A TRAP DESIGN FOR THE COLLECTION OF HAEMATOPHAGOUS DIPTERA FROM CATTLE

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ABSTRACT. A cattle-baited trap for collecting haematophagous Diptera is described. During fly season, 10 species of Tabanidae, 6 species of Culicidae, at least 7 species of Simuliidae and 3 or more species of Ceratopogonidae were collected with the trap near St. John's, Newfoundland; at least 18 species had blood-fed.

INTRODUCTION

Reviews by Service (1976, 1977, 1981) and Bram (1978) indicate that 3 basic trapping techniques have been developed to assess the numbers and species of biting flies attracted to and feeding on large mammal hosts. The simplest method involves the removal of flies landing on a tethered animal, a technique possibly biased by the collector's presence. The second method consists of an animal secured in an enclosed structure (bed nets, stable traps and Magoon traps), with various forms of openings to permit access for the flies. Enclosure traps may inhibit the entrance of some species or disrupt bloodfeeding behavior once the flies are inside. In some instances, entrance into enclosures may not be a result of attraction to the host. A third method involves the suspension of a large net or tent several feet above the host. The device is periodically lowered to enclose the animal. The suspension of such a device over an animal bait may deter some host-seeking flies, especially the simuliids. One trap avoids these problems. Jones (1961) designed a sheep-baited trap where a net-tent folded on the ground was remotely flipped over a sheep by springs to avoid human influence on the catch. This trap would not be appropriate for larger animals due to size and animal reaction to sudden trap movement and enclosure.

The cattle-baited trap described herein was designed in an attempt to meet 2 criteria: (1) to present a large bait animal to the biting fly population in a relatively normal manner, without the presence of a collector or the use of enclosed or suspended structures which may influence host-seeking activity, and (2) to provide information on blood-feeding behavior in a field situation.

MATERIALS AND METHODS

The cattle-baited trap consisted of 3 major components: a metal frame, an attached collapsible tent and a wooden pen to contain the bovine bait (Fig. 1). The metal frame, consisting of a rectangular base with 3 hoops spanning the width of the rectangle, was constructed in bolted sections for easy transport.

The base of the metal frame was constructed from 4 straight lengths and 4 right-angle corner pieces of 4.3 cm diam galvanized steel piping. When bolted together with electrical conduit connectors (Fig. 2a), these pieces formed a rectangle 2.4 m × 3.0 m. The 3 hoops were made from 2.1 cm diam galvanized steel piping. Each hoop measured 2.1 m at the top of its arc and could be broken down into 2 straight side pieces and an upper curvature. To support the 3 hoops in an upright position, 6 pieces of coupling pipe, each 13 cm long with an inside diameter of 2.4 cm, were welded to the rectangular base at each corner and in the middle to act as hoop sockets (Figs. 2a, b). The two ends of each hoop could then be fitted inside the hoop sockets.

The collapsible tent was custom-made (United Sail Workers, St. John's, Newfoundland) and constructed from fine-mesh netting (sufficiently small to prevent the escape of *Culicoides*) with a 30 cm wide white sail canvas border at the bottom (Fig. 2b). The shape of the tent was complementary to that of the metal frame but was approximately 6 cm smaller in all dimensions so as to fit inside the frame. The ends were sewn in place and a zipper running

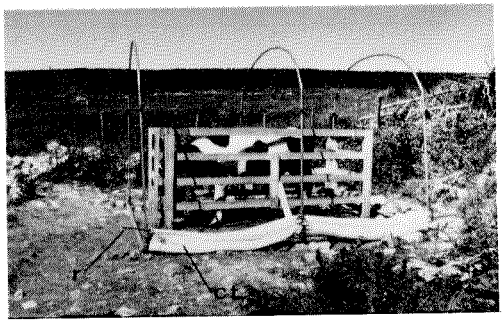

Fig. 1. Cattle-baited trap with collapsible tent in down position. ct = collapsible tent; r = rod.

