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Efficiency of NITSE traps on *Stomoxys calcitrans* and other Diptera in Amurum forest reserve, North Central Nigeria

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Abstract

The efficiency of the NITSE trap to catch dipteran insects was tested in the Amurum Forest, Jos-east Plateau State, Nigeria during the mid-wet season (2nd July-30th September) of 2004. Five non-baited NITSE traps were positioned randomly along water bodies in the study site. The NITSE trap was highly effective in trapping dipteran flies such *as Stomoxys calcitrans* 3,227 (50.1%), *Haematopota pluvialis* 1,062 (16.5%) *Chrysops* sp. 544 (8.5%), *Tabanus* sp. 845 (13.1%) and *Musca sp.* 760 (11.8%). Females of *H. pluvialis* and *S. calcitrans* also showed great susceptibility to trap. The high catches suggest that NITSE trap can be used for practical fly control in isolated settings at a relatively low cost. The results were discussed in relation to veterinary and medical importance to livestock and humans respectively in the forest, as well as its ecological significance.

Key words: *Stomoxys, Haematopota,* NITSE trap, Amurum Forest.

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Introduction

The stable flies (Diptera:Muscidae) are a small but diverse group of blood-sucking insects associated with livestock and wildlife throughout the world. (Mihok *et al.*, 1995). They are pests of many animals and can also act as mechanical vectors of trypanosomes (Mihok *et al.*, 1992). In Africa, this cosmopolitan species is also a pest of cattle and is an occasional pest of wildlife (Greathead and Monty, 1982). Situation also exist where they may be involved in the transmission of *T. congolense* Broden (Mihok *et al.*, 1992). Like most blood sucking insects, *S. calcitrans* is attracted to carbon dioxide and possibly other host odours (Warnes and Finlayson, 1985, 1986).

In general, techniques for sampling biting flies have received little attention (Vale, 1993), with most information derived indirectly from studies on tsetse flies (Vale, 1982). In the absence of tsetse flies (*Glossina* sp.) for example, tabanids are presumed to be important mechanical vectors of *Trypanosoma vivax* Ziemana in South America (Otte and Abuabara, 1991). In Africa, tabanids have also been implicated in the transmission of *T. evansi* in the absence of tsetse flies (Dirie *et al.*, 1989). This fly is closely associated with cattle throughout the world and may actually transmit parasites by regurgitation rather than through its mouthpart (Strait *et al.*, 1992).

Numerous traps for tsetse flies (Glossinidae, *Glossina* spp.) and other large biting flies (Tabanidae, Muscidae, Stomoxyinae and stableflies) have been developed by researchers studying insect species in different continents (Mihok 2002).

In Africa, the transmission of pathogenic trypanosomes prompted the early development of many efficient trapping devices (Cuisance, 1989) and baits (Green, 1994) for sampling and control of tsetse and other biting flies as vectors, one of these, the NITSE trap named after the National Institute for Trypanosomiasis Research was developed in 1994 at the National Institute of Trypanosomiasis Research, Kaduna, Nigeria for the effective trapping of *Glossina* species (Omoogun *et al.*, 1994). Outside Africa, researchers have designed many traps for biting insects (Muirhead-Thomson, 1991), but detailed behavioural studies are few (Allan *et al.*, 1987), there are only rare examples of their use for control. Hence, much of what is known about host and trap oriented behaviour is derived from studies of tsetse flies (Gibson and Torr, 1999). This study is to determine the incidence and population dynamics of different species of haematophagous flies within the Amurun Forest using the NITSE trap and to test the efficiency of NITSE traps in estimating the populations of different species of haematophagous flies.

Materials and Methods

Study Area

The experiments were carried out in Amurum forest (9° 53′N, 8° 59′E), Jos-east Local Government, Plateau State, Nigeria, during the mid-rainy season of 2004 (2[nd] July-30[th] September). The forest is bordered by grassland to the south and human-inhabited areas to the north and south. Traps were set in and around the forest along the cattle and livestock route and near cattle residence; few were set in a narrow strip of thickets along the stream.

