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Breeding ecology of mosquito species in Umunze community, Orumba south local government area, Anambra state, Nigeria

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Abstract
Mosquito-borne diseases have great impact on human and animal health throughout the world. A survey of mosquito breeding sites was conducted in Umunze community, Anambra State, from April to October 2018.The study sought to determine ecological parameters of mosquito breeding habitats in the community. Immature stages of mosquitoes were collected using standard larval sampling methods. Temperature, pH, Salinity, Total Dissolved Solid, Total Suspended Solid, Dissolved Oxygen**,** Chemical Oxygen Demand, Sulphate, and Iron concentration were also determined using standard procedures. A total of 750 larvae and pupae were collected from 48 breeding sites: ground pools (20.3%), domestic containers (18.3%), tyres (17.1%), clay pots (15.5%), broken bucket/tins (14.7%) and reservoir tanks (14.3%). There was no significant difference in breeding habitat collections (P=0.626). Four mosquito species; *Aedes albopictus* (29.9%),, *Aedes aegypti* (28.55%), *Culex quinquefasciatus* (26.5%) and *Anopheles gambiae* (15.1%), were identified from rearing the larvae and pupae to the adult stage. There was no significant difference in species abundance (P=0.395). Ugwunano village (17.7%) had the highest number of mosquitoes reared from larvae and pupae, while the least was recorded in Amuda village 78 (10.4%). Hence, there was significant difference in the number of immature stages collected from the different villages (p=0.010). The ecological parameters of mosquito breeding habitats showed that the temperature of water from various mosquito breeding habitats varied from 20.4 °C to 26.3 °C with the highest value (26.3°C) recorded in reservoir tank and the lowest in used tyres (20.4°C). There was no significant difference in temperature of the breeding habitats (P= 0.586), unlike the Total Suspended Solid (TSS), which was significantly different (P=0.15). The breeding characteristics of *Aedes*, *Culex* and *Anopheles* mosquitoes collected from this study, provide useful information for evidence-based control intervention against the vectors in the study area.

Keywords: ecology, mosquitoes, species, breeding, habitats, parameters, umunze, *Anopheles*

Introduction

Mosquitoes are major vectors of public health importance and the most common blood sucking arthropods (Gerald and Larry, 2010) [22]. They are among the major causes of illness and death, particularly in tropical and subtropical countries. In Nigeria, mosquitoes are regarded as public health enemies because of their biting annoyance and noise nuisance, sleeplessness, allergic reaction and disease transmission due to their bites (Kumar *et al.*, 2014) [11].

Mosquitoes have worldwide distribution and are found in both tropics and temperate regions of the world. *Anopheles, Culex, Mansonia and Aedes*are common in the tropics or warm climates and lay their eggs on the open surface of all sorts of both permanent and temporary water collections, just above the water level on walls of containers or attach them to some partially submerged objects, depending on the species. Environmental changes due to human activities greatly influence the distribution and survival of many mosquito species (Adeleke *et al.*, 2008) [2]. Amusan *et al.*, (2005) [3] opined that the recent increase in agricultural activities and urbanization contributed to the breeding of different mosquito species. The present reality of demographic growth and urbanization being experienced in many parts of Nigeria has come withmany public health problems (Adeleke*et al.*, 2010) [1]. These problems, including unplanned urban growth, inadequate waste disposal, irrigation and poor drainage, usually alter ecosystem and thus promote prolific breeding of mosquitoes.

Mosquitoes transmit human diseases such as malaria, yellow fever, dengue fever, filariasis encephalitis etc. Mosquitoes also transmit animal diseases like fowl pox of poultry, myxomatosis of rabbits, rift valley fever of sheep, encephalitis of horses and birds, dirofilariasis of dogs (Magu *et al.*, 2015). Mosquitoes also transmit the relatively new but deadly threat of West Nile virus and while the disease in humans is been deadly but rare, it has quickly become established as a real threat to horses with 40% of horses that contact the disease dying of illness (Angenvoort *et al.*, 2014) [4]. All these diseases cause great suffering to man and livestock. They do not only cause high morbidity and mortality in human and animal populations, but also lead to huge economic losses. Mosquitoes and mosquitoes-borne diseases are now being imported into many countries that were previously free from the diseases. Post-yellow fever epidemic, entomological investigation conducted in September 1991 in Delta State, Nigeria, yielded eggs of *Aedesalbopictus* mosquito that was then unknown in Nigeria (Ezike *et al*, 2001 and Savage *et al*, 1992) [7, 17].

