A COMPARISON OF OVIPOSITION TRAPS AND NEW JERSEY LIGHT TRAPS FOR *CULEX* POPULATION SURVEILLANCE[1]

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ABSTRACT. Populations of *Culex restuans* and *Culex pipiens* were monitored at 16 locations throughout St. Joseph County, Indiana using one oviposition trap and one New Jersey light trap at each site. Over a 12-week period, the total number of egg rafts collected weekly from ovitraps was positively correlated with the weekly number of *Culex* females ($r=0.53$), *Culex* males ($r=0.67$) and with the total *Culex adults* ($r=0.63$) collected from light traps. Pairwise comparisons of weekly collections from individual ovitraps and light traps at each site showed that the number of egg rafts in ovitraps was positively correlated with the total number of adult *Culex* from light traps. The number of significant correlations between weekly collections of adult *Culex* and egg rafts increased from 38% to 50% when ovitraps were aged one week prior to use. Although ovitraps and light traps sample different segments of the *Culex* population, both demonstrate a similar pattern of *Culex* activity.

The incrimination of *Culex pipiens* (Linn.) as the primary vector of St. Louis encephalitis (SLE) (Hammon et al. 1945, Reeves et al. 1942, Lumsden 1958) and the implication of *Culex restuans* (Theobald) as a vector of this virus in the Chicago area during a 1975 epidemic (Luby 1979), has made these mosquitoes important targets of arbovirus surveillance programs throughout the midwest. The New Jersey light trap is commonly used to monitor adult *Culex* populations. However, because close similarities in adult female morphology make it difficult to separate *Cx. pipiens* from *Cx. restuans* (Saul et al. 1977), they are usually pooled in light trap collection results (Main et al. 1968, Helson et al. 1980). Ovitraps can also be used to monitor *Culex* population levels (Madder et al. 1980), with the advantage that larvae from egg rafts collected by this method can definitely be identified to species (Dodge 1966).

To date it has not been shown whether New Jersey light traps and ovitraps give comparable results when used to monitor *Culex* population levels. In order to make this comparison, both methods were used to monitor *Culex* populations on a county-wide basis. Additionally, ovitraps were used to provide information on the relative abundance of *Cx. pipiens* and *Cx. restuans* throughout one summer.

MATERIALS AND METHODS

Sixteen New Jersey light traps, located throughout St. Joseph Co. Indiana, were operated from 2200 to 0600 hrs. daily from May through October, 1981. The traps were located in a variety of environments ranging from rural to urban. The light traps were checked and cleared every Monday, Wednesday and Friday. The contents were taken back to the laboratory where the adult mosquitoes were sorted and identified. No attempt was made to separate *Cx. pipiens* from *Cx. restuans*.

The manure ovitrap as described by Hoban (1980), consisted of a 5 liter plastic bucket ¾ full with water, and a lid (Fig. 1). The lid was propped open approximately 10 cm with a clothespin to allow entry of *Culex* females. A cloth bag with 300 g of fresh cow manure was added as

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Fig. 1. The *Culex* manure ovitrap.

an attractant. Approximately 0.5 kg of rocks were placed inside the bag to prevent it from floating on the surface. The addition of one Altosid® minipill containing methoprene (Zoecon Corporation) per bucket ensured that any hatched *Culex* larvae would not successfully emerge as adults. One ovitrap was placed in a shaded area within 5 m of each light trap.

The ovitraps were examined on Mondays, Wednesdays and Fridays from 25 May to 14 August. They were closed on Friday and reopened the following Monday. Egg rafts were counted every Wednesday and Friday at which time a sample of 5 rafts was taken from each trap for identification. The rafts were hatched individually over the next 2–3 days in vials to which one drop of liver powder suspension had been added. Larval *Culex* were identified as first instars using a compound microscope. The number of egg rafts of each species per ovitrap was calculated from the number of sample rafts identified as that species. Fresh ovitraps were set out twice during the sampling period (June 17 and July 19).

RESULTS

During the ovitrap sampling period, 365,992 mosquitoes were collected from light traps. Of these, 60,283 were *Culex* adults (25,232 females and 35,051 males). At the same time 4,193 rafts were collected from ovitraps. Both sampling methods showed that *Culex* population levels peaked in early July when 18,856 adults were taken from the light traps in one week and 960 egg rafts were recovered from the ovitraps one week later (Fig. 2).

The number of adult *Culex* females, males, and total *Culex* from the 16 light traps were compared to the total number of *Culex* egg rafts using the Pearson product-moment correlation test (Sokal and Rohlf 1969). The correlation coefficient between egg rafts and adult females was 0.53; between egg rafts and adult males, 0.67; and between egg rafts and total adult *Culex*, 0.63. Both the males and combined *Culex* were significantly correlated (product-moment correlation, $P<0.05$) with the total number of rafts collected.

Product-moment correlations were also used for pairwise comparisons of weekly collections from individual light traps and ovitraps (Table 1). Significant correla-

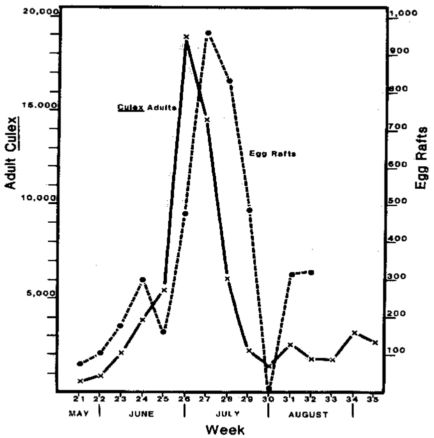

Fig. 2. The number of *Culex* adults and egg rafts collected weekly from New Jersey light traps and ovitraps.

tions ($P<0.05$) between total adult *Culex* and the number of rafts collected at that location occurred in 38% of the 16 light trap-ovitrap pairs. When data from the first week following each ovitrap replacement were eliminated from the analysis, the percentage of significant positive correlations rose to 50%.

