Seasonal distribution and abundance of Glossina fuscipes fuscipes (Diptera: Glossinidae) in Kajo-Keji County South Sudan

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Full Length Research Paper

Seasonal distribution and abundance of *Glossina fuscipes fuscipes* (Diptera: Glossinidae) in Kajo-Keji County South Sudan

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Tsetse flies are veterinary and medical vectors of genus *Trypanosoma*, they are haemoparasites that causes Human African Trypanosomiasis (HAT) or sleeping sickness in humans and of Nagana in Cattle. *Glossina f. fuscipes* has been identified as the main vector of HAT in South Sudan. Hence, a one-year cross-sectional survey was conducted in four Payams of Kajo-keji County (KKC) to determine seasonal distribution and abundance of *G.f. fuscipes.* 56 biconical traps were deployed to monitor the dynamic of this fly. Flies were identified, segregated into sexes, counted and apparent density of flies/trap/day was determined. Total catches between the dry and wet seasons was analyzed using unpaired t-test. Flies mean apparent density was performed using ANOVA. Moreover, SPSS 16.00 statistical package compatible to microsoft windows was used. A total of 6,161 adult *G.f. fuscipes* were harvested in the dry and wet seasons. Out of which 3,606 flies (1,811 females and 1,795 males) and 2,555 flies (1,583 females and 972 males) were captured in the dry and wet seasons, respectively. The mean apparent density showed two peaks of 8.3 flies/ trap/ day in January and of 5.0 flies in December during the dry season. Such apparent densities varied significantly (F = 7.19, P = 0.0005) among the four Payams of the County. Fly catches in dry season were significantly higher than that of the wet season t(10) = 5.224, P = 0.0004. The dynamic distribution and abundance of tsetse flies in the study area are seasonal. This study is imperative for developing control strategy of tsetse flies in KKC South Sudan.

Key words: Tsetse flies, Glossina fuscipes fuscipes, seasonal dynamics, abundance, apparent density.

INTRODUCTION

Tsetse flies have been associated with the transmission of African trypanosomes for a century (Aksoy et al., 2003) transmitting *Trypanosoma brucei gambiense* and *Trypanosoma brucei rhodesiense* which cause Human African Trypanosomiasis (HAT) that affect human welfare directly in tsetse infested area. Moreover, tsetse flies are the vectors of the causative agents of Animal African Trypanosomiasis (AAT) or Nagana in cattle which is a major obstacle to sustainable development of livestock production systems (Itrad et al., 2003).

Evidence has shown that tsetseflies, *Glossina fuscipes* are the most important vectors of HAT, in almost 90% of all disease cases across Africa (Omolo et al., 2009). However, *G. f. fuscipes* are the main tsetse vectors of the

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Abbreviations:

AAT: Animal African trypanosomiasis; **BMGF:** bill and melinda gates foundation; **CNRES:** college of natural resources and environmental studies; **KCC:** Kajo-keji county; **HAT:** human African trypanosomiasis; **TMRI:** tropical medicine research institute; **SAT:** sequential aerosol technique; **VRI:** veterinary research institute.

Table 1. The seasonal distribution of *Glossina fuscipes fuscipes* in Kajo-keji County, greater Central Equatoria state South Sudan.

Tsetse fly Seasonal distribution	*Glossina fuscipes fuscipes*		Total fly catches	Female: Male ratio
	Females (%)	Males (%)		
Dry season	1,811 (50.22)	1,795(49.78)	3,606	1:1
Wet season	1,583 (61.96)	0 972 (38.04)	2,555	1.6:1.0
Total fly catches	3,394	2,767	6,161	

Gambian type of HAT in the endemic foci of the greater Central Equatoria State South Sudan, (Mohamed et al., 2010). Being a member of the Palpalis group of tsetse flies, *G.f. fuscipes* inhabit low bushes or forests at the margins of rivers, lakes or temporarily-flooded scrub land including KKC. In East African countries, populations of the *G.f. fuscipes* appear to respond to seasonal weather patterns, often disappearing during the bi-annual dry season from sites where they were previously abundant (Askoy et al., 2013).

