

LABORATORY STUDIES ON THE SEASONAL HATCHABILITY OF EGG BATCHES OF *AEDES SOLLICITANS*, *A. TAENIORHYNCHUS*, AND *PSOROPHORA CONFINNIS*

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INTRODUCTION. Most multivoltine flood-water species of the genera *Aedes* and *Psorophora* are inactive from November to March in southwestern Louisiana. Exceptions are *Aedes sollicitans* which breeds throughout the year and *Aedes vexans* which, in this area, is inactive during the warmer months but abundant from fall to spring. The eggs of these species that are inactive during the cooler months were said by Clements (1963) to be in a state of facultative diapause, and he concluded that facultative diapause occurs only in eggs laid in late summer or autumn. However, Moore and Bickley (1966), in a study of colonized *Aedes taeniorhynchus*, found that less than 10 percent of the females produced batches of eggs that were nearly all in a state of deep diapause. These eggs, they said, plus a few from nearly all egg

batches, were responsible for "installment hatching" as defined by Mallack *et al.* (1964) and Breeland and Pickard (1967).

In the present study, we have examined the variability of hatching of consecutively laid egg batches produced by spring and fall broods of the multivoltine species, *Aedes sollicitans*, *A. taeniorhynchus* and *Psorophora confinnis*. We hoped to relate the presence of batches that were in a less hatchable state to the season and to individual females.

METHODS AND MATERIALS. The aquatic stages of *P. confinnis* and *A. taeniorhynchus* are normally absent from local breeding areas from November to March because their eggs are in a state of facultative diapause. We therefore collected newly emerged females from the first and last major broods of the three species in the field in late May and mid-September of 1966 and in mid-April and mid-September

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of 1967 by using battery-powered aspirators. The females were taken to the laboratory, given their first blood meal, and isolated for oviposition in individual glass shell vials (95 x 25mm) provided with a moist cotton plug and a raisin. After each oviposition, the females were refed and transferred to clean vials. All eggs were counted and stored for hatching. The first 10 females of each species in 1966 and the first 20 females of each species in 1967 that laid two egg batches were used for the study. (Some females died after laying their first egg batch; others were reluctant to re-feed and were therefore discarded.) All eggs were flooded once for 24 hours with a hatching stimulus (one part corn juice to 100 parts distilled water). The first egg batch of a female was normally flooded when the eggs were 2 weeks old; the succeeding batches were flooded after they had aged at least 1 week. Eggs that failed to hatch were cleared with sodium hypochlorite and checked for maturity. If eye spots and the egg breaker were present, the eggs were considered viable and therefore hatchable; eggs without these characters were considered nonviable and were subtracted from the total number of eggs in each batch. In 1966, the adults and eggs were held at 75–80° F., and the egg hatching studies were done at that temper-

ature; in 1967, the temperature was maintained at 80° F.

RESULTS. *Aedes sollicitans.* The egg-hatching data for *A. sollicitans* are presented in Table 1. In 1966, 83 and 79 percent of the egg batches in the spring and fall, respectively, had better than 90 percent hatch. In 1967, all egg batches in the spring and all but one in the fall also had better than 90 percent hatch. During both years, only one spring egg batch and three fall egg batches had less than 10 percent hatch.

Aedes taeniorhynchus. The egg-hatching data for *A. taeniorhynchus* are presented in Table 1. All but one egg batch each spring had better than 90 percent hatch, and 24 of 32 (75 percent) and 23 of 54 (43 percent) of the fall egg batches also had better than 90 percent hatch. However, it is more important that 16 and 33 percent of the fall egg batches both years had less than a 10 percent hatch. Also, none of the spring egg batches failed to hatch some eggs, but 12 of 86 (14 percent) of the fall egg batches did not hatch at all, and 27 percent had less than a 10 percent hatch.

Psorophora confinnis. The egg-hatching data for *P. confinnis* are presented in Table 1. Almost half (11 of 24) of the spring egg batches in 1966 and 55 of 63 (88 percent) of the spring egg batches in 1967

TABLE 1.—Egg batches of *Aedes sollicitans*,¹ *A. taeniorhynchus*,² and *Psorophora confinnis*,³ grouped by the percentage of viable eggs that hatched.

Hatching group by %	Numbers of egg batches											
	<i>Aedes sollicitans</i>				<i>Aedes taeniorhynchus</i>				<i>Psorophora confinnis</i>			
	1966		1967		1966		1967		1966		1967	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
100	19	23	80	71	26	2	51	17	5	3	35	12
90.1–99.9	16	21	20	7	11	18	16	6	6	5	20	3
50.1–90.0	5	9	..	..	..	..	1	4	9	4	6	2
10.1–50.0	1	1	..	..	1	3	..	9	2	2	..	1
0.1–10.0	..	..	..	..	..	3	..	8	1	1	..	4
0	1	2	..	1	..	2	..	10	1	38	2	36
Total no.	42	56	100	79	38	32	68	54	24	53	63	58

¹ *A. sollicitans*—10 ♀♀ in the spring and fall of 1966 and 20 ♀♀ in the spring and fall of 1967.

