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Retrospective mortality assessment of *Glossina palpalis palpalis* collections from Ijah-Gwari field station, Niger state Nigeria

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Abstract
Handling and transportation of tsetse flies are fundamental for mortality assessment during fly collections. Previous works have indicated that tsetse fly mortalities increase with the rise in ambient temperatures. A seasonal mortality assessment of *Glossina palpalis palpalis* population collected from Ijah-Gwari field station was carried out based on the record as kept in the insectary of the Nigerian Institute for Trypanosomiasis Research, during the period between 2011- 2018; in order to determined fly mortality rates associated with handling and transportation of flies. Results indicated that whereas high percentage mortalities were recorded between 2016 (44%) and 2017 (57%); moderate mortalities were recorded in 2011 (36%), 2014 (29%), 2015 (19%) and 2018 (30%); while low mortalities of 10% were recorded in 2012 and 2013. Hot months of May (51%) and July (25%) gross mortalities contributed significantly to the increase in mortalities recorded in these years. The findings of this study show that extreme temperatures and relative humidity might be contributing factor of fly mortality. The handling and transport conditions might have sustained the high temperatures and humidity during transportation. Mean percentage mortality was observed to be higher in male (44%) than the female (33%) flies from Ijah-Gwari. The implication of this study as pertains salivary gland hypertrophy virus transmission is discussed.

Keywords: mortality, *Glossina palpalis palpalis*, Ijah-Gwari, trypanosomiasis

Introduction
Tsetse flies are vectors of Human African Trypanosomiasis (HAT or sleeping sickness) and African Animal Trypanosomiasis (AAT or nagana) (Kariithi *et al.*, 2013) [8]. Although over 30 species and sub-species of tsetse are described in the genus *Glossina* and most of which can transmit trypanosomes, only 8-10 *Glossina* species are of medical and agricultural importance (Kariithi *et al.*, 2013) [8].

Trypanosomiasis is widely distributed in Africa, Asia and Latin America (Hotez and Kamath, 2009) [6]. In Africa, trypanosomiasis is restricted to 37 sub-Saharan African countries; however, its distribution extends to more than 10 million square kilometers of the African continent (Cecchi *et al.*, 2008) [3]. The major characteristics of the disease include fever, severe anemia, cachexia, edema and reproductive disorders leading to death if untreated (FAO, 2002). African animal trypanosomiasis is the main parasitological constraints to livestock production in many sub-Saharan African countries infested with tsetse flies (Itard, 2003) [7]. African trypanosomiasis is responsible for 3 million livestock deaths and the death of about 55 000 people annually (Abenga *et al.*, 2002) [1]. Tsetse flies are found exclusively on the African continent, between 5°N to 20°S latitudes. They are closely related to the vegetation which protects them from solar radiation and wind. The eco-climates generally corresponds to that of wood land areas situated in regions receiving more than 1000 mm of rain fall, but may also occur in areas with slightly lower rain fall (Meberate *et al.*, 1999) [11]. The range of tsetse flies does not extend into areas with very high or low temperatures. Their geographical range is limited by the excessive drought conditions in the North, the cold temperature in the South and by high altitude regions (Maudlin, 2006) [10]. The Nigerian Institute for Trypanosomiasis Research (NITR) is saddled with the responsibility of conducting research and development for the control and eradication of Trypanosomiasis and Onchocerceasis in all the ecological

zones of Nigeria in order to promote food security, improve human and animal health and facilitate sustainable agricultural and rural development for optimum land use. In fulfilling its mandate, it embarks on field trips to various tsetse infested parts of the country to collect flies for research purposes. In the course of collection and transportation of flies, mortality of the flies do occur which this study seeks to address.

The aim of the study therefore, was: (1) To determine mortality at the time of collection at Ijah-Gwari (2) To determine fly mortality during handling and transportation from the field to the insectary (3) To investigate if mortality was associated with the sex of the flies captured.

Description of Study Area

Ijah Gwari (near Suleja) lies between latitude 9° 12′ N and 9° 24′ N and longitude 7° 12′ E and 7° 20′ E in Tafa Local Government Area of Niger State. Several small streams traverse the area and the vegetation is riverine fringing forest forming a dense two-storey canopy inhabited by *G. palpalis* (Shaida *et al.*, 2018) [16].

