

A COMPARISON OF MOSQUITO CATCHES WITH MINIATURE LIGHT TRAPS AND CO₂-BAITED TRAPS¹

C. D. MORRIS AND G. R. DEFOLIART

Department of Entomology, University of Wisconsin, Madison

A dry-ice baited trap described by De Foliart and Morris (1967) has been used as the major collecting device in seasonal succession studies of bloodsucking Diptera in Wisconsin for the past several years (DeFoliart *et al.*, 1967).

During the first year of use (1965) the trap appeared especially efficient in collecting species of Tabanidae and Simuliidae, but *Aedes* collections were somewhat erratic and often less than expected with the populations prevailing at the time. There were rarely large catches of *Anopheles*, *Culex*, or *Culiseta*, and *Uranotaenia* were never obtained.

In order to compare CO₂ traps and CDC miniature light traps (Sudia and Chamberlain, 1962), as collecting devices for mosquitoes, catches were compared with respect to species composition and parity rates of 4 *Aedes* species.

MATERIAL AND METHODS. The study area, Gallistel Woods, is a mixed deciduous forest in the University of Wisconsin Arboretum. The dominant tree species are white oak and black oak with a few hickories and cherries underplanted with magnolia, tulip tree, sweet gum and other species not normally found in Wisconsin.

One to four pairs of traps were operated on 24 nights during the summer of 1966, on 10 nights in June, 13 in July, and one in August. This procedure yielded collections from 50 trap-nights on which to base comparisons.

The traps were set between 3 and 5 p.m. (C.D.T.) and collections were picked up between 8 and 9 a.m. the following day.

Each CO₂ trap was baited with 4-5

pounds of dry-ice each evening. This provided a CO₂ release rate comparable to that used in the seasonal succession studies (approximately 400-500 ml./minute). This rate was substantially higher than Reeves' (1953) estimates of that for chicken (25 ml./min.) and man (250 ml./min.). The CO₂ release rate thus was comparable to that of a large mammal.

Light traps were operated on 6-volt batteries with a resistor in the circuit. The standard collapsible collecting bag was replaced with a cellulose acetate cylinder 4 inches in diameter and 8 inches long, and fitted at one end with a 7-inch cloth sleeve for attachment to the light trap. The other end was fitted with a cap of 28 x 32 mesh saran screening.

Parity rates of *Aedes vexans*, *A. trivittatus*, *A. communis* group, and *A. stimulans* group were determined by Detinova's (1962) technique utilizing changes in ovarian tracheolation following deposition of the first batch of eggs. Up to 25 females of each of the 4 species from each trap collection were dissected. The ovaries were removed, placed in a drop of distilled water on a glass slide and allowed to dry at room temperature. Each pair of ovaries was classified as parous or nulliparous by examination at 160 magnification.

RESULTS AND DISCUSSION. The 13 species of which 10 or more specimens were taken are shown in Table 1.

Most *Aedes* species were taken in larger numbers in CO₂ traps than in light traps, the differences being especially pronounced for *Aedes cinereus* (81 percent taken by CO₂) and *A. stimulans* group (88 percent). Exceptions were *A. trivittatus*, only 46 percent of which were taken in CO₂ traps and *A. triseriatus*. Data on the latter, however, are limited to only 22 specimens taken by both methods.

¹This work was supported in part by Public Health Service Grant A107453 from the National Institute of Allergy and Infectious Diseases. Approved for publication by the Director, Wisconsin Agricultural Experiment Station.

TABLE 1.—Number of females caught by CO₂ traps and CDC miniature light traps on 50 trap-nights during 1966.

Species	Total number collected	Percent caught in CO ₂ traps
<i>Aedes canadensis</i>	184	60
<i>A. cinereus</i>	134	81
<i>A. communis</i> group	218	62
<i>A. stimulans</i> group	720	88
<i>A. triseriatus</i>	22	14
<i>A. trivittatus</i>	4113	46
<i>A. vexans</i>	8151	54
<i>Culex pipiens-restuans</i>	281	9
<i>C. salinarius</i>	125	52
<i>C. territans</i>	219	14
<i>Mansonia perturbans</i>	849	9
<i>Culiseta inornata</i>	152	33
<i>Anopheles punctipennis</i>	41	10
Others	20	30
Total	15,031	50

Two of the three *Culex* species were taken in greatest numbers in light traps. The exception was *C. salinarius*, 52 percent of which were taken by CO₂ trap. Representatives of three other genera, *Mansonia perturbans*, *Culiseta inornata*, and *Anopheles punctipennis*, were taken in considerably greater numbers in light traps.

Inasmuch as the CO₂ release rate in these tests approximated that of a medium large mammal, the results with *Aedes* were about as expected. Most *Aedes* are known to feed readily on large mammals. Of the above species *A. cinereus*, however, may prefer small mammals (R. E. Wright, University of Wisconsin, personal communication, 1968), and *A. canadensis* appears to feed more readily on turtles (DeFoliart, 1967) and smaller mammals (Wright, personal communication) than on man in Wisconsin.

