Ecology Of Man-Biting Mosquitoes In The Development Site Of Nnamdi Azikiwe University Awka, Anambra State Southeastern Nigeria

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Abstract

A study of man-biting mosquitoes at the permanent site hostels of Nnamdi Azikiwe University, Awka, was carried out between February and July 2008. Mosquito larvae were sampled from flood pools around the hostels using ladle. Indoor biting and resting adult mosquitoes were collected using pyrethrum knockdown collection method (PKC). Outdoor biting mosquitoes were collected using human volunteers as baits and collectors. 1265 mosquitoes made up of 5 mosquito species were collected as larvae. Culex quinquefasciatus 466(36.84%) and Aedes aegypti 400(31.62%) formed the bulk of the larval collection. 72 adult mosquitoes comprising 3 mosquito species were collected inside the university hostels. Anopheles gambiae, 50(69.45%), constituted the highest percentage of indoor biting and resting mosquitoes. A room density of 8.2 mosquitoes/room/night was recorded, 6 mosquitoes/room/night were A. gambiae. 132 outdoor biting adult mosquitoes were collected, A. aegypti 67(57.5%) and A. albopictus 38(28.79%) had the highest numbers. A biting rate of 5.97 mosquitoes/man/hour was observed, 3.04 mosquitoes/man/hour were A. aegypti. The students in the hostels are therefore exposed to mosquito bites and mosquito-borne diseases. Self-protection by the students and general provision of mosquito control strategies in the students hostels by the institution is hereby suggested

INTRODUCTION

Developmental projects, such as civil engineering constructions, mining and agricultural projects including deforestation, which are intended to improve the quality of life of the people often bring with it favorable conditions for the breeding of large populations of disease vectors and the associated disease burden. Sharma and Upreathy (1982) observed that dams, lakes, irrigation schemes and other developmental projects though essential for the economic growth of many countries, unfortunately cause increases in malaria and other vector-borne diseases such as filariasis, arboviruses and other health problems. Service (1991) noted that the policy, in the 1970s, of clearing forest in Enugu region of Nigeria for planting of the valuable timber trees, teaks and gmelina, increased the people's exposure to the bites of forest mosquitoes. He noted that the situation was aggravated as a result of rot holes which developed in the tree stumps left behind after clearing operations which later became filled with water and formed ideal larval habitat for Aedes africanus – a yellow fever vector. WHO (1993) observed that schistosomasis infection has increased over the years due to large scale irrigation projects which created new habitats for the aquatic snails.

The permanent site of Nnamdi Azikiwe University, Awka, in Anambra State of Nigeria is a relatively new project development site. Until March 2006, the institution was located at a temporary site within Awka metropolis but today all the departments have relocated to the permanent site. Most lecture halls, offices, research laboratories and access routes are still under construction. The new site is hitherto uninhabited. It was a vast expanse of agricultural land with such poor topographical features as sluggishly flowing streams, water logged land for the most part of the year, marshy terrain and ground water pools formed by collection of rain water in depressions near and around the hostels, lecture halls and administrative blocks. The land was primarily used for cultivation of rice, maize cassava, yam and vegetables. Wild palm trees and forest galleries punctuate the otherwise derived savannah vegetation. Occasionally monkeys are sited in some parts of the campus. Vectors such as tabanids sometimes fly through the windows into offices and lecture halls. Experience from personal

interactions with the students and records from the University Medical Centre indicate that many students complain of malaria and other febrile illnesses suspected to be vector-borne. Large populations of people, students, lecturers, administrative staff, construction staff and people from all walks of life with various interests in the University frequent the campus. The general objective of the study was to investigate the man-biting mosquito species and their breeding sites within the permanent site. The specific objectives were to collect outdoor man-biting mosquitoes using human volunteers (Hbc), collect indoor man-biting mosquitoes using pyrethrum knockdown method (PKC) and finally determine their breeding sites through collection of the immature stages of various mosquitoes breeding around the hostels. The choice of the hostels for study was because only the students in the hostels spend 24 hours daily within the University environment.

MATERIALS AND METHODS

STUDY AREA

Awka town is the capital city of Anambra State of Nigeria. It has geographical co-ordinates of approximately 60,14" and 60,18" North latitude and 70,5" and 70,09" East longitude. It is located in the tropical rainforest zone, although it has derived savanna vegetation. It has two marked season, the dry and wet seasons. There are about 8 months (April – November) of wet season and four months (November – March) of dry season. It has a relative humidity of 70% reaching 80% during rainy season and an annual rainfall of about 2000mm (Iloeje, 2001).

The daily temperature ranges from 260C – 350C during the dry season stretching from November to March, and from 22.10C – 300C during wet season stretching from April to November. The people are ethnically Igbos. Occupationally the indigenes were mainly itinerant traders, craftsmen and farmers. With the creation of Anambra State in 1991, and the establishment of Government machineries and institutions of higher learning, over 60% of the population are civil servants, students and lecturers while the remaining 40% are farmers, traders and other occupations.

