SCIENTIFIC NOTES

OBSERVATIONS ON SURVIVAL OF THREE SPECIES OF MOSQUITO LARVAE STRANDED ON DAMP SOIL [1]

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Most mosquito workers have seen larvae stranded in the field by receding waters when conditions are such that breeding water is either absorbed or evaporated before larval and pupal development is completed. Such occurrences are common in salt marsh areas, and they prevent or greatly attenuate the successful emergence of broods of primarily flood water mosquitoes. However, Schoof, *et al.* (1945) reported survival of larvae and pupae of *Anopheles quadrimaculatus* Say and *A. punctipennis* (Say) for about 2 days on damp muck, and Bick and Penn (1947) reported the survival of larvae and pupae of *Aedes vexans* (Meigen) (4 to 5 days), *Anopheles walkeri* Theobald (about 5 days), and *Wyeomyia smithii* (Coquillett) (as much as 8 days) on damp filter paper in the laboratory.

The observations reported here were made by personnel of the Gulf Coast Marsh and Rice Field Mosquito Investigations Laboratory, Lake Charles, Louisiana, during February and March 1971, in breeding areas near Hackberry, Louisiana. These areas consisted of grassy swales with some low spots that are flooded by tides or rains. After a complete flooding, the water sometimes remained as long as 3 weeks without additional rains and tides. The areas progressed from a flooded condition to a complete lack of standing water several times during the period and had populations of three species of mosquitoes: *Aedes sollicitans* (Walker) a floodwater species, *Culex salinarius* Coquillett and *Culiseta inornata* (Williston), which often breed in fairly recently flooded areas. Larval *A. sollicitans* can be collected in large numbers soon after a flooding and for about a week thereafter. Egg rafts of *Culex salinarius* and *Culiseta inornata* can be collected the third day after flooding, and these species are present until the surface water disappears.

Our first observation of stranding occurred Monday, February 1 when only larvae of *Culex salinarius* and *Culiseta inornata* were present (the water had been standing several weeks, and all *A. sollicitans* had completed development). On this date the water in the breeding area was low and contained heavy concentrations of second, third, and fourth instars of the two species. By the next day, only two pools, less than 2 square yards of total surface area remained. By mid-morning of February 3, a pool approximately 5 inches in diameter remained. When we returned at 10:30 a.m. February 4, we collected two 15 x 28 inch sod samples from the lower parts (now only damp) of the breeding area. These were returned to the laboratory and held in a large outdoor cage for further study.

Rain fell in the observation area 3 times before we returned on February 8. A small amount had fallen February 4 at mid-afternoon (0.45 inch measured at Lake Charles Airport), then towards evening February 6 and 7, more rain fell (measured at Lake Charles Airport as 0.30 and 0.74 inch, respectively). Therefore, on February 8 the general area was flooded. Collections made February 8 and 9 contained third and fourth instar larvae and pupae of the two species. Moreover, the numbers and sizes of the larvae, which were scattered generally throughout the area, indicated that more larvae had survived than just those few present in the last areas to dry.

The sod samples we had placed in the large cage on February 4 were not covered and were therefore dampened by rain February 4 and flooded by weekend rains. When they were checked February 9, they contained third and fourth instar *Culex salinarius* and *Culiseta inornata* which obviously came from the damp sod.

The second series of observations began Monday, March 8, 1971 when the water level was low overall and almost gone from three small holes. However, many larvae of *A. sollicitans* and the other two species were seen in the shallow water. By March 9, the three small holes were completely free of surface water but when a small area in one of the holes was flooded briefly with a bucket of water, numerous larvae floated from the damp soil, including fourth instar *Culex salinarius,* second, third, and fourth instar *A. sollicitans,* and third and fourth instar *Culiseta inornata.* Sod samples were therefore taken at several points and returned to the large outdoor cage at the laboratory. Subsequent daily sampling of the study holes by flooding them with a bucket of water produced the following results: March 10: living larvae and pupae of all three species were collected; March 11: survival was lower, and the larvae were mostly third instar *A. sollicitans;* March 12: only one third instar *A. sollicitans* was observed, and it was in poor condition; March 15: although parts of the study area were briefly flooded, only one living third instar *A. sollicitans* was produced.