² *A. taeniorhynchus*—10 ♀♀ in the spring and fall of 1966; 18 ♀♀ in the spring and 20 ♀♀ in the fall of 1967.

³ *P. confinnis*—9 ♀♀ in the spring and 10 ♀♀ in the fall of 1966; 20 ♀♀ in the spring and fall of 1967.

had better than 90 percent hatch, but only 8 (15 percent) and 15 (26 percent) of the fall egg batches both years had better than 90 percent hatch. However, only 2 of 24 (8 percent) and 2 of 63 (3 percent) of the spring egg batches in 1966 and 1967, respectively, had less than a 10 percent hatch. About 72 and 62 percent of the fall egg batches in 1966 and 1967, respectively, failed to hatch any eggs.

DISCUSSION. Table 2 shows that 97 per-

part, the continuous breeding of *A. sollicitans* throughout the year in southwestern Louisiana. Only 4 of 277 egg batches failed to hatch, and these were laid by four females and were in each instance the last batch produced by that female. These four failures occurred despite a strong hatching stimulus. Thus, though it is rare, *A. sollicitans* is capable of placing some eggs in a state of diapause.

Table 3 indicates that certain females

TABLE 2.—Summary of egg hatching of *Aedes sollicitans*, *A. taeniorhynchus* and *Psorophora confinnis* during the spring and fall of 1966 and 1967.

Species	Average % hatch of eggs				Both years	
	1966		1967		Spring	Fall
	Spring	Fall	Spring	Fall		
<i>Psorophora confinnis</i>	73	19	93	24	87	22
<i>Aedes taeniorhynchus</i>	99	83	99	60	99	71
<i>Aedes sollicitans</i>	93	93	99	99	97	97

cent of the viable eggs of *A. sollicitans* hatched during the study, 99 percent of the viable spring eggs and 71 percent of the viable fall eggs of *A. taeniorhynchus* hatched, and 87 percent of the viable spring eggs and 22 percent of the viable fall eggs of *P. confinnis* hatched. Thus the eggs of both the spring and the fall females of our control species, *Aedes sollicitans*, hatched equally well which explains, in

are responsible for producing egg batches in which some or all of the eggs are in a state of diapause and therefore more resistant to hatching stimuli. Also, this trait was much more pronounced in the fall than in the spring and was most evident in *P. confinnis* (25 of the 30 fall females laid at least one egg batch with 0 percent hatch. Table 4 gives the data on hatch of eggs of certain individual females of *P.*

TABLE 3.—Numbers of female *A. sollicitans*, *A. taeniorhynchus* and *P. confinnis* by percentage (0 or 0.1–10%) eggs hatching in batches laid in the spring and fall.

Species	Season	Number of females	No. of females producing one or more egg batches with indicated %		
			0%	0.1–10.0%	
<i>Aedes sollicitans</i>	Spring	30	1	0	
	Fall	30	3	0	
	<i>Aedes taeniorhynchus</i>	Spring	28	0	0
		Fall	30	10	4
<i>Psorophora confinnis</i>	Spring	29	3	1	
	Fall	30	25	0	

TABLE 4.—Percentage hatch of consecutive fall egg batches of individual *A. taeniorhynchus* and *P. confinnis*.

Female code number and year	% hatch of consecutive fall egg batches							
	1st	2nd	3rd	4th	5th	6th	7th	8th
<i>Psorophora confinnis</i>								
4—1966	0	0	0	0	0	0	0	0
14—1966	0	0	0	0	0	99	81	19
2—1966	100	99	0	0	..	..	..	..
17—1967	0	0	100	..	..	..	..	..
14—1967	100	100	0	47	..	..	..	..
<i>Aedes taeniorhynchus</i>								
6—1966	2	10	100	100	96	..	..	..
4—1966	99	32	97	..	..	..	..	..
4—1967	1	0	100	100	..	..	..	..
15—1967	0	0	0	..	..	..	..	..
5—1967	100	62	18	37	95	100	..	..

confinnis and *A. taeniorhynchus*. There was apparently no set pattern in production of batches that were in various degrees of hatchability. Some laid numerous egg batches, none of which hatched; some laid easily hatchable batches and then diapausing egg batches; some completely reversed this last pattern. These results demonstrate the difficulty of predicting the number of female contributors to a nonhatching egg group based on a study of the first egg batches laid by each.

Fall females are certainly the main contributors of eggs for "installment hatching."

References

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