The proper understanding of the environmental factors that promote the breeding of mosquitoes is imperative for successful planning of mosquito control measures. The World Health Organisation (WHO, 1975) advised that the planning, execution and evaluation of any anti-vector measures have to be based on a perfect knowledge of the bionomics of the vector species; that is the knowledge of the breeding sites, resting, biting habits and longevity. Hence, theneed to study the breeding ecology of mosquitoes in Umunze, a semi urban community in Anambra State, Nigeria. The objectives of the study are to: determine the breeding habitats and abundance of mosquito species and investigate the ecological parameters of the breeding habitats of the mosquitoes in the community.

Materials and Methods

Study area

The study was carried out in Umunze, the headquarters of Orumba South Local Government Area in Anambra South Senatorial Zone, Anambra State, Southeast Nigeria (Fig. 1). The geographic coordinates of Umunze are Lat. 5° 58′ 5″ N, Long. 7° 14′ 13″ E. The study area lies within the tropical rain forest biome of Nigeria. The study spanned the dry and wet seasons. The dry season usually runs from November to March while wet season is from April to October. The average daily humidity is about 70%, reaching 80% during rainy season and the annual rainfall is about 2000 to 3000mm (Iloeje, 2001) [10]. The maximum temperature in the dry season ranges from 35.7°C to 37.5°C, while the minimum is between 26.5°C to 28.7°C. During the wet season, the maximum temperature is 30.8°C while the minimum is 22.1°C. According to (NPC, 2006), Umunze has a population of 42,000 people as at 2006. The people are ethnically *Igbos* of Nigeria. There are seven villages that make up Umunze community, namely; *Amuda, Nsogwu, Ururo, Lomu, Ubaha, Ozara and Ugwunano.* In addition to four (4) primary health centres and eight (8) private clinics, Umunze has a General Hospital with one tertiary institution called Federal College of Education (Technical) Umunze. Umunze also has many secondary and primary schools. It has the famous *Nkwo* market with many lock-up and open stalls. The streets of Umunze have many potholes, Spillage of water from broken water pipes is a common site and electricity supply is epileptic. Occupationally, the majority of the inhabitants are farmers with agricultural products like yam, maize, cassava, cowpea and melon cultivated. There are also petty traders, students and others.

