Research Article

MOSQUITO DIVERSITY IN AKOKO NORTH WEST LOCAL GOVERNMENT AREA, ONDO STATE

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Abstract

The distribution and diversity of mosquitoes in Akoko North West Local Government Area were studied for November 2021–February 2022. Forty (40) positive breeding sites across the local government area were sampled using standard dipping techniques with a plastic dipper. The habitats sampled include containers, stagnant water, domestic run-off, and gutters. The larvae collected after rearing to adult stage were preserved in a 1.5-ml Eppendorf tube and identified to genera level using a digital microscope and morphological keys. The mosquitoes sampled were identified into five (5) genera, which include *Aedes*, *Anopheles*, *Culex, Toxorynchytes,* and *Mansonia*. *Anopheles* species were found to be most abundant in the study area, with a total abundance of 237 species, followed by *Aedes*species (160), *Mansonia* species (85), *Culex* species (46), and *Toxorynchytes* (24). The study also revealed that Okeagbe is the village with the highest diversity of mosquitoes in the study area. A combination of factors such as temperature, pH, dissolved oxygen, total dissolved solids, conductivity, and anthropogenic-related factors contributed to the increasing abundance of mosquitoes in the study area. The high occurrence of *Anopheles* and *Aedes* is suggestive of the prevalence of vector-borne diseases such as malaria, yellow fever, and dengue fever in the study area. Therefore, intensive vector control programs and public enlightenment, especially on human activities that encourage mosquito breeding, are recommended.

Keywords: Mosquito, Diversity, Akoko North West LGA, OndoState.

INTRODUCTION

Mosquitoes, the deadliest insects on earth, are vector agents to bring forth mosquito-borne diseases like malaria, dengue, elephantiasis, yellow and West Nile fever, and many more, critically disturbing human and animal health (Rasheed and Zaidi, 2023). Many countries around the world are affected annually by mosquito-borne diseases, bringing about excessive economic deficits globally; certainly half of the earth's population is affected by them (Rasheed and Zaidi, 2023). Malaria is one of the most severe global public health problems worldwide, particularly in Africa, where Nigeria has the greatest number of malaria cases (Simon-Oke *et al.,* 2012). About half of the world's population is at risk of malaria; in 2015, there were roughly 212 million malaria cases and an estimated 429,000 malaria deaths (Simon-Oke *et al.,* 2012). Nigeria suffers the world's greatest malaria burden, with approximately 51 million cases and 207,000 deaths reported annually, while 97% of the total population is at risk of infection (Simon-Oke *et al.,* 2012); yellow fever epidemics have also had devastating effects on human populations (Olayemi *et al.,* 2010). These bloodthirsty creatures cause serious harm to livestock, domestic animals, and even pets (Rasheed and Zaidi, 2023). The larval and pupal stages of mosquitoes live in fresh water and play an important role in the food chain and as indicators of water quality (Qasim *et al.,* 2014). Mosquitoes also constitute a very important component in the determinants of insect-borne diseases of public health importance, especially in places where the availability of diverse water bodies supports their breeding (Afolabi *et al.,* 2019). The diversities of aquatic habitats for mosquito breeding frequently make them occur in an adequate population to constitute biting nuisances or vectors of disease-causing organisms (Afolabi *et al.,* 2019).

