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STUDY OF DISTRIBUTION AND ABUNDANCE OF TSETSE FLY (GLOSSINA SP.) IN GASHAKA-GUMTI NATIONAL PARK, NIGERIA

[1,*]Wama B. E., [2]Naphtali, R.S., [1]Houmsou, R.S., [1]Joseph J., [2]Alo, E. B.

[1]Department of Biological Sciences, Taraba State University, Jalingo, Nigeria
[2]Department of Zoology, Modibbo Adama University of Technology Yola, Adamawa State, Nigeria

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ABSTRACT

A study on the distribution and abundance of tsetse flies was conducted between November, 2016 and January, 2017 at Gashaka-Gumti National Park (GGNP), Nigeria. The aim of the study was to determine the distribution and abundance of the fly (Glossina sp.) in the Park. Thirty (30) Biconical traps (Charlier and Laviessiere, 1973) were used to trap the tsetse flie in three locations (Kwano, Gashaka and Mayo-kam). A total of six hundredand ninety eight (698) flies were caught during the study period. Kwano, Gashaka and Mayo-kam had 372 (53.3%), 168 (24.1%) and 158 (22.6%) respectively. Location of the traps varied significantly with tsetse catch ($\chi 2 = 250.150$; $P<0.000$). Glossina tachinoides. Glossina palpalis, Glossina morsitans and Glossina fuscipes were trapped in the area. Overall, Glossina tachinoides had higher frequency of 476 (68.2%) and least from Glossina fuscipes 6 (0.9%). Tsetse catches were significantly higher in the month of November ($\chi 2 = 23.425$; $P = 0.001$) than December and January as dry season progress. Female tsetse flies collected during the studies were significantly higher than males for all the species except G. morsitans, ($\chi 2 = 56.185$; $P = 0.000$ at df 3). The results therefore suggest for a strategic control of tsetse flies in the park.

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INTRODUCTION

Tsetse flies, of the genus *Glossina* are large biting and blood-feeding flies of great economic, veterinary, and medical importance, due to their ability to transmit African trypanosomiasis in humans and animals, they are cyclical vectors that transmit animal trypanosomiasis which constitute a significant barrier to the development of farming and food security in the regions of Africa where they are prevalent (Bouyer *et al.*, 2013). Tsetse-transmitted trypanosomiasis occur in 38 sub-Saharan African countries with averages of 15,000 human cases and one million cattle deaths reported yearly, exposing over 70 million people and 160 million cattle to the risk of infection in the region , (OIE Terrestrial Manual, 2008). Tsetse flies are distributed over wide range of habitats covering about 10 million square kilometers of potential grazing and farming lands in sub-Saharan Africa (Kuzoe, 1993).

Corresponding author: **Wama B. E.,**
Department of Biological Sciences, Taraba State University, Jalingo, Nigeria.

Tsetse abundance and feeding behaviours determine the degree of vector-host contact and may have a serious impact on the risk of pathogen transmission. The degree of contacts between vectors and vertebrate hosts is an important determinant of their vectoral capacity and is determined by the vector feeding patterns on its hosts. As vectors of human and animal trypanosomes', the epidemiology of these diseases is determined largely by their abundance, density, and feeding behaviours (Ducheyne *et al.,* 2009). The threat to tsetse fly infestation exists in most national parks/wildlife park and is a major health risk to tourists coming to tropical Africa (Sabbah *et al*., 1997; Conway-Klaassen *et al*., 2002; Jelinek *et al*., 2002). The study was carried out in Gashaka-Gumti National Park (GGNP; located in the remote mountainous region of north-eastern Nigeria, between the boundaries of Adamawa and Cameroon, between latitudes 6°55' and 8 °13'N and longitudes 11°11' and 12°13'E with an estimated landmass of 6,402.48square kilometers of undulating terrains and deep rolling valleys. It is an important water catchment area for the Benue River with abundant river flow even during the

