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Ecology of Mosquito Larvae in Northern Part of Nasarawa State, Nigeria

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1. Abstract
Vector-borne diseases are increasingly becoming a major health problem among communities in the rural settings with large to medium, slow moving to stagnant water bodies. This study assessed mosquito larvae abundance and distribution of breeding sites in Akun Development Area, Nassarawa Eggon Local Government Area, Nasarawa State, Nigeria, during the dry season. In this cross-sectional survey, mosquito larvae were sampled across all ostensibly naturally occurring and artificial habitats using standard dipper. Each habitat was dipped five to ten times. All collected larvae were reared to adult after which they were identified using standard identification keys. A total of 1,493 culicidae larvae were collected from 61 breeding sites across 29 villages, out of which the culicine larvae were more abundant 1,285 (86.07%) than the anopheline 208 (13.93%). The abundance of mosquito larvae across breeding habitat types differed significantly (χ^2 = 114.22, df = 16, P < 0.001). The highest number of larvae was collected in riverbed habitat 624 (41.80%) whereas no mosquito larvae were observed in drainages, wood pool, tyre and pot water habitats, respectively. Wagenku community recorded the highest population of mosquito larvae 1,105 (74.01%) while Ngamaka community had the least larval abundance (0.27%), and differences across the 29 communities surveyed varied significantly (χ^2 = 1509.1, df = 28, P = 0.0001). The abundance of mosquito larvae in relation to distance to the nearest human habitation varied significantly (χ^2 = 376.82, df = 8, P = 0.0001) with most breeding activity taking place at sites that were between 51 m and 150 m away from houses. In conclusion, inhabitants of Akun Development Area should always clear stagnant water bodies so as to control and or limit mosquitoes breeding success.

2. Keywords
Mosquito, Culicidae larvae, Breeding sites, Dry season, Abundance along gradients, Nassarawa Eggon LGA, Nasarawa State

3. Introduction
Mosquitoes are responsible for the transmission of many diseases of man in the tropical and subtropical regions of the world. It is on record that about 40% of human sufferings that require hospitalization in Nigeria arise directly or indirectly

from parasitic infection most of which are mosquito-borne [1]. Various species of mosquitoes are found all over Nigeria and are not restricted by change in topography across the country [2]. Many species act as vectors of diseases such as malaria, yellow fever, West Nile virus, dengue fever, filariasis, and other arboviruses. Three thousand five hundred (3,500) species of mosquitoes grouped into 41 genera have been identified and many are vectors of diseases [3]. The importance of mosquitoes to man, therefore, lies in their capacity to act as vectors of parasitic worms, protozoa, bacteria and viruses. Mosquitoes are the greatest enemies of humans because of the widespread suffering and death caused by the diseases transmitted. Mosquitoes also constitute a very important component in the determinants of insects-borne diseases of public health importance, especially in places where the availability of diverse water bodies support their breeding. The diversities of aquatic habitats for mosquitoes breeding frequently make them occur in adequate population to constitute biting nuisance or vectors of disease-causing organisms [4].

An aquatic habitat for oviposition is required by all mosquito species for larval and pupal development. McCrae [5] reported that larval habitats water-type play important roles in determining mosquito oviposition site selection, and hence, the productivity of such sites regarding adult mosquito emergence rates is critical factors determining the vectorial capacity of mosquitoes. Many species breed in both natural and artificial habitats such as concrete gutters, stagnant pools, abandoned plastics, abandoned tyres, and even open unused drums [6,7]. Malaria, Zika virus, filariasis, and yellow fever are diseases vectored by mosquitoes these diseases cause high morbidity and mortality in human [8]. Malaria is one of the most severe global public health problems worldwide, particularly in Africa, where Nigeria has the greatest number of malaria cases [8].

The abundance and distribution of adult *Anopheles* mosquitoes are predicated on the presence and productivity of larval breeding habitats [1]. The productivity of such habitats influences the conditions of larval development and plays a major role in the eventual size of adult mosquitoes, which in turn affects factors such as longevity, abundance, morphology and blood meal volume [9,10]. Agricultural changes of the landscape such as afforestation, deforestation, irrigation and desertification provide a conducive breeding ground for the proliferation of mosquito species. Land use and land cover changes such as agricultural expansion and increased human population contributed immensely to the increase in breeding sites and formation of habitat for mosquito species [11]. Furthermore, anthropogenic activities have seriously encouraged the breeding successes of mosquito species close to human habitation, thereby increasing the rate of disease transmission. Climate change

such as temperature extremes, rainfall, relative humidity are major ecological factors which have devastating effect on the environment, thereby influencing the abundance and diversity of mosquito species [12,13].

