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Research Article

Preliminary Study on the Ecology and Diversity of Mosquito Species in Nnamdi Azikiwe University Hostels, Awka, Anambra State

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Abstract

Malaria is one of the most severe global public health problems worldwide, particularly in Africa, where Nigeria has the greatest number of malaria cases. Malaria, Zika virus, Filariasis and Yellow fever are diseases vectored by mosquitoes; these diseases cause high morbidity and mortality in human. The preliminary study on the ecology and diversity of mosquito species in Nnamdi Azikiwe University Hostels was undertaken between 1st November and 15th November. Larva stages of mosquitoes were sampled from gutters, used discarded tyres, plastic containers, clean ground water pools and dirty ground water pools using ladles, sieves and bowels. Indoor biting and resting mosquitoes were collected using pyrethrum knockdown collection method. 609 mosquitoes comprising of 406 larva and 203 adult mosquito species were collected. 6 mosquito species namely *Anopheles gambiae, Anopheles funestus, Aedes aegypti, Aedes africanus, Aedes albopictus, Culex quiquefasciatus* were identified. *Anopheles gambiae* 89 (43.80%) having the highest abundance, *Culex quiquefasciatus* 39 (19.20%), *Aedes aegypti* 27 (13.30%), *Aedes africanus* 18 (8.90%), *Anopheles funestus* 18 (8.90%) and *Aedes albopictus* 12 (5.90%) respectively. Two sampling methods dipping and pipetting was used for sampling the mosquito species. Dipping method having the greatest catch of (75.25) and pipetting method of (26.25). The pH, temperature and dissolved oxygen were recorded from the different sampling sites. In male hostel, the pH, temperature and dissolved was 7.30, 27.30 0C, 3.76 respectively and in the female hostel the pH, temperature and dissolved oxygen was 7.16, 28.00 0C and 2.43 respectively. Shannon Weiner diversity index of mosquito species in the male and female hostels was -1.38 and -1.60, respectively while Simpson index was 0.34 and 0.23, respectively. There was no statistically significant difference ($p > 0.05$) in the results gotten. The result of this study was analyzed with SPSS version 25. Descriptive statistics was used to present the data for the abundance of mosquito in the habitat. Student t test was used to compare the catch success of the different sampling methods. Shannon Weiner diversity index was used to analyze the diversity of the mosquito while Simpson index was used for species dominance. Most of the challenges posed by mosquito-borne diseases consist not only in their cosmopolitan nature and ability to survive in air, aquatic and terrestrial habitats, their ability to breed in any collection of standing water such as wheelbarrows, cesspits, flower vests and drainage systems make such a prolific source of mosquito production. It is recommended that reduction in vector population could be achieved by eliminating all possible breeding sites. The students should also be advised to use personal protective measures to avoid mosquito bites. Finally, the state ministry of environment should continuously prevent epidemic by daily surveillance and monitoring for mosquito population.

Keywords: Ecology; Diversity; Mosquito Species

Introduction

Mosquitoes are small arthropods, midges-like flies that belong to the class insect, order *diptera* and family *culicidae*. They are the greatest enemies of humans because of the widespread suffering and death caused by the diseases transmitted [1]. Mosquitoes have world-wide distribution and they inhabit both aquatic and terrestrial habitats. There are 3 sub-families of the family *Anophelinae*, *Culicinae* and *Taxohynchitinae*. It is only subfamilies of *Anophelinae* and *Culicinae* that contain medical important man-biting mosquito. Many species breed in both natural and artificial habitats such as concrete gutters, stagnant pools, abandoned plastics, abandoned tires and even open unused drums [2].

Mosquitoes are known to show preference to water with suitable pH, optimum temperature, dissolved oxygen, concentration of ammonia and nitrate [2]. It has been suggested that the strong correlations found between certain physic-chemical parameters and larva abundance confirm the influence of these parameters on the distribution and abundance of mosquito larva in their breeding habitats and also indicate the possibility of mosquito lava control through the manipulations of such parameters [3]. In addition, temperature and concentration of some heavy metals may have effect on the survival of immature stages of mosquitoes in their breeding habitats [4]. Furthermore, environmental changes due to human activities greatly influence the distribution and survival of many mosquito species [4,5].

Malaria, Zika virus, Filariasis and Yellow fever are diseases vectored by mosquitoes; these diseases cause high morbidity and mortality in human [6]. Malaria is one of the most severe global public health problems worldwide, particularly in Africa, where Nigeria has the greatest number of malaria cases [7]. 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 [7]. 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 [7]; yellow fever epidemics have also had devasting effects on human population.

