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# Assessment on the diversity of mosquitoes found in dumpsites of Gashua *metropolis*, bade local government area, Yobe state, north-Esatern, Nigeria

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**Abstract**
The study on the assessment on the diversity of mosquitoes found in dumpsites of Gashua metropolis was carried out from the period of May to August, 2019. A total of one hundred and fifteen (115) mosquito larvae and one hundred and sixty two (162) adult mosquitoes from five different sites were identified. For the mosquito larvae, *Culex* species has a total percentage of 66.96%, *Anopheles* species has 26.09% and *Aedes*species has the least percentage of 6.95%. However the male and female mosquito's species were also identified from the adult's samples collected and culex male has a percentage of 16.67%, *Culex* female has a percentage of 38.27%, anopheles female has a percentage of 29.01% and anopheles male species has the least percentage of 16.05%. However, out of the total samples of mosquito's larvae and adults collected, *Culex* species has the highest percentage in all the sampling sites and Aedes species has the least percentage, this shows that dominating mosquito species found in Gashua metropolis are the *Culex* mosquito species.

**Keywords:** assessment, mosquitoes, dumpsites, Gashua *metropolis*

## Introduction
The continued function and survival of any human society is dependent, for a large extent on its adaptability and resilience to environmental events (Young and Berlaut, 2006). As globalization accelerates the rate and spatial scale of human environment interacting, the distinction between natural and man-made disasters becomes blurred (Pezzzoli and Turkey, 2007) [32]. The human environment interaction had led to the modification of landscapes in a process called urbanization and thus has greatly impacted on the health of the environment and not humanization. Some authorities argue that exposure to different sources of pollution can aggravate health problem especially among the most vulnerable group (Gren *et al.*, 2001; Wang *et al.*, 2006 and Blatia, 2009) [41]. Others specifically posit that waste dumps could provide conditions in which disease vectors could persist and reproduce (Weidong *et al.*, 2006; Sogoba *et al.*, 2007) although this depends o waste constituent, environmental conditions, age of the dumps and waste management practices (Tony, 1978; Swan *et al.*, 2002) [39].

Mosquitoes are viscous biters and their bite constitute biting nuisance, allergic reactions, slain irritations, scratching restlessness and sleepless nights (Amusan, *et al.*, 2005; Onyido *et al.*, 2009) [3, 26]. Some bite during the day while others bite at the night or at both night and day periods. Through their blood sucking habits, they act as vectors of a variety of human pathogens including viruses, bacteria, protozoa and helminthes diseases. They transmit to man such deadly disease as malaria, yellow fever, filariasis, dengue and various forms of viral encephalitis (Ulapai and Ajolau, 2003), the anopheles mosquitoes especially, *Anopheles gambiae*, transmit malaria and filariasis. The aedes mosquito particularly *Aedes aegypti*, albopictus, Ae africaplus, Ae luteocephalis and *Ae. simponi* transmit yellow fever, dengue, haemarlagi fever and various forms of viral encephalitis. The *Culex* mosquito particularly culex quingufasciatus are very important transmitters of *filarial worms* especially *Wuchereria* which causes elephantiasis. They also transmit various forms of viral encephalitis (Onyido *et al.*, 2009) [27].

Mosquitoes also bite livestock and transmit some disease of veterinary importance like fowl pee disease of poultry, myxomatos of rabbits, sift valley fever of sheep, encephalitiees of horses and heat worm disease of dogs (Service, 1980) [33]. All these medical and somatic disease cause high death toll on both human and animal populations and lead to poor socio economic development of many countries.

Mosquitoes which are strong fliers with long, stylet shaped proboscis for piercing the skin of their hosts and sucking bood are majorly responsible for causing malaria infection, hunting for their hosts both indoors and outdoors (Gordon and Lavoipiene 1976). This disease is caused by the bite of an infected female Anopheles mosquitoes which transmit the lasmodium sporozoite into the human blodstrea, fromthere it travelsl to othe liver, where it grows and multiplies from a period of 8 days to seven months and even years (Afolabi, 2006) [22].

