

FIELD OBSERVATIONS ON THE BIOLOGY OF *Aedes triseriatus*¹

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Aedes triseriatus (Say) is the suspected vector of the LaCrosse virus of the California encephalitis group (CEV) in Wisconsin (Thompson *et al.*, 1967). This virus is the only one of the CEV group known to produce illness in humans in Wisconsin (Thompson and Inhorn, 1967). During the summers of 1967 and 1968 we had an opportunity to make observations on several aspects of the biology of this mosquito in an area where tree holes are numerous and it breeds abundantly.

RATIO OF *Aedes triseriatus* to *A. hendersoni*. At the time we initiated this work, we were unaware, unfortunately, of Hedeén's report (1963) of the closely related "western" species *A. hendersoni* Cockerell in Illinois. Consequently, it became necessary in 1968 for us to determine the composition of the tree hole mosquito population at our study site.

In 1968, both *A. triseriatus* and *A. hendersoni* emerged from eggs laid the previous summer in oviposition traps. These traps, described by Loor and DeFoliart (1969), consisted of beer cans with black cloth sleeves and organic matter added to the water. The traps were placed randomly at ground level, and at 4, 7, and 14 feet above ground level. From June to September, all larvae were brought into the laboratory, and, if not in the fourth instar, allowed to develop to fourth instar before identification. We also collected larvae from the tree holes, following the procedures for those collected in traps.

Table I shows that, proportionally, more larvae of *A. hendersoni* were found in the traps than in the tree holes, but the overall ratio is not considered large enough to negate our biological data on *A. triseriatus*. The finding of *A. hendersoni* constitutes a new state record.

TABLE I.—Numbers and percentages of *Aedes triseriatus* and *Aedes hendersoni* larvae taken in tree holes and can traps in Iowa County, Wisconsin.

Type of Container	Number of larvae collected		Percentage of total that were
	<i>Aedes triseriatus</i>	<i>Aedes hendersoni</i>		Aedes triseriatus
Beer cans	635	42	94
Tree holes	532	1	99
Total	1,167	43	96

We looked for intermediate individuals between the two species, but found none. The only unusual feature observed was the presence of very long gills on some larvae, about three or more times the length of segment 9, but otherwise with all the characters of *A. triseriatus*. Our results do not deny, however, the possibility of interbreeding (Truman and Craig 1968).

In addition to *A. hendersoni*, 9 larvae of *Orthopodomyia signifera* were found in the oviposition traps.

SEASONAL BITING ACTIVITY. Within our study area, one site was chosen at which to make biting counts. They were made on 2 or 3 days per week, while the collector sat with legs exposed. The collector, at the end of each hour-long collection, walked by the same route as at the beginning of the collection in order to cause the same amount of disturbance to the mos-

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quito population at the beginning of each hour.

It soon became evident that *A. triseriatus* was not going to bite legs and preferred, instead, the upper parts of the body. Placing one of the collector's hands on his head proved a better means of attracting the mosquito, and once that was tried more than 90 percent of the biting females were collected by that method.

Both in 1967 and 1968 *Aedes triseriatus* began its biting activity in the second half of June and it increased steadily to the second half of August (Table 2). It out-

indicated very little activity of *A. triseriatus* in the morning compared to activity in the afternoon. The species was found to bite in the early morning (5-9 a.m.), however, the greatest activity recorded in the comparatively few tests being 18 bites per hour between 6 and 7:00 a.m. in August.

HOSTS. No host comparison studies were made, but in 1967 several sentinel rabbits for virus studies were located in the study area, about 8 feet above ground and *A. triseriatus* fed readily on them. A rabbit in a Magoon trap attracted *A. triseriatus* to the outside of the trap at about the same

TABLE 2.—Seasonal biting activity of *Aedes triseriatus* and other *Aedes* species.