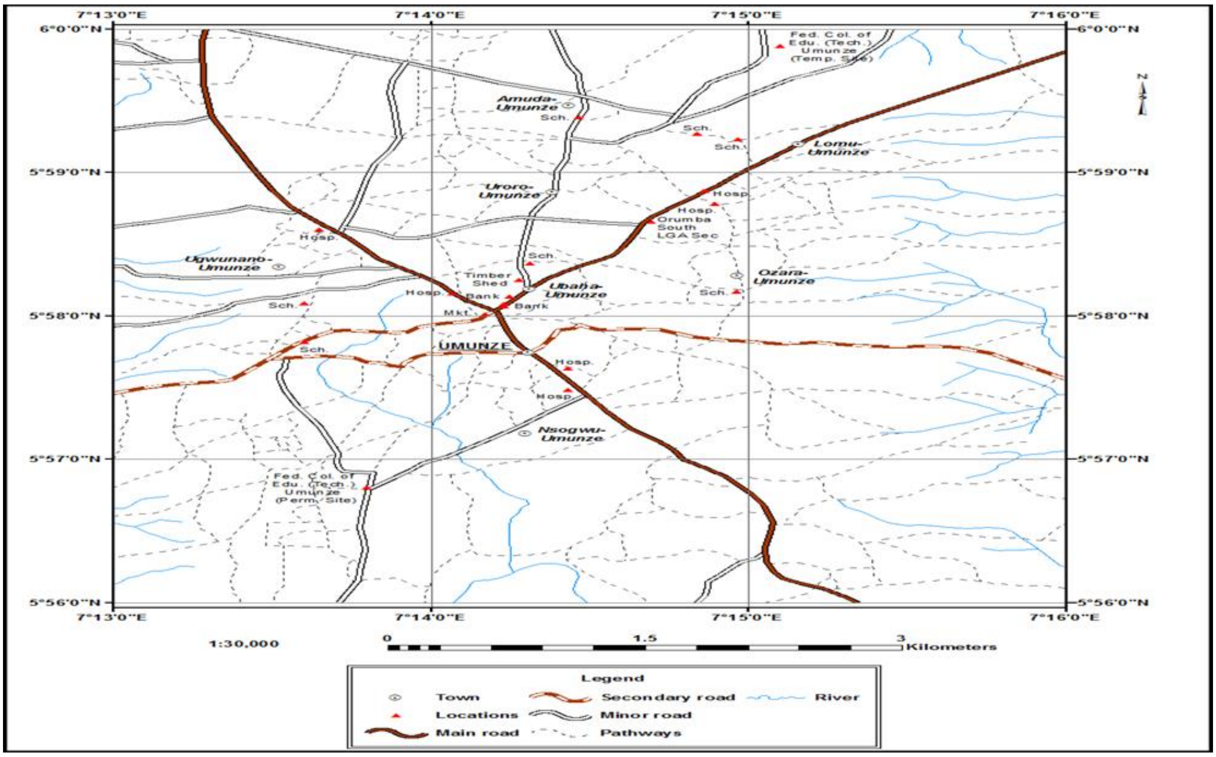

Fig 1: Map showing sample collection points in Umunze Orumba South L.G.A Anambra State, Nigeria

Advocacy and ethical considerations for the study

Advocacy visit to sensitize and elicit the cooperation of stakeholders in the community was paid to the traditional ruler and other community leaders. This was facilitated with a letter of introduction from the Department of Parasitology and Entomology, Nnamdi Azikiwe University, Awka. Household members whose rooms were to be used for indoor survey were adequately sensitized and prepared. The volunteers who assisted with the collection of the outdoor man-biting adult mosquitoes were trained on the skills for the sampling of outdoor biting mosquitoes and safety precautions to be observed. Written informed consent were gotten from all participants.

Study design

The study design used was experimental research design. The study involved both parasitological and entomological survey. Field based study that lasted for a period of 6 months (April to October 2018) was adopted for the collection of immature and adult mosquitoes. Morphological characterizations of mosquitoes, physicochemical and biological characterization of the breeding sites and the infectivity of female *Anopheles* mosquitoes were laboratory based. Systematic sampling technique was used to select the households included in the research (WHO, 2003). A total of ten (10) households were sampled from the seven (7) villages for monthly collection for both mature and immature stages of mosquitoes.

Determination of breeding habitats and collection of immature stages (larvae and pupae) of mosquitoes

Breeding habitats of mosquitoes were identified by surveying the environment for water collection points. This involved moving around the villages and sampling for immature stages of mosquitoes. Larvae survey of mosquitoes was carried out using dippers, ladles and pipettes, as described by Adeleke (2008) [2]; by lowering the dipper gently at an angle of 45° just below the water surface. The larvae and pupae flows in with the water. In containers such as used tyres and broken containers where dipper cannot be used, the container holding the larvae were turned over into a 30 × 15 cm plastic tray and carefully observed for the presence of mosquito larvae. Larvae and/ or pupae present were then picked with a pipette and transferred to a labeled bottle. Each bottle was covered with cotton wool to ensure that the larvae collected remained alive and undamaged as they were transported to the insectary. The larvae collected were reared in the insectary in white plastic bucket as described in the study of Rohani *et al*, (2011).

Rearing of the immature stages and identification of adult mosquitoes

A cage was constructed with wood and nets and divided into rooms for different larvae collected from different villages. The rooms were labeled for proper identification. Mosquitoes from different breeding habitats were separately reared to adult for proper identification to species level according to WHO (2003). The plastic bowls were covered with nets sewed with an elastic material to fit the size of the bowls. This served as a precautionary measure to prevent emerging mosquitoes from escaping and also prevent wild mosquitoes from ovipositing in the container. The larvae were reared at room temperature and fed with a mixture of yeast and powdered biscuits. The emerged adult mosquitoes were chilled to death and preserved with silica gel in Eppendorf tubes. They were then taken to National Arbovirus and Vectors Research Centre (NAVRC) Enugu, for morphological identification. The mosquitoes were identified using the keys described by Gillet (1972) [8] and Coetzee, (2020) [6].

