A HOST-BAITED CDC TRAP

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ABSTRACT. A new host-attractant trap constructed from a CDC miniature light trap is described and compared to CO_2-baited CDC light traps and lard can bait traps. The unit is inexpensive to construct and run, is self-contained, portable and can easily be converted back to a standard CDC. When baited with house sparrows, the trap was found to catch significantly more *Culiseta melanura* than the CDC + CO_2 and significantly more *Cs. morsitans* than either of the other trap types.

INTRODUCTION

Advantages of using animal-baited traps in ecological studies of mosquitoes are discussed by Service (1976). Although bait traps are considered the least biased trap in which an attractant is used, researchers have had varied success using conventional trap designs to sample *Culiseta melanura* (Coquillett) populations.

No female *Cs. melanura* were collected from a domestic chick-baited Magoon trap that was run continuously throughout a summer in the Pocomoke Cypress Swamp, Maryland (Moussa et al. 1966). This was at the same time that large collections were being obtained from CDC miniature light traps in the same area. Joseph and Bickley (1969), also in Pocomoke Cypress Swamp, used louvered box traps baited with 2 species of birds and placed at 3 elevations to capture only 5 *Cs. melanura* during 90 trap nights. Means (1968) was successful with intermittent suction traps, but these are too cumbersome for many studies and trap bulk itself may serve as a visual attractant (Bidlingmayer and Hem 1979). The best success was achieved by Hayes (1961) in Massachusetts whose rotary-mounted, bird-baited lard can traps (Bellamy and Reeves 1952, Dow et al. 1957) caught a nightly average of 153 *Cs. melanura*. Using stationary lard can traps, Main et al. (1966) had limited success in Massachusetts and Stamm et al. (1962) had poor success in Alabama, as did the authors in New York.

Because of our failures with lard can traps, a CDC trap with the lid and lamp removed was placed overnight adjacent to an occupied brown thrasher *(Toxostoma rufum)* nest and the resultant *Cs. melanura* catch far surpassed lard can and standard CDC + CO_2 catches that night. These results were verified with several nights of trapping and duplicated when using a caged bird. This report documents the development and description of a new host attractant trap, the host-baited CDC trap (Fig. 1), and the results of comparisons with other baited traps.

Preliminary trap configurations were tested during February 1980 in Fellesmere, Florida. These included: placing the bait animal in a 5.5 in. diam. cylindrical cage within acetate funnels of varying diameters so as to have the suction equally spread around the bait (Fig. 2); running the traps continuously vs. running them 20% (1 min out of 5) and 80% of the time[1]; running traps with and without lids and with lids at varying heights above the trap body. In all cases, the original trap design, that is, with the bait bird to one side of the cylinder, surpassed the other configurations both in numbers of *Cs. melanura* and total female mosquitoes collected.

[1] Nasci, R. S. 1980. Vector biology of *Culiseta melanura* (Coquillett) in southeastern Massachusetts. Ph.D. Dissertation, Univ. Mass., 100 pp.

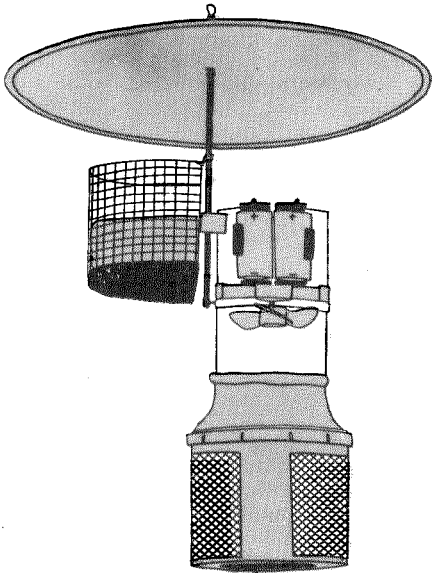

Fig. 1. Host-baited CDC trap (BB-CDC).

MATERIALS AND METHODS

This trap is a standard CDC miniature light trap with the lamp removed and with modifications to allow the attachment of a bait holding cage. An 8 × 0.25 in. threaded rod was attached to the outside of the CDC trap cylinder and fitted with a metal hook at its midpoint to hold the bait cage. The trap lid was positioned 5 in. above the cylinder to allow room for the bait cage. The cage was semi-cylindrical, 6 × 4.5 × 4 in., made from 0.5 in. hardware cloth formed around a D-shaped base of 0.5 in. plywood. The cage top was also made from hardware cloth, hinged on one side and secured with a twist tie. Traps were wired to operate on 4 D-cell batteries (Johnston et al. 1973) and run 4–5 nights per set of batteries.

