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Preliminary Study on Population Structure, Infection Rate and Habitats of Glossina fuscipes fuscipes (Diptera: Glossinidae) in Western Equatoria State South Sudan

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ABSTRACT

Preliminary study on population structure, infection rate and habitats of *Glossina fuscipes fuscipes* with *Trypanosoma brucei* was carried out in Yambio and Tambura Counties, Western Equatoria State, South Sudan in 2013. In each County, unbaited biconical traps were deployed along four streams. Tsetse fly catches were identified morphologically, sorted into males and females and checked for tenerality. Apparent density of flies per trap per day was determined and parasitological examination of dissected midguts of wild flies was made. Ecosystem of the flies were observed and recorded. Out of the total 260 *G.f. fuscipes* Yambio County revealed 45% females and 55% males compared to 44% females and 56% males in Tambura County. The average apparent density of flies /trap/day in Yambio County was 2.32 compared to 0.71in Tambura County. In Yambio County, 92% and 8% of *G. f .fuscipes* population was non-teneral and teneral compared to 90% and 10% in Tambura County, respectively. The average infection rate in *G. f fuscipes* in Yambio County was 2.38% compared to 2.02%in Tambura County. The plants, *Lantana camara* were abundantly scattered along the streams as the main habitats of *G.f.fuscipes*. Further studies are needed in wet season such that vector control strategy is developed in Western Equatoria State, South Sudan

Keywords: *Glossina fuscipes fuscipes; Population Structure; Habitats, Infection Rate*, South Sudan.

INTRODUCTION

Tsetse flies ,*Glossina fuscipes* have been shown across the African continent as one of the most important vectors of human African trypanosomiasis (HAT) which transmit almost 90% of all disease cases (Omolo *et al*., 2009). Evidence has shown that HAT is one of the re-emerging and neglected tropical diseases (Cattand *et al*., 2001) which has infected 300,000 to 500,000 people and exposed 60 million people at high risk by the end of 1990s and up to 2001 (Cano *et al*., 2007).

Glossina fuscipes inhabit low bushes or forests at the margins of rivers, lakes or temporarilyflooded scrub land. In East Africa, populations of the subspecies *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 (Katunguka-Rwakishaya and Kabakambe, 1996).

The choice between elimination or sustainable control of a tsetse population requires knowledge of its population structure as a key milestone. Nevertheless, in isolated populations elimination of tsetse may be feasible. This was demonstrated by the success obtained in eradicating the *G. austeni* Newstead in Unguja Island of Zanzibar in 1997 on which the Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC) initiative was based (Bouer *et al*.**,** 2005). This PATTEC initiative is intended to free the sub-Saharan Africa from tsetse flies **(**Kabayo, 2001).But, understanding tsetse population dynamics is critical for determining the most appropriate vector control strategy (Torr *et al*., 2005).

A few studies were carried out in the population status and main habitats of tsetse flies in post-independent South Sudan. Hence, the aim of this study was to understand the population dynamics, infection rates and ecosystem of tsetse in Yambio and Tambura Counties. This is intended to generate data for mapping and developing a control strategy for tsetse and trypanosomiasis (T&T) in Western Equatoria State (WES) South Sudan.

MATERIALS AND METHODS

Study Area

Yambio County is located in West South of WES, South Sudan at 04°33′54″N and 28°22′30″E compared to Tambura which is located in North West of WES at 5°36'0 N and 27°28'0 E (Fig. 1).The most important common ecological features between Yambio and Tambura are the characteristic habitats around their streams ranging from peri-domesticated to single and double gallery forest habitats where tsetse flies occur in equatorial or semi-equatorial climate. The highest mean maxima temperatures occur during January just before the rain**y** season and they range between 30-32^{o}C. The mean minima temperatures occur during the rainy season as from February to November and range between 19-27^{o}C.The annual mean rainfalls range between 800 to 1200 mm.