The relative scarcity of *Mansonia*, *Culiseta* and *Anopheles* in CO₂ traps may have been the result of some physical aspect of the trap design which discouraged their entry into the catch chamber. All three are known to readily accept large mammals as hosts. Or, possibly, in the case of *C. inornata* and *A. punctipennis* the volume of CO₂ released was insufficient to attract them in numbers, as ex-

perience in Wisconsin indicates they feed more avidly on bovine-sized animals than on man. Contrarily, *Culex* entry in CO₂ traps might have been increased by reducing the CO₂ output (Reeves, 1953).

Although they are not attracted by CO₂, males of 4 species were caught in CO₂ traps. Their occurrences were density-dependent, coinciding with peak male collections in light traps, and their appearance, therefore, in CO₂ traps could be used as an indication of new emergences of a species.

The light traps attracted gravid specimens of 9 species. Only the three most abundant *Aedes* species (*A. vexans*, *A. trivittatus*, and *A. stimulans* group) were represented by gravid specimens in CO₂ traps and their occurrences there are presumed to be accidental.

Engorged specimens were 2.8 times more abundant in CO₂ traps than in light traps (128 to 46). Most of these contained fresh, partial bloodmeals, and, consequently, were potential mechanical vectors of disease agents.

PARITY RATES. Specimens from CO₂ trap collections, in addition to their use in determining seasonal occurrence of species, have been pooled for virus isolation attempts (DeFoliart and Morris, 1967). It was desirable, therefore, to compare traps with respect to the physiological age of the specimens caught, since a difference in the relative numbers of pars and nullipars collected by the two types of traps could influence the number of viral isolations made. Data were obtained on *A. communis* group, *A. stimulans* group, *A. trivittatus*, and *A. vexans*.

As can be seen in Table 2, CO₂ traps caught the largest number of parous specimens of *A. communis* group, *A. stimulans* group, and *A. trivittatus* even though the percentage parous of *A. communis* and *A. stimulans* was higher in light trap collections. With *A. vexans*, on the other hand, light traps took the larger number of parous specimens even though a greater number of *A. vexans* were caught in CO₂ traps.

In the absence of transovarial or mechan-

TABLE 2.—Comparative age structure of 4 *Aedes* species caught by CO₂ traps and CDC miniature light traps on 50 trap-nights during 1966.

Species	Total caught	No. dissec.		% parous		% of total in CO ₂	% of total parous in CO ₂
		CO ₂	Light	CO ₂	Light		
<i>A. communis</i> group	218	102	62	52	69	62	59
<i>A. stimulans</i> group	720	465	74	57	64	88	86
<i>A. trivittatus</i>	4113	902	835	62	37	46	60
<i>A. vexans</i>	8151	964	620	23	36	54	45

ical transmission, only pars are epidemiologically significant so a trap which collects more pars is a better surveillance tool than one which simply collects the greatest number of a species. The data obtained indicate that the CO₂ trap would serve as a better method of detecting viruses in *A. communis* group, *A. stimulans* group and *A. trivittatus*, especially when the incidence of infection is low, because CO₂ traps collected more parous specimens of these species than did light traps. Other things being equal, however, the data also indicate that a somewhat higher vector infection rate might be expected from light trap collections of *A. communis* group, *A. stimulans* group and *A. vexans*, and that in utilizing a trap for arbovirus surveillance, age structure of the specimens collected should be considered in interpreting infection rates.

SUMMARY. In comparisons of light and CO₂ traps, the CO₂ attracted greater numbers of *Aedes* species, particularly *A. stimulans* group and *A. cinereus* but fewer specimens of *Anopheles*, *Culiseta*, and *Mansonia*. Catches of *Culex salinarius* were equal in the two traps but the light traps attracted greater numbers of the other *Culex* species. Reducing the CO₂ release rate to a level more comparable to that of birds should increase catches of *Culex*.

Light trap catches had slightly higher percentages of parous *A. communis* group, *A. stimulans* group and *A. vexans*, while CO₂ trap catches had a much higher percentage of parous *A. trivittatus*. A greater number, however, of parous *A. communis* group, *A. stimulans* group and *A. trivittatus* were taken in CO₂ traps.

Males collected in CO₂ traps indicated new emergences of the dominant species. CO₂ traps caught 2.8 times more blood engorged specimens than did light traps but only occasional gravid females.

References Cited

- DEFOLIART, G. R. 1967. *Aedes canadensis* (Theo.) feeding on Blanding's turtle. J. Med. Ent. 4(1):31.
- DEFOLIART, B. R., and MORRIS, C. D. 1967. A dry ice-baited trap for the collection and field storage of hematophagous Diptera. J. Med. Ent. 4(3):360-362.
- DEFOLIART, G. R., RAO, M. R., and MORRIS, C. D. 1967. Seasonal succession of bloodsucking Diptera in Wisconsin during 1965. J. Med. Ent. 4(3):363-373.
- DETINOVA, T. S. 1962. Age-grouping methods in Diptera of medical importance. WHO Monog. Series No. 47. 216 p.
- REEVES, W. C. 1953. Quantitative field studies on a carbon dioxide chemotropism of mosquitoes. Amer. J. Trop. Med. Hyg. 2(2):325-331.
- SUDIA, W. D., and CHAMBERLAIN, R. W. 1962. Battery-operated light trap, an improved model. Mosq. News 22(2):126-129.