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Field observations of tsetse flies (*Glossina* spp. (Diptera: Glossinidae)) with new odour-baited trapping devices

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Abstract

Three new trapping devices (M1, M2 and M3 traps) were tested and compared with current trapping devices (the F3 and the Epsilon traps) for tsetse flies (*Glossina* spp.) in Zimbabwe. The most effective was the M3 trap which caught 80% and 73% more male and female *G. morsitans* Westwood and 110% and 39% more male and female *G. pallidipes* Austen, respectively. The mean catch for the standard Epsilon trap which was not so effective was six male *G. morsitans*, 24 female *G. morsitans*, 76 male *G. pallidipes* and 199 female *G. pallidipes*.

Introduction

A proportion of tsetse flies (*Glossina* spp.) which approach odour-baited mechanical traps, fly around them and depart before they enter the body of the traps or land on the outside surfaces (Green, 1986).

Field observations of the upwind flight of *G. pallidipes* Austen near a source of host odour in the absence of visual stimuli have shown that insects tend to overshoot the odour source and then execute a U-turn (Bursell, 1984). According to Torr (1988b) *G. pallidipes* and *G. morsitans* Westwood that were caught on the upwind side of the net were presumably those that flew upwind past the odour source and then executed a reverse turn.

Observations with odour-baited Epsilon traps have shown that tsetse (*Glossina* spp.) tend to rest on the two upwind sides of traps where there is shade (Mhindurwa, unpublished data) during the hours preceding sunset when they are most active (Brady & Crump, 1978). It was reasoned that if the traps had entrances on all sides instead of only on one side as with the F3 and Epsilon traps, some of these tsetse might be caught. It is particularly important to improve the performance of traps for *G. morsitans* (Hargrove, 1977; Flint, 1985).

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Materials and methods

Studies were conducted near Rekomitjie Research Station, Zimbabwe, between April 1992 and July 1992, where *G. pallidipes* and *G. morsitans* are both present.

The three new devices (the M1, M2 and M3 traps), the F3 and Epsilon traps were made from phthalogen blue cloth (Green, 1986). All traps were baited with acetone, 3-n-propylphenol, 1-octen-3-ol and 4-methylphenol released at 500 mg/h, 0.1 mg/h, 0.4 mg/h and 0.8 mg/h, respectively (Vale & Hall, 1985).

The M1 trap (fig. 1) is a modification of the F3 trap (Flint, 1985). There are four external entrances (A, B, C and D), one on each side of the trap, which lead the tsetse into the sub-bodies of the trap and subsequently into the common netting cone and finally into the collector through the internal triangular entrances (a, b, c and d). The four sub-bodies of the trap join together at the inside centre. A 35×40 cm black band of cotton cloth (Flint, 1985) is sewn centrally on the blue cloth opposite each external entrance in a vertical orientation. Each external entrance has a horizontal shelf 22.5 cm wide. The trap has a right-angled pyramidal netting cone of smaller base joining with the edges of the shelves. The dimensions of the trap are shown in figure 1.

The M2 trap (fig. 2) is a modification of the standard Epsilon trap. There are three external entrances (A, B and C) which lead the tsetse into the three sub-bodies of the trap which in turn lead the flies to the common netting cone and finally into the trap collector through the internal triangular

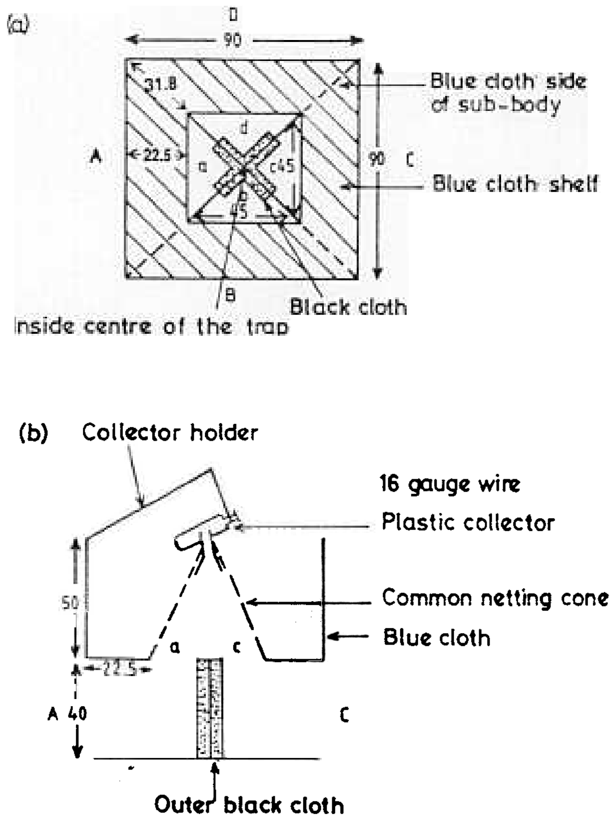

Fig. 1. (a) horizontal section of M1 trap; (b) cross section of M1 trap; A, B, C and D are the external entrances into the body of the trap; a, b, c and d are the internal entrances into the netting cone; N.B. the figure is not drawn to scale and all measurements in cm.

entrances (a, b and c). The sizes of the M2 trap and the standard Epsilon trap netting cones are the same. The three sub-bodies of the trap join each other at the common inside centre of the trap. A 35 × 40 cm black band of cotton cloth is sewn centrally onto the blue cloth in the inside section, opposite each external entrance. Each external entrance has a horizontal shelf 17 cm wide. The dimensions of the trap are shown in figure 2.

