American Journal of Applied Sciences 8 (11): 1067-1072, 2011
ISSN 1546-9239

Catch Composition of Tsetse Flies (*Glossina: Glossinidae*)

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Abstract: Problem statement: A study to determine the composition of tsetse flies species was conducted between January and December, 2007 in Kamuku National Park, Nigeria, using Biconical and Nitse traps. Tsetse flies were trapped along gallery forest in five streams for two trapping days and were collected daily. **Approach:** All tsetse flies caught were identified to species level, sexed, separated into teneral and non-teneral, hunger staged and Mean Hunger Stage computed. Fly density were calculated, the age structure examined using wing fray techniques for males and ovarian technique for females; the reproductive status of female flies were assessed. Two species of tsetse flies (*Glossina palpalis palpalis* robineau-desvoidy and *Glossina tachinoides* Westwood) were caught in total of five hundred and two (502) flies. Out of these, 309(61.6%) *Glossina tachinoides* and 193(38.4%) *G. palpalis* were caught. Male catches (309, 61.6%) were significantly ($P < 0.05$) higher than females (193, 38.4%) also, the teneral flies (289, 57.6%) were more than the non-teneral flies (213, 42.4%). The Mean Hunger Stage (MHS) of 3.6 obtained indicated a hungry fly population. Fly density was generally low (0.1fly/trap/day) and varied between months with highest density (3flies/trap/day) occurring in February and lowest (0.2 fly/trap/day) in July. **Results:** The estimated mean age for males was 11 days and females were 8 days. The insemination rate of 93.8% generally was high, *G. tachinoides* recorded 95.5% more than *G. palpalis* of 91.6%. Whereas parity rate (25.8%) was low; *G. palpalis* was 37.4% while *G. tachinoides* parity rate is 17.2%. **Conclusion:** The study shows that two species of tsetse flies abound in the park although at low densities their presence may bear semblance to Trypanosomiasis and its impact to ecotourism.

Key words: Tsetse flies, age structure, Mean Hunger Stage (MHS), insemination rate, *glossina tachinoides*, wing fray, instar larva

INTRODUCTION

Vector-borne disease have for long been a bane to the continent of Africa. One of the most economically important is trypanosomiasis transmitted by the *Glossina* species. Tsetse flies are responsible for the transmission of the protozoan parasites of the Genus *Trypanosoma*, the pathogenic agents of sleeping sickness in humans and nagana in cattle (Hu and Askoy, 2006). Tsetse flies are confined only to the afro tropical regions of Africa, where they occupy an area over 7 million km^2. In Nigeria, they infest 75% of the total land mass covering the five agro-ecological zones from Lat 4-13° to Long 2-15° Onyiah. Out of the thirty one species and subspecies described in Africa (PAAT, 2008; Goodings and Krafsur, 2005) Nigeria harbors eleven of these species and subspecies (Davies, 1977).

The genus *Glossina* consists of three distinct subgenera, Morsitans (*Glossina*), Palpalis (Nemorhina) and Fusca (Austenina). These subgenera are differentiated on anatomical features and on their restriction to a relatively specific habitat Leak (1999) quoted Goodings and Krafsur (2005), thus the Morsitans group are classed as savannah-inhabiting species, Palpalis group as riverine or lacustrine species and Fusca group as forest-inhabiting species (Leak *et al*., 2008). Their distribution and abundance being determined by the vegetation type along river banks (Bouyer *et al*., 2005).

Tsetse and trypanosomiasis lies at the heart of Africa's struggle against poverty affecting 37 countries

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in sub-Saharan Africa where the disease is endemic (PAAT, 2008). It is recognized as a neglected disease, principally because it is rural and its impact on the socio-economic development is devastating (Oluwafemi, 2009).

Tsetse flies infestation in most National Parks and Game Reserves poses a major health risk to tourist coming in to tropical Africa (Conway-Klaassen *et al*., 2002; Jelinek *et al*., 2002; Sabbah *et al*., 1997 quoted in Abenga and Lawal, 2005) as well as to rural communities and livestock. These consequently, may result in reduction of revenue with resultant burden on the economy. This study reports the tsetse species present within the park, their sex, age, density and physiological state and reproductive status.

