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Original Research Article

Mosquito Vector Abundance and Distribution in a University Campus, Atiba Local Government, Southwestern Nigeria

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Abstract

Mosquitoes are important vectors of diseases that pose major public health challenges. This study investigated the prevalence and distribution of *Aedes* and *Culex* species within Ajayi Crowther University, Oyo State, Nigeria. Larvae were collected from ten randomly selected sites over a five-month period (November–March). A total of 10,033 mosquitoes were recorded, comprising *Culex* spp. (5,141; 53.8%) and *Aedes* spp. (4,892; 46.2%). Statistical analysis showed significant variation across months ($p = 0.005$) and locations ($p = 0.002$), while no significant interaction was observed ($p = 0.074$). The predominance of *Culex* highlights the risk of diseases such as lymphatic filariasis and West Nile virus, whereas *Aedes* remains relevant for dengue, yellow fever, and chikungunya transmission. These findings provide baseline data for vector control programs in Atiba Local Government and contribute to understanding mosquito distribution in Oyo State.
Keywords: Arboviruses, *Aedes*, *Culex*, Oyo State, Nigeria.

INTRODUCTION

Mosquitoes (*Diptera: Culicidae*) are among the most important arthropod vectors of human and animal diseases, transmitting a wide range of pathogens including arboviruses, protozoa, and filarial nematodes (Nebbak *et al.*, 2022). Globally, more than one billion people are infected annually with mosquito-borne diseases, leading to over one million deaths (Chandra & Bhattacharjee, 2024; Organization, 2014; Parnell *et al.*, 2024). Of the over 3,600 described mosquito species, members of the genera *Aedes*, *Culex*, and *Anopheles* are of greatest public health importance (Tyagi, 2025; Tyagi *et al.*, 2025).

Aedes and *Culex* mosquitoes, in particular, are responsible for transmitting several arboviruses of health concern. *Aedes aegypti* and *Aedes albopictus* are the principal vectors of dengue, chikungunya, Zika, and yellow fever viruses, while *Culex quinquefasciatus* and related species are important in the transmission of West Nile virus, St. Louis encephalitis, Rift Valley fever, and lymphatic filariasis (Braack *et al.*, 2018; Näslund *et al.*, 2021). Unlike malaria, where vector control through insecticide-treated nets and indoor residual spraying has shown major impact, arboviral diseases remain largely uncontrolled due to the differences in feeding and resting behaviors of culicine mosquitoes, the absence of widely available vaccines, and inadequate diagnostic capacity in many endemic regions (Nalinya *et al.*, 2022)

In sub-Saharan Africa, the burden of mosquito-borne arboviruses has been increasingly documented (Poungou *et al.*, 2023; Weetman *et al.*, 2018). Outbreaks of yellow fever continue to occur in Nigeria despite the availability of vaccines, while dengue and chikungunya are under-reported due to misdiagnosis as malaria (Adam & Jassoy, 2021; Nwangwu *et al.*, 2024; Salam *et al.*, 2018). Similarly, *Culex*-transmitted infections such as lymphatic filariasis remain endemic in many Nigerian communities, with significant implications for long-term morbidity and disability (Cano *et al.*, 2014; Van den Berg *et al.*, 2013). The co-circulation of multiple arboviruses, coupled with weak surveillance systems, creates an urgent need for localized vector studies that can inform targeted interventions.

Educational institutions represent distinctive ecological niches that may facilitate mosquito proliferation. University campuses often have dense human populations, poorly managed waste, open drains, and artificial containers such as discarded plastics, flowerpots, and construction sites that serve as larval habitats (Bedoya-Rodríguez *et al.,* 2022; Contreras Velásquez *et al.*, 2024; Wheeler Jr, 2008). Such environments create opportunities for both *Aedes* and *Culex* mosquitoes to thrive, increasing the risk of arboviral transmission within and beyond the institution. Despite this, entomological surveillance in academic environments remains scarce, and most Nigerian vector studies have focused on residential or peri-urban settings (Okeke, 2024; Yahaya, 2022; Zerbo, 2022).

