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OPERATIONAL AND SCIENTIFIC NOTES

A DEVICE FOR MONITORING POPULATIONS OF LARVAL MOSQUITOES IN CONTAINER HABITATS

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ABSTRACT. A device was developed for repetitive sampling of mosquito larvae without undue disruption of the larval habitat. The sampler is a 3-oz. (*ca.* 100-ml capacity) transparent plastic cup with a hole in the center of its convex bottom. The device is buoyed by corks so that the water level is 15 mm above the bottom rim of the cup and 5 mm above the hole. There was significant correlation between 24-h samples of *Aedes albopictus* and *Culex quinquefasciatus* 4th-instar larvae in the larval sampling device and populations in tires. Greater numbers of immature mosquitoes were found per unit surface area of the sampling device than the tire as a whole, demonstrating that immature mosquitoes were trapped by the sampler.

Sampling the immature stages of container-inhabiting mosquitoes is an important part of many research projects examining species composition and densities. Suction devices as simple as the turkey baster (Service 1976) or more complex ones, like that of Waters and Slaff (1987), Livdahl and Willey (1991), or Morris et al. (1985), have been the methods of choice. However, most of them are not applicable to small containers. To be sure that the sample is representative, the entire container must be emptied or the contents at least mixed before a small sample is drawn. The impact of mixing or withdrawing a significant fraction of the water renders these methods unsuitable for repetitive sampling or continuous monitoring of the population of immature mosquitoes in small container habitats such as tires. Experimentation with a light trap for mosquito larvae (Beehler and Webb 1992) showed that a properly placed cone can passively trap larvae even without an attractant. We developed a simple larval sampling device and tested it in experimental tire habitats with natural populations of immature mosquitoes.

Upon encountering a barrier when surfacing, mosquito larvae continue rising, following its upward slope. We expect larvae surfacing beneath a concave surface to be guided through an opening in its center as they rise. Above a convex surface, the larvae should be less likely to leave by the same opening. A device such as this would not attract larvae; they would enter by their random movements bringing them under the cup. A practical device for use in the container habitats should be small and remain at a constant depth near the surface.

A 100-ml transparent plastic cup (Sweetheart, 3 oz., Wilmington, MA) with a convex bottom seemed to have the proper attributes. The larval sampling device was constructed by making a 6-mm-diam hole in the center of the cup bottom. Four longitudinal halves of #7 corks were cemented, equally spaced, around the outside of the cup. The sampler floated with the outer rim of its bottom 15 mm below the surface with about 5 mm of water above the hole in the center (Fig. 1).

The device was tested from June 10 to November 24, 1992, in golf cart tires set upright in a vegetated outdoor area in Gainesville, FL. Thirty to 37 g of autoclaved leaf litter (combination of pine and oak) and 3 liters of water were placed in each tire. The tires were colonized by wild *Aedes albopictus* (Skuse) and *Culex quinquefasciatus* Say. At least 60 days later one larval sampler was floated on the water in each tire. Twenty-four hours later one tire was brought into the lab and all larvae and pupae were removed from both the sampler and the tire and counted in 3 categories: small larvae (1st- through 3rd-instar larvae), 4th-instar larvae, and pupae. This procedure was repeated weekly with a different tire. Data were analyzed with general linear models (SAS 1987) for correlation between the population in the tires and numbers in the samplers. The number of larvae per cm^2 in the sampler and in the tire were compared to determine whether larvae were trapped and concentrated by the device. The concentration factor, or "trapping ratio," was calculated by dividing the number of larvae/cm^2 in the sampler (10 cm^2) by the number of larvae/cm^2 (*ca.* 525 cm^2) in the tire. A t-test tested the hypothesis that the trapping ratio was greater than one. Analyses were done on both species together and separately.