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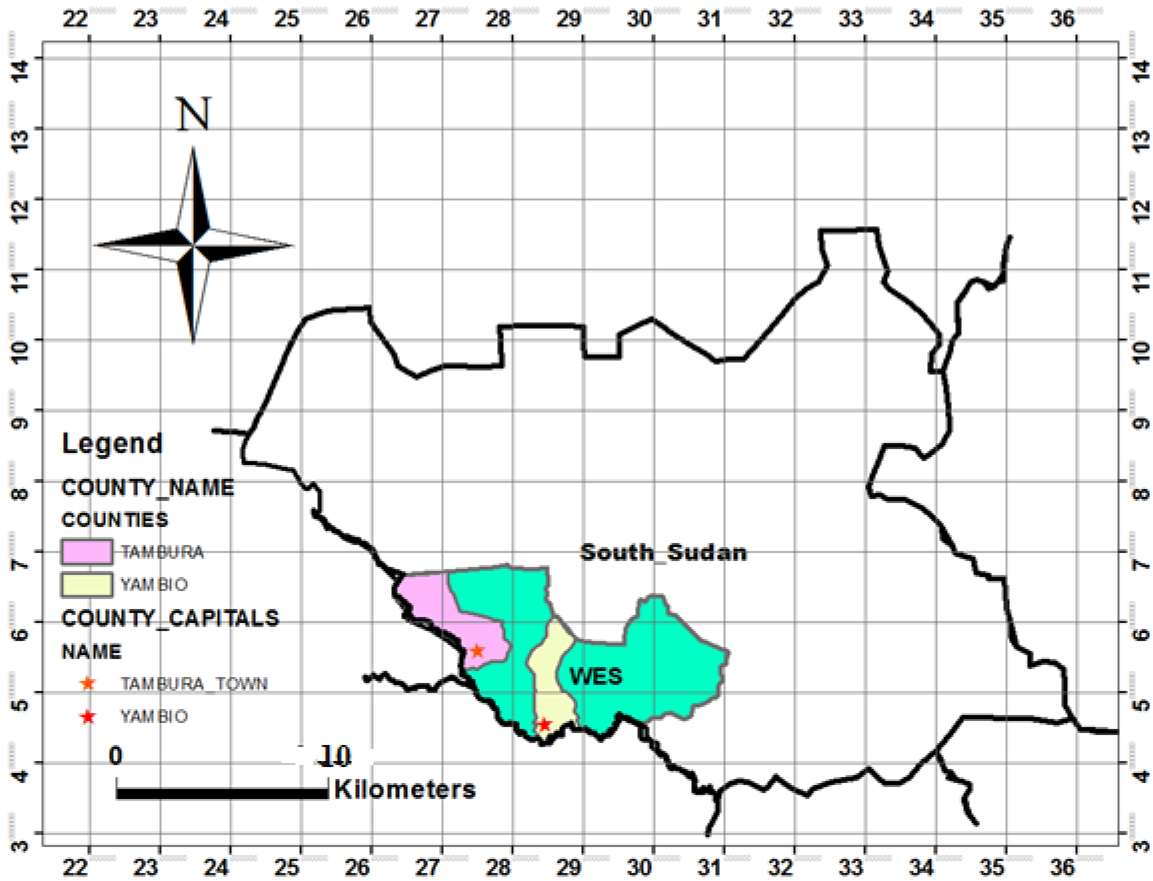

Figure 1. Map showing Tambura and Yambio Counties, Western Equatoria State, South Sudan

Entomological Survey

At each one of the four streams in both counties, unbaited biconical traps were deployed (Challier *et al.*, 1977) at least 1 meter in the various vegetation types suspected to harbor tsetse flies at 1m from the vegetation edge **(**Mohamed-Ahmed and Wynholds**,** 1997).

Identification of the Glossina species and determination of the apparent density and infection rate (IR%)

Captured flies (pooled males and females) were collected every 24hrs, counted, identified morphologically and examined for tenerality. The apparent density of tsetse at each location was calculated from the mean catch/trap/day, based on Tsetse Training Manual (FAO, 1979). Dissection of the collected *Glossina* species was carried out in 1 x PBS under dissecting microscope. Dissecting instruments were immersed in 5% sodium hypochlorite, rinsed in distilled water and immersed in 0.9% normal saline (w/v). Flies' mid guts were examined

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under stereo microscope for the presence or absence of the trypanosomes.

The IR% is calculated based on the equation :

$$IR\% = \frac{\textbf{Positive cases}}{\textbf{Total Number Dissected}} X100$$

$$\text{Average IR\%} = \frac{\textbf{IR\%}}{\textbf{No.of streams sampled}}$$

Ecological Survey

The main vegetative covers including the trees and grasses in the vicinity of the study area in the tsetse habitats were observed, inspected and identified (Dharani, 2011; Van WYKB and Oudtshoorn, 1992).

Data management and statistical analysis

A descriptive data analysis was made. All the graphs were drawn using Excel 2007 for Microsoft Windows 2007.

