DECLINE IN MALE/FEMALE SEX RATIO OF *AEDES AEGYPTI* (L.) DURING HATCHING[1]

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It has been demonstrated that the male of *Aedes aegypti* (L.) begins to pupate about 8–10 hours sooner than the female. Furthermore, the male spends about 2–3 hours less than the female in the pupal stage (Haddow et al. 1959). Elzinga (1961) showed that after initial immersion in water the male egg also hatches more quickly than the female. The study described here was designed to provide a detailed mathematical description of the male-to-female ratio during the first 30 minutes after hatch begins. The initial hatching time, not the time of immersion, was chosen as a starting point, since observations had shown that the time from immersion to initial hatch was too variable to reveal consistent and significant minute-by-minute changes in the sex ratio.

METHODS.—The mosquitoes used in these experiments were taken from the regular colony of *Aedes aegypti* (L.) reared continuously in this laboratory for about 23 years. The eggs were held 20 to 27 days at 70 percent relative humidity

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and 28° C. until submersion. Paper strips with eggs attached were submerged in a paper cup containing tap water at room temperature (25° C.). The eggs were observed continuously until hatching began (under our conditions, usually about 3–7 minutes after immersion). Three series of tests were made. Hatching was permitted to continue for 1 minute in Series A, 2 minutes in Series B, and 3 minutes in Series C, after which the paper was rinsed rapidly by an up-and-down motion in the cup to remove the larvae which had already hatched and immediately transferred to another cup of water to permit additional hatching. This process was repeated with the same egg paper after 3, 6, 9, 13, 17, 21, and 25 additional minutes. The paper was then left in the last cup for 3 hours. Two hundred larvae were randomly sampled from each cup and placed in enamel pans of water to which food was added as required.

The eggs that hatched from each mass were not counted; the percent hatch was assumed to be constant. The larvae placed in the pans were counted in all tests and the mortality was seldom above 2 percent to 3 percent. The pupae were removed from the pans and placed in cages made from pint paper cups and screen wire until all adults emerged, at which time the sexes were separated and counted.

Each of the three series was duplicated twice with a minimum of 1,800 mosquitoes per duplication. The ratios of males to females from these duplications were averaged and statistical analyses were made.

RESULTS.—The results obtained by our procedure (table 1) agreed closely with those obtained by Elzinga. Although Elzinga used distilled, de-ionized, autoclaved water and we used regular tap water, the sex ratio of hatching eggs was probably not dependent on the ionic condition of the water. We deliberately used shorter test intervals than Elzinga so that we could observe the decline in ratio of males to females during the relatively straight portion of the curve he demonstrated. Generally our data proved to fit straight-line regression. The total curve, however, suggested that over a longer time the decline in the ratio of males to females could be more nearly approximated by a logarithmic curve. Our data are therefore presented in the form of a regression computed in terms of the logarithms of the ratios (fig. 1). The ratio of males to females usually approached or fell below unity after 3 hours.

The series beginning 1 minute after initial hatch (series A) was considerably different from series B and C. The regression coefficient of the series was much smaller and had a much lower Y intercept than the coefficients of the other two series (fig. 1). This phenomenon was unex-

TABLE 1.—Ratio of the number of males/number of females of *Aedes aegypti* hatching at various times after initiation of hatching.

Series A			Series B			Series C		
Interval after initiation of hatching (minutes)	Ratio (males/females)		Interval after initiation of hatching (minutes)	Ratio (males/females)		Interval after initiation of hatching (minutes)	Ratio (males/females)	
	Test 1	Test 2		Test 1	Test 2		Test 1	Test 2
0–1	1.68	..[a]	0–2	2.42	2.00	0–3	3.20	2.25
1–4	1.30	1.02	2–5	2.40	2.38	3–6	2.34	2.14
4–7	1.36	1.58	5–8	1.38	1.72	6–9	1.83	1.70
7–10	1.35	1.30	8–11	1.73	1.75	9–12	2.08	1.76
10–14	1.04	1.47	11–15	1.43	1.93	12–16	1.45	1.65
14–18	0.90	0.89	15–19	1.36	1.43	16–20	1.41	1.44
18–22	0.92	1.14	19–23	1.06	1.47	20–24	1.19	1.19
22–26	1.09	1.06	23–27	0.98	1.10	24–28	1.25	1.04
26–180	0.76	0.77	27–180	1.02	1.10	28–180	0.66	1.15

[a] Larvae died prior to pupation.

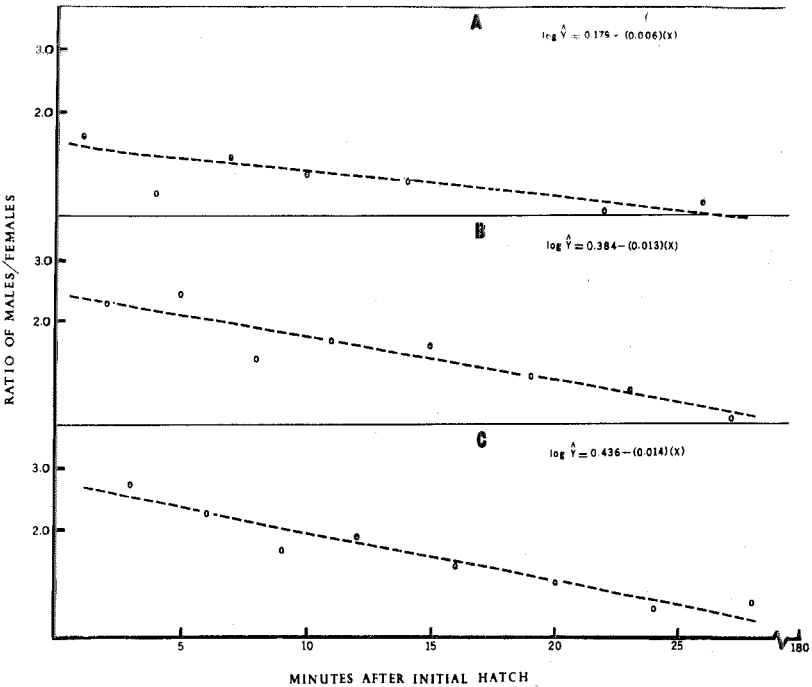

FIG. 1.—The sex ratio of *Aedes aegypti* (L.) as a function of time after initial hatch. (A) the series beginning 1 minute after hatch; (B) the series beginning 2 minutes after hatch; and (C) the series beginning 3 minutes after hatch.

pected. There was probably no error in sampling, since we obtained the same results in both replicates (table 1). The regression coefficient of all three series combined gave a slope of 0.0098 with the regression equation thus reading log $\hat{Y} = 0.293 + (-0.0098)(X)$.

For 4 additional tests we obtained ratios that did not follow the logarithmic curves plotted in fig. 1. In all 4 tests the ratios were consistently higher than those in table 1 and exhibited greater randomness. To determine the cause we considered the following factors: (1) Time between initial immersion and initial hatch; (2) number of days of conditioning from oviposition to immersion; and (3) time of day of initial immersion. None of these factors appeared to be related to the deviations recorded. In each rejected test, however, the points scattered about the lines plotted in fig. 1.

SUMMARY.—These data indicated that the ratio of males/females declines logarithmically to unity within approximately 3 hours. The data thus extend and closely measure the sex ratio phenomenon previously reported by Elzinga (1961). It also shows that the ratio is not greatly influenced by the ionic condition of the water used to hatch the eggs.

References

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