The M3 trap (fig. 3) is a modification of the M2 trap. The netting cone of this trap is half the size of the standard Epsilon and the M2 trap netting cones.

Experiments were carried out during the last three hours before sunset on each occasion when tsetse flies are most active (Brady & Crump, 1978). Trapping devices were roughly 150 m apart in a seemingly homogeneous and fairly open deciduous woodland interspersed with shrubs. A latin square design experiment was conducted consisting of 5 treatments × 5 sites × 3 blocks (months). The same sites were used each month and the sites were in a north-south orientation. The absolute daily catches (x) were normalized by log(x+1) base 10 transformation prior to analysis. The transformed data were subjected to three way analysis of variance. The difference between the treatment means was assessed by the least significant different (LSD) test. Each group of days for each month was treated as a block. For the purpose of discussion, detransformed mean catches (antilog-1) were used unless otherwise stated.

Results

Table 1 shows the statistical analysis of the effects of three factors (trap type, site and time in months) on the catches of the two species. There was no evidence of interaction between the three factors.

Effect of time (block) and site

There was a significant ($P < 0.05$) decline in the number of flies caught in each month for the months the experiment was conducted. The effect was greater for females of both species. Despite the apparent homogeneity of sites, there was a significant ($P < 0.05$) site effect for both sexes of *G. pallidipes* and for female *G. morsitans*. Vale (1991) has demonstrated that despite choosing sites for their similarity of appearance, catch differences were experienced.

Comparison of the traps

The mean daily catches of tsetse and the individual comparisons of the different trapping devices are shown in table 2.

The M2 trap caught 57% more male *G. morsitans*, 71% more female *G. morsitans*, 88% more male *G. pallidipes* and 27% more female *G. pallidipes* than the standard Epsilon trap. All these catch increases were significant ($P < 0.05$) except for female *G. pallidipes*. The most effective trapping device, the M3 trap, caught 80% more male *G. morsitans*, 73% more female *G. morsitans*, 110% more female *G. pallipides* and 39% more female *G. pallidipes* than the standard Epsilon trap. All these catch increases were significant ($P < 0.05$).

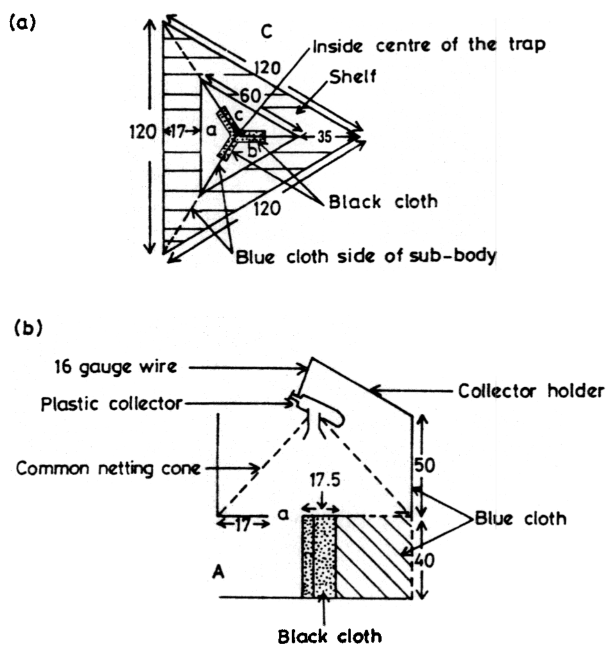

Fig. 2. (a) horizontal section of M2 trap; (b) cross section of M2 trap; A, B, and C are the external entrances into the body of the trap; a, b, and c are the internal entrances into the netting cone; N.B. Not drawn to scale and all measurements in cm.

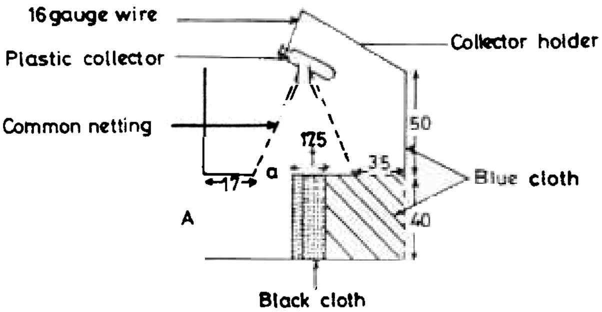

Fig. 3. Cross section of M3 trap: A is an external entrance into the body of the trap; a is an internal entrance into the netting cone; N.B. not drawn to scale and all measurements in cm.