RESULTS

Comparison of Glossina average apparent density and the total catch between Yambio and Tambura Counties

In Yambio County the average apparent density of *G.f.fuscipes*/trap/day was 2.23 compared to 0.71 in Tambura County (Fig.2). However, Yambio County had the highest abundance of 262 *G. f. fuscipes* of which 125 and 137 of the population were females and males, respectively. In Tambura County, the total fly catches of 90 *G. f. fuscipes*, revealed 40 females and 50 males (Fig.3).

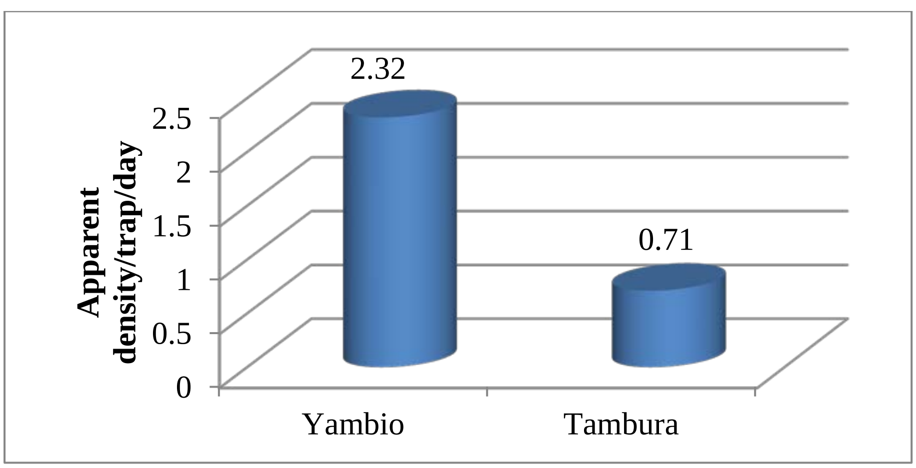

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Figure 2.*Glossina fuscipes fuscipes* Apparent Densities in Yambio and Tambura Counties, Western Equatoria State South Sudan

Figure (4a) revealed total catches of flies in Yambio County were only 8% teneral flies where as the non teneral made up 92% of the total *G.f. fuscipes* population. In Tambura County the teneral flies made up a population of 10% compared to 90% of non-teneral flies in the dry season (fig.4b). However, the total fly catches in WES were 352, of which only 9% and 91% were teneral and non-teneral flies, respectively.

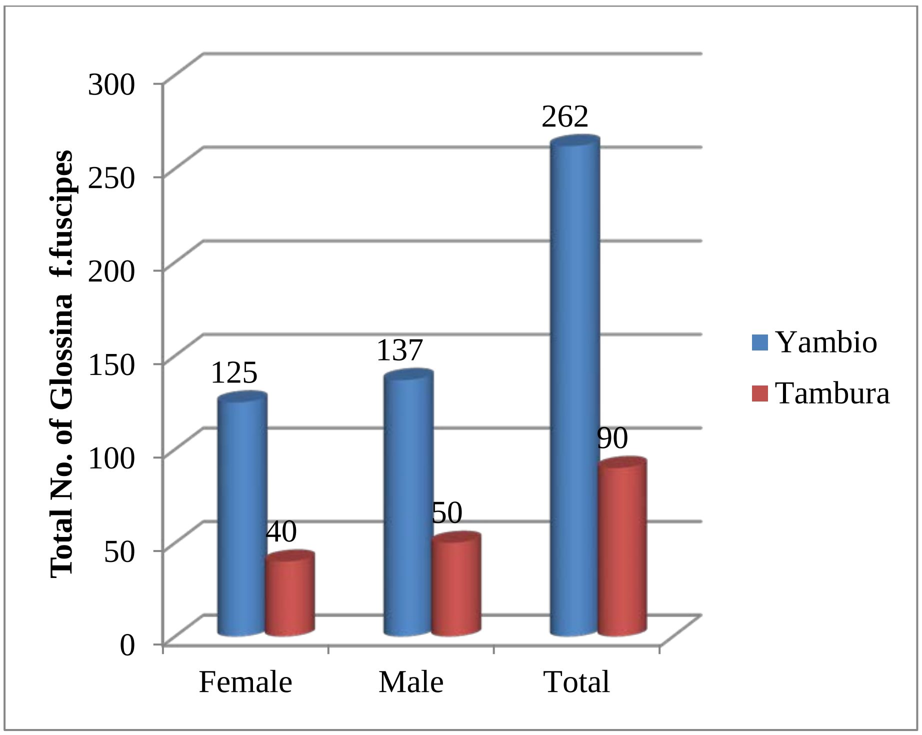
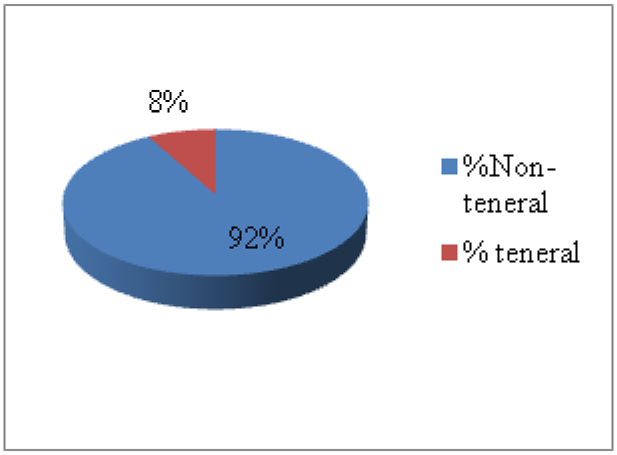