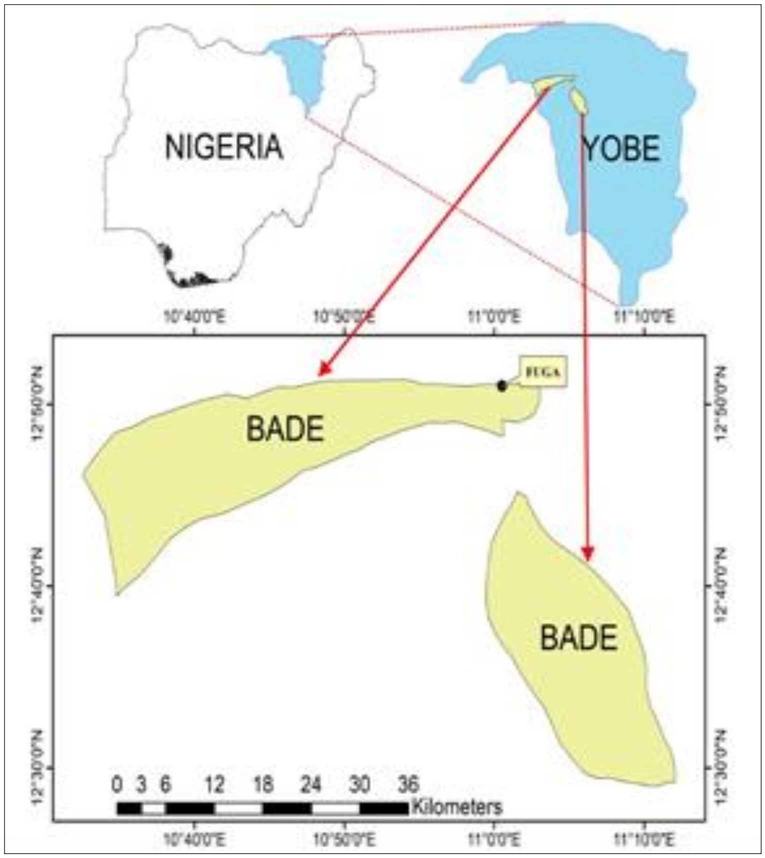


**Fig 1**

Malaria vectors are female mosquitoes in the genus anopheles because they support the sporogonic development of human malaria parasites (Brier *et al*., 1998). Worldwide there are over 500 species of anopheles mosquitoes, but fewer than 50 are considered competent malaria vectors. Many vector species are polymorphic. In some cases, sharply contrasting forms are found in different geographic areas or in differing ecological circumstances and one population may be of much greater importance as a malaria vector than its subtle differing neighbour. A number of studies have investigated that incidence of malaria all over the world (Gerritsen *et al.*, 2008) [9] it is estimated that the annual death resulting from this disease is between 1.1 and 2.7. Million people out of which over one million are children under the age of five in the sub-saharan Africa (Snow, 1997; Ikhisemoge, 2006; Moorthy *et al.*, 2007 and Killan *et al.*, 20017) [37, 13, 22]. Much attention was focused on the pregnant women and children due to their high vulnerability and exposure to conditions that cause malaria, added to the increasing resistance of malaria parasite to modern drugs (Hemingway, 1999; Jumbo *et al.*, 2001 and Orasanya *et al.*, 2007) [12, 15, 28]. Malaria is holoendemic in Nigeria as high intensity transmission occurs all year round, with rates of transmission higher in the wet season than in the dry season, and with more victims in the southern than in the Northern part. (Okogun, 2003) [24], there is limited evidence from the results of all these studies to suggest that the breeding and multiplication of mosquitoes on solid waste dumps can lead to increase in the incidence of malaria.

## Materials and Methods

### Study Area

**Gashua** is one of the Local Government areas situated on coordinates latitude and longitude in Yobe North Zonal District of Yobe State, Nigeria. Yobe State is one of the Six States that makes up the states of the North East Nigeria. The Study area falls within the tropical dry climate region on the desert area. The economy of the area is predominantly agrarian and fishing in the first instance but fast changing because of the transformation of the water log in the area. The level of Sanitation in the area is very poor as no artificial drainage system exist, indiscriminate refuse and sewage disposal and bushy environments: all these serve as breeding sites for mosquitoes (Ifatimehin & Musa, 2009).