Understanding the ecology, distribution, and seasonal dynamics of mosquito species is critical for designing sustainable vector control programs. Previous studies across Nigeria have reported varying levels of *Aedes* and *Culex* abundance, influenced by ecological settings, breeding habitats, and human activities (DONATUS *et al.*, 2022; Living-Jamala *et al.*, 2024; Omoregie *et al.,* 2025) However, limited attention has been paid to educational institutions, which represent unique microhabitats due to their high human density, poorly managed waste systems, and artificial water-holding containers. Such environments may serve as reservoirs for vector populations, with implications not only for students and staff but also for surrounding communities.

This study therefore investigates the prevalence and distribution of *Aedes* and *Culex* species within Ajayi Crowther University, Atiba Local Government Area, Oyo State, Nigeria. By generating baseline data on species composition and abundance across seasons and locations, the study provides evidence to strengthen arboviral disease surveillance and guide targeted vector control interventions in institutional settings.

MATERIALS AND METHOD

Study Area

The town of Oyo, which was chosen for the research, is located in the state of Oyo. It is a southern Nigerian inland state. Its capital, Ibadan, is Africa's third most populated city (Nenge, 2019). Oyo State is Nigeria's fifth most populated, with an estimated population of 7,840,864 in 2016. Oyo state is the 14th largest in terms of area, with a total area of 28,454 square kilometres. The climate is tropical, with dry and wet seasons and high humidity levels. The dry season runs from November to March, while the wet season is from April to October. The average daily temperature is between 25^{0}C (77.0^{0n}F) and 35^{0}C (95.0^{0}F) (Nenge, 2019).

Study Location

Samples were taken from 10 different locations at Ajayi Crowther University. Ajayi Crowther University is located in Atiba local government, Oyo town, Oyo State, Nigeria. It is located between the equator's latitudes of 7^{0}50ˈ5''N and 3^{0}56ˈ58''E. The details of the sampling location and Global Positioning System (GPS) are listed in Table 1.

Mosquito larvae collection

The collection of mosquito larvae was carried out in the selected sites using standard dipper methods. All suitable habitats were inspected for the presence of mosquito larvae. Different sites in the surveyed locations were sampled by using the standard dipping technique (Medlock *et al.*, 2018). When mosquito larvae were present, 10–18 dips were taken using a 350 ml standard dipper.

Rearing of larvae to adult

The larvae were reared to the fourth instars until they were pupated with each mosquito cage containing a single collection from a particular breeding site. Larvae were fed with yeast. Regular cleaning of larval bowls was carried out by changing water due to excess feed to prevent larval mortality. Pupae were pipetted out of the rearing cage each morning with hand pipettes and transferred into labelled plastic cups which were placed in adult mosquito cages and left for emergence. The purpose of rearing the larvae was to properly identify the adult genera. At the end of each day emerged adults were counted and recorded. The adults that emerged from the larvae were fed with glucose solution in cotton wool. The emerged mosquitoes were preserved in labelled 1.5ml Eppendorf tubes containing silica gel desiccant and transported to the Department of Microbiology and Biotechnology, Ajayi Crowther University for proper identification.

Identification of the collected mosquitoes

The mosquitoes were identified using the gross morphology of the species: external morphology of the head, mouthparts, antenna, proboscis, patches of pale and black scales on the wings and legs, and the terminal abdominal segments (Becker *et al.*, 2020; Mandal, 2025).

Data Analysis

The data obtained were subjected to descriptive statistics; percentages were calculated and presented in tables. Analysis of variance (ANOVA) was used to determine the significant difference ($p<0.05$) between mosquito compositions with Study locations using SPSS.

