OPERATIONAL AND SCIENTIFIC NOTES

ATTRACTION OF *AEDES TRISERIATUS* TO CARBON DIOXIDE

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Aedes triseriatus (Say) is a low-density, diurnal species that does not readily enter animal-baited traps and is not attracted to light traps (Craig 1983). A variety of other methods have been used to monitor populations. The ovitrap (Loor and DeFoliart 1970) is a useful detection tool, although results are influenced by rainfall and the availability of competing oviposition sites (Berry et al., 1980) and it provides only a qualitative measure of population. Suction devices have proven effective in some situations (Nasci 1981, Beier et al. 1982), but their use is relatively laborious and time-consuming for routine monitoring. Human-biting counts also can be quite time-consuming for routine monitoring, and they are subject to extensive variation depending on environmental conditions and the differential attractiveness of collectors (Service 1976). In addition, biting counts may be ill advised in La Crosse encephalitis endemic areas.

A standardized method of measuring relative biting activity of this species would be useful in research and, potentially, for routine monitoring by mosquito abatement districts and health departments in areas where the human population is at risk of La Crosse encephalitis. As large catches of *Ae. triseriatus* have been occasionally observed in CO_2-baited CDC miniature light traps operated near tire dumps in Ohio (R. L. Berry, personal communication), we focused on CO_2 as an attractant. To determine whether movement, as provided by the presence of a small animal, might enhance the attractivity of CO_2, we tested the following in a trap adapted from the design of Pfunter (1979): 1) CO_2 alone, from sublimating dry ice (1.0–1.4 kg/24 hr), 2) a female white mouse, and 3) CO_2 from dry ice plus a female white mouse. A trap with neither dry ice nor a mouse was used as a control. The 3 attractants and the control were randomly assigned to traps at 4 sites in areas of known *Ae. triseriatus* oviposition activity on the R. P. and M. G. Hanson farm in Iowa County, Wisconsin (Hanson and Hanson 1970). The traps were emptied and the attractant changed daily. The attractivity of CO_2 released from a pressurized cylinder was also tested, but only during the last 45 days of the season and not as part of the experimental rotation described above.

The Pfunter trap, as modified, is shown in Fig. 1. A polyvinyl chloride (PVC) coupling for 10.2 cm diam sewage pipe was used as the trap body (A). An 8 cm length of sewage pipe (B) was inserted into the upper part of the coupling. The motor mount (C) was constructed from a piece of PVC (3.8 × 5 × 1.9 cm); a semi-circular notch was cut in one end to accommodate the motor (D), and the other end was rounded to the inner contour of the trap body, to which it was attached by metal screws. A vertical hole, 3.2 cm in diameter, was cut in the middle of the mount to increase air flow. The motor was held in place by a spring (E). A circular cover (F) from an old CDC light trap was fastened 22 cm above the trap body using

