

Distribution and Habitat Preference Index of *Culex* Mosquitoes in Bonny Island, Nigeria

Agbaru, G. A.^{*1}, Ebere, N.^{2,3} & Amuzie, C.C.³

¹Department of Biology, Ignatius Ajuru University of Education, Rumuolumeni, Rivers State, Nigeria; ²Department of Maritime Science, Rivers State University, Port Harcourt, Nigeria; ³Department of Animal and Environmental Biology, Rivers State University, Port Harcourt, Nigeria. *Email: agbaru.greg@ust.edu.ng

Abstract

Article History

Received: Oct. 6, 2026

Accepted: Oct. 13, 2026

Published: Oct. 16, 2026

Journal homepage:

<https://www.iarpub.org>

Studies have shown the distribution of *Culex* mosquitoes in places where they were previously absent, implicating anthropogenic impact, especially rapid urbanization. Literature on the distribution and habitat preference of the mosquito species in Bonny Island is sparse. This study was hence conducted to fill the knowledge gap. Larval collection was conducted in three habitats (drainages, pools of water, and discarded containers) across four locations in the Island, namely, Akiama, Abalamabie, Workers' Camp and Finima, from July – December, 2023, using standard 350 mL adjustable dippers and syringes. Larval identification was done using appropriate keys; data collected were recorded and habitat preference indices were computed. Relevant statistical analysis was done to test for significant differences in the number of larvae isolated from the habitat types investigated. Results showed that all the habitats were significantly different with drainages holding a larger number of larvae (1,778; 42.72%), followed by pools of water (1,477; 35.49%) and discarded containers (907; 21.79%). Habitat preference index showed no preference for any location with values ranging approximately from 0.24 – 0.26. Thus, *Culex* larvae were found to be ecological generalists in the locations of Bonny Island hereby examined, thereby requiring even spread of vector control measures.

Keywords: Culicine Mosquitoes, Bionomics, Bonny Island, Vector Control, Breeding Preference.

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INTRODUCTION

Studies on the distribution and habitat preference of mosquitoes are necessary for the determination of dominant species, identification of emerging diseases, and selection of appropriate control measures (Ukubuiwe et al., 2016). Though physicochemical parameters of breeding habitats may influence the distribution of mosquito larvae, *Culex* and *Anopheles* mosquitoes have been shown to thrive in polluted habitats (Woke et al., 2025).

Meena and Sakhuniya (2021) reported that the rapid development of urban areas has led to *Culex* mosquitoes adopting several habitats (including drains, seepage channels, stale water etc.) for breeding. Some *Culex* mosquitoes also use animal water troughs

(Romero-Weaver et al. (2023) and depressions on trees (Okiwelu & Noutcha, 2012) for breeding. This has been proven by several studies in Nigeria and other countries. In selected locations in Lagos, Nigeria, Otubanjo (2018) identified six *Culex* species with *Cx. quinquefasciatus* as the uedominant species in water drainage canals. From Bayelsa State, Nigeria, Amuwulu and Amakiri (2018) identified *Culex quinquefasciatus* (67.0%) and *An. gambiae* (32.94%) from six microhabitats. They reported that while *Cx. quinquefasciatus* had high preference for dumpsites and water pools, *An. gambiae* were more abundant in block holes and motor tyres. In Northeastern Iran, Sofizadeh et al., 2024 identified thirteen mosquito species from four genera including *Anopheles*,

Culex, *Culiseta* and *Uranotaenia* from both natural and artificial oviposition sites.

Though there are reports on distribution and other aspects of mosquito ecology in parts of the Niger Delta, Nigeria, information from Bonny Island is sparse. This research was thus conducted to assess distribution and habitat preference index of *Culex* mosquitoes from selected locations at Bonny Island to fill the gap and provide relevant data necessary for informed vector control strategies.

