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A comparison of three types of "M" traps for sampling tsetse fly (*Diptera: Glossinidae*) populations at South Luangwa Game Management Area, Zambia

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SUMMARY

A field trial was conducted between 27th July and 1st August, 1992 in Mfuwe, south Luangwa, Zambia to assess the effectiveness of locally developed "M" traps for suppressing and sampling the tsetse flies *Glossina pallidipes* Austen and *Glossina morsitans morsitans* Westwood.

The tsetse catches in the "M" traps and the standard F3 traps were collected at 24 hour intervals. The highest catches of both tsetse species in the series of "M" traps were in the M3 trap. The numbers of female flies caught for both species in all the trap types were significantly higher than those for male flies ($p < 0{,}001$). Trap catches for *G. pallidipes* were uniformly distributed among the M2, M3 and F3 traps. In contrast, there was a significant drop in the M1 catches. For *G. m. morsitans*, the results were not significantly different between the M1and the M3 catches.

Based on the results of this trial, it is been recommended adopting the M1 trap, a more cost effective trap for suppression and the M3 trap for sampling of *G. m. morsitans* which is the only species in Kampumbu (our trial suppression area) in the Isoka district of Zambia.

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INTRODUCTION

The campaign for tsetse control has seen the emergence of a wide range of devices and techniques since the development of the Harris trap in 1930.[3] Electric nets are among the devices which have been introduced to sample tsetse populations in recent years[5] in the attempt to find an effective trap. Several research workers in present times have diverted their attention to odour – baited traps as sampling and suppression devices[4] which tend to have higher tsetse catches enhanced by the presence of attractants.[2,10] Insecticide impregnated targets as a method for controlling tsetse flies seem a very ideal solution for a number of African countries infested with tsetse. Adoption of targets has been recommended following the successful trials in Zimbabwe.[8] Vale *et al*,[7,8] observed that targets are simple to construct and easier to use. They are found to be a more cost effective method of controlling both *G.m. morsitans* and *G. pallidipes* which are major vectors for trypanosomiasis.

In this paper are reported results of work carried out in Zambia to identify a trap for sampling and suppressing *G.m. morsitans* using locally designed "M" series of traps (Figures II and III). These devices would later be deployed in the north Luangwa around Kampumbu area, a zone of tsetse flies s dominated by *G.m. morsitans*.

Figure I: Sketch diagram of M1 trap.

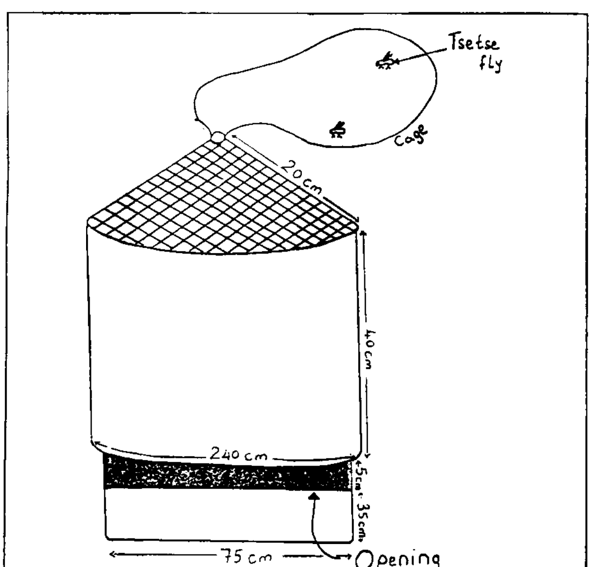
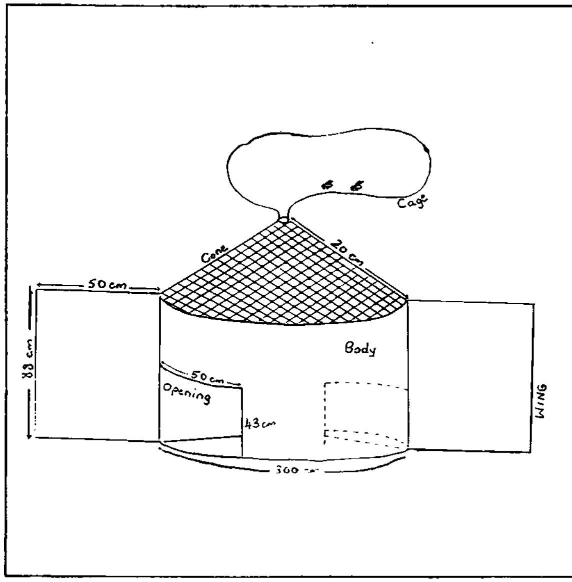