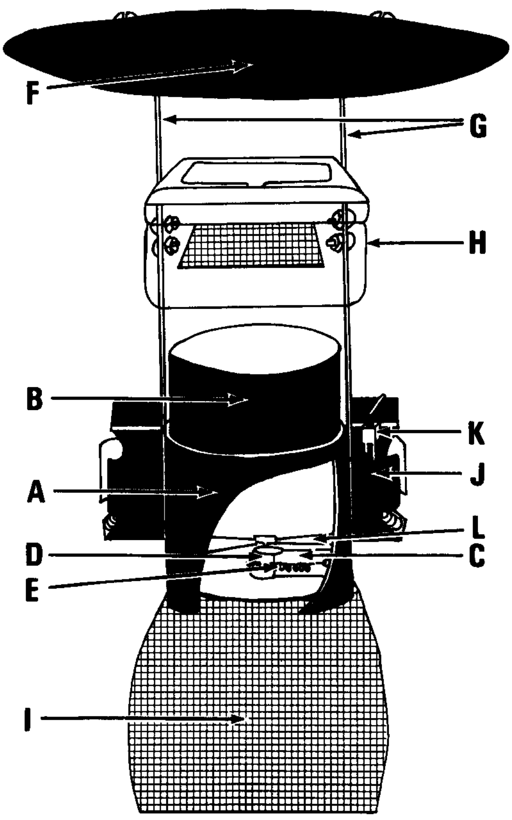

Fig. 1. Pfuntner trap, modified for collecting *Aedes triseriatus:* (A) trap body, (B) sewage pipe insert, (C) motor mount, (D) motor, (E) spring to hold motor in place, (F) trap cover, (G) aluminum strips, (H) plastic crisper, (I) collecting bag, (J) D-cell battery holder, (K) miniature toggle switch, and (L) propeller.

two 25 × 3.8 × 0.16 cm strips of aluminum (G). To accommodate animals used as bait, a plastic crisper (H) (30 × 12.7 × 6.4 cm) with a screen floor was attached by metal screws to the aluminum strips midway between the cover and trap body. The crisper was furnished with food and a water dish. A net collecting bag (I), elasticized around the top and open at the bottom, was slipped onto the trap body and closed at the bottom with binder clips.

Three D-cell battery holders (J) were fastened to the wall of the trap body and wired in parallel. A simple miniature toggle switch (K) was fastened to the center battery holder. A 1.5 v Mabuchi RE-26 motor (4500 RPM) was used with a nylon Top Flight 13.3 cm—3 propeller (L) (both the motor and propeller are available in hobby stores). The blades of the propeller were cut to fit within the trap. A bushing was made of nylon rod to attach the propeller to the motor shaft. The entire trap, except the crisper, was painted flat black. A trap was assembled in about 6 hr at a cost of less than $15, excluding cost of labor, batteries, replacement parts and CO_2.

The trap was suspended from a tree branch, approximately 1.5 m above the ground using a chain with an S-hook. A styrofoam box (26.7 × 25.4 × 21.6 cm) was used to hold dry ice when this was used as the source of attractant. The box was suspended slightly above and to the side of the trap. Two 46 cm lengths of 1.27 cm diam copper tubing were inserted into the box to allow escape of the gas.

Trap operation began on July 6, 1985, and the 4-site rotation continued for 90 days. Mice were rotated daily from a laboratory colony and provided water and food ad lib. One battery per trap was changed daily. Motors were replaced approximately every 10 days.

All of the mosquitoes of the *Ae. triseriatus*/*Aedes hendersoni* Cockerell complex that were collected were morphologically identified as *Ae. triseriatus*. They were not subjected to further analysis as previous studies involving morphological identification of larvae (Loor and DeFoliart 1970) and electrophoretic examination of engorged adults collected by D-Vac (Burkot and DeFoliart 1982) indicated that *Ae. triseriatus* outnumbers *Ae. hendersoni* by a ratio of approximately 19:1 at this site.

The data show (Table 1) that traps baited with CO_2 from dry ice attracted significantly more *Ae. triseriatus* than were attracted to the control or traps baited with a mouse. The added presence of a mouse did not increase the attractivity of carbon dioxide.

The data clearly show the importance of trap location. Traps at sites A and C captured 94% of the total *Ae. triseriatus* collected, and the trap at site C collected 76% of the total. When baited with CO_2 alone or CO_2 plus a mouse, catches per day (24 hr) in the trap at site C averaged 11.4 and 10.8 respectively. Beier et al. (1982) noted the tendency of resting *Ae. triseriatus* to aggregate and suggested that the horizontal distribution of adults may delimit the zone of heaviest biting activity.

Results from the trap that was operated only for the last 45 days of the season cannot be directly compared with those obtained in the experimental rotation. In this trap, baited with CO_2 released from a pressurized cylinder at the rate of approximately 0.5 liter per min, the average catch was 5.0 *Ae. triseriatus* per day (24 hr) with a peak 1-day collection of 75. The CO_2 cylinders are relatively heavy (25 kg when full), but they require replacement only about one-third as often as dry ice, and, under our conditions of use, the cost of CO_2 was reduced by approximately 50% ($0.80/24 hr as opposed to $1.70/24 hr for dry ice).

