THE DISTRIBUTION AND VECTOR COMPETENCE OF TSETSE FLIES IN RELATION TO ANIMAL TRYPANOSOMIASIS IN THE FEDERAL CAPITAL TERRITORY, ABUJA.

H. U. Wintola[1]* and H. S. Idris[2]
[1]Federal Ministry of Agriculture, Federal Department of Livestock and Pest Control, Abuja, Nigeria.
[2]University of Abuja, Department of Biology, F.CT. Abuja, Nigeria.
[*]**Corresponding Author's email address: hwintola@yahoo.com**

ABSTRACT

The entomological and parasitological surveys were undertaken between June 2006 and May 2007 in the agro- pastoral area of the 6 Area Councils of the Federal Capital Territory (FCT) Abuja, Nigeria. This area was previously sprayed in the 1950[s] to control the vector (Glossina) the tsetse-flies of animal trypanosomaisis. Detailed entomological studies on the vector (Glossina) were conducted in the riverine areas of reflict forest of the FCT Abuja. Acetone baited bi-conical traps were used as traps for Glossina. A mean total of 832 flies (378 males and 454 females) were trapped, collected and identified. The flies were dissected and examined for trypanosome infection with G. p. palpalis as the most abundant (756) compared with 76 of G. tachinodes and other Glossina species in the relict forest and riverine of the FCT. The abundance was significantly different (T= 6, df=5 P< 0.05) from other species. The distribution of Glossina within the 6 Area Councils were Gwagwalada Area Council, 73(8.77%); Kwali 98 (11.77%), AMAC 47 (5.64%); Abaji 455 (54.65%); Bwari 276 (33.80%) and Kuje Area Council 299 (35.93%). A mean total of 376 non-teneral flies were examined for trypanosomes out of which 124 (33.00%) were found positive. Out of this 51(32.96%) had T. vivax while T. congolense were seen in 11 (2.92%). The difference was significant (T= 11, df=5 P< 0.05). The infection rate was lower in the dry season and higher in the early raining season/mid-wet season and the difference was significant (T= 7, df=5 P< 0.05). Abundance was consistently higher in the larger riverine habitats of Abaji and relict forest of Bwari and Kuje Area Councils. Sex ratio of Glossina was 1:1. However, the collection had more females than the males, out of a total of 449 flies collected, 196 (43.00%) were males and 253 (57.00%) females and the difference was significant ((T= 12, df=3 P< 0.05). Also, detailed parasitological studies were conducted to determine the infection rate of animal trypanosomosis species in Zebu cattle. A total of 1440 blood samples were collected and screened using Enzyme-Linked Immunosorbent Assay (ELISA) Technique. The overall results of infection rate of Trypanosoma in Zebu breed recorded mean of 53 (22.00%). They were all positive for T. vivax.

INTRODUCTION

Trypanosomosis is a serious parasitic disease of humans and domestic animals with prolonged effect when an infected host is not treated, and could lead to nervous disorder, abortion, loss of weight, progressive anaemia and subsequent death (W.H.O., 2009).

Maudlin *et al*. (2004) reported that tsetse flies transmit animal trypanosomasis (nagana) viviparous, haematophagous Dipterans of the genus *Glossina*, mostly found in Africa in sub-Saharan African especially in the rural areas.

There are 23 described living species and 14 sub-species (Itard, 1989) with 4 extinct species from the Oligocene shales of Florissant Colorado, USA (Kranowski and Marriott, 1995). In Nigeria, there are 11 species, all of which are capable of contacting and transmitting leading to half a million cases annually, and that the disease is responsible for the massive decline in agricultural development in Africa. For several decades, there have been concerted efforts aimed at controlling tsetse flies and the menace associated with little success (Marcella, 2012). Tsetse *Glossina* flies are

the infections. Some of the areas that have been reported free of tsetse are becoming re-infested primarily due to lack of consolidated achievements (David, 1977; Marcella, 2012).

The Federal Capital Territory and the Sub-urban areas of Abuja fall within the northern area where cases of tsetse flies infestations have been reported. The area has a promising agricultural potential in crop and livestock resources.

However, available information on the prevalence and distribution of tsetse flies has revealed that tsetse flies constitute serious constraints to effective utilization of the resources (Ilemobade, 1983; Hagrove, 2004a).

In Africa, the problem has made it practically impossible to undertake profitable livestock development programs (Feldmann and Hendricks, 2001). The total area affected by the tsetse transmitted disease is about 10 million km^2 of tropical Africa, including an additional 7 million km that would have been suitable for the grazing of livestock but has been devastated by trypanosomosis (FAO, 2013). FAO (2004) also estimated that 37 countries are at the risk of being infected by the disease in Africa while 2,500,000 people are reported to have been infected with sleeping sickness. Out of this, about 250,000 have been dead due to the disease infection, while about 65 million people are at risk of contracting the disease. FAO Map (2013) also showed that 3.5 million livestock die yearly and 55 millions of cattle are at risk in Africa.

