

The Microhabitat Ecology of *Culex quinquefasciatus* (SAY) and *Anopheles gambiae* in Some Parts of Bayelsa State, Nigeria

Ebenezer Amawulu^{1,2,*}, Amakiri Goodluck Consider¹

¹Department of Biology, Isaac Jasper Boro College of Education, Sagbama, Nigeria

²Department of Biological Sciences, Niger Delta University, Wilberforce Island, Amassoma, Nigeria

Email address:

ebenezeramawulu@gmail.com (E. Amawulu)

*Corresponding author

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Abstract: The effective control of malaria through larva source management requires the information on the breeding sites. This study investigated the ecology of mosquito larva in Sagbama town. The breeding sites of mosquitoes were identified in five locations. Mosquito larva in each breeding sites was collected into labeled containers using standard procedures. Morphological identification of larva followed standard procedures. Two hundred and twenty mosquito larva were collected from six microhabitats; motor tyres, dumpsites, gutter, containers, water pools and block holes. Species compositions were *Culex quinquefasciatus* (67.0%) and *An. gambiae* (32.94%). The differences of mosquito species across microhabitats were significant ($F=12.8231$, $df=1$, $p<0.05$). The larva productivity in each of the breeding sites varies with the mosquito species. *Culex quinquefasciatus* in the order of increasing abundance across microhabitats were dumpsites (92.3%), water pools (61.2%), motortyres (57.3%), gutter (57.0%) and block holes (46.3%). *An. gambiae* were more abundant in block holes (58.7%), followed by motor tyres (44.7%) and least in dumpsite (7.7%); *An. gambiae* vary significantly across the breeding sites ($F=5.8715$, $df=16$, $p<0.05$). The breeding adaptability of these mosquitoes to wide range of microhabitats is an indication that there are increase transmission foci of filariasis and plasmodiasis in the rural communities.

Keywords: Microhabitat, Ecology, *Culex quinquefasciatus*, *Anopheles gambiae*, Bayelsa State

1. Introduction

Mosquitoes (family: Culicidae; order: Diptera) are important vectors of human and animals diseases in tropical Africa [1-2]. Over 3000 species of mosquitoes have been described and 100 species are known to transmit several diseases of human and veterinary importance [3-4]. The parasites transmitted by insect vectors are *Wuchereria bancrofti* transmitted by *Culex quinquefasciatus*; *Aedes aegypti* transmits yellow fever virus, dengue and viral encephalitis; *Mansonia perstans* transmitted by *Culiseta* (biting midges) while *Loa loa* is transmitted by *Chrysops dimidiata*. Malaria parasite is transmitted by female *Anopheles* mosquito species [4].

Mosquito are responsible for >90% of disease burden and 630,000 in deaths sub-Saharan Africa [5], infant and

childhood accounted for >20-30% of the total death. Over 500 thousand people suffer from mosquito borne diseases annually [6], causing huge economic losses, social disgrace, low productivity and sleeplessness among individuals and communities [7]. In Nigeria alone, about 60% of people hospitalized were diagnosed of mosquito-borne parasitic infection [8].

Mosquitoes have four distinct stages in their life cycle; egg, larva, pupa and adult which exhibit transition from water to land [9]. Adult lives on land while the eggs, larva and pupa are found in water. The population distribution and diversities of the larva and adult mosquitoes are affected by several ecological factors, such as hydrologic variability, rainfall and availability of suitable breeding habitats and relative humidity [10]. *An. funestus* shows breeding preferences to weedy and permanent clearwater such as

swamps, edges of streams, rivers, ditches and ponds under shades; *An. gambiae* breeds in temporary but clean water collection completely or partially exposed to direct sunlight while *Culex* mosquitoes breed in all types of water body [11].

Several studies have elucidated the breeding behavior of vectors in different ecological settings [12-13]. The Knowledge about the bionomics of the vector species and their breeding site preferences are pre requisites for initiating long lasting larva source management of vector-borne diseases [14]. However, there is paucity of this information in Bayelsa State, Nigeria. This research therefore investigated the ecology of mosquito of public health importance in some part of Bayelsa State. The result of this study shall unveil the likelihood of vector borne parasitic infections and the possibility of transmission foci in the rural communities of Bayelsa State.

2. Materials and Methods

2.1. Study Area

Sagbama Local Government Area (longitude 5° 09'N and latitude 6° 14'E) is located in the tropical rain forest, where most houses showed traditional architecture; some having mud walls and thatched roofs [15] while few had block walls and corrugated iron sheets. The major occupations of the people are fishing, farming and petty trading. The study combine both field and laboratory study. A field and cross sectional study design was adopted. It is cross sectional because the study was carried out at a single visit without necessarily going out for a follow up.