Vector control remains a viable alternative for large-scale control of trypanosomiasis. As such, suppression and monitoring tsetse flies are imperative using a variety of techniques including traps, insecticide-impregnated targets, live-baits, Sequential Aerosol Technique (SAT) and Sterile Insect Technique (SIT) (Cuisance et al., 2003). Apart from preliminary tsetse field surveys conducted in 2010 and 2011, no progress has been made in the distribution and abundance of *G. f. fuscipes* as a function of seasonality in KKC. But, it appeared that most of the studies had focused on the control of the parasites, *T.b. gambiense*.

Hence, the aim of this study was to determine the seasonal distribution and abundance of *G. f. fuscipes* in the dry and wet seasons. Such information provides impetus for key stakeholders including Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC) initiative which was adopted in the African Summit held in Togo in 2000 (Kabayo, 2002) for developing strategy of tsetse and HAT control in the endemic foci of KKC, South Sudan.

MATERIALS AND METHODS

This study was conducted in four Payams of Lire, Kangapo (I), Kangapo (II) and Liwolo of KKC, greater Central Equatoria State - South Sudan. The study area lies between geographical latitude 3°53′N 31°40′E and longitude 31°40′E. The ecological vegetation covers range from the mangrove thick forest to mixed rain forest and grasslands. Dry season begind from November to March while the wet season is doing so from April to October. Tsetse flies were caught from January to December 2013 using 56 biconical traps of 5 m distance from the gallery forest in seven sites along the banks of eight streams in the four Payams. Sampling of these flies was taken once every week during the dry and wet seasons. Harvested flies were stored in cool boxes, identified (Cordon-Obras et al., 2014) and segregated into females and males. Flies apparent density was estimated as number of catches per number of traps per number of days (Dede et al., 2005). The total catches were transformed using the formula Log10(x+1) (McDonald, 2009) , where x = fly density. This transformation was made to normalize the data used for parametric statistical tests. Graphical presentation was drawn and tables created using Microsoft Excel 2010 for Windows. Comparison of total catches between the dry and wet seasons was analyzed using unpaired t-test. Comparison of mean apparent density of the flies /trap/day of the four Payams was performed using ANOVA.SPSS 16.00 statistical package compatible to Microsoft Windows was used in all statistical analyses.

RESULTS

A total of 6,16 1*G. f. fuscipes* of which 3,606 flies(1,811 females and 1,795 males) were captured in the dry season as compared to 2,555 flies (1,583 females and 972 males) captured in the wet season (Table 1). Total fly catches in the dry season were higher than wet season catches. Female fly catches were higher than male catches in both dry and wet seasons. Female to male ratio was almost 1:1 in the dry season as compared to 1.6:1 in the wet season.

Figure 1 illustrates the evolution of *G. f. fuscipes* apparent density/trap/day with seasons in which two peaks of apparent densities were observed in January and December throughout the study period. The highest peak of 8.3 flies/trap/day revealed in January and the second highest peak (5.0 flies/trap/day) in December.

From Table 2, the apparent densities of *G.f. fuscipes* varied significantly ($F = 7.19$, $P = 0.0005$) between the four Payams of KKC. Of which, the differences are significant at $P \leq 0.05$.

Table 3 shows that the dry season total fly catches were significantly higher than the wet season catches ($t(10) = 5.224$, $P = 0.0004$). The differences are significant at $P \leq 0.05$.