Sample Collection

Adult flies were collected with standard blue bi-conical traps pitched at 100m intervals in vegetation around the banks of river/stream/courses and areas suspected to harbor tsetse flies. Trap catches were harvested after every 24 hours and transported in cool boxes to the insectary of NITR Kaduna, where they were sorted into species and sexes; live and dead flies. Analyses of data were carried using SPSS statistical package (Version 16.0).

Results

A total of 2798 tsetse flies (*Glossina palpalis palpalis*) were collected over the years, comprising of 1283 males and 1515 females. The Percentage mortality of this collected are indicated in figures 1 and 2 below.

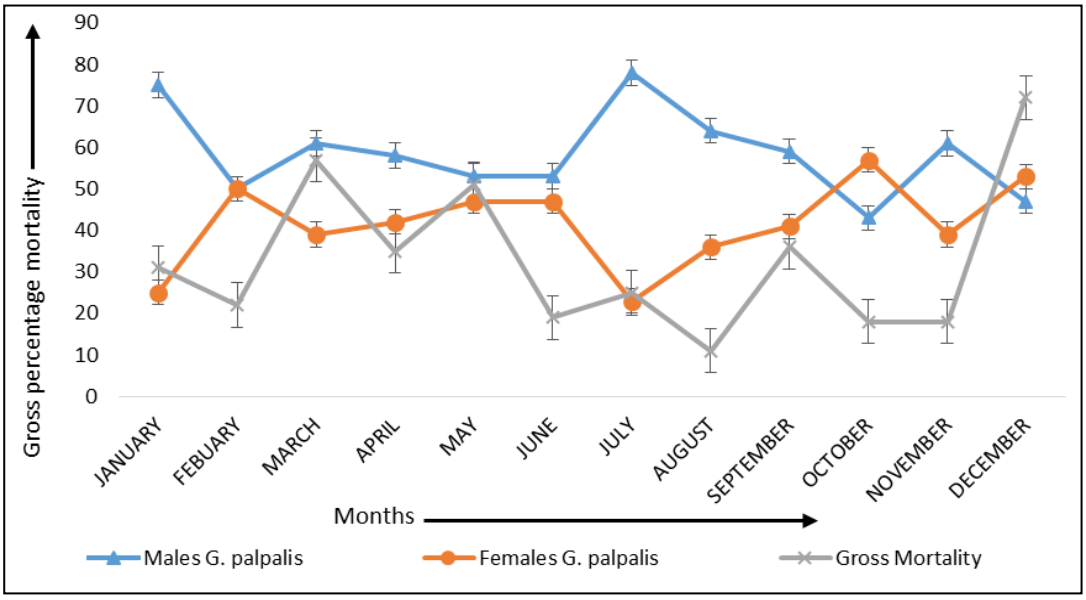

Fig 1: Sex and seasonal mortality rates of *Glossina palpalis palpalis* in the months between January to December

