SEASONAL FLUCTUATION AND RELATIVE ABUNDANCE OF TSETSE FLY (GLOSSINIDAE) IN OBINAGU (OBEAGU), ENUGU SOUTH LOCAL GOVERNMENT AREA, ENUGU STATE, NIGERIA

[1]DALLA, Victor Chatcham, [1]ANI, Nweze Michael, [1]ONWE, David Aja, [1]ORICHI, Martin Nwele and [2]OGUNLEYE, Oluyomi Olajumoke

[1]Nigerian Institute for Trypanosomiasis Research (NITR), Southeast Zonal Office, Enugu, Enugu State, Nigeria.
[2]Nigerian Institute for Trypanosomiasis Research (NITR), Ilorin Liaison Office, Ilorin, Kwara State, Nigeria.

Corresponding Author: Dalla, V. C. Nigerian Institute for Trypanosomiasis Research (NITR), Southeast Zonal Office, Enugu, Enugu State, Nigeria. **Email:** chatchamdallas@gmail.com **Phone:** +234 7030477559

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ABSTRACT

Trypanosomiasis, transmitted by tsetse flies has remained a serious health threat to both animal and human life in Nigeria and other countries in the sub-Saharan Africa. This study was conducted between June – July (wet season) and November – December (dry season) of 2017. Biconical traps were deployed at three sampling sites along the gallery forest of River Ewu in Obinagu and the captured tsetse flies were identified and sexed. A total of 182 tsetse fly of the species Glossina palpalis were collected, out of which 42(23.07 %) flies were caught during the dry season and 140(76.92 %) during the wet season. Out of the 42 flies caught during the dry season, 28(66.6 %) were males and 14(33.3 %) were females and of the 140 caught during the wet season 71(50.7 %) were males and 69(49.2 %) were females. The difference in flies caught during the wet and dry season was significant (p<0.05). Similarly, significantly more males (p = 0.01) and female (p = 0.01) were trapped during the wet season compared to dry season. The relative abundance of tsetse flies between dry and wet seasons were 23.07 and 76.9 % respectively, thus, tsetse flies captured were more abundant during the wet season than the dry season. Also, the abundance of the male tsetse flies caught was more than the female tsetse flies. The study confirmed the presence of tsetse flies in Obinagu, Obeagu community in Enugu South LGA Enugu State Nigeria.

Keywords: Tsetse fly, Seasonal fluctuation, Abundance, Obinagu, Enugu

INTRODUCTION

The biting nuisance and the vectorial competence of tsetse fly in transmission of trypanosomiasis have been of great concern in Public Health, Veterinary and Agriculture. The distribution and abundance of tsetse fly are determined by the interplay of suitable climatic conditions, habitat and host availability (Nnko *et al*., 2017; Simwango *et al*., 2017), and negatively impact human and animal Health (Imna *et al*., 2011). Recent report by WHO (2021) indicated that sleeping sickness threatens millions of people in 36 countries in sub-Saharan Africa. Many of the affected populations live in remote rural areas with limited access to adequate health services, which complicates the surveillance and therefore the diagnosis and treatment of cases. In addition, displacement of populations, war and poverty are important factors that facilitate transmission. Recently, it has been estimated that the population at risk is 55 million people for the period 2016 – 2020; with only three million people at moderate or higher risk (WHO, 2021).

More so, the annual economic losses attributed to African Animal Trypanosomiasis (AAT) are measured in billions of dollars (Angara *et al*., 2014). At present, the disease incidence differs from one country to another as well as in different regions of a country. In the last five years, over 70 % of reported cases occurred in the Democratic Republic of Congo, with about 1000 cases declared annually. Angola, Central African Republic, Chad, Congo, Gabon, Guinea, Malawi and South Sudan declared between 10 and 100 new cases in 2019, while Cameroon, Côte d'Ivoire, Equatorial Guinea, Uganda, United Republic of Tanzania, Zambia and Zimbabwe declared between 1 and 10 new cases. Countries such as Burkina Faso, Ghana, Kenya and Nigeria, have reported sporadic cases in the last 10 years (WHO, 2021).

