Trop. Anim. Hlth Prod. (1987) 19, 11–20

TRYPANOSOME INFECTION RATE OF *GLOSSINA PALLIDIPES* DURING WET AND DRY SEASONS IN SOMALIA

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SUMMARY

Using biconical traps the distribution, population composition, insemination rate, pregnancy, age structure and trypanosome infection rate of G. pallidipes *were studied during the wet season 1982 and the dry season 1983 at Mareerrey Somalia. Flies restricted to the riverine gallery forest in the dry season become dispersed into approximately 1 km of the* Acacia *thickets in the wet season. There was no significant variation in population components of* G. pallidipes *between wet and dry seasons. The male: female ratio remained at 0·5:1 in both seasons. The insemination rate of females was significantly high during the wet season. Pregnancy stages were not statistically different between the two study periods. A significantly greater proportion of females that were below age category 4 were found in the wet season. The trypanosome infection rate was 2·6% and 1·5% in the wet and dry seasons respectively. Flies were found infected with only the vivax and congolense group trypanosomes. A linear positive correlation existed between the trypanosome infection rate and the physiological age of females.*

INTRODUCTION

The distribution of tsetse in Somalia is shown in the recent OAU maps (Ford and Katondo, 1977). Four species of *Glossina* exist in Somalia, *G. austeni, G. brevipalpis, G. longipennis* and the most widely distributed *G. pallidipes.* The four species infest some 1,500 km^2 of vegetation fringing the river systems of Shabbeelle and Juba with an additional 1,000 to 2,000 km^2 in the southern border with Kenya. This infestation varies in density and distribution with the season. In the wet cool season tsetse have a high density and may disperse some 9 to 20 km from the rivers (Ryan, 1981). In the hot dry season tsetse may become light in density and restricted to the riverine vegetation.

Little definitive information was available on the trypanosomiasis situation in Somalia. However, it has been estimated that about 88 million US dollars are lost annually as a result of the impact of trypanosomiasis on livestock. To date sleeping sickness has not been reported in Somalia despite its occurrence in neighbouring Ethiopia and Kenya. Realising the huge economic losses due to animal trypanosomiasis and the risk of introduction of sleeping sickness in the country, the Somali Government created the National Tsetse and Trypanosomiasis Control Project (NTTCP). It had been also realised that before commencing on an extensive control project some field data on the biology and trypanosome infection rate of tsetse in Somalia must be obtained. This was essential for the justification, choice and assessment of the likely effectiveness of the control technique.

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Ryan (1981) did a limited investigation on sampling methods, estimates of population density and biology of *G. pallidipes*, *G. brevipalpis* and *G. longipennis* at Geed Faque. However, more data covering wet and dry seasons is required. The present communication therefore deals with field studies on *G. pallidipes* in Somalia in the periods May to August 1982 (wet cool period) and February to March 1983 (dry hot period).

MATERIALS AND METHODS

The study area at Mareerrey, Somalia lies at latitude 4°N. and longitude 47°E. on the River Shabbeelle in the west of Mogadishu 6 km south of the Tsetse and Trypanosomiasis Research Laboratory at Afgooye (Fig. 1). The site of study is a deserted farm land of 2 km^2 and is typical in its location, flora and fauna for habitat of *G. pallidipes*, *G. brevipalpis* and *G. longipennis* in the middle and northern half of the Somali tsetse belt. In this region of the country there are two cool rainy seasons and two hot dry seasons. The long rainy season is in April to August followed by a short hot dry period in September and October. A short rainy season during late October and November is followed by the long dry season December to April.

The vegetative cover consists of isolated trees and thickets which abruptly change into a thick gallery forest strip at the bank of the river. The area is surrounded by banana cultivation plots from north and south, River Shabbeelle in