Trypanosomosis is described as one of the most endemic livestock diseases on the continent of Africa (Kassai *et al*., 1988; OIE, 2000). The losses due to trypanosomosis are estimated at about 4 US Billion Dollars Annually in Africa (Mulligan *et al*., 1979). An outbreak of both animal trypanosomosis and sleeping sickness in humans was reported in the Federal Capital Territory, Abuja (Maudlin *et al*., 2004), within the northern region of Nigeria. The prevalence of *G. p. palpalis* in this region, which is an efficient transmitter of *T. b. gambiense* in humans in Nigeria, is a good indicator of the flies in the region (Omoogun *et al*., 1994).

Tsetse flies remain one of the most important vectors of trypanosomosis in Africa that have variously exacted a great impact on humans, livestock and agriculture. One of such diseases that have adversely affected sub-Saharan Africa is trypanosomosis caused by several species of unicellular, flagellated, parasitic protozoan of the genus *Trypanosoma* which develop cyclically in the tsetse flies (Maudlin *et al*., 2004). The aim of this research is to ascertain status of the distribution and vector competence of tsetse flies in relation to animal trypanosomiasis in the Federal Capital Territory; Abuja; and to determine the prevalence of trypanosomosis in Zebu cattle; the species composition of tsetse flies present in the Federal Capital Territory; the sex ratio of the flies and the vector Competence of *Glossina* within six area Councils of the FCT Abuja.

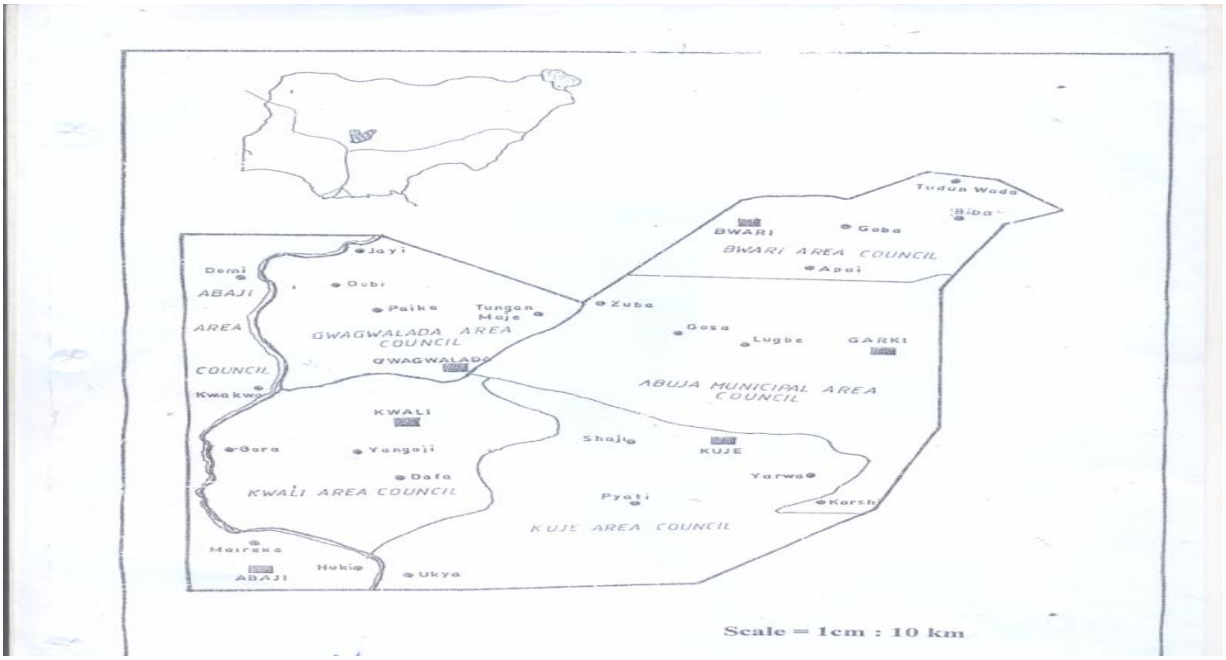
Materials and Methods

The Study Area:

The study was carried out in the six Area Councils of Abuja namely Gwagwalada, Abuja Municipal, Kwali, Abaji, Bwari, and Kuje Area Councils. Abuja, the Federal Capital Territory (FCT) of Nigeria was created in 1976. It lies between latitudes 8^0 25′ and 9^0 20′ North of the equator and longitude 6^0 45′ East of Greenwich meridian. Geographically, FCT is placed at the centre of Nigeria and within the Guinea Savannah Zone (Kanffman, 1986), is one of those areas where there has been repeated outbreaks of trypanosomosis in livestock in 1950's to 1960's (Glover and Aitchison, 1966). Geographically, FCT is placed at the centre of Nigeria and within the Guinea Savannah Zone (Mulligan, *et al*., 1979). The mean monthly relative humidity (rh) range between approximately 80% in the wet season and 40% in the dry season. Abuja is characterized by hills and basement complex rocks which account for about three quarters of its total area. There are several river systems in FCT that flow from North to South and East to West direction. The major river is River Gurara which flows through the territory skirting the western border. It flows in a deeply sharp bed in the north and gradually widens out into the flat flood plains and eventually empties into river Niger in Kogi state. Other rivers include R. Usuman, R. Bobo, R. Wasika, R. Afara Bokwoi, R. Tapa, to mention but a few. These rivers flow through the territory westerly into the Gurara river and flow through the reflect gallery forest. Most of these rivers are perennial while some tributaries (Fig.1).

The pastoralists, encouraged by the good pasture of this area and settle here. The number of cattle within FCT was estimated to be 46,468 as at 1993 (MFCT, 1994). Average number of cattle per house hold was estimated to be 398 in the hands of the 79 households. Fulani tribe is the major herdsmen in the FCT, Abuja

.



Source: Doxiadis Associates Nigeria Ltd. (1983).

Fig. 1: FCT showing the 24 Villages in the Six Area Councils

Sample Collection

***Trapping and Collection of tsetse flies (Glossina species)*:** Trapping of the *Glossina* species were conducted between 1st June, 2006 and 31st May, 2007 and in 4 randomly selected villages of each of the six area council of the FCT. A total of 48 bi-conical traps (white and blue) see (Plate 2) were set in the six area councils of the FCT (Challier and Larvessier, 1990). That is, 8 traps in each Area Council, 2 traps were set in each village. The traps were set and baited with acetone (Ahmed *et al*; 1993) to enhance trapping of *G. palpalis* and other *Glossina* species. The traps were set in the fringes forest by the river plains, streams and ponds where the villagers fetch water, and cattle graze and drink water (Ahmed *et al*., 2000). The 2 traps in each village were set at approximately 1-2 km apart and they were labeled. The catch in the traps were emptied after every 5 days into small insect boxes. At the point of removal from the trap, they were killed by exposure to ether or chloroform and then taken to the laboratory for identification and other analyses (Hagrove, 2004).

Plate 1: Biconical Trap

***Identification of fly species*:** All the catch as from the 4 traps in each Area Council were sorted and counted. The sex of the flies were equally identified and counted to determine the sex ratio. Details on the identification and determination of the sexes of the *Glossina* collected were based on description by Davies (1982) and Pollock (1982). Non-tenerals (engorged flies, those that have taken blood meal) were selected for dissection (Itard, 1989).

***Dissection of Glossina and identification of Trypanosome spp.*:** The teneral fly by definition could not be infected because they are flies that have not taken any blood meal, and could possibly therefore have no infection and were not dissected. Thus only the non-teneral tsetse flies (those that have taken blood) which can easily be identified with their gorged abdomen were dissected. The wings were carefully detached from the thorax, after which the body of the tsetse was placed on slide under a dissecting microscope. A piercing needle was used to separate the head from the body gently. The hypopharynx was removed onto a clean microscopic slide with a drop of saline added; and the slide observed under microscope using X320 magnification. The same procedure was applied to the gut and salivary gland; they were separated on 2 different slides followed by addition of saline (Moloo *et al*., 1973), Penchenier and ITARD (1981) technique for the location of trypanosomes. The mouth parts (labrum and hypopharynx), mid-gut, and salivary glands were squashed on slide and examined. The trypanosomes were identified and differentiated into species by their location within the insect, presences of flagellum, position of kinetoplast, size and mobility (Oniyah *et al*., 1997).

Collection and analysis of Blood Samples: A total of 1440 samples were collected from each bovine (zebu cattle) in the FCT. Two hundred and forty blood samples were collected from each cattle of Area Council; that is, 60 samples (30 males and 30 females) in each of the four villages in the Council. The samples were collected between 7.00 and 9.10 am before the animals were released for grazing. Samples

were collected from Zebu breed which were randomly selected from open ranches under the prevailing average temperature of 31^0C and 55% relative humidity.

Five millitres of blood was collected from the Zebu via the jugular vein (Macodimba, 1990; Molyneux, 2004). The blood samples were immediately emptied into 20 ml bottles containing EDTA as anticoagulant (Eisler *et al*., 2004); which were then packed in a potable cooler containing ice blocks and transported to the Parasitological Laboratory at the National Veterinary Research Institute Vom, Jos, Plateau State, Nigeria for analysis. Direct ELISA test was conducted to diagnose blood samples according to the method of Natuluya (1989).

