African Journal of Applied Zoology & Environmental Biology. 2005. Vol. 7, 14 – 18
ISSN 1119-023X
www.uniportjournals.com/ajazeb

SEASONAL VARIATIONS IN HUMAN ONCHOCERCIASIS TRANSMISSION BY BLACK FLIES (*SIMULIUM damnosum s. l.*) IN A FOREST AREA OF CROSS RIVER STATE, NIGERIA

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ABSTRACT

Observations on seasonal variations in onchocerciasis transmission by *Simulium damnosum sensu lato* were made in a study carried out in Kwa Falls, Aningeje in Akamkpa LGA (a typical forest area) of Cross River State, Nigeria. The study was carried out for three months of the rainy season (August, September and October, 1999) and three months in the dry season (November, December, 1999 and January, 2000). Black flies were caught on five consecutive days of each month by two flycatchers working alternate hours for a total of eleven hours in a day (07 hr. – 1800 hr.). The black flies caught were dissected fresh in the field to determine the physiological age (parity). Parous flies were stained with Mayer's Haemalum and dissected to determine the infection\infectivity rates (percentages) due to *Onchocerca volvulus*. During 30 days of black flies catching, a total of 7,403 *S. damnosum s. l.* vectors were attracted to man. Out of this figure, 230 (3.1%) black flies were parous. More black flies were caught in the rainy season than in the dry season. This was also true of the parous black flies identified. The infection\infectivity rates (percentages) averaged 9.4\5.7. The problem of onchocerciasis in the study area is more of a biting nuisance by the vector.

Keywords: *Simulium damnosum*, Black flies, Human onchocerciasis, Dry Season, Rainy Season, Forest

INTRODUCTION

Human onchocerciasis (River blindness) is a parasitic disease of immense public health importance in view of the medical and socioeconomic problems associated with the disease. A parasitic nematode worm, *Onchocerca volvulus* that causes itching and disfiguring skin disease, serious eye lesions and blindness in countries where the disease is endemic, causes onchocerciasis. It also causes abandonment and\or prevention of cultivation of fertile lands in endemic communities (Taylor et al., 1990, Edungbola & Parakoyi, 1991, Wigg, 1993, Bassanaz et al., 1994, WHO, 1995a, WHO, 1995b, WHO, 1995c). In addition, onchocerciasis could result in such important complications as onchocercomata, hanging groins, hernia and elephantiasis (Edungbola et al., 1991, Botto et al., 1997).

Onchocerciasis is transmitted from an infected human to a no-infected one by the bite of the infected black fly known to naturalists as *Simulium damnosum* (Tsalikis, 1993). In West Africa and East Africa, the predominant species is *Simulium damnosum* complex, which coexist with other species such as *S. sirbanum, S. sanctipauli* and *S. soubrense* (Braide, 1996). In Nigeria, *Simulium* species are responsible for the prevalence of onchocerciasis. The disease varies in endemicity in the endemic States including the Federal Capital Territory with sporadic infections in others (WHO, 1995a). In Cross River State, Nigeria, *S. damnosum* complex was incriminated as the main vector of onchocerciasis. This complex was made up of the following *Simulium* species: *S. damnosum, S. alcocki, S. cervicornutum, S. unicornutum and S. impukne* (Iboh & Braide, 1987).

Cytotaxonomic studies of the *S. damnosum* complex from different parts of Nigeria have revealed the presence of the five cytospecies, these include: *S. damnosum sensu stricto, S. sirbanum, S. squamosum, S. yahense and S. soubrense* (including the Beffa form). In these studies, the biogeographical distribution of the sibling species was mostly similar to that observed further west of the Onchocerciasis Control

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Programme (OCP) area, although geographic variation was recorded in *S. sqamosum* s. *str.* and *S. sirbanum* (Mafuyai et al., 1996). Biting by these black flies occurs out-doors at almost any daylight hour, but each species of black fly may have its preferred times of biting (Awolola and Ogunrinade, 1996, Adewale et al., 1996). A study conducted in Obubra LGA, Cross River State, Nigeria revealed that the biting density of *Simulium* vary with the time of the day (Iboh & Braide, 1987). In addition, researchers working in different countries of the world have observed that irrespective of the posture of the catchers, the legs and any exposed part of the body nearest to the ground are the preferred biting sites of *Simulium*. Variations have also been observed in the monthly proportions of *S. damnosum s. l.* biting various body regions (Iboh & Braide, 1987, Adebote, 1990).