MATERIALS AND METHODS

Study area: The study was conducted in Kamuku National Park (10° 25´N and 6°30´E), Birnin Gwari Local Government Area of Kaduna State Nigeria in 2007. The park lies within the northern edge of the Southern Guinea Savanna Zone (Keay, 1953) and spans an area of 1,120km². The vegetation is typically of the savanna woodland type; there is graduation in vegetation cover being denser, greener and containing fewer *Doka spp* along river banks. The park is characterized by a variety of flora and fauna. Plants species such as *Isoberlina doka, Piliostigma thonningii, Raphia sudanica, Burassieus ethiopum* abound; and animals species detected by direct sighting, footprints and dung included *Loxodonta africanus, Papio papio, Tragelaphus scriptus, Kobus allipsiprymmus*.

Five streams: Dagara, Kabungu Bungu, Kango Kabungu, Kuzomani and Kurishi streams (Fig. 1) transverse the park giving rises to riverine forests and thickets along water courses where trapping was done. Two seasons characterizes this area i.e., wet (May-October) and dry (November-April) seasons.

Tsetse trappings: Biconical (Challier and Larveissiere, 1973) and Nitse (Omoogun, 1994) traps were used for trapping and collection of tsetse flies in both the wet (May- October) and dry (November-April) seasons of 2007. Four Traps were placed at about 100 m apart for two days along each of the five streams each month and collected every day. All flies collected from traps in each stream's trapping points were labeled and conveyed in an ice cooled box to the camp site for entomological examination. The tsetse flies were identified to species level according to method described by Black and Seed (2001) and Pollock (1982) and were sexed based on the presence of hypopygium at the posterior end of the abdomen for males and which is absent in females.

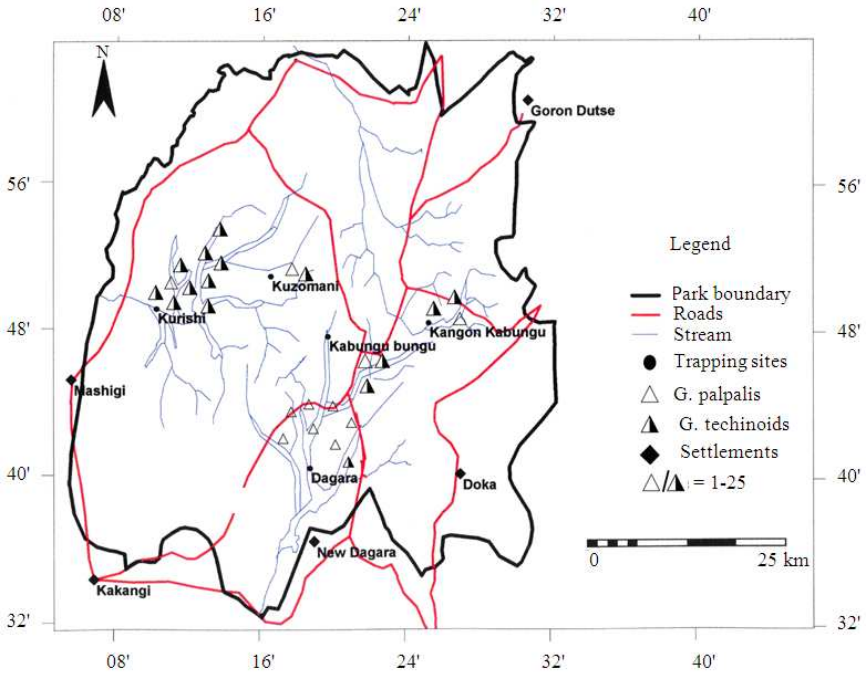

Fig. 1: Kamuku National Park showing the trapping sites and Tsetse species

The flies were categorized as teneral on soft to touch and whitish abdomen and non-teneral when the thorax is firmer and has a dark area underside of abdomen. Flies were categorized into physiological states (i.e. gorged, replete, intermediate and hungry) according to Jackson (1933) and the Mean Hunger Stage (MHS) was computed by arranging flies in the different physiological categories and then multiplied by factors of 1, 2, 3 and 4 respectively. The sum of the product obtained is divided by the total number of flies; the calculated value is the MHS (Black and Seed, 2001). Male flies were age-graded by Wing Fray (WF) analysis. The trailing end of fly wing is examined with a dissecting microscope to assess the degree of wing fray and then assigned to the six standard; the mean wing fray value is then obtained by multiplying the number of flies in each category by a factor of 1,2,3,4.4,5.5and 6.9 respectively. The sum of the product is divided by the total number of wings examined; the mean value calculated is then crosschecked with the standard to obtain the estimated average age in days. The females were age graded by Ovarian method (Saunders, 1962) and the uterine contents (egg, 1st, 2nd, 3rd instar larva) were examined to determine the pregnancy stages. The pregnancy rate was determined as a percentage of the total no of flies with eggs, 1st, 2nd, 3rd instar lavae in utero. Temperature and relative humidity of each trap point were recorded using whirling Hygrometer.