Figure 3.Total catches of *Glossina fuscipes fuscipes* in Yambio and Tambura Counties, Western Equatoria State, South Sudan



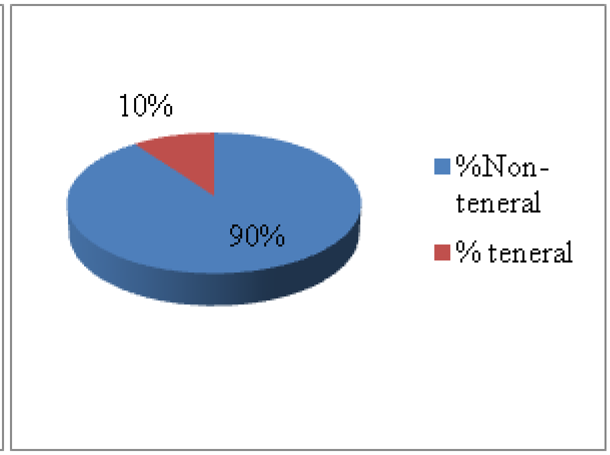


Figure 4a.*Glossina f.fuscipes* % abundance in Yambio County

Figure 4b.*Glossina f .fuscipes %* abundance in Tambura County

Glossina fuscipes fuscipes average infection rates(AIR%) in Yambio and Tambura Counties

Yambio County had the highest average infection rate (AIR %) of 2.38% in the *G. f. fuscipes* compared to 2.02% in Tambura County (fig. 5).

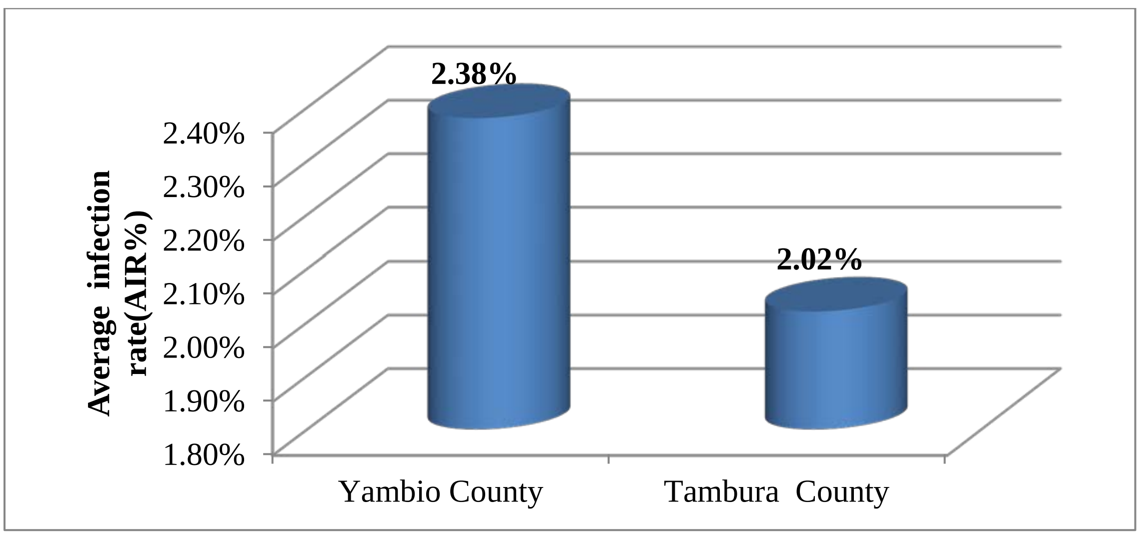


Figure 5.*Glossina fuscipes fuscipes* average infection rate (AIR %) in Yambio and Tambura Counties, Western Equatoria State, South Sudan

Figure 6. *Lantana camara* plant in the vicinity of Yambio Town.