Data Analysis

- Data was analyzed using T=Test pair's method in comparing the following:
- The species composition of tsetse flies present in the Federal Capital Territory.
- Vectorial capacity of the vectors within each Area Council.
- The sexes of the flies.
- The prevalence of trypanosomiasis in Zebu cattle, using blood samples.

Results

Distribution of *Glossina* : A total of 4991 *Glossina* spp. were trapped during 132 trap-days. The highest number of *Glossina* (488) was observed in the month of May in Abaji Area Council, while the lowest (1) was observed in the month of September in AMAC. No flies were encountered throughout the dry season, including the late dry season/early rains when the climatic conditions were most severe. The flies were generally more abundant in Abaji Area council with total of 1819 flies trapped and AMAC had the lowest of 186 flies (Table 1).In Gwagwalada Area Council had 290 flies. Kwali recorded 393 flies, A.M.A.C. had 189, Abaji Area Council ,had the highest number of flies of1819,Bwari Area Council recorded 1104, and Kuje Area Council recorded 1196.

Table 1: Monthly Distribution of *Glossina* spp. in the Six Area Councils (June, 2006 – May, 2007).

Area Council	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Total
Gwagwalada	98	56	48	12	0	0	0	0	0	0	0	76	290
Kwali	110	51	38	10	17	0	0	0	0	0	31	109	393
AMAC	85	40	11	1	3	0	0	0	0	0	0	49	189
Abaji	488	280	161	118	103	97	8	0	0	33	168	360	1819
Bwari	373	162	115	33	44	28	3	0	0	0	134	212	1104
Kuje	430	142	101	98	54	46	0	0	0	0	142	183	1196
													4991

Abaji had the highest number of 488 tsetse flies in June (what year?)
*AMAC had the lowest number of 85 flies in June (what year?)

In Kuje Area Council,*G. p. palpalis* was significantly (T= 2.9 df= 3, P < 0.05) more than *G.tachinodes* with ratio 1:13.

Table 2: Distribution and Species Composition of Glossina *sp in the Six Area Councils of the F. C.T, Abuja*

Area Council	Non-Teneral *Glossina*	Male *Glossina*	Female *Glossina*	*G. palpalis*	*G. tachinodes*	Total Flies collected
G/lada	220	117	173	258	32	290
Kwali	225	165	228	358	34	393
AMAC	86	77	112	177	12	189
Abaji	600	839	980	1583	236	1819
Bwari	583	524	580	1049	54	1104
Kuje	541	546	650	112	84	1196
Total	2255	2268	2723	4538	453	4991
Average	376*	378	454	756*	75*	832*

Female =454, male = 378 differences was not significant at T= -2; df=5 and P< 0.05.

**G. palpalis* = 756, G. *tachinodes* = 75 differences was significant at T= 2.9; df=5 and P< 0.05*

No of flies =832, No of non-teneral = 376 differences was significant at T=-3.25; df=5 and P<0.05 *G/lada Gwagwalada*

Species Composition of *Gossina*:With respect to species composition, its relative abundance in the six area councils of the FCT Abuja, *G.p. palpalis* (Robineau-Desvoidy 1830) and *G. tachinoides* (Westwood, 1850) were the only tsetse species trapped within the riverine of relict forest of FCT, Abuja, Nigeria in this study (Table 2). *G. p. palpalis* had the highest number of 4538 while *G.tachinoides* was 453. Their numbers were significantly different (T=3.3. df=5, P<0.05) from each other, with a ratio of 10:1. Abaji Area Council had the highest number of *G. p. palpalis* (1583), while

the lowest number (1) for this species was recorded in Abuja Municipal Area Council. Abaji Area Council also had the highest number of *G.tachinoides* (236) while Abuja Municipal Area Council had

the lowest number. Gwagwalada Area Council recorded 258 *G.p. palpalis* and 32*G.tachinodes*, *G.p.palpalis* was significantly (T=3.3 df=3 p<0.05) more abundant than *G.tachinodes*, with ratio 8:1.InKwali Area Council recorded 358*G.palpalis palpalis* and 34 *G.tachinodes, G.p.palpalis* was significant (T=4 df=3 p<0.05) more abundant than *G.tachinoides*. In Abuja Municipal Area Council had 117 *G.p. palpalis* and 12 *G.tachinodes*,*G. p. palpalis* was significantly different at (T= 4. 20, df= 3, P< 0.05)more than *G. tachinoides* with ratio 1:13.Bwari Area Council recorded 1049 *G.p.palpalis* and 54 *G.tachinodes*, *G. p. palpalis* was significantly (T= 2.3, df= 3, P < 0.05) more than *G.tachinoides* with ratio 1:9.Abaji Area Council 1583 *G.p.palpalis* and 54 *G. tachinodes*,G. p. palpalis was significantly at (T= 2 df= 3, P< 0.05) more than *G.tachinodes*. Kuje Area Council recorded 112 *G.p.palpalis* and 84 *G.tachinodes*,*G. p. palpalis* was significantly (T= 2.3, df= 3, P < 0.05) more than *G.tachinoides* with ratio 1:10.

