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RELATIVE ABUNDANCE AND DISTRIBUTION OF ADULT SPECIES OF THE *ANOPHELES GAMBIAE* COMPLEX IN UNIVERSITY OF ABUJA STAFF QUARTERS, GIRI ABUJA FCT, NIGERIA

***Madara A. A.[1] and Ebuzoeme V.[1]**

1 Department of Biological Sciences
Faculty of Science
University of Abuja, P.M.B. 117, Abuja FCT Nigeria
* Corresponding author e-mail: alhajimadara@yahoo.com

ABSTRACT
A study on the distribution and abundance of *Anopheles* mosquito species was carried out in University of Abuja staff Quarters Giri, Nigeria. A total of 848 adult mosquitoes were collected. Sampling of mosquitoes performed using various methods: pyrethrum spray catches, human baits, electric mosquito killer and larval collections. Four species were encountered namely, *Anopheles gambiae, Anopheles arabiensis, Anopheles funestus and Anopheles rufipes*. *Anopheles arabiensis* was the most abundant of the four species with 367(43.30%) followed by *Anopheles gambiae 257(30.30%), Anopheles funestus* 117 (13.80%) *and Anopheles rufipes* 107(12.60%) respectively. Of the 848 Anopheline mosquitoes, 511(63.30%) were females while 337(39.70%) were males. These results indicate that members of the anopheline Gambiae complex which are amongst the most efficient and effective human malaria vectors in Nigeria are breeding in the study area, most of which are encouraged by human activities. There is need to develop control strategies that will target the vector species.

Keywords: *Distribution, abundance, anopheles mosquitoes, Unibuja staff Quarters*

INTRODUCTION

Mosquitoes are a delicate slender, fragile two winged insects measuring about 4-6mm long. The body is generally covered by a flexible protective exoskeleton. The entire body is divided into head, thorax and abdomen. Mosquitoes belong to the phylum arthropoda, class insecta order diptera, family culicidae, and the sub-families of *Anopheline* and *Culiine*. (Gillet, 1972). Studies in various habitats in Nigeria have demonstrated the abundance of various mosquito species. They include mosquitoes of the genera *Anopheles*, *Culex*, *Aedes* and *Eretmapodites* (Igbinosa, 1989; Iwuala, 1979; Nwoke *et al.*, 1993). Various mosquito species from these genera are possible vectors of human diseases, including yellow fever, arboviruses in general, malaria and bancroftian filariasis (Service, 1963; Service, 2008; WHO, 2013).

However, mosquitoes are readily distinguished from other insects by their conspicuous projecting proboscis and scales on their wing vein (Service, 1993; Robert, 2004). They are apparently attracted to humans or animals by moisture, lactic acid, carbon dioxide, body heat and movement (Gillies, 1980, Sutcliffe, 1977). Adult mosquitoes do move around in short flights and on rare occasions may move a long distance of up to 3 (three) kilometers from their breeding sites (Robert, 2004). Most mosquitoes are active in the evening or on overcast (cloudy) days. During the day, they remain on vegetation or any slide object taking flight only when a suitable host passes by (Foss and Dearborn, 2002).

Mosquitoes are cosmopolitan in distribution, though found mostly in the warm humid tropical countries of West and East Africa, South-East Asia. The Caribbean, north and South America, and Europe (Service, 1963). Mosquitoes are found both in the forest and human dwellings and have their adaptive features (mouth-parts) specialised for both sucking nectar of flowers or blood of man and other animals. They also have efficient flight habit, biting and vectorial capacity to enable them cope with their environment. Mosquitoes undergo complete metamorphosis, going through four distinct stages in its life cycle (egg – larva – pupa – adult). The length of the first three stages is dependent on the species and temperature. The larva and pupa stages are active and aquatic, while the eggs are laid either in water or near water, also in moist depressions which will be filled with water in time. *Anopheles* is a genus of Mosquito (*Culicidae*) with approximately 3,800 *Anopheles* species, of which 30-40 transmit four different species of parasites of the genus *Plasmodium* that cause malaria which affects humans in endemic areas. According to the World Health Organization, malaria is still the major cause of death in children in sub-saharan Africa (WHO, 2015). In Nigeria, it is reported that 50% of Nigerians suffer from one form of malaria or the other, making it the most significant health problem in Nigeria (Chukwuocha, 2012). The distribution pattern, transmission and intensity of malaria is determined by indigenous *Anopheles* mosquitoes, their abundance, feeding and resting behavior and their *plasmodium* infectivity among other factors (WHO, 2003, CDC, 2015). *Anopheles gambiae* is one of the best known species, because of its predominant role in the transmission of the most dangerous *Plasmodium* called *Plasmodium falciparum* (Coetzee and Goos, 2013). Some species of *Anopheles* can also serve as the vectors for canine heartworm *Dirofilaria immitis,* the Filariidae *Wuchereria bancrofti* and *Brugia malayi,* and viruses. Mosquitoes in other genera *(Aedes, Culex)* can also serve as vectors of disease agents (Alaba and Alaba, 2010).