Ecological survey:

The main evergreen trees observed and identified in Yambio and Tambura Counties include *Ficus religiosa* (Sacred Ficus), *Borassus aethiopum* (African Fan Palm), *Ziziphus spina-christi* (Thorn Jujube), *Tamarindus indica* (Tamarind Tree), *Khaya senegalensis* (African Mohagony), *Anogeissus leiocarpus* (African Birch) and *Combretum glutinosum* (Common caper-bush). The vegetative covers are comprised of *Lantana camara* (Wild-Sage) in fig.(6), *Acacia nilotica* (Scanted-pod Acacia), *A. sieberiana* (Paper-bark Thorn), *A. seyal* (Sweet Thorn) and *A. mellifera* (Black-Thorn) and the deciduous trees of *A. leiocarpus* and *C. glutinosum*. The main grasses included *Imperata*, *Panicum* and *Andropogo*n species. The water courses generally originate from the Nile/ Congo water shed. Along these water courses, the evergreen trees consist of *F.religiosa*, *T. indica*, *Azadirachta indica* (Neem Tree), *A. leiocarpus* altogether with *Combretum spp* and various climbers and grasses.

DISCUSSIONS

Western Equatoria State is an endemic area of Gambian HAT due to *T.b.gambiense*. Such G-HAT was identified in Tambura and Yambio since 1918 and 1924, respectively (Bloss, 1960). *Glossina f.fuscipes* was identified as the sole vector in the study areas which could be explained by the presence of appropriate ecosystem similar to that of Kajo-keji County, Central Equatoria State (Mohamed *et al*., 2010). Aspects of ecological characteristics such as vegetation of tall shaded trees have constituted typical habitats for riverine species of tsetse flies (Bouyer *et al*., 2007). Flies of the *palpalis* group generally occupy riverine and locustrine habitats and are opportunistic feeders **(**Leak, 1998).This is substantiated in the sense that *G. f. fuscipes* inhabit south western Ethiopia and southern Sudan **(**Rogers and Robinson**,** 2004). Moreover, it seems that the presence of *G. f. fuscipes* in the study area is justifiable in their ability to adapt themselves to peridomestic situations and their linear habitat that allows them to easily disperse between favorable riverine forests acting as genetic corridors (Ahmed, 2004). *L.camara* plants appeared to be the abundant habitats of *G.f.fuscipes* .This could be attributed to its attractive colorations and the relative darkness for tsetse resting period.

Variations in *G. f.fuscipes* infection rates and apparent density between Yambio and Tambura Counties might be linked to climatic factors or the environmental condition in each site where traps were deployed. A high ambient temperature in the vicinity of Tambura County could be contributory factors as evidenced by the lesser number of tsetse flies during the survey. The infection rates in *G. f. fuscipes* in the study area are slightly higher compared to the rates of 1.4% and 1.9% reported in Uganda and the Republic of Congo Brazzaville, respectively (Rogers *et al*.,1972). HAT in historic foci had shown new epidemiological features in urban areas (Ebeja *et al*., 2003; Courtin *et al*., 2005).It appeared that contiguous relationships between urban areas and surrounding HAT-endemic villages could create conditions favorable for HAT in urban areas (Ebeja *et al*., 2013; de Deken *et al.*, 2005). This is exacerbated by the possible contact between human and flies by increased human population density that attracts tsetse flies to rural and peri-urban areas and concentrate tsetse flies (Fournet *et al*., 1999).This has been the case of Yambio and Tambura urban centers that have been surrounded by HAT endemic and *G f fuscipes* infested villages.

CONCLUSION

This study showed no significant differences in *G.f.fuscipes* infection rates, apparent density and abundance between Yambio and Tambura Counties. Further study is recommended in wet season to provide an inference into whether such parameters are comparable to the dry season such that vector control strategy is developed in WE S, South Sudan

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Conflict of Interest

The authors have declared that there is no conflict of interest.

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