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VERTICAL AND TEMPORAL ASPECTS OF ALSYNITE® PANEL SAMPLING FOR ADULT *STOMOXYS CALCITRANS* (L.) (DIPTERA: MUSCIDAE)

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ABSTRACT

A 45 cm X 3 m vertical Alsynite® panel coated with Tack Trap® was used to study adult flight behavior of *Stomoxys calcitrans* (L.) at 3 different land use areas in Michigan. Data indicated 2 daily plateaus of stable fly activity at 1000 to 1300 h and 1500 to 1800 h. Ninety-five percent of the total trap catch occurred below 180 cm and between 0800 and 2000 h. More females than males were trapped closer to the ground. The largest number of both male and female flies were captured where equine host activity was greatest.

RESUMEN

Para estudiar el comportamiento de vuelo de adultos de *Stomoxys calcitrans* en Michigan en tres areas donde el uso de la tierra era diferente, se usaron paneles verticales de Alsynite® de 45 cm x 3 m en tomaño cubiertos con Tack Trap.® Los datos indicaron altiplanos diarios de actividad de *S. calcitrans* a las 1000-1300 h y a las 1500-1800 h. Noventa y cinco % de las moscas que se encontraron en las trampas fueron capturadas debajo de 180 cm y entre 0800 y 2000 h. Más cerca del suelo más hembras que machos fueron capturadas. El numero más grande de machos y hembras fue capturadas debajo de 180 cm y entre 0800 y 2000 h. Más cerca del suelo

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más hembras que machos fueron capturadas. El numero más grande de machos y hembras fue capturado donde la actividad equina era máxima.

Traps constructed of Alsynite® translucent panels covered with Tack Trap® have been used in sampling adult populations of *Stomoxys calcitrans* (L.) (Williams 1973, Williams and Rogers 1976, Ruff 1979, Berry et al. 1981, Buschman and Patterson 1981).

In 1976, Williams and Rogers used this trap to examine vertical flight behavior of stable flies by exposing panel traps for one week intervals at selected heights below 22.9 m. Ninety-one percent of their total catch occurred when traps were placed at 0.3 and 1.2 m heights above the ground; the remaining 9% were captured at heights of 2.1, 8.5, 15.2 and 22.9 m.

Typical use of these traps has been to index adult activity at a certain location. If more precise information is to be obtained from these traps, such as population parameters based upon mark-release-capture techniques, then the operational characteristics of these traps need to be more precisely defined. The objectives of this study were to: 1) determine if an optimal location for Alsynite® panels near ground level exists to maximize attraction of adult stable flies; and 2) determine temporal changes of male and female stable fly attractancy to Alsynite® panels over a 24 h period.

Materials and Methods

Location

The study was conducted in the North Central United States on the island of Mackinac which lies 12 km off the north eastern coast of Michigan's lower peninsula. The island has a surface of ca. 990 ha with ca. 13 km of shoreline. The vegetation is primarily northern coniferous forest with ornamental trees and shrubs introduced into populated areas.

The island's economy and recreation have developed around tourism. During the summer, approximately 500 to 600 horses are brought to the island and utilized either as saddle horses or to pull carriages and wagons. The resultant feed and waste from the horses together with garbage from residents and tourists create a favorable organic media for the development of *S. calcitrans*.

Sampling

To test for vertical and temporal activity patterns, 10 translucent Alsynite® panels (30 cm x 45 cm) were coated with Tack Trap® and arranged in a continuous vertical column on one stake. Thus, each experimental set of panels formed an Alsynite® rectangle of 45 cm X 3 m with the base of the first panel located at ground level. Although other investigators have used Alsynite® in a cross configuration, one plane was considered sufficient to examine stable fly behavior and attractancy in relation to the panels. Each set of panels was left in place for 1 h. At the end of that hour, the panels were labeled, removed from the stake, and placed within a screened enclosure. This enclosure prevented additional flies from attaching to the panel while in transit to the laboratory. New panels were then placed on the stake for another hour of exposure.

Twelve experimental runs were conducted, each consisting of 24 sequential hours of exposure. In 4 of the 12 runs, 10 panels were changed every hour for 24 h. In the remaining 8 runs, only one set of 10 panels was left in place during the time interval 2200 to 0600 h since less than 0.1% of the total trap catch occurred during this exposure period.

