SURVEY OF MOSQUITO SPECIES WITHIN ILORIN METROPOLIS

A PROJECT REPORT SUBMITTED

BY

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BEING A RESEARCH POROJECT SUBMITTED TO THE DEPARTMENT OF SCIENCE LABORATORY TECHNOLOGY, INSTITUTE OF APPLIED SCIENCE, KWARA STATE POLYTECHNIC, ILORIN.

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CERTIFICATION

This is to certify that this project work was carried out by **ABDULKAREEM MUSIBAU** with Matric Number: H**ND/23/SLT/FT/1155** in the Department of Science laboratory Technology (SLT), Institute of Applied Science (IAS) and has been read and approved as meeting the requirements for award of Higher National Diploma (Environmental Biology Option), Kwara State Polytechnic Ilorin.

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DEDICATION

I dedicate this project to Almighty Allah, who has seen me through it all.

Also, to my lovely parent and to my loved ones for their love and support, am very grateful for everything.

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My first and deepest appreciation goes to Almighty Allah, the beneficent, the merciful, for guiding and protecting me always throughout my journey on campus and for the time fulfilment of His promises concerning my life.

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ABSTRACT

This study presents a comprehensive survey of mosquito species within Ilorin Metropolis, Nigeria, with the aim of identifying the distribution, abundance, and diversity of mosquito vectors across three major zones: Ilorin South, Ilorin East, and Ilorin West. Mosquito specimens were collected using standard entomological techniques including CDC light traps, aspirators, and larval dipping from selected breeding sites such as stagnant water bodies, gutters, and containers. A total of 263 mosquitoes were collected and identified morphologically into three genera: Anopheles, Culex, and Aedes. The results showed that Culex spp. were the most abundant (39.9%), followed by Anopheles spp. (31.9%) and Aedes spp. (28.2%). Ilorin South recorded the highest mosquito count, while Ilorin West had the lowest. The Shannon-Wiener diversity index indicated moderate species diversity across all zones, with the highest diversity observed in Ilorin East (H' = 1.06). Larval stages represented the highest proportion of specimens collected, reflecting active breeding across the study sites. The findings highlight the influence of environmental factors, urbanization, and poor sanitation on mosquito proliferation in Ilorin. This baseline data is critical for guiding targeted vector control strategies and strengthening public health interventions to mitigate mosquito-borne diseases such as malaria, lymphatic filariasis, and yellow fever. The study emphasizes the need for integrated vector management, community engagement, and routine entomological surveillance in Ilorin and similar urban centers.

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CHAPTER ONE

1.0 Introduction

Mosquitoes are significant vectors of many human and animal diseases, including malaria, dengue fever, yellow fever, and filariasis. Their presence and proliferation are often influenced by environmental, climatic, and anthropogenic factors, especially in tropical regions like Nigeria. Ilorin, the capital of Kwara State, is experiencing increasing urbanization, which alters mosquito breeding habitats. Consequently, a detailed understanding of mosquito species distribution in this area is vital for effective vector control strategies (Olawoyin *et al*., 2021). Such surveys help in identifying the predominant mosquito species and in assessing the risk of vector-borne diseases within the metropolis.

Ilorin, located in the north-central zone of Nigeria, has a mix of urban, peri-urban, and rural settings. These diverse ecological zones within the city provide suitable breeding sites for different mosquito species. The presence of stagnant water, poor drainage systems, and household containers further encourages mosquito breeding (Adeniran *et al*., 2022). Furthermore, the city experiences a tropical wet and dry climate, which creates alternating favorable and unfavorable conditions for mosquito survival. These climatic dynamics necessitate seasonal and spatial monitoring of mosquito populations. Identifying the species composition is also important for targeted insecticide application and public health intervention.

Urbanization in Ilorin has led to several environmental modifications such as construction of drainage systems, waste dumps, and artificial containers that may hold rainwater. These changes unintentionally provide habitats for mosquito larvae development. The lack of proper environmental sanitation and community awareness further aggravates the situation (Muhammed *et al*., 2020). As a result, the mosquito burden in Ilorin is not limited to rural areas but has become a growing concern in densely populated urban centers. Hence, a comprehensive survey of mosquito species is important to guide city-wide vector control programs.