2.2. Mosquito Sampling and Collection

The study was carried out in Sagbama community. The study locations are Mile1, mile 2, mile 3, mile 4 and mile 5. In each location, waste dumpsites, water containers and water pools were identified. The breeding sites in each location were examined for the presence of mosquito larva. In smaller containers larva were collected using a giant plastic pipette. In some other cases, the entire container was over turn into a collection vessel. In a water pool, the dipping method was adopted [9]. Dipping was done using a ladle. In each water pool, 10 dips were made. The larvae and pupae found were put into a plastic bucket containing a little water. Samples collected were labeled according to the types of containers, the macro habitat and ecological foci.

2.3. Morphological Identification

Identification of mosquito larvae were done with the aids of published standard keys [16-17] (De Meillon, 1931 and Hopkins, 1952). Larva position on the water body was used to separate the *Anopheles* from *Culex* and *Aedes*.

2.4. Method of Data Analyses

Two statistical tools were used; simple percentage and ANOVA. Simple percentage was used to show the distribution of mosquito larva in different micro habitats and

locations. The relationship between larva abundance and microhabitats were all determined by ANOVA at $P=0.05$.

3. Results and Analyses

3.1. Mosquito Larva Productivity by Study Location

Two thousand six hundred and twenty three mosquitoes larva were collected from 6 micro habitats across 5 locations in sagbama community. The mosquitoes were *Culex quinquefasciatus* (67.06%) and *Anopheles gambiae* sl.(32.94%). The differences of the mosquito species were significant ($F=12.8231$, $df=1$, $p<0.05$) (table 1).

The mosquito larva population by study location in their increasing order of larva productivity is mile 2 (22.95%), mile 4 (21.54%), mile 5 (21.50%), mile 1 (18.26%) and mile 3 (15.74%). The differences were not significant ($F=0.4744$, $df=4$, $p>0.05$) table 2. The trend in the larva population of *Culex quinquefasciatus* and *Anopheles gambiae* vary across the study locations (figure 1). More *Culex* larva was collected from mile 2 and the least were collected from 3. Conversely, more *Anopheles* larva was recovered in mile 3 and least were collected in mile 2.

Table 1. Population of mosquito fauna in Sagbama during March-August, 2017.

Species	No. Counted	% counted
<i>Culex quinquefasciatus</i>	1759	67.06
<i>Anopheles gambiae</i>	864	32.94
Total	2623	100

Table 2. Larva productivity by study location during March-August, 2017.

location	species		
	Total counted	<i>C. quinquefasciatus</i>	<i>Anopheles gambiae</i>
Mile 5	564(21.50)	399(70.7)	165(29.3)
Mile 4	565(21.54)	378(66.9)	187(33.1)
Mile 3	413(15.74)	236(57.1)	177(42.9)
Mile 2	602(22.95)	466(77.4)	136(22.6)
Mile 1	479(18.26)	280(58.5)	199(41.5)

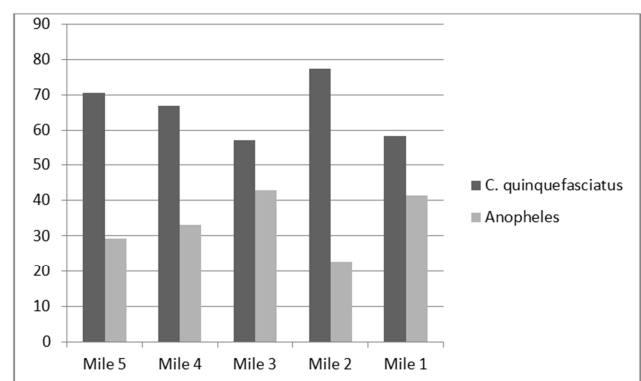


Figure 1. Trend in the mosquito larva productivity across locations.

3.2. Mosquito Larva Productivity Across Breeding Sites

Six breeding sites of mosquitoes were identified and studied. These are; motor tyres, dumpsites, gutter, containers, water pools and block holes. The detailed information about

the mosquito larva productivity across the breeding sites is shown in table 3.

When the mosquito larva was pooled into breeding sites, larva productivity showed variation (figure 2). More mosquito Larvae (22.4%) was recovered in water pools, followed by motor tyres (17.8%). The least was recovered in block holes (12.3%). Differences in the larva productivity across the breeding sites was not significant ($F=0.300793$, $df=5$, $p>0.05$).