The focus of this present study was to observe the biting behavior of *S. damnosum s. l.* and also to measure some entomological indices\parameters of human onchocerciasis transmission in the forest area of Cross River State, Nigeria during two distinct seasons (that is, rainy and dry seasons). The findings of this study will definitely contribute to improved planning, effective monitoring and evaluation of the progress of control programmes.

MATERIALS AND METHODS

STUDY AREA/SITE

The study area\site is located in the Cross River State which is situated within the Cross River Basin, between latitude 5° 32' and 4° 27' north and longitude 7° 50' and 2° 20' east. The study was carried out in Kwa Falls, Aningeje in Akamkpa LGA. This study area is a typical forest area with numerous plantations including palm, rubber, cocoa etc. The area is about 68 km eastward from the State Capital, Calabar. Cross River State experiences two climatic seasons, the rainy season from May to October and the dry season from November to April. In this State, there is an all year round rainfall of about 350 mm along the coastal area. Rainfall in the hinterland is between 120 mm and 200 mm annually with maximum precipitate occurring from July to September. The State's ambient temperature remains high throughout the year (22.4°C – 33.2°C). Its relative humidity is high (60% - 93%). The right and left bank tributaries of the Cross River drain the State.

ADULT BLACK FLIES COLLECTION

Two trained flycatchers drawn from the study area working alternate hour from 0700 hr. – 1800 hr. caught adult black flies. The study was conducted in three months of the rainy season (August to October, 1999) and three months in the dry season (November, 1999 to January, 2000). A total of 30 days (that is, five days a month) were used for black flies catching spread over the six months period of field studies. Flies were captured before they settled to feed by flycatchers dressed in knickers or with trousers folded up to the knee level using glass-catching tubes.

DISSECTION AND IDENTIFICATION OF ADULT BLACK FLIES

The black flies captured were immediately dissected fresh in the field to determine their physiological age (parity) according to Mokry (1980). Each fly dissected was first anaesthetized with chloroform and placed on a glass slide in a normal saline solution. Where it was not possible to dissect all the flies caught, they were brought back to the laboratory alive, in perforated collecting tubes with a piece of cotton wool soaked in 1% glucose solution (Iboh & Braide, 1987, Mafuyai et al., 1997, Okon et al., 2002).

RESULTS

During the study, a total number of 7,403 black flies were caught\dissected for parity. Out of this number, 5,411 flies were for the rainy season while 1,992 flies were for the dry season (Tables 1 and 2). The parous flies were 53(2.7%) in the rainy season and 30 (4.7%) in the dry season. The biting densities, infection\infectivity rates and transmission potentials of *O. volvulus* by black flies for rainy and dry seasons are also shown on Tables 1 and 2.

The infection rate was 7.5% during the rainy season and 6.2% in the dry season. The infectivity rates were 5.7% and 3.3% in the rainy and dry seasons, respectively. The total\average transmission potentials were 16\5 and 3\1 for the rainy and dry seasons respectively.

Table 1: BITING DENSITIES AND TRANSMISSION POTENTIALS OF *Onchocerca volvulus* by *Simulium damnosum s. l.* AT KWA FALLS, ANINGEJE (A FOREST AREA) DURING 30 MAN\DAYS OF COLLECTION FROM AUGUST – OCTOBER 1999 (RAINY SEASON)

Data on	Months of collection			Total/ Average
	August 1999	September 1999	October 1999	
No. of black Flies (i) Caught\dissected	1,943	1,906	1,562	5,411
(ii) Parous	53	53	77	183
(iii) With 1st or 2nd or 3rd stage larvae in the thorax	4	6	5	15
(iv) With infective larvae* of *O. volvulus* (3rd stage larvae in the head)	3 (2.0)	4 (1.4)	2 (2.1)	9 (5.5)
Rate (Percent):				
(i) Parous	2.7	2.8	4.9	3.4
(ii) With 1st or 2nd or 3rd stage larvae in the thorax	7.5	11.3	6.5	8.2
(iii) With infective larvae of *O. volvulus* (3rd stage larvae in the head)	5.7	7.5	2.6	4.9
Transmission potential +	6	6	4	16/5

* Average number of infective larvae per infective black fly in parentheses.
\+ Total number of infective larvae available for transmission rounded off (that is, product of infective biting density and average number of infective larvae per infective black fly).