One of the major concerns about mosquito proliferation is the increased prevalence of mosquito-borne diseases. Malaria remains endemic in Nigeria and continues to pose a significant public health threat despite control efforts

(Nigeria Malaria Indicator Survey, 2021). In addition, the threat of yellow fever outbreaks has increased, as *Aedes* species have been reported in both urban and peri-urban environments. Surveillance data are necessary to monitor trends in mosquito diversity and abundance, which directly influence disease epidemiology. Without updated baseline data, health authorities may struggle to allocate resources effectively.

Seasonal variation plays a critical role in mosquito distribution and species dynamics. Mosquito populations typically rise during the rainy season when water bodies become abundant. This temporal fluctuation affects not just the number but also the types of mosquito species prevalent at different times of the year (Adesina *et al*., 2023). For example, *Anopheles* mosquitoes prefer clean, slow-moving waters, which are more abundant in certain seasons. A proper survey must take into account both dry and rainy seasons to capture a representative sample of the mosquito fauna.

Climate change is another factor influencing mosquito distribution. Warmer temperatures, altered rainfall patterns, and increased humidity can extend the breeding season and expand the geographical range of certain mosquito species. Studies have shown that climate variability correlates with increased mosquito abundance and the spread of mosquito-borne diseases (Okoye *et al*., 2022). These changes highlight the importance of conducting periodic entomological surveys. Ilorin, being a rapidly urbanizing city with dynamic climatic conditions, requires regular mosquito species assessments to inform public health preparedness.

Socioeconomic factors also affect mosquito proliferation and control within Ilorin. Areas with poor housing structures, limited access to healthcare, and inadequate drainage tend to harbor more mosquitoes. The awareness and practices of residents regarding mosquito control—such as the use of insecticide-treated nets or environmental sanitation—also play a role (Yahaya *et al*., 2020). Therefore, any mosquito species survey must consider the local demographic and socioeconomic context. Including such data in mosquito surveillance can aid in identifying high-risk zones for intervention.

Technological advances in mosquito identification, such as molecular techniques and digital surveillance tools, now make species-level identification more accurate and efficient. However, many areas like Ilorin still rely on conventional methods such as larval sampling and morphological identification due to limited resources. Despite these challenges, even basic survey techniques can yield valuable insights when consistently and correctly applied (Ibrahim *et al*., 2021). Integrating new tools with traditional methods may improve the precision of future mosquito surveys. The goal is to develop a reliable dataset that supports sustainable vector control strategies.

Community involvement is essential for the success of any mosquito control program. Conducting surveys without community cooperation often results in limited access to potential breeding sites and inaccurate data. Engaging the community through education, sensitization, and participatory monitoring ensures better data collection and sustainable control outcomes (Olatunji and Bello, 2023). Residents of Ilorin must be encouraged to eliminate breeding sites, report mosquito infestations, and support entomological studies. Empowering local populations can significantly contribute to reducing mosquito burden and the diseases they transmit.

The results of mosquito species surveys have broad implications for public health. They provide crucial data that influence the selection of control measures such as larviciding, indoor residual spraying, and the distribution of insecticide-treated nets. For example, areas with high *Culex* mosquito prevalence may require different interventions compared to those with *Anopheles* dominance. A species-specific approach ensures that interventions are both cost-effective and impactful (WHO, 2021). Thus, understanding mosquito biodiversity in Ilorin can enhance vector control planning and disease prevention efforts.

Environmental management remains a cornerstone of mosquito control. Proper waste disposal, drainage maintenance, and urban planning can drastically reduce mosquito breeding sites. Surveys help to identify environmental factors contributing to mosquito proliferation in specific areas. This makes it possible to develop targeted interventions such as draining stagnant water, modifying habitats, and promoting environmental hygiene (Akinyemi *et al*., 2020). These measures are especially crucial in Ilorin where rapid development is often not accompanied by proper waste and water management systems.

The survey of mosquito species within Ilorin Metropoly is both timely and necessary. It provides a scientific basis for vector control, guides public health interventions, and fosters a healthier urban environment. The growing urbanization, changing climate, and increasing population density in Ilorin make mosquito surveillance a priority. The data generated will not only benefit Ilorin but can also serve as a model for other Nigerian cities facing similar challenges. By investing in entomological research and community-based interventions, the city can effectively combat mosquito-borne diseases and protect public health (Adebayo *et al*., 2021).