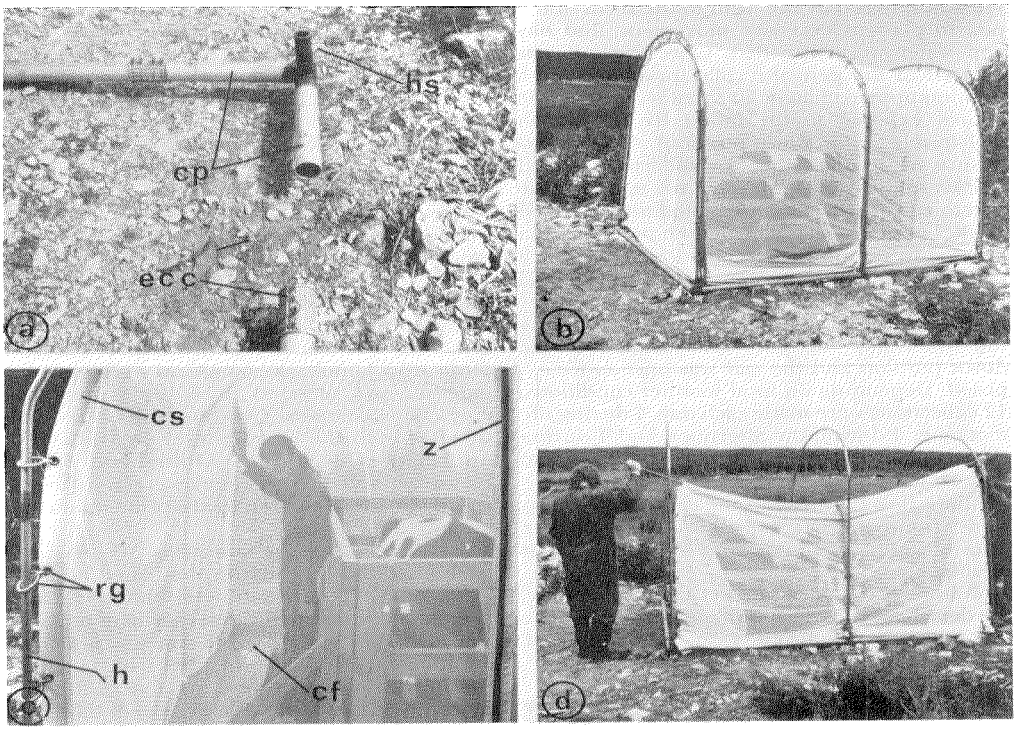

Fig. 2. Various aspects of the cattle-baited trap. (a) close up view of one corner section of the rectangular base; (b) cattle-baited trap with collapsible tent in up position; (c) attachment of collapsible tent to metal frame; (d) operation of cattle-baited trap. cf = canvas flap; cp = corner piece; cs = canvas strip; ecc = electrical conduit connector; h = hoop; hs = hoop socket; rg = metal ring and attached brass eye; z = zipper.

down the middle of one end permitted entrance. Three 8 cm wide strips of sail canvas were also sewn to the tent such that one canvas strip would lie in a position directly under each hoop of the metal frame. Twenty 1.5 cm diam brass eyes were inserted in each canvas strip (approximately 28 cm apart) and each eye was in turn tied to a 5 cm diam metal ring (Fig. 2c). Each metal hoop was guided through its appropriate set of 20 rings so that the tent would hang by these rings from the inside of the metal frame (Figs. 2b, c). The 30 cm wide sail cloth border around the base of the tent lay flat on the ground when the trap was in the up position. These acted as flaps to prevent the escape of flies under the bottom of the tent.

The pen which contained the bovine bait (Fig. 1) was built from spruce "two by fours" (approximately 4 cm × 9 cm) and measured 2.4 m long × 1.2 m wide × 1.2 m high. The front had a swinging gate which allowed the bovine bait access to the pen.

Initially, the collapsible tent lay folded along the bottom of one side (Fig. 1) of the rectangular metal base with the canvas border of the opposite side lying uppermost. A sleeve was sewn along the entire bottom length of this leading canvas border. Inserted into this sleeve was a 3.6 m rod (Fig. 1) which was pulled and hoisted at each end, by 2 persons, across the metal frame to the opposite side, thus pulling the collapsible tent with it (Fig. 2d) to completely enclose the bovine bait. With a minimal amount of practice, the bait animal could be completely enclosed in the collapsible tent in 3 seconds or less.

TRAPPING PROCEDURE. The cattle-baited trap was placed between a zone of scrub vegetation and second growth boreal forest on a dairy farm near St. John's, Newfoundland. A Holstein bull calf was used as bait. The calf was 7 mo old and weighed approximately 160 kg when the trapping began and weighed approximately 250 kg 3 months later at the end of the study.