MATERIALS AND METHODS

Study Area: Bonny Island is located between latitudes 4°25'N and 4°30'N and longitudes 7°10'E and 7°15'E in Nigeria's Niger Delta. The island has boundaries with the Atlantic Ocean, and is surrounded by extensive mangrove forests and brackish water bodies. The climate is typical tropical monsoon type characterized by the wet (April - October) and dry (November – March) seasons.

Mosquito sampling was carried out in four distinct communities (Fig. 1) within the Island, namely, Abalamabie, Akiama, Finima, and Workers Camp.

Abalamabie is a densely populated residential area in southern part of Bonny Island. It experiences flooding during the wet season and has poor drainage systems which account for stagnant pools of water commonly found in the area. Akiama is a semi-urban neighborhood, faced with the challenges of waste management and open drainage systems. Finima is located near the southern coastal edge of Bonny Island and is known for hosting the Nigerian Liquefied Natural Gas (NLNG) residential and industrial facilities. The area is relatively well-planned and maintained, with improved infrastructure and better sanitation systems. However, proximity to mangrove swamps and natural water bodies creates persistent mosquito habitats despite ongoing environmental management efforts. Workers Camp is an enclosed residential estate developed primarily for industrial workers and expatriates characterized by organized housing, regular sanitation, and vector control programs.