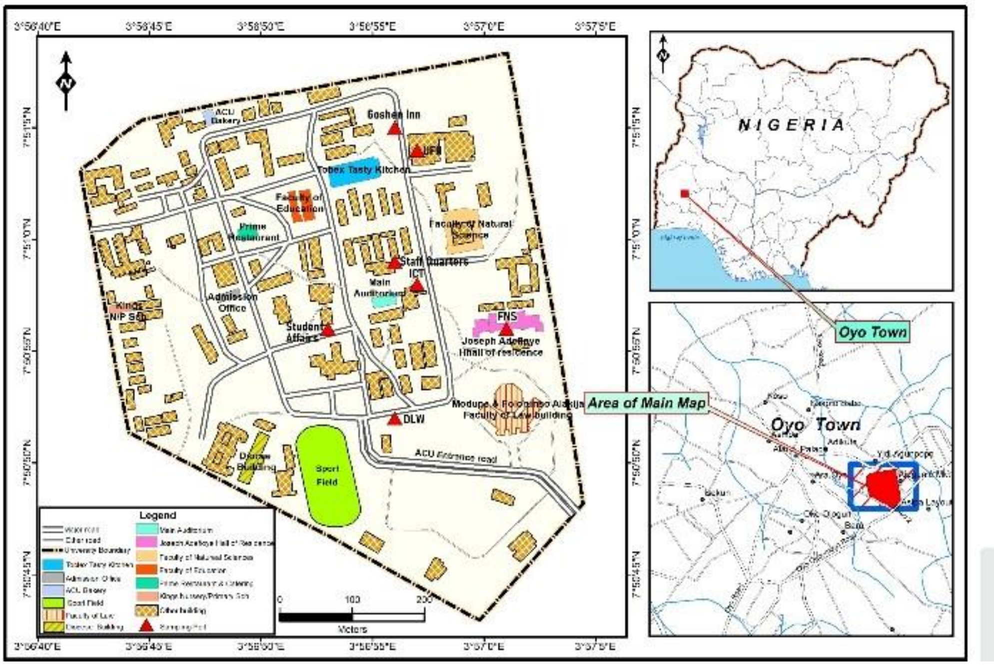

Figure 1: Map of Ajayi Crowther University campus, Oyo showing sampling points

Table 1: Showing the sample locations Global Positioning System (GPS)

S/N	Locations	Longitude	Latitude
1.	FNS	7^{0}50ˋ56’’N	3^{0}57ˋ1’’E
2.	UFH	7^{0}51ˋ4’’N	3^{0}56ˋ57’’E
3.	ICT	7^{0}50ˋ58’’N	3^{0}56ˋ57’’E
4.	Student Affairs	7^{0}50ˋ56’’N	3^{0}56ˋ53’’E
5.	Law	7^{0}50ˋ55’’N	3^{0}57ˋ4’’E
6.	Welcome Center	7^{0}50ˋ5’’N	3^{0}56ˋ58’’E
7.	DLW	7^{0}50ˋ52’’N	3^{0}56ˋ46’’E
8.	Goshen Inn	7^{0}51ˋ5’’N	3^{0}56ˋ46’’E
9.	Staff Quarters	7^{0}50ˋ59’’N	3^{0}56ˋ52’’E
10.	Social Sciences	7^{0}50ˋ52’’N	3^{0}56ˋ48’’E

Key: FNS – Faculty of Natural Sciences; UFH – University Female Hostel; ICT – Information and communication technology; DLW – Diocese of Lagos West

Plate 1a: *Aedes* spp.

Plate 1b: *Culex* spp.

RESULTS

A total of 10,033 mosquitoes were collected between November 2023 and March 2024 across ten sampling sites in Ajayi Crowther University, Atiba Local Government, Oyo State. Of these, *Culex* spp. accounted for 5,141 individuals (53.8%) and *Aedes* spp. for 4,892 (46.2%), indicating a slightly higher prevalence of *Culex* within the study area.

Mosquito abundance varied across locations (Table 2; Figure 6). The Faculty of Natural Sciences recorded the highest numbers of both *Aedes* (1,264) and *Culex* (1,601). In contrast, the Staff Quarters yielded the lowest collections, with 212 *Aedes* and 147 *Culex*. Other notable hotspots included the Law Faculty, which showed a higher dominance of *Aedes* (1,128) compared to *Culex* (541), and the Student Affairs unit, where *Culex* (790) exceeded *Aedes* (470). Overall, while *Culex* predominated in most sites, *Aedes* abundance was greater in the Law Faculty and Goshen Inn.

Monthly collections revealed marked fluctuations in abundance (Table 3; Figures 2–6). In November, *Aedes* (n = 1,300; mean 130 ± 119.9) slightly outnumbered *Culex* (n = 1,173; mean 117.3 ± 123.1). December and January showed comparable abundances between the two genera, with minor shifts. By February and March, however, *Culex* populations increased substantially, peaking at 1,224 individuals in March compared to 936 *Aedes*. These seasonal patterns suggest a progressive rise in *Culex* towards the late dry season.