Determination of ecological parameters of the breeding habitats of mosquitoes collected

The physicochemical characteristics of water samples from various mosquito breeding habitats surveyed were determined according to the method described by Oyewole (2009). Water temperature was determined at the site using mercury in glass thermometer. Water samples were then collected from the breeding habitats using 500 ml capacity specimen bottle. The water sample was taken to Project Development Institute, Federal Ministry of Science and Technology (PRODA) in Enugu, to determine the pH, Salinity, Total Dissolved Solid (TDS), Total Suspended Solid (TSS), Dissolved Oxygen (DO)**,** Chemical Oxygen Demand (COD), Sulphate, and Iron concentration.

Determination of pH

The pH meter was used to determine the pH of various mosquito habitats. The pH meter was switched on and the pH electrode was placed into the pH buffer solution one after the other. A standby beaker (250ml) filled with water was placed for rinsing before changing from one buffer solution to another. The pH meter was calculated by pressing the CALCULATE button. After calculation, the samples were read by pressing the READ button.

Determination of Total Dissolved Solid (TDS)

Total Dissolved Solid (TDS) was measured by weighing an empty beaker (250ml capacity) (initial weight) and 50 ml of water sample was measured out and was filtered using a filter paper into a weighed beaker. The beaker was heated to dryness, allowed to cool and after cooling was reweighed (final weight). The Dissolved Solid residue was calculated by subtracting the initial weight of the beaker from the final weight and the TDS value in mg/l using the formula.

$$TDS = \frac{\text{DS residue} \times 100}{\text{Volume of sample used}}$$

Determination of Total Suspended Solid (TSS)

To determine the Total Suspended Solid (TSS), an empty filter paper was weighed (initial weight).This filter paper was used to filter 50 ml of water for TDS. The same filter paper containing the residue was allowed to dry and reweighed (final weight). The initial weight of the filter paper was removed from the final weight and the weight of the Total Suspended Solid was obtained and converted to mg/l.

Determination of Chemical Oxygen Demand (COD)
In the determination of Chemical Oxygen Demand (COD), two set-ups were used for each water sample; one is for the blank test (distilled water) and the other for the test water (water sample from breeding site). Ten (10) ml of the test water sample was collected using pipette into a beaker while ten (10) ml of distilled water was added into the other beaker. In each of the beakers, 5 ml of 0.025N potassium dichromate (K2Cr2O7), 15 ml of concentrated tetraoxosulphate (IV) acid (H_2SO4) and 40ml of distilled water were added to it to get 70ml solution. The solution became hot on addition of the acid. Seven (7) drops of phenanthroline ferronsulphate indicator (Ferron indicator) was added and was allowed to cool. In the burette, 0.025N Ferron Ammonium sulphate was used to titrate the solutions until the colour turns from greenish blue to orange. The Chemical Oxygen Demand was calculated using the formula

$$COD = \frac{(T_1 - T_2) \times 0.025N \times 5000}{\text{Volume of sample used}}$$

Where
T_1 = titer value for blank
T_2 - titer value water sample
N = Normality for ferron ammonium sulphate used which is 0.025

Determination of Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD).
The dissolved oxygen (DO) meter was used to measure the Biochemical Oxygen Demand (BOD) in the water sample. The initial dissolved oxygen concentration (mg/l) in each sample was measured and then placed in a dark incubator at 20°C for five days. After five days, the DO meter was used again to measure the final dissolved oxygen concentration (mg/l). The final DO reading was subtracted from the initial DO reading and the result is the BOD concentration (mg/l).

Determination of Sulphate concentration
In determining the Sulphate concentration, ten (10) ml of water sample was added into a conical flask (250 ml) using volumetric pipette and 5ml of 2M HCl (Hydrochloric acid) and 2 ml of 0.05M BaCL (Barium chloride) was added equally and was boiled for 5 minutes and allow to cool. After cooling, 2ml of ammonia and 5 ml of 0.01N EDTA were added and boiled for another 5 minutes. 5 ml of buffer 10 and 3 drops of Eriot (Solochrome Black T) indicator was added and was titrated with 0.01ml $MgCl_2$. Colour change was observed from deep blue to light purple. Calculation of sulphate concentration was done using the formula

$[10- (TV \times 0.9)] \times 96.014$ mg/l.