Nigeria is estimated to have 19.5 million cattle, 72.5 million goats, 41.3 million sheep, 7.1 million pigs, 28,000 camels and 974,499 donkeys, and majority of these livestock at risk of AAT because they are located in tsetse-infested regions (Isaac *et al.,* 2017). Human African Trypanosomiasis (HAT) occurs mainly in large areas of the savannah, in cattle settlements, and wild game reserve where tsetse flies are prevalent and the animals serve as reservoir of the parasites. The most exposed population comprises rural dwellers who are involved in farming, animal husbandry, hunting, fishing, swimming, logging and other domestic activities like washing of clothes and fetching of water in rivers and streams visited by tsetse fly. Controlling tsetse and trypanosomiasis has been a herculean task due to the antigenic variation of the parasite and the nature of the life cycle of the vector. Vaccine development has not been successful yet. Recent control efforts are geared towards the vector. Several tsetse fly control methods such as bush clearing, chemical control, destruction of wild life etc. have been employed in time pass but are accompanied with severe consequence (WHO, 2022). The Area Wide Integrated Pest Management (AW-IPM) which utilizes the sterile male release technique (SMRT) has been employed in tsetse fly control (Vreysen, 2001).

Van den Bossche and De Deken (2002) noted that knowledge of temporal, dry and wet seasons, prevalence of trypanosomiasis and distribution of tsetse fly are important when devising appropriate strategies for control, as the success of this control method is based on the knowledge of the species composition in the intended survey area. This study therefore, seeks to establish an entomological baseline for seasonal density of tsetse fly and identify the composition of the species at the varying season.

MATERIALS AND METHODS

The Study Area: A community based entomological survey was conducted between June – July (wet season) November – December (dry Season) of 2017 in Obinagu (Obeagu) community, Enugu South Local Government Area, Enugu State, Nigeria (Figure 1).

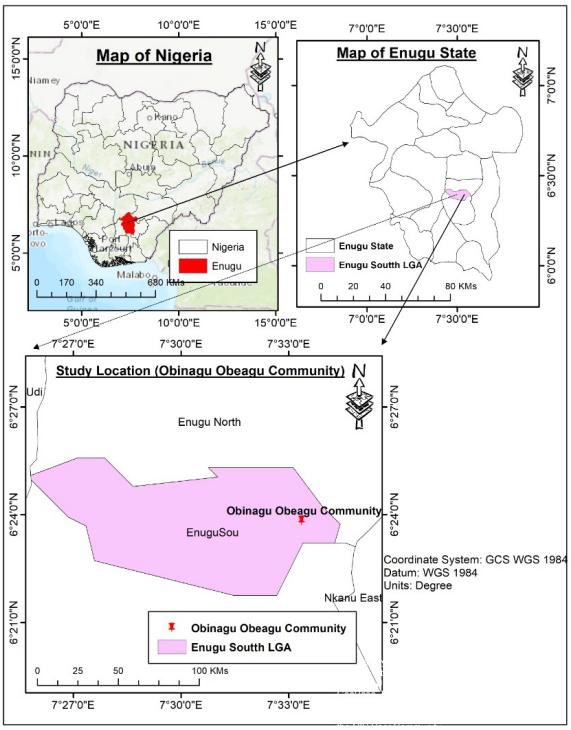

Figure 1: Map of the study area. Source: GIS Unit, Geography Department, University of Nigeria, Nsukka

Enugu South with her headquarters in the town - Uwani has an area of 67 km² and a projected population of 267,300 persons as at 2016 (Wikipedia, 2017).

Obeagu is a semi urban community just a few kilometers from Enugu metropolis. Obinagu is one of the communities in Obeagu. It has a coordinate of Latitude 06°23˙20 and Longitude 07°33˙04.