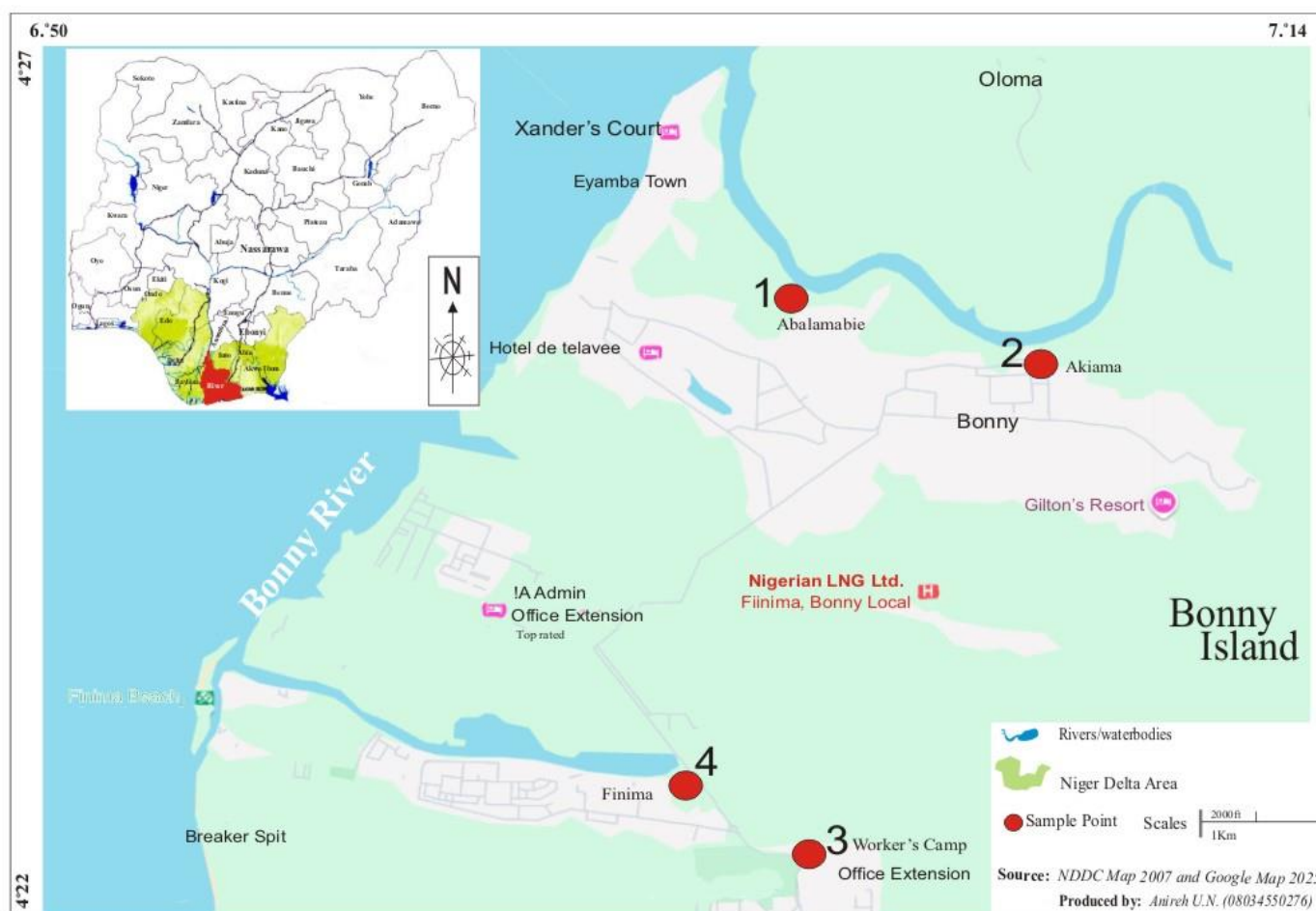


Fig. 1: Map of Bonny Island showing the Sample Locations.

Study Duration and Sample Collection: Mosquito sampling was conducted from July to December 2023; each location was visited three consecutive days per month. Breeding sites such as drainages, pool of stagnant water, and discarded water and beverage containers were identified for larval collection. Larvae were collected using ladles, standard 350 mL adjustable dippers and syringes. Ten dips were made for each identified breeding site. For the discarded water and beverage containers, waste water was collected from all such containers until the volume was enough for ten dips. These breeding sites were carefully surveyed in all four study locations.

Collected larvae were placed in labeled plastic containers partially filled with water from the collection site and transported to the Mosquito Research Laboratory, Rivers State University, Port Harcourt.

Identification of Mosquito Larval Species: Mosquito larvae were identified using taxonomic keys of Hopkins (1952) and Harbach (2011).

Determination of Habitat Preference Index (HPI) of *Culex* Larvae in Bonny Island:

The Habitat Preference Index (HPI) of *Culex* larvae was computed as follows:

$$\text{Habitat Preference Index (HPI)} = \frac{\text{Number of Larvae in Specific Habitat}}{\text{Number of Larvae in all habitats}}$$

$$\text{HPI} = \text{HPI}_i = \frac{(L_i/L_t)}{(H_i/H_t)}$$

Where:

L_i = Number of larvae collected from habitat type i

L_t = Total larvae collected from all habitats

H_i = Number of habitat units of type i examined

H_t = Total habitat units examined

Statistical Analyses: Descriptive statistics of mean and standard deviation were used for data presentation. Regression analysis was done to test for association between number of larvae and habitat type. Anova single factor was used to test for significant differences between the number of larvae among the habitat types investigated, and mean separation was done with Tukey test. Significance was taken at $p < 0.05$.

RESULTS

Distribution of *Culex* Larvae across Various Habitats in Bonny Island: A total of 4,162 *Culex* larvae were collected from the habitats examined from sample locations over the sample period. Out of this number, a total of 1,778 (42.72%), 1,477 (35.49%) and 907 (21.79%) larvae were found in each of drainage, stagnant pool of water, and discarded containers. The range of *Culex* larvae collected from drainages was 42 – 108; from stagnant pool of water, 20 – 99, and from discarded containers, 18 - 61.

Regression analysis gave an r value of 0.66 indicating there was a strong, positive association between breeding site and the number of *Culex* larvae in Bonny Island. Anova – single factor analysis between the mean number of *Culex* larvae from the habitat types revealed significant differences ($p=0.00$; Table 1).