COLLECTION OF OUTDOOR BITING MOSQUITOES

The collection of outdoor biting adult mosquitoes around the student hostels was carried out between 17.00 and 20.00 hours local time (5.00 – 8.00pm). Two human volunteers were involved in the study. Materials used were torch lights, test-tube vials, cotton wool, wrist watches for keeping time, pens and papers for recording the time of collections, cellophane bags for collation of catches and low stools. All catches were recorded at quarter-hourly intervals. The two human volunteers had the sleeves of their shirts and pairs of trousers rolled to their elbows and knees respectively. They put off their shoes and sandals, sat on the low stools each about a pole away from the other. They searched meticulously over their body especially their extremities for the arrival and alighting of any mosquito on their bodies. Mosquitoes alighting on the body to suck blood were collected with a test tube vial, stoppered with a ball of cotton wool; the time of collection was recorded and kept separate. At the end of the collection period, the collections were sorted into quarter-hourly collections and placed in separate cellophane bags. All collections were taken to the National Arbovirus and Vector Research Centre Laboratory at Enugu for proper identification.

COLLECTION OF INDOOR BITING AND RESTING ADULT MOSQUITOES

Indoor biting and resting adult mosquitoes were collected from the students hostels using pyrethrum (insecticide) knockdown collection techniques (PKC). Nine rooms were selected from the students hostels based on the students cooperation. Five rooms were from the ground floor, three rooms were from the first floor while one room was from the second floor. Two white cloth sheets measuring 12ft (3.6 x 3.6m) were used to cover the floor of each room.

The cloths were laid from wall to wall and were make to overlap with each other at the centre of the room to avoid escape of falling mosquitoes. The houses have no open eaves and so the windows and doors were properly shut and the whole room sprayed with Baygon aerosol commonly available in the local markets. After 20 minutes of fleeting each room, the doors and windows were opened, and the cloths were folded starting from edges to ensure that all fallen mosquitoes concentrated at the centre. They were then taken to the open space outside where they were opened and all mosquitoes collected into the vials.

COLLECTION OF IMMATURE STAGES OF MOSQUITOES

Sampling of mosquito larvae and pupae around the students hostels was made in concrete mixer tanks, dirty water pools, clean stagnant water pools, polluted waters in gutters, clean waters in potholes, clean water pools in gutters and dirty water in potholes. Collections were done between 10.00am –

12.00noon. Materials used were plastic bowls and buckets, ladles (dippers), sieve and specimen bottles. Mosquito larvae and pupae were collected using ladles into the plastic bucket. The collections were sieved into another plastic bowl to remove debris. With the aid of micropipette the larvae were picked into specimen bottles. All the collections were taken to the Research Laboratory of the National Arbovirus and Vectors Research Centre at No.33 Park Avenue, GRA Enugu, for proper identification.

ETHICAL CONSIDERATIONS

A letter of intent to use the students' hostels was written by the departmental head to the hostel warden and consent was obtained. Students whose rooms were used were properly informed and their consent obtained. Volunteer staff used for the collection of the outdoor man-biting adult mosquitoes were educated on the nature of the job and the implications. They were given yellow fever vaccinations 10 days before the commencement of the studies. Their health problems were taken care of during the study period.

RESULTS

A total of 1265 mosquitoes were collected as larvae from different breeding sites around the University hostels (table 1). The mosquitoes collected were A. gambiae 267 (12.12%), A. funestus 71(5.61%), C. quinquefasciatus 466(36.84%), C. tigripes 61(4.82%) and A. aegypti 400(31.62%). A. gambiae was collected from clean rainwater pools in concrete mixer tanks used by the contractors, clean water pools in depressions, potholes and gutters. A. funestus was collected in the same habitats with A. gambiae except the concrete mixer tanks. C. quinquefasciatus was collected in polluted water pools in depressions, pot holes and gutters. C. tigripes was collected in both clean and polluted water pools but not in concrete mixers. A. aegypti was collected in small water holdings in discarded tin cans and depressions.

Seventy-two indoor biting and resting adult mosquitoes were collected inside the 9 rooms selected from the ground, first and second floors of the hostels, (table 2). 33 mosquitoes (45.83%) were collected from the 5 rooms in the ground floor, 35 mosquitoes (48.61%) from three rooms selected from the first floor and 4 mosquitoes (5.56%) from one room selected from the second floor. The different mosquito species collected were A. gambiae 50(69.45%), A. funestus 11(15.27%) and C. quinquefasciatus 11(15.27%). All the three species were collected from the three floors of the hostels. The room density of the mosquitoes was 8 mosquitoes per room. Out of every eight mosquitoes in a room, 6 mosquitoes were A. gambiae while A. funestus and C. quinquefasciatus were 1.2 mosquitoes per room respectively.

