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The biting behaviour of Blackflies *Simulium damnosum*, the vector of human onchocerciasis in Akamkpa Local Government Area, Cross River State, Nigeria

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ABSTRACT: The biting behaviour of *Simulium damnosum* was studied in Akamkpa Local Government Area of Cross River State, Nigeria between June and August, 1999. Out of the 7604 flies collected in the entire studies, 1416, 2300 and 3888 flies were collected from Kwa-fall, Eku and Ikpan river banks respectively. The larger number of flies in Eku and Ikpan river banks corresponded with higher mean daily rainfall, higher relative humidities and lower temperatures of these sites. Two peaks of biting behaviour of the flies, one in the morning and another in the afternoon were observed in all the study sites. The morning peaks for Kwa-fall, Eku and Ikpan river banks were 7.00 – 8.00 a.m.; 9.00 – 10.00 a.m. and 10.00 – 11.00 a.m. while the afternoon peaks were 12.00 – 1.00 p.m.; 2.00 – 3.00p.m. respectively. Biting by the flies steadily decreased from 3.00 to 7.00 p.m. when they were presumed to be resting. Out of 7,604 flies dissected, 371 (4.88%) were parous while 7,233 (95.12%) were nulliparous. The number of parous flies reduced steadily with corresponding increase in the nulliparous flies with increasing rainfall. The knowledge of the biting activities could be utilized in the development of appropriate control strategies for the control of onchocerciasis taking into consideration the peak biting activity of the flies which in most cases correspond with the time of outdoor working engagements of the endemic population.

Key words: Biting behaviour, *Simulium damnosum*, Vector, Human Onchocerciasis.

Introduction

S. damnosum are dipterans in the order – Nematocera and family Simuliidae easily recognised by their dark colour, presence of prominent hump back and the nature of their tarsi. *S. damnosum* act as the intermediate host of *Onchocerca volvulus*, the filarial worm that is the causative agent of human onchocerciasis (Pierkaski, 1989; Nwoke and Uwazie, 1991; Cook, 1996). The disease, onchocerciasis is a parasitic disease that poses both public health and socio-economic problems of considerable magnitude in the world. It is responsible for the highest blindness rates in the world, including Nigeria (Ukoli, 1990; Somo et al., 1993; Cook, 1996).

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The diurnal biting activity of *S. damnosum* and other species that transmit *Onchocerca volvulus* have been studied by various workers in many areas with similar climatic conditions, in Ecuador by Shelley and Arzube, 1985, in Guatemala by Collins et al., 1981, in Kenya by Mebrahtu et al., 1986, in South Western Cameroon by Somo et al., 1993, in Yakurr clan, Obubra local Government Area of Cross River State, Nigeria by Iboh and Braide, 1987.

Studies in Ecuador showed that the biting pattern of *Simulium exiguum* from the two sites studied were similar in that biting occurred throughout the day but with more intensified activity before mid-day (Shelley and Arzube, 1985). In another study carried out in Nigeria, the biting density of *Simulium* was found to vary with the time of the day with peak biting period in all six streams studies (7.00 – 8.00 a.m. and 2.00 – 3.00 p.m.) (Iboh and Braide, 1987).

There have been previous records of the occurrence and distribution of Onchocerciasis in Akamkpa Local Government Area, Cross River State, Nigeria (NOCP, 1994). Hence, the objectives of the present studies were to observe the biting activity of these flies, assess the preferred site of biting and determine their parity levels. This studies will contribute to the development of appropriate control measures against these dipteran vectors.

Materials and Methods

Study Areas/Sites

The study area was Akamkpa in Cross River State, Nigeria located between Latitude 5°45' and 0°45' East. The area is about 68km from Calabar. It is a typical rainforest with numerous plantations including Gmelina, palm, plantain, banana, rubber, cocoa etc. Three study sites selected for the investigation included Kwa-Falls, Eku and Ikpan River banks in Aningeje, New Ndebiji and Eklong Anaku respectively (Fig. 1). ten days mostly from June to August 1999 were used for the field study in each study site. The biting activity of *S. damnosum* was studied daily in each site from 7.00 a.m. to 7.00 p.m. (12 hours).

Collection and Identification of Black Flies

Human bait technique was employed in the collection of the flies as described by Shelley and Arzube (1985), Iboh and Braide (1987) and Wilton and Collins (1978).

The human bait (flycatcher) dressed only in short knicker or with the legs of his trousers folded to knee level, seated 10 metres away from the river banks. The flycatcher used glass suction tubes to catch *Simulium* flies settling on him. These flies were then dissected fresh to determine their physiological age (parity) and then kept in separate tubes preserved in 80% alcohol. Where it was not possible to dissect all the flies caught, the flies were transported to the laboratory alive, in perforated collecting tubes with a piece of cotton wool soaked in 1% glucose solution (Iboh and Braide, 1987, Mafuyai et al., 1997). Each fly dissected was first anaesthetized with chloroform and placed on a glass slide in a normal saline solution. The fly catcher collected the flies immediately on landing on him taking precaution that the flies do not feed on him. Every attempt was made to catch the fly on landing. The flies collected were kept and separated into hourly slots in containers, preserved and taken to the laboratory. The preferred biting sites on the human bait were noted both on sitting and standing positions.