### Collection of sample

Mosquito larvae were captured using a dipper with telescoping handle by dipping the dipper in the located area. The larvae were placed in a container that was labeled base on the located areas of sample collection and taken to the laboratory for further processing.

### Processing, Examination and Identification of Mosquitoes species

The study sample (Mosquitoes) were processed by making a protective larvae cage in the laboratory and placing the containers inside under favourable environmental condition where the larvae were fed and control in order to grow.

The study was done by carrying out a wet preparation of the sample under X10 or X40 lens objective of the microscope. Illumination by transmitted light was adjusted so that the glands will show up clearly against the background. A shute's needle was held in the left hand and placed flat across the thorax. Very gentle pressure was exerted which caused the two trilobed salivary glands to pop out from the end of the neck. It may also be accompanied by fat globules, some muscle fibres and other tissues. When the glands were located under X10 objective lens of the microscope, it was freed from the debris and pulled to the edge of the slide. A drop of saline solution was added and a cover slip was gently placed on it. The glands were pressed down on the cover slip with a dissecting needle. The ruptured gland was then examined under X40 objective lens of the microscope for the sickle-shaped motile sporozoites.

The Mosquitoes were identified microscopically with the aid of published keys by Hopkin (1952). Similarly, the taxonomic keys of (Gillies and De Meillon, 1968; Gillies and Coetzee, 1987) were used to identify the various 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.

## Results

### Mosquitoes examined

From the sample collected, One hundred and fifteen (115) mosquito larvae were obtained from five sites: zangon Kanwa, Katuzu, federal university Gashua, Sabon Gari and Bakin Kasuwa. And 162 adult mosquitoes were also obtained from the sites.

### Percentage occurence of different Mosquitoes species

From the five (5) sampling sites, in Zangon Kanwa, culex spp had the highest percentage of 11.30% while *Aedes* spp had the lowest percentage of 2.69%. From bakin kasuwa, culex recorded the highest percentage of 13.04% while Aedes had the lowest of 1.74%. The highest percentage of 13.91% in sabon gari was recorded by culex spp while Aedes spp was not found in this sites from katuzu and federal university Gashua, cukex recorded the highest percentage of 15.65% and 13.04% respectively, while Aedes recorded the lowest in both sites.

**Table 1:** Percentage of different mosquito species from Five (5) Sites

| Species of mosquitoes | Zangon kanwa | Bakin kasuwa | Sabon gari | Katuzu | Federal university |
|---|---|---|---|---|---|
| Culex | 13(11.3%) | 15(13.04%) | 16(13.91%) | 18(15.65%) | 15(13.04%) |
| Anopheles | 4(3.48%) | 7(6.09%) | 6(5.22%) | 2(1.74%) | 11(9.57%) |
| Aedes | 3(2.69%) | 2(1.74%) | 0(0%) | 2(1.74%) | 1(0.87%) |

### Total

From the result in table 2, the highest percentage of larvae from the overall sampling sites was recorded by culex spp 66.96% while Aedes had the lowest percentage of 6.95%

**Table 2:** Percentage occurrence of different mosquito species Larvae

| Species of Mosquitoes | Frequency | Percentage |
|---|---|---|
| Culex | 77 | 66.96% |
| Anopheles | 30 | 26.09% |
| Aedes | 8 | 6.95% |

### Percentage of occurrence of male and female mosquito's species

From the five (5) sampling sites, in zangon James the culex female app has the highest percentage of 7.41% while culex male has the lowest percentage of 3.09%. From bakin kasuwa culex female has the highest percentage of 8.64% while anopheles and culex males has the lowest percentage of 3.09% each. Also, in sabon gari culex female has the highest percentage of 6.79% while male anopheles has the lowest percentage of 1.85%. In katuzu, the female culex has the highest percentage of 8.64% while the male culex has the lowest percentage of 1.85%. In federal university Gashua, female culex has the highest percentage of 6.79% while the male anopheles has the lowest percentage of 4.32%.