Sex ratio of *Glossina*: On the whole there was no significant difference between the number of male and female *Glossina* spp. encountered in the study area that were trapped (T= -4.7, df=5, p< 0.05); being almost 1:1 that is 2268 males and 2723 females (Table 4). In Gwagwalada Area Council, recorded 117 males and 173 females there was no significant difference in the sex ratio (T= - 3.8.00, df =3 and p<0.05).In Kwali Area Council, the number of male and female did not differ significantly from each other (T= - 2.7, df= 3, P<0.05), with a ratio of 1:1 that is 165 males and 228 females. In Abuja Municipal Area Council had 77 males and 112 females, female was significantly (T=3 df=3 p<0.05) more abundant than male, with ratio 2:1. Abaji Area Council, recorded 89 males and 980 females, female was significantly (T=1.6 df=3 p<0.05) more

abundant than male, with ratio 4:3, Bwari Area Council had 524 males and 580 females, the number of male and female did not differ significantly from each other (T= - 4.6, df= 3, P<0.05), with a ratio of 1:1. In Kuje Area Council, recorded 544 males and 657 females, the number of male and female did not differ significantly from each other (T= -2, df= 3, P<0.05), with a ratio of 1:1.

Infection rate of *trypanosoma.:* Of 2255 non-teneral flies in the FCT Abuja dissected and examined for trypanosomes infection between June 2006 and May 2007; 744(33.00%) were positive. More females 452(20.00%) and 292(13.00%) males were infected; there was significant difference (T= -2.7. df=5 p< 0.05) betwmeen the two rates.. A total of 608(30.00%) were positive for *T.vivax*, 123 (5.00%) for *T. congolense* and 23 (1.00%) for *T. brucei*.Of the 220 non-teneral flies examined in Gwagwalada, 51(23%) were positive. More females 32(15%) were infected than males 19(9%); and there was a significant difference (T=2, df=3, p<0.05) between the rates. A total of 46(21.00%) were positive for *T.vivax;* and 5(2.00%) for *T. congolense.* The rate of infection with *T.vivax, T.congolense* and *T. brucei*, were 25%, 11% and 5% respectively. In Kwali Area Council a total of 255 non-teneral examined, 145(64.00%) were positive. More females 88(34.00%) were infected than males 57(22.00%) and there was a significant difference (T= 4.5, df= 3, P< 0. 05) between the rates. A total of 80(82.00%) were positive for *T.vivax, T. congolense*, 12 (4.00%) and 3 (1.00%). Of the 86 non-teneral flies examined in AMAC, 23(27%) were positive. More females 15(19.00%) were infected than males 8(9.00%); and there was a significant difference (T=2.9, df=3, p<0.05) between the rates. A total of 19(22.00%) were positive for *T.vivax*; and 4(5.00%) for *T. congolense*. Of the 600 non-teneral flies examined in Abaji Area Council, 160(27%) were positive. More females 94(16%) were infected than males 66(11%); and there was a significant difference (T=3, df=3, p<0.05) between the rates. A total of 46(21.00%) were positive of *T.vivax* and 5(2.00%) for *T. congolense.*

Table 3: Infection Rate with trypanosomes of Glossina in the Six Area Councilof the FCT

Area Council	Number examined	Number positive	Male Flies	Female Flies	T. vivax	T. congolense	T. brucei	% positve
G/lada	220	51	19	32	46	8	0	23.00
Kwali	225	145	57	88	119	26	8	64.00
AMAC	86	23	8	15	19	4	0	27.00
Abaji	600	160	66	94	121	38	1	27.00
Bwari	583	190	78	112	153	33	8	32.00
Kuje	541	175	64	111	150	21	4	8.00
Total	2255	744	292	452	608	123	13	33.00

*2255 flies examined, 744 positive,. LSD value at (P< 0.05) T= 15 significant.
* 292 males and 34 females *Glossina* positive, LSD =(P< 0.05) T= 2 significant.
* 744 flies positive, *T.vivax* = 608 *T. congolensis* = 153, *T. brucei* 13, P< 0.05. LSD = (P< 0.05) T= 2.5 significant