Most of the challenges posed by mosquito-borne diseases consist not only in their cosmopolitan nature and ability to survive in air, aquatic and terrestrial habitats, their ability to breed in any collection of standing water such as wheelbarrows, cesspits, flower vests and drainage systems make such a prolific source of mosquito production [8]. Oviposition, development of larva, adult emergence and many other processes take place in mosquito lava habitats, which thus play an important role in determining adult distribution and abundance [9]. Many species prefer habitats with vegetation while some breed in open, sunlit pools [10]. The distribution of mosquito activity can be highly variable even in the same geographical area [11]. This suggests that mosquito distribution is influenced by a number of factors which in turn affect emergence and re-emergence of diseases [12].

Studies to determine the abundance of mosquitoes in various habitats have been carried out in various parts of Nigeria [13,14]. These studies helped to ascertain the present state of the different mosquito species in each locality as this is necessary in mosquito control. For any vector control measures to be successful, knowledge of the breeding ecology of mosquitoes including, the types and preferences for larva habitats, spatial and temporal distribution of breeding sites, as well as the physical, biological and chemical characteristics of the habitats are required.

In Nigeria, vector control strategy is mainly focused on measures targeted on adult mosquitoes including, the promotion of the use of insecticide treated bed nets and indoor residual spraying. These methods have drastically reduced morbidity and mortality due to mosquito transmitted diseases when applied properly but it may not be sufficient to achieve the WHO targets regarding mosquito transmitted diseases. Therefore, effective mosquito vector control in areas of high disease burdens must be predicated on a good understanding of the occurrence of specific important vector species composition, their abundance and hence, potential for disease transmission in the area [12]. It is important therefore, the need for continuous updating of information on the diversity of mosquito vectors in Nnamdi Azikiwe University hostel to complement efforts towards effective and integrated vector control studies.

Malaria, Zika virus, Filariasis and Yellow fever are diseases vectored by mosquitoes; these diseases cause high morbidity and mortality in human [15]. The knowledge of the population and ecology of mosquito is very critical in effective control and management of these diseases, hence the need for this study.

The aim of this study is to assess the ecology and diversity of mosquito species in Nnamdi Azikiwe University. Its objectives are to determine the mosquito species diversity in the study area Nnamdi Azikiwe university hostel areas, ascertain the abundance of mosquito in the study site, compare the different sampling methods for mosquito and determine the ecology of mosquito (Physio chemical properties).

Materials and Method

The study was conducted at Nnamdi Azikiwe University Hostels Awka. Awka is the capital of Anambra state and located in the lowland rain forest zone of southern latitude 5^0 and 6^025 and longitude 7^0E and 8^0E. Field investigation will be carried out in two locations in the University which include: The school male hostel and school female hostel. Sampling was performed within the period of two weeks. Sampling was done personally, performed twice a week and each site was sampled differently. Sampling of each site was done at the early hours of the morning for 2 hours**.** The sampling incorporates the collection below

Mosquito sampling

Indoor collection of adult mosquitoes

This was done using Pyrethrum knockdown collection method. The collection was performed in the early hours between 7am and 9am. Rooms where at least five persons slept the previous night were chosen for the exercise. Pyrethroid Raid was used for the collection, following the standard operation procedure by [16].

Larva sampling

The larva mosquito population in this study area was obtained using larva sampling techniques [17,18]. Samples were taken from ditches, car tires, littered water containers, buckets with the aid of pipette and gutters using standard dipping techniques with a plastic dipper from each habitat type; 3 dips were taken and the mosquito larvae collected. Collection was done between 9am and 11am. The samples were collected into plastic bowl using ladles then sieved into another plastic bowl to remove debris. With the aid of micropipette, the larva was transferred into specimen bottles and labeled properly.

Identification of mosquito species

All the collection was transported to the laboratory unit of the Department of Zoology, Nnamdi Azikiwe University Awka for proper identification.

The taxonomic keys of [19] were used to identify the Anopheline and Culicine mosquitoes to species level. The identification was based on gross external morphological features, appearance of the antennae, palps, proboscis, thorax, terminal abdominal segments, wings, colour of hind legs and striations on the body.

Physio-chemical parameters of larva habitats

Water samples from various locations were collected and analyzed for physicochemical properties such as pH, and temperature. The pH and temperature will be measured in situ using the HANNA pH/temperature meter (HANNA HI 991300) in the laboratory.