Disaggregated analysis (Figures 2–6) showed variable genus dominance across sites and months. *Aedes* outnumbered *Culex* at the Law Faculty in November and December, whereas *Culex* predominated in Student Affairs and the University Female Hostel throughout most of the study. Some sites exhibited sharp shifts; at Goshen Inn, *Aedes* was dominant in November (95 vs. 0) but later declined relative to *Culex*.

A mixed-model ANOVA (Table 4) confirmed significant temporal variation in mosquito abundance across months (F, p = 0.005) and significant spatial variation across locations (F, p = 0.002). However, the interaction effect between month and location was not significant (p = 0.074), indicating that temporal and spatial effects were independent.

Table 2: Total number of mosquitoes species distribution based on location

S/N	Location	Species	
		Aedes	***Culex***
1.	FNS	1264	1603
2.	UFH	219	332
3.	ICT	472	263
4.	Student Affairs	470	790
5.	Law	1128	541
6.	Welcome Centre	329	374
7.	DLW	203	486
8.	Goshen Inn	326	250
9.	Staff Quarters	212	147
10.	Social Sciences	269	355
	Total	**4892**	**5141**

Key: FNS – Faculty of Natural Sciences; UFH – University Female Hostel; ICT – Information and communication technology; DLW – Diocese of Lagos West

Table 3: Number and percentage of *Aedes* and *Culex* species collected over the months

Months	*Aedes* spp.	*Mean and SD*	*Culex* spp.	Mean and SD	Total
November	1300 (52.6)	130±119.89	1173 (47.4)	117.3±123.1	2473
December	864 (48.5)	86.4±72.87	918 (51.5)	91.8±87.93	1782
January	854 (50.3)	85.4±77.92	845 (49.7)	84.5±60.44	1699
February	938 (48.9)	93.8±77.62	981 (51.1)	98.1±83.25	1919
March	936 (43.3)	93.6±71.92	1224 (56.7)	122.4±81.62	2160
Total	**4892 (48.8)**		**5141 (51.2)**		**10,033**