Table 2: BITING DENSITIES AND TRANSMISSION POTENTIALS OF *Onchocerca volvulus* by *Simulium damnosum s. l.* AT KWA FALLS (A FOREST AREA) DURING 30 MAN\DAYS OF COLLECTION FROM NOVEMBER 199 – JANUARY 2000 (DRY SEASON)

Data on	Months of collection			Total/ Average
	November 1999	December 1999	January 2000	
No. of black Flies (i) Caught\dissected	638	655	699	1,992
(ii) Parous	30	9	8	47
(iii) With 1st or 2nd or 3rd stage larvae in the thorax	2	1	2	5
(iv) With infective larvae* of *O. volvulus* (3rd stage larvae in the head)	1 (1.0)	1 (1.8)	0	2(2.8)
Rate (Percent):				
(i) Parous	4.7	1.3	1.1	2.4
(ii) With 1st or 2nd or 3rd stage larvae in the thorax	6.7	11.1	25.0	10.6
(iii) With infective larvae of *O. volvulus* (3rd stage larvae in the head)	3.3	11.1	0	4.3
Transmission potential +	1	2	0	3/1

* Average number of infective larvae per infective black fly in parentheses.
\+ Total number of infective larvae available for transmission rounded off (that is, product of infective biting density and average number of infective larvae per infective black fly).

DISCUSSION

The results from this study significantly confirm seasonal variations in human onchocerciasis transmission by the vector, *S. damnosum s. l.* in the forest area of Cross River State, Nigeria. In this forest area, the black flies show serious biting nuisance. This biting nuisance was greater in the rainy season than in the dry season. The bites of these blood sucking adult female flies are not only a source of discomfort to the villagers who regularly bathe, fetch water and wash their wares in the stream around the Kwa Falls, but also to the oil palm farmers and fishermen who engage in their chosen occupations in and around the Falls.

The Daily Biting Rate (DBR) and the Monthly Biting Rate (MBR) were higher in the rainy season than in the dry season. This finding agrees with that of (Cheke et al., 1997) working in Bioko island of Equatorial Guinea. This led to the conclusion that, due to restricted distribution of *S. damnosum* complex in dry season, vector eradication may be feasible. The Monthly Transmission Potentials (MTP) had mix distribution, oscillating between low

and high in the study site. These potentials were higher during the rainy season than during the dry season. The overall proportion of parous flies caught was higher in the rainy season than in the dry season.

In Kwa Falls, the lower transmission potentials compared to the high number of female adult black flies caught strengthens the argument for high degree of biting nuisance by the black flies. This proportion differs from what was obtained in the study carried out at five sites across the Guinea Savanna and Montane areas of Nigeria (Mafuyai et al., 1997). However, the overall infection and infectivity amongst parous flies were higher in the dry season than in the rainy season. These later findings are in consonant with that made by Mafuyai et al. (1997) studying in Nigeria. The results from the study site will be better appreciated when one considers the fact that Kwa Falls was completely flooded in the month of October 1999. This incident brought about a reduced productivity of existing breeding sites during the rainy season.

The seasonal changes in the rates of infected and infective flies in the study site are indication of changes in the flies' contact rates with infected people. Such changes could be mediated by variations in human behavior, such as a higher proportion of people visiting the riverside in the dry season or by increased anthropophily of the flies (Cheke et al., 1992). In the study area, there was less human activity during the rainy season, especially in the month of October 1999 when the rains were very heavy. Intensive human activity was however recorded in November and part of December 1999 when the rains had gone down drastically. These months happen to fall within the farming season and oil palm harvesting period.

ACKNOWLEDGEMENT

We are thankful to Messrs. U. E. Akpanebong and Fidelis Ntui for their invaluable assistance in the collection of black flies.

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