Previous research and methods for vector control has focused on biting habits of female mosquitoes and physical protection and how the adult population can be reduced in a reactive manner. Research today focuses instead on proactive methods that reduce the population at an early stage by utilizing those mosquitoes inhabit two different habitats during their life cycle; one aquatic and the other terrestrial. Information on the mapping of mosquitoes breeding in Akun Development Area of Nassarawa Eggon Local Government Area (LGA), Nasarawa State, Central Nigeria, is limited, hence, the need for this research which will immensely contribute to existing malaria control database leading to effective integrated vector management via larval source management.

4. Materials and Methods

4.1. Study Area

The sampling design included 29 study sites within Akun Development Area, Nassarawa Eggon LGA, Nasarawa State. The main economic activities in the area include large-scale livestock production and agricultural activities. The average annual rainfall is about 265 mm while annual mean relative humidity is 40%. It has a warm climate with mean annual temperature of 26.2 ℃ ranging from 9.4 ℃ to 44.2 ℃ which support larval development as observed by Kudom, et al. [14]. It is a rural area with majority of the population living in straw houses on hills and foot-hills, close to rivers. Socio-economic condition of villagers is low and they solely depend on agricultural farming and livestock keeping. Natural earth, dams and rocks block the water flow in the study area, and create suitable places for mosquitoes breeding. An average population density in this area is approximately 1000 to 10,000 people/km^2.

4.2. Experimental Design

A cross-sectional survey was conducted in relation to 29 villages in Akun Development Area, Nassarawa Eggon LGA, Nasarawa State. The sampling sites were coded based on location and point of sampling. This labeling system was employed to avoid confusion or mix up of the results, and for easier analysis of the specimen.

4.3. Sample Collection

Mosquito larval collection was conducted around the 29 selected villages across Akun Development Area, and a standard dipping sampling method was used. The larval collection was conducted within the period of two weeks, from 9th to 23rd March, 2022. The collection was done from early hours of the day around 7:00 am to 4:00 pm daily irrespective of the site. The dipper was lowered gently at an angle of 45° to avoid disturbance of the water, this enable larvae to flow into the dipper, the dipper is then raised gently to avoid water spillage, and different mosquito larvae were estimated per dip. Mosquito larvae were also sampled using 5 ml graduated pipettes from water bodies, which were too shallow for use of the standard dippers. For small habitats such as hoof prints, several hoof prints were pooled to get the required sample volume. Quantitative sampling from small habitats may overestimate larval density as compared to large habitats since larvae may not escape in small habitats where whole water can be sampled. Five to ten dips were made in each of the habitat types examined for mosquito larvae, depending on the habitat size [15]. The larvae collected were then transferred into a well labelled 1000 ml container, this was to facilitate moving from one habitat type to another within the communities. Larvae were collected from rice field, tree holes, containers, swamp, drainages, rock pools, river beds marshy area, foot prints, ponds and animal hoof prints. The larvae collected were then transferred into a jerry-can and transported to the insectary for adult emergence.

4.4. Mapping of Mosquitoes Breeding Habitats

When a sampling point was selected along a channel, its location was recorded using Global Positioning System (GPS) software. The coordinates of the habitats containing mosquito larvae were later incorporated into a geographic information system (GIS). GIS tool was used to estimate the distance from the breeding sites to human habitation in order to evaluate the relevance of mosquito abundance and distribution in the study area.

4.5. Rearing of Larvae to Adults

Cages were arranged and marked according to the 29 villages. The larvae collected from the field in each community were distributed into smaller rubber plates and kept into the cage, the larvae were fed with compounded biscuit and yeast twice a day from the day of collection. Introduction of yeast was to enable the growth of phytoplankton and zooplankton thereby enriching the water body to enhance larval growth and development [1].

4.6. Identification of Mosquito Larvae

All mosquito species sampled from various sites were morphologically identified using a dissecting microscope and standard identification keys [13,16,17].

