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The ecology of *Glossina palpalis* in Abraka, Nigeria

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ABSTRACT

An entomological survey of tsetse fly density and infection rate were carried out in some communities in Abraka (Urhouka, Umeghe, Urhovie, Oria and Ugono), Nigeria. A total of 83 flies were caught. Dry season catches were significantly higher than the wet season fly population ($p<0.05$). The mean infection rate was 0.072 (6 out of 83 flies). Among the Abraka communities sampled for tsetse flies, Urhouka had the highest fly population (0.63). The mean differences in fly density of these communities were significant ($p<0.0001$). The highest number of fly was collected along water ways ($p<0.0001$). The number of flies caught along river banks during the dry seasons was significantly higher than the number collected in the wet seasons ($p<0.0001$). Negative associations were observed for rain fall and relative humidity with monthly fly density at -0.853 and -0.803, respectively; while, a positive correlation was seen for air temperature and monthly fly density ($r = 0.013$). These associations were statistically significant ($p<0.05$). In conclusion, the behaviour of Glossina palpalis in Abraka is not different from the typical ecological behaviour of 'riverine' tsetse species which suggests that during the dry season period, vector control efforts for the purpose of human African trypanosomiasis (HAT) disease control should be intensified especially along river lines in Abraka, Nigeria.

Key words: *Glossina palpalis*, Ecology, Nigeria, fly density.

INTRODUCTION

Human African trypanosomiasis (HAT) known as sleeping sickness is a neglected tropical disease which is caused by *Trypanosoma brucei gambiense* in West Africa. Members of the *Glossina palpalis* group are the principal vectors of human sleeping sickness in Nigeria [1, 2]. Tsetse fly density and infection rate are the main entomological factors related to transmission risk [3]. Knowledge of vector abundance and distribution is fundamental to vector control strategies [4].

The habitat of the palpalis flies occur mainly in the drainage systems leading to the Atlantic or the Mediterranean Ocean, extending from the wet mangrove and rain forests along the coastal regions of West Africa to the drier savannah areas just north of the rain forests. The flies in the palpalis group are less tolerant to the wide range of climatic conditions of the savannah belt, and are therefore restricted to the ecoclimate of the watercourses. The *G. p. palpalis* in Côte d'Ivoire, prefer peri-domestic conditions and have been observed to maintain close association with villages [5]. Similarly, it is thought that the advancement of *G. tachinoides* into Eastern Côte d'Ivoire and Togo have been attributed to the intense agricultural development and the rapid human population growth around the plantations [6].

The *G. palpalis* group distribution is strictly riverine vegetation and permanent pools of water [7]. However, deviation in this typical ecological behaviour has been documented [8,9]. This investigation is therefore aimed at confirming for the first time the ecological behaviour of *G. palpalis* in Abraka, a HAT endemic area in Nigeria [10].

MATERIALS AND METHODS

This investigation was carried out in rural Abraka communities in Ethiope East Local Government Area of Delta State, Nigeria. Abraka is located between latitude 5˚.45’-5˚.50’N and longitude 8˚06’-8˚15’E. The vegetation ranges from the mangrove thick forest to mixed rain forest and grass lands. Dry season is from November to February while the rainy season lasts for 8 months. Rainfall peaks in July and October. The major source of water for the rural dwellers in Abraka is the Ethiope River.

Tsetse flies were caught from May 2008 to January 2010. Sampling of these flies was carried out bimonthly within 48-72 hours for six months during the wet seasons and weekly for three months in the dry seasons. Traps (Nitse and biconical) were pitched in the five Abraka communities along river banks, farms and in dwelling areas.

Tsetse flies were harvested every 24 hours and briefly stored in a container with 70% alcohol. Flies were immediately identified using the keys of [11] and dissected [12] to check for trypanosomes. Fly density was estimated as number of catches per number of traps per number of days [13].