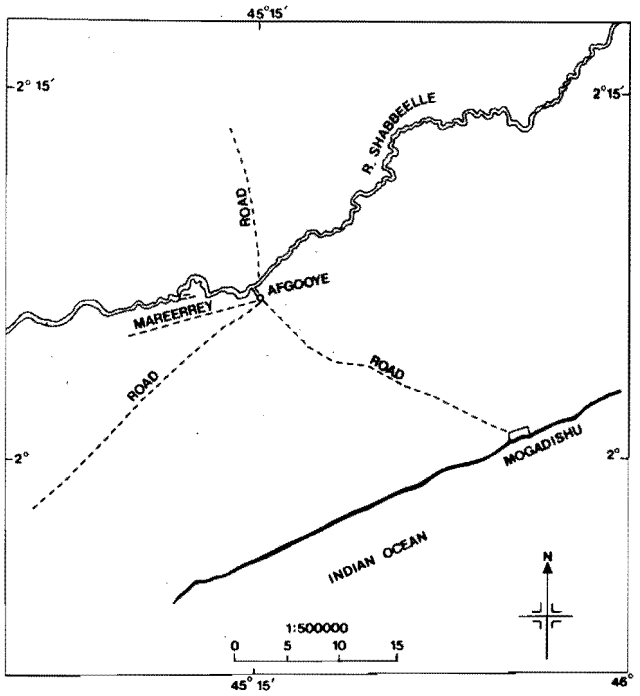

FIG. 1. Location of Mareerrey village.

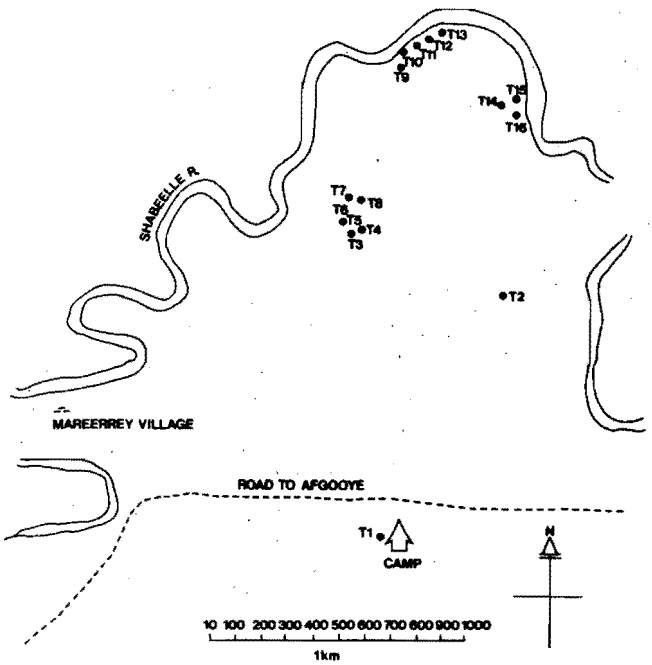

FIG. 2. Deployment of traps at Mareerrey study site during the wet season (T1–T8) and the dry season (T9–T16).

the west and road and open cultivated land in the east (Fig. 2). The main flora as identified by Dr Kasmi of the Somali National Herbarium are:

1. Trees and shrubs: *Acacia nilotica, Salvadora persica, Cordia gharaf, Ficus* spp., *Conocarpus lancifolias, Maerua angolensis, Solanum* spp..
2. Herbs and grasses: *Heliotropium* spp., *Barleria* spp., *Achyranthes sicula, Commelina* spp., *Curcribtache* spp., *Momordica* spp., *Abutilon* spp..

The game animals identified from fresh dung and spoors: plenty of warthog, hippopotamus, baboon, hyena, dikdik, crocodiles and monitor lizards. Domestic animals were not seen in the study area with the exception of a few camels in the dry season.

Tsetse were captured by continuous 24 h trapping in eight biconical traps (Challier and Lavessiere, 1973) during the wet season April to September 1982 and dry season February to March 1983. Preliminary catches showed that flies were abundant in the *Acacia* thickets during the wet cool season; most abandon these thickets to the gallery forest strip in the hot dry season. Therefore traps T1 to T8 in the thickets and T9 to T16 in the gallery forest were used to sample tsetse during the wet and dry seasons respectively. Traps T1 and T2 were installed to determine the extent of the distribution in the favourable cool period (Fig. 2).