markedly dry season. Enclaves for local Fulani pastoralists exist within the park's boundary allowing for farming and grazing. Three locations were selected to represent the various vegetations in the area; they are Kwano, Gashaka village and Mayo-kam. Kwano (research center) lies between the coordinates of latitude 7°19.405'N and longitude 11°34.834'E. It is a forested area, waterlogged in some places and has some rivers hence gallery forest. Gashaka village (enclave) also found directly after the park between the coordinates of latitude 7°21.524'N and longitude 11°28.432'E, it comprises of savannah woodland, plantations, human habitation as well as riparian forest along banks of river. Mayo-kam (along buffer zone) on the other hand lies between the coordinates of latitude 7°21.373'N and longitude 11°22.174'E, it is also located in the savannah woodland vegetation area, with gallery forest along the bank of river. All the rivers in the three locations flow throughout the year.

All the traps were baited uniformly with acetone (Brightwell *et al*., 1997). Acetone was poured on the ground about 30 cm around and away from the trap pole. The poles of traps were greased to prevent fly predators, mainly ants. Traps were allowed to stay at the site of deployment for a period of 48h before collection. Traps were places before insect activity time and in areas where sunlight is adequate. Where the trap visibility was poor, the grasses and bushes were cleared using machete to improve its visibility (Bouyer *et al.,* 2005).

Identification of species and sex determination

The flies were sorted into species and sex using hand lens, forceps and Dissecting Microscope and petri dish and identification key described by Leak *et al*., (2008); Grzimek, (1980); Crooskey, (1973); Potts, (1973) and Murray *et al*. (1983), Database was created using Microsoft Excel version 2010.

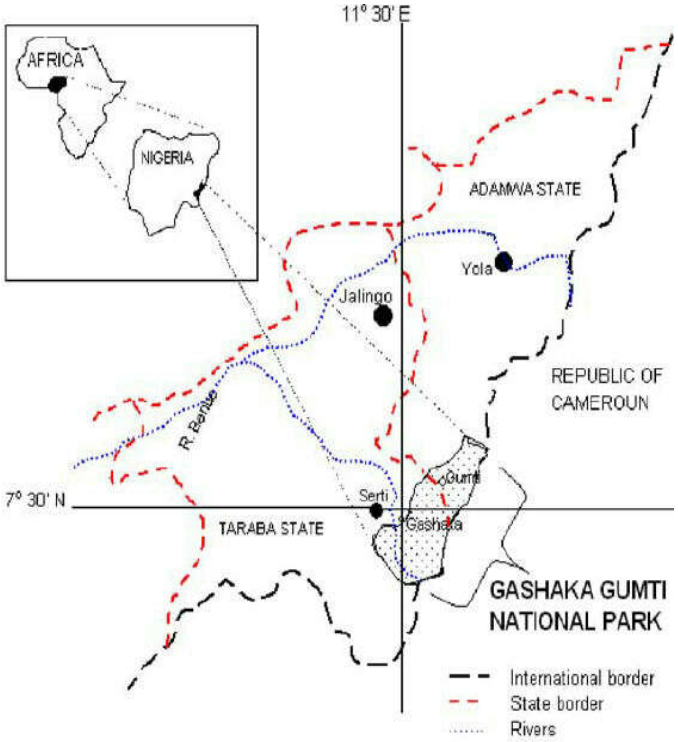

Figure 1. Gashaka-Gumti National Park (Warren, 2004)

Table 1. Number of *Glossina species* caught at Various Altitudes in Gashaka-Gumti National Park

		Glossina species (%)				
Location	Altitude (m)	*G. tachinoides*	*G. palpalis*	*G. morsitans*	*G. fuscipes*	Total
Mayokam	312	149 (94.3)	1(0.6)	5(3.2)	3(1.9)	158(100.0)
Gashaka	334	163(97.0)	2(1.2)	1(0.6)	2((1.2)	168(100.0)
Kwano	548	164(44.1)	205(55.1)	2(0.5)	1(0.1)	372(100.0)
Total		476	208	8	6	698

χ^2 =250.150 P< 0.05

The study was conducted for three (3) months from November, 2016 to January, 2017. Tsetse flies were harvested after 48 hours. Thirty (30) traps were deployed, ten (10) in each location as stated above. Each trap was labeled based on area mounted; 100m apart along water courses, habituated areas and farm lands and 200m apart in forested areas (Bouyer *et al*, 2005).

