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ACTIVITY BY *AEDES TRISERIATUS* IN OPEN TERRAIN[1]

GENE R. DEFOLIART AND MARSHA A. LISITZA

Department of Entomology, University of Wisconsin, Madison, Wisconsin

Most research on the epidemiology of LaCrosse (LAC) virus has aimed at elucidating the mechanisms whereby the virus survives in its natural endemic foci—forests and large woodlots with water-containing treeholes that are suitable for larval development of the vector, *Aedes triseriatus* Say. It has become increasingly apparent, however, that the majority of human clinical cases of LaCrosse encephalitis are contracted from mosquitoes bred in man-made water containers in the vicinity of human habitations. One of us (DeFoliart 1980) stated that "quantitative documentation is lacking, but the available evidence suggests that a high proportion of LaCrosse encephalitis cases in Wisconsin could be prevented through simple sanitation—the removal of old tires and other man-made containers from the vicinity of human habitations. Such containers around farm and suburban hillside homes and in shaded residential neighborhoods are readily colonized by female mosquitoes emigrating from their woodland haunts, and, with transovarial transmission of virus to progeny, they serve as long-term foci of infection that are in intimate contact with humans."

Documentation of the preceding is now becoming available. A followup of 34 clinical cases in Minnesota during 1979 (C. W. Hedberg and J. W. Washburn, Minn. Dept. of Health, pers. com.) revealed that man-made water containers, including old tires, were near the residences of 32 of the cases. Of 18 cases with no reported history of travel to other sites of possible infection, *Ae. triseriatus* was found breeding in artificial containers near 15 cases. A similar followup of 22 cases during 1979 in Ohio (Peterson 1980, personal communication) revealed man-made containers near the probable site of infection of 15 of the cases. Earlier, Barton (1978) conducted a survey in western Hennepin County, Minnesota, following hospitalization of two LaCrosse encephalitis cases and reported that "The most common breeding site found was the discarded tire."

Incidental to an endeavor during 1979 to identify woodlots that would be suitable as future experimental plots, we made several observations that bear upon the activity of *Ae. triseriatus* in open areas and its utilization of discarded tires and other man-made water containers as breeding sites. During early May, before spring vegetative growth was well underway, we entered 15 wooded areas in three southwestern Wisconsin counties and one south-central county (Dane) to determine whether ground-level treeholes were present. A return visit was made to 8 of the sites in the southwestern counties during late August in order to obtain biting counts (Table 1). Thirteen of the 15 areas were more or less isolated from surrounding woods, two areas were relatively narrow extensions from large forested areas (plots C and D, Table 1). The search for breeding sites, with one exception (plot C), was not thorough, only sufficient to establish that breeding sites were or were not present and to gain a rough estimate of their density.

Biting counts were taken by capturing individually, in test tubes, mosquitoes attracted to the observer. Exposure continued for 20 min

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Table 1. *Aedes triseriatus* biting rates in woodlots in southwestern Wisconsin, August, 1979.

Woodlot	County	Man-made containers present?	Biting rate/min
A	Grant	Yes	0.75
B	Grant	Yes	1.67
C	Crawford	No	1.07
D	Crawford	Yes	1.63
E	Crawford	No	0.88
F	Crawford	No	0.05
G	Crawford	Yes[a]	1.00
H	Vernon	Yes[b]	0

[a] *Aedes triseriatus* breeding in tires 50 m beyond canopy edge.
[b] Detected treeholes were filled, tires were stacked and covered.

or until the 1st 15 mosquitoes were collected, whichever period was shorter.

Basal treeholes were found in all but one of the 15 areas (plot C) but treehole density did not exceed 2–3 per ha. in any of the areas. Discarded tires and, in some cases, other man-made water containers were associated with 7 of the areas, although, again, their density was low. The largest single man-made container was an old upturned automobile fender in plot A that held several gallons of water in both May and August, and teemed with *Ae. triseriatus* larvae on both occasions. Considering the relatively low density of breeding sites, we were surprised at the high biting counts obtained in August (Table 1). They were much higher than those obtained by Scholl et al. (1979) who found an average ground-level biting rate of only 0.47/min at a long-studied LAC virus endemic site in Iowa County, Wisconsin. Counts taken by those investigators, however, extended over a full season. The mosquitoes in our plots were very aggressive and the method used underestimated the actual biting rate as, with the numbers present in some cases, it was not possible to collect the individuals rapidly enough to get all that landed and began probing.