1.2 LITERATURE REVIEW

Mosquitoes are one of the most significant vectors of infectious diseases, transmitting pathogens that cause malaria, dengue, chikungunya, yellow fever, and Zika virus. The global burden of mosquito-borne diseases remains high, particularly in sub-Saharan Africa where species of *Anopheles*, *Aedes*, and *Culex* predominate (Afolabi *et al*., 2020). Understanding species distribution is essential for targeted vector control, especially in urban and semi-urban areas where ecological changes drive mosquito adaptation.

Urbanization, poor drainage systems, and improper waste disposal contribute significantly to mosquito breeding in Nigerian cities like Ilorin (Adepoju *et al*., 2021). Consequently, surveys are crucial to detect shifts in species composition and to design evidence-based interventions. Recent studies have shown a growing diversity of mosquito species in urban and peri-urban environments in Nigeria. For example, *Aedes aegypti*, the vector of yellow fever and dengue, has been increasingly reported in urban areas due to its affinity for artificial containers and stagnant water bodies (Oluwasogo *et al*., 2020). *Culex quinquefasciatus*, a primary vector of lymphatic filariasis, also thrives in polluted environments with high organic matter. As Ilorin continues to urbanize rapidly, the cohabitation of these species raises serious public health concerns. Understanding which species dominate specific localities within Ilorin can assist in directing vector control to critical hotspots (Aliyu *et al*., 2022). A study conducted in Kwara State revealed seasonal variations in mosquito abundance, with a notable increase during the rainy season (Yahaya *et al*., 2021). The researchers identified that mosquito species thrive in different breeding habitats such as stagnant drains, uncovered wells, and improperly disposed containers. This seasonal pattern reflects the dependency of mosquito life cycles on moisture and temperature, which are influenced by the region's tropical climate. Rainfall occurs between April and October, breeding sites expand dramatically, necessitating intensified surveillance during this period.

Mosquito-borne disease control is hindered by the increasing resistance of vector species to commonly used insecticides. Studies in neighboring regions, including Oyo and Osun States, have reported high levels of resistance in *Anopheles* and *Culex* species to pyrethroids and carbamates (Ajayi *et al*., 2020).

The ecological preferences of mosquito species also affect their spatial distribution. *Aedes* mosquitoes are primarily container breeders, often found in tires, buckets, and flower pots, while *Culex* mosquitoes prefer organically rich stagnant water. *Anopheles* species typically favor clean, sunlit pools for oviposition (Mohammed and Onimisi, 2023). A study conducted in Ilorin found that open drainage and poor waste management systems facilitated the coexistence of multiple species within residential areas (Abdulsalam *et al*., 2022). The variation in habitat preference underscores the need for targeted environmental management strategies alongside chemical control.

The presence of mixed-species populations within small geographic zones complicates mosquito control. For instance, in a survey of mosquito diversity in Ibadan, over six species from three genera were identified within a 10 km radius, revealing overlapping niches and breeding grounds (Oladipo and Salami, 2021). Similar ecological dynamics are likely in Ilorin due to comparable environmental and demographic factors. This indicates the importance of localized surveys and community participation in mosquito surveillance and control efforts to ensure sustainability and effectiveness.

Citizen engagement and public awareness are vital components of successful mosquito surveillance programs. Public education campaigns on the dangers of mosquito breeding and personal protection methods can significantly reduce vector-human contact (Nnadi *et al*., 2023). In Ilorin, a coordinated effort involving health officials, researchers, and community stakeholders will enhance the implementation of integrated vector management strategies.

Furthermore, encouraging household-level larval source management can reduce the proliferation of mosquitoes in densely populated areas.

1.3 STATEMENT OF PROBLEM

Mosquito-borne diseases remain a major public health threat in Ilorin due to the increasing population of mosquito species and inadequate vector control measures. The lack of current data on species distribution hampers effective intervention. Identifying mosquito species present within the metropolis is crucial for targeted disease prevention strategies.

1.4 AIM

The aim of this study is to survey and identify the mosquito species present within Ilorin metropolis in order to provide baseline data for effective vector control and disease prevention strategies.