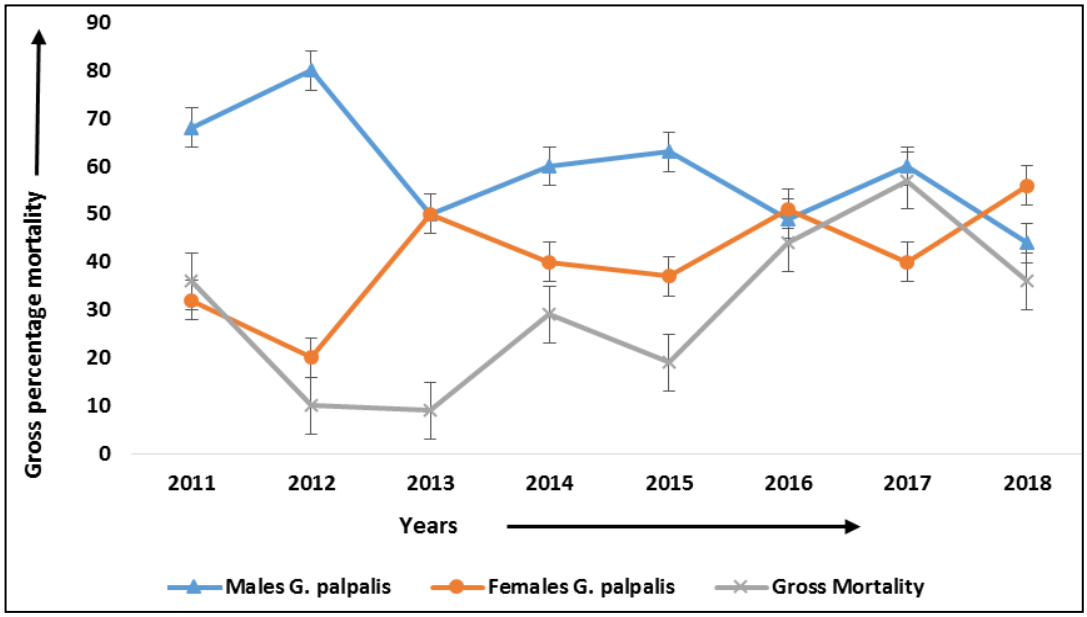

Fig 2: Sex and seasonal mortality rates of *Glossina palpalis palpalis* between 2011- 2018

Discussion

In this study, annual gross percentage mortality did not show any particular pattern. A 10% mortality was found in 2012 and 2013. The 10% level of mortalities obtained in these years might be attributed to the favorable seasonal weather conditions that prevailed during the periods of fly catching as accounted for by collections made in the months of June to November. Even lower percentages of gross mortalities were obtained in the months of June (19%), July (25%), August (11%), October (18%) and November (18%).

In 2011, 2014, 2015 and 2018, annual gross percentage mortalities ranged from 19% to 36% which can be considered as moderate. Gross mortalities were found to be 36% (2011), 29% (2014), 19% (2015) and 30% (2018). The relative increase in gross mortalities found in these years might be attributed to increased temperature conditions. For instance, in the hot month of May and July gross mortalities recorded were 51% and 25% respectively as a result of increase in ambient temperatures.

Higher annual percentage mortalities were found in the years of 2016 (44%) and 2017 (57%). There was higher level of mortalities in the cold months of February (100%) and December (72%); and hot month of May (79%). In 2017, there was higher level of mortalities in the months of January (100%), March (100%), September (67%) and October (77%). These might be attributed to higher temperature conditions in these years.

Collectively, the finding of this study agrees with work of Hargrove (2004)[5], who reported that tsetse flies (specifically: *G. pallidipes, G. tachinoides and G. morsitans*) mortalities increase with the rise in ambient temperatures. In addition, positive correlation between mortality and temperature was evident. Since tsetse are poikilotherms, at least part of the factors that increased mortality may stem from the rise in ambient temperature and humidity conditions (Hargrove, 2004) [5].

Also, in this study, male *G. palpalis* appeared to have higher mortality rates than females. It is possible that higher percentage mortalities associated with male flies might have contributed significantly to the gross mortalities recorded over the years. The reason for this is not well understood; but it has previously been shown that, male *Glossina palpalis palpalis* are prone to higher infection rates with salivary gland hypertrophy virus (SGHV) than the females (Dale *et al.*, 1995; Peacock *et al.*, 2012) [4, 13]. It is very possible that concurrent infection with SGHV and harsh weather conditions the male flies were subjected to might be responsible for the higher level of male *G. palpalis palpalis* mortality.

Conclusion

The findings of this study show that extreme of temperatures and humidity conditions could cause *G. palpalis palpalis* mortality. However, it was found that even in most favorable months of the years studied, mortalities were still recorded, particularly in male *G. palpalis palpalis* where the highest mean mortality percentages (44%) were observed compared to the females (33%). This was probably due to the fact that, male flies were more prone to SGHV infections than females.

Recommendation

Based on our findings, it is suggested that:

i). To optimize trapping of *G. palpalis* and subsequent collection, field trips to Ijah-Gwari should be carried out between June to September, which shows favorable seasonal weather conditions with lower cases of mortality

ii). Field trips between Decembers to February; April and May should be strongly discouraged.

iii). Further molecular work should be done to identify the prevalence of salivary gland hypertrophy (SGHV) virus among the male *G. palpalis* obtain from Ijah-Gwari. This is because previous studies have shown an association between male *Glossina palpalis palpalis and prevalence* of salivary gland (SGHV) infection with *T. brucei* than the females (Dale *et al.*, 1995; Peacock *et al.*, 2012) [13].

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