Where
TV = titer value of sample and 96.01464 is the molecular weight of sulphate.

Determination of heavy metals
All the water samples were first boiled to 100°C, filtered to remove clogs and then allowed to cool. They were poured into a vacuum vial and were placed in an atomic absorption spectrophotometer. Using various wavelengths of metals, the concentration of iron, cadmium, lead, manganese and phosphorous were read and the values recorded.

Analysis of Data
Data collected were summarized using tables. Test of significance was conducted using ANOVA, Chi square, Correlation, T- test and Friedman test at 5% level. Correlation analysis was used to compare the abundance of mosquito larvae with the different physical and chemical parameters of the breeding sites. The Statistical Package used was SPSS version 25.0.

Results
Findings from this study showed that six (6) breeding habitats of mosquitoes were identified in Umunze community. These were ground pools, used tyres, domestic containers, broken buckets/tins, clay pots and reservoir tanks. A total of 750 larvae/pupae were collected from all the breeding habitats. Of these, the habitat with the highest larval collection was ground pools (20.3%) 152/750, followed by domestic containers (18.3%) 137/750, used tyres (17.1%) 128/750, clay pots (15.5%)116/750, broken bucket/tins (14.7%)110/750 and the least was reservoir tanks (14.3%) 107/750, as shown in Table 1. The abundance of mosquito larvae according to breeding habitats was not statistically significant (P= 0.626).

Table 1: Breeding habitats and mosquito larvae/pupae collected in Umunze, Anambra State.

Breeding habitats	Number of larvae collected (%)
Ground pools	152 (20.3%)
Domestic containers	137 (18.3%)
Used tyres	128 (17.1%)
Clay pots	116 (15.5%)
Broken buckets/tins	110 (14.7%)
Reservoir tanks	107 (14.3%)
Total	750

The result also showed that the species of mosquito identified from rearing immature stages to the adult stage were *Aedes albopictus* (29.9%) 224/750, *Aedes aegypti* (28.55%) 214/750,*Culex quinquefasciatus* (26.5%) 199/750, and *Anopheles gambiae* (15.1%) 113/750 in decreasing order. This is shown in Table 2. There is no significant different among species of mosquitoes collected (P = 0.395).

Table 2: Mosquito species identified from rearing immature stages collected from different breeding habitats to adults.

Mosquito species	Breeding Habitats						Total (%)
	Ground pools	Used tyres	Domestic containers	Broken buckets	Clay pots	Reservoir tanks	
Aedesalbopictus	22	43	45	36	32	46	224 (29.87)
Aedesaegypti	47	35	41	44	40	7	214 (28.53)
Culexquinquefasciatus	0	45	51	30	34	39	199 (26.53)
Anopheles gambiae	83	5	0	0	10	15	113 (15.07)
Total	152	128	137	110	116	107	750 (100)

It was also found thatUgwunano village (17.7%) 133/750 had the highest number of mosquitoes reared from larvae/pupae, followed by Lomu village (15.9%)119/750, Nsogwu village (14.8%)111/750, Ubaha village (14.7%) 110/750, Ozara village 107 (14.3%) 107/750, Ururo village 92 (12.3%) and the least was Amuda village 78 (10.4%) as shown in Table: 3. The abundance of mosquito larvae in different villages in Umunze community is statistically significant (P=0.010)

Table 3: The distribution of larvae/pupae collected from villages in Umunze community

Study Villages	Total larvae/pupae collected	(%) larvae collected
Amuda	78	10.4
Ugwunano	133	17.73
Nsogwu	111	14.8
Ururo	92	12.27
Ubaha	110	14.67
Ozara	107	14.27
Lomu	119	15.87
Total (%)	750 (100)	100