The vegetation ranges from shrubs to trees and grassland with both domesticated and wild animals. Human activities include logging, hunting with villagers visiting the stream to fetch water. Wet season begins from March and last through October while dry season begins from November to February (Wikipedia, 2017).

Vector Studies and Morphological Identification: Biconical traps were deployed at three sampling sites along the gallery forest of River Ewu in Obinagu for each of the season. The three traps were set along the length of gallery forests at some distance upland as described by Abah *et al.* (2019) and sampling was done weekly for a period of 3 weeks (21 days) in each season (dry and wet season). Traps were checked for flies and emptied regularly. Tsetse flies caught were identified and sexed according to Leak *et al*. (2008).

Relative Abundance: Relative abundance of tsetse flies was estimated by weekly sampling for a period of three weeks for each of the seasons in 2017 in Obinagu Obeagu of Enugu South LGA. The sites were selected through stratified random subsampling of the major vegetation types in the area (Vreysen *et al*., 2013). A total of three sites were identified and one biconcal trap was deployed at each site located at least 100 m apart. At each trapping site, the grass vegetation was cut to ground level and the leg of the trap greased to avoid ants consuming caught flies.

Data Analysis: Data was analysed using Statistical Packages for Social Sciences (SPSS) version 20.0 (IBM Corporation, Armonk, USA). Kruskal-Wallis H test was used to compare the relative abundance of tsetse fly among stations in the study area. Numerical data were presented as mean ± SE (standard error of mean).

Student's t-test was used to compare the tsetse relative abundance between the wet and dry seasons. Level of significance was kept at $p<0.05$.

RESULTS

From the three traps deployed at the three sampling sites along the gallery forest of Ewu River a total of 182 tsetse fly were collected. Out of which 42(23.07 %) flies were caught during the dry season (Table 1) and 140(76.92 %) tsetse flies during the wet season (Table 2).

Table 1: Tsetse fly abundance in Obinagu (Obeagu), Enugu South Local Government Area, Enugu State, Nigeria during the dry season

Day	Trap ID	Tsetse caught	Male	Female
Week 1	Trap 1	8	6	2
	Trap 2	3	2	1
	Trap 3	0	0	0
Week 2	Trap 1	14	8	6
	Trap 2	1	1	0
	Trap 3	1	1	0
Week 3	Trap 1	14	9	5
	Trap 2	0	0	0
	Trap 3	1	1	0
Sum		42	28	14
Mean		4.67 ± 5.83	3.11 ± 3.55	1.56 ± 2.35
Relative abundance (%)		23.07	66.67	33.33

Table 2: Tsetse fly abundance in Obinagu (Obeagu), Enugu South Local Government Area, Enugu State, Nigeria during the wet season

Day	Trap ID	Tsetse caught	Male	Female
Week 1	Trap 1	17	10	7
	Trap 2	11	6	5
	Trap 3	19	9	10
Week 2	Trap 1	20	7	13
	Trap 2	2	2	0
	Trap 3	13	5	8
Week 3	Trap 1	20	10	10
	Trap 2	16	7	9
	Trap 3	22	15	7
Sum		140	71	69
Mean		15.56 ± 6.19	7.89 ± 3.69	7.67 ± 3.67
Relative abundance (%)		76.92	50.71	49.29

Out of the 42 flies caught during the dry season, 28(66.67 %) were males and 14(33.33 %) were females and out of the 140 tsetse caught during the wet season 71(50.71 %) were males and 69(49.29 %) were females (Table 3).

Table 3: Sex distribution of tsetse fly in Obinagu (Obeagu), Enugu South Local Government Area, Enugu State, Nigeria during the dry and wet seasons

Period	Dry season		Wet season	
	Male	Female	Male	Female
Week 1	8	3	25	22
Week 2	10	6	14	21
Week 3	10	5	32	26
Sum of flies caught	28	14	71	69
Relative abundance (%)	66.67	33.33	50.71	49.29

The difference in flies caught during the wet and dry season was significant ($p<0.05$). Higher number of tsetse flies were trapped during the wet than dry season ($t = 3.842$, $p = 0.01$); similarly, significantly more males (71.71, $p = 0.001$) and female (83.13, $p = 0.01$) were trapped during the wet season compared to dry season (Table 4).