Culex pipiens and *Cx. restuans* were the only mosquito species found in the identification of egg rafts collected from the ovitraps (Fig. 3). *Culex restuans* predominated until mid-July, when *Cx. pipiens* appeared in the ovitraps. After peaking in mid-July, *Cx. restuans* numbers fell while the *Cx. pipiens* numbers steadily increased. Non-hatching egg rafts comprised less than 6.0% of the total rafts collected for identification.

DISCUSSION

St. Louis encephalitis surveillance programs routinely use the New Jersey light trap to monitor *Culex* population levels while the various types of oviposition traps are used less frequently (Maw and Bracken 1971, Jupp 1978, Hoban 1980, Madder et al. 1980). Both sampling methods used in this study demonstrated a similar pattern of *Culex* activity. The strong positive correlations between the weekly total number of egg rafts from ovitraps and the total number of adult *Culex* from light traps indicate that ovitraps can detect temporal changes in *Culex* population levels as efficiently as New Jersey light traps.

The positive correlations between weekly collections from ovitraps and light traps from the 16 locations throughout the county indicate that single ovitraps can yield results comparable to individual light traps when used over a range of environments. When data from the first week following each ovitrap replacement were omitted from the analysis, positive correlation coefficients of 0.25 or better were found for 14 of 16 pairwise comparisons between ovitraps and light traps. The 2 ovitraps which showed negative correlations (sites B and M) with light traps were located in areas containing abundant *Culex* breeding sites. In these

Table 1. Product-moment correlation coefficients between egg rafts collected in ovitraps and adult mosquitoes from New Jersey light traps for both full data (all weeks included) and partial data (the first week after each ovitrap replacement excluded).

	Full data			Partial data		
Ovitrap	Males	Females	Total	Males	Females	Total
A	.85*	.66*	.79*	.88*	.73*	.84*
B	−.07	−.30	−.14	−.04	−.20	−.08
C	.42	.12	.37	.42	.11	.37
D	.80*	.47	.71*	.87*	.57	.79*
E	.86*	.87*	.86*	.85*	.86*	.86*
F	.25	.21	.23	.26	.22	.25
G	.65*	.50	.61*	.65*	.59	.63*
H	.26	.20	.24	.28	.22	.26
I	.34	.39	.38	.32	.39	.36
J	.46	.44	.46	.72*	.73*	.73*
K	.24	.49	.38	.29	.49	.40
L	.63*	.64*	.66*	.66*	.75*	.69*
M	.10	−.09	.04	.07	−.19	−.01
N	.65*	.63*	.64*	.74*	.74*	.74*
O	.31	−.02	.13	.46	.25	.38
P	.16	.05	.15	.83*	.51	.74*
Percent significant	38	25	38	50	31	50

* Significant correlation at $p<0.05$.

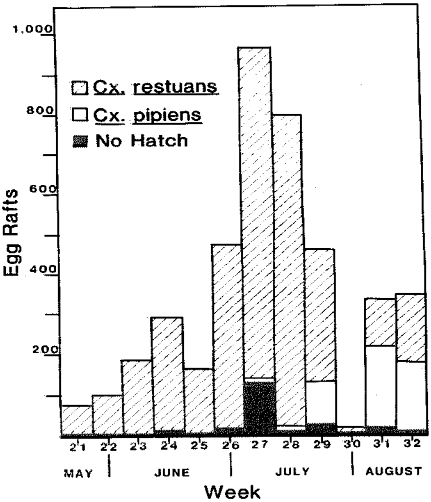

Fig. 3. The number of *Culex pipiens* and *Cx. restuans* egg rafts deposited weekly in ovitraps.

cases the availability of natural oviposition sites may have inhibited ovitrap use by gravid *Culex*.

The fresh cow manure used in ovitraps served as an effective attractant for gravid *Culex*. Attractiveness was enhanced when the ovitraps were allowed to age for one week. Hoban (1980) demonstrated that fresh cow manure is a better attractant than substrates conventionally used in ovitraps such as sod, grass infusions, alfalfa pellets and other types of manure (Jupp 1978, Madder et al. 1980).

Identification of larvae from egg rafts collected in ovitraps facilitated the temporal monitoring of *Cx. restuans* and *Cx. pipiens*. The transition from an early predominance of *Cx. restuans* to a late season buildup of *Cx. pipiens* is similar to the pattern seen for larval *Culex* developing in catch basins in Indiana (Munstermann and Craig 1977), as well as in other areas where these species are sympatric (Covell and Resh 1971).

Local mosquito programs that are primarily concerned with SLE surveillance and mosquito control face the problem of efficiently monitoring *Culex* populations. Assessment of the relative abundance of these 2 species of *Culex* through the use of ovitraps instead of New Jersey light traps offers several advantages. Manure ovitraps are inexpensive to assemble and operate. Because placement is not limited by the availability of electric outlets, remote areas can be easily sampled. The relatively small size of the manure ovitrap allows easy relocation. Many more ovitraps than light traps can be operated with the same number of man-hours without sacrificing precision in *Culex* surveillance. In an epidemic situation, a large number of ovitraps could be assembled and put in place in a matter of hours. The proper placement of the same number of light traps would take much longer. For these reasons, we believe the manure ovitrap used alone merits serious consideration for *Culex* population surveillance.

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