Blood Samples Analysis

Prevalence of bovine trypanosomiasis: Of 1440 zebu cattle were examined in FCT between June 2006 and May 2007, 53(22.08%) were positive for *T. vivax*. More females 38 (15.20%) were positive than males, 15(6.25%); there was significant difference (T=22, df=5 P<0.05) between the two rates, Bwari 61(25.00%) and Kuje Area Council had 58(28.00%) the difference was significant (T= 8,df = 5,P < 0.05).Gwagwalada Area Council recorded 17.00 %(40), Kwali had 49(20.00%), AMAC 31(13.00%), In Gwagwalada Area Council more females 30 (12.50%) were more infected than males 10(4.10%) and there was significant difference (T=16, df=3 p<0.05) between the two rates. In Kwali Area Council more females 34 (14.16%) were more infected than males 15(6.25%) and there was significant difference (T=10.8, df=3 p<0.05) between the two rates. Abuja Municipal Area Council more females 8 (3.33%) were more infected than males 23(9.58%) and there was significant difference (T=16, df=3 p<0.05) between the two rates.

Table 4: Infection Rate with trypanosomes of Glossina in the Six Area Council of the FCT

Area Council	Number examined	Number positive	Male Flies	Female Flies	T. vivax	T. congolense	T. brucei	% positve
G/lada	220	51	19	32	46	8	0	23.00
Kwali	225	145	57	88	119	26	8	64.00
AMAC	86	23	8	15	19	4	0	27.00
Abaji	600	160	66	94	121	38	1	27.00
Bwari	583	190	78	112	153	33	8	32.00
Kuje	541	175	64	111	150	21	4	8.00
Total	2255	744	292	452	608	123	13	33.00

*2255 flies examined, 744 positive,. LSD value at (P< 0.05) T= 15 significant.

* 292 males and 452 females *Glossina* positive, LSD =(P< 0.05) T= 2 significant.

* 744 flies positive, *T.vivax* = 608, *T. congolensis* = 123, *T. brucei* 13, P< 0.05. LSD = (P< 0.05) T= 2.5 significant

In (22.91%) were more infected than males 23(12.91%) and there was significant difference (T=11, df=3 p<0.05) between the two rates. In Bwari Area Council more females 44 (18.33%) were more infected than males 17(7.08%) and p<0.05) between the two rates. In Kuje Area Council more females 41(17.08%) were more infected than males 17(7.08%) and there was significant difference (T=17, df=3 p<0.05) between the two rates.

Table 5: Prevalence of Bovine Trypanosomiasis in Zebu Cattle in the Six Area Councils of the FCT, Abuja

Area Council	Total No Exam	MA L E		F E M A L E		Total No +VE	Total % +VE	*T.vivax*	*T. congolensis*	*T.brucei*
		No Examined	No +VE	No Exam	No +VE					
G/lada	240	120	10	120	30	40	12.00	40	0	0
Kwali	240	120	15	120	34	49	20.00	49	0	0
AMAC	240	120	8	120	23	31	13.00	31	0	0
Abaji	240	120	23	120	55	75	31.00	75	0	0
Bwari	240	120	17	120	44	61	25.00	61	0	0
Kuje	240	120	17	120	14	58	28.00	58	0	0
TOTAL	1440	720	90	720	197	314	28.00	314	0	0
Average	240	120	15	120	33	48	13.40	48	0	0

*15 males and 33 females were positive and had significant difference at (T= 22, df = 5 P<0.05)

Discussion

Species composition and relative abundance of *Glossina* in the FCT, Abuja

Glossina p. palpalis and *G. tachinoides* were the only species encountered in the relict of the riverine forest of the six Area Councils of the FCT, Abuja, Nigeria. The presence of these species in the area is consistent with the earlier report of Mauldlin (2006), which indicated the presence of the two species in the Guinea Savanna Zone of Nigeria.

Contrary to the report by MFCT report (1996) that the prevalence rate of the *G. tachinoides* was high in the FCT, a significantly reduced number of *G. tachinodes* was recorded in the FCT in the current studies. The observed reduction of *G. tachnoides* might be linked to the disappearance of the domestic pig and hog from the area. The area according to Madubunyi (1988) has been identified as an important focus of *G. tachinodes* in Nigeria and a part from the fact that *G. tachinodes* strive well within narrow mean temperature range of 27°c and 30°c, the observed high catches of *G. palpalis* in the FCT might have also been influenced by baited acetone trap used in this studies (Challier *et al*., 1990).

In a related study, Groenendijk (1996) observed that high catches of tenerals could be boosted by artificial bait, similar to the high population of *Glossina* observed in Abaji, Bwari and Kuje Area Councils which might be as a result of more stable climatic conditions in the relict forest and perennial rivers at these sites.