Tsetse collected at 24 h intervals were examined in the laboratory at Afgooye while those collected at 7·00, 13·00 and 16·00 h were examined at the base camp. Flies were then killed by forceps, counted, sexed and inspected for tenerality. Fresh females were afterwards dissected for physiological age using the ovarian technique (Saunders, 1962; Challier, 1965). Males were aged by the wing fray

TABLE I

Mean temperature and relative humidity (r.h.) in the Acacia *thicket and Riverine gallery at Mareerrey during the hot dry season*

Region	Location in shade	Mean temperature in 28 days (°C)		Mean r.h. in 28 days (%)	
		8·00–10·00 h	13·00–14·00 h	8·00–10·00 h	10·00–14·00 h
Acacia thicket	air	28·6	30·8	66·5	57·5
	soil	26·7	26·7	—	—
Riverine gallery	air	27·8	30·1	74·2	65·1
	soil	25·6	26·4	—	—

method (Jackson, 1946). Flies including tenerals were dissected so that the salivary glands, labrum, hypopharynx and gut could be examined separately for trypanosomes. Trypanosome infections found in the hypopharynx or labrum alone were referred to as vivax (Duttonella) group. Those found in the hypopharynx, labrum and gut were referred to as congolense (Nannomonas) group. In addition to the latter organs the salivary glands were examined to detect the presence or absence of brucei (Trypanozoon) group. No attempt was made to differentiate between mature, immature or mixed infections.

During the dry season air and soil temperatures in shade in the *Acacia* thickets and riverine gallery were measured using minimum and maximum and soil thermometers. Relative humidity (r.h.) in the shade was measured by a wet bulb whirling hygrometer. Soil temperature was measured at a depth of 5 cm and shade air temperature at a height of 2 m (Table I).

RESULTS

Observation showed that *G. pallidipes* increase in density and spread into the thickets during the wet cool season and decrease in density and retreat to the riverine gallery forest during the dry hot season. The mean catch/trap/day in the thickets was 9·3 and 3·3 flies during the wet and dry seasons respectively. However, even during the wet cool period flies were never caught in trap T1 at the base camp and only one fly in trap T2 situated in a relatively low thicketed area (Fig. 2). Thus at Mareerrey the distribution of *G. pallidipes* was restricted to about 1 km of the riverine vegetation. Although it was known that *G. longipennis* and *G. brevipalpis* co-exist with *G. pallidipes* in this site only one pair of non-teneral *G. longipennis* were captured in biconical traps during the two study periods. This may indicate the very low density of these fusca group.

The chi^2 test showed that there was no statistically significant difference between population components of *G. pallidipes* during the wet and dry seasons of 1982/1983 (Table II) yet it was clear that biconical traps catch more females than males and more non-tenerals of any one sex. The insemination rate was significantly higher in females trapped in the wet season than in the dry season ($chi^2 = 4·2$, $P < 0·05$). Conversely no significant difference was observed between the two samples of females in abortion rate or pregnancy stages (Table III).

Figure 3 shows the distribution of age structure of female *G. pallidipes* during wet and dry seasons. A significantly higher proportion of females of age category

TABLE II

Population composition of G. pallidipes *captured by biconical traps at Mareerrey during the wet and dry seasons*

Components of population	Wet season	Dry season	χ^2 test value ($P = 0{\cdot}05$)
Total flies caught	3,088	407	—
Teneral males	82	11	2·8
Non-teneral males	983	121	0·3
Teneral females	53	11	1·4
Non-teneral females	1,970	264	0·1
Total tenerality (males + females)	135	22	0·7
Sex ratio male : female	0·5 : 1	0·5 : 1	—

1 ($chi^2 = 14{\cdot}6$, $P < 0{\cdot}01$) were captured in the wet season. Also 65% of females caught in the wet season were below age category 4 compared with only 47% in the dry season. Thus it was apparent that female *G. pallidipes* sampled by biconical traps in the wet cool period included many more younger females than when sampled in the hot dry period ($chi^2 = 17{\cdot}6$, $P < 0{\cdot}01$). The age structure of male *G. pallidipes* is shown in Table IV. Males with wing fray categories 1 and 3 were significantly different between the two seasons. Also 90% of the males sampled in the wet season were of wing fray categories 1 and 2 in contrast to 67% in the dry season. Wing fray categories 5 and 6 were found only in the dry season sample of males. This indicated a higher rate of fray of wings and apparently more older males in the hot dry period than in the wet cool season. The trypanosome infection rates are summarised in Table V. *G. pallidipes* had a higher infection rate with trypanosomes in the wet than in the dry season although not significantly so ($chi^2 = 3{\cdot}4$, $P > 0{\cdot}05$). The infection rate of flies with the congolense group trypanosomes were also higher in the wet than in the hot dry period. However, none of the flies was found infected with brucei group trypanosomes in any one period. Another important fact was that no male fly was