The M1 trap catch increases were significant only for males (83% male *G. morsitans*, 82% male *G. pallidipes*, 30% female *G. morsitans* and 17% female *G. pallidipes*). A similar trend was observed with the F3 trap but with lower values (69%, 57%, 43% and −3%), respectively.

Table 3 shows the different catch indices for each sex for the two species for the different trapping devices. Each trap catch index is obtained by expressing each trap catch as a proportion of the standard Epsilon trap catch. The new trapping devices had higher catch indices than the standard Epsilon trap.

There was no evidence to suggest that the ratio of the *G. morsitans* to *G. pallidipes* was improved. Instead, more *G. pallidipes* were caught in traps per every *G. morsitans*. For every one *G. morsitans*, ten *G. pallidipes* were caught.

Discussion

The better performance of the M3 trap over the standard Epsilon trap is due to the three entrances on all sides of the trap. The three entrances each with a black band of cotton cloth on each inside centre increased the efficiencies of the new traps. Flint (1985) has demonstrated that with a 40-cm-tall entrance, black areas near or on the inside base opposite the entrance improved the catches by up to two times. He further demonstrated that three or four black faces inside the entrance, instead of one, doubled catches. The three M3 entrances allowed a greater proportion of tsetse flying around the trap to have a greater opportunity of entering (Green, 1986). Trap catches with the M3 trap were almost doubled for the two species with the exception of female *G. pallidipes*. It is not understood why the M1 trap with four entrances, each with a black band of cotton cloth on the inside centre, was not more effective than the M3 trap.

Table 1. Three way analysis of variance for *Glossina morsitans* and *G. pallidipes*

		G. morsitans		*G. pallidipes*	
		male	female	male	female
Source of variation	d.f	f. value			
	4	3.899*	4.933*	5.741*	3.081*
	4	1.239	2.850*	3.523*	4.026*
	2	5.300*	14.781*	7.439*	33.615*
2-factor interactions					
Trap types × months	16	0.521	0.850	0.496	0.718
Months × sites	8	1.331	1.192	0.589	0.903
Trap types × sites	8	1.035	0.605	0.399	1.006
Residual	32				
Total (corr.	74				

*Significantly different at $P < 0.05$ level of probability.

Table 2. Detransformed mean daily catches and 95% confidence intervals (95% c.i.) for each mean for *Glossina morsitans* and *G. pallidipes* with the different odour-baited trapping devices

	G. morsitans		*G. pallidipes*	
	male	female	male	female
M1	11.8a	31.3ab	138.0a	
95%c.i.	(2.7-3.5)	(0.1-7.4)	(34.2-45.3)	
M2	10.2a	41.0a	142.5a	
95%c.i	(2.4-3.0)	(7.9-9.7)	(35.3-53.9)	
M3	11.6a	41.6a	159.7a	
95% c.i	(2.7-3.4)	(8.0-9.8)	(39.5-52.4)	
F3	10.9a	34.4a	119.5a	
95% c.i	(2.5-3.2)	(6.6-8.2)	(29.6-39.3)	
Epsilon	6.5b	24.0b	76.0b	
95% c.i	(1.6-2.0)	(4.8-5.8)	(18.9-25.0)	

Detransformed mean daily catches in the same column followed by different letters have means which are significantly different (LSD) at $P < 0.05$ level of probability.

Table 3. Catch indices for *Glossina morsitans* and *G. pallidipes* for the different odour-baited trapping devices.

	G. morsitans		*G. pallidipes*	
	male	female	male	female
M1			1.82	1.17
M2			1.88	1.27
M3			2.10	1.39
F3			1.57	0.97
Epsilon			1.00	1.00

Traps are the main survey tools for *G. pallidipes* but are not as effective as bait-oxen as survey tools for *G. morsitans* and should be complemented with the latter technique (Vale, 1993). The species composition of catches varies with the technique used, area surveyed and the time of the year. Vale (1974) has demonstrated that the ratio of *G. morsitans* to *G. pallidipes* caught using stationary bait-ox was 1:4 and T.N.C. Mangwiro (pers. comm.) found a ratio of 1:6. However, the traps used in this experiment had a higher ratio (1:10) with a bias towards *G. pallidipes*.

There was no clear evidence to suggest that the size of the netting cone affected the performance of the M3 trap. Reducing the size of the base area while maintaining the height of the netting cone reduced the quantity of the netting material required by half. The quantity of cloth material used to produce the M3 trap is little different from the standard Epsilon trap. The M3 trap is as convenient as the standard Epsilon trap when erecting it in the field.

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