4.7. Statistical

Data obtained was analyzed using SPPS software version 27. Proportions of variables were compared using Pearson's Chi-square test. Statistical value at $P < 0.05$ was considered significant.

5. Results

5.1. Composition and Distribution of Mosquitoes Larvae across Breeding Sites

During the survey, all ostensibly probably breeding sides were sampled. A total of 1,493 mosquito larvae were collected from 17 habitat types made up of 61 breeding points across 29 villages in this study as shown in Table 1 and well mapped out (Figure 1). The highest number of larvae was collected in riverbed 624 (41.80%) followed by pond 325 (21.77%), rock pool 141 (9.44%), riverbank 107 (7.17%), under bridge 81 (5.43%), ditch 72 (4.82%), swamp 39 (2.61%), hoof prints 32 (2.14%), puddle 25 (1.67%), marshy ground 17 (1.14%), container 16 (1.07%), rice field 13 (0.87%), foot prints1 (0.07%), while the apparently potential breeding sites surveyed that had no catch 0 (0.00%) were drainages, wood pool, tyre and pot water respectively. Thus, mosquito larval abundance between breeding sites showed a very high significant difference ($\chi^2 = 114.22$, df = 16, P = 0.0001). Plates 1a and 1b shows the natural and artificial mosquito breeding sites surveyed. Table 2 shows the populations of mosquito groups in each breeding habitat. The overall dry season larval composition favored the culicine 1285 (86.07%) over anopheline 208 (13.93%). The mean abundance of less than 10 anopheline and over 40 culicine was recorded as shown in Figure 2.

Table 1: Checklist of dry season mosquito breeding sites in Akun development area of Nassarawa Eggon LGA, Nasarawa State, Nigeria.

Community	Habitat Types																	Total (%)
	River Bed	Rock Pool	Pond	Under Bridge	Hoof Prints	Ditch	Container	Drainage	Foot Prints	Swamp	Puddle	Wood Pool	Marshy Ground	Tyre	Rice Field	Pot Water	River Bank	
Agba	-	-	26	-	-	-	-	-	-	-	-	0	-	-	-	-	-	**26 (1.74)**
Akwaji	-	-	-	-	-	-	-	-	-	30	-	-	-	-	-	-	-	**30 (2.01)**
Alushi Erro	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0 (0.00)**
Alushi Wakyuku	-	-	-	-	-	-	-	0	-	-	25	-	-	-	-	-	-	**25 (1.67)**
Angwanali	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0 (0.00)**
Angwantsoko	-	-	-	-	2	0	16	0	-	9	-	-	-	-	-	-	-	**27 (1.81)**
Apkata	-	-	-	-	-	-	-	0	-	-	-	-	-	-	13	-	-	**13 (0.87)**
Atamakolashe	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0 (0.00)**
Ekumale	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0 (0.00)**
Endehu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27	**27 (1.81)**
Kagbuendehu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	**40 (2.68)**
Kagbuerro	-	-	32	-	-	-	-	-	-	-	-	-	17	-	-	-	-	**49 (3.28)**
Kagbuwulko	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0 (0.00)**
Lamis	-	-	34	-	-	-	-	-	-	-	0	-	-	-	-	-	-	**34 (2.28)**
Lapkagaji	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0 (0.00)**
Ngamaka	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**4 (0.27)**
Ngowa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0 (0.00)**
Ola	-	-	-	-	-	72	0	-	-	-	-	-	-	-	-	-	-	**72 (4.82)**
Ongreenkuje	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0 (0.00)**
Ongretsa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0 (0.00)**
Pkawuna	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0 (0.00)**
Pkawunalashe	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0 (0.00)**
Sabon Gida Asse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0 (0.00)**
Ube	-	-	-	-	-	-	-	0	1	0	-	-	-	-	-	-	40	**41 (2.75)**
Wa'ayi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0 (0.00)**
Wagenku	624	141	229	81	30	0	-	-	-	-	-	-	-	-	-	-	-	**1105 (74.01)**
Wagenshe	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0 (0.00)**
Washo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0 (0.00)**
Wulko	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0 (0.00)**
Total (%)	**624 (41.80)**	**141 (9.44)**	**325 (21.77)**	**81 (5.43)**	**32 (2.14)**	**72 (4.82)**	**16 (1.07)**	**0 (0.00)**	**1 (0.07)**	**39 (2.61)**	**25 (1.67)**	**0 (0.00)**	**17 (1.14)**	**0 (0.00)**	**13 (0.87)**	**0 (0.00)**	**107 (7.17)**	**1,493**

Breeding sites absent in the community; 0: Potential breeding sites present in the community but no larvae was found.