TABLE III

Insemination and pregnancy of G. pallidipes *captured in biconical traps at Mareerrey during the wet and dry seasons*

	Uterine stage (%)		
Results of dissection	Wet season ($n = 375$)	Dry season ($n = 201$)	χ^2 test
Insemination	95·0	91·0	4·2[a]
Nulliparous females	15·0	11·0	2·7
Abortion	12·0	10·0	0·7
Egg	29·0	30·0	0·01
1st instar larva	26·0	32·0	1·9
2nd instar larva	12·0	14·0	0·2
3rd instar larva	6·0	3·0	3·3

n = Number of females.
[a] Indicate statistically significant difference between the two samples of females.

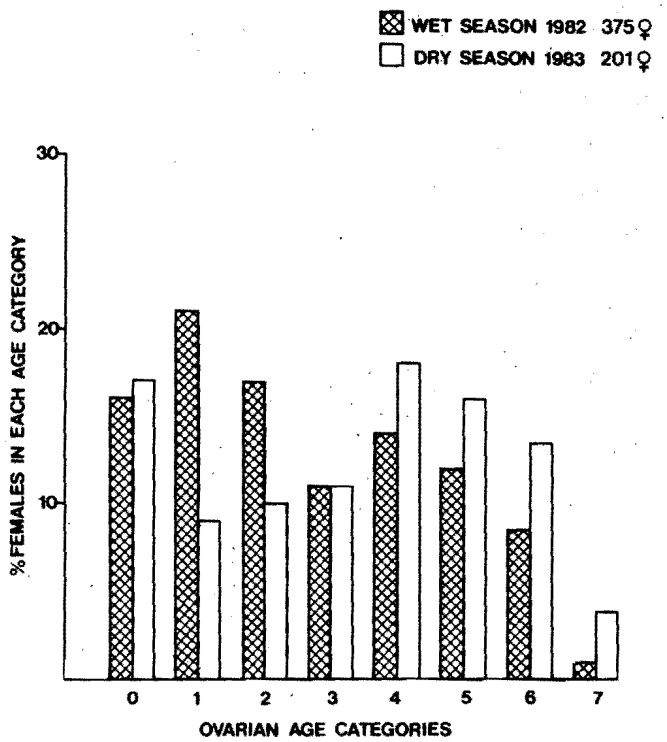

FIG. 3. Age structure of *G. pallidipes* captured by biconical traps at Mareerrey during the wet and dry seasons 1982–83.

found infected during the hot dry season in contrast to 0·7% infected males in the wet cool season.

With regard to the infected females it had been noticed that in the wet season flies were found positive for trypanosome infections from age category 1 up to age category 7; in the dry season females were only positive for trypanosomes from

TABLE IV

Percentage male G. pallidipes *found in each wing fray category at Mareerrey during the wet and dry seasons*

	% males in each category		
Wing-fray category	Wet season ($n = 1065$)	Dry season ($n = 132$)	χ^2 test ($P = 0{\cdot}05$)
1	54·0	38·0	12·8[a]
2	36·0	29·0	3·0
3	12·0	20·0	5·5[b]
4	8·0	8·0	—
5	0	3·0	—
6	0	2·0	—

[a] Number of males examined in each season.
[b] Indicate that the difference is significant at the stated probability.

TABLE V

Trypanosome infection rate of G. pallidipes *captured in biconical traps at Mareerrey during the wet and dry seasons*

Season	Total no. of flies	Total no. of infections	Total trypanosome infection rate %	Species of trypanosomes as percentage from infection rate		
				T. vivax	*T. congolense*	*T. brucei*
Wet season (1982)	3,088	80	2·6	42·3	57·7	0
Dry season (1983)	407	6	1·5	66·7	33·3	0

age category 4 and older categories. This reflected an increase of trypanosome infection in female *G. pallidipes* with increasing age. Therefore on plotting the regression of percentage infected females in each ovarian age category (y) on ovarian age category (x) irrespective of season a linear positive correlation was obtained (Fig. 4). Thus the trypanosome infection rate of female *G. pallidipes* was directly proportional to the age of the flies ($r = 0{\cdot}8$, $P < 0{\cdot}01$).