Species	Bites per hour ¹							
	June		July		August		September	
	1-14	15-30	1-14	15-31	1-14	15-31	1-15	15-30
	1967							
<i>A. triseriatus</i>	..	3	10	23	50	61	37	..
<i>A. vexans</i>	..	45	39	17	10	1	2	..
<i>A. trivittatus</i>	..	14	13	3	3	2	1	..
<i>A. communis</i> g.	..	1	121	3	1	0	0	..
<i>A. stimulans</i> g.	..	1	1	0	1	0	0	..
<i>A. canadensis</i>	..	1	19	3	1	0	0	..
	1968							
<i>A. triseriatus</i>	..	3	18	49	63	72	45	..
<i>A. vexans</i>	..	1	24	19	10	1	1	..
<i>A. trivittatus</i>	..	2	55	28	34	6	2	..
<i>A. communis</i> g.	..	0	13	5	1	0	0	..
<i>A. stimulans</i> g.	..	0	1	1	0	0	0	..
<i>A. canadensis</i>	..	1	3	2	1	0	1	..

¹ Average of the highest man-hour biting counts obtained on three days during each two-week period.

numbered all other mosquito species in the study area after mid-July and greatly predominated from mid-August onward.

DIEL BITING ACTIVITY. Data in Table 3 were obtained by the same hour-long biting counts as described under the preceding section. The data indicate that *A. triseriatus*, insofar as its biting activity is concerned, in our area is not mainly a crepuscular mosquito as has been sometimes reported elsewhere. Heaviest biting activity occurred in the afternoon prior to 6 p.m. (DST); biting activity was very low after 7 p.m. and rare after 8 p.m.

Few late-morning or mid-day collections were made after a few such tests in 1967

rates as they were attracted to a human sitting 40 feet away. Few of the mosquitoes, however, entered the trap.

SWARMING AND MATING. On several occasions while biting counts were being made, the collector, in a sitting position, became aware of mosquitoes swarming 3-6 feet above his head. In nine of the instances when this happened the swarm was swept through three or more times with an aerial net and mosquitoes thus collected placed in ice cream cartons for further identification and separation of the sexes.

The swarms usually started about 1 or 2 hours before sunset although the range

TABLE 3.—Diel biting activity of *Aedes triseriatus*.

Time (DST)	Number of hour-long collections	Average number of bites per hour			
		July	August	September	Average
1967					
3-4 p.m.	5	..	13	15	14
4-5 p.m.	18	..	31	21	28
5-6 p.m.	29	10	18	11	14
6-7 p.m.	30	7	7	2	6
7-8 p.m.	28	4	3	0	3
8-9 p.m.	16	1	1	..	1
9-10 p.m.	16	1	0	..	1
10-11 p.m.	9	0	..	..	0
1968					
12-1 p.m.	2	8	..	..	8
1-2 p.m.	6	11	..	..	11
2-3 p.m.	22	14	66	43	32
3-4 p.m.	23	15	34	32	22
4-5 p.m.	23	8	27	26	15
5-6 p.m.	22	7	19	21	13
6-7 p.m.	20	4	9	11	7
7-8 p.m.	19	4	3	4	4
8-9 p.m.	4	1	0	..	1

was from 30 minutes to 191 minutes before sunset. Duration of swarming was one-half to one hour.

On 7 of the 9 days when swarms were observed, the sun shone brightly. Temperatures ranged from 64 to 76° F and matings were observed on each occasion. Twice, swarms occurred when the sun was not visible, there being clouds on one occasion and fog on the other. The temperature was 59 and 61° F, respectively. The fact that matings did not occur on either occasion would indicate that 61° is below the threshold temperature for mating of *A. triseriatus* rather than that the species mates only in sunshine since Hayes and Morlan (1957) observed mating to occur during periods of semidarkness, and Wright *et al.* (1966) stated that swarming occurred in the evening, commencing 2 hours before total darkness.

On two occasions when swarms were large, a few males approached females as they were on the collector's half-raised hand (not over the head but at eye level). The pairs stayed there for a few seconds apparently mating but never finished there; instead, they flew away from the hand while still coupled. There are very few

reports of nematocerans initiating mating on the host animal.