Figure 1: Mapped out mosquitoes larvae breeding habitats in Akun development area, Nassarawa Eggon LGA, Nasarawa State, Nigeria.

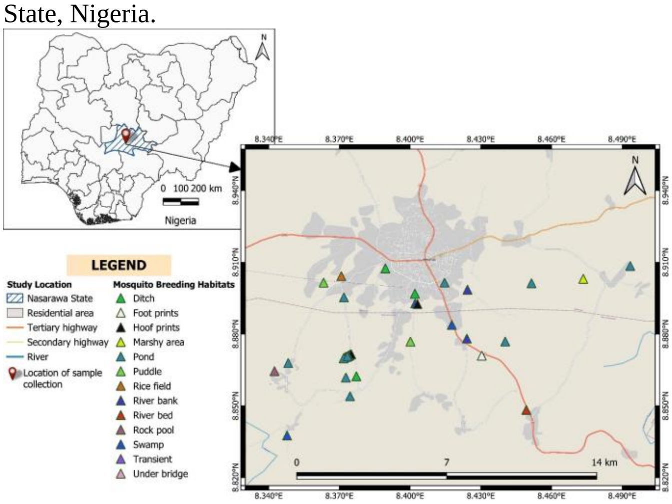
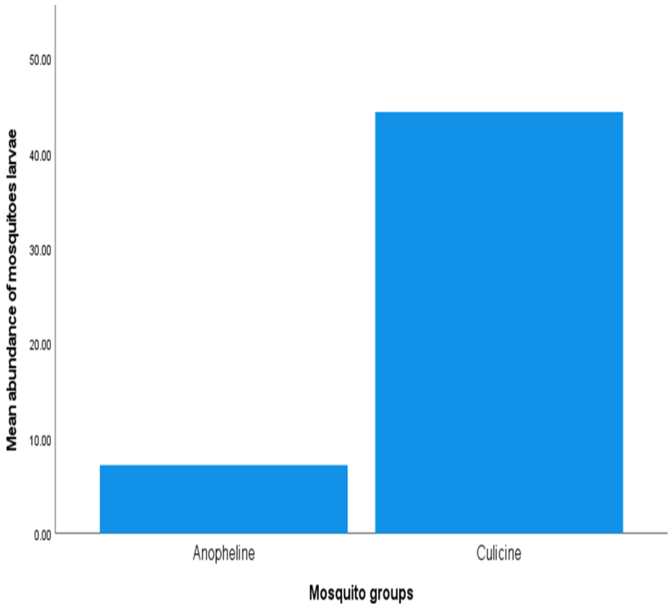


Plate 1a: Natural mosquito breeding sites found in akun development area.

Plate 1b: Artificial mosquito breeding sites found in Akun development area.

Figure 2: Dry season mean abundance of mosquito larvae in akun development area, Northern part of Nasarawa State, Nigeria.



5.2. Abundance of Mosquito Larvae in Relation to Communities

Table 3 shows the distribution of mosquito larvae across communities within the study area. Mosquito larval abundance between communities showed a high significant difference (χ^2 = 1509.1, df = 28, P = 0.0001). The highest number of larvae was recorded in Wagenku, 105 (74.01%) followed by Ola 72 (4.82%), Kagbuerro 49 (3.28%), Ube 41 (2.75%), Kagbuendehu 40 (2.68%), Lamis 34 (2.28%), Akwaji 30 (2.01%), Angwantsoko and Endehu recorded 27 (1.81 %) larvae each followed by Agba 26 (1.74%), Alushiwakyuku 25 (1.67%), Apkata 13 (0.87%) and Ngamaka 4 (0.27%), while Agwanali, Sabongidaasse, Ekumale, Wageshe, Alushierro, Pkawuma, Pkawumalashe, Washo, Atamakolashe, Wa'ayi, Ungretsa, Ngowa, Lakpagaji, Ongreenkuje, Kagbuwulko and Wulko had no mosquito larvae. Communities within the study area that had no breeding sites during the survey were tagged NBS (no breeding site(s)).