The data obtained from this study was analyzed statistically using Pearson Chi-Square test. The results were presented in histogram, bar charts and tables.

RESULTS

Distribution of *Glossina* species: The distribution of tsetse flies in the study area showed a high population of tsetse flies

Plate III: *Glossina tachinoides* (Field survey 2016-2017)

Plate IV: *Glossina palpalis* (Field survey 2016-2017)

Plate V: *Glossina morsitans* (Field survey 2016-2017)

Plate VI: *Glossina fuscipes* (Field survey 2016-2017)

Plate VII: Male *Glossina* sp. (Field survey 2016-2017)

Plate VIII: Female *Glossina* sp (Field survey 2016-2017)

Table 3. Species composition and habitat type of *Glossina* sp. in Gashaka-Gumti National Park

Habitat	Specie (%)			
	G. tachinoides	*G. palpalis*	*G. morsitans*	*G. fuscipes*
Forest	165[a]	205[b]	2[c]	1[d]
Woodland Savanna	311[a]	3[b]	6[c]	5[d]

(χ^2_{cal} = 209.6; P<0.05)

Table 4. Abundance of male and female *Glossina* sp. at Gashaka-Gumti National Park

Sex	Species (%)			
	G. tachinoides	*G. palpalis*	*G. morsitans*	*G. fuscipes*
Male	188[a]	26[b]	3[c]	5[d]
Female	288[a]	182[b]	5[c]	1[d]

(χ^2_{cal}= 56.19 P<0.05)

NOTE: Superscript with the same letter in the same row shows non-significance; while those with different letters shows significance.

in Kwano (372) and moderate population in Gashaka 168) and Mayo-kam (158), (Table 1). From Table 2, it revealed that the forested habitat type (53.44%) had more species than the woodland savannah (46.56%). Chi-square showed that the association between species composition and habitat type is significant (Table 3).

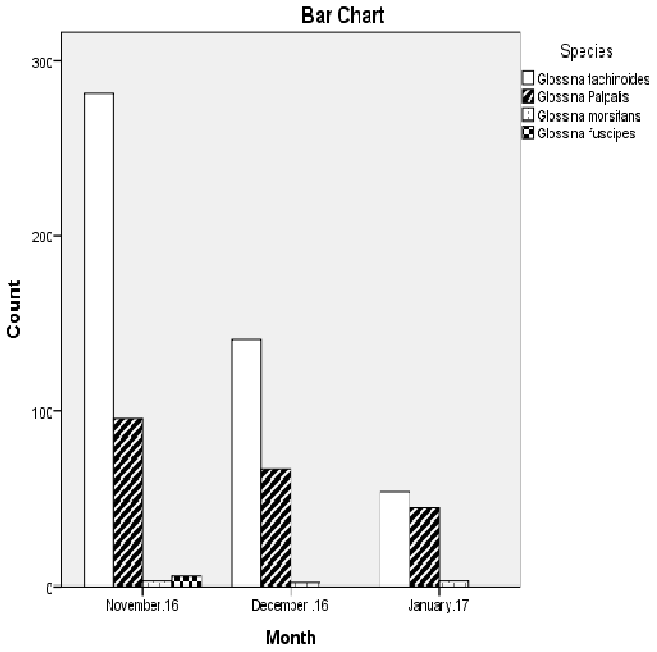

Figure 3. Monthly abundance of *Glossina species* in Gashaka-Gumti National Park

Abundance of *Glossina* species: Two groups of tsetse flies were encountered during the study. The Nemorhina (*Palpalis*) and *Morsitan* group: Three (3) from the Nemorhina (*Palpalis)* group: *Glossina tachinoides* (Plate I)*, Glossina palpalis* (Plate II)*, Glossina fuscipes* (Plate III) and one from the *Morsitan* group; *Glosssina morsitans*(Plate IV) respectively. In all, 698 flies were caught comprising 476 (68.19%) of *Glossina tachinoides,* 208 (29.80%) of *Glossina palpalis,* 8 (1.15%) of *Glossina morsitans,* and 6 (0.86%) of *Glossina fuscipes*, (Table 1). The study recorded November the highest (55.3%) catch, December (30.1%) and January (14.6%) of *Glossina* species (Figure 3).