DISCUSSIONS

This study showed that the distribution and abundance of

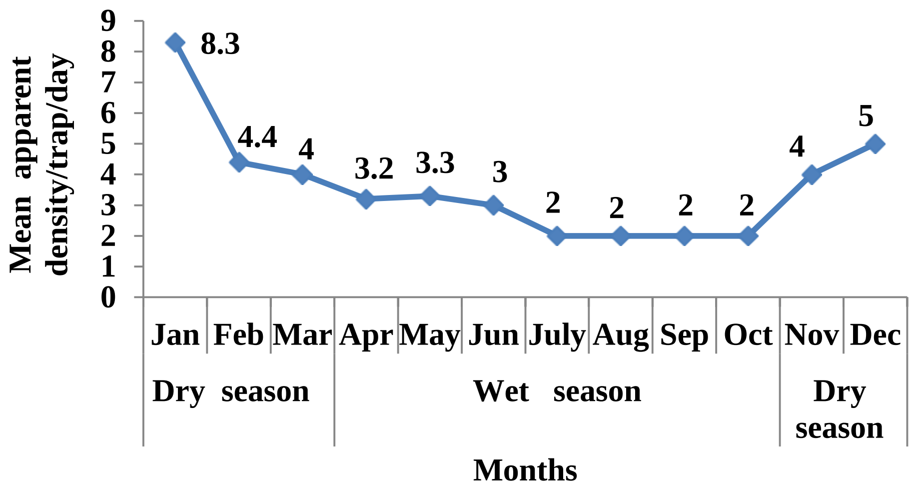

Figure 1. Evolution of *Glossina fuscipes fuscipes* abundance with seasons in Kajo-keji County, greater central Equatoria State South Sudan.

Table 2. Difference in mean apparent densities *of Glossina fuscipes fuscipes* /trap/day in Kajo-keji County, greater Central Equatoria State South Sudan.

	DF	Sum of square	Mean square	F-Value	P-Value
Between Payams	3	4.167	1.389	7.19	0.0005**
Within Payam	44	8.5	0.193		

*Significant (P<0.05); ** highly significant (P<0.01); NS Non significant (P>0.05) one-tailed *P* level.

Table 3. Differences between the fly catches in the dry and wet seasons in Kajo-keji County greater Central Equatoria State South Sudan.

DF	t-Value	p-Value
10	5.224	0.0004**

*Significant (P<0.05); ** highly significant (P<0.01); NS Non significant (P > 0.05) one-tailed P level.

tsetse flies was at high density during the dry season as compared to wet season. This dynamic pattern could reflect the typical behaviours of Palpalis group (Okoh et al., 2012). The concentration of *G.f. fuscipes* within riverine gallery forest or high capture performance of the trap during the dry season might have led to such high density or abundance (Selby, 2011). The low fly abundance in the wet season compared to the dry season might be due to lower ambient temperatures which provide lower rate of breeding (Isaac et al., 2011). On the contrary, the highly significant fly catches in the wet season was shown as compared with the dry season (Isaac et al., 2011). Such disparity in tsetse seasonal dynamics between the both seasons was expected (Lehane, 2005). The socio-economic activities of the rural dwellers including fishing, bathing and water snatching can also influence the distribution of tsetse flies in an area (Lukaw and Ochi, 2012). Moreover, the low fly apparent density in the wet season could be due to the presence of full vegetation covers, which implies that many areas become water-logged that could attract predators including spiders, dragonflies and ants to tsetse flies. Consequently, flies might have been forced away from riverine vegetation into the open woodland (Okoh et al., 2011). Dispersion of the flies beyond water courses during the wet season is contrary to flies' dispersion along river banks during wet seasons (Cano et al., 2007).

Female fly catches were higher than male catches in both dry and wet seasons as shown by the high female to male ratio. This could be explained by the natural longevity of females to cope with reproductive efficiency and production of much more larvae for biotic survival of the flies. Similarly, it was reported that male flies had immediate response to static objects and traps which might lead to high percentage of male catches (Okoh et al., 2011). This study showed that the overall monthly mean apparent density of *G. f. fuscipes* in KKC was highest during the dry season, decreased rapidly at the beginning of rainy season and peaked again during the dry season (December). It seemed that the increase in temperature is associated with increase in fly apparent density (Isaac et al., 2011). This could be explained by the effect of optimum temperature on the normal physiological activity of tsetse flies during summer season as compared to rainy season. However, in Cameroon the mean apparent density of tsetse was revealed higher during the wet season that had culminated in substantial trypanosomiasis challenge 15 (Mamoudou et al., 2006).

CONCLUSION

Dynamic distribution of tsetse fly in the study area seemed to be seasonal. The study did not look into factors that could be responsible for tsetse fly seasonal fluctuations. But it seemed that temperature among other environmental factors played a role in influencing tsetse seasonal distribution in the study area. It can be concluded that understanding the seasonal dynamic distribution and abundance of tsetse in the study area is imperative. Such data and information provide an impetus for the key stakeholders including PATTEC initiative to develop control strategy of tsetse to reduce prevalence of HAT in KKC, South Sudan.

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