The result on ecological parameters of mosquito breeding habitats in the study area showed that the temperature of water from various mosquitoes breeding habitats varied between 20.4 °C and 26.3 °C as shown in Table 4. The highest value (26.3 °C) was recorded at reservoir tanks followed by broken buckets (25.2°C), ground pools (24.2°C), domestic containers (23.6°C) clay pots (22.1°C) and the least was recorded at used tyres (20.4°C). The water temperature in which mosquito larvae breed in Umunze community was statistically not significant (P=0.586)**.** The mean Total Suspended Solids (TSS) concentration in the mosquito breeding waters ranged from 115mg/L - 312mg/L. The lowest value (115mg/l) was recorded in broken buckets and the highest value (312mg/l) in ground pools. When compared with the EPA MPL of 1000mg/L for TSS, all the values recorded from the six sites were below it as was shown in Table: 4. The TSS of water in which mosquito larvae breed in Umunze community was statistically significant (P=0.15)

In addition, the mean Total Dissolved Solids (TDS) concentration of the water varied between 122mg/L and 1136mg/L from the various sites. The lowest value (122mg/l) was obtained from ground pool and the highest value (1136mg/l) in domestic containers. The rest of the data points from the remaining sites were generally above when compared with the EPA MPL of 50mg/L for TDS in fresh surface waters. The TDS in water in which mosquito larvae breed in Umunze community was statistically not significant (P=0.885).The Dissolved Oxygen (DO) content of the mosquito breeding water sources in the seven communities ranged from 2.76 mg/L – 6.69mg/L. The lowest value (2.76mg/l) was recorded in broken buckets and the highest value (6.69mg/l) was recorded in ground pools. All the mean values recorded from the various mosquito breeding waters were far below the EPA MPL of 50mg/L. The DO in water in which mosquito larvae breed in Umunze community was statistically not significant (P=0.201).

The pH levels of all the mosquito water breeding sites further varied between 5.89 and 7.68. The lowest value (5.89) was recorded in domestic containers whilst the highest (7.68) was recorded in used automobile tyres. The pH of water from the entire sites was generally within the EPA MPL range of 6-9. The pH of water in which mosquito larvae breed in Umunze community was statistically not significant (P=0.05).TheSulphate and potassium in water in which mosquito larvae breed in Umunze community was statistically significant (P<0.05) while in BOD, Fe, Mn, and Zn in water in which mosquito larvae breed in Umunze community was statistically not significant (P=0.966).

Table 4: The ecological parameters of mosquito breeding habitats in Umunze

Water parameters	**Breeding habitats**					
	Broken buckets	**Used tyres**	**Clay pots**	**Reservoir tanks**	**Ground pools**	**Domestic containers**
Temperature (ºC)	25.2	20.4	22.1	26.3	24.2	23.6
Ph	6.7	7.68	6.82	6.74	7.06	5.89
BOD (mg/l)	40.89	52	27	17	67	23.9
TDS (mg/l)	447	990	233.1	465	122	1136
TSS (mg/l)	115	250	210	190	312	290
COD (mg/l)	27.9	19.8	28.18	32.9	22.1	20.98
DO (mg/l)	2.76	4.1	5.27	5.71	6.69	6.56
Sulphate (mg/l)	33.2	32.64	29	24	43.2	39.04
Fe (mg/l)	0.65	2.8	1.96	0.76	1.6	0.23
Cd (mg/l)	0.01	0.02	0.01	0.03	0.02	0.01
Pb (mg/l)	Nil	0.4	Nil	1.8	0.4	0.3
Mn (mg/l)	0.11	0.14	0.2	0.18	0.31	0.45
Zn (mg/l)	Nil	Nil	Nil	0.1	Nil	0.67
P (mg/l)	1.5	2.7	2	1.75	3.1	2.2
Total	110	128	116	107	152	137

Discussion

The ecology of mosquitoes in study area showed various species of mosquitoes in relation to their breeding sites. In the course of larval sampling, 750 mosquitoes were collected as larvae and pupae from different breeding sites which includes ground pools, used tyres, domestic containers, broken buckets/tins, clay pots and reservoir tanks around the seven villages in Umunze community. This is an indication of intensive breeding as well as preponderance of their breeding sites. This finding corroborates earlier observations of Onyido *et al*. (2011a) [16] who noted that the preponderance of mosquitoes in Awka metropolis was due to the prevailing habitats in the area. The intensive breeding of different species of mosquitoes could be attributed to human activities in the community such as preponderance of improperly covered water storage/discarded water-holding containers, land excavations and landscaping, civil engineering constructions including road creation and construction of gutters which are usually filled up with water. The upgrade of Federal College of Education (Technical) Umunze to Degree awarding university came with construction of new buildings and reservoir tanks and the concomitant increase in population.All these factors led to increase in the number of discarded water-holding materials by the inhabitants. These materials collect and hold rain water which serves as breeding sites for different species of mosquitoes. This finding agrees with the findings of WHO (1982) which observed that mosquitoes are widely distributed throughout the world and they utilizes different water bodies for their breeding.