Table 4: Seasonal relative abundance of tsetse fly in Obinagu (Obeagu), Enugu South Local Government Area, Enugu State, Nigeria

Relative abundance (%)	Dry season	Wet season
Male in wet and dry season	28.28	71.71
Female in wet and dry season	16.87	83.13
Total	23.01	76.9

The relative abundance of tsetse between wet and dry seasons was 76.9 and 23.01 % respectively when compared as depicted in Figure 2. Interestingly all flies caught during the survey were morphologically identified to be *Glossina palpalis palpalis* Robineau-Desvoidy, 1830 (Diptera: Glossinidae).

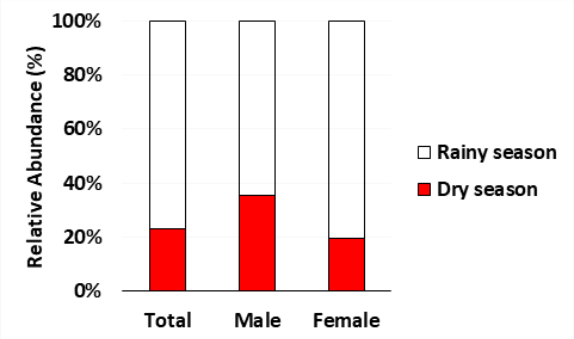

Figure 2: Relative abundance of tsetse fly in Obinagu (Obeagu), Enugu South Local Government Area, Enugu State, Nigeria during the dry and wet seasons

DISCUSSION

The study confirmed the presence of tsetse flies of the species *G. palpalis palpalis* in Obinagu community as earlier reported by Onyekwelu *et al*. (2017) in Emene and other parts of Enugu State. *G. palpalis* is an important vector of human trypanosomiasis (Wamwiri and Changasi, 2016) and have the ability to withstand harsh dry season weather conditions (Ohaeri and Eluwa, 2007).

The relative abundance of tsetse flies during the wet and dry season indicated higher abundance during wet season Globally, it has been revealed that population of tsetse flies significantly varies with seasons (Abah *et al.,* 2019). This trend have been observed in Kaduna, Nigeria (Ahmed, 2007; Umar *et al.,* 2020) and in Adamaoua region of Cameroon where higher densities of tsetse flies were reported during the wet season (Mamoudou*, et al.,* 2006; Abah *et al.,* 2019). Tongue *et al*. (2015) observed a high abundance of *Glossina fuscipes fuscipes* Newstead, 1910 (Diptera: Glossinidae), *G. morsitans submorsitans* Newstead, 1910 (Diptera: Glossinidae) and *G. fusca* Walker, 1849 (Diptera: Glossinidae) in Dodeo basin. Similarly, study conducted in Tanzania by Nnko *et al*. (2017) on tsetse fly species showed monthly changes in abundance with most of *G. swynnertoni* Austen 1922 (Diptera: Glossinidae) and *G. morsitans morsitans* Westwood, 1851 (Diptera: Glossinidae) collected in July.

In Zambia, the index of apparent density of tsetse fly (*G. morsitans morsitans*) increased in the beginning of the wet season in November to reach a peak at the end of the wet season in April (Van den Bossche and De Deken, 2002). In a study conducted in Maze National Park, Gamo Zone, Southwest Ethiopia, it was observed that the density of *G. pallidipes* Austen, 1903 (Diptera: Glossinidae) was found to be high during wet months and decreased during dry months (Zuma, 2021). It is important to note that during the dry season most flies lack resting sites due to drying vegetation or bush burning and oviposition sites which result to population decline. Abah *et al*. (2019) also found reduced population during the dry season.