Panels were returned to the laboratory and the following data were recorded from each panel: 1) the number of female and male stable flies; 2) height interval; 3) date; 4) time of exposure; and 5) site location. In addition, temperature and humidity were recorded in the field using a hygrothermograph.

The experiment was run at 3 locations on the island during the months of July and August 1980. One site was a dray operation where 8 horses were stabled. This site was outside the downtown city area and away from main roads used by animals and people. The second site was within the city area adjacent to a high-use road; however, no horses were held in corrals or stables at this site. The last site was a commercial horse drawn carriage tour operation that maintained ca. 300 horses next to a main route for horse drawn wagons.

Variability in the raw data required transformation to percent of total capture at each time or height interval. An analysis of variance was used to determine if there were significant differences between trap catches at different heights and times. Comparison among treatment means of sex ratios over time and at different heights were made using the Duncan's Multiple Range Test. The probability level of 0.05 was used to denote significant differences.

Results and Discussion

Temporal Factors

The mean number of flies caught per panel, the percentage of total trap catch, female to male sex ratios and associated meteorological factors over time are presented in Table 1. Stable fly activity, as reflected in trap catch, increased steadily from 0600 h to 1000 h, where it then remained at a plateau from 1000 h to 1500 h. A decrease in trap catch followed and a second plateau occurred between 1500 h and 1800 h (Table 1). This was followed by a steady decline until 0600 the following day. The 2 plateaus of increased fly activity occurred when air temperature was increasing or near maximum and humidity was decreasing or at the minimum daily value. These plateaus occurred within the temperature range of 21 to 32°C during which time Voegtline and co-workers (1965) also observed heavy biting activity of stable flies in the upper peninsula of Michigan. In contrast to our findings, LaBrecque et al. (1975) in Florida reported that flight activity was minimal during peaks of temperature and light intensity. Other workers have also reported 2 daily peaks of adult stable fly activity (Hafez and Gamal-Eddins 1959, Kunz and Monty 1976) but at other times of the day, depending on the study area.

Less than 0.1% of the total trap catch occurred between 2200 and 0600 h (Table 1). This low trap catch reflects both the inability of the panels to be attractive in the absence of the sunlight and the decrease in stable fly activity that occurs during nocturnal conditions (Miller et al. 1969).

TABLE 1. MEAN NUMBER OF STABLE FLIES CAPTURED FOR EACH HOUR OF EXPOSURE WITH ASSOCIATED SEX RATIOS AND METEOROLOGICAL FACTORS (N = 12).

Time	$\bar{X}$ Flies Captured[1]	% of the Total Flies Captured	Sex Ratio F/M[1]	Temp. °C	Rel. Humid. %
0600-0700	23h	0.9	1.20c		
0800	28h	1.1	1.26c	19	92
0900	74g	2.9	1.41b		
1000	110f	4.3	1.34b	20	86
1100	179d	7.0	1.39b		
1200	174d	6.8	1.59a	22	78
1300	212dc	8.3	1.61a		
1400	148e	5.8	1.66a	23	75
1500	169ed	6.6	1.61a		
1600	338a	13.2	1.41b	24	71
1700	284b	11.1	1.34b		
1800	338a	13.2	1.24c	25	68
1900	253cb	9.9	1.23c		
2000	143e	5.6	1.40b	23	82
2100	54g	2.1	1.63a		
2200	26h	1.0	1.61a	22	89
2200-0600	5i	0.2	—		

[1]Values followed by different letters differ significantly ($p < 0.05$).

Female to male ratios for adult flies captured from 0600 to 1000 h and 1600 to 1900 h were significantly lower than sex ratios occurring during other time intervals (Table 1). These data suggested that perhaps a greater proportion of male stable flies were actively flying in the early morning and late afternoon. This hypothesis is supported by the work of Charlwood and Lopes (1980) who found increased biting activity of male stable flies in Brazil during similar time periods. Buschman and Patterson (1981) also found that male stable flies captured on fiber glass panels consistently outnumbered females and appeared earlier in the day than did females.

Height Factors

Figure 1 shows the percentage of total trap catch as a function of height above ground level with respective sex ratios for each height. Partitioning of the trap catch revealed that 95% of the catch occurred below 180 cm. Sex ratios occurring below and above 90 cm were significantly different from each other with more females than males being captured closer to ground level.