Sex of *Glossina* sp.: The highest abundance of *Glossina* was recorded among the female species 68.19% than in the male 31.81% (Table 4). Results at P<0.05 show that the difference in sex of tsetse fly and species composition was statistically significant.

DISCUSSION

Baseline data on tsetse distribution, relative abundance and species composition, are essential for the development of an appropriate cost effective, sustainable area-wide control strategy (Leak *et al.,* 2008; Shaw, 2009). An understanding of tsetse population distribution and dynamics is essential for understanding the epidemiology of human and animal trypanosomiasis (Aksoy, 2003; Hao *et al*., 2001). The distribution of tsetse flies in the study area showed considerable proportions in all the sampling locations with a high population in Kwano and moderate population in Gashaka and Mayo-kam. The presence of more flies at Kwano during the study period may be due to the presence of riverine gallery forest and dense vegetation (forest vegetation) of tall shaded trees along the trapping area which provides shade and maintains a suitable microclimate for tsetse flies as well as a habitat for their vertebrate hosts. Similar case was observed by Rogers and Randolph, (1985); Okoch *et al*., (2011), they said such environmental parameters have created suitable conditions for the survival and flourishing of flies. Less human activities and disturbance also may be a factor for the higher abundance of tsetse flies in Kwano. This agrees with the previous findings by Malele, (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 activities pose a significant threat of reducing tsetse habitat. These human activities were present in Gashaka village and Mayo-kam.

The species of tsetse flies encountered during the study were *Glossina tachinoides, Glossina palpalis, Glosssina morsitans* and *Glossina fuscipes*. The same species were also reported in the same region by Karshima *et al*., (2011) and in other parts of the country by Ahmed, (2004) at Kontagora town in Niger state and Ohaeri, (2007) in Abia state. Davis, (1977) reported in his work on tsetse fly in Nigeria that the four most important species of *Glossina* in Nigeria are *G. palpalis*, *G. tachinoides*, *G. mortisans* a s*ubmortisans* and *G. longipalis*. In all, 698 flies were caught comprising 476 (68.19%) of *Glossina tachnoides,* 208 (29.80%) of *Glossina palpalis,* 8 (1.15%) of *Glossina morsitans,* and 6 (0.86%) of *Glossina fuscipes*. The high abundance of *G. tachinoides* compared to the other species owes to the fact that it can survive more than the others in the far Northern Nigeria. This was predicted in the tsetse prediction map designed for FAO and DFID, (Leak *et al*., 2008) by ERGO and confirmed from these studies. *G. tachinoides* is also a riverine species; hence its abundance than

the other species. The findings disagrees with earlier findings by Karshima, *et al*., (2011) around the region, on the abundance of *G. palpalis* over *G. tachinoides*, which may be due to the seasons of the year as these studies was conducts in the early dry season.

Conclusion

The location specific entomological data gathered for this study provide evidence of the extensive distribution of tsetse in the area, with fluctuations in the population which is due to the season and availability of natural vegetation and host. It also revealed the presence of four species of economic, medical and veterinary importance. Differences in tsetse flies distribution, abundance and ecology imply that different control strategies may be needed for the control of the species in the study area. The role that game parks and other protected areas may play in sustaining tsetse populations, as well as the circulation of trypanosomes in game animals and humans and the potential dispersal of both the vector and pathogen from these areas need to be emphasis.

Recommendation

This study therefore points to the importance of strategic vector (*Glossina* sp.) control in Gahaka-Gumti National Park and other areas so as to reduce risk and transmission of both animal and human trypanosomosis as the area is frequently visited by both native people, rangers, researcher, tourists and student for educational purposes.

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