Data for Abraka on rainfall, air temperature and relative humidity for the two-year sampling period were obtained from the Meteorological Station, Delta State University, Abraka.

Data were entered into Microsoft Excel spread sheet and fly density was transformed using the formula $Log_{10}(x+1)$ [14], where x=fly density. The relationship between fly density and these ecological abiotic factors were analysed with Spareman rank correlation test using InStat statistical package.

RESULTS

Table 1 shows yearly tsetse fly density and infection rate. A total of 83 flies were caught (1 *G. tachinoides* and 82 *G. p. palpalis*) for the 2-year sampling period. In 2008, 38 flies were caught with 37 *G. p. palpalis* and 1 *G. tachinoides.* In 2009, 45 *G. p. palpalis* were caught. The wet season average fly density was 0.14 (1 fly/7 traps/day) while dry season average fly density was 0.3 (1 fly/3 traps/day). The overall average apparent fly density was = 0.2 (2 flies/10 traps/day). In 2008, the infection rate was 0.05 (2 out of 38 flies were infected) while in 2009, the infection rate was 0.08 (4 out of 45 flies were infected). In all, annual mean infection rate was 0.072 (6 out of 83 flies).

Figure 1 shows the mean monthly fly densities in Abraka. Monthly fly densities were highest in the months of December (0.3) and January (0.36) and lowest in the months of June (0.08) and July (0.1). The difference in fly densities for dry seasons was significantly higher than the wet seasons ($t = 4.38$, $p<0.001$, 95% CI: 0.008 to 0.029).

Among the Abraka communities sampled for tsetse flies, Urhouka had the highest mean fly density of 0.41, followed by Umeghe (0.33), and then Ugono (0.22), Oria (0.13) and Urhovie (0.06) in that order (Figure 2). The differences in mean fly density in these communities were not statistically significant ($F=2.438$; $p>0.05$).

The mean fly densities within sampling areas (river lines, farms and dwelling places) were: Urhouka (0.72, 0.51 and 0), Umeghe (0.52, 0.31 and 0.18), Ugono (0.45, 0.23 and 0), Oria (0.26, 0.13 and 0) and Urhovie (0.16, 0.03 and 0), respectively (Figure 2). In all, the mean fly densities were highest along river lines (0.42), then the farms (0.24) and lowest in dwelling areas (0.036). The differences in mean fly densities in these sampling areas were also statistically significant ($F=7.48$, $p<0.05$). Additionally, the overall mean fly density along river lines in both dry (0.63) and wet (0.22) seasons was 0.43. The difference in mean fly density for dry seasons was significantly higher than the wet seasons (OR=0.15, 95% CI: 0.15 to 1.60, $p<0.05$).

Negative associations were observed for rain fall ($r = -0.901$) (Figure 3) and relative humidity with monthly fly densities ($r = -0.854$) (Figure 4); while, a positive correlation was seen for air temperature and monthly fly density ($r = 0.722$) (Figure 3). These associations were statistically significant ($p<0.05$).

Table 1: Yearly and seasonal tsetse fly density and infection rate

Year	Number of flies caught	Fly density		Infection rate		
		Wet season	Dry season	Wet season	Dry season	Total
2008	38	0.16	0.24	0.012	0.012	0.05
2009	45	0.12	0.5	0.022	0.066	0.08
Total	83	0.14	0.3	0.024	0.048	0.072