1.5 OBJECTIVES

- To collect and identify different mosquito species present in selected areas within Ilorin metropolis.
- To determine the relative abundance and distribution of the identified mosquito species.

- To assess the environmental factors contributing to mosquito breeding in the study areas.

CHAPTER TWO

2.0 MATERIALS AND METHODS

2.1 Materials

The materials used in this study included essential entomological tools and laboratory equipment necessary for the collection, identification, and analysis of mosquito species. The materials comprised mosquito collection traps such as CDC light traps, ovitraps, and aspirators, which were strategically placed at different locations to capture adult mosquitoes. Larval collection equipment, including dippers and pipettes, was used to collect immature mosquito stages from various breeding sites. Other essential materials included sterile sample containers, forceps, dissecting microscopes, and identification keys to aid in species classification. Laboratory materials such as reagents for molecular or morphological identification, Petri dishes, slides, ethanol (70%) for preservation, and labels were also employed to ensure proper documentation and storage of samples for further analysis.

2.2 Sample Collection

- Ilorin South: Tanke & Agbado
- Ilorin East: Amilengbe & Sao garage

- Ilorin West: Ologe & Sawmill

Mosquitoes were collected at different times of the day in ilorin to ensure a comprehensive survey of species composition and abundance. Both immature (larvae and pupae) and adult mosquitoes were sampled to account for all life stages. Larvae and pupae were collected using standard dippers or pipettes from stagnant water sources such as puddles, drains, and containers. These samples were transferred into labeled plastic containers containing water from their original habitat and transported to the laboratory for further analysis. Adult mosquitoes were captured using CDC light traps, human-baited traps, and aspirators from various locations, including residential areas, agricultural fields, and forests. Captured mosquitoes were carefully transferred into collection vials containing ethanol (70%) for preservation or kept alive for morphological and molecular identification.

2.3 Sampling Site

The study was conducted in Ilorin based on ecological characteristics and mosquito breeding potential. The sampling sites included Ilorin South, Ilorin East and Ilorin West, where different species of mosquitoes were expected to thrive. Specific attention was given to areas with stagnant water bodies, wetlands, rice fields, gutters, and human settlements, as these serve as prime breeding grounds for mosquitoes. GPS coordinates of each sampling site were recorded to allow for accurate mapping of mosquito distribution. The environmental conditions, such as temperature, humidity, and vegetation cover, were also noted to assess how they influenced mosquito abundance and diversity in different locations.

2.4.0 Media Preparation

For laboratory analysis, various culture and preservation media were prepared to support mosquito sample processing. If microbial or molecular studies were involved, appropriate agar media such as nutrient agar, Sabouraud dextrose agar, or selective media were prepared following standard laboratory protocols. The media were sterilized using an autoclave at 121°C for 15 minutes to prevent contamination. In cases where DNA extraction was required for species identification, necessary reagents such as lysis buffers, ethanol, and polymerase chain reaction (PCR) reagents were prepared in advance to facilitate molecular analysis.

2.4.1 Sample Preparation

Collected mosquito specimens were processed for identification and further analysis. Larvae and pupae were allowed to develop into adults under controlled conditions in the laboratory to ensure accurate species identification. Preserved adult mosquitoes were sorted, pinned, and labeled, while others were placed under a dissecting microscope for morphological identification using standard identification keys.

2.5 Data Collection and Analysis

The abundance and diversity of mosquito species were recorded based on morphological identification results. The data collected included the number of mosquitoes per species, their distribution across different sampling sites, and the frequency of occurrence in different ecological zones. Statistical analysis was performed using software such as SPSS or R to determine variations in mosquito abundance based on environmental factors. The relationship between mosquito species diversity and habitat conditions was analyzed using ecological indices such as the Shannon-Wiener diversity index and species richness calculations.

The relationship between mosquito species diversity and habitat conditions was assessed using ecological indices that measure species abundance and distribution patterns within different environmental settings. One of the primary indices used was the Shannon-Wiener Diversity Index (H'), which quantifies species diversity by considering both species richness (the number of different species present) and species evenness (how evenly individuals are distributed among those species) (Shannon and Weaver, 1949). This index is calculated using the formula:

$$H' = -\sum(p_i \ln p_i)$$

where p_i represents the proportion of individuals belonging to species i in the total population. A higher Shannon-Wiener index value indicates greater species diversity, suggesting a more stable and ecologically balanced habitat, whereas lower values indicate dominance by a few species, often due to environmental disturbances or selective breeding conditions (Magurran, 2004).