A significant difference occurred between those flies caught below 60 cm and flies caught above this height. Since stable flies had the opportunity to land anywhere between 0 and 3 m, these data indicated that optimal trap placement for maximizing stable fly attraction to Alsynite® panels would occur below a 60 cm height above the ground.

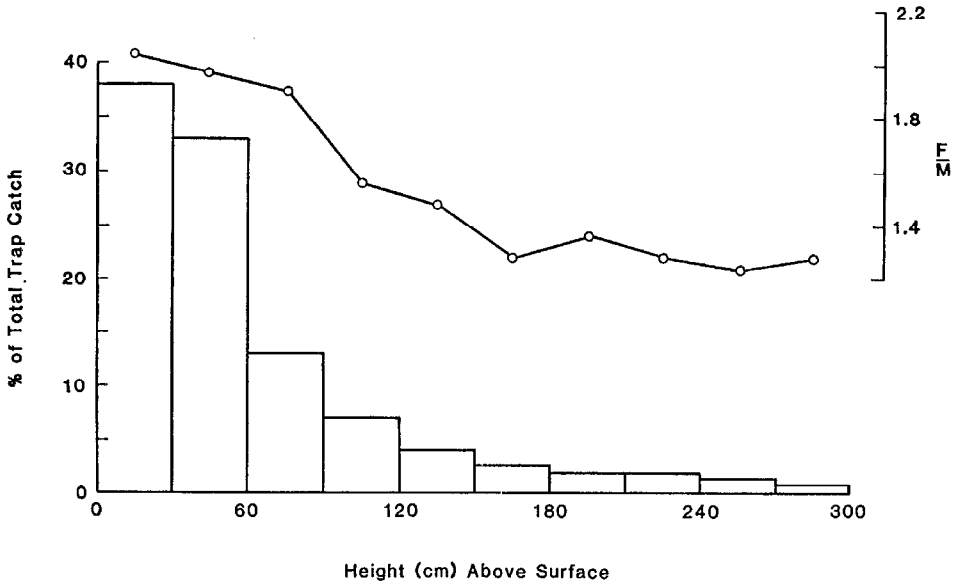

Fig. 1. Distribution of trap catch (vertical bars) and sex ratios (open circles) of stable flies captured at 30 cm intervals above ground level.

Location

Adult stable fly movement and aggregation at a particular site have generally been associated with mating and host seeking (Gatehouse and Lewis 1973, Buschman and Patterson 1981) and in the case of females, search for a suitable ovipositional media. Thus, adult activity at a particular location should reflect both host activity and the presence of organic wastes.

Table 2 separates panel trap catches and sex ratios by location. The largest total trap catch and the greatest female to male ratio occurred where the resident host density was greatest. The lowest female to male ratio occurred where resident host density was lowest, although the number of working horses passing both these sites was similar.

Overall sex ratios at all locations for trapped stable flies ranged from 1.50 to 1.61: 1 females to male. These ratios lie within the normal population range of 1.4 to 1.6: 1 (females to male) reported by Kuntz and Monty (1976) as determined by sweepnet sampling. Since the sex ratios at these locations were not significantly different, the observed variation in total trap catch could not be attributed to changes in activity patterns of a particular sex.

TABLE 2. MEAN NUMBER OF CAPTURED STABLE FLIES, ASSOCIATED SEX RATIOS, AND NUMBER OF STABLED HORSES AT EACH STUDY LOCATION (N = 4 REPS/SITE).

Location	Mean no. captured flies/24th	Mean F/M ratio	No. of stabled horses
Dray	2223	1.57 : 1	8
City	2543	1.50 : 1	0
Barn	2914	1.61 : 1	300

Summary and Conclusions

This study showed that flight activity of *S. calcitrans* as reflected by Alsynite® panel catch varies both through time and space. In northern Michigan the greatest periods of adult fly activity occurred from 1000 to 1300 h and from 1500 to 1800 h. At all times of the day more females than males were captured in the traps. Over 95% of the total trap catch occurred between 0800 and 2000 h and below 180 cm.

For those researchers interested in biting fly population estimates based on mark-release-recapture techniques, this study clearly indicated that variation in the numbers of flies captured can be reduced by the standardization of Alsynite® panel trap height and placement (i.e., distance from host activity).

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