Figure II: Sketch diagram of M3 trap.

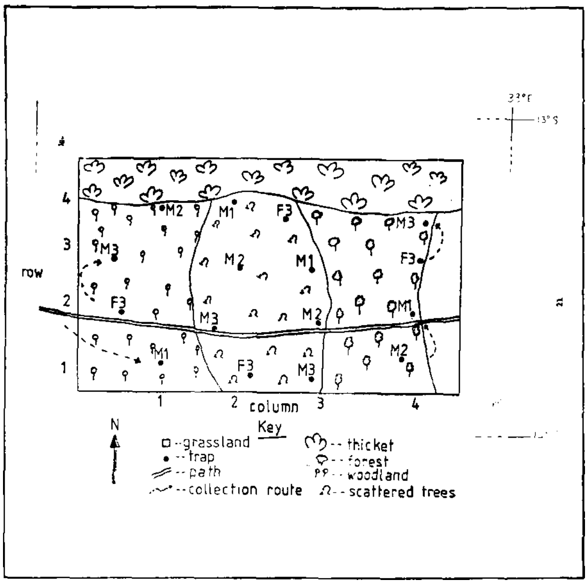


MATERIALS AND METHODS

The experimental site in south Luangwa game management area was located at Mfuwe near Kakumbi (13°32'S, 32°45'E). Maximum average daily temperatures were around 20,9°C and 53 pc relative humidity. The study trial was performed over a five day period in the cold dry season. The area harbours the largest collection of wild animals in the country and is also infested with *G.m. morsitans* and *G. pallidipes*.

Design and experiment: The trial block of 450m x 450m Latin square design composed of four trap types: M1, M2, M3 and standard F3, was set up embracing three different vegetation types including scattered trees, woodland and forest (Figure I). This was in an area where the density of tsetse was relatively high with considerable activity of wild animals. The traps developed at Tropical Diseases Research Centre, Zambia were made from the same locally manufactured materials. A shade of blue cotton cloth was used for the lower half and white nylon netting for the upper cone of the trap. The inner walls facing entrance points were backed by black cloth. The "M" series of traps with wire frames and bamboo poles for support, were made of the same design with variations in the entry mechanism.

Figure III: Sketch map showing trap sites.



The M1 trap was positioned about half a meter above the ground to allow flies to enter from the bottom. For the M2 trap which rests on the ground with an entrance in the blue lower half, it has a provision of a one metre wing extension to increase the landing surface area under the opening of the trap. The M3 trap which is very similar to the M2 trap but with a wider circumference has two wing extensions from either openings. The traps were arranged in four lines 1–4 (Figure I) and included only one trap type in each line set up in the experimental block. Daily catches from the traps were collected once every 24 hours between 10.00 hours and 12.00 hours when flies were less active. This was performed for five consecutive days. The tsetse flies found alive were killed by gently squeezing their thorax before emptying the cages.

Analysis: The data for tsetse catches was entered into an IBM personal computer using Lotus 1-2-3. Analysis was done using statistical package "Statgraphics". Male and female tsetse data collected were subjected to separate analyses. Daily catches (n) from the replicates of the Latin square design were subjected to an analysis of variance after a log (n+1) transformation. Where the treatment effect was significant the differences between treatment means (catch per trap per day) were further compared using Duncan's multiple range test. The term 'significant' used in this paper implies a significant difference between transformed means at the 0,05 level of probability.

The relative efficacies of the different traps tested were estimated by computing an index of increase relative to the standard trap. Sex proportions of the two tsetse species in the collection were also determined and for clarity, the geometric means are presented along with the computed index of increase.