DISCUSSION

Earlier as well as recent findings (Moggridge, 1936; Ryan, 1981) that *G. pallidipes* in Somalia is restricted to 1 to 2 km of the riverine vegetation have been confirmed by the present study. It had also been shown that the population components of this species did not differ significantly between the wet cool season and the hot dry season when sampled by biconical traps (Challier and Lavessiere, 1973). During both seasons the male:female ratio was 0·5:1. A similar sex ratio was obtained by Ryan (1981) in the wet season at Geed Faque.

In the present study biconical traps captured only one pair of *G. longipennis* and none of *G. brevipalpis*. However, further attempts with bait ox and vehicle head lights at dusk succeeded in capturing one teneral male *G. brevipalpis* close to the river bank. This confirmed that *G. longipennis* and *G. brevipalpis* coexist with *G. pallidipes* at Geed Faque as reported by Ryan (1981).

There was a significantly better insemination rate of females during the wet than in the dry season although it was above 90% during both periods. This result is also in accord with Ryan (1981). Unlike Ryan a relatively consistant high abortion rate in flies was reported in the present work. Abortion of pregnant flies was expected because it had been well known that abortion is the principal reproductive abnormality in wild *Glossina* (Madubunyi, 1978). At Mareerrey a few females were found to contain third instar larvae in both wet and dry seasons. This might be attributed partly to the relatively low activity of this group of pregnant flies and partly to the use of traps in sampling. In support of the latter suggestion several workers observed that traps attract more females with egg stages than with early larvae and least with the third instar larvae (Saunders, 1962; Harley, 1966; Ryan, 1981).

The ovarian age of *Glossina* depends on temperature (Mohamed Ahmed, 1981) and method of sampling (Saunders, 1962). Therefore the observed difference in physiological age of females between the wet and dry seasons could

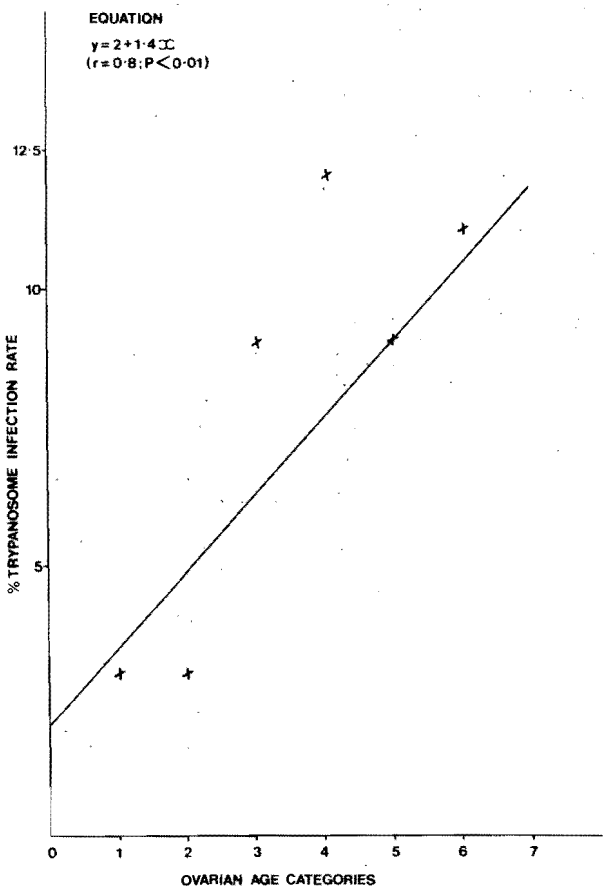

FIG. 4. Relationship between trypanosome infection rate and ovarian age categories of *G. pallidipes* at Mareerrey.

only be attributed to variation in seasonal temperature and not to sampling as only biconical traps were used during the two study periods.

Total trypanosome infection rates of 2·6% and 1·5% with vivax and congolense group trypanosomes were recorded for *G. pallidipes* at Mareerrey; no brucei trypanosome group were detected in flies. The latter fact is in agreement with Clarke (1969) in Zambia, Moloo, Stieger and Brun (1973) in Tanzania and Lambrecht (1980) in Kenya who could not detect brucei group trypanosomes in wild caught *G. pallidipes*. During the wet season at Mareerrey most of the trypanosome infections of flies were of the congolense group. This was possibly due to the greater dependence of the fly on the warthog host. Jordan (1974) reported that 81% of infections of *G. m. submorsitans* were due to congolense group trypanosomes where the fly had fed extensively on warthog. The lower infection rate of flies with congolense group trypanosomes in the dry period might have been caused by a temporary reduction in population of warthog resulting from increased farming activity, fire wood felling in the riverine gallery and noise of heavy machinary used in road construction (Fig. 2).