Figure in parenthesis=%; SD – Standard deviation

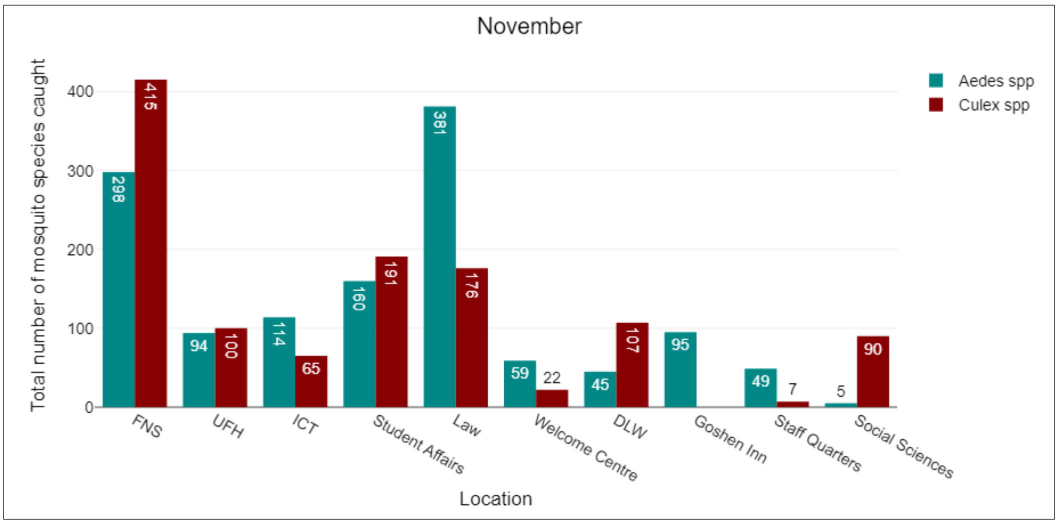

Figure 2: Mosquitoes species distribution across the study area for November

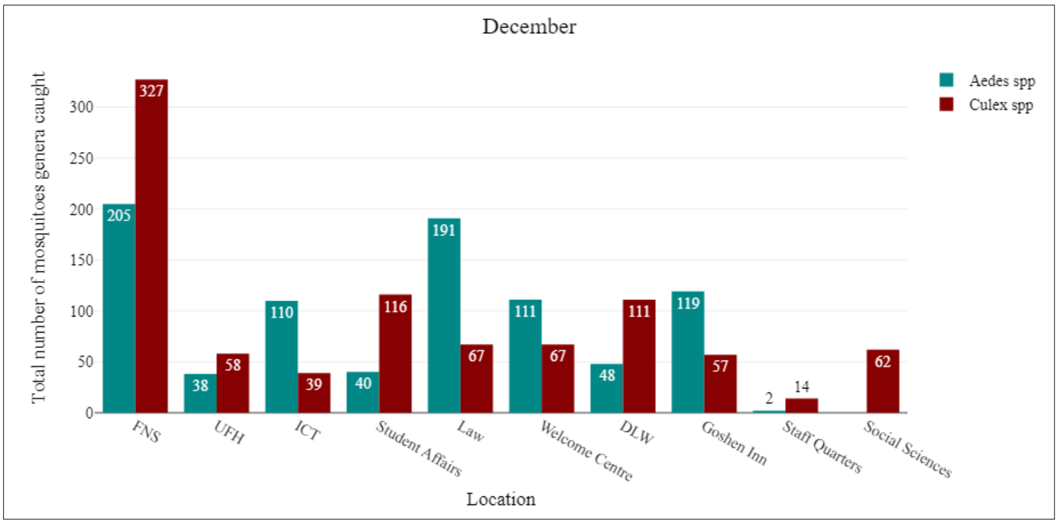

Figure 3: Mosquitoes species distribution across the study area for December

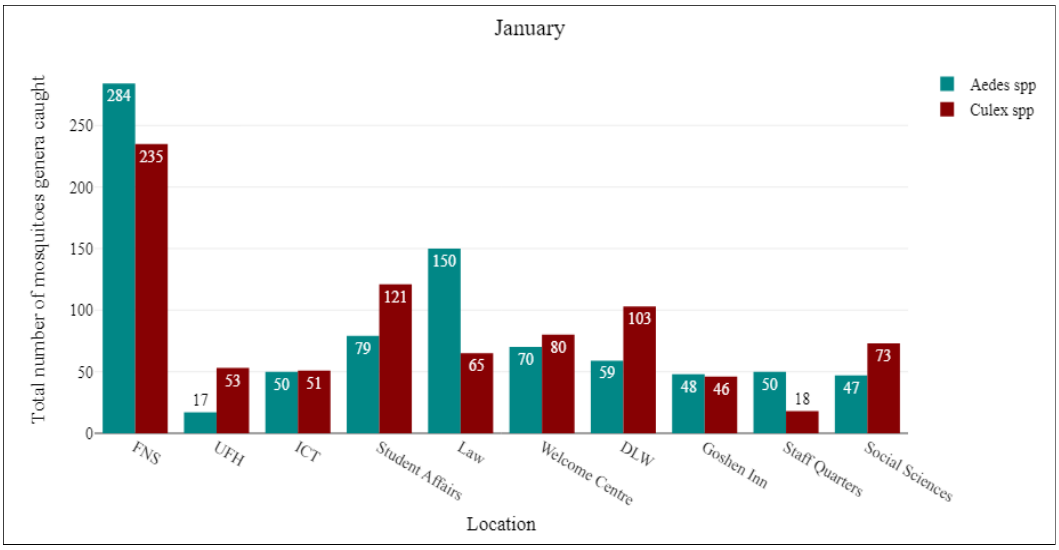

Figure 4: Mosquitoes species distribution across the study area for the month of January