**Table 3:** Percentage occurrence of male and female mosquito species

| Mosquitoe Species | Zangon Kanwa | Bakin Kasuwa | Sabon Gari | Katuzu | Federal University |
|---|---|---|---|---|---|
| culex male | 5(3.09%) | 5(3.09%) | 6(3.70%) | 3(1.85% | 8(4.94%) |
| Culex female | 12(7.41%) | 14(8.64%) | 11(6.79%) | 14(8.64%) | 11(6.79%) |
| Anopheles male | 6(3.70%) | 5(3.09%) | 3(1.85%) | 5(3.09%) | 7(4.32%) |
| Anopheles female | 8(4.94%) | 12(7.41%) | 8(4.94%) | 9(5.56%) | 10(6.17%) |

From the result in table 4. The highest percentage of male and female mosquito's species from overall sampling sites was recorded by female culex species with 38.27%. While anopheles male had the lowest percentage of 16.05%.

**Table 4:** Total percentage of Male and Female Mosquito species five in the Five Sites

| Mosquito Species | Frequency | Percentage |
|---|---|---|
| culex male | 27 | 16.67% |
| Culex female | 62 | 38.27% |
| Anopheles male | 26 | 16.05% |
| Anopheles female | 47 | 29.01% |

## Discussion

This study involved the systematic sampling of mosquitoes from five sites of Zangon Kanwa, Bakin Kasuwa, Sabon Gari, Katuzu, and federal university Gashua. Our sampling during this rainy season further supports studies that have shown the widespread distribution of Anopheles spp, Aedes spp and Culex spp. (Causton *et al.,*. 2006, Bataille *et al.*, 2012, Asigau *et al.,*. 2017. Generally, abundances of all species decreased with elevation and at least for *Culex* spp mosquito abundances were mainly concentrated but not limited to coastal low elevations. For both species, abundances of mosquitoes were very high in the Gashua metropolis. However, the widespress of culex spp, anopheles spp and Aedes spp shows that there are favourable climatic and environmental conditions

Necessary for the survival and growth of mosquitoes in the area. Thus, it is possible that wind (LaPointe 2008, Freed and Cann 2013) and human-aided transportation could be aiding their dispersal and widespread to other areas close to the Gashua metropolis. It is therefore no surprise that Culex spp favors such habitats associated with human populations given its preference for fresh stagnant rain water collected in old tires, ditches, drains, tanks, or containers, which are essential for larval development (Teng *et al*., 1999).

Abiotic factors, particularly precipitation, influence mosquito distribution and abundance (Ahumada *et al*., 2004, Reisen *et al.*, 2008). Mosquito abundance is an important component of vector capacity and the basic reproductive rate (Ro) (Moller-Jacobs *et al.,* 2014). Therefore, high mosquito abundances may be an indicator for disease hotspots. Since mosquitoes require water bodies to ovipost eggs and for larvae to develop, their abundances and distributions should covary with precipitation. For instance, abundances of Cx. tarsalis in certain regions of California are positively correlated with total precipitation (Reisen *et al.,*. 2008). Precipitation has also been found to increase abundances of mosquitoes in arid environments by providing standing water habitats that were not previously available (Vasconcellos *et al*., 2010). Even in semi-drought conditions, such as wetlands that dry out during drought periods, mosquito abundances flourish following increased precipitation. Dry conditions eliminate mosquito predators and competitors that generally take longer to colonize shared mosquito habitats, thereby allowing habitat generalist and opportunist species such as mosquitoes to quickly re-colonize wetlands following drought periods (Chase and Knight 2003). However, increased precipitation from extreme rainfall events can also result in mosquito mortality by flooding standing water and thereby reducing ideal aquatic habitats required for larval development (LaPointe *et al*. 2012). Both Ae. taeniorhynchus and Cx. quinquefasciatus larvae feed on microorganisms and detritus and increased precipitation may dilute or flood these water bodies, making them less favorable for mosquitoes. Results from our analysis did not find any association between precipitation and mosquito abundances. Even though this result may seem inconsistent with the biology and development of mosquitoes, it is not surprising given the mixed results of effects of precipitation on mosquito abundance found in other studies (DeGaetano 2005, De Little *et al*. 2009, Roiz *et al*. 2010, Dieng *et al*. 2012, Bashar and Tuno 2014). 2The presence of mosquitoes in the sites is not surprising given these sites are in an agricultural and human-inhabited town.