Regression of percentage infections of females on their respective ovarian age categories produced a linear positive relationship. This was expected because tsetse can become infected with vivax and congolense group trypanosomes throughout life (Jordan, 1974). It follows that the overall infection rate of a population of *Glossina* with trypanosomes will increase as flies become older.

From the results it can be concluded that the population of *G. pallidipes* at Mareerrey does not differ significantly from other populations of the same species elsewhere in Africa with regard to population composition, insemination, pregnancy and age structure. However, the trypanosome infection rate of flies at Mareerrey was somewhat lower than in other parts of Africa (Jordan, 1974) but control of tsetse is still justified in Somalia as many cattle were found suffering from trypanosomiasis (Dairri, 1982).

ACKNOWLEDGEMENTS

Thanks are due to Dr M. Abdu Allahi of the NTTCP, Somalia and Dr F. Jumaa of the Arab Organization for Agricultural Development, Khartoum for the encouragement and sponsorship of this research.

Accepted for publication April 1986

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TAUX D'INFECTION TRYPANOSOMIENNE DE *GLOSSINA PALLIDIPES* DURANT LA SAISON DES PLUIES ET LA SAISON SECHE EN SOMALIE

Résumé—On a étudié avec des pièges biconiques la distribution, la composition des populations, le taux d'insémination, l'état de fécondation, la pyramide des âges et le taux d'infection trypanosomienne de *Glossina pallidipes* pendant la saison des pluies 1982 et la saison sèche 1983 à Mareerrey, en Somalie. Les mouches rassemblées dans la forêt galerie ensaison sèche, sont dispersées dans un rayon d'environ 1 km des fourrés à *Acacia* en saison des pluies. Il n'y a pas de variations significatives des paramètres des populations de *G. pallidipes* entre les deux saisons. Le rapport mâle/femelle reste 0·5 : 1 dans les deux saisons. Le taux d'insémination des femelles est significativement plus élevé en saison des pluies. Les états des fécondations ne sont pas statistiquement différents entre les deux périodes d'étude. On a trouvé une proportion significativement plus élevée de femelles en dessous de la catégorie 4 en saison des pluies. Le taux d'infection trypanosomienne est de 2·6% et 1·5%

respectivement en saison des pluies et en saison sèche. On n'a trouvé de mouches infectées que par des trypanosomes des groupes *vivax* et *congolense*. Une corrélation linéaire positive existe entre le taux d'infection et d'âge physiologique des femelles.

TASA DE INFECCION CON *TRYPANOSOMA* DE *GLOSSINA PALLIDIPES* DURANTE LAS ESTACIONES LLUVIOSA Y SECA EN SOMALIA

Resumen—Se estudió la distribución, composición de la población, tasa de inseminación, preñes, edad y tasa de infección con *Trypanosoma* de *Glossina pallidipes*, durante la estación lluviosa de 1982 y seca de 1983, en Mareerrey Somália. Para el efecto, se utilizaron trampas bicónicas. Se encontró, que las moscas restringidas a los bosques de galería durante la estación seca, se dispersan aproximadamente 1 km afuera del monte de *Acacia* en la estación lluviosa. No hubo variación poblacional significativa de la mosca entre estaciones. El rango macho: hembra se mantuvo 0·5 : 1 en ambas estaciones. La tasa de inseminación de las hembras fue significativamente alta en la estación lluviosa. No se notó diferencia estadística en estados de preñez entre los períodos de estudio. Durante la estación lluviosa, se encontró un mayor número de hembras por debajo de la categoría de edad 4. La tasa de infección con *Trypanosoma* fue de 2·6% y 1·5% en la estación lluviosa y seca respectivamente. Las moscas se encontraron infectadas, solamente con los tripanosomas del grupo vivax y congolense. Se encontró tambien, una correlación linear positiva, entre la infección con tripanosomas y la edad fisiológica de las moscas.