Mosquitoes' feeding behavior and breeding places are dependent on temperature (Attaullah *et al.,* 2021). Some mosquitoes are attracted to hosts by their choices, for example, the odor of the skin, temperature, moisture, or visual cues (Attaullah *et al.,* 2021). They bite almost any animal, which is enough to provide them with a blood meal (Attaullah *et al.,* 2021). Some species are host-specific, and the specificity for blood feeding by mosquitoes plays an important role in disease transmission (Caraballo and King, 2014). Mosquitoes are cosmopolitan and are found in all types of habitats, such as sewage water, stagnant water, and fresh water (Attaullah *et al.,* 2021). Many species of mosquitoes are adaptable to their specific habitats, such as *Aedes*species*,* which are adaptable to cooler regions where their eggs are more dominant compared to the warmer regions (Gadahi *et al.,* 2012). An aquatic habitat for oviposition is required by all mosquito species for larval and pupal development (Gadahi *et al.,* 2012). Karim *et al.* (2021) reported that larval habitat water type plays an important role in determining mosquito oviposition site selection, and hence, the productivity of such sites regarding adult mosquito emergence rates is a critical factor determining the vectorial capacity of mosquitoes. Many species breed in both natural and artificial habitats such as concrete gutters, stagnant pools, abandoned plastics, abandoned tires, and even open unused drums (Afolabi *et al.,* 2013). The population expansion and breeding pattern of medically significant mosquitoes are influenced by the physicochemical features of their habitats (Amini *et al.,* 2020), as oviposition is regarded as one of the most important components of mosquito-borne infections (Aslan and Karaca, 2012). These factors not only influence mosquitoes'ovipositi on selection sites but correspondingly affect larval mass and species composition (Hanafi-Bojd *et al.,* 2012; Nikookar *et al.,* 2017). osquitoes are known to show preference for water with a suitable pH, optimum temperature, dissolved oxygen, concentration of ammonia, and nitrate (Afolabi *et al.,* 2013). It has been suggested that the strong correlations found between certain

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physico-chemical parameters and larval abundance confirm the influence of these parameters on the distribution and abundance of mosquito larvae in their breeding habitats and also indicate the possibility of mosquito larval control through the manipulation of such parameters (Olayemi *et al.,* 2010). The study therefore aimed at determining the diversity of mosquitoes in AkokoNorth West Local Government Area.

MATERIALS AND METHODS

Study Area

Ondo State is situated in the south-western part of Nigeria with geographical coordinates of 5° 45 ' N, 4° 20' E, and 7° 52' N, 6° 05' E, as shown in Fig. 1 (Oniya *et al.,* 2019). The state lies in a tropical rainforest biome with excellent vegetation that spawns almost all year round, indicative of a good breeding environment for all sorts of fauna and flora. Aside from the state capital, Akure, and a few other towns where dwellers are largely civil servants, a good number of inhabitants engage in one form of agricultural activity or another. Akoko North West Area (Fig. 1) is one of the eighteen (18) local government areas in the state, with eight (16) villages that include Iye, Ese, Okeagbe, Ikaram, Arigidi, Erusu, Ibaram, Iyani, Ase, Irun, Ogbagi, Ajowa, Afin, Oyin, Eriti, and Igasi. They are all largely rural communities whose main occupations are teaching, trading, and farming. The villages are clean (drainage systems are functioning well and are maintained by environmental agencies), conducive, but there is a shortage of water supply.

Sample Collection

Mosquito larvae were collected from 40 positive breeding sites in the villages. Samples were taken from ditches, car tires, littered water containers, and buckets using standard dipping techniques with a plastic dipper for each habitat type. The geographical coordinates and altitudes of each site were measured using GPS and the physico-chemical parameters were measured using the Handheld Multi-meter (Yieryi, China) for pH, total dissolved solids, electrical conductivity, and temperature. Larvae collected were taken to the laboratory for rearing.

Physico-chemical Parameters of Larvae Habitats

The physico-chemical parameters of the breeding sites (pH, electrical conductivity, temperature, and total dissolved solids) were measured with a hand-held multimeter by Yieryi, China, to determine their correlation with the larval density and abundance of the study area.

Data Analysis

Larvae density and larvae abundance were calculated immediately at the study site to determine the number of larvae collected per site and village.