He was tethered by the head to the front of the pen to prevent excessive movement, and hay and water were provided. Once the calf was secured in the pen, the collectors moved to a position approximately 20 m away, leaving the animal exposed to the biting fly population (collapsible tent in down position). After an exposure of 10 min, the two collectors walked quickly to the trap and hoisted the tent over the pen to enclose the bovine bait and any attracted adult biting flies. Following another 10-min interval to permit flies to blood-feed, one or 2 collectors entered the tent and removed all captured specimens. A further 10 min were allotted for this collection purpose. Following the collection, the tent was returned to the down position and the calf was once more exposed. Depending on local weather conditions, 12 collections were made each day, 4 during the morning, 4 during the afternoon and 4 during the evening on selected days from May 26 to August 25, 1982.

Biting flies captured in the cattle-baited trap were removed with a Black and Decker "Dustbuster®" hand vacuum (Fig. 3). Slight modifications were made to convert it to an aspirator. The filter located at the distal end of the detachable nozzle and the internal flap near the apex were removed. Into the opening of the nozzle apex was inserted a rectangular collecting bag approximately 8cm × 15 cm. Two flaps at the opening of the collecting bag were folded back onto the outside of the nozzle and held with an elastic band that thus secured the bag. After completing the collection, the bag with its contents were removed from the nozzle opening, sealed with a spring clip and placed in a killing jar. Before transportation to the laboratory, black flies and *Culicoides* spp. were placed in vials of 70% alcohol; mosquitoes and tabanids were placed in plastic pill bottles. Biting flies were recorded by species and by the number blood-fed as determined by presence of blood in the abdomen. Adults from the *Simulium venustum* Say and the *S. verecundum* Stone and Jamnback complexes were grouped together and referred to as the *S. venustum/verecundum* complex. *Culicoides* spp. were identified only to the generic level due to lack of information on the Newfoundland fauna. However, several specimens were sent to the Biosystematics Research Institute in Ottawa and identified to species.

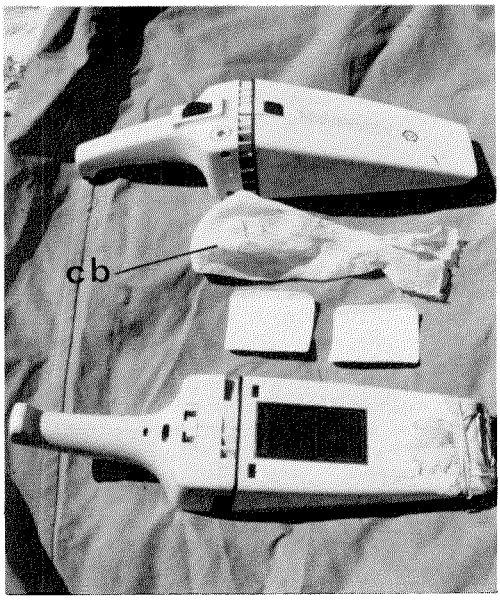

Fig. 3. Modified hand vacuum used as a field aspirator. cb = collecting bag.

ATTRACTIVENESS OF UNBAITED TRAP. A comparison of the fly catch in the baited and unbaited trap was made to determine the attractiveness of the structural conformation of the trap. On July 4, the bovine bait was placed in the trap and left for 5 min, after which the tent was hoisted to the up position and all the flies captured in the tent were removed. The tent was then dropped to the down position and the bovine bait moved to a location approximately 30 m away. The tent was then returned to the up position and all flies that may have been attracted to the immediate vicinity by the calf during its removal were collected. The tent was again returned to the down position, the collector left the trapping area, and the trap, minus the bovine bait, exposed for 5 min. After this interval, the tent was again raised to the up position and all flies captured were removed. The calf was again placed in the trap and the entire trial repeated. This procedure was repeated twice again on July 7 and July 8, giving a total of 6 trials with the bovine bait present and 6 with it absent. The total numbers of flies collected with and without the bovine bait were then compared.

RESULTS AND DISCUSSION

A minimum of 26 species of biting flies in 4 families were collected in the cattle-baited trap near St. John's, Newfoundland, from May 26 to August 25, 1982 (Table 1). A total of 11,407 flies (all female) were collected in 337 samples.