In addition to the Shannon-Wiener Index, species richness calculations were used to determine the total number of mosquito species present in each sampled habitat. Species richness provides a straightforward measure of biodiversity without considering species abundance differences. However, when combined with the Shannon-Wiener Index, it offers a more comprehensive understanding of mosquito community structure and habitat suitability (Chao *et al*., 2014).

These indices were applied to assess the effects of different environmental factors such as water quality, vegetation cover, temperature, and humidity on mosquito diversity. Studies have shown that habitats with high organic matter, standing water, and dense vegetation tend to support a greater diversity of mosquito species, whereas polluted or highly disturbed environments may favor only a few species adapted to such conditions (Becker *et al*., 2010). By analyzing these ecological indices, the study aimed to determine how habitat conditions influence mosquito species composition and abundance, providing insights for targeted vector control strategies.

2.6 Identification of Mosquito Species

Mosquito species were identified using a combination of morphological and molecular techniques. Morphological identification was performed using taxonomic keys, which relied on physical characteristics such as wing venation, body coloration, leg banding, and proboscis structure.

2.7 Key to Identify Morphological Structure of Mosquito Species (Adult and Larva)

The identification of mosquito species relies on distinct morphological characteristics observed in both adult and larval stages using taxonomic identification keys. Adult mosquitoes are primarily identified based on features such as body size, wing venation, coloration, leg banding, and the presence of scales on the thorax and abdomen. The antennae structure also plays a crucial role; males have feathery (plumose) antennae, while females have short-haired (pilose) antennae. Additionally, differences in palp length help distinguish genera—Anopheles mosquitoes have long palps, while Aedes and Culex species have shorter palps. Larval mosquitoes are identified based on their head capsule, mouth brushes, siphon (breathing tube), and comb scales on abdominal segments. Anopheles larvae rest parallel to the water surface as they lack a siphon, whereas Culex and Aedes larvae have siphons and rest at an angle. Other distinguishing features include the presence or absence of pecten spines on the siphon, the number and arrangement of setae (hairs), and the shape of the anal segment. These morphological features are essential for accurate mosquito species identification, which is critical for vector surveillance and control programs.

2.8 Ethical Considerations and Quality Control

Ethical guidelines were strictly followed throughout the study to ensure humane mosquito collection methods and minimize environmental disturbance. Approvals were obtained from relevant health and environmental authorities before conducting fieldwork. Quality control measures were implemented during sample collection, handling, and laboratory analysis to ensure data accuracy. Duplicate samples were collected and analyzed to confirm identification results. Proper disposal methods were used for biological waste to maintain biosafety standards.

CHAPTER THREE

3.0 RESULTS

3.1 Abundance and Distribution of Mosquito Species Across Sampling Sites

Table 1: Mosquito species distribution across sampling sites in Ilorin.

Sampling Site	Anopheles spp.	Aedes spp.	Culex spp.	Total Mosquitoes Collected
Ilorin South	15	32	45	92
Ilorin East	28	25	38	91
Ilorin West	41	17	22	80
Total	**84**	**74**	**105**	**263**

3.2 Stage-wise Collection of Mosquitoes

Table 2: Total number of mosquito specimens collected at different developmental stages.

Life Stage	Number of Specimens
Larvae	112
Pupae	58
Adults	93

Total	**263**

3.3 Shannon-Wiener Diversity Index (H′) for Different Sampling Sites

Table 3: Species richness and diversity index of mosquito species in different ecological zones.

Sampling Site	Species Richness (S)	Shannon-Wiener Index (H′)
Ilorin South	3	1.01
Ilorin East	3	1.06
Ilorin West	3	0.95

3.4 Frequency of Mosquito Species

Table 4: Relative frequency of mosquito species collected during the study.