$$\text{Larvae density} = \frac{\text{Total number of larvae per site}}{\text{Total volume of water, in ml}}$$

$$\text{Larvae Abundance} = \frac{\text{Total number of larvae in a village}}{\text{Total number of positive sites}}$$
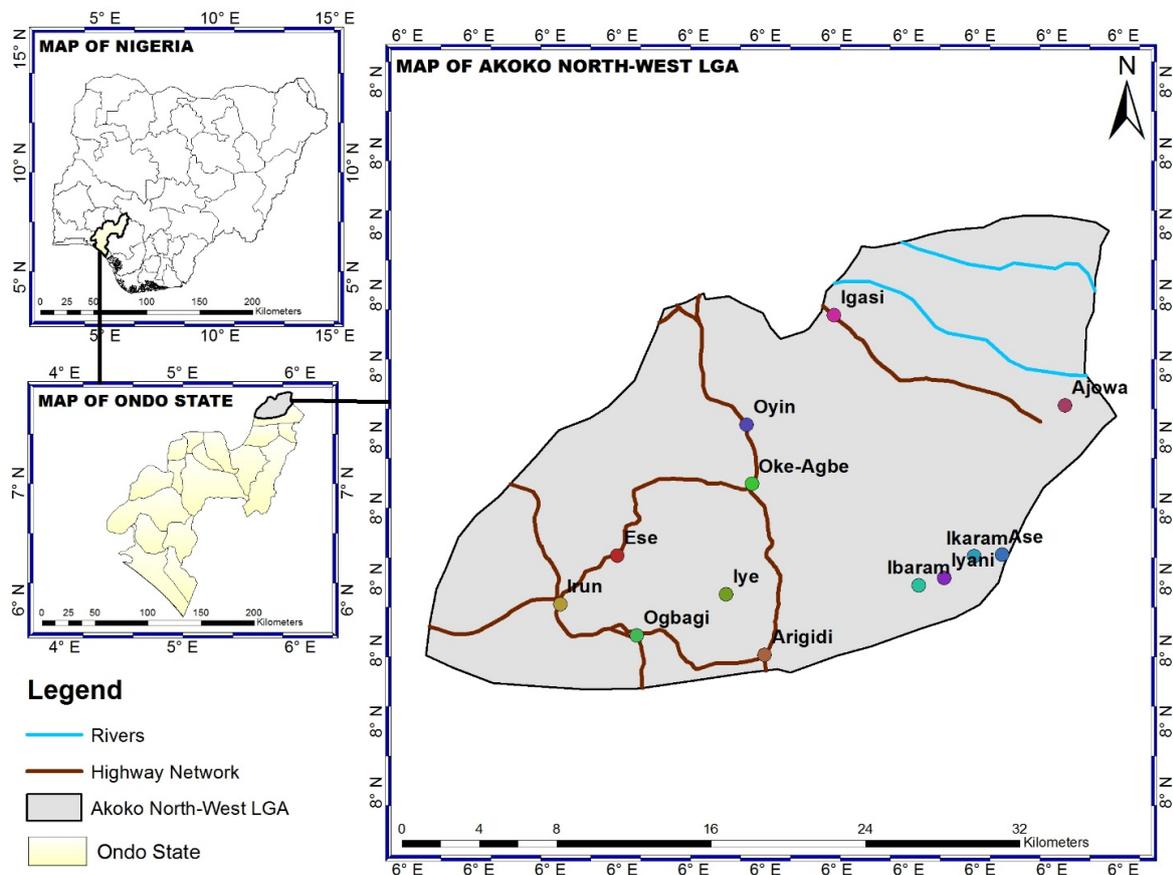

Fig. 1: Map of Nigeria Showing the Positions of Ondo State and Akoko North West Local Government Area

Also, the mean of larval density and larval abundance were calculated. The statistical analysis of the mosquito and physical and physico-chemical parameters was determined by correlation analysis and comparison of means using SPSS package version 24.

RESULTS

Table 1 shows the general population of mosquito species in Akoko North West Local Government Area. It was discovered that *Aedes* species had the highest population (160), comprising of 88 males and 72 females, accounting for 29% of the species population, followed by *Anopheleswelcomei,* which had a population of 126, comprising of 88 males and 38 females, which accounted for 23% of the species general population. It was also discovered that *Mansonia* species had a population of 85, comprising 65 males and 20 females, accounting for 16% of the species general population, followed by *Anophelesfunestus* with a total of 55, comprising 12 males and 43 females, accounting for 10% of the species general population, followed by *Culex* species with 46 total species, comprising 12 males and 34 females, which accounted for 8% of the species general population. *Anophelesgambiae* had a total of 44 species, comprising 24 males and 20 females, accounting for 8% of the species general population, followed by *Toxorynchytes* species, which had a total of 24 species, comprising 12 males and 12 females, which was equivalent to 4% of the species generation population. It was also discovered that *Anophelesimplexus* was the least identified species in the study area, with a total of 12 species, comprising 9 males and 3 females, which accounted for 2% of the species general population.