Of the six major breeding sites in study area, ground pools 152 (20.27%) and used tyres 128(17.07%) yielded more developing stages of mosquitoes while reservoir tanks yielded the least 107(14.27%). Similar result was recorded by Onyido *et al*., (2009b) [15].

Four mosquito species (*Aedesalbopictus, Culexquinquefasciatus, Anopheles gambiaes* and *Aedesaegypti*) were collected from different breeding sites, with *Aedesalbopictus* and *Aedesaegypti* predominating the collection. *Aedesalbopictus* and *Aedesaegypti* were collected from water in the used tyres, domestic containers, broken buckets, clay pots and reservoir tanks. *Culexquinquefasciatus* was collected from used tyres, domestic containers, broken buckets clay pots and reservoir tanks. *Anopheles gambiaes* was collected mostly from ground pools and few from broken buckets and reservoir tanks. This breeding ecology is in tandem with the reports of Service (1980).

Of the 224 *Aedesalbopictus* collected at their developing stages, 46 (20.53%) were from reservoir tanks. *Ae. albopictus* belong to the *stegomyia* subgroup that breed in temporary pools of water especially in man-made water-holding containers (Gordon and Laviopierre 1979, Service, 1980) [9]. The large number of reservoir tanks and discarded tyres in the study area provides good breeding sites for *Aedes mosquitoes*. The number of *Aedesalbopictus* 224 (29.98%) collected from the study area is obviously a subset of the population of this species. Knowing the vectorial capacity of *Ae. Albopictus* can trigger a disease outbreak if there are circulating arboviruses and susceptible host in the community (Onyido*et al*., 2009a) [14].

Most of the *Anopheles* larvae 83(74.45%) were collected from ground pools. *An. gambiae*s.1 is a selective breeder usually found in sunlit, stagnant ground pools/puddles,around our homes from where they fly into homes to bite (Service, 1980) [18]. Chukwuekezie *et al*. (2020) [5] in their studyacross the five Southeast states, exclusively collected *An. gambiae*s.l as the only *anopheline* from sunlit ground pools. Gordon and Lavoipierre (1976), also observed that the more important vector of mosquito-borne diseasesare those which show a close association with man and prefer man to other animals as source of food.

Conclusion

The present study is of public health concern because the mosquito species collected in the area have been implicated in onemajor type of mosquito-borne disease or the other and the findings suggest that almost every person in Umunze community is at the risk of filariasis, yellow fever, malaria and/or other arboviral infections. Human activities, indiscriminate disposal of used tyres, household materials and poor sanitation as well as abundant rainfall may be contributing factors in the species diversity in study area. Since most mosquito species found breeding in the area are potential vectors of diseases of Public Health importance sustained environmental management and the use of insecticide-treated bed nets should be used to control the mosquitoes. This will help to prevent the transmission of diseases among the people.