RESULTS

The main effects which were statistically significant for the two tsetse species sampled are shown in Table I and II. Data for both species showed significant differences in mean catches among traps, days and sexes. Significant differences were also observed in mean catches among rows and columns for *G. pallidipes*.

*Table I: Analysis of variance for **G.m. morsitans** data.*

Source of variation	SS	df	MS	F-Ratio
Row	0,391	3	0,130	1,4
Column	0,162	3	0,054	0,6
Trap	2,144	3	0,715	7,9***
Day	4,275	4	1,069	11,8***
Sex	2,158	1	2,158	23,9***
Residual	13,114	145	0,090	
Total	22,229	159		

*******Asterisks indicates level of significance at 0,1 pc.***

Table II: Analysis of variance for G. pallidipes data.

Source of variation	SS	df	MS	F-Ratio
Row	3,165	3	1,055	13,3***
Column	1,512	3	0,504	6,4***
Trap	5,893	3	1,965	4,8**
Day	1,795	4	0,449	5,7***
Sex	5,334	1	5,334	67,5***
Residual	11,465	145	0,079	
Total	29,164	159		

*****Asterisks indicate level of significance at 1 pc.***
******Asterisks indicate level of significance at 0,1 pc.***

*Table III: Mean trap catches per day and indices of increase relative to standard F3 trap, in series of M traps for **G.m. morsitans and G. pallidipes.***

	G.m. morsitans					*G. pallidipes*				
	Mean catch			Index increase		Mean catch			Index increase	
Trap	M	F	Ratio	M	F	M	F	Ratio	M	F
M1	15	25	1 : 1,7	2,1	1,1	1	7	1 : 7	0,1	0,2
M2	13	17	1 : 1,3	1,9	0,7	6	34	1 : 5,7	0,4	1,1
M3	17	43	1 : 2,5	3,4	1,9	13	39	1 : 3	0,9	1,3
F3	7	23	1 : 3,3	1,0	1,0	15	31	1 : 2,1	1,0	1,0

Table IV: Comparision of sex ratios in tsetse flies caught.

Sex	*G.m. morsitans* Mean catch	Index increase	*G. pallidipes* Mean catch	Index increase
Male	2,28	1,0	1,3	1,0
Female	4,59	2,0*	4,2	3,2*

Index of increase which is significantly different from unit (p < 0,001).

On the performance of different trap types based on daily mean catches, it is shown from Table II that M3 trap was supreme over other traps for both *G.m. morsitans* and *G. pallidipes*.

The findings based on multiple range analysis were that the performance of the M2, M3 and F3 traps for *G. pallidipes* were comparable but significantly lower in the M1 trap. For *G.m. morsitans*, the performance was comparable in the M1, M2 and F3 traps. The sex ratios for both species of tsetse flies are shown in Tables III and IV. For both species, the traps were catching greater numbers of females than males. The number of females was twice as much and three times as much for *G.m. morsitans* and *G. pallidipes*, respectively.

The daily variations in catches showed a uniform distribution over the first four days for both species. A significant drop in tsetse flies caught was noticeable only on the fifth day (p < 0,001). On average, the daily catch varied from 2,9 – 5,9 and 2,5 – 3,3 for *G.m. morsitans* and *G. pallidipes* respectively, over the first four days; while the mean catch on day five was about one for both species (Table V).

Site effect for positions of traps had an impact only in the case of *G. pallidipes*. There were variations in the mean catches among rows and columns. The catches in row four which lay in the interface of a thicket and savannah, were significantly higher than those in other rows (p < 0,001). Columns three and four also yielded significantly higher mean catches compared to those in columns one and two (p < 0,001) (Table V and Figure I).

Table V: Daily tsetse catches, geometric means and indices of increase relative to day five.

Day	*G.m. morsitans* Mean catch	Index increase	*G. pallidipes* Mean catch	Index increase
1	2,9 a	2,4	2,7 b	2,3
2	4,2 a	3,5	2,5 b	2,1
3	5,9 a	4,9	3,3 b	2,8
4	3,5 a	2,9	2,9 b	2,4
5	1,2	1,0	1,2	1,0

Means followed by the same letter are not significantly different from each other.