On 3 occasions, we were attacked by one or more *Ae. triseriatus* after leaving the woods. After leaving plot B at 3:30 p.m. CDT on August 21, a female attacked one of us in the open about 10 m from the canopy edge. Later that day, after leaving plot C about 5:00 p.m., 3 females attacked during a pause in an adjoining alfalfa field, about 40 m from the canopy edge. The sky was overcast, temperature was approximately 23°C and RH was high although we had no means of measuring the latter. On August 22, after leaving plot D at about 10:00 a.m., a female that had presumably crossed a county highway attacked in the open about 15 m from the nearest canopy edge. The sky was cloudless, there was a slight breeze, and temperature was approximately 20°C. It seems likely that these episodes resulted, in each case, from mosquitoes that followed us out of the woods.

Near plot G *Ae. triseriatus* was found to be breeding profusely in old tires (about 20) that had been placed on either side of a culvert to help prevent soil erosion. Except for a small sapling about 15 m from the culvert, the nearest canopy was 50 m distant. Only 2 treeholes had been found in plot G (about 2 ha. in area) despite a fairly thorough search in the spring. It seems probable that the high biting count obtained (1/min) was at least partly attributable to mosquitoes bred in this unshaded accumulation of tires.

These observations have several implications relative to the suppression of *Ae. triseriatus* and the prevention of LaCrosse encephalitis cases. They indicate that, contrary to general belief, *Ae. triseriatus* ventures forth from the protection of the forest canopy rather readily. This was further indicated by observations within the Twin Cities Metropolitan Mosquito Abatement District (environs of Minneapolis and St. Paul) during visits in June and September, 1979. Accompanied by Dr. Robert Sjogren, Director, visits to neighborhoods where LaCrosse encephalitis cases had occurred in recent years revealed that, in many cases, canopy cover could be described at best as only "intermittent." The speed with which *Ae. triseriatus* infiltrates and establishes itself in such areas probably depends on the density of both vegetative cover and of water containers suitable for colonization.

Observations in plot C, an approximately 5 ha. area at the tip of a large forest, indicated that little would be accomplished by eliminating breeding sites to a distance of even several hundred meters around homes located within the edges of extensive uninterrupted woodlands. No basal treeholes or other water containers were detected during a thorough search in May, yet a biting count of 1.07/min was obtained in August. This would appear to agree with the experimental data of Sinsko and Craig (1979) who found that dispersal within a woodlot was not completely random but that the mosquitoes moved freely within the woodlot.

Observations in plot H, approximately 2 ha. in area, indicated that *Ae. triseriatus* can be suppressed by elimination of breeding sites in woodlots that are well isolated. Except for one small open woodlot (less than 1 ha. in area) about 200 m distant, all other woodlots were more than 500 m distant. One treehole containing *Ae. triseriatus* larvae was found, and filled, in May, using pipe insulating cement as suggested by Scholl and DeFoliart (1979). Tires were present but were stacked and covered. The biting count in August was zero.

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NOTE ON SOME EFFECTS OF SIMULATED AQUATIC PLANTS ON PREDATION ON MOSQUITO LARVAE BY THE FATHEAD MINNOW

NELLO P.D. ANGERILLI

Pestology Centre, Department of Biological Sciences, Simon Fraser University, Burnaby, British Columbia. V5A 1S6.

The objective of these experiments was to identify possible effects of different shapes of vegetation on the rates at which an aquatic predator could find and consume mosquito larvae.

The experiments were carried out in 19 litre glass aquaria (20×26×41 cm) each containing one fathead minnow *(Pimephales promelas* Rafinesque), that was visually isolated from the others and that had been starved for 2 days. The 4 shapes or types of simulated aquatic vegetation used are shown in Figure 1. One vegetation type was placed into 2 aquaria randomly selected from the 5 at 0800 hrs. of the 1st day of testing. At 1400 hrs., a randomly selected mixture of 30 laboratory-reared 2nd and 3rd stage *Aedes aegypti* L. larvae were put in each aquarium, and the time the fish took to consume all the larvae or the number of larvae remaining after 10 min. was recorded. Predation rate was calculated as elapsed time divided by the number of larvae consumed. Each vegetation shape was tested on 5 consecutive days. The data were analyzed for differences in predation rates between fish and between days (but within treatments) by using a 2-way analysis of variance without replication. There were no significant added variance components ($p<0.05$), that is, none of the simulated vegetation shapes affected the rate at which the fish found and consumed mosquito larvae.

It was assumed that the presence of plant shapes would affect predation rate by impeding the movement of the predators or by reducing prey accessibility. It appears, however, that while one or both of the above assump-