In the laboratory, each fly was placed dorsally on a slide and observed on the dissecting microscope. Morphological characteristics were observed and noted in order to identify *S. damnosum*. Dissection of each fly was carried out on its dorsal side by teasing the abdomen gently with two dissecting pins on the dissecting microscope in order to bring to view the ovaries. In order to differentiate the parous from the nulliparous, the ovaries were stretched out with the dissecting pins.

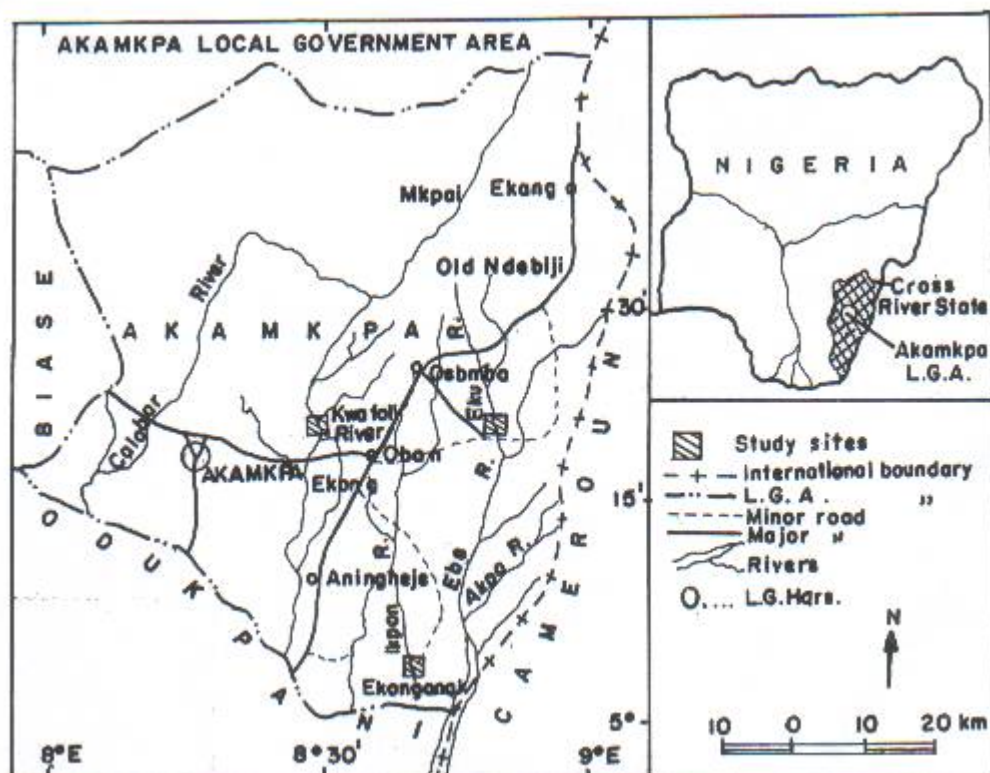


Fig. 1: The Study Area

Results

The results showed that a total number of 7604 flies were caught. Out of these number, 1416 (19.21%) came from Kwa falls, 2300 (30.25%) were collected from Eku River Bank while 3888 (51.13%) were collected from Ikpan River Bank (Tables 1 and 2).

In all the sites, two peaks of biting behaviour of the flies were observed, one in the morning and the other in the afternoon. At Kwa falls, the early morning peak was between 7.00 – 8.00 a.m. while the afternoon peak was between 12 – 1p.m. (Table 2). Eku river had its peaks between 9.00 – 10.00.a.m. and 2.00 – 3.00 p.m. while Ikpan River had its peaks between 10.00 – 11.00 a.m. and 2.00 – 3.00 p.m. (Table 2). In all the sites, the number of flies biting reduced steadily from 3.00 p.m. to 7.00 p.m. when the flies returned to their resting place. The preferred biting sites were mostly the legs, ankles and other exposed parts of the body nearer to the ground.

Out of the 7604 flies dissected, 371 (4.88%) were parous while 7233 (95.12%) were nulliparous. Out of the 371 parous flies, 150 (10.59%), 113 (4.91%) and 108 (2.78%) were collected from Kwa Fall, Eku and Ikpan River Banks respectively (Table 3). Moreso, out of the 7,233 nulliparous flies, 1266 (89.41%), 2187 (95.09%) and 3780 (97.22%) were collected from Kwa-Fall, Eku and Ikpan River Banks respectively (Table 3).

The monthly rainfall totals in the study sites throughout the duration of the investigation for June, July and August 1999 were as follows: 270.3mm, 349.9mm and 494.5mm respectively. The monthly mean temperatures from June to August, 1999 were 30.1°C, 29.3°C and 29.2°C respectively. Moreover, the mean monthly relative humidity were 85%, 88% and 89% respectively.

Table 1: Total daily distribution of *S. damnosum* caught biting man at the various sampling sites at different months.