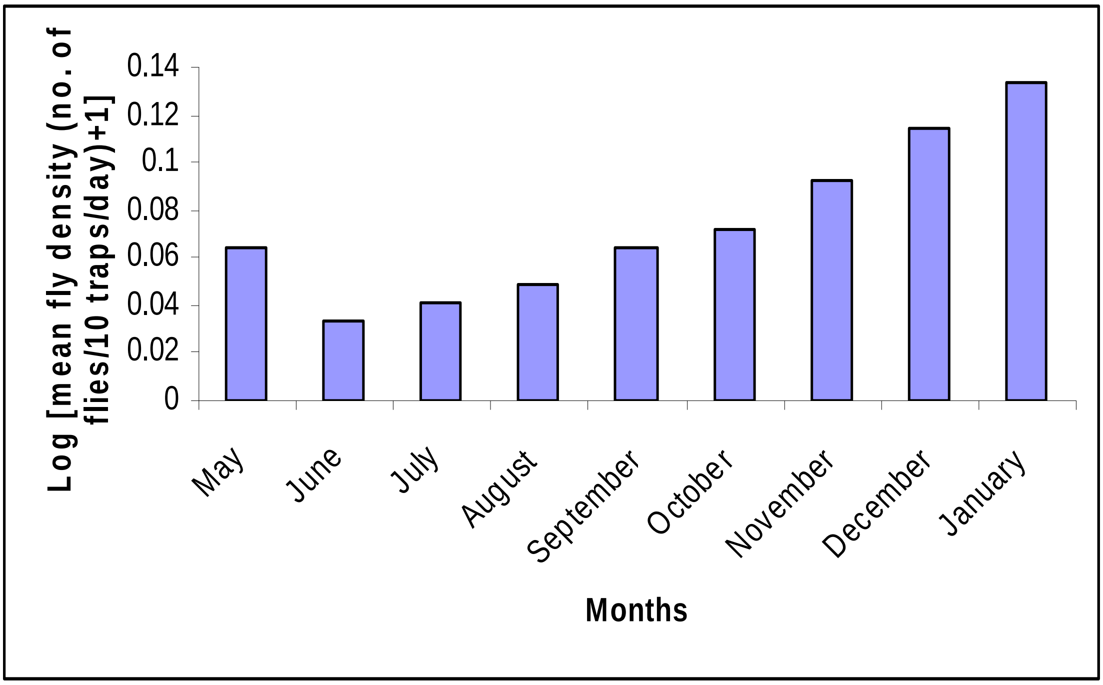

Figure 1: Mean monthly fly densities in Abraka

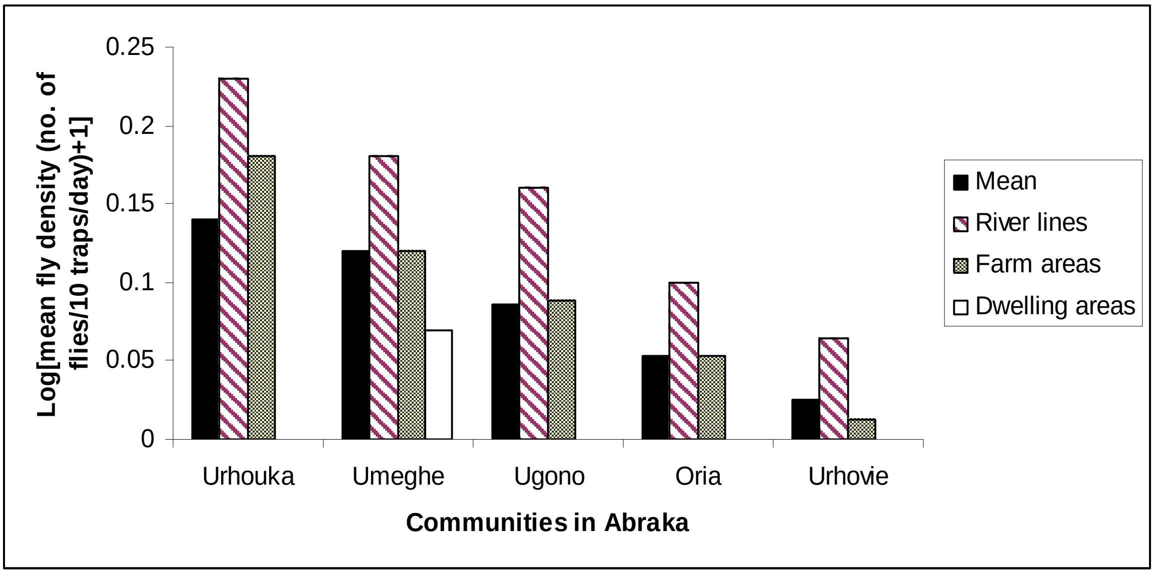

Figure 2: Tsetse fly densities in some communities in Abraka

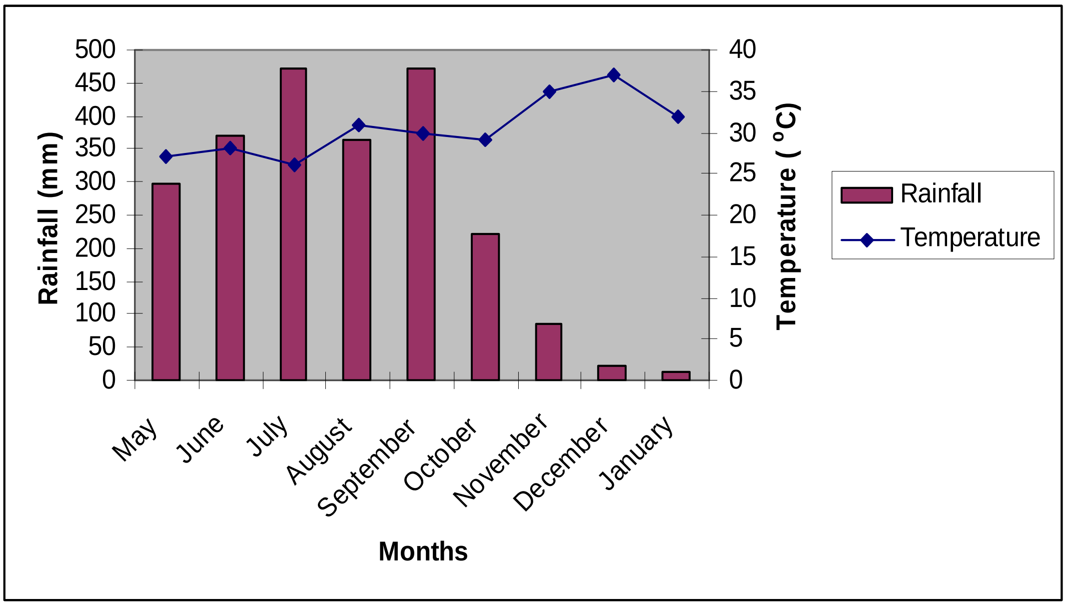

Figure 3: Monthly rainfall and temperature variations

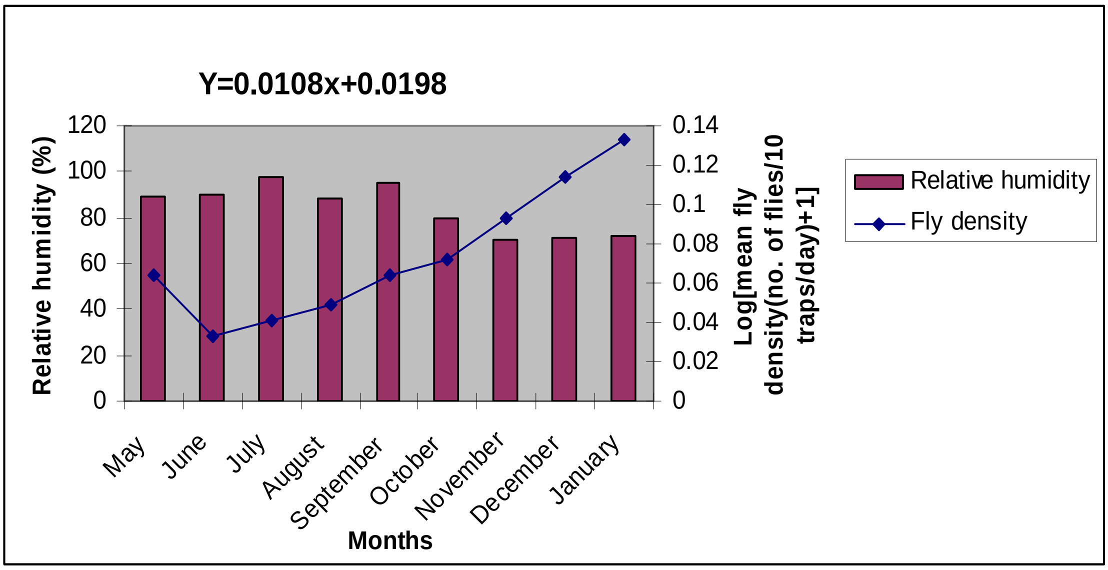

Figure 4: Relative humidity and fly densities

DISCUSION

The fly density and infection rate reported in this study can be said to be low. However, flies caught during dry season were more in number than flies collected during wet season. This demonstrates the typical behaviour of *G. palpalis* group [7] in this area contrary to some deviations reported elsewhere [8, 9]. Tsetse flies have been documented to give lower rate of breeding and reduced longevity due to lower temperature in the wet season than the dry season period (15). The data of less than 1% infection rate contradicts the report of [15] where an overall infection rate of 18.2% was reported. Less than 10% of original population of bloodstream forms of trypanosomes have been documented to be viable and are able to transform into procyclic form [16, 17, 18]. Also, the low infection rate could be on the account that trypanocidal lectins in the midgut of tsetse flies can terminate some trypanosome infections as demonstrated by [19] where infected flies were significantly increased when fed with glucosamine, a lectin binding sugar.