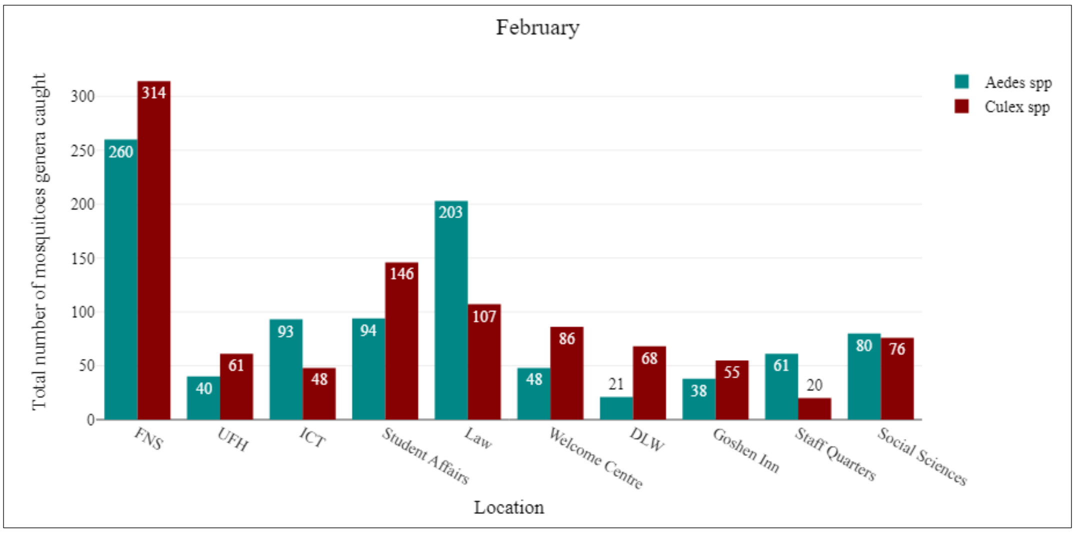

Figure 5: Mosquitoes species distribution across the study area for the month of February

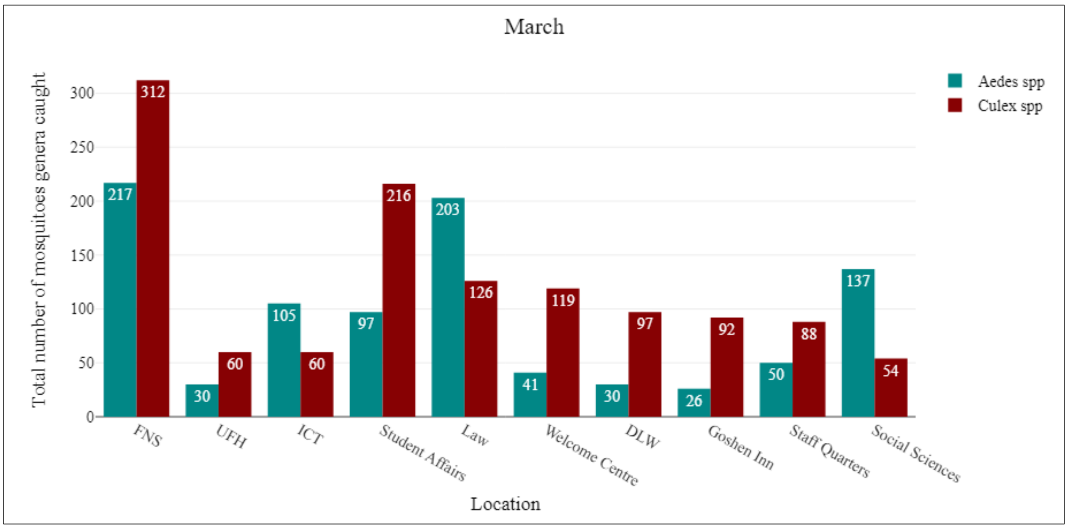

Figure 6: Mosquitoes species distribution across the study area for the month of March