Days	Kwa-Fall River Bank (June)	Eku River Bank (July)	Ikpan River Bank (August)
Day 1	78	846	1322
Day 2	147	300	79
Day 3	182	200	74
Day 4	151	95	81
Day 5	128	185	455
Day 6	181	150	362
Day 7	170	155	812
Day 8	117	149	318
Day 9	131	120	219
Day 10	131	100	146
Total	1416	2300	3888

Table 2: Total hourly distribution of *S. damnosum* caught biting man at the various sampling sites at different months.

Hours	Kwa-Fdall River Bank (June)	Eku River Bank (July)	Ikpan River Bank (August)
7.00 – 8.00 a.m.	157	111	88
8.00 – 9.00 a.m.	99	193	135
9.00 – 10.00 a.m.	79	242	218
10.00 – 11.00 a.m.	114	183	342
11.00 – 12noon	122	199	368
12.00 – 1.00 p.m.	177	233	510
1.00 – 2.00 p.m.	166	160	533
2.00 – 3.00 p.m.	106	322	571
3.00 – 4.00 p.m.	141	155	414
4.00 – 5.00 p.m.	99	167	306
5.00 – 6.00 p.m.	93	135	264
6.00 – 7.00 p.m.	63	100	139
Total	1416	2300	3888

Table 3: Classification oof *S. damnosum* from the different sites into parous and nulliparous species after dissection.

Sample site	Total No. of flies collected	Parous Flies	Nulliparous Flies
Kwa-Fall River Bank	1,416	150 (10.58)	1,266 (89.9)
Eku River Bank	2,300	113 (4.91)	2,187 (95.09)
Ikpan River Bank	3,888	108 (2.78)	3,780 (97.22)
Total	7604	371 (4.88)	7,233 (95.12)

Discussion

The diurnal biting activity of *Simulium damnosum* was studied from June to August, 1999. Out of the 7604 flies collected in the course of the entire studies, 1416 flies were collected from Kwa-Falls in June, 2300 flies from Eku River in July, while 3888 flies were collected from Ikpan River in August.

The observation at Eku and Ikpan River Banks in July and August respectively showed a high mean daily rainfall with a corresponding larger number of flies biting at those sites. Rainfall must have contributed to the increase in the number of breeding sites and hence more flies in the areas. Fryaueff and Tripis (1986) observed that rainfall increases the number and variety of preferred larval substrates and increase the current speed, making creeks and small rivers more conducive to the breeding of the flies. The

total number of biting flies showed a seasonal pattern with a gradual increase as the rains became heavy. This was consistent with the observation of Collins et al., (1981) and Cox (1993).

The number of biting flies varied per hour in each day indicating that they had preferred biting time (peaks). The biting activity was peaked in the morning and afternoon in this study. In Kwa-Fall River Bank, the peaks were between 7.00 – 8.00 a.m. and 12.00 – 1.00 p.m. In Eku River Bank, the peaks were between 9.00 – 10.00 a.m. and 2.00 – 3.00 p.m. Moreover, in Ikpan River Bank, the peaks were between 10.00 – 11.00 a.m. and 2.00 – 3.00 p.m. The variations in the morning peak periods were probably as a result of delayed or early sunlight at dawn in the study sites. Shelley and Arzube (1985) explained the difference in time of commencement of biting as being probably due to delay in the increase in light intensity at dawn in the forest catching stations.

The present study indicates that low temperature and high humidity also influence increase in the biting activity. It was observed that at Eku and Ikpan River Banks with lower temperatures and high humidities, more flies were caught. Baker and Abdelnur (1986) observed higher humidities and low but nearly constant diurnal temperature between 21°C and 31°C to favour the breeding and vectorial capacity of the blackflies.

Parity determination was carried out by dissecting each fly to displace the ovaries which when stretched out with the dissecting pins will either break or continue to stretch. The parous flies presented elastic ovaries when stretched while the nulliparous ovaries were inelastic. The number of parous flies reduced steadily as the rains became heavy while the nulliparous flies were increasing as the rains became heavier. Hence more nulliparous flies were found during the rainy season. This observation is similar to that made by Baker and Abdelnur (1986) in which they pointed out that *S. damnosum* vectors were encountered mostly in areas with ninety percent of the annual rainfall of 1,100mm.

The preferred biting sites were mostly the legs, ankles and any other exposed parts of the body nearer the ground. This indicated that the flies were low-biters. This finding was consistent with the observation by Cox (1993), Wilton and Collins (1978), Shelley and Arzube (1985) and Iboh and Braide (1987). It was also observed that when the fly was about to feed, it delayed a little before piercing the skin. After feeding, it was difficult to fly away when filled with blood. A similar observation was noted by Iboh and Braide (1987), Service (1980) and Cook (1996).

The peak biting activities of these flies corresponded with the time of active human activities like fetching of water, bathing, washing etc. The knowledge of the biting activity of *S. damnosum* can be utilized in the development of control strategies for the control of onchocerciasis in the study area in particular and other similar ecological settings in general. The peak biting time could be avoided by man in his outdoor working engagements. Moreover, the wearing of suitable clothings could also prevent bites on the legs.

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