Sex Ratio

Although the sex ratio of testse at emergence is 1:1 (Paynter *et al*., 1992), the monthly catches in the six Area Councils of the FCT was predominantly females. Sex composition of tsetse population is often influenced by the catching method (Mizell *et al*., 2002). Challier *et al*. (2004) had noted that traps generally caught a higher percentage of females.

Climate

High density of *Glossina* observed in the wet season and declined in the dry season contradicting with observation of Nash and page (1953) on the study in Northern Guinea Savanna Zone of Nigeria. However, the current result showed minimum density of flies in October-April which makes it impossible to collect flies throughout the year in the FCT, Abuja which may be due to deforestation activities taking place in this zone. *G.p. palpalis* was

found almost throughout the season in Abaji Area Council except (November-January) when temperature dropped between 20° - 24°C in the relict forest.

Infection Rates of Trypanosomesin *Glossina*

In the current result, the trypanosome infection rates of tsetse in the FCT showed that large populations of the flies found in the Area Councils were infected with trypanosomes mainly *T. vivax* and very few *T. congolense* the total infection rate of 29.00% in the area which is high. The prevalence rate recorded in the flies in this study is higher than the 13.9% recorded by Onyah *et al*. (1985) in Kanji Lake wild life parks in Niger State, which is less than the rate reported by MFCT report (1994).

The possible factors that contributed to the endemicity of trypanosomasis in FCT Abuja and susceptibility to outbreaks are outlined.

- Widespread presence of tsetse in most of the hydrographic systems, where livestock graze and water.
- High tsetse challenge on the livestock
- High *trypanosome* infection in the *Glossina*
- Long (7 months) dry season, which ensured close and prolong contact between tsetse and livestock
- Year around abundance of several species of other biting *dipterans* which probably act as mechanical vectors.

REFERENCES

Ahmed, M. M. M.., E. I. Abdel Karim & A. H. A. Rahman (1993). Reproductive status, catch and age composition of a Natural Population of *G. m. submorsitans* in Bahr El Arab belt. Sudan. Insect Sci. Appl. 14 (4): 445-458.

Ahmed, A. B., G. A. Omoogun, & S. S. Shaida (2000). Trypanosome Infection in *Glossina species* at the Kainji Wildlife Park, Nigeria. Entomological Society of Nigeria Publ. 32:57-62.

Challier, A & C. Larvessiere, (1990). The Ecology of Tsetse (*Glossina* spp.) (Diptera: Glossinidae): A review (1970-1981). Insect Science Applications, 3:97-143.

Davies, H. (1977). *Tsetse flies in Nigeria Handbook for junior staff*. (3rd edition), Oxford University Press, Ibadan, p. 54-68.

Davies, H. (1982): The eradication of tsetse in the Chad River System of Northern Nigeria. Journal of Applied Ecology, 2: 287- 403.

Eisler, M. C., P.Lessard, R. A. Masake, S. K. Maloo & A. S. Percgrine. (1998). Sensitivity and specificity of ant-capture ELISA for diagnosis of T. *congolense* and T. *vivax* infection in cattle. Veterinary Parasitology,79,187-201.

F.A.O. (2004) Map of Africa showing infested area by tsetse-flies. Tcpprogramme@laea.org.

F. A. O. (2013). Operational procedures for the control of tsetse fly and Animal trypanosomiasis: A review of current activities and prospects including research and training requirements for the future. http:// www.laea.

Feldmann, U. & J. Hendrichs, (2001). Integrating the sterile insect Technique as a key component of area with tsetse and trypanosomiasis interaction. PAAT Technical and Scientific Series No. 3**:** 66.

Glover, P. E. & P. J. Aitchison (1966). Tsetse control and land use in Northern Nigeria. A feasibility study of area 1. Baraka Press, Kaduna.

Groenendijk, C. A. (1996). The response of tsetse flies to artificial baits in relation to age, nutritional and reproductive state. Entomologia Experimentalis et Applicata 78, 335-340.

Hagrove, J. W. (2004a). Distribution and abundance of tsetse-flies (Glossina spp). Journal of Animal Ecology, 55: 1007-1025

Hagrove, J. W. (2004).The control of tsetse flies in relation to fly Movement and trapping efficiency. Journal of Applied Ecology, 29: 163-179.

Ilemobade, A. A. (1983). Research in the field of animal Trypanosomiasis in Nigeria: An overview. In Ilemobade, A. A. *Proceedings 1st National Conference Tsetse and Trypanosomiasis Research In Nigeria*, Kaduna, Nigeria. p. 31-33.

ITARD, (1989). African animal trypanosomiasis. In: M. Shah. Fishcher and Ralph Say. R. (English translates). Manual of Tropical Veterinary Parasitology. CAB International, UK, p. 199-292.