Table 1: Distribution of *Culex* Larva Across Various Habitats in Bonny Island

Breeding Site	Mean±SD	Sum	Minimum	Maximum	P-value
Drainage	74.08±17.62 ^c	1778.00	42.00	108.00	.000
Pool of water	61.54±20.68 ^b	1477.00	20.00	99.00	
Container	37.79±11.12 ^a	907.00	18.00	61.00	
Total	57.81±22.56	4162.00	18.00	108.00	

Habitat Preference Index (HPI) of *Culex* Larvae in Bonny Island: The HPI values of 0.241951, 0.257088, 0.239068, and 0.261893 were obtained at Akiama, Abalamabie, Workers Camp and Finima respectively. All the values were <1 (Table 2).

Table 2: Habitat Preferred Index of *Culex* Larva in Bonny Island

Station	No of <i>Culex</i>	HPI	Interpretation
Akiama	1007	0.241951	Low preference
Abalamabie	1070	0.257088	Low preference
Workers Camp	995	0.239068	Low preference
Finima	1090	0.261893	Low preference
Total	4162		

DISCUSSION

Culex mosquitoes use diverse array of habitats for breeding (Okiwelu & Noutcha, 2012; Amuwulu and Amakiri (2018); Woke et al., 2025) and this has contributed to their successful distribution in several urban and rural locations. In this research, three habitats were examined for *Culex* larvae namely drainages, stagnant pools of water, and discarded containers. The results showed that in the study locations in Bonny Island, *Culex* sp. larvae were found in larger numbers in drainages (n= 1778; 42.72%) followed by pools of water (n=1477; 35.49%) and lastly, containers (n=907; 21.79%) giving a total of 4,162 larvae collected over the study period. This is due to the preference of dirty and polluted environments for breeding by *Culex* spp. In Bayelsa State, Nigeria, for instance, Amawulu and Amakiri (2018) found a higher number of *Cx. quinquefasciatus* larvae in dumpsites, followed by water pools, motor tyres and block holes. The more polluted environment of dumpsites had higher number of *Culex* larvae as also found in the present research where drainages had more numbers of the same species.

However, *Culex* larval abundance in breeding habitats appear to vary in different locations. For instance, Okiwelu and Noutcha (2012) found that the container-type of habitat yielded more larvae of *Culex* than both pools and phytotelmata in selected locations in Ikwerre Local Government Area of Rivers State, Nigeria. Yet they found variations in individual study locations; for instance, in Ozuaha location, more larvae were collected from pools (gutters).

The Habitat Preference Indices of *Culex* larvae from the sample locations in Bonny Island ranged approximately from 0.24 – 0.26. This index was used to explain the extent to which *Culex* mosquito larvae preferred particular habitats relative to their availability in a given area. It gave site-specific abundance weighting of *Culex* larvae in Bonny Island. The HPI indicated whether the *Culex* larvae preferred a habitat (HPI>1), used it proportionally to availability (HPI ≈ 1), or avoided it (HPI<1). Thus, the results indicated absence of larval preference for any of the study locations. This also implied broad habitat tolerance for the species suggesting that *Culex* larvae in Bonny Island were ecological generalists, exploiting a wide variety of breeding sites rather than

concentrating in a specific habitat (WHO, 2017). Thus, vector control efforts should adopt multi-habitat management strategies rather than site-restricted interventions.

CONCLUSION

A total of 4,162 *Culex* larvae were isolated from three habitats (drainages, pools of water and discarded containers) from four locations (Akiama, Abalamabie, Workers' Camp, and Finima) in Bonny Island, Nigeria. The abundance of the larvae in the habitats showed higher distribution among drainages (42.72), followed by pools of water (35.49%) and lastly, discarded containers (21.79%).

The Habitat Preference Index (HPI) revealed no preference of the larvae for any of the study locations, instead presenting the species as ecological generalists in the Island. Thus, vector control efforts should be evenly carried out in identified breeding sites in all study locations.

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