ARTICLES

BLOOD FEEDING AND OVIPOSITION OF SOME FLOODWATER MOSQUITOES IN LOUISIANA: LABORATORY STUDIES[1]

H. C. CHAPMAN AND D. B. WOODARD[2,3]
Entomology Research Division, Agr. Res. Serv., U.S.D.A., Lake Charles, Louisiana

Many culicidologists believe that most mosquitoes are capable of maturing and depositing a batch of eggs after each blood meal. Such eggs may be withheld in the laboratory if mating or ovipositional stimuli are not satisfied.

Breeland *et al.* (1961) stated that most floodwater mosquito species in the Tennessee Valley "require two or three blood meals before viable eggs are laid." Breeland and Pickard (1963) presented laboratory data for four pest species of the Tennessee Valley—*Aedes vexans* (Meigen), *Psorophora confinnis* (Lynch-Arribalzaga), *P. cyanescens* (Coquillett), and *P. ciliata* (Fabricius)—which indicated these species possessed a preoviposition period of 5 to 39 days with 1 to 8 preoviposition blood meals. Additional studies by Breeland and Pickard (1964) showed that these three species of *Psorophora* required several blood meals (mode, 3–5) before they deposited their first eggs and a preoviposition period with a mode of 13–15 days. The technique of these workers consisted of isolating and holding the field-caught females in quart ice-cream containers for blood feeding and oviposition data.

The study reported herein was occasioned in part by our strong belief that mosquitoes in nature mature and deposit a batch of eggs after each blood meal, and that most mosquitoes would do the same in the laboratory if a suitable technique was used.

The senior author has often used the technique of Barr and Al-Azawi (1958), who caught and usually fed female mosquitoes in the field, then isolated and held them in relatively small vials to obtain eggs for various purposes. By using this technique most specimens of the following species that lived for at least 5 days deposited a batch of eggs after the first known blood meal: *Aedes campestris* Dyar and Knab, *A. communis* (DeGeer), *A. dorsalis* (Meigen), *A. increpitus* Dyar, *A. nigromaculis* (Ludlow), *A. niphadopsis* Dyar and Knab, *A. vexans,* and *Orthopodomyia californica* Bohart.

METHODS. In this study we utilized female mosquitoes of the following species: *Psorophora ciliata, P. confinnis, P. cyanescens, P. ferox* (Humboldt), *P. howardii* Coquillett, *Aedes atlanticus-tormentor* complex Dyar and Knab, *A. fulvus pallens* Ross, *A. infirmatus* Dyar and Knab, *A. sollicitans* (Walker), *A. taeniorhynchus* (Wiedemann), and *A. triseriatus* (Say). We made every attempt to secure adult female specimens shortly after their emergence and prior to any blood meals. We must admit the possibility that some of our specimens may have obtained their first blood meal and deposited a batch of eggs prior to collection. Our initial plans were to collect females in vials immediately after they fed on us in the field, but this plan was modified in that the specimens were collected from our vicinity with battery-powered aspirators, placed in cages, and fed their blood meal later in the laboratory. This change was ne-

[1] In cooperation with McNeese State College, Lake Charles, Louisiana.

[2] F. E. Glenn, A. J. Mayeux, O. R. Willis, and J. D. Hicks of our laboratory assisted in some of these studies.

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cessitated by the omnipresent hordes of *Aedes sollicitans* and *A. taeniorhynchus* in all collecting areas, plus the large numbers of *A. atlanticus-tormentor* complex and *Psorophora ferox* that often were present in wooded habitats.

All field-collected female mosquitoes that took a full blood meal were isolated in shell glass vials (95 mm x 25 mm). A wad of absorbent cotton, moistened with either pond or brackish water according to the species involved, was placed in the bottom of the vial and a raisin pinned on the neeting at the top of the vial. All vials were numbered, placed in an incubator containing a temperature of 27°–29° C. and a relative humidity of 70 percent to 85 percent, and checked daily for eggs or the death of the specimen. Cotton wads were moistened as needed. As soon as a specimen oviposited, the raisin was removed and the female was offered a blood meal from our arms each day until she accepted or died. Once a blood meal was taken, the specimen was placed in a clean vial furnished with raisin and moistened cotton as previously described. Eggs were counted and returned to the old vials for storage. Only specimens that lived at least 5 days after their first known blood meal were included in these tests.

RESULTS. Tables 1 and 2 summarize the data obtained and indicate that 84 percent of all the specimens deposited an egg batch after their first known blood meal. The average preoviposition period for all specimens was 7.0 days and ranged from a low of 4.9 days for *P. cyanescens* to 9.9 for *A. atlanticus-tormentor* complex. We believe that preoviposition periods in excess of 5–6 days at the temperatures used probably reflect our inability to satisfy the oviposition stimulus required by certain species.

Psorophora cyanescens. 95 percent of our specimens deposited eggs after the first blood meal. This species deposited the most eggs per oviposition of any *Psorophora* and also the greatest lifetime total. *P. cyanescens* was the slowest feed-

TABLE 1.—Blood feeding, longevity, and oviposition data from laboratory observations of 5 species of *Psorophora,* made during the summer and fall of 1964. (Ranges indicated by hyphenated numerals, means in parentheses.)

