

OVIPOSITION OF *CULISETA MORSITANS* (THEOBALD) AND COMMENTS ON THE LIFE CYCLE OF THE AMERICAN FORM ¹

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INTRODUCTION. Little information exists about the oviposition activity of *Culiseta morsitans* and the eggs of this species are unknown in North America (Howard *et al.*, 1915, Barr, 1958). What is known of the biology of this species is reviewed by Horsfall (1955). Most published observations of it are from Europe.

Marshall (1938) summarized the life history of this species in England as follows: "Adults are found from April to

August. The eggs are laid singly in dried-up hollows or above the water level of partly filled ones in the manner of *Aedes* eggs. The eggs hatch in the fall and the larvae develop to fourth instar by November. The fully grown larvae remain on the bottom during the winter and pupate the following spring." However, Barr (1958) expressed doubt that the American and European forms are identical since most American *Culiseta* oviposit on the water surface, lay eggs in rafts, and hibernate as adult females; and there has been no confirmation of the cycle in America. Howard *et al.* in 1915 reported one generation a year for the American form, and

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Matheson in 1944 concurred with this opinion. Howard *et al.* also suggested that hibernation may take place in the egg stage. The purpose of this communication is to add to the information concerning oviposition and biology of the American form of *Culiseta morsitans*.

PROCEDURE. Adult females of the species were collected from diurnal resting places at Shade Swamp, Connecticut, during the late summer and fall of 1967. The mosquitoes were returned alive to the laboratory and the gravid or blood-engorged ones were placed in glass-lantern chimney cages over oviposition water for observation of egg-laying activity. Ten percent sucrose solution in cotton pads was provided for food, and the cages were placed in a constant-temperature room maintained at $80^{\circ} \pm 2^{\circ}$ F. and 70 ± 10 percent relative humidity. Most of the mosquitoes initially held in this manner fell to the surface of

the water and died within a 2-week period without oviposition. Accordingly, the holding cage was modified to include a moist substrate upon which the mosquitoes could rest: moist paper toweling was used to line the walls of half-pint ice-cream cartons which were then half-filled with water and fitted to the bottom of the lantern chimneys.

RESULTS. On 5 September an egg mass was produced by a female that was collected on 1 September, and another was deposited 11 September by a female that was collected on 5 September. These two egg masses were located $1\frac{1}{2}$ and 2 inches above the water line and firmly secured to the moist substrate, in contrast to the free-floating rafts produced by other species of *Culiseta*. The first mass contained 160 eggs and the second 245 eggs. In both, the eggs formed a compact unit in the shape of a rectangular or oval raft (Figure

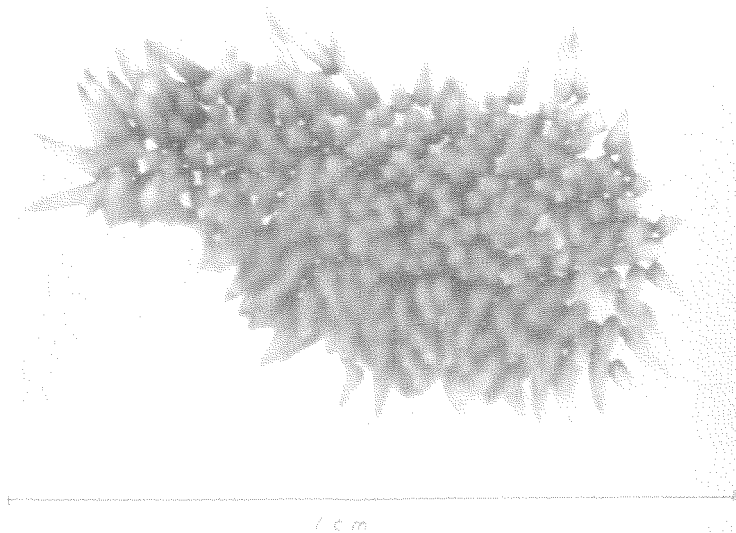


FIG. 1.—Eggs of *Culiseta morsitans* deposited in raft-shaped mass on moist substrate above the water line.

1). Although these eggs developed embryos 5 days after oviposition, no hatching occurred and they were retained for further study. Seven additional egg rafts of a similar nature were obtained from gravid females collected from 8 through 11 September. These contained an average of 195 eggs and were found within the same distance above the water line as the first two.

DISCUSSION. This demonstration that eggs of the American form of *C. morsitans* are deposited in raft-shaped masses and not singly as described for the English form, supports the opinion of Barr (1958) that the two forms differ in their biology.

It is also apparent that the life cycle of *C. morsitans* differs from that of most other *Culiseta*, which oviposit on the water surface and hibernate as adult females. While there has been no direct confirmation of the life cycle of this species in America, several observations have been made regarding the sequence of development. Anderson (1967) found larvae of this species in Connecticut only during the early spring. Wallis (1957) observed a build-up of unfed adult females in resting places in June and early July, and found that the peak of blood-feeding activity occurred during a 4-week period from mid-July to mid-August. In the present study the incidence of females containing fresh blood diminished after mid-August and the occurrence of gravid ones increased between that time and mid-September. Oviposition was observed in the laboratory during the first part of September, and non-ovipositing females exhibited poor capacity for survival.

Although most species of *Culiseta* overwinter as hibernating adult females, it seems unlikely that such is the case with *C. morsitans* in Connecticut. As a rule, gravid female mosquitoes are very suscepti-

ble to cold and only unfed ones are able to overwinter unless gonotrophic dissociation occurs (i.e., blood is taken but the ovaries remain undeveloped). Most of the *C. morsitans* specimens collected in September contained well-developed eggs.

SUMMARY. Oviposition of the North American form of *Culiseta morsitans* is described in which egg deposits were in the form of egg rafts placed on a moist substrate above the water line. This and information concerning the life cycle of this mosquito are discussed. It is suggested that, unlike most other *Culiseta*, this species does not overwinter in the adult stage.

ADDENDUM. Since this manuscript was prepared there has been a revision of the subgenus *Culicella* Felt (Stone, A. 1967. A synoptic catalog of the mosquitoes of the world, supplement III (Diptera: Culicidae). Proc. Ent. Soc. Wash. 69(3):197-224). In this, the species *Culiseta morsitans* (Theobald) has been replaced in North America by the subspecies *Culiseta morsitans dyari* (Coquillett).

References

- ANDERSON, J. R. 1967. Connecticut Agr. Exp. Sta., New Haven. Personal communication.
- BARR, A. R. 1958. The mosquitoes of Minnesota (Diptera, Culicidae: Culicinae). Univ. Minnesota Agr. Exp. Sta. Tech. Bull. 228, 154 pp.
- HORSFALL, W. R. 1955. Mosquitoes; Their Bionomics and Relation to Disease. New York: Ronald Press. 723 pp.
- HOWARD, L. O., DYAR, H. G., and KNAB, F. 1915. The Mosquitoes of North and Central America and the West Indies. Vol. III, Systematic Description, Part I. Washington: Carnegie Inst. 523 pp.
- MARSHALL, J. F. 1938. The British Mosquitoes. London: Brit. Mus. (Nat. Hist.). 341 pp.
- MATHESON, R. 1944. A Handbook of the Mosquitoes of North America. 2nd ed. Ithaca, New York: Comstock. 314 pp.
- WALLIS, R. C. 1957. Host feeding of *Culiseta morsitans*. Proc. Ent. Soc. Wash. 59:199-200.