Table 2: Population of mosquito groups in relation to breeding sites.

Breeding Site	No. of Points	Larval Abundance Across Mosquito Groups		Total (%)
		Anopheline	Culicine	
Riverbed	8	41	583	**624 (41.80)**
Rock Pool	3	11	130	**141 (9.44)**
Pond	12	42	283	**325 (21.77)**
Under Bridge	1	0	81	**81 (5.43)**
Hoof Prints	2	3	29	**32 (2.14)**
Ditch	3	14	58	**72 (4.82)**
Container	3	0	16	**16 (1.07)**
Drainage	14	0	0	**0 (0.00)**
FootPrints	1	1	0	**1 (0.07)**
Swamp	3	27	12	**39 (2.61)**
Puddle	3	7	18	**25 (1.67)**
Wood Pool	1	0	0	**0 (0.00)**
Marshy Ground	1	11	6	**17 (1.14)**
Tyre	1	0	0	**0 (0.00)**
Rice Field	1	8	5	**13 (0.87)**
Pot Water	1	0	0	**0 (0.00)**
Riverbank	3	43	64	**107 (7.17)**
Total (%)	**61**	**208 (13.93)**	**1,285 (86.07)**	**1,493**

5.3. Abundance of Mosquito Larvae along Gradient

The gradient 101-150 m had the highest number of mosquito larvae 608 (40.7%) collected from 13 (21.31%) habitats which spread across anopheline 43 (20.67%) and culicine 565 (44.00%) followed by 51-100 m with 572 (38.3%) mosquitoes larvae from 14 (22.95%) habitats divided into anopheline 55 (26.44%) and culicine 517 (40.23%) then 0-50 m which had 25 (40.98%) habitats containing 146 (9.8%) larvae which spread into 40 (19.23%) and 106 (8.25%) for anopheline and culicine groups, respectively, 251-300 m had 133 (8.9%) mosquitoes larvae collected from 5 (8.197%) habitats which spread across anopheline 51 (24.52%) and 82 (6.38%) for culicine larvae, 351-400 m with total of 30 (2.0%) mosquitoes larvae from only 1 (1.639%) habitat which spread across 18 (8.65%) and 12 (0.93%) for anopheline and culicine groups, respectively, whereas 151-200 m had the least number of larvae (4, 0.3%) from 3 (4.92%) habitats they spread across anopheline 1 (0.48%) and culicine 3 (0.23%) as shown in Table 4. Therefore, the mosquito's larval abundance in relation to gradients showed a high significant difference (χ^2 = 376.82, df = 8, P = 0.0001).

Table 3: Mosquito larval abundance in relation to communities and culicidae groups.

Community	Anopheline	Culicine	Total No. of Larvae (%)
Wagenku	68	1037	**1105 (74.01)**
Ube	12	29	**41 (2.75)**
Angwanali (NBS)	0	0	**0 (0.0)**
Sabon Gida Asse (NBS)	0	0	**0 (0.0)**
Ekumale (NBS)	0	0	**0 (0.0)**
Angwantsoko	11	16	**27 (0.0)**
Lamis	0	34	**34 (2.28)**
Wagenshe (NBS)	0	0	**0 (0.0)**
Ola	14	58	**72 (4.82)**
Apkata	8	5	**13 (0.87)**
AlushiWakyuku	7	18	**25 (1.67)**
Alushi Erro (NBS)	0	0	**0 (0.0)**
Pkawuma (NBS)	0	0	**0 (0.0)**
Pkawumalashe (NBS)	0	0	**0 (0.0)**
Washo (NBS)	0	0	**0 (0.0)**
Akwaji	18	12	**30 (2.01)**
Atamakolashe (NBS)	0	0	**0 (0.0)**
Agba	7	19	**26 (1.74)**
Wa'ayi (NBS)	0	0	**0 (0.0)**
Ongretsa (NBS)	0	0	**0 (0.0)**
Ngamaka	1	3	**4 (0.27)**
Kagbuerro	30	19	**49 (3.28)**
Ngowa (NBS)	0	0	**0 (0.0)**
Lapkagaji (NBS)	0	0	**0 (0.0)**
Ongreenkuje (NBS)	0	0	**0 (0.0)**
Kagbuwulko (NBS)	0	0	**0 (0.0)**
Kagbuendehu	19	21	**40 (2.68)**
Endehu	13	14	**27 (1.81)**
Wulko (NBS)	0	0	**0 (0.0)**
Total	**208**	**1,285**	**1,493**

NBS: No Breeding Site(s); χ^2 = 1509.1, df = 28, P = 0.0001.