Table 1. The Species General Population in Akoko North West Local Government Area

Species	Male	Female	Total	Species percentage (%)
Anophelesfunestus	12	43	55	10
Anophelesgambiae	24	20	44	8
Anopheleswelcomei	88	38	126	23
Anophelesimplexus	9	3	12	2
Culex species	12	34	46	8
Toxorynchytes species	12	12	24	4
Mansonia species	65	20	85	16
Aedes species	88	72	160	29
Total			552	100

Fig. 2 shows the distribution of different mosquito species found in the Local Government Area. It was discovered that *Anopheles* species were the most prevalent mosquitoes found in almost all the villages in the Local Government Area except in Iye and were equally dominant in villages such as Ase, Ikaram, Iyani, Ibaram, and Oyin, while the least distributed mosquitoes found in the Local Government Area were the *Toxorynchytes* species occurring in Ogbagi, Arigidi, Ibaram, Ikaram, and Ase. Fig. 3 shows the diversity of mosquito species in the Local Government Area where Ajowa, Ase, Ese, Igasi, Irun, Iyani, Iye, Ogbagi, and Oyin villages have a diversity of 1–10; Ibaram and Ikaram have a diversity of 11–20; Arigidi village has a diversity of 41–50; and Oke-Agbe has a diversity of 200 and above. This illustrates that Oke-Agbe village will be exposed to different kinds of mosquito diseases, such as yellow fever, malaria, dengue virus, and filariasis, among others.
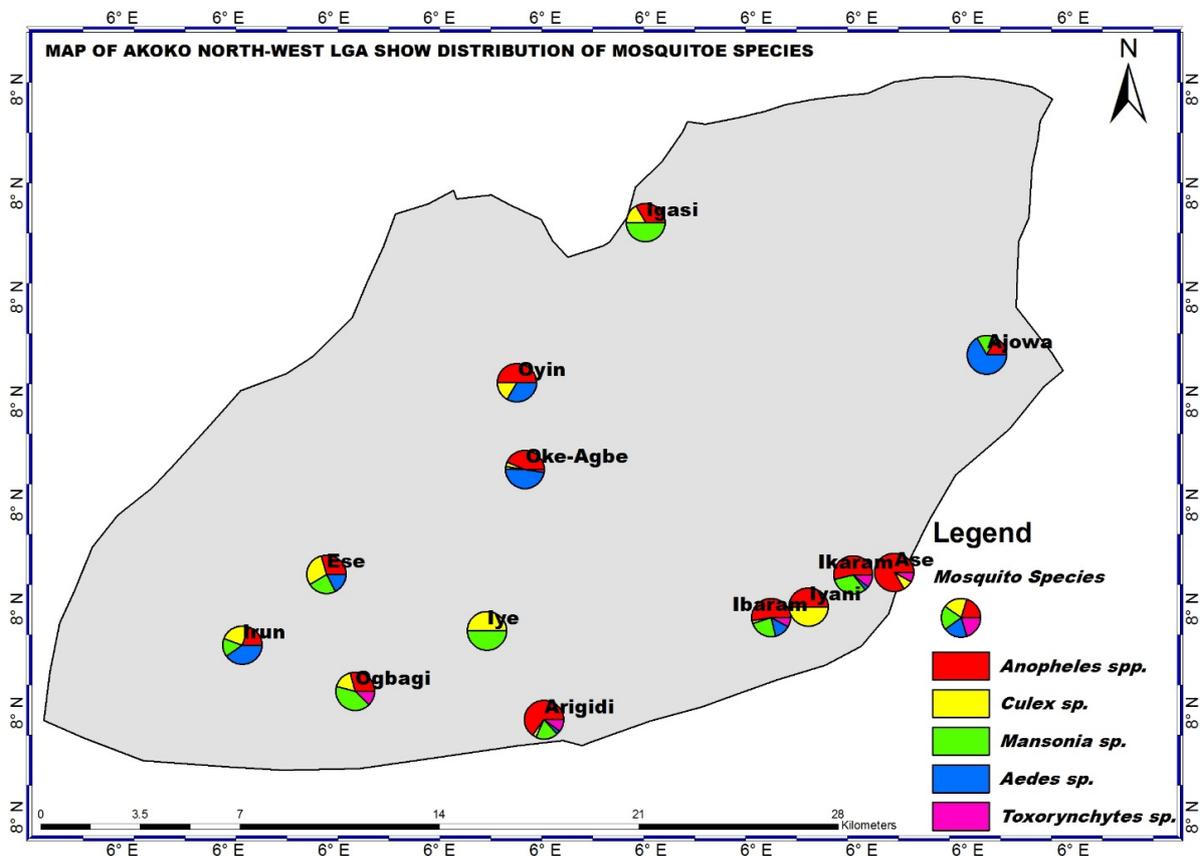
Fig. 2. Distribution of Mosquitoes Species in Akoko North West Local Government Area
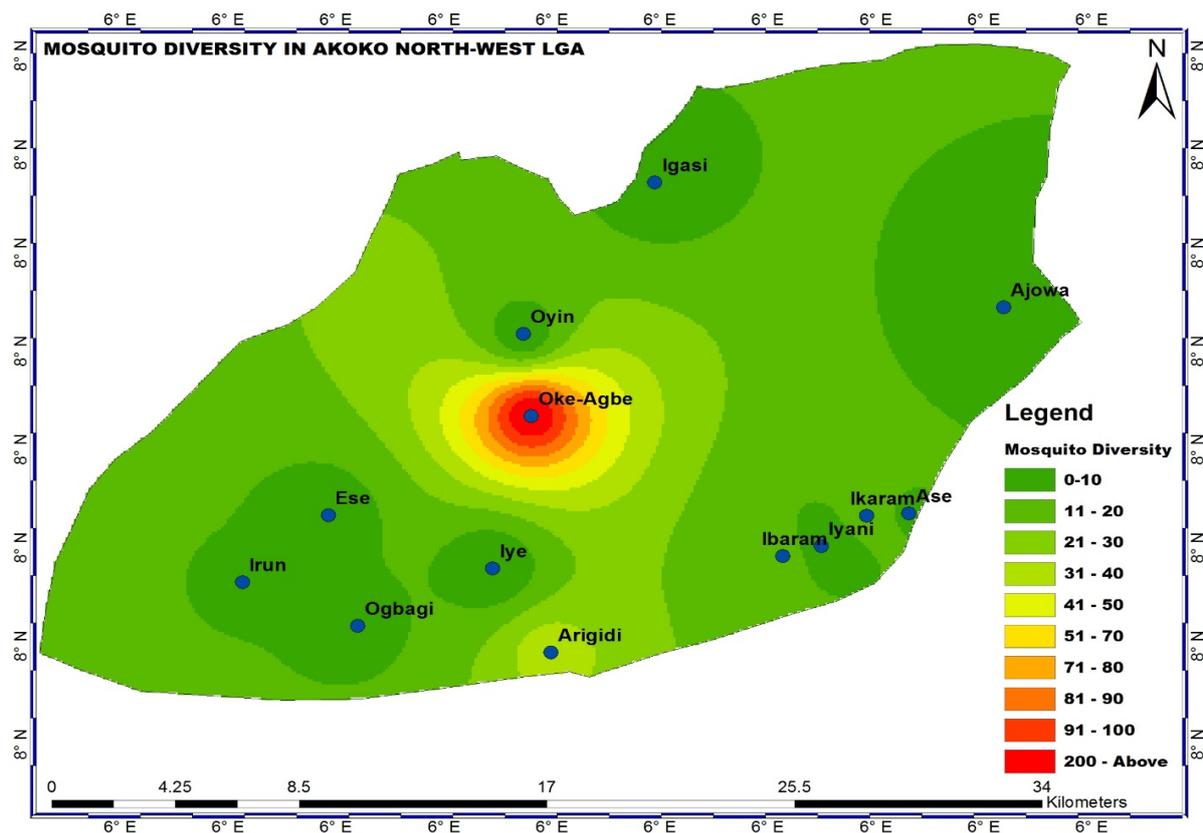
Fig. 3. Diversity of Mosquitoes Species in Akoko North West Local Government Area