A total of 132 outdoor biting adult mosquitoes were collected outside the University hostels between 17 and 20 hours (5.00 – 8.00pm) local time; in three consecutive days using human bait method (table 3). The mosquitoes collected were A. aegypti 67(5.75%), A. albopictus 38(28.79%), A. africanus 11(8.33%), A. taylori 2(1.52%), A. gambiae 8(6.06%). A biting / landing rate of 5.97 mosquitoes per man per hour was observed. Out of every 6 mosquitoes that bit man 3 mosquitoes were A. aegypti, 2 were A. albopictus while others were less than one mosquito/man/hour.

Figure 1

Table 1: Mosquito larvae collected from different breeding sites around the University hostels

Mosquito species	Breeding Sites								Total	%
	Concrete mixer tank	Dirty water pools	Clean water pools	Polluted water in gutters	Clean water in gutters	Clean water in potholes	Dirty water in potholes	Liter cans		
Anopheles gambiae	43	0	26	0	32	166	0	0	267	21.12
Anopheles funestus	0	0	15	0	0	44	12	0	71	5.61
Culex quinquefasciatus	0	2	0	208	0	0	256	0	466	36.84
Culex tigripes	0	12	14	2	0	0	33	0	61	4.82
Aedes aegypti	0	0	20	0	110	0	55	215	400	31.62
Total	43 (3.40%)	14 (1.12%)	75 (5.93%)	210 (16.23%)	142 (11.23%)	210 (16.60%)	356 (28.14%)	215 (17.0%)	1265	100

Figure 2

Table 2: Indoor-biting and resting adult mosquitoes collected inside the University hostels using pyrethrum knockdown method.

Mosquito species	House Floor and Room									Total	%	Mean room density
	Rm 1 ground floor	Rm 2 ground floor	Rm 3 ground floor	Rm 4 ground floor	Rm 5 ground floor	Rm 15 first floor	Rm 18 first floor	Rm 19 first floor	Rm 28 second floor			
Anopheles gambiae	4	5	4	2	6	5	10	11	3	50	69.45	5.8
Anopheles funestus	2	2	2	3	1	0	0	0	1	11	15.27	1.2
Culex quinquefasciatus	0	2	0	0	0	3	4	2	0	11	15.27	1.2
Total and % collection/100m	6 (8.33%)	9 (12.5%)	6 (8.33%)	5 (6.94%)	7 (9.72%)	8 (11.11%)	14 (19.44%)	13 (17.57%)	4 (5.56%)	72	100	8.2

Figure 3

Table 3: Outdoor biting adult mosquitoes collected around the hostels using human bait method

Mosquito species	Periods of Collection										Total	Biting rate
	5.0 to 5.15	5.15 to 5.30	5.30 to 5.45	5.45 to 6.00	6.00 to 6.15	6.15 to 6.30	6.30 to 6.45	6.45 to 7.00	7.00 to 7.15	7.15 to 7.30	7.30 to 7.45		
Aedes aegypti	8	12	4	16	8	8	3	3	2	2	1	67(57.5%)	3.04
Aedes albopictus	3	9	6	6	3	9	2	0	0	0	0	38(28.79%)	1.72
Aedes africanus	0	0	0	0	0	0	0	0	2	5	4	11(8.33%)	0.5
Aedes taylori							1		1			2(1.52%)	0.09
Anopheles gambiae						2		1		3	2	8(6.06%)	0.06
Culex quinquefasicutus				1	1				1	1	2	6(4.55%)	0.03
Total	11	21	10	23	11	19	6	4	6	11	9	132 (100%)	5.97
Percentage	8.33%	15.91%	7.50%	17.42%	8.33%	14.39%	4.55%	3.03%	4.55%	8.33%	6.82%	100%	

DISCUSSION

The study area which is the University Permanent Site could be considered to be a large development site in a formerly uninhabited area with many buildings and access routes still under construction. This also involved massive ecological changes including deforestation, land excavations and landscaping. Civil engineering constructions including roads frequently create land excavations which fill up with rain water and constitute suitable aquatic habitats for various mosquito species and even snail intermediate hosts of schistosomiasis (Youdeowei & Service, 1986). This probably explains the multiplicity of mosquito breeding sites around the hostels. In addition far-reaching ecological changes in an environment often alter the disease patterns in an area by exposure of the inhabitants to the existing pathogens and vectors or by introducing new diseases and pathogens to the area. The collection of two species of urban mosquitoes namely Aedes aegypti and Culex quinquefasciatus and also Anopheles mosquitoes in a relatively new environment corroborates with the observations of Youdeowei and Service (1986), and hence the complaint of the students. The relocation of the University to its permanent site went with it the movement of large populations of both immune and non-immune individuals into the uninhabited area. The students residing in the University hostels were from diverse environmental conditions and immunological status. This has the public health implication of exposing the students and staff populations to various vectors and vector-borne diseases which they had little or no natural resistance to. Youdeowei and Service (1986) observed that movement of populations to formerly uninhabited areas for agricultural purposes, mineral exploitation or road construction usually expose them to a variety of diseases.