The total number of immatures in the tire hab-

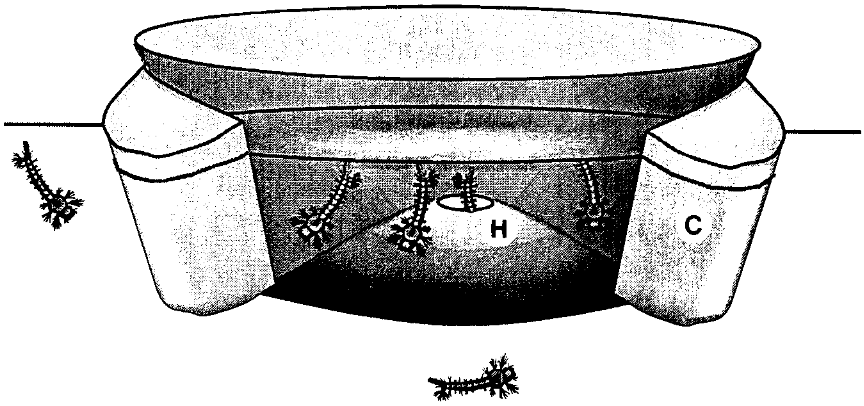

Fig. 1. Larval sampling device: H, entry hole; C, cork float.

itats ranged between 6 and 1,098, with a mean of 216. An average of 47, or about 22% of them were in the sampler. The numbers of 4th-instar larvae of both *Ae. albopictus* and *Cx. quinquefasciatus* in the larval samplers showed a significant correlation with the tire population (Table 1). The total number of pupae in the larval sampler also showed a correlation with the tire population, but their numbers were too few to establish a correlation separately for each species (Table 1). Trapping ratios were 13.1 ± 1.7 for small larvae, 13.9 ± 2.2 for large larvae, and 6.7 ± 2.0 for pupae. All are significantly greater than one ($P > 0.001$), demonstrating that larvae were trapped and accumulated by this device. Differences between trapping ratios of different stadia or species were not significant.

We think that the variability within the early instar larval counts can be partially overcome by omitting the first instars. They are less mobile than the later instars and those that hatch during the 24-h sampling period would have less opportunity to enter the device, thereby increasing variability resulting from the random location of the larval sampler in the tire.

The accumulation, or trapping of mosquito larvae in the sampler improves the probability of obtaining a positive sample from a low density population. Like other sampling devices, our device cannot be used to determine absolute pop-

Table 1. Correlation between samples of immature *Aedes albopictus* and *Culex quinquefasciatus* in the larval sampling device and their populations in tires.

Stage	Mean numbers of immatures		Correlation		
	Total	Sampler	Slope	Intercept	r
		Both species combined (46)[1]			
Small larvae	172	40	0.60	94.4	0.26
Large larvae	35	7	0.50	19.3	0.50[2]
Pupae	9	1	0.50	7.7	0.37[2]
		Aedes albopictus (46)			
Large larvae	164	36	3.40	17.4	0.48[2]
Pupae	9	1	0.89	8.1	0.20
		Culex quinquefasciatus (16)			
Large larvae	23	13	0.54	0.03	0.58[2]
Pupae	1	0	0.07	1.1	0.01

[1] Number of samples, each consisting of one tire and one sampling device.
[2] Correlation between tire and cup significant at the 0.05% level.

ulations in natural habitats. However, we found it useful for monitoring the age structure and relative population density of immature mosquitoes in container habitats, such as tires, where other sampling methods are too destructive.

REFERENCES CITED

Beehler, J. and J. Webb, Jr. 1992. Use of an aquatic light trap for monitoring larval populations of *Culex quinquefaciatus*. J. Med. Entomol. 29:898–900.

Livdahl, T. and M. Willey. 1991. An efficient, inexpensive and fun-to-use contraption for sampling mosquito larvae. J. Am. Mosq. Control Assoc. 7:496–498.

Morris, C. D., J. L. Callahan and R. H. Lewis. 1985. Devices for sampling and sorting immature *Coquillettidia perturbans*. J. Am. Mosq. Control Assoc. 1:247–250.

SAS Institute. 1987. SAS version 6.04. Carey, NC.

Service, M. W. 1976. Mosquito ecology: field sampling methods. Halsted Press, New York.

Waters, B. T. and M. Slaff. 1987. A small habitat, larval mosquito sampler. J. Am. Mosq. Control Assoc. 3:514.