OVIPOSITION SITE SELECTION BY *Aedes triseriatus*. In the summer of 1968 a hill with an approximate 45 degree slope was selected on which to study oviposition selection of *A. triseriatus*. Three oaks that did not have water-containing cavities were chosen, one at the base of the hill, one halfway up, and another at the top, 170 feet apart in a more or less straight line. A set of three beer can oviposition traps, each lined interiorly with a black cloth sleeve, filled with distilled water which had organic debris, and externally covered with beige masking tape, were arranged on each of the oaks in the following manner: one at ground level, one at 10, and one at 20 feet. Upper traps were raised into position by means of ropes and pulleys and then brought into juxtaposition to the tree trunks. Each week for 7 weeks the water, organic debris, and black cloth sleeves were changed and the old material conveyed to the laboratory for egg counting.

Data in Table 4 show a great preference of *A. triseriatus* for oviposition sites at ground level at all points on the hill from

TABLE 4.—Oviposition site selection by *Aedes triseriatus* on vertical gradients from ground level upward and from base of hill upward.

Location on hill	Height above ground						Totals	
	0 ft.		10 ft.		20 ft.			
	Number of eggs	Percentage of total	Number of eggs	Percentage of total	Number of eggs	Percentage of total	Number of eggs	Percentage of total
Base of hill	1,626	76	345	16	177	8	2,148	31
Halfway up hill	927	83	84	7	110	10	1,121	16
Top of hill	2,644	74	307	9	622	17	3,573	52
Totals and average percentage	5,197	76	736	11	909	13	...	..

top to bottom. This preference is further indicated by the fact that during the last 2 weeks of our observations in 1968, 19 September to 3 October, 86 more eggs were deposited in the ground-level traps but none in those at 10 or at 20 feet.

Regarding a preference for egg laying at the top or the bottom of the hill, the data are inconclusive, although 52 percent of the total were deposited at the top of the hill.

THE DIEL OVIPOSITION ACTIVITY. The diel oviposition activity was determined on the basis of the daily schedule shown in Table 5. At the beginning of August,

TABLE 5.—The diel oviposition activity of *Aedes triseriatus*.

Daily period ¹	Ave. no. of eggs per hour	Ave. temp. ° F	Ave. R.H. %
August			
Noon-3 HBSS	8	4.2	78
3 HBSS-1 HBSS	8	12.0	76
1 HBSS-SS	8	20.0	73
SS-1 HASS	8	27.8	71
1 HASS-1 HBSR	8	4.5	68
1 HBSR-SR	8	0.5	65
SR-1 HASR	8	3.7	66
1 HASR-Noon	8	9.4	70
September ²			
Noon-3 HBSS	4	3.6	68
3 HBSS-1 HBSS	4	6.8	67

¹ HBSS=hours before sunset, SS=Sunset, HASS =hours after sunset, HBSR=hours before sunrise, etc.

² Counts for all periods from 1 HBSS through SR to Noon were 0 in September. Average temperature never exceeded 60° F.

1968, we selected two trees, each with a natural cavity at its base. An oviposition trap, as previously described, was set in each cavity, which then was otherwise completely plugged. At the end of each time interval, exposed traps were stored in a closed carton and conveyed to the laboratory for counting of eggs.

Data in Table 5 show that egg-laying continued, at least at low level, throughout the 24 hours, but peak activity occurred during a 2-hour period extending from 1 hour before sunset to 1 hour after sunset. The average of 4.5 eggs per hour for the period beginning 1 hour after sunset to 1 hour before sunrise is misleading as no eggs were laid during those hours on 6 of the 8 nights. Hayes and Morlan (1957) found oviposition occurring mostly at night in colonized *A. triseriatus*. Night-time temperatures that may frequently be too cool may explain the different behavior of the population that we observed. Data not shown indicated that oviposition activity stopped at temperatures below 64° F.

SUMMARY. Field observations on a population of *Aedes triseriatus* in southwestern Wisconsin revealed that: (1) Biting activity increased from mid-June to a peak in the second half of August; (2) Greatest biting activity occurred in the afternoons before 6 p.m. DST; biting after 8 p.m. was rare; (3) Mating occurred both in swarms and on a host; (4) Oviposition occurred at heights up to at least 20 feet above ground but was greatest in cavities and containers at ground level; and (5) Peak

oviposition activity occurred during a 2-hour period extending from one hour before sunset to one hour after sunset.

Aedes hendersoni Cockerell was found for the first time in Wisconsin.

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