The house sparrow *(Passer domesticus)* was selected as a representative host to collect *Cs. melanura*, an ornithophilic mosquito (Joseph and Bickley 1969, LeDuc et al. 1972, Morris et al. 1980b). During the first trials with this new trap in May 1980, cold overnight temperatures caused excessive mortality of the bait birds. This cold-induced mortality was substantially reduced when holding cages were fitted with a 1.5 in. thick household sponge with a small depression cut from its center.

Catch chambers used on our CDC traps were made from plastic 1-quart frozen food storage containers with screw-on lids. Three sections from the sides and one from the bottom of the container were replaced with window screening to allow air to flow through the chamber. The middle was removed from the container lid and replaced with an elastic sleeve. Both the screening and cloth were embedded into the container using a soldering iron to melt the plastic. These catch chambers are advantageous to standard designs because specimens are more easily removed and cannot get crushed.

A comparison of bird-baited CDC traps (BB-CDC) to bird-baited lard can traps (BB-LC, Fig. 3) and standard CO_2-baited CDC traps (CO_2-CDC, Fig. 4) was conducted during Aug.–Sept. 1981. Three traps were suspended 40 in. above the ground in an open field in each of 2 parallel rows 130 and 260 ft. from the edge of Toad Harbor Swamp, a red maple *(Acer rubrum)* swamp and known *Cs. melanura* breeding area (see Morris et al. 1980a for study area description). Each row comprised 3 trap sites 130 ft. apart. One of each trap type was randomly assigned to each site each of 12 nights with the provision that no trap would be in one site more than 4 times. CO_2-CDC traps were baited with 3–4 lbs. of dry ice hung in a cloth bag from the wooden trap supports. Both the BB-CDC and BB-LC traps were baited with house sparrows. Sparrows were arbitrarily assigned to traps each night after preliminary studies indicated minor intraspecific variation in attractiveness. All traps were run from 1800–0800 hr. To test for differential attraction by gonotrophic age, parity of 30 *Cs. melanura* from each of the 3 trap types

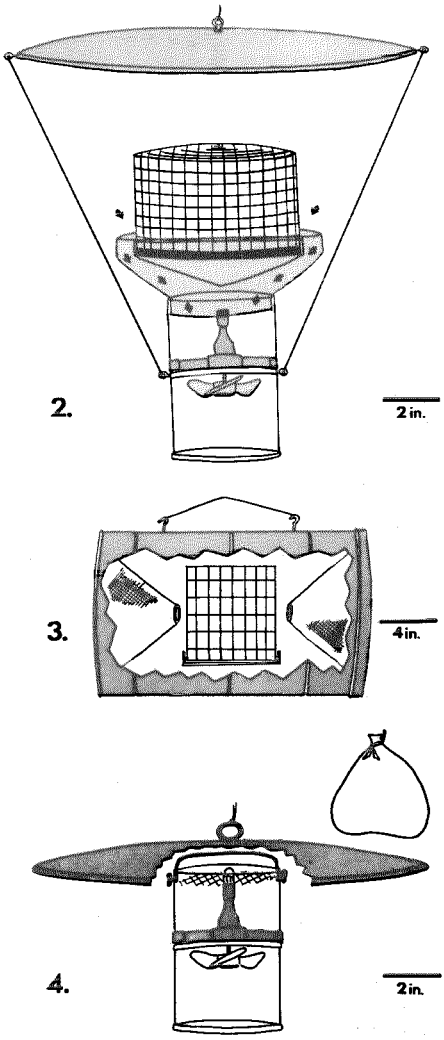

Fig. 2. Preliminary trap configuration using an acetate funnel.

Fig. 3. Baited lard can trap (BB-LC).

Fig. 4. CO_2-baited CDC trap (CO_2-CDC).

was determined by the tracheal method of Detinova (1962) for 2 nights.

A Friedman 2-way analysis of variance by ranks showed no significant differences among trap positions within or between rows for each of the 3 major species caught or for total female mosquitoes caught. Thus, data for the 12 nights were combined for an ANOVA and a Duncan's multiple range test conducted for each of the 6 major species or genera caught and for total females caught. These latter 2 statistical analyses were run under release 79.5 of SAS (Statistical Analysis System) at Syracuse University.