Statistical analysis

The result of this study was analyzed with SPSS version 25. Descriptive statistics was used to present the data for the abundance of mosquito in the habitat. Student t test was used to compare the catch success of the different sampling methods. Shannon Weiner diversity index was used to analyze the diversity of the mosquito while Simpson index was used for species dominance.

Results

Mosquitoes numbering 609 were collected during the sampling period consisting of 406 larvae and 203 adults. Table 1 six adult mosquito species namely *Anopheles gambiae* 89(43.80%), *Anopheles funestus* 18(8.90%), *Aedes aegypti* 27(13.30%), *Aedes africanus* 18(8.90%), *Aedes albopictus* 12(5.90%) and *Culex quiquefasciatus* 39(19.20%) were identified. Table 2 shows the mean number of adult and larva mosquito species gotten at the different study site. In the male and female hostel, the mean number of adult mosquito species were 27.00 (± 7.55a), 23.75 (± 4.33 a) respectively and the mean number of larvae mosquito species were 52.00 (± 20.81a), 49.50 (± 16.76 a) respectively. No significant difference in the mean no of adult and larva mosquitoes caught in the study site, with $p = 0.722$ and $p = 0.929$ respectively. The diversity and dominance indices of mosquito species collected from male and female hostel are shown in table 3. In male hostel, the Simpson's index (C) of the mosquito species was 0.34 and Shannon Weiner (H) was -1.38. in the female hostel, the Simpson's index (C) of the mosquito species was 0.23 and Shannon Weiner (H) was -1.60 in all the two study sites was approximately 2. Mosquito species collected from male hostel recorded highest value, H - value of 1.38 and female hostel with H - value of 1.60. Comparison of mean no of the different

sampling method shown in figure 2 describes that dipping method with the mean no of 75.25 has greater catch than pipetting method with mean no of 26. 25. Table 4 shows comparison of the WHO standard temperature, and pH to the temperature, and pH of the water containing mosquito larva species collected from the different sampling site.

Species	Male hostel No (%)	Female hostel No (%)	Total
Anopheles gambiae	59 (29.10)	30 (14.80)	89 (43.80)
Anopheles funestus	12 (5.90)	6 (3.00)	18 (8.90)
Aedes aegypti	15 (7.40)	12 (5.90)	27 (13.30)
Aedes africanus	8 (3.90)	10 (4.90)	18 (8.90)
Aedes albopictus	4 (2.00)	8 (3.90)	12 (5.90)
Culex quiquefasciatus	10 (4.90)	29 (14.30)	39 (19.20)
Total	108 (53.20)	95 (46.8)	203 (100)

Table 1: Abundance of Mosquito species in the habitat.

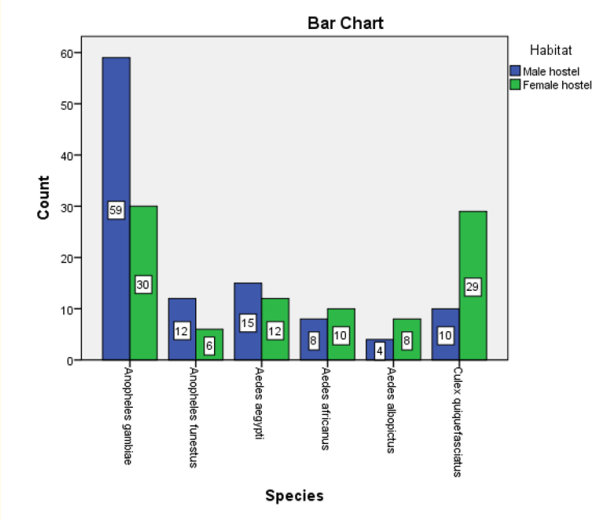

Figure 1: Bar chart showing level of abundance of mosquito species.

Categories	Male hostel	Female hostel
Adult	27.00 7.55[a]	23.75 4.33[a]
Larva	52.00 20.81[a]	49.50 16.76[a]

Table 2: Comparison of mean no of adult and larva mosquito species.

Habitats	Shannon Weiner(H)	Simpson Dominance(C)
Male hostel	-1.38	0.34
Female hostel	-1.60	0.23

Table 3: Diversity indices of the habitat.