Trap
Five NITSE traps made from blue and black cotton and white polyester mosquito netting were used. The NITSE trap is horizontally cylindrical, with two large, rectangular openings of 35 × 30 cm, corresponding to the flanks of a haematophagous fly host. Catches of all traps were collected after a 48-hour session; five sessions were carried out per month. The traps were always set close to water and in open habitats without any bait.

Sampling
Five sampling sites were established 50-100 m apart, each incorporating large expanses of shrubs and open areas. Insects caught were immobilised in ethyl acetate solution (0.001%) and transferred into bottles containing a mixture of 70% ethanol, 10% glycerine and 20% distilled water. The insects were later sorted and counted according to species. Identification was based on Pont (1973). The computer software package SPSS (version 11.0 2001) was used for data analysis.

Results

A total of 3,227 *Stomoxys calcitrans*, 1062 *Haematopota pluvialis*, 845 *Tabanus* sp., 544 *Chrysops* sp. and 760 non-biting Muscinae were captured with 5 NITSE traps in the Amurum Forest from July- September, 2004 with individual NITSE traps differing in their catching efficiencies (Table 1).

The daily (48 hourly) average catches for each species was nearly identical for all traps (one-way ANOVA, df = 4, p = 0.434, Table 2) however; almost all trapped species caught were higher during the initial month of sampling (Fig. 1). Trap captures by sex were only slightly female-biased in all species throughout the study period except *H. pluvialis* in which catches were extremely female-biased (Table 3).

Table 1. Total fly catches in NITSE traps in Amurum forest during July-September, 2004

	Traps										
Species	**1**	*(%)*	**2**	*(%)*	**3**	*(%)*	**4**	*(%)*	**5**	*(%)*	**Total**
Stomoxys calcitrans	844	(26.2)	620	(19.2)	441	(13.7)	371	(11.5)	951	(29.5)	3227
Haematopota pluvialis	447	(42.1)	240	(22.6)	142	(13.4)	233	(21.9)	0	(0)	1062
Tabanus spp.	297	(36.1)	0	(0)	195	(23.1)	128	(15.1)	226	(26.7)	846
Chrysops spp.	202	(37.1)	110	(20.2)	0	(0)	156	(28.7	76	(14.0)	544
Musca spp.	284	(37.4)	245	(32.2)	121	(15.9)	26	(3.4)	84	(11.1)	760
Total	**2074**		**1215**		**899**		**914**		**1337**		**6439**

F-ratio (traps) = 3.02 and 3.01 $p<0.05$; F-ratio (spp.) = 1.47 and 3.01 $p> 0.05$

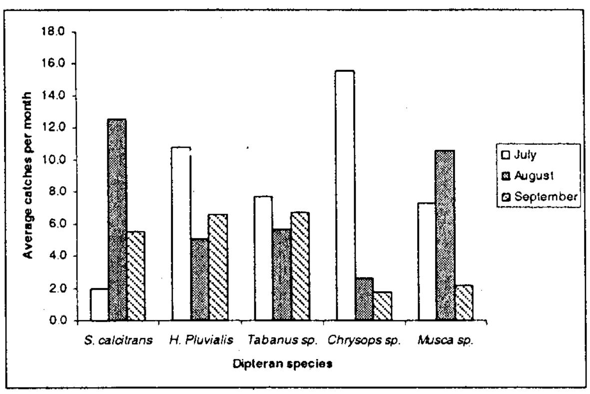

Fig. 1. Monthly variation in dipteran trap catches.