RESULTS AND DISCUSSION

Nightly means and results of the ANOVA are shown in Table 1. The BB-CDC averaged more *Cs. melanura* than the BB-LC and significantly more than the CO_2-CDC. Similarly, the BB-CDC caught significantly more *Cs. morsitans* (Theobald) than either of the other 2 trap types. The BB-CDC also averaged more *Culex pipiens-restuans* complex than the other 2 trap types, but differences were not significant.

CO_2-CDC traps caught significantly more *Aedes vexans* (Meigen), *Anopheles* spp. and *Coquillettidia perturbans* (Walker) than did either the BB-CDC or the BB-LC traps. Also, the CO_2-CDC caught significantly more female mosquitoes than the other 2 trap types, but this was due largely to the high number of *Ae. vexans* attracted to this type trap.

Previous studies have shown differential attraction of CO_2 to parous and nulliparous mosquitoes (Feldlaufer and Crans 1979). We found no differences in the parity rates of *Cs. melanura* caught in the 3 trap types.

The BB-CDC has been field tested by us in Toad Harbor Swamp for 2 mosquito seasons and was found to have several advantages over conventional traps for host attraction studies and arbovirus surveillance. From a practical standpoint, the unit is small, lightweight and is self-

Table 1. Means (standard errors) of female mosquitoes captured per night (N = 24) in 3 types of traps set 40 in. off the ground in an open field adjacent to Toad Harbor Swamp, Oswego Co., NY.

Species	Trap type		
	BB-CDC	CO_2-CDC	BB-LC
Culiseta melanura	84.0 a* (16.7)	42.8 b (6.4)	55.4 ab (11.1)
Cs. morsitans	9.9 a (1.9)	4.5 b (1.0)	2.6 b (0.5)
Culex pipiens-restuans complex	12.6 a (5.8)	3.5 a (1.1)	6.0 a (2.2)
Aedes vexans	1.5 b (0.5)	219.3 a (66.7)	0.0 b (0.0)
Anopheles spp.**	0.5 b (0.2)	14.5 a (1.9)	0.0 b (0.0)
Coquillettidia perturbans	0.5 b (0.2)	3.0 a (0.9)	0.3 b (0.1)
Total***	110.0 b (21.8)	293.4 a (66.0)	64.4 b (12.2)

* Within a species, means followed by the same letter are not significantly different (Duncan's multiple range test, p = 0.05).

** Includes specimens of *Anopheles punctipennis* (Say), *An. walkeri* Theobald and *An. quadrimaculatus* Say.

*** Included are 128 *Aedes cinereus* Meigen, 22 *Culiseta minnesotae* Barr, 12 *Ae. canadensis* (Theobald) and 5 *Ae. dorsalis* (Meigen).

contained so it can be easily hoisted to various heights within habitat types. Bait birds can be transported to and from the field in the holding cages and then simply hung on the trap. Birds are adequately protected from precipitation and remain dry even during heavy rains. The sponges serve the dual purpose of protecting birds from exposure and facilitating cage cleaning. Traps are easy to collect and catches can be transported live back to the laboratory.

The trap is inexpensively and easily constructed from readily available materials and can quickly be converted back to a standard CDC unit. Considering the cost and availability of dry ice, housing easily obtainable and low maintenance bait birds such as house sparrows, starlings *(Sturnus vulgaris)* or rock doves *(Columba livia)* may be less costly.

Sublimation rates of dry ice, hence CO_2 concentrations around a trap, are dependent on ambient weather conditions and are, in general, more suitable for attracting large mammal-feeding mosquitoes, as demonstrated by our tests. By using birds as an attractant, our traps selected against many mammal-feeding species and caught almost exclusively ornithophilic ones. This selectivity makes collection identification less time consuming and reduces the chances of possible interspecific interactions biasing the collections.

The BB-CDC trap simply outperformed the other traps for sampling host-seeking *Cs. melanura,* our target species. This is a non-aggressive mosquito: we have observed individuals alighting on the screen funnels of BB-LC traps and not entering the baffle of this passive trap. Unlike the BB-LC trap, where the bait is enclosed within a dark cylinder (Means 1968), BB-CDC birds, are more exposed and provide visual as well as chemical cues to host-seeking females. Bait cages can easily be modified to house other types of small animals, or 2 or more traps can be placed around a larger animal cage.