The collection of 1265 mosquitoes as larvae from the different breeding sites around the hostels is an indication of intensive breeding of mosquitoes in the area as well as preponderance of their breeding sites. This finding corroborates with the observations of Mbanugo and Okpalaononuju (2003) who noted that the preponderance of mosquitoes in Awka metropolis was due to prevailing habitats in the area. Five mosquito species including A. gambiae, A. funestus, A. aegypti, C. quinquefasicatus and C. tigripes were collected as larvae from the various breeding sites. Although these mosquitoes breed in stagnant water, they differ in microecological requirements in their breeding habitats. The anopheles group were collected from clean water pools scattered around the hostels, the culex group were collected in polluted water pools whereas the aedes group were collected in small water pools in discarded tin cans and utensils. Their breeding ecology is in tandem with the work of Service (1980).

A. gambiae, A. funestus and C. quinquefasciatus were the three species of man-biting mosquitoes caught indoors, with A. gambiae, 50(69.27%), predominating the collection. Culex and anopheles mosquitoes are night biters and usually enter houses to bite their victims when asleep. Gordon and Lavoipierre (1976) observed that the more important vectors of mosquito-borne diseases are those which show a close association with man and prefer him to other animals as source of food. Service (1980) indicated that adults of A. gambiae are mainly anthropophilic, endophagic and endophilic.

The room density of all the mosquitoes caught indoors is 8 mosquitoes / room/night out of which 5.8 or approximately 6 mosquitoes per room/night were A. gambiae while A. funestus and C. quinquefasciatus were 1.2 mosquitoes/room/night respectively. This suggests that approximately 2 mosquitoes may feed on each student per night as the students are allocated four to a room. Out of the 2 mosquitoes, one must be an anopheles. This is of public health interest because anopheles mosquitoes are very efficient malaria transmitters and can infect many people in a place even at lower densities (Service, 1980).

Six mosquito species namely A. aegypti, A. albopictus, A. africanus, A. taylori, C. quinquefasciatus and A. gambiae were caught biting outdoors around the hostels. With the exception of A. gambiae and C. quinquefasciatus which bite mainly indoors but occasionally bite outdoors, the rest were aedes mosquitoes which are diurnal and crepuscular insects (Onyido et al., 2008). Although these Aedes species bite man, they also indiscriminately bite other animals (Onyido et al., 2006 a, b, Service, 1980).

A biting rate of 5.97 mosquitoes / man / hour was recorded outdoors of which 3.04 mosquitoes/man/hour were A. aegypti while 1.72 mosquitoes / man / hour were A. albopictus. In the presence of yellow fever outbreak in the environment, these biting rates are enough to amplify the spread of the infection (WHO, 1986).

From both larvae and adult mosquito collections, eight mosquito species were collected of which four species were aedes mosquitoes while culex and anopheles mosquitoes had

two species each. All the four species of Aedes – A. albopictus, A. aegypti, A. africanus and A. taylori are proven vectors of yellow fever and other arboviruses (Gillet, 1972; Service,1980; WHO, 1986) and all have been variously involved in yellow fever epidemics in Nigeria (Lee and Moore 1972, Lee et al. 1974, Service 1974, Fagbani et al. 1975, Savage et al., 1992).

A. gambiae and A. funestus are important vectors of malaria in Nigeria and sub-Saharan Africa (FMOH, 1990; Ukpai & Ajoku, 2001; Matur et al., 2001). Gordon and Lavoiperre (1976) noted that Anopheles gambiae is an important vector of malaria and filariasis in Africa especially in rural communities. Culex quinquefasciatus is an urban mosquito responsible for transmission of filariasis especially Bancroftian filariasis (Amusan et al., 2003). Culex mosquitoes are not only important transmitters of filariasis but also vectors of several of the mosquito-borne encephalitides (Gordon & Larvoiperre, 1976; Service, 1980).

The present study is of public health concern because the mosquito species collected have been implicated in one type of mosquito- borne disease or the other. The students in the hostels are thus exposed to a variety of mosquito-borne diseases. In addition to advising the students to protect themselves from mosquito bites, organized control strategies should be used to reduce mosquito-man contacts vis-à-vis disease transmission among the students. As many students may not afford the daily use of insecticide aerosols in their rooms, it may be necessary to provide mosquito-net screens on the windows and doors to protect both indigent and well-to-do students from mosquito bites.

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