EVALUATION OF THE EFFECT OF VARYING MOSQUITO EMERGENCE ON THE EFFICIENCY OF EMERGENCE TRAPS OVER ENCLOSED ENVIRONMENTS

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We used tanks covered with emergence traps (Fig. 1) to evaluate the mosquito control efficacy of selected fish species in waste water environments. Traps provide estimates of mosquito emergence because the tanks' simulated marsh environments make direct counts of emerged mosquitoes impossible. Therefore, it is important that our design provide efficient, unbiased estimates of mosquito abundance (Southwood 1978). Castleberry (1986) showed that the percentage of emerged *Culex tarsalis* (Coquillett) captured was high, varied little and that attempts to enhance efficiency using economical attractants was not effective. Since Castleberry's (1986) objective was to evaluate attractants, he did not address sampling biases related to numbers of mosquitoes emerged. Because such a bias can render an experiment invalid or inconclusive (Hurlbert 1984), we evaluated the effect of variation in numbers of mosquitoes emerged on the efficiency of emergence traps. In addition, since we used *Cx. pipiens* (Linn.), we compared them with *Cx. tarsalis*.

We used the same tanks (Fig. 1) and similar procedures to Castleberry (1986), but substituted various pupal stocking densities for Castleberry's treatments. Twenty-five *Cx. pipiens* pupae (taken from a nonautogenous laboratory population at the University of California, Davis) were placed in water contained in 207-ml cups. These cups allowed us to count the number of pupae emerged. Varying numbers of cups (1, 2, 4 or 8) were then floated in each tank to achieve tanks with 25, 50, 100 and 200 pupae in them. Five replicates of these four pupal density treatments were arrayed in a randomized block design in 20 tanks at the University of California, Davis, Waste Water Treatment Facility. We conducted the experiment from May 25 through June 3, 1987. Emerged pupae (exuviae) and trapped mosquitoes were counted each day. These counts were continued until all pupae had emerged and all adults were trapped or had died in the enclosures. After each count, exuviae and captured mosquitoes were removed so that the next count would consist only of those mosquitoes emerged and captured since the last count.

Differences in total numbers of mosquitoes captured with varying numbers of pupae planted were evaluated by taking ratios of numbers of adults trapped to numbers of pupae emerged (to remove variation in numbers of pupae emerged from variation in numbers of adults trapped) and applying a logarithmic transformation (to normalize ratios) and a two-way ANOVA (Snedecor and Cochran 1980).

There were no significant differences in ratios of mosquitoes trapped to emerged between the four pupal densities (Fig. 2), indicating that our sampling procedure is unbiased with respect to variation in numbers of mosquitoes emerged. Highest efficiencies were achieved for tanks with lowest stocking densities, but such a ranking was not achieved until half-way through the experiment and was, again, not statistically sig-

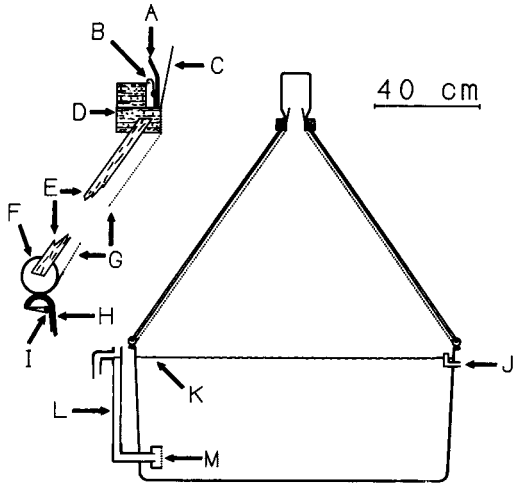

Fig. 1. Cut-away, scale diagram of a tank. Insets provide detail on jar attachment (top) and drawstring tie-down (bottom). The fiberglass window screen (G) formed a funnel attached at the bottom by a drawstring (I) to the tank lip and supported by four hardwood dowels (E). Dowels extended from a ring of polyethylene pipe (F), which rested on the outside edge of the round, 210 liter fiberglass tank (H), to a round plywood jar support (D). The top of the window screen funnel was sandwiched between two pieces of plywood supporting the jar. The 0.95 liter collection jar (A) screwed into a canning jar lid (B) attached to the jar support. A plastic cup with its bottom removed (C) inhibited escape from the jar. Water flowed in through polyvinylchloride (PVC) pipe (J) and out through a screened PVC pipe (M). Water level (K) was maintained by an exterior standpipe (L).

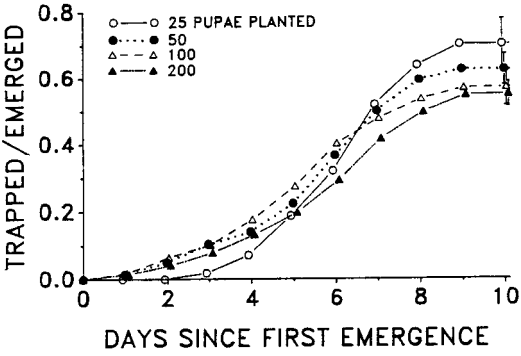

Fig. 2. Mean cumulative number of mosquitoes trapped per number emerged (n = 5) of varying numbers (see figure key) of *Culex pipiens* pupae placed in tanks. The figure has been simplified by limiting error bars (±SE) to the last data points. There are no significant differences in capture efficiency among tanks with different numbers of pupae.

nificant. This experiment also extends the findings of Castleberry (1986) for *Cx. tarsalis* to *Cx. pipiens* since, under similar conditions, we observed similar trap efficiencies ($\bar{x} \pm SE$) for both species (59 ± 8 vs. $62 \pm 4.5\%$, respectively). In both experiments, some mosquitoes were never available for capture because they died immediately after emergence, probably before or during their initial flight. Because our estimate of trappable mosquitoes (exuviae) includes mosquitoes not available for capture, traps are more efficient than our analysis indicates.

Previous comparisons of trap efficiencies have looked at traps sampling wild populations of mosquitoes (Bidlingmayer 1985, Service 1976). This study differs in that it sampled from a known number of captured mosquitoes over enclosed tanks. Because of this difference, we can not compare our known efficiencies with other studies. The traps were cheap, the most expensive part was the window screen, and easy to construct, requiring only a drill, saw and sewing machine.

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