Like all mosquitoes, anophelines go through four stages in their life cycle: egg, larva, pupa, and imago. Members of the *Anopheles gambiae* complex are the most important vectors of malaria in sub Saharan Africa. The complex consists of seven species that vary in their ability to transmit malaria (White, 1974). Two species of the complex *Anopheles gambiae* and *Anopheles arabiensis* are both the most widely distributed and the most efficient vectors of malaria (White, 1974; Coetzee *et al*. 2000). The range and relative abundance of *Anopheles gambiae* and *Anopheles arabiensis* is strongly influenced by climatic factors especially total annual precipitation (Lindsay *et al.*1998).

Knowledge of the species abundance and disease relationship is of importance in disease forecasting and monitoring. This study is aimed at investigating the abundance and distribution of the adult anopheles mosquito in University of Abuja Staff Quarters. While the specific objectives of the study are to identify the mosquitoes to species level, determine the sexes and to provide information on the abundance of malaria vectors.

MATERIALS AND METHODS

Study Area

The University of Abuja staff quarters is located near Giri in Gwagwalada area council of the Federal Capital Territory, Abuja and it lies between latitude 9^0N and longitutde 12^0E. Nigeria. The FCT climate is typically tropical with annual temperature, relative humidity and rainfall ranges of 24^0-37^0 C, 60-80% and 1400-1600 respectively and experiences two weather conditions in the year. These are the rainy season which begins around March and runs through October and the dry season usually characterized by bright sunshine begins from October and ends in March. The temperature of this area is highly influenced by the Niger Benue trough where heat is trapped. The highest temperature ranges between 27^0 C and 37^0C during the dry season while in the rainy season it ranges between 23^0 C and 34^0C. The natural vegetation in the staff quarters is reflects that of the Guinea savanna zone, characterized by a predominance of tall and short grasses, which are frequently removed by bush burning and grazing activities in the dry season.

Sample Collection

Mosquitoes were collected indoors and outdoors between 05:00 and 07: 00 hours as recommended by (WHO 2002) from all the streets. Mosquitoes were caught by spraying with pyrethrum-based aerosol spray (Raid) and electric mosquito killer. The samples were preserved dry on silica for further analysis (Gillies and Coetzee, 1987). This is in order to preserve delicate parts such as antennae, wings and legs which are important in identification. In the laboratory, the mosquitoes collected were identified to species level and counted, while the anopheline mosquitoes were identified as far as possible using the morphological keys of Gillies and Coetzee (1987). The sexes were also determined according to Gillies and De Meillon, (1968).

Immature larval and pupal stages were collected from natural breeding sites like shallow temporary puddles, pools, gutters and ditches using the scooping net method. The scooped larvae and pupae were reared on location to adults in plastic cups containing cold water according to WHO (1995). A total of 1200 larvae were placed in plastic buckets containing water and covered with polystyrene net held by rubber bands and kept at room temperature. The larvae were fed with ground fish diet powder. The set up was monitored daily and the adults that emerged (usually within one to four days depending on the larval and pupal stages) were removed and anesthetized using a drop of acetyl acetate placed on Whitman's filter paper placed on the net covering the cup. The dead mosquitoes were removed and individually identified using the taxonomic keys of (Gillies and Coetzee, 1987). Nonmembers of the *Gambiae* complex were discarded. The number of *Anopheles* species harvested were physically counted and recorded at different times of harvest in the various sites.

Data Analysis

Data were presented in percentages. Species abundance was determined in percent as the number of species per street out of the total number of mosquitos collected.

RESULTS

A total of 848 adult species of *Anopheles* mosquitoes were identified with *Anopheles arabiensis* being the most abundant with 367(43.30%) followed by *Anopheles gambiae 257(30.30%), Anopheles funestus* 117 (13.80%) *and Anopheles rufipes* 107(12.60%) respectively. The four species coexisted in several locations but in disproportionate numbers. Table 1 shows the distribution of adult anopheles species by streets in University of Abuja staff Quarters. The result of the study revealed that of the 848 Anopheline mosquitoes, obtained during the study 511(63.30%) were females while 337(39.70%) were males. Distribution of adult anopheles species by sex is shown in table 2.