In contrast to the present study, Lukaw *et al*. (2015) reported a significantly high catches of *G. fuscipes fuscipes* in dry than the wet season in Kajo-Keji County South Sudan. In Kogo (Equatorial Guinea), the apparent density of *G. palpalis palpalis* fell from 1.23 fly/trap/day in July (wet season) to 0.27 fly/trap/day in December (dry season) (Cano *et al.,* 2007). This variation in seasonal abundance of tsetse flies population could be linked to the effect of optimum temperature on the normal physiological activity of tsetse flies during seasons in each agro-ecological zone (Abah *et al.,* 2019).

Omoogun and Akinboade (2000) in a study in the Egbe area of kogi State, Nigeria observed significantly greater numbers of *G. palpalis palpalis* and *G. tachinoides* Westwood, 1850 (Diptera: Glossinidae) in the dry season than in the wet season reflecting the seasonal trend in tsetse density in the studied community. This trend was attributed to flooding of pupal sites by storms of the early rains, reduced mean temperature of the environment, high humidity where the atmosphere was saturated with vapour. During the 3 weeks of study in the region, the majority of tsetse flies caught were male compared to female. This was similar to the findings of Abah *et al.* (2019) in a study in Cameroun where majority of the tsetse flies caught were males. Similarly, Okoh *et al*. (2011) in their investigation, found the majority of tsetse flies caught to be male. Similarly, in Nigeria, male tsetse fly catches (309, 61.6 %) were significantly ($p<0.05$) higher than females (19338.4 %). This trend observed in this study may be attributed to high fly activity in search for food and mating partner (Abah *et al.,* 2019). Contrary to the findings of this study, Abubakar *et al.* (2016) recorded more female than male flies in their various studied sites at Salt Lick B and Guruntun Areas of Yankari National Park, Bauchi State, Nigeria.

Higher number of flies were caught in trap 1 compared to traps 2 and 3; this may be attributed to the frequent activities that were observed in that location. Most villagers visited the site for washing and fetching of water for their domestic use. These uneven occurrences of tsetse in different trapping sites may perhaps be due to human activities around the pool which serves as an attraction for tsetse in search of host to feed. Traps 2 and 3 had relative catches both during the dry and wet season. Anthropogenic activity such as logging and road/ house construction were common sights during the survey and these have been shown to affect tsetse population (Reid *et al*., 2000). This was in agreement with findings of Imna *et al.* (2011) in Tanzania, Munang'andu, (2012) in Luangwa and Zambezi valley ecosystem in Zambia and Salekwa *et al*. (2014) in Simanjiro, northern Tanzania, that anthropogenic activity pose a significant threat of reducing tsetse fly habitat. Tsetse fly habitat destruction has been shown to increase with peridomestic activities in *G. palpalis* (Ahmed, 2004; Isaac *et al*., 2011). The presence of these peridomestic tsetse flies usually constitutes serious danger for sleeping sickness transmission even at low density (Ahmed, 2004).

Previous studies highlighted also that the combination of many factors such as vegetation density, the presence of nutrient and hosts could explain the high density of tsetse flies in any specific area (Abah *et al.,* 2019). In Nigeria, Wama *et al*. (2018) in a study in Gashaka-Gumti National Park located in the mountainous region of north-eastern Nigeria, attributed the abundance of tsetse flies to the presence of riverine gallery forest and dense vegetation (forest vegetation) of shaded trees along the trapping area which provided shade, resting sites and a suitable microclimate for the flies as well as a habitat for their vertebrate

hosts. A similar case was reported by Okoh *et al*. (2011), who opine that such environmental parameters, creates suitable conditions for the survival and flourishing of tsetse flies.

Conclusion: The study confirmed the presence and the abundant distribution of tsetse fly population with marked seasonal fluctuations in Obinagu Obeagu community, Enugu South LGA of Enugu State, Nigeria. Therefore, the present study calls for strategic vectors control intervention programmes that will help prevent the surge of tsetse flies density and the consequent scourge of trypanosomiasis in this agrarian community and spread to other areas.

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