

EVALUATION OF A "COW-TYPE" SILHOUETTE TRAP WITH AND WITHOUT CO₂ BAIT FOR MONITORING POPULATIONS OF ADULT *SIMULIUM LUGGERI* (DIPTERA: SIMULIIDAE)

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ABSTRACT. A "cow-type" silhouette trap with "head" and "body" collecting chambers was evaluated for use in monitoring adult populations of *Simulium luggeri* in Saskatchewan. Ninety-five percent of the black flies taken were *S. luggeri*. Other species collected included *S. vittatum*, *S. meridionale*, *S. venustum* and *S. decorum*. Traps baited with CO₂ collected significantly more ($P < 0.01$) *S. luggeri* than unbaited traps. The "body" collecting chamber took significantly more ($P < 0.01$) *S. luggeri* than the "head" collecting chamber.

INTRODUCTION

Black flies, *Simulium* spp., particularly *S. luggeri* Nicholson and Mickel, are pests of livestock in the northeastern agricultural areas of Saskatchewan. A quantitative, easy to use sampling method is needed to continuously monitor black fly populations in the pasture for evaluation of herd management strategies. This sampling method would also provide data that would correlate adult populations of black flies on the farm with larval populations in the North and South Saskatchewan Rivers.

Most black fly species are attracted to visual and chemical stimuli (Service 1981). Fredeen (1961) developed a "cow-type" silhouette trap which was effective for monitoring adult populations of *S. arcticum* Malloch that were attacking cattle. Shipp (1985) showed that "cow-type" silhouette traps are more effective than sticky or suction traps and silhouette traps with a CO₂ bait collected 12 to 16 times as many *S. arcticum* adults as unbaited traps. Light traps are probably not an effective sampling method for collecting *Simulium luggeri* because this species is diurnally active.

The objectives of this study were to determine if a modified "cow-type" silhouette trap is useful in monitoring population densities of *S. luggeri* in the field and to determine if CO₂-baited traps are more effective in collecting adult *S. luggeri* than unbaited traps.

MATERIALS AND METHODS

Twenty silhouette traps modified from the "cow-type" design developed by Fredeen (1961) were constructed. The trap, consisting of a "body" with a collecting chamber, was modified to include a "head" also with a collecting chamber (Fig. 1). This design was implemented to accommodate the behavior of *S. luggeri* of swarming around animals' heads (F.J.H. Fredeen, personal communication).

The traps were set up in a field, 2 km from the South Saskatchewan River near the Birch Hills Ferry, that contained no cattle or other livestock. Each trap was placed 100 m from its neighbors and paired with one neighbor in a split plot design. One trap of each pair was baited with CO₂, provided from either a block of dry ice or a cylinder of CO₂ with controlled release set underneath the front of the trap. To eliminate topographical bias CO₂ bait was alternated in each pair of traps from trial to trial. The study was conducted over 19 days for 24 hr collection periods between June and August 1985. Trials on days 1 and 2 had 5 and 6 replicates, respectively. All other trials were performed with 10 replicates. A light trap was run on seven of the trial dates for comparison. Collected black flies were preserved in 80% ethanol and identified using the keys of Fredeen (1981).

An analysis of variance was done (SAS statistical package) to compare *S. luggeri* numbers in the CO₂-baited vs non-baited samples, "head" versus "body" samples, trap location, trial days, and interactions between these parameters. Geometric means were calculated to normalize the distribution of the sampling errors. The geometric mean of the original counts is equal to the antilog of the mean of the transformed counts (Elliott, 1977). The error mean square was 0.108 for the transformed data $\log(X + 1)$.

RESULTS

Females of five black fly species were collected in the silhouette traps during this study; *S. luggeri*, *S. vittatum* Zetterstedt, *S. meridionale* Riley, *S. venustum* Say and *S. decorum* Walker (Table 1). *Simulium luggeri* was the most abundant black fly species, comprising more than 95% of the black flies collected. Only numbers of this species were analyzed statistically because of the low numbers of the other species. The second most abundant species, *S. vittatum* constituted about 3% of the total

¹ Contribution no. 926.