Table 1. Distribution of adult anopheles species by streets in University of Abuja staff Quarters

Streets surveyed	*An Arabiensis* N(%)	*An. funestus* N (%)	*An. rifipes* N (%)	*An. gambiae* N (%)	Total N (%)
Albert Ozigi	30(3.5)	18(2.1)	5(0.6)	23(2.7)	76(9.0)
Aliyu Idrees	39(4.6)	11(1.3)	22(2.6)	18(2.1)	90(10.6)
Emmanuel Odumuh	26(3.1)	5(0.6)	4(05)	29(3.4)	64(7.6)
F.A.B. Akhidime	40(4.7)	0(0.0)	3(0.4)	12(1.4)	55(6.5)
Muhammed Idiaro	19(2.2)	9(1.1)	17(2.0)	27(3.2)	72(8.5)
Musa Babayo	45(5.3)	55(6.5)	20(2.4)	50(5.9)	170(20.1)
Simon Ebele	70(8.3)	0(0.0)	10(1.2)	50(5.9)	130(15.3)
Umar Birai	32(3.8)	9(1.1)	17(2.0)	19(2.2)	77(9.1)
Yakubu Habi	39(4.6)	0(0.0)	5(0.6)	17(2.0)	61(7.2)
Yomi Akande	27(3.2)	0(0.0)	14(1.7)	12(1.4)	53(6.3)
Total	**367(43.3)**	**107(12.6)**	**117(13.8)**	**257(30.3)**	**848(100)**

Table 2. Distribution of adult anopheles species by sex in University of Abuja staff Quarters

Anopheles species	Male N (%)	Female N (%)	Total N (%)
Anopheles arabiensis	166(19.6)	201(23.7)	367(43.3)
Anopheles funestus	32(3.8)	85(10.0)	117(13.8)
Anopheles rifipes	99(11.7)	8(0.9)	107(12.6)
Anopheles gambiae	40(4.7)	217(25.6)	257(30.3)
Total	**337(39.7)**	**511(60.3)**	**848(100)**

DISCUSSION

The abundance of Anopheles species in University of Abuja staff Quarters could be due to human activities like poor sanitation, abundance of pools, domestic runoffs, indiscriminate disposal of household wastes, provides numerous breeding sites. The study has revealed that, four different species of *Anopheles* mosquitoes abound in the study area with *Anopheles arabiensis* showing the highest preponderance over other species followed by *Anopheles gambiae* while *An. rufipes* was the lowest in population. All species of mosquitoes reported in this study have also been reported by different researchers elsewhere in Nigeria (Okogun *et al.*, 2005, Adeleke, 2010, Adebote *et al*., 2008, Bunza *et al*., 2010; Afolabi *et al.*, 2013, Yayock *et al*., 2014). This confirms the wide range of geographical distribution of the anophilines. In sub-Saharan Africa *Anopheles arabiensis* and *Anopheles gambiae* the most common species in the study area are listed among the most effective and efficient dominant vector species of human malaria (Sinka *et al.*, 2010: Gilles 1968). The anthropophagy of these two competent malaria vectors has been well documented by (Awolola *et al.*, 2002 and Awolola *et al.*, 2005)

In the present study *Anopheles arabiensis* was the most prevalent species, and its predominance prevailed in some localities as reported by (White 1974, Lindsay *et al.* 1998, Coetzee *et al.* 2000; Coluzzi *et al.*1979 and Ayanda, 2009). Variations observed in different geographical zones of the country might be as a result of differences in physico-chemical factors. As combination of factors such as temperature (26.5 to 29.3°C), pH (7.1 to 7.3), dissolved oxygen (1.44 to 2.7 mg/L), relative humidity, conductivity (66.3 to 108.0 µs) and anthropogenic related factors (such as opened drainage system) contribute to the increasing abundance of mosquitoes in the breeding sites. The result obtained in this study revealed the presence of both sexes of members of the *Anopheles gambiae* complex within the study site and the result compares well with those reported by (Onyabe and Conn, 2008). The researchers reported on the distribution of *Anopheles* mosquitoes in Nigeria. The occurrence of *Anopheles gambiae* complex is suggestive of the prevalence of vector-borne diseases such as malaria and yellow fever in the area. Therefore, intensive vector control programmes and public enlightenment especially on human activities that encourage mosquito breeding are recommended and the data from the study are expected to assist in vector control efforts.

CONCLUSION

The result of this study revealed the abundance of anopheline mosquito species in the study area. The abundance and distribution of the mosquito species in the study area may be related to the availability of breeding sites in the area. An attempt has been made to provide baseline information on the presence of members of the Anopheline gambie complex especially *Anopheles arabiensis* and *Anopheles gambie* which are among the most effective and efficient vectors of human malaria. All four Anopheles spp encountered in the study are potential vectors of malaria, which is an endemic parasitic disease in the study area. There is need to develop control strategies that will target the vector species.

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