. The town experiences 122.5 mm (4.82 inches) amount of rainfall annually and relative humidity of 25-34% from January to March, increasing from April and reaching its peak around 80% in August due to the influence of a humid maritime air mass. Temperature in the town ranges from 25°C in the morning to 37°C. At some points it reaches 42° C in march and April. There is drastic drop in temperature at the onset of rain fall. Most of the inhabitants are farmers, traders, and civil servants. Warm temperatures and humidity of the study area, are suitable for mosquito breeding. Other factors that support the breeding of mosquitoes in the area, are the availability of stagnant water, presence of vegetation, clogged gutter and unused tyre.

Collection of Larva and Water Samples

The mosquito larval stages were sampled from various breeding sites which include abandoned tyres, clocked gutters, hoofs, stagnant pools / ponds, pot holes, rice fields, plastic and metallic containers that were encountered in the sampled locations.

Sampling Techniques: Larval stages of mosquitoes were collected twice in a month at about 7.00am to 10.00am and from 4.00pm to 6.00pm from available breeding sites using a plastic dipper 7cm-8cm in diameter and depth of 5cm, with a 30cm long handle (Yayock et al., 2014). Five (5) dips were collected at each sampling sites and where the breeding sites do not allow 5 dips, the larval stages were carefully scooped and preserved in 70% ethanol in covered and labeled

specimen bottles. Physical properties of the water, such as Temperature were determined at the spot with a thermometer device, while 200mls of water sample from the breeding sites were collected into 250 ml specimen containers to be used for determination of the physico-chemical parameters. All specimens were transported to the laboratories, for the various analyses and observations at the Federal college of education Yola.

Identification of Mosquitoes Larvae

The mosquito pupae were sorted out and discarded while the larvae were identified in the laboratory using the Olympus dissecting microscope with objective lens identified 10x and 20x with the guide of pictorial keys by Hopkins (1952); Gillies and Coetzee (1987) using simple taxonomic characters such as tergal appendages, tiffs, gills and meta-pleural spines. The larvae of species identified were recorded appropriately.

Determination of Physico-chemical parameters of the Breeding Sites

Physico-chemical parameters of water samples obtained at the various breeding sites were ascertained in the laboratory. The physical parameters such as Temperature was measured at site using a thermometer, PH, turbidity, electrical conductivity and chemical parameters such as magnesium, iron, Sulphate and phosphate were determined using FAAS (Flame Atomic Absorption Spectrometer, Labtron: LAAS-A12) at the Federal College of Education Yola.

Data Analysis

The characteristics of the breeding sites of mosquitoes were described and displayed descriptively using tables, percentages. ANOVA was sed to analyze the data obtained for mosquito abundance relative to Physico-chemical parameters in the breeding sites using SPSS software version 25.0. The significant difference between the physiochemical parameters were considered at $p< 0.05$.

RESULTS AND DISCUSSION

The percentage composition of Mosquito Species Sampled in Some Selected Locations within Jimeta (Yola North) Metropolis

A total of 1622 immature mosquitoes belonging to 3 genera Culex, Anopheles and Aedes were sampled and seven species of mosquitoes were identified comprising; Culex quinquefasciatus 410 (25.28%), Aedes aegypti 372(59.93%), Culex decens 42(2.59%), Aedes vittatus 105 (6.47%), Culex Tarsalis 44(2.71%) and Culex pipiens 30 (1.84%), Anopheles gambiae 19(1.17%). Aedes aegypti was more common in all the study sites, followed by Culex quinquefasciatus, then Aedes vittatus while the least species was Anopheles gambiae as demonstrated in Table 1.

Table 1: Diversity of Mosquito Species Sampled in Some selected Locations within Jimeta (Yola North LGA) Metropolis

	Bachure	Lugere	Location Woro-jebbe	Jambutu	Total	Percentage (%)
Cq	39	126	201	44	410	25.28
Ae	117	289	372	194	972	59.93
Cd	7	10	13	14	42	2.59
Av	3	24	41	37	105	6.47
Cp	9	8	9	4	30	1.84
Ct	4	16	10	14	44	2.71
Ag	3	3	7	6	19	1.17
					1622	100

Keys: Anopheles gambiae = Ag Culex Tarsalis = Cs Aedes vittatus = Av Aedes aegypti = Ae
Culex quinquefasciatus = Cq Culex decens = Cd

Larval indices in Breeding Sites Sampled in Some Selected Locations within Jimeta (Yola North LGA) Metropolis

Water samples were collected from four different subunits of the study area (Wuro jebbe, Lugere, Jambutu and Bachure. Three hundred and seventy-four (374) breeding sites were selected for this study. In Bachure, 67 breeding sites were sampled and 52 (20.71%) were found positive for mosquito larvae, Jambutu 85 were selected and 45 (17.92) were positive, 92 breeding sites were sampled from Lugere and 67(26.69) found positive for mosquito larvae, and 130 breeding sites were sampled in Wuro-jebbe and 87 (34.66%) were found positive for mosquito larvae as shown in Table 2.