5.4. Composition of Emerged Adult Mosquitoes from Field Cultured Larvae

Out of 1,493 larvae that were collected and reared, only 1,215 (81.38%) larvae emerged as adults which spread across four genera in order of dominance: *Culex quinquefasciatus* 1,085 (89.30%) > *Aedes aegypti* 83 (6.83%) > *Anopheles* species 42 (3.46%) > *Mansonia uniformis* 5(0.41%) as shown in Table 5.

6. Discussion

This study observed mosquito larval heterogeneity in habitats across the 29 selected communities within Akun Development Area in Nassarawa Eggon LGA of Nasarawa State, Nigeria. This non-random distribution suggests that there are differences in the water body's dynamics among habitats, suggesting that some environmental variables such as nutrients, habitat dehydration, physical features and social interactions could influence the distribution and aggregation patterns of mosquito larvae. This is in accordance with the findings of Lapang, et al. [1] whose studies on culicidae larvae showed heterogeneity across the 5 habitat types within Shendam LGA., Plateau State, Nigeria. Similarly, studies by Wilke, et al. [18], Bashar, et al. [19] and Emidi, et al. [20] showed mosquito larval habitats heterogeneity in Bangladesh, Tanzania and Florida respectively. Also, Novak, et al. [21], Carrieri, et al. [22], Costanzo, et al. [23], Daniels, et al. [24] and Marini, et al. [25] reported the co-existence of culicine larvae in their respective locations. On the other hand, Devi and Jauhari [26] and Impoinvil, et al. [27] reported that anopheline and culicine immature were found to have an aggregated distribution within the different habitat types.

The great variation observed in larval abundance between culicine and anopheline mosquitoes could indicate that the habitat types studied possibly supports more of the culicine mosquito during the late dry season period. This agrees with the findings of Awolola, et al. [2] and Wilke, et al. [18] who reported a significant difference in mosquito larval abundance in Lagos, south-western Nigeria and in urbanized areas of Miami-Dade County of Florida, USA., respectively, but contradicts the findings of Emidi, et al. [20] and Lapang, et al. [1] whose studies showed no significant variation in mosquito larval abundance between the two groups in Muheza, Tanzania and Shendam L.G.A., Plateau State, Nigeria respectively. Culicine larvae showed higher abundance over anopheline larvae on the average which clearly indicate that culicine spp. larvae have a greater degree of adaptability to different habitats types than anopheline larvae. This agreed with the findings of Dida, et al. [28] and Lapang, et al. [1] who had similar observations but contradict the findings of Emidi, et al. [20] who recorded higher anopheline larvae than culicine larvae.

Our finding in this study showed that river bed habitat had preponderance of mosquito larvae 624 (41.80%) over other habitat types. This could be possibly be attributed to availability of water along first order rivers as at the course of this research which took place during the late dry season period. This relates with the finding of Gabriel, et al. [29] who reported that the highest population of mosquito larvae productivity was observed in drying streams in Kenya and Tanzania. However, our finding disagrees with the work by Hudson, et al. [30] who accounted that pond and stream habitats in Uganda had the highest mosquito larvae productivity. The apparently potential breeding sites surveyed in this research that had zero larval catch were drainages, wood pool, tyre and pot water habitats, respectively. This may be linked to frequent disturbance activities that was observed in these habitats.

Location-wise, majority of the mosquito in Akun Development Area prefer to breed in Wagenku village. This may possibly be due to favourable microclimatic conditions in the area over other the study locations. Also, it may most likely be due to anthropogenic activities in Wagenku community which supports and creates a verse number of breeding points, thus resulted in high larval abundance. This in-turn agrees with the findings of Lapang, et al. [1] and Wilke, et al. [18] who recorded a great variation in mosquito larval abundance in relation to neighborhoods in Plateau State, Nigeria and Florida, USA, respectively.