However, when the mosquito larva was separated into species across the breeding sites, there was significant disparity between *Culex quinquefasciatus* and *Anopheles*

gambiae (Figure 3). The *Anopheles* productivity across breeding sites in their increasing order of abundance is; Block holes (58.7%), motor tyres (44.7%), Gutter (43.0%), water pools (38.8%). Containers (11.3%) and Dustbin (7.7%). The *Culex quinquefasciatus* larva productivity in their increasing order of abundance across breeding sites is; waste bin (92.3%), water pools (61.2%), Motor tyres (57.3%) Gutter (57.0%), and Block holes (46.3%). *An. gambiae* vary significantly from *Culex quinquefasciatus* across the breeding sites ($F=5.8715$, $df=16$, $p<0.05$).

Tables 3. Mosquito Larva productivity across breeding sites.

micro habitats	No. counted		Total	% counted	
	Anopheles	Culex		Anopheles	Culex
MT	199	267	466(17.8%)	44.7	57.3
WB	31	374	405(15.4%)	7.7	92.3
GT	171	227	398(15.2%)	43.0	57.2
CT	47	369	416(15.9%)	11.3	88.7
WP	228	360	588(23.4%)	38.8	61.2
BH	188	162	350(13.3%)	53.7	46.3

MT- Motor Tyre, WB- waste Bin, GT-Gutter, CT-Container, WP- Water Pool, BH-Block Holes

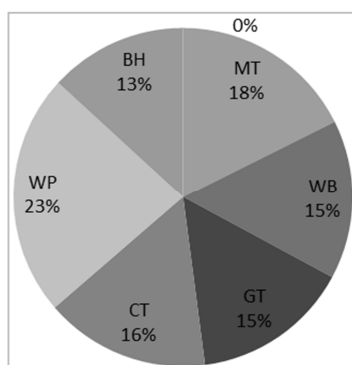


Figure 2. Frequency of mosquito larva counted at different micro habitat.

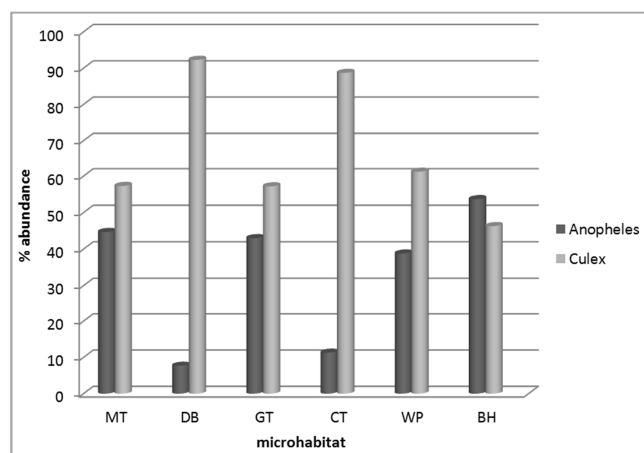


Figure 3. Frequency of mosquito larva species counted at different micro habitat.

4. Discussion

The presence of the mosquito larva of two mosquito species in all the study location is an indication that the

environment is conducive for their development [18]. The high population of the mosquito larva in the 6 microhabitats across the study locations agreed with Ogbalu and Onwuteaka [13]. The wide adaptability of the two mosquito species; *Culex quinquefasciatus* and *Anopheles gambiae* in different microhabitats highlighted a suitable condition of humidity and temperature in the water body, regardless of whether the breeding site is natural or man- made. The high numbers of *Cx. quinquefasciatus* larvae than *Anopheles gambiae* larva collection in this study is an indication that the species, which was once considered an urban mosquito [19]) is also colonizing rural pockets that were once free of this mosquito [12]. In urban areas, the typical breeding sites of *Cx. quinquefasciatus* were described as stagnant polluted water and in rural areas as mainly privies [20]. The population abundance of *Cx. quinquefasciatus* in all the breeding sites is an indication that the changes in the oviposition behavior of *Cx. quinquefasciatus* were necessitated by human population characteristics. The establishment of the Isaac Jasper Boro College of Education in this area may not be unconnected with these changes. The populations of *Anopheles gambiae* larva in block holes and sunlit stagnant water pools, motor tyres and gutter had been reported [21].

5. Conclusion

The study has established that mosquito species are adapting to wide range of micro-habitats. The mosquitoes which were exclusive to urban areas are now adapted to breeding in rural environmental conditions. The breeding site was necessitated by population characteristics in the area, which may not only influence the oviposition behavior but also the disease profile in the area. The presence of *Culex quinquefasciatus* and *An. gambiae* is an indication that

Sagbama is a foci zone for filariasis and plasmodiasis. Understanding many of the emerging microhabitat characteristics can initiate effective control measures.

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