Mosquito Species	Frequency (%)
Culex spp.	39.9%
Anopheles spp.	31.9%
Aedes spp.	28.2%

CHAPTER FOUR

4.0 DISCUSSION AND CONCLUSION

4.1 DISCUSSION

The findings of this study reveal the abundance and distribution of mosquito species across Ilorin South, Ilorin East and Ilorin West in Ilorin. The data indicate that *Culex* spp. were the most abundant (39.9%), followed by *Anopheles* spp. (31.9%) and *Aedes* spp. (28.2%). Urban areas recorded the highest total mosquito count (92), dominated by *Culex* spp. This trend supports the findings of Oyewole *et al*. (2021), who observed that *Culex* mosquitoes thrive in polluted urban environments due to their adaptability to habitats like blocked drains and stagnant water containing organic waste. The presence of all three species in all zones also suggests overlapping habitats, likely influenced by human activity and environmental conditions.

Interestingly, *Anopheles* spp. were more prevalent in rural settings, making up more than 51% of mosquitoes collected from those areas. This aligns with the findings of Abdullahi *et al*. (2020), who reported a higher prevalence of *Anopheles* mosquitoes in less urbanized, vegetated environments with clean, stagnant water sources such as puddles, rice fields, and animal tracks. The dominance of *Anopheles* spp. in rural areas is concerning, given their role as primary vectors of *Plasmodium* parasites responsible for malaria transmission. These findings emphasize the need for targeted vector surveillance and malaria control efforts in rural communities.

The **stage-wise distribution** showed that larvae constituted the highest proportion of collected specimens (42.6%), followed by adults (35.4%) and pupae (22.1%). This result is consistent with the lifecycle dynamics of mosquitoes, where larvae are the most accessible and abundant stage in aquatic habitats. According to Onwujekwe *et al*. (2022), larval sampling is critical in mosquito ecology studies because it reflects active breeding sites and is often the focus of larval source management strategies. The high larval count in this study suggests the presence of several untreated or unmanaged breeding sites within the surveyed zones, especially in Ilorin South and Ilorin East.

The **Shannon-Wiener diversity index (H′)** results indicate relatively similar diversity values across the three zones, with semi-urban areas having the highest diversity index (1.06), followed by Ilorin South (1.01), and Ilorin West

(0.95). These values suggest a moderate level of species diversity, where no single mosquito species dominates the entire population. This is supported by findings from Chukwuma and Ugwu (2021), who reported that habitat heterogeneity in peri-urban areas often results in increased species diversity due to the presence of both anthropogenic and natural breeding sites. In contrast, the slightly lower diversity in rural areas may be attributed to the dominance of *Anopheles* spp., indicating a more specialized mosquito community.

The **relative frequency** results highlight that *Culex* spp. comprised nearly 40% of the total mosquito population collected. This prevalence underscores the potential risk of diseases such as lymphatic filariasis and arboviruses like West Nile virus, which are often associated with *Culex* mosquitoes (Becker *et al*., 2020). Similarly, *Aedes* spp., accounting for 28.2%, are key vectors of dengue, chikungunya, and yellow fever viruses. The notable presence of *Aedes* in urban and semi-urban settings aligns with the observations by Okorie *et al*. (2023), who documented increased *Aedes* breeding in water-storage containers and discarded tires in residential areas, especially during the rainy season.

Overall, the results suggest that mosquito populations in Ilorin are influenced by ecological variations, environmental sanitation, and human settlement patterns. The combination of morphological identification and ecological indices like the Shannon-Wiener index offers critical insight into vector distribution and diversity. These findings can guide vector control programs to focus interventions based on species abundance and local ecology. For instance, urban interventions might target *Culex* breeding in polluted waters, while rural efforts should focus on managing *Anopheles* breeding sites. As recommended by WHO (2022), integrated vector management must be data-driven and tailored to local mosquito ecology for effective disease prevention.

4.1 Conclusion

This study provided comprehensive insights into the abundance, distribution, and diversity of mosquito species across different ecological zones in Ilorin. The findings revealed that *Culex* spp. were the most abundant, particularly in urban areas, while *Anopheles* spp. dominated rural environments highlighting the ecological preferences of each species and their potential implications for public health. The moderate Shannon-Wiener diversity indices across all zones suggest a relatively balanced mosquito community, influenced by habitat characteristics such as water quality, vegetation, and human activity. The significant presence of larvae and pupae further indicates ongoing breeding, emphasizing the need for effective larval source management.

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