Table 1. The effects of trap site and attractant on the number of female *Aedes triseriatus* collected in Iowa County, Wisconsin in 1985.

		Mean no. of Ae. triseriatus females collected per day					
Trap site	Total no. collected	All* baits	Dry ice	White mouse	Dry ice and mouse	Control	Range***
A	109	1.25a	2.39	0.04	1.65	0.09	0–17
B	26	0.32a	0.63	0.05	0.54	0	0– 3
C	473	5.44b	11.43	1.48	10.78	0.30	0–37
D	14	0.17a	0.08	0.15	0.47	0.04	0– 4
All sites**	622	1.83	3.77t	0.48s	3.18t	0.16s	
Range***			0–37	0–21	0–30	0–5	

* Means followed by the same letter are not significantly different ($P > .01$) using the Bonferroni significant difference test. BSD = 2.46.

** Means followed by the same letter are not significantly different ($P > .01$) using the Bonferroni significant difference test. BSD = 2.57.

*** Number of females collected in one day.

These tests establish that, if due attention is paid to location of traps, CO_2 is a suitable attractant for monitoring the biting activity of *Ae. triseriatus*. The significant differences found between trap sites (Table 1) indicate that if CO_2 is to be used as a tool for routine monitoring, several trap locations should be tested initially. Traps at low-yielding locations can then be removed.

The trap described above requires minor modifications if used only with CO_2. The plastic crisper used to house a bait animal in our tests is unnecessary. The circular cover can also be eliminated and the trap suspended directly below a dry ice container. The amount of dry ice needed could be reduced by supplying only enough to last through the daylight hours and picking up the catch at the end of the day. This would necessitate 2 trips per day to service the traps, but would extend battery and motor life. Battery and motor life could also be extended by adding a photo-activated switch (Pfunter 1979). This would necessitate a larger supply of dry ice or use of CO_2 from a pressurized cylinder and addition of a method of killing the accumulated mosquitoes; otherwise, they would escape when the fan is turned off.

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AN ADJUSTABLE RESTRAINER FOR SENTINEL CHICKENS USED IN ENCEPHALITIS SURVEILLANCE

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Sentinel chickens are routinely used in many areas of the United States for St. Louis, eastern equine and western equine encephalitis virus surveillance (Crans 1982, Emmons et al. 1982, Burgess et al. 1984, Day and Carlson 1985). Periodic blood collections are made from the wing vein of each chicken to detect antibodies to these mosquito-borne viruses. The technique normally requires two persons, one to hold the chicken while the other draws the blood (Sudia et al. 1970, Florida Dept. Health and Rehabilitative Services 1979).

In 1984, the Indian River Mosquito Control District constructed and began using an adjustable device designed to temporarily immobilize a sentinel chicken to allow a single person to collect the blood samples. The restrainer is a wooden assembly (measuring 10 × 46 × 31 cm, fully assembled) designed to immobilize the chicken on its back. The bird's body, legs, neck and wings are secured with Velcro® straps[1]. A vertical attachment (measuring 4 × 10 × 20.5 cm) on one end of the restrainer holds the bird's legs upward, with each leg strapped individually, for better stability. The underside of each wing is held downward by extensions attached to the base of the device at a 45° angle. Birds of varying sizes can be held by sliding the individual strap sections (secured onto the device with machine bolts and wing nuts) along routed slots. Separate adjustments for the leg

[1] Velcro® pressure-sensitive fabric fasteners, available in varying sizes or in rolls, consist of two strips, each containing either hook or loop material on one side. Straps for the restrainer were cut from a 26 mm (= 1 in) width roll (total length = 1.5 m).