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Vector abundance and species composition of *Anopheles* mosquito in Calabar, Nigeria

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Malaria is a major cause of morbidity and mortality in Nigeria creating a significant barrier to economic development. Accurate estimation of the extent of the morbidity and mortality is difficult in view of the weakness of the reporting systems for infectious diseases in Africa. In 2008, World Health Organization reported an estimated value of 243 million cases with a mortality of about 863 thousand in the world[1]. Malaria transmission in the coastal South States of Nigeria is known to be holoendemic, and perennial. High humidity (80%) and a high mean temperature of 35°C in this area favour the bionomics of the principal malaria vectors (*Anopheles gambiae* complex and *An. funestus*)[2]. Vector control is a major component of the Global Malaria Control Strategy (GMCS) and still remains the most generally effective measure to prevent malaria transmission[3]. However, successful application of vector control measures in a given location requires the understanding of the bionomics of *Anopheles* species responsible for malaria transmission, including correct and precise identification of the target species[4] and its distribution[5].

Studies on malaria entomology in Nigeria are not only few but limited to the north and south-west of the country and are further confounded by the presence of different ecological zones that support breeding of different *Anopheles* species[6]. This study seeks to fill the gaps in the knowledge of bionomics of *Anopheles* from the south zone of the country.

The study was carried out in Calabar Municipality (4°57N, 8°19'E) located in Cross River State – south Nigeria where the vegetation is typically of the rain forest. Mosquitoes were collected using the pyrethrum spray catch (PSC) technique. Collection was carried out twice on the second and fourth week of every month with an average of six houses per area for three localities for 6 months in the morning hours (0600 to 1000 hrs). Between 10 and 15 min after spraying the insecticide, mosquitoes knocked down on white sheets were collected and placed on damp filter papers properly labelled before transfer to the laboratory. Rainfall measurement was carried out by the National Meteorological Centre. Mosquitoes collected were identified with the aid of a stereomicroscope using morphological keys[7]. Each correctly identified *An. gambiae* complex mosquito was kept in dry silica gel and stored at 4°C.

DNA extracted from legs or wings of samples identified as *An. gambiae* were subjected to a species-specific polymerase chain reaction (PCR) assays following the procedure of Scott *et al*[8]. Laboratory strains of the *An. gambiae* complex provided by the Molecular Entomology Laboratory at the Nigerian Institute of Medical Research, Lagos were used as positive controls. PCR products were electrophoresed with 10% ethidium bromide stained agarose gels at 120 volts for 1 h. The amplified fragments were then visualized by illumination with short wave ultra violet trans-illuminator and photographed.

The relationship between the amount of rainfall and vector abundance in the selected area during the experimental period showed a correlation of 0.604. Higher density of mosquitoes was collected between April and June (wet season) than January and March (dry season) as more breeding sites are available in the wet season (data not shown). This has been corroborated by several studies as the rains present favourable environmental conditions that enhance mosquito breeding and survival, through the proliferation of larval habitats and improved humidity, respectively[9].

A total of 675 mosquitoes were caught through PSC. The higher proportion of the culicines (64.1%) compared to the anophelines (35.9%) was thought to be as a result of environmental practices which has subjected most available breeding sites to pollution, hence, encouraging

Table 1. Morphological identification of mosquitoes caught during the study

Study areas	Culicines		Anophelines		Total
	Male	Female	Male	Female	
State housing	46 (25.5)	71 (39.4)	16 (8.8)	47 (26.1)	180
Federal housing	67 (25.5)	92 (35.1)	39 (14.8)	64 (24.4)	262
Old Odukpani	38 (16.3)	123 (52.7)	20 (8.6)	52 (22.3)	233
Total	151 (22.3)	286 (42.3)	75 (11.1)	163 (24.1)	675

Figures in parentheses indicate percentages.

Table 2. Species composition of *Anopheles* females caught during the study

Study areas	Number caught	*Anopheles gambiae* complex			*An. funestus* complex
		An. gambiae s.s.	*An. arabiensis*	Unidentified species	
State housing	47	34	4	2	7
Federal housing	52	34	6	4	8
Old Odukpani	64	38	8	6	12
Total	163	106 (65)	18 (11)	12 (7.3)	27 (16.7)

Figures in parentheses indicate percentages.

the proliferation of more culicines and reducing the suitability of these sites for anopheline proliferation. The result are presented in Table 1.

Morphological identification of members of the *Anopheles* collected in this study revealed two major groups with majority (83.4%) belonging to the *An. gambiae* s.l. and *An. funestus* complex (16.5%). Molecular characterization of *An. gambiae* s.l. by polymerase chain reaction assays showed the presence of two sibling species; *An. gambiae* s.s. (65%) and *An. arabiensis* (11%) with unidentified species (7.3%) (Table 2). This study confirms the presence of two members of the *An. gambiae* complex that are capable of transmitting malaria all year round. The predominance of the most efficient vector of malaria *An. gambiae* s.s. in this study is consistent with available data[10,11]. *An. arabiensis,* the least abundance found in this study and other studies[10,11] has been described as a savannah and dry season zoophilc vectors with a tendency to exhibit exophagic and exophilic behaviour[12].

All the species of *Anopheles* found in this area have been substantially linked to malaria in the country[11,13]. This study provides a baseline data on the malaria vector species present in Calabar Municipality area giving an insight to the high prevalence of malaria recorded in the region, but more research work is required to properly present and document data on the entomological profile and dynamics of the malaria vectors in this area.

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