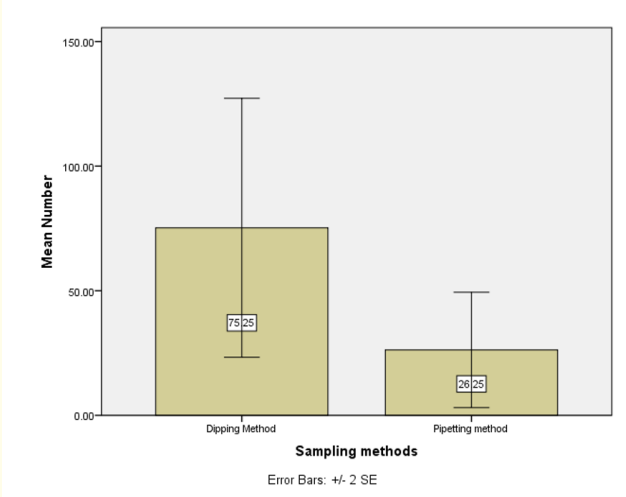

Figure 2: Comparison of mean number on the different sampling method.

Site	Temp (^{0}C)	pH	WHO (^{0}C)	WHO (pH)
Male hostel	27.30	7.30	23.00-30.00	6.80-7.20
Female hostel	28.00	7.16	23.00-30.00	6.80-7.20

Table 4: PH and Temperature comparison.

Discussion

The result of the present study showed that six species of mosquitoes were collected. The variety of mosquito species sampled in the university hostels accounts for the many bushy and forest in the university hostel surroundings. The presence of farms in the study area may have also contributed to mosquito species diversity.

Result of this study showed that *Anopheles gambiae* has the highest density with abundance of 43.80%. this indicates the high survival and fecundity rate of the species. In addition, the geographical location of the university i.e., the area is located in the tropics, could add to the optimum biotic and abiotic factors for the survival of the species. The study area also has a river partway and [4] had earlier reported river banks as one of the habitats that support the breeding of Anopheles mosquitoes. The composition of the various locations may be responsible for the abundance of *Anopheles gambiae.*

The result of the study further showed that *Culex quiquefasciatus* was the second most abundant with the percentage abundance of 19.20%. this supports the report of previous researcher who stated that *Culex species* were found to breed in both artificial containers that are contaminated with organic matters and also in polluted ground water pools [3].

The result of the study further showed that *Aedes aegypti* was the third most abundant with the percentage abundance of 13.30% This could be attributed to the presence of monkeys in the study area. Lymphatic filariasis and yellow fever outbreak is imminent. This supports the findings of Ottesen, (2006) who stated that lymphatic filariasis is also transmitted by various species of mosquitoes including *Anopheles, Mansonia, Culex* and *Aedes*. The disease affects 120 million people with 40 million having overt disease and 80million hidden damage. The occurrence of *Aedes, Anopheles* and *Culex* is suggestive of the prevalence of vector-borne diseases such as malaria, yellow fever, dengue fever and filariasis in the area [2]. In contrast, [13] observed that *Aedes aegypti* was generally predominant in Ikenne, Ogun State, Nigeria. Likewise, [2] observed that *Aedes* mosquito was the most predominant in Zaria and indiscriminately breeds in various habitats including the tree holes.

The result of this study compared the mean no of the different sampling method dipping and pipetting showing that dipping method with the mean no of 75.25 has greater catch than pipetting method with mean no of 26. 25.

The result further showed that the pH and temperature parameters of the different sampling sites, in the male hostel 7.30, 27.30 ^{0}C respectively and in the female hostel 7.16, 28.00 ^{0}C respectively was in agreement to the WHO standard pH and temperature.

Conclusion

The study revealed that Nnamdi Azikiwe University male and female hostels has habitat favourable for the breeding, growth and survival value of mosquitoes particularly those species that transmit diseases. Sequel to this, there may be outbreak of mosquito borne diseases like yellow fever, dengue fever and helminth infection in the study area. Inadequate environmental sanitation might have brought about the high mosquito population in the community. Mosquito species collected from the study area are vectors of one mosquito borne diseases. The high population of *Anopheles, Culex* and *Aedes* species of mosquito in the area is a danger sign of possible epidemic, if any arbo-viral disease agents is introduced. It is recommended that reduction in vector population could be achieved by eliminating all possible breeding sites. The students should also be advised to use personal protective measures to avoid mosquito bites. Finally, the state ministry of environment should continuously prevent epidemic by daily surveillance and monitoring for mosquito population.

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