Table 2. 48 hourly Average catches of *Stomoxys calcitrans*, *Haematopota pluvialis*, *Tabanus* sp., *Chrysops* sp. and non-biting *Musca* sp. during July-September 2004

Date	*S. calcitrans*	*H. pluvialis*	*Tabanus* sp.	*Chrysops* sp.	*Musca* sp.
2/7/04	25.4	4.1	5.1	0.8	10.4
4/7/04	6.9	7.6	5.2	1.1	0.3
6/7/04	6.5	-	9.5	5.2	1.1
8/7/04	15.8	2.9	5.2	6.1	1.0
10/7/04	1.6	5.0	8.9	1.2	2.0
22/8/04	2.9	2.5	2.4	1.2	6.4
24/8/04	4.1	2.6	5.8	3.9	1.9
26/8/04	7.9	12.7	13.8	0.7	-
28/8/04	11.1	10.1	2.6	1.9	0.4
30/8/04	1.8	10.5	0.3	6.2	0.7
22/9/04	0.4	12.1	0.8	38.1	7.6q
24/9/04	3.9	13.8	28.6	27.1	2.3
26/9/04	1.9	5.4	1.7	6.5	6.4
28/9/04	1.7	12.1	6.9	-	19.5
30/9/04	8.0	10.7	3.2	-	40.0
Total	**3227**	**1062**	**846**	**544**	**760**

(one-way ANOVA, df = 4, p = 0.434)

Table 3. Species composition of Stomoxyinae, Tabanidae,and Muscidae in NITSE traps in Amurum forest during 2 July-30 September 2004.

Species	♂	%	♀	%	Sum	%
S. calcitrans	1352	(41.9)	1875	(58.1)	3227	(50.1)
H. pluvialis	403	(38.0)	659	(65.1)	1062	(16.5)
Tabanus sp.	398	(47.1)	447	(53.0)	845	(13.1)
Chrysops sp.	232	(42.7)	312	(57.4)	544	(8.5)
Musca sp.	-	-	-	-	760	(11.8)
Total	**2385**		**3293**		**6438**	**(100)**

Discussion

These results were obtained in mid-wet season using one method of enumerating flies. Both male and female dipteran insects responded to the traps but with differences in trap-oriented behaviour that was pronounced in *S. calcitrans*. Results for other Dipterans in the forest were similar to results obtained by other workers (Mohammed-Ahmed and Mihok, 1999). These increases in catch appear to be due to trap efficiency and high density of non-biting Muscidae, rather than attraction, since no bait was used. This trend supports the findings of Moloo (1993) that marked host preference of stable flies for cattle suggests a potential link between mechanical and biological transmission cycles of trypanosomiasis and other diseases.

Trap catches of other dipterans, decreased as the experiment progressed although not as dramatic as expected for Stomoxyinae, which are often species-specific as reported by Mihok *et al.* (1995). This trend could have been due to familiarity with trap sites by the species or gradual decline in actual field population sizes due to trap efficiency.

This first baseline information for Stomoxyinae, Tabanidae, and Muscidae in the forest revealed an intriguing feature of female-biased sex ratios in the five species caught, even though this could also be due to female flies' thirst for a blood meal noting that traps were set along a cattle route and beside human habitation.

Other workers have reported bias in bait animal catches of *S. calcitrans* and *S. niger niger* (Kunz and Monty, 1976) but of lower magnitude than seen here. The differences in catches made by individual traps can be considered as an indicator of heterogeneity in the spatial distribution of the species caught.

Lastly, these traps were set along cattle routes and beside human habitation, near meal times when dipterans take on a linear distribution, e.g. in the gallery forest on the banks of River Shebbele (Mohamed-Ahmed and Mihok, 1999).

In conclusion, our work stressed the efficiency of the NITSE trap in sampling dipteran insects and the importance to site it where such insects either breed or feed, which is related to host location as key starting points in the design of experiments. More focussed ecological research and better experimental designs are now needed to exploit the findings of this research, especially because of the medical and veterinary importance of the species trapped. This will be of great value noting that Amurum Forest is not only an ecological research centre but also a tourist destination, which requires the protection of human visitors.

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