*Table VI: Column and row effect in the catches of **G. pallidipes.***

Column	Mean catch	Row	Mean catch
1	1,5 d	1	1,8 ab
2	1,8 d	2	2,0 ab
3	3,6 e	3	1,7 ab
4	2,9 e	4	5,0

Means followed by the same letter are not significantly different from each other.

DISCUSSION

It is clear from the study results that M3 trap was more efficient for sampling both *G.m. morsitans* and *G. pallidipes*. The variability in trap performance could have been a result of both intrinsic and extrinsic factors. Visual responsiveness of the M3 owing to it's relative large size made it easily distinguished from other traps by tsetse flies. *Glossina spp.* have been observed to be more attracted to the darker and more shaded areas of the trap[3] and this increase their chances of being trapped once on the landing bay. The increased surface area in M3 trap as evidenced by the presence of tsetse flies on the landing surface during the study enhanced the chances of more tsetse entering the trap.

The elevation and wide bottom opening of the M1 trap probably made gain into the trap easier for *G.m. morsitans*. However, it might not be apparent from this study as to the causes of variability in trap catches obtained in the series of the M traps.

Further studies on trap efficiency would be more precise in comparing approach and entry into traps by various tsetse species in view of bias in some devices.[6]

The higher catches of females in the collections could have resulted due to a combination of factors. It has clearly been shown that diurnal variation in the activity of males and females affects trap catches. Female tsetse flies are associated with high activity early in the day[6] Dranfield *et al* observed greater mobility of female *G. pallidipes* compared to males. Hunger status and search for shade might to a larger extent determine that onset of activity for female flies. Day to day variability in the number of trapped flies is still a subject of study as shown in the study of *G. pallidipes* by Willians *et al.*[11]

An interesting observation was that the trend of variability was similar for both *G.m. morsitans* and *G. pallidipes*. During a five day period the peaks showed on day three with a mean catch of 5,9 for *G.m. morsitans* and 3,3 for *G. pallidipes*. A similar trend was also observed at Ngurumah[11] for *G. pallidipes* in a four day study which showed tsetse peaks to be correlated to nutritional condition phenomenon. According to Randolph *et al*[6] they found that tsetse flies are highly susceptible to local climatic changes. The build up of stronger winds after the peak in the latter part of the survey (Table VII), probably contributed to the decline in the tsetse flies caught on the fifth day. Both tsetse species recorded a significant drop.

Table VII: Climatic conditions of Mfuwe (27th July – 1st August 1992).

Date	R.H. pc	Tempt. °C	Wind speed K/s	Rainfall mm
27	54	21,9	6,8	0
28	54	20,2	6,7	0
29	53	19,9	5,5	0
30	46	22,1	8,2	0
31	62	19,7	8,6	0
01	51	21,8	8,0	0

R.H. = Relative humidity.
K/s = Knots per second.

A striking observation was the impact of vegetation type on flies caught. The significant catches of *G. pallidipes* (Figure I) in row four, an area in the interface of thicket savannah was not surprising as this is a typical habitat dominated by *G. pallidipes.*[12] The proximity of the path to row two did not adversely affect the catches in traps probably because of inactive traffic along the path.

Noticeable also, were the significant collections in columns three and four, influenced greatly by wooded forest environment. The flies which normally feed in more open situations of the woodland are observed to retreat to the forest margins for shade and deposition of larvae.[12] Thus, site effect which is paramount in tsetse flies caught[9] must be considered carefully in the sampling studies of *Glossina spp.* While the present results highlighting the feasibility of identifying locally developed tsetse traps are encouraging, an aspect of community participation must be emphasized. This could adversely affect the success of a tsetse campaign as sustenance of traps will mainly be supported by the commnunity.

Conclusion: Adoption of the M1 trap for suppression of *G.m. morsitans* would be a more cost effective way to control this species as the M1trap, is simple to construct and maintain compared to the M3 trap. The M3 trap could be used to monitor the tsetse populations.

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