A limitation to this trap is that it is suitable only for host-attraction studies, not engorgement studies and differences must be considered when interpreting results (Service 1976). Unless the bait in a BB-LC is double screened with window screening, mosquitoes are free to take a bloodmeal. In our comparison study, 69.9% of *Cs. melanura,* 75.8% of *Cs. morsitans* and 53.8% of *Cx. pipiens-restuans* complex collected from the BB-LC were engorged, while less than 0.02% of these 3 species were engorged in BB-CDC traps. However, depending on the objec-

tives of the study, this may be advantageous since on nights with large collections, blood loss can be debilitating or even fatal to the host animal. Preliminary studies conducted in 1979 indicate that double-screening the bait cages of a BB-CDC trap with 16 mesh outer and 0.5 in. inner screening to prevent blood-feeding reduces collections by an average of 88%, probably by interfering with the host odor cone emitted. Thus, protecting bait birds in BB-LC traps will probably reduce the catch further.

References Cited

Bellamy, R. E. and W. C. Reeves. 1952. A portable mosquito bait-trap. Mosq. News 12:256–258.

Bidlingmayer, W. L. and D. G. Hem. 1979. Mosquito (Diptera:Culicidae) flight behavior near conspicuous objects. Bull. Entomol. Res. 69:691–700.

Detinova, T. S. 1962. Age-grouping methods in Diptera of medical importance. WHO Monogr. Ser. 47. 216 pp.

Dow, R. P., W. C. Reeves and R. E. Bellamy. 1957. Field tests of avian host preference of *Culex tarsalis* Coq. Am. J. Trop. Med. Hyg. 6:294–303.

Feldlaufer, M. F. and W. J. Crans. 1979. The relative attractiveness of carbon dioxide to parous and nulliparous mosquitoes. J. Med. Entomol. 15:140–142.

Hayes, R. O. 1961. Host preferences of *Culiseta melanura* and allied mosquitoes. Mosq. News 21:179–187.

Johnston, J. G. Jr., J. W. Weaver and W. D. Sudia. 1973. Flashlight batteries as a power source for CDC miniature light traps. Mosq. News 33:190–194.

Joseph, S. R. and W. E. Bickley. 1969. *Culiseta melanura* (Coquillett) on the eastern shore of Maryland (Diptera: Culicidae). Univ. Maryland Agr. Exp. Sta., Bull. A-161. 84 pp.

LeDuc, J. W., W. Suyemoto, B. F. Eldridge and E. S. Saugstad. 1972. Ecology of arboviruses in a Maryland freshwater swamp. II. Blood feeding patterns of potential mosquito vectors. Am. J. Epidemiol. 96:123–128.

Main, A. J., R. J. Tonn, E. J. Randall and K. S. Anderson. 1966. Mosquito densities at heights of five and twenty-five feet in southeastern Massachusetts. Mosq. News 26:243–248.

Means, R. G. 1968. Host preferences of mosquitoes (Diptera: Culicidae) in Suffolk County, New York. Ann. Entomol. Soc. Am. 61:116–120.

Morris, C. D., M. E. Corey, D. E. Emord and J. J. Howard. 1980a. Epizootiology of eastern equine encephalomyelitis virus in upstate New York, USA. I. Introduction, demography and natural environment of an endemic focus. J. Med. Entomol. 17:442–452.

Morris, C. D., R. H. Zimmerman and J. D. Edman. 1980b. Epizootiology of eastern equine encephalomyelitis virus in upstate New York, USA. II. Population dynamics and vector potential of adult *Culiseta melanura* (Diptera: Culicidae) in relation to distance from breeding site. J. Med. Entomol. 17:453–465.

Moussa, M. A., D. J. Gould, M. P. Nolan, Jr. and D. E. Hayes. 1966. Observations on *Culiseta melanura* (Coquillett) in relation to encephalitis in southern Maryland. Mosq. News 26:385–392.

Service, M. W. 1976. Mosquito ecology; field sampling methods. John Wiley and Sons, NY. 583 pp.

Stamm, D. D., R. W. Chamberlain and W. D. Sudia. 1962. Arbovirus studies in south Alabama, 1957–1958. Am. J. Hyg. 76:61–81.