Table 2: Larval indices in Breeding Sites Sampled in Some Selected Locations within Jimeta (Yola North LGA) Metropolis

Locations	Breeding sites No.	Breeding sites positive for mosquito Larvae	Total (%)
Bachure	67(17.91)	52	20.71
Lugere	92(24.59)	67	26.69
Wuro-jebbe	130(34.76)	87	34.66
Jambutu	85(22.72)	45	17.93
Total	374	251	

Table 3, depict high variation of mosquito specie composition in the various breeding sites, such as gutter (154), tyre (51), Rice farm (45), Plastic Container (44), ponds (42), pools (19) and metallic container (19). The result shows gutter as the major breeding sites (1) followed by tyre (1783) and rice farm (314). The result showed statistically significant ($P<0.05$) among the breeding sites.

Table 3: Variation of Mosquito Species in some Selected Locations in Relation to the Type of Breeding Sites within Jimeta (Yola North LGA) Metropolis

Locations	Gutter	Tyre	Rice farm	Plastic container	Ponds	Pools	Metallic container	F. cal	P. value
Bachure	23	7	4	6	9	2	5	2.124	0.07
Lugere	45	16	13	7	9	2	4		
Wuro-jabbe	55	12	17	19	12	7	6		
Jambutu	31	16	12	12	12	8	4		
Total	**154**	**51**	**45**	**44**	**42**	**19**	**19**		

The Physico-Chemical Parameters of Breeding Sites in Some Selected Locations within Jimeta (Yola North LGA) Metropolis

The result shows temperature and turbidity were not statistically significant ($p>0.05$) between sites but significant difference was shown in conductivity and this can be as result of variation in the larval abundance. However, the levels of SO_3, PO_4 and Mg/L were statistically significant $p<0.05$ between the sites as shown table 4.

Table 4: The Physico-Chemical Parameters of Breeding Sites in Some Selected Locations within Jimeta (Yola North LGA) Metropolis

Location	Temp(^{0}C)	PH	Turbidity	Conductivity	Mg(mg/L)	Fe_4(mg/L)	SO_3(mg/L)	PO_4(mg/L)
Bachure	29.50–31.10	6.20-6.70	28.60-29.10	221.45-235.20	8.10-8.70	13.14-13.46	7.33-7.82	0.45-0.76
Lugere	28.40–32.20	6.10-6.50	23.50-28.20	231-50-336.40	7.70-8.40	13.566-13.84	7.30-7.70	0.37-0.79
Wuro-jebbe	27.30–33.10	7.60-7.80	25.00-29.20	235.50-236.10	7.77.8.88	13.58-13.92	7.50-7.62	0.40-0.59
Jambutu	28.40–32.20	7.10-7. 90	22.90-28.60	231-50-336.40	7.60-8.40	13.50-14.22	7.40-7.80	0.30-0.69

Discussion

Mosquito-diseases remain a paramount public health problem in tropical regions and their transmission is becoming more prevalent these days due to the widespread of mosquitoes as a result of the availability of their breading sites. The presence of the seven species of mosquito found in this study is an indication that the climatic and environmental condition of the study area is favourable for mosquito breeding. The prevalence of mosquito species recorded in the study, also indicate availability of the breeding sites around the region. *Aedes* species was reported in the present study as the most predominant species found. This report is in agreement with the findings of Afolabi *et al.* (2010) that observed *Aedes aegypti* mosquito as the most predominant in Zaria and Adeleke (2010) in Ikenne, Ogun State, Nigeria. However, some scholars recorded high prevalence of *C. quinquefasciatus* in their previous study (Okeke, *et al*., 2024; Amini *et al*., 2020). This information pointed out that this study area is facing public health threat, especially in tropical region that favours the breading activity of various mosquito species that are serve as vector for mosquito-borne diseases (Chinery, 1969). This study observed significant variation in distribution and abundance of seven species of mosquitoes within the study sites, which appears to be influenced by some physicochemical parameters (Temperature, PH, Turbidity and conductivity) and some sociological Factors. Differences in biological and physical characters of breeding sites, found in the study areas creates favorable conditions for mosquito species. The dominance as observed in this study has been reported by similar work that was reported by Oguche *et al*. (2022) in Kaduna, Amini *et al*. (2020) in Ilorin, Simon *et al.* (2012) in Ekiti State, Olayemi *et al*. (2014) in Minna, Mgbemena *et al*. (2012) in Imo State.

Clocked drainages and Tyres harboured Aedes vittatus, *Culex pipiens*and and Culex simpsoni while plastic container, rice fields and metallic containers harboured *Anopheles gambiae*. The mosquito species reported in this study have also been reported by different researchers elsewhere in some parts of the country, like those of Oguche *et al*., 2022, Afolabi *et al*., 2013, Mgbemena *et al.*, 2012, Ogwoma and Ikpeze 2008, Olayemi *et al.,* 2014.