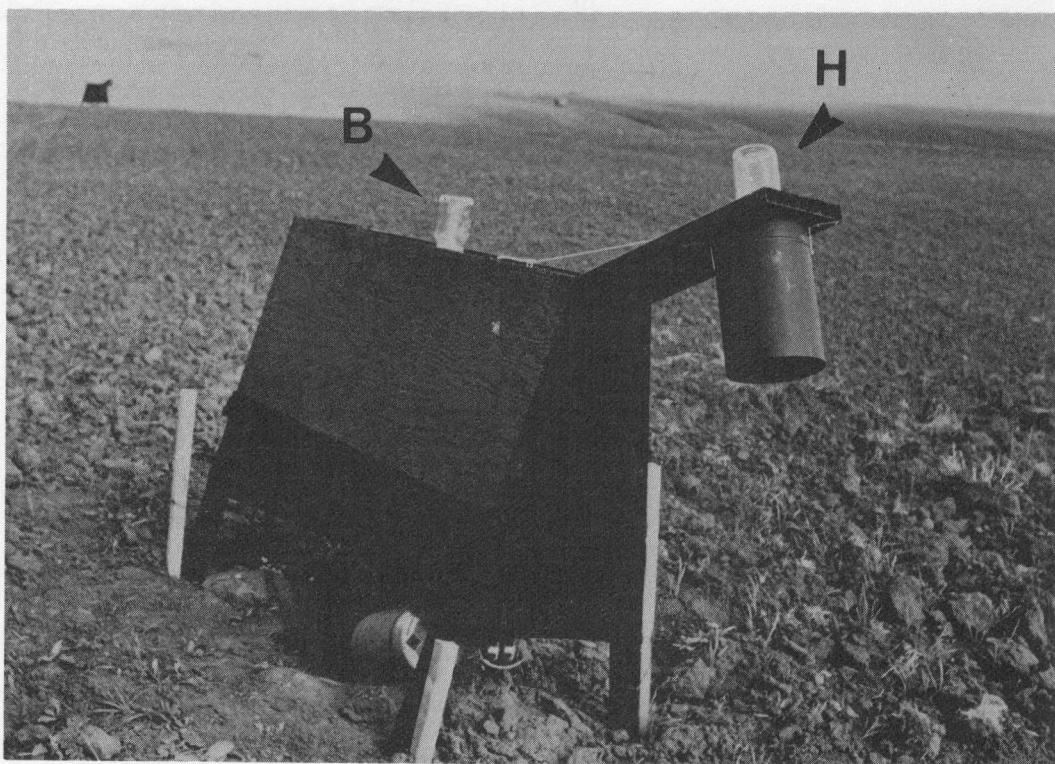


Fig. 1. Modified design of the "cow-type" silhouette trap (Fredeen 1961). H—"head" collection chamber; B—"body" collection chamber.

number of collected black flies. A total of 31 *S. luggeri* were collected in the light trap while an average of 152 were collected in the silhouette traps during the same seven days.

Significantly more ($P < 0.01$) *S. luggeri* were collected in CO_2 -baited traps (mean 1.72) than in unbaited traps (mean 0.06) over the trial period. The number of black flies collected was higher in the baited traps than in the unbaited traps on every trial day except two days (Fig. 2). Significantly more ($P < 0.01$) *S. luggeri* were collected in the "body" (mean 1.28) than in the

"head" (mean 0.27) in baited and unbaited traps over the trial period. Approximately six times as many *S. luggeri* were collected in the "body" (mean 3.76) than the "head" (mean 0.55) of CO_2 -baited traps and about twice as many were collected in the "body" (mean 0.09) than the "head" (mean 0.04) of unbaited traps. The number was consistently higher in collections from the "body" chamber than from the "head" chamber on each trial day (Fig. 3). The numbers of *S. luggeri* collected in all traps were also significantly different ($P < 0.01$) between

Table 1. Number of adult female black flies collected in silhouette traps with CO_2 and without bait over 19 trial dates; June to August 1985 near Birch Hills, Saskatchewan.

| Species | Baited | | | Unbaited | | | Totals | | |
|-----------------------|--------|------|------|----------|----|-----|--------|------|------|
| | H* | B** | H+B | H | B | H+B | H | B | H+B |
| <i>S. luggeri</i> | 446 | 4826 | 5272 | 12 | 39 | 51 | 455 | 4531 | 5323 |
| <i>S. vittatum</i> | 16 | 104 | 120 | 10 | 26 | 36 | 26 | 130 | 156 |
| <i>S. meridionale</i> | 5 | 45 | 50 | 0 | 0 | 0 | 5 | 45 | 50 |
| <i>S. venustum</i> | 0 | 10 | 10 | 1 | 3 | 4 | 1 | 13 | 14 |
| <i>S. decorum</i> | 0 | 4 | 4 | 0 | 0 | 0 | 0 | 4 | 4 |
| Totals | 464 | 4989 | 5456 | 23 | 68 | 91 | 487 | 4723 | 5547 |

* H = Head collecting jar.