DISCUSSION

Mosquitoes, the deadliest insects on earth, are vector agents that bring forth mosquito-borne diseases like malaria, dengue, elephantiasis, yellow fever, West Nile fever, and many more, critically disturbing human and animal health (Yi *et al.,* 2014). Vector-borne diseases have shown a magnificent expansion and pose tremendous commercial and public health complications. To consider the availability of diverse breeding grounds for ovipositing mosquitoes in different areas is of great essence before implementing anti-mosquito processing.

Of the eight (8) species of mosquito observed in this study, *Aedes* species and *Anopheleswelcomei* had the highest abundance and distribution in the study area. This suggests that these two species are cosmopolitan and breed indiscriminately in all habitats (Afolabi *et al.,* 2019). The dominance of *Aedes* species and *Anopheleswelcomei* mosquitoes had also been reported by Simon-Oke*et al.* (2012) in Ekiti State, Nigeria. Likewise, Adeleke (2010) had earlier reported that *Aedes* mosquitoes prefer man-made larva habitats such as old tires, clogged gutters, and animal pet bowls as breeding sites. On the contrary, *Anophelesgambiae* was observed to be sparsely distributed and in relatively low abundance in the study area. This low abundance of *Anophelesgambiae* might be due to their innate characteristics of endophagy (indoor feeding) and endophily (indoor resting) (Afolabi *et al.,* 2019). Their association with human dwellings might suggest that *Anophelesgambia* are selective breeders that breed in containers with clean water within and around human houses for easy accessibility to the host. Generally, it was observed from this study that *Anopheles* species were found in all the villages in the study area and were prevalent and more distributed in locations such as Ase, Ikaram, Iyani, Ibaram, and Oyin.

This corresponded with the work of Bartlett-Healy *et al.* (2012), who reported that artificial habitats are more troublesome as they can be anything that retains water and progresses into a breeding area for mosquitoes. Also, areas with high anthropogenic activities may have a high population density of mosquitoes, while areas with low anthropogenic activities may have a low population density of mosquitoes (Hanafi-Bojd *et al.,* 2012). Mosquitoes are important disease vectors, and their diversity determines the course of disease transmission and the ecological status of the native environment. From the study, it was discovered that Okeagbe had the highest diversity of mosquitoes (200 and above), which suggested the prevalence of mosquito diseases in the villages. The villages with diversity ranging from 1–10 will show little or no prevalence of diseases, while those ranging from 11–20 and 41–50 will be exposed to certain diseases such as malaria, yellow fever, e.t.c. Okeagbe being inscribed with the highest diversity of mosquitoes shows the inhabitants of such a village will have a high prevalence of mosquito diseases such as malaria, yellow fever, dengue fever, etc., which is in line with the work of Thongsripong *et al.* (2013).

Conclusion

The current study has investigated different larval breeding habitats of mosquito species in the study area. Information on the population dynamics of mosquitoes and particularly of vectors is necessary in order to develop an environment friendly control strategy. Environmental factors such as temperature, rainfall, humidity and other related climatic attributes affecting the breeding of mosquitoes can help in detecting ovipositional site selection and distribution of vector species thereby providing a way for controlling vectors with

great accuracy The five mosquito genera (*Aedes, Anopheles, Culex, Toxorynchytes*and *Mansonia*) encountered in Akoko North West Local Government Area are well-known vectors of parasites and help in transmission of diseases such as yellow fever, malaria, and filariasis. All these diseases are associated with high morbidity and mortality. This suggests that a sustainable public health campaign on vector management and control should be intensified in Nigeria.

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