During the normal trapping schedule, several observations were made regarding the general

operation of the trap. With the possible exception of *Culicoides* spp., these include:

(1) Due to the speed (3 sec or less) in which the collapsible tent was hoisted up, the majority of biting flies swarming around the bovine bait or engaged in blood-feeding appeared to be captured within the tent, few escaping.

(2) Few or no biting flies entered into or escaped from the collapsible tent when the collector(s) entered the tent at each collection interval.

(3) Virtually all biting flies captured in the tent could be removed during each 10-min collection interval with the aid of the hand vacuum.

(4) Blood-feeding by females of several species did not appear to be disrupted while enclosed in the collapsible tent (Table 1).

A comparison of the number of black flies collected in the trap with and without the bovine bait yielded 97 *S. venustum/verecundum* complex, 28 *P. mixtum* and 15 *S. mutata* with the bait and 4 *S. venustum/verecundum* and 4 *Prosimulium mixtum* without. The mean number of black flies collected per trial (N = 6) with the bovine bait was 21.0 ± 13.0 and 1.3 ± 1.86 without; the difference was highly significant ($P < 0.01, t = 3.68$, df = 5). This indicates that the majority of the black flies were not attracted to the structural conformation of the trap alone. All of the 10,747 black flies collected with the cattle-baited trap (May 26–August 25) were non-gravid females with over 56% of the total blood-fed, suggesting that the majority of the black flies collected were host-seeking. The numbers of mosquitoes, tabanids and sand flies were too low to compare the catch without and with bovine bait. However, only non-gravid fe-

Table 1. Number and species of biting flies collected in 337 samples from a cattle-baited trap near St. John's, Newfoundland (May 26–August 25, 1982).

Family and species	Number		Percent blood-fed
	Collected	Blood-fed	
Simuliidae			
Cnephia ornithophilia Davies, Peterson & Wood	11	0	NC[1]
Eusimulium spp.	10	0	NC
Prosimulium mixtum Syme & Davies	3,395	1,181	35
Simulium decorum Walker	24	13	54
S. venustum/verecundum complex	6,849	4,756	69
S. vittatum Zetterstedt	241	57	24
Stegopterna mutata (Malloch)	217	12	6
Totals	10,747	6,019	56
Culicidae			
Aedes abserratus (Felt & Young)	113	81	72
Ae. canadensis (Theobald)	1	1	NC
Ae. decticus Howard, Dyar & Knab	1	1	NC
Ae. hexodontus Dyar	1	1	NC
Ae. punctor (Kirby)	82	56	68
Culiseta impatiens (Walker)	165	43	26
Totals	363	183	50
Ceratopogonidae			
Culicoides spp.[2]	191	93	49
Tabanidae			
Chrysops excitans Walker	33	21	64
C. frigidus Osten-Sacken	29	2	7
C. furcatus Walker	28	10	36
C. mitis Osten-Sacken	1	0	NC
C. sordidus Osten-Sacken	3	0	NC
C. zinzalus Philip	1	1	NC
Hybomitra frontalis (Walker)	1	0	NC
H. lurida (Fallen)	1	0	NC
H. minuscula (Hine)	1	0	NC
H. zonalis (Kirby)	8	3	NC
Totals	106	37	35

[1] Collected in numbers too low to calculate a meaningful percent.

[2] Identification of several specimens indicated that *C. yukonensis* and members of the *C. obsoletus* group were collected in the cattle-baited trap.

males were collected and blood-fed specimens of most species were obtained (Table 1); evidence supporting the assumption that these females were also host-seeking.

The high proportion of blood-fed *S. venustum/verecundum* complex (Table 1) collected indicates that the trap did not greatly inhibit the blood-feeding of at least the members of this complex. The high proportion of blood-fed *Aedes abserratus, Ae. punctor* and *Chrysops excitans* (Table 1) suggests the same was true for these species.

On the basis of one trapping season it appears that the cattle-baited trap can be effectively used in the field to study the host-seeking activity and blood-feeding behavior of black flies and possibly other families of biting flies attracted to cattle. Other families of flies would probably be collected in much higher numbers at other sites. In addition, by altering the dimensions but retaining the principle of design, other species of mammals or birds could be used as bait. Possibly in the future, especially with gentle bait animals, pens should be constructed of metal tubing and/or wire rather than wood, thus presenting them as a more visible silhouette as they would appear in a pasture or grassland.

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