Three hundred and seventy-four (374) breeding sites were sampled and 251 breeding sites were positive for mosquito larvae with 67.11% indices while 123 breeding sites did not have mosquito larvae with 32.89% indices. The breeding sites positiveness for mosquito larvae was due to the presence of some substances such as Fe_4, Mg, nitrate, oxygen etc. Dissolved ions were highest in Wuro-jebbe with iron (Fe_4), ranging from 13.58 to 13.92 and lowest in Bachure (13.14-13.46). Turbidity was high and was caused by mud, algal bloom, sand storm, saw dust, which increases the temperature by engrossing more heat. This gave the mosquito short incubation period between the egg and adult emergence as also reported by Watsenga *et al*. (2021). Turbidity was highest in Bachure (28.60-29.10) and lowest in Jambutu (22.90-28.60).

The information derived from this study shows that the inhabitants of this area are faced with serious public health problems, more especially in area of diseases such as yellow fever, Filariasis, and Malaria where cases are always reported. Physical parameters of mosquito breeding sites are vital in ascertaining mosquito oviposition (Puntasecca *et al*., 2021). In this study, habitats sampled had temperatures between 27.30 -32.20^{0}C. This study is in agreement with the report of Olayemi *et al*. (2016) which state that most species survived within temperature range of 27-00^{0}C- 35.43^{0}C. Even though 30.00^{0}C, appeared to favour growth of most mosquito species. In this study, Wuro-jebbe had temperature range of 27.30 – 33.10^{0}C which was effective in breeding sufficient mosquitoes for the transmissions of diseases (filariasis, yellow fever, Dengue fever, Chikungunya and Malaria). The concentration of hydrogen ion in a habitat is dependent on the available amount of nutrients in that habitat (Olayemi *et al*., 2010). The present study expressed that almost all the breeding sites had pH level of 6.10 – 7.90. Similar values have been reported by Oguche *et al*., 2022 in Kaduna, Oloruniyi *et al*. (2016) in Lagos, Mgbemena *et al*. (2009) in Imo State. Adebote *et al*., (2016) reported *Aedes* breed in water with pH 7.4, while Okogun *et al*., (2005) revealed that pH of 6.8 to 7.2 is worthy for hatching the first inster larvae from the egg shells. A Similar study was recorded by Service (1993) that PH lower than 5.0 and higher 7.4 have deadly effect on

mosquito species. In this study, Jambutu had pH range of 7.10- 7. 90 which provide favourable condition for mosquito breeding. The findings showed that temperature, pH, conductivity and magnesium was significant factors associated with mosquito development and it is important in explaining the presence and abundance of *Aedes* and Culex and anopheles in the study area as state by Adebote *et al*., (2016). The present study revealed that electrical conductivity of 221.45-336.40 supported the growth and development of mosquitoes in all breeding sites encountered. Oguche *et al.,* 2022, reported similar association of conductivity with *Aedes aegypti* larvae in his study conducted in Kaduna metropolis. Abundance of Aedes and culex species showed significant relationship with conductivity as is the measurement of the accumulated ions in the various breeding sites. On the contrary Rim-Rukeh *et al*. (2013) reported negative association of conductivity with *Culex quinquefasciatus* larval presence. *Aedes aegypti* was mostly found in turbid water compared to less turbid water for oviposition. *Aedes aegypti* are mostly more prevalent in the rainy seasons as this could be associated with the rains as compare to dry season, where there was no or rare turbid waters created by rain water that flows into the pools and ponds. The prevalence of *Aedes* species over *Culex*, and *Anopheles*' mosquitoes in that area may be related to the deference's in larval habitat needed of the deferent species as reported Okogun *et al*. (2005). *Aedes* and *Culex* species usually breed richly in polluted gutters, abandoned tyres, and abandoned pools/ponds with high organic matters (Hidayah, 2019). Few presences of *Anopheles* species were observed in the study area, because they prefer clean ground pools and man-made containers (such as water pots). This study areas have so many clocked gutters, abandoned tyres, pools/ponds, metallic/plastic containers which could have provided favourable environment for the breeding of *Culex* and *Aedes* mosquitoes (Luza *et al*., 2021).

CONCLUSION

This study revealed the breeding habitats supporting mosquito species abundance and diversity in the selected locations within Yola Metropolis. Three of the species; *Culex quinquefasciatus, Aedes aegypti* and *Anopheles gambia* are known vectors of human diseases (Malaria, Yellow fever, filaria and chikungunya) transmissions. Lack of efficient drainage system attributed to the prevalence and the diversity of mosquito species in study areas. Clocked drainages were the most productive habitats which may cause epidemiological threat to the humans in the research areas in relation to mosquito borne diseases. Breeding sites characterizations and Physico-Chemical Parameters of the breeding habitats in the selected locations varied significantly and are typical of the species breeding habitats, which explain the abundance and diversity of mosquito species in the study area and reveals potential threat to public health in case of disease outbreak. There is need for public enlightenment on the dangers of mere throwing refuges into drainages and storing water in open containers for longer period of time.

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