Peridomestic behaviour of *G. palpalis* was observed in Umeghe community. This is not surprising because of the proximity of this community to the river compared to the other surveyed communities. *G. p. palpalis* are known to travel up to 3km from their breeding grounds [20]. Also, environmental conditions of suitable environmental temperature, high humidity, presence of shade/shelter and suitable food source have been identified to establish peridomestic behaviour by a population of *Glossina* species [21]. We therefore assume that the peridomestic behaviour *G. p. palpalis* in Umeghe-Abraka area is an indication of the fulfillment of the above conditions and this could pose great risk of infection to members of this community.

Greater number of tsetse flies was caught along water ways in the dry season than wet season. We therefore assert that during the wet season, flies disperse beyond the water ways contrary to the report of [22] that flies disperse along river banks during wet seasons. Our observation may be attributed to the fact that the microclimate that supports the survival of *G. palpalis* along river banks are closely similar beyond these areas (farm areas and and human dwelling places) during the rainy season.

Generally, it was observed that increased rainfall and humidity led to reduced fly density. Rainfall does not have any direct effect on tsetse, but does so indirectly by affecting the humidity, causing local flooding which may drown many pupae and maintaining different vegetation zones, according to how much rain falls and how long the rainy season lasts [23]. These reasons could have contributed to the low fly density in the wet season.

Increase in temperature was associated with increase in fly density. Our finding agrees with the study in Ugbodigha in southern Nigeria [24]. Reduced temperature in the wet season has been reported to slow down the rate of development of the eggs in the ovaries, lengthens the larval period and cause inactivity of *Glossina* males which leave many *Glossina* females unfertilized [25]. This may account for the reduced fly abundance in the wet season compared to the dry season fly catches in Abraka.

In conclusion, the behaviour of *G. palpalis* in Abraka is similar to the typical behaviour of ‘riverine’ tsetse flies. The transmission level was higher in the dry season than wet season given the data of fly abundance and infection rate for the two seasons. In order to achieve the elimination goal for HAT, efforts toward vector control should be intensified along river banks during the dry season in Abraka, Nigeria.

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