References

1. Adeleke MA, Mafiana CF, Idowu AB, Sam Wobo SO, Idowu OA. Population dynamics of indoor sampled mosquitoes and their implication in disease transmission in Abeokuta, South-Western Nigeria. Journal of Vector Borne Diseases,2010:47(1):33–38.
2. Adeleke MA, Mafiana CF, Idowu AB, Adekunle MF, Sam-Wobo SO. Mosquito larval habitats and public health implication in Abeokuta, Ogun State, Nigeria. Tanzan Journal of Health Research,2008:10(2):103–107.
3. Amusan AA, Mafiana CF, Idowu A, nB, Olatunde GO. Sampling mosquitoes with CDC light-traps in rice field and plantation communities in Ogun state, Nigeria. *Tanzania Health Research Bulletin*,2005:7:111–6.
4. Angenvoort J, Fischer D, Fast C, Ziegler U, Eiden M, delaFuente JG. Limited efficacy of West Nile virus vaccines in large falcons (*Falco* spp.). Veterinary Research,2014:45(1):41.
5. Chukwuekezie O, Nwosu E, Nwangwu U, Dogunro F, Onwude C, Agashi N, *et al*. Resistance status of *Anopheles gambiae* (s.l.) tofour commonly used insecticides for malariavector control in South-East Nigeria. Parasitesand Vectors,2020:13:152. https://doi.org/10.1186/s13071-020-04027-z
6. Coetzee M. Key to the females of Afrotropical *Anopheles* mosquitoes (Diptera: Culicidae). Malaria Journal, 2020, 19**:**70.
7. Ezike VI, Ozumba NA, Nwankwo ACN, Nasidi A, Onyido AE, Nwankwo EA. Ecology, Distribution and Epidemiological impact of *Aedesalbopictus*in Nigeria. Paper presented at the Annual Conference of the Nigerian Society of Parasitology held at the Federal University of Technology, Yola, Adamawa State, Nigeria. *Freshwater Hydrobiologia*,2001:595:477-487.
8. Gillet JD. *Common African Mosquitoes and their Medical Importance*. William Heinemann Medical Books Ltd., London, UK.,1972:106.
9. Gordon RM, Lavoipierre MM. Entomology for students of medicine, fourth printing. *Blackwell Scientific Publications*, Oxford, 1979.
10. Iloeje NP. A new geography of Nigeria, new revised edition. Longman Nigeria PLC, Ikeja. ISBN 0582 60396X (Nigerian edition), 2001, 199.
11. Kumar RD, Chawla P, Dhamodaram, Balakrishnan N. Larvicidal Activity of *Cassia occidentalis* (Linn.) against the Larvae of *Bancroftian Filariasis* Vector Mosquito *Culexquinquefasciatus*. Journal of Parasitological Research, 2014, 13.
12. Muga GO, Onyango-Ouma W, Sang R, Affognon H. Review Article: Sociocultural and Economic Dimensions of Rift Valley Fever. American Journal of Tropical Medical Hygiene,2015:92(4):730-738.
13. National Population Commission. Population Census of Nigeria, Federal Republic of Nigeria. Population distribution in Local Government Areas by Sex and Number of Households. Legal Notices on publication of the details of the breakdown of the National and State Provisional population census totals. Official Gazette,2006:94(24).
14. Onyido AE, Ezike VI, Ozumba NA, Nwosu EO, Ikpeze OO, Obiukwu MO, Amadi ES. crepuscular man biting mosquitoes of tropical zoological Garden in Enugu, South East Nigeria, thr internet journal of parasitic diseases,2009a:4(1):1-9.a
15. Onyido AE, Deezia NPL, Obiukwu MO. Ecology of mosquitoes in the new development site of NnamdiAzikiwe University, Awka, Nigerian. The Internet Journal of Health,2009b:9:2.
16. Onyido AE, Obinatu SC, Umeanaeto PU, Obiukwu MO, Egbuche MC. Malaria Prevalence and Mosquito Vector Abundance in Uli Town, Ihiala Local Government Area, Anambra State, Nigeria. African Journal of Biomedical Research,2011a:14(3):175-182.
17. Savage HM, Ezike VI, Nwankwo CAN, Spiegel R, Miller RR. First Record of Breeding Population of *Aedesalbopictus*in Continental Africa: Implications for Arboviral Transmission: Journal of American Mosquito Control Associaion,1992:8(1):101-103.

18. Service MW. *A Guide to Medical Entomology*. MacMillan International College Edition. MacMillan Press Ltd. London, 1980, 1-44.
19. World Health Organisation. Manual for Practical Entomology in malaria; prepared by the WHO Division of malaria and Parasitic Diseases 1, 1975:(1):1-160.
20. World Health Organisation. Manual on Environmental Management for Mosquito Control with special emphasis in malaria vectors. WHO Offset Publication,1982:140-148.
21. World Health Organisation, 2003. The African Malaria Report. WHO/CDS/MAL/1093.Geneva:WHO/UNICEF.
22. Gerald DS, Larry SR. Foundations of Parasitology. International Edition, 2010, 602-610.