Datum	*ciliata*	*confinnis*	*cyanescens*	*ferox*	*howardii*
Number of specimens used	48	56	41	48	1
Number that deposited eggs after 1st blood meal	36	45	39	47	1
First blood meal preoviposition period in days	5–16 (8.6)	4–24 (6.2)	3–8 (4.9)	4–21 (5.5)	6 (6)
Number of blood meals	1–3 (1.6)	1–4 (2.0)	1–4 (2.2)	1–7 (2.9)	2
Number of ovipositions	1–3 (1.3)	1–3 (1.3)	1–3 (1.7)	1–7 (2.1)	1
Number eggs 1st oviposition	1–110 (31)	5–164 (84)	16–208 (126)	9–183 (80)	(51)
Number eggs all ovipositions	1–110 (33)	1–164 (76)	2–208 (107)	4–183 (63)	(51)
Longevity in days	4–29 (14)	6–48 (16)	4–23 (15)	5–48 (22)	15 (15)
Lifetime egg deposition	1–131 (42)	1–223 (93)	16–389 (174)	9–351 (132)	(51)

ing species of all mosquitoes used in the test.

Psorophora confinnis. Approximately 80 percent of our specimens deposited eggs after the first blood meal. This was the second most prolific species of *Psorophora* according to the number of eggs deposited in all ovipositions.

Psorophora ferox. About 98 percent of this species laid eggs after the first known blood meal. Specimens of this species took the greatest number of blood meals, deposited the most egg batches, and lived the longest of any *Psorophora* we tested.

Psorophora ciliata. It appeared evident to us that our vials should have been larger in diameter for this large species. Only 75 percent of our specimens laid eggs after their first known blood meal. They laid the fewest eggs per oviposition of any *Psorophora,* and less than any *Aedes* except *atlanticus-tormentor.*

Psorophora howardii. Only one specimen was available for study; thus, no comparative data were available.

Aedes taeniorhynchus. About 95 percent of this species laid eggs after the first known blood meal. *A. taeniorhynchus* took more blood meals and laid the most egg batches of the 11 species in this study.

Aedes sollicitans. Mortality in this species appeared excessive since only 67 percent deposited eggs after the first known blood meal. Although this species had the shortest average life span (14 days), it laid the most eggs of any species of

TABLE 2.—Blood feeding, longevity, and oviposition data from laboratory observations of 6 species of *Aedes,* made during the summer and fall of 1964. (Ranges indicated by hyphenated numerals, means in parentheses.)

Datum	*atlanticus-tormentor* [a]	*infirmatus*	*sollicitans*	*taeniorhynchus*	*triseriatus*	*fulvus pallens*
Number of specimens used	86	33	42	42	6	10
Number that deposited eggs after 1st blood meal	67	31	28	40	4	9
First blood meal preoviposition period in days	5–26 (9.9)	4–18 (7.5)	4–9 (5.0)	4–20 (8.1)	4–10 (7.2)	5–15 (8.4)
Number of blood meals	1–8 (2.4)	1–7 (3.1)	1–7 (3.1)	1–14 (3.4)	1–6 (2.3)	1–4 (2.4)
Number of ovipositions	1–7 (2.2)	1–6 (2.6)	1–6 (2.5)	1–14 (3.0)	1–5 (1.8)	1–4 (2.1)
Number of eggs 1st oviposition	1–64 (26)	2–113 (49)	4–185 (91)	4–140 (61)	30–123 (65)	5–101 (45)
Number of eggs all ovipositions	1–64 (24)	2–113 (54)	3–185 (67)	1–140 (51)	20–123 (61)	5–128 (57)
Longevity in days	6–61 (26)	5–71 (26)	5–33 (14)	5–62 (24)	6–67 (28)	10–49 (23)
Lifetime egg deposition	1–156 (53)	2–484 (151)	4–415 (167)	12–438 (151)	30–464 (169)	6–302 (120)

[a] Adult females of *Aedes atlanticus* and *A. tormentor* are inseparable. Studies of eggs derived from these females indicated about one-tenth of specimens were *A. tormentor.*

Aedes during the first oviposition, and the largest total number. It ranked third of the 11 species in number of blood meals and ovipositions.

Aedes infirmatus. 94 percent of our specimens deposited eggs after the first known blood meal. Except for *A. taeniorhynchus,* this species took more blood meals and oviposited oftener than any other species in the study.

Aedes atlanticus-tormentor. About 78 percent of this species laid eggs after the first known blood meal. This species complex laid the fewest eggs per oviposition; the eggs were surprisingly large compared with those of similar sized species.

Aedes fulvus pallens. All but one of the 10 specimens laid eggs after the first known blood meal. This large mosquito deposits a very small egg for its body size.

Aedes triseriatus. Our data for this species are based on only 6 specimens. These specimens had the longest average life span of any species in the study and the highest lifetime egg deposition among the *Aedes.*

DISCUSSION. Our most important floodwater pest mosquitoes in southwestern Louisiana are *Aedes taeniorhynchus* and *A. sollicitans* in salt marshes and *Psorophora confinnis* in fresh marshes, whereas major woodland pests are *Aedes infirmatus, Aedes atlanticus-tormentor,* and *Psorophora ferox.*

Data in tables 1 and 2 clearly indicate why most of these species are important since they are capable of taking more blood meals, making many ovipositions, and depositing larger numbers of eggs per oviposition and during their lifetime than many of the less important species.

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