The data were statistically analysed using Anova, Chi square and Student unpaired t-test.

RESULTS

A total of (502) tsetse flies were caught in the five streams during the study. Tsetse catches varies significantly among streams; the highest number of flies caught 217 were from Kurishi stream followed by these catches: 166, 45, 41 and 33flies from Dagara, Kango Kabungu, Kuzomani and Kabungu Bungu streams respectively. Of the 502 tsetse flies caught 309 (61.6%) were *G. tachinoides* (199♂ and 110♀) while 193 (38.4%) were *G. palpalis* (110♂ and 83♀) (Table 1). Teneral flies constitute the majority with 57.6% of the total catch while non-teneral flies were 42.4%. Tenerality rate were higher in *G. tachinoides* (62.1%) than for *G. palpalis* (50.3%); teneral and non-teneral flies caught were seasonally significant (Table 2).

Out of the 115 non-teneral male tsetse flies sampled, only 1 (0.9%) were fully gorged with blood, 7 (6.1%) were repleted, 26 (22.6%) were in intermediate stage while 81 (70.4%) were hungry. The Mean Hunger Stage computed were 3.6 (Table 3). Monthly densities of the flies caught were highest in February with 3flies per trap per day and lowest in July with 0.2 F/T/D (Fig. 2). 93.8% of the 193 females dissected had been fully inseminated; pregnancy rate were 25.8% and pregnancy stages included 30 flies with egg in-utero, 8 flies each with 1st and 2nd instar larvae, 1 fly with 3rd stage instar larva and 3 flies with an empty uterus (Table 4). The estimated age of male tsetse samples from wing fray method was 11 days, while that of female flies was 8 days.

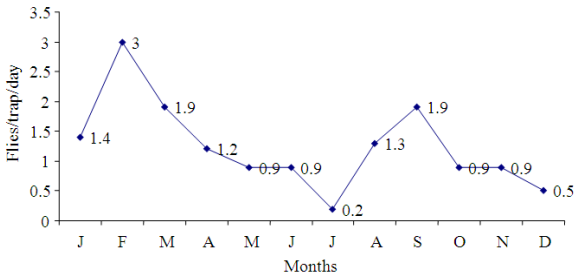

Fig. 2: Mean densities of tsetse flies caught at Kamuku National Park in 2007

Table 1: Tsetse species composition at Kamuku National Park in 2007

Species	Sex ♂	Sex ♀	Streams Dagara Bungu	Kabungu Kabungu	Kango	Kuzomani	Kurishi	Total
G. tachinoides	199	110	5	31	44	16	213	309 (61.6%)
G. palpalis	110	83	161	02	01	25	04	193 (38.4)
Total	309	193	166	33	45	41	`217	502
% Total	61.6%	38.5%	33.1%	6.6%	9%	8.2%	43.2%	

Table 2: Tenerality composition of tsetse species according to seasons in 2007

Tenerality	Species G. palpalis	G. tachinoides	Total	Seasons Dry	rainy
Teneral	97 (50.3%)	192 (62.1%)	289 (57.6%)	37.2±14.6	11±4.2
Non-teneral	96 (49.7%)	117 (37.9%)	213 (42.4%)	16.8±2.6	18.7±4.6
Total	193	309	502	54.0±17.2	29.7±8.8

Table 3: Physiological stages of male tsetse species caught at Kamuku National Park in 2007

Species	No of flies	M.H.S	Physiological categories (%) G	R	I	H
G. tachinoides	67	3.5	-	5	15	47
G. palpalis	48	3.6	1	2	11	34
Total	115	3.6	1(0.9%)	7(6.1%)	26(22.6%)	81(70.4%)

G-Gorged; R-Replete; I-Intermediate; H-Hungry; M.H.S-Mean Hunger Stage

Table 4: Pregnancy stages of tsetse species at Kamuku National Park in 2007

Species	No dissected	Pregnancy rate (%)	No inseminated (%)	Egg	Uterine content 1st	2nd	3rd	E
G. palpalis	83	31 (37.4%)	76 (91.6%)	14	3	3	1	3
G. tachinoides	110	19 (17.2%)	105 (95.5%)	16	5	5	-	-
Total	193	50 (25.8%)	181 (93.8%)	30	8	8	1	3