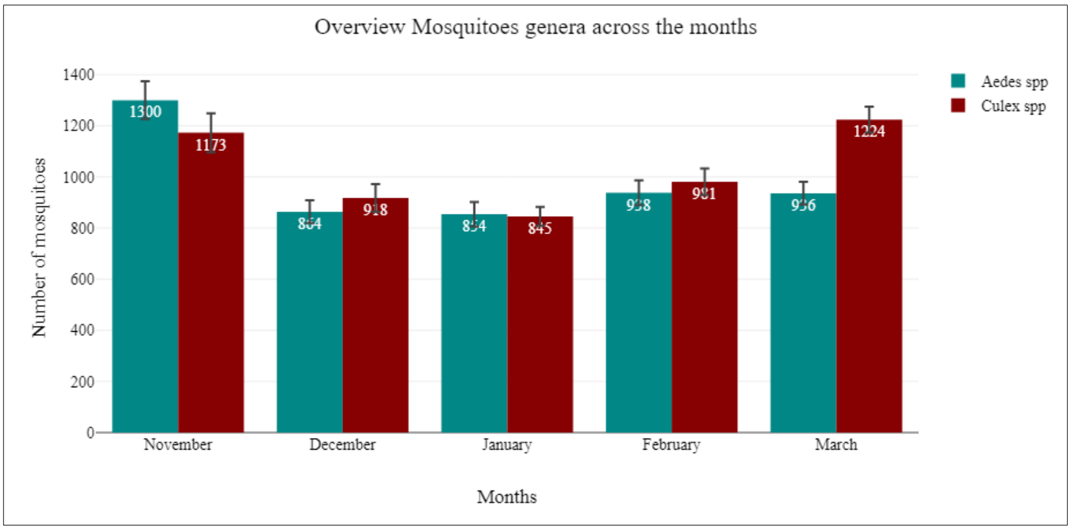

Figure 7: The overview of the mosquitos' genera across the months

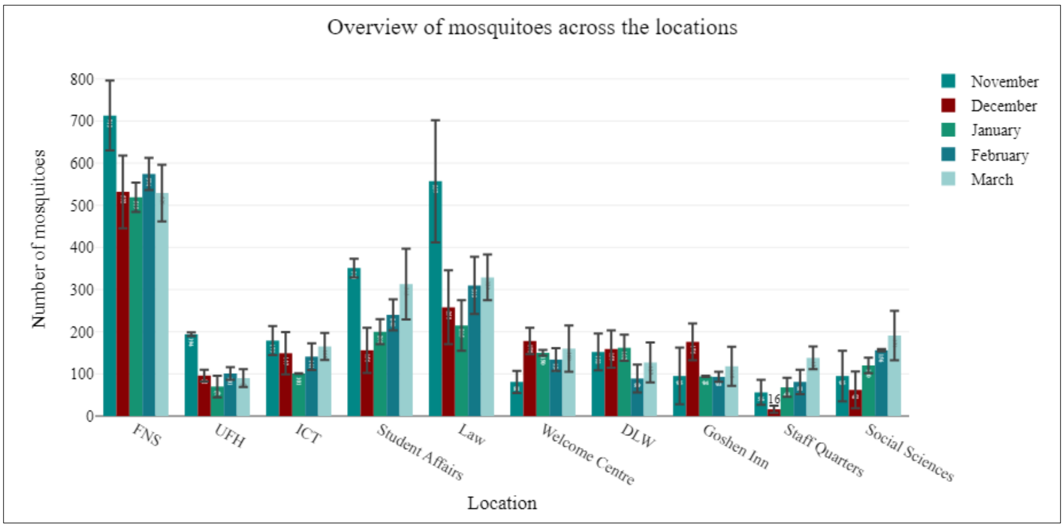

Figure 8: The overview of the mosquito's genera across the locations

DISCUSSION

This study investigated the distribution and abundance of *Aedes* and *Culex* mosquitoes in ten locations within Ajayi Crowther University, Atiba Local Government, Oyo State, Nigeria. Overall, *Culex* spp. (53.8%) were slightly more abundant than *Aedes* spp. (46.2%), a pattern consistent with findings from Lopez-Solis *et al.*, (2023) and Diallo & Diallo, (2020), who reported similar dominance of *Culex* in comparable ecological settings. In contrast, studies from Abia State (Egwu *et al.*, 2018) and Lagos–Ibadan axis (Sule & Oluwayelu, 2016) documented higher *Aedes* prevalence, suggesting that local ecological factors strongly shape mosquito community composition. Likewise, Onodua *et al.*, (2020) in Ughelli reported different proportions of *Culex* and *Aedes*, further underlining how climatic seasonality, habitat availability, and anthropogenic activities can drive site-specific variations.