Kanffman, R. (1986). An introduction to the sub humid zone of West Africa and the ILCA sub humid zone programme. Proc. 2nd ILCA/NAPRI symp. Kaduna, Nigeria. October 29 to November 2nd 1984.

Kassai, T.; M. Cordero Del Campillo, J. Euzeby, S. Gaafar, T. Hiepe & C. A. Himonas (1988). Standardized nomenclature of animal parasitic diseases (SNOAPAD). Veterinary Parasitology, 29: 299-326.

Kranowski, W. J. & F. H. C. Marriott (1995). *Multivariate Analysis part 2 classification, covariance structure and repeated measurement*. Arnold London, 280 pp.

Macodimba, F. A. (1990).The effects of temperature and storage on the Infectivity and motility of African trypanosomes in the blood of different hosts. Acta Tropica, 47(1):53-60.

Madubunyi, L. C. (1990). Ecology of *Glssiona species* in habiting peridomestic agro-ecosystems in relation to options for tsetse fly control. Sterile insect technique for tsetse control and eradication. Proc. Final Res. Coord. Meeting, Vom, Nigeria.

MFCT, (1994). Feasibility Report of the Development of Grazing Reserves in Abuja, Federal Capital Territory. *Sam Prints.* pp. 23-24.

Marcella, A. (2012). The effect of tsetse fly on African development. *National Bureau of Economic Research*, http://www.people.fas.harvard.edu/~malsan/

Maloo, S. K. M. C Eisler, P.Lessard, R. A. Masake, & A. S. Percgrine (1973). Sensitivity and specificity of ant- capture ELISA for diagnosis of *T. congolense* and *T. vivax* infection in cattle. Veterinary Parasitology, 79:187-201.

Maudlin, P. H., F. Holmes & M. A. Miles, (2004). The African Trypanosomiasis , (Second edition) p. 405-708.

Maudlin, I. (2006). African Trypanosomiasis. Annals of Tropical Medicine and Parasitology, 679.708.

Mizell, R. F.III, R. F. IV Mizell, & R. A**.** Mizell (2002). Trolling: a novel trapping method for *Chrysops* spp. (Diptera:*Tabanidae*).Florida Entomologist **85,** 356-366.

Molyneux, D. H. & R. W. Ashford (2004). Diagnostic methods in animal trypanosomiasis. Veterinary Parasitology, 1: 5-17.

Mulligan, K., D. M. Bourn & R. Chachu, (1979). Dry and wet Season patterns of cattle and land use in four regions of the Nigerian sub humid zone. Report to the International Livestock Centre for Africa, sub-humid zone programme, Kaduna-Nigeria. p. 232-547.

Nash, T. A. M. & W. A. Page (1953). The ecology of *G. palpalis* Northern Nigeria. Trans. R. Entomol. Soc. 104: 71-169.

Natuluya V. M. & K. J. Lindquist (1989) Antigen detection enzyme immnosorbent assays for diagnosis of T. *vivax* , T. *congolense* and T. *brucei* infections in cattle. Tropical Medicine and Parasitology, 40, 251-390.

OIE, (2000). Trypanosomiasis (Tsetse borne) classified as an OIE list Disease (B113). www.oie.int/eng/maladis/fiches/a-b113.htm

Omoogun, G. A., J. A. Onyiah, & S. S. Shaida, (1994). An Improved tsetse trap for *Glossina tachinoides* in Nigeria. the Nitse trap. Insect Sci. Appl. 15(45): 529-534.

Onyiah, J. A. (1985). Tsetse distribution map of 30 states and Fed Capital territory of Nigeria.

Onyiah, J. A. (1997). African Animal Trypanosomiasis: an overview of the current status in Nigeria. Tropical Veterinarian, 15 (3-4):111-116.

Packer, M. J. & M. L. Warnes, (1991). Responses of tsetse to ox sebum: a video study in the field. Medical and Veterinary Entomology 5, 23-27.

Paynter, Q. & Brady, J. (1992). Flight behaviour of tsetse flies in thick bush (*Glossina pallidipes* (Diptera: Glossinidae). Bulletin of Entomological Research, 82, 513-516.

Penchenier,I and ITARD, (1981). A new technique for the rapid dissection of salivary glands and gut of tsetse. Entomology and Medical Parasidology, 19**:** 55-57

Pollock, J. N. (1982). *Training Manual for Tsetse Control Personnel.VI Tsetse Biology, Systematics and Distribution Techniques*. p. 42-61.

Torr, S. J. (1994) Responses of tsetse flies (Diptera: Glossinidae) to warthog (*Phacochoerus aethiopicus* Pallas). Bulletin of Entomological Research, 84**,** 411-419.

World Health Organization (2009). The vector tsetse fly .Bulletin of World Health Organization 79 File/A/Trypanosomiasis ntm. Division of control of tropical diseases. www.