1st = first instar larva; 2nd = second instar larva; 3rd = third instar larva; E = empty uterus

DISCUSSION

The study shows the abundance of two species of tsetse flies specifically; the riverine species (*G. palpalis* and *G. tachinoides)* which are important vectors of human trypanosomiasis. In Kamuku National Park, the higher number of flies caught at Kurishi and Dagara than in other streams may be associated with local concentration of breeding sites provided by the dense vegetation of tall shaded trees and thick*et al*ong these streams; these form suitable habitat for the flies. This finding agrees with the habitat description for riverine species of tsetse in relation of their abundance by Bouyer *et al*. (2005).

The preponderance of more males than the females in trap catches due to their responsiveness to stationary objects and to trap Jaenson (1981) and Etten (1981) attributed to high fly activity (searching for food and mating partner) may possibly have suggested for the high percentage of male catches observed in this present study. This finding is in agreement with the investigation made by Mohammed-Ahmed *et al*. (1993). The significantly ($P < 0.05$) higher population of teneral flies particularly in the dry season (Table 2) may probably be due to local concentration of flies and breeding locations along streams and increased rate of eclotion.

Fly density was generally low. This is evident by the calculated apparent density of 0.1F/T/D but became higher in the dry months of the year, especially in February when the apparent density of 3F/T/D was recorded. This pattern of population activity is governed by; firstly tsetse flies concentrating in thickets and/or forest out layers because of the drier surroundings and associated increase in temperature. Secondly emergence plays a greater role in determining the density of tsetse as reported by several authors (Omoogun *et al*., 1991; Baldry, 1969; Nash, 1937). Low density of tsetse in the wet season correlates with low emergence and vice versa in the dry season. The low and high apparent densities obtained in the wet and dry seasons, respectively, during this investigation, bear credence towards these assertions; furthermore, several of these factors namely vegetation type during the wet season is full leaf, many areas which normally were dry became water-logged, abundance of predators on tsetse flies e.g. spiders, dragonflies and ants and fly dispersal away from riverine vegetation into the open woodland following increase in humidity may also result in low density of flies amongst others.

Results derived by analyzing the hunger stages of male tsetse population at Kamuku National Park revealed a Mean Hunger Stage of 3.6, thus indicating a hungry population. This may probably be so because, trap caught flies are usually hungry and thus underestimate the true representation of the population. The assertion that gorged flies were a rare occurrence in trap catches basically because, they are relatively inactive at this period and as such not available to capture method concurred with the findings of this study, since only 1 (0.9%) gorged fly was captured.

Age analysis for male tsetse catches indicated 11days and for females 8 days (due to high sampling of females in category 0 forming about 74% of the total sample); this suggest that they constitute a relatively young and growing population supporting the observation made by Mohammed-Ahmed *et al*. (1993) a similar young male population. However, this finding is in contrast to the finding of Ahmed (2004) who observed older population in Kontagora town, Nigeria.

The high insemination rates (93.8%) and the abundance of young parous and nullipars caught suggest that the female population has high reproductive potential in the Park with suitable biotype for breeding. Generally, the frequency of encounter of pregnancy stages in a sample of tsetse occurs in the order egg, first, second and third instar larvae (Ahmed and Dairri, 1987; Saunders, 1962). In this present study, the frequency of encounter of pregnancy stages of flies in the first and second instar larvae was same, hence contradict this order. A similar observation was made by Mohammed-Ahmed *et al*. (1993) and Ahmed (2004).

CONCLUSION

The result from the study shows that tsetse population is low in the National Park.. Seasons did not show significant variation in the abundance of the tsetse in the park although tsetse catches were more in the dry season. Reproductive, physiological status and aging revealed a viable, hungry and young tsetse population, respectively. It is recommended that tsetse control be undertaken in the park during the dry season by trapping method when the fly density is high.

ACKNOWLEDGEMENT

The researchers are grateful to Nigeria Institute for Trypanosomiasis Research, Kaduna, Nigeria for support to undertake this research and permission to publish the results of the study. The approval and assistance of the Conservator General and Director of Kamuku National Park is highly acknowledged. We thank the Park rangers and Field staff that assisted in this study.

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