The four mosquito species obtained among the emerged adults possibly suggests the presence of disease-vectors that can likely give rise to the transmission of mosquito-borne infections in the area. This study agrees with Lapang, et al. [1] who reported 17 mosquito species that emerged from wild field reared larvae in a lowland area of Plateau State, Nigeria. Similarly, adult mosquito collection by Ombugadu, et al. [31] in Nassarawa Eggon LGA of Nasarawa State affirms the three species of the four species found in this study. Furthermore, Omar, et al. [32] in an assessment of mosquito larval habitats in Katagum LGA, Bauchi State, Nigeria reported four mosquito species from emerged adults.

Table 4: Mosquito larval abundance along gradients.

Distance Range Along Gradient (m)	No. of Habitats (%)	Mosquito Group Abundance		Total No. of
		Anopheline (%)	Culicine (%)	Larvae (%)
0-50	25 (40.98)	40 (19.23)	106 (8.25)	**146 (9.8)**
51-100	14 (22.95)	55 (26.44)	517(40.23)	**572 (38.3)**
101-150	13 (21.31)	43 (20.67)	565 (44.00)	**608 (40.7)**
151-200	3 (4.92)	1 (0.48)	3 (0.23)	**4 (0.3)**
201-250	0 (0.00)	0 (0.00)	0 (0.00)	**0 (0.00)**
251-300	5 (8.20)	51 (24.52)	82 (6.38)	**133 (8.9)**
301-350	0 (0.00)	0 (0.00)	0 (0.00)	**0 (0.00)**
351-400	1 (1.64)	18 (8.65)	12 (0.93)	**30 (2.0)**
401-450	0 (0.00)	0 (0.00)	0 (0.00)	**0 (0.00)**
Total	**61**	**208**	**1,285**	**1,493**

χ^2 = 376.82, df = 8, P = 0.0001.

Table 5: Checklist of emerged adult mosquitoes from field cultured larvae.

Habitat	Species				No. of Emerged Adults
	Anopheles species	*Culex quinquefasciatus*	*Aedes aegypti*	*Mansonia uniformis*	
Riverbed	5	499	12	0	**516 (42.47)**
Rock Pool	0	108	16	0	**124 (10.21)**
Pond	6	234	19	5	**264 (21.73)**
Under Bridge	0	77	0	0	**77 (6.34)**
Hoof Prints	2	25	0	0	**27 (2.22)**
Ditch	4	50	7	0	**61 (5.02)**
Container	0	8	8	0	**16 (1.32)**
Drainage	0	0	0	0	**0 (0.00)**
Foot Prints	0	0	0	0	**0 (0.00)**
Swamp	12	12	0	0	**24 (1.98)**
Puddle	1	18	0	0	**19 (1.56)**
Wood Pool	0	0	0	0	**0 (0.00)**
Marshy Ground	2	4	2	0	**8 (0.66)**
Tyre	0	0	0	0	**0 (0.00)**
Rice Field	3	3	2	0	**8 (0.66)**
Pot Water	0	0	0	0	**0 (0.00)**
Riverbank	7	47	17	0	**71 (5.84)**
Total (%)	**42 (3.46)**	**1,085 (89.30)**	**83 (6.83)**	**5 (0.41)**	**1,215**

7. Conclusion

This study found that rock pools, ponds, containers, rice fields, drying or slow moving streams with low water levels, sections of exposed river beds, aggregation of water under bridge, river bank, and swampy areas were widely distributed across communities in Akun Development Area in Nassarawa Eggon LGA, Nasarawa State, Nigeria, which are particularly and potentially ripe for the development of mosquito larvae compared to other habitat types. These habitats are critical breeding grounds to look out for in Northern part of Nasarawa State during the dry season period because they may play an important role in local malaria transmission and other mosquito-borne diseases. Anopheline and culicine mosquito larvae were found co-existing in the habitats throughout the breeding sites. Mosquitoes survey should be carried out in the wet season period so as to have a complete and comprehensive record of their spatial distribution in the area. Inhabitants of the area should always clear stagnant water bodies so as to limit mosquito breeding success. Lastly, individuals should employ the use of long-lasting insecticidal mosquito treated bed nets so as to prevent human-vector contact.

8. References

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