The seasonal trend observed in this study of higher *Culex* abundance towards the late dry season supports the role of climate in shaping mosquito dynamics. Mosquito populations are closely tied to temperature and rainfall, with warmer, drier periods favoring container breeding species such as *Culex* (Gorris *et al.*, 2024). The temporal peak in November, followed by a dip in January, likely reflects fluctuations in rainfall and humidity. Previous climate based projections suggest that changing rainfall intensity and prolonged dry spells will further alter mosquito breeding cycles in West Africa (Valdez *et al.*, 2017). This highlights the need to integrate entomological surveillance with climate monitoring in order to anticipate future vector trends.

Spatial differences were also pronounced. The Faculty of Natural Sciences recorded the highest abundance of both genera, likely due to availability of artificial breeding habitats such as clogged drains and abandoned containers, which are known to favor *Aedes* and *Culex* proliferation (Kampango *et al.*, 2021). By contrast, residential sites such as the Diocese of Lagos West and Goshen Inn yielded the lowest mosquito counts, possibly due to routine insecticide use and environmental management practices (Townson *et al.*, 2005). These findings suggest that institutional and peri-urban environments with poor sanitation may serve as hotspots for vector breeding.

Statistical analysis confirmed significant spatial and temporal differences in mosquito abundance, while the lack of interaction between the two factors indicates that monthly trends were consistent across locations. This pattern may be explained by the relative environmental uniformity of the study area during the dry season and the ecological adaptability of both *Aedes* and *Culex* (Farajollahi & Price, 2013). Similar findings have been reported in other African urban settings where both genera maintain stable populations despite temporal fluctuations (Becker *et al.*, 2012; Juliano & Philip Lounibos, 2005).

The higher prevalence of *Culex* has important public health implications. *Culex* mosquitoes are established vectors of West Nile virus, lymphatic filariasis, Rift Valley fever, and encephalitis, all of which can cause significant morbidity and mortality in human populations (Bicout & Sabatier, 2004; Roiz *et al.*, 2018). On the other hand, *Aedes* spp. remain critical vectors of dengue, chikungunya, yellow fever, and Zika virus. Dengue alone caused over five million infections and more than 5,000 deaths globally in 2023 (Moyenuddin, 2025), while yellow fever continues to pose a major burden in Africa, accounting for approximately 90% of annual global cases (Barnett, 2007). The coexistence of both mosquito genera in substantial numbers therefore represents a dual public health challenge for Atiba Local Government and surrounding communities.

Vector control remains a cornerstone in preventing arboviral transmission. While efforts increasingly focus on vaccine development, integrated vector management is essential to reduce disease burden (Powell, 2018). The higher abundance of *Culex* suggests the need for targeted interventions such as larviciding polluted water bodies, improving drainage systems, and environmental sanitation campaigns. At the same time, *Aedes*-specific strategies, including container management and household-level control, should not be neglected. Ultimately, sustained entomological monitoring is required to track shifting mosquito populations and guide adaptive public health responses.

CONCLUSION

This study provides baseline data on the prevalence and distribution of *Aedes* and *Culex* mosquitoes in Atiba Local Government, Oyo State, Nigeria. The dominance of *Culex* spp., coupled with the substantial presence of *Aedes* spp., highlights the dual risk of arboviral and filarial disease transmission in the study area. Spatial and temporal variations observed underscore the influence of ecological and anthropogenic factors on mosquito abundance. Strengthening vector surveillance, coupled with targeted control measures adapted to local ecological settings, remains critical for reducing the burden of mosquito-borne diseases.

RECOMMENDATION

From the study carried out the following recommendations are made: implement targeted control measures, which could include larval habitat removal, use of larvicides and adult mosquito control; Public awareness should be conducted to educate people about the public health implications; The use of surveillance and monitoring efforts to better understand their distribution and abundance; allocation of research efforts towards understanding the factors contributing to the abundance of the mosquito species and potential strategies for their control and management.

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Author Contributions

AEA conceived the research idea, AEA, OAF and JOO collected the samples and performed the laboratory experiment, AEA and OAF carried out the analysis, AEA, OBA, JOO wrote and edited the manuscript.

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Declarations

Ethical approval and consent to participate: Not applicable.

Consent for publication: The authors thus consent to the publication of this article.

Competing interests: The authors declare no competing interests.

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