High relative humidity can maintain basic survival rates of mosquitoes and induce high hatching rates (Nielsen and Nielsen 1953, Pedrosa *et al*. 2010). High humidity can increase mosquito survival (Clements 2011) but could also be an indication of incoming rainfall which could affect larval growth, larval development, mosquito dispersal, and ovipositing positively or negatively, depending on the intensity of precipitation. At the other extreme, eggs laid at low humidity are highly likely to desiccate and adult mosquito longevity is decreased (Wigglesworth 1972, Day 2016). Thus, experimental research on mosquito's response to extreme weather conditions and how this may influence disease transmission is needed. Many studies have shown the importance of temperature in larval development, adult dispersal and lifespan, and disease transmission (Moore and Bickley 1966, Nayar 1967, 1972, Day 2016). Under controlled environments, mosquito species eggs readily hatch when exposed to summer temperatures of 23° C (75° F) for a week, although mature embryos can undergo facultative diapause when winter temperatures drop as low as −10° C (14° F) (Moore and Bickley 1966). The time period spent during the pupal stage was inversely proportional to temperature. For example, the duration of the pupal stage at 20.8° C is 61 h and 37 h at 29° C (Nielsen and Haeger 1954), and adult lifespan of females significantly declines when temperatures reach a high of 32° C (Nayar 1972). A particularly important effect of temperature is its influence on the incubation of parasites such as avian malaria. Temperatures for sporogonic development of Plasmodium species occurs at 16 to 30° C and ideally at 28 to 30° C. This means that lower elevations are likely to have temperatures that would encourage the growth of Plasmodium parasites in competent arthropod vectors, although temperatures higher than 30° C may be lethal and temperatures below 16° C may inhibit parasite development (LaPointe 2000).

## Conclusion

The study is one of the evidence that support the argument that exposure to unsanitary environment such as waste dumps, can contribute to urban public health and survival of pathogen of related diseases. It is of public health concern because most of the species of mosquitoes encountered have been incriminated in the transmission of one form of disease or the other. The case study is nonetheless, a clear demonstration that accumulation of solid wastes in proximity to residential areas constitutes a pathway of many vector based diseases including malaria. There is great need to further explore the waste-malaria padigm in environmental health studies with the view to developing new strategies for intervention and prevention of this disease. Ultimately, the promotion of the urban cleanliness and effective management of municipal wastes may be the most sustainable strategies to "Roll Back Malaria" in Nigerian urban areas in the years ahead. Most efforts of government towards the controlling of the vector of malaria are yet yield a positive results, and to achieve this, a detailed ecological knowledge of these mosquitoes will be of great assistance especially at the local levels.

## Recommendations

Gashua town is an endermic zone for the spread of mosquitoes and therefore the following recommendations are proposed:

a. Identifying the sibling species of the mosquitoes
b. Carefully locating and identifying their breeding sites
c. Regular and frequent sanitation exercises such as clearing of bushy environments, and proper waste disposal should be encouraged.
d. Adequate fundings to all levels of government for proper mosquito control.
e. Ecological knowledge and behaviour of the vectors of malaria would greatly assist in their total eradication. This is because the source from which malaria vectors disperse may change seasonally within the year as breeding sites

dry out or are created (Carter and coluzzi, 2013). This information calls for all stake holders involved in the concerted effort of malaria vector control to pay particular attention to the indigenes of Gashua in Bade L. G. A in order to come up with measures that will ensure little risk of exposure to malaria infection.

f. Mass awareness of personal hygiene should be created via the media (Radio. IV. Bill boards, Newspaper, etc).

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