** B = Body collecting jar.

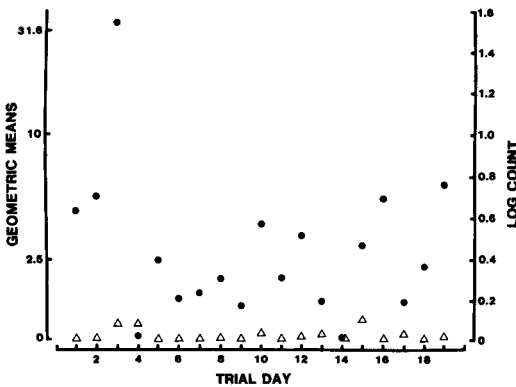


Fig. 2. Mean (Geometric) numbers of adult females of *Simulium luggeri* collected in CO₂ baited (●) and unbaited (Δ) silhouette traps on 19 trial days from June to August, 1985 (standard error for transformed data using LOG 10 (X + 1.0) was 0.329).

trial days indicating that population density and/or activity levels (seasonal and environmentally influenced) were not constant throughout the trial period. The numbers of *S. luggeri* caught in a particular trap were significantly different ($P < 0.01$) between trap locations and between trial days suggesting a contagious disperse.

DISCUSSION

The silhouette trap was effective in consistently collecting adult females of *S. luggeri*. The low numbers of the other three species may be accounted for by the following: they are univoltine, *S. venustum* reaches maximum abundance in June; *S. meridionale* is not attracted to cattle (and thus an imitation of one); or *S.*

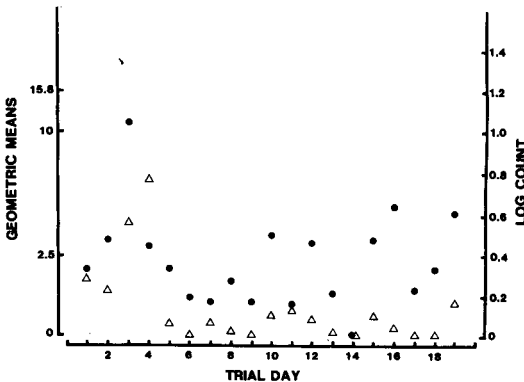


Fig. 3. Mean (Geometric) numbers of adult females of *Simulium luggeri* in the head (Δ) and body (●) chambers of silhouette traps on 19 trial days from June to August, 1985 (standard error for transformed data using LOG 10 (X + 1.0) was 0.329).

decorum is not common in the study area. That the "head" caught significantly fewer black flies than the "body" is possibly a function of area since their openings were 0.07 m² and 0.927 m², respectively, and numbers collected per unit area of opening were similar for the head and body positions (ANOVA $P = 0.68$). The swarming behavior of *S. luggeri* may thus not necessitate modification of the basic design (Fredeen 1961) to collect this species.

At the population levels experienced during this study, which were not of outbreak proportions, CO₂ was essential to attracting significantly greater numbers of black flies. Shipp (1985) collected 12 to 16 times more *S. arcticum* in dry ice baited than unbaited silhouette traps. Rates of CO₂ release were not constant in the study reported here and higher rates tended to draw in more black flies. For example, traps containing dry ice with an estimated initial release rate of about 5–10 liters/min (day 3), caught 2045 *S. luggeri*. When CO₂ from a cylinder was released at a rate of 1 liter/min (day 19), 702 *S. luggeri* were caught.

This study has demonstrated that the "cow-type" silhouette trap is a useful device for continuous monitoring of adult populations of *S. luggeri*. The use of a CO₂ bait was necessary to monitor low as well as high population densities. Silhouette traps show promise for obtaining quantitative data in studies on the *S. luggeri*—cattle management problem and for assessing the effectiveness of larvicide treatments of rivers.

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