One portion of the sod samples collected March 9 had been covered to prevent flooding by rains; it was flooded in the laboratory on

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March 11, and several living fourth instar *Culex salinarius* and early third instar *A. sollicitans* were observed. A second section of sod was flooded March 12, but no living larvae were observed. The remainder of the sod sections were flooded March 15, but no living larvae were observed.

We concluded that mosquito larvae of these three species survived about 3 days without surface water at this time of year. However, survival would be shorter in the summer because of the higher temperatures. Survival during stranding is enhanced by cover, but whether sheltered larvae die because of desiccation, even on damp soil, or because of starvation is uncertain though desiccation is most likely, even though feeding does not take place in the absence of free water.

References

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Schoof, H. F., Schell, S. C. and Aston, D. F. 1945. Survival of anopheline larvae and pupae in muck. J. Econ. Entomol. 38:113–114.

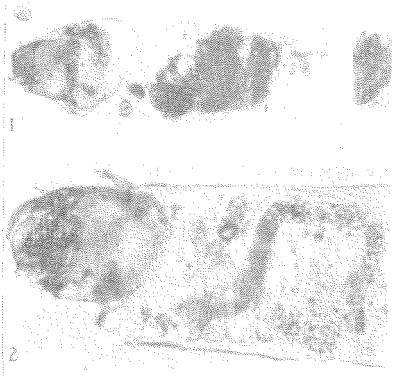

FIG. 1—Two first-instar *Simulium damnosum* larvae among midgut contents of mature *S. damnosum* larva, enclosed within peritrophic membrane (x330).

FIG. 2—Enlargement of first-instar *S. damnosum* larva in midgut of older *S. damnosum* larvae (x588).

CANNIBALISM AMONG *SIMULIUM DAMNOSUM* (SIMULIDAE) LARVAE

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Various investigators have reported ingestion of larvae of *Simulium* and other water insects by older or larger *Simulium* larvae. Although some have surmised that skins with intact head capsules might have been ingested (Grenier, 1948), others saw younger larvae eaten by older ones (Petersen, 1924; Peterson and Davies, 1960; Smart, 1934; Fredeen, 1963; Peterson, 1963). Several have observed *S. venustum* undertaking acts of cannibalism. Dissection of gut contents of older larvae has often revealed whole or partially digested larvae of the same species. Sometimes dead larvae are seen to be eaten (Wu, 1931). Other water insects which have been found in the gut of *Simulium* larvae are chironomid larvae (Puri, 1925; Welch, 1963; Downes, 1963) and first instar mayfly nymphs (Zahar, 1951).

During field studies on the aquatic stages of the vector of onchocerciasis in the Upper Region of Ghana, dissections were made of midguts of older *Simulium damnosum* Theobald larvae which had been collected on the Red Volta River at Nangodi. Among 100 large larvae dissected, 12 were found to have one or more head capsules, or partially digested bodies, of what were undoubtedly first instar larvae of the same species (Figs. 1–2). Some of the dissected larvae had been collected from a large leaf bearing a mass of hatched eggs, while others had been arranged along a grass stem.

Attempts were made to observe any instances of cannibalism among *S. damnosum* larvae being reared in a laboratory aquarium, with the aid of a horizontally-directed stereoscopic microscope which had been placed against the aquarium glass. It was noted that attached larvae sometimes browsed along the substratum, raking up particles, presumably seeking diatoms or other algae. Several first instar larvae were seen to be ingested during such browsing activities. In one instance where streams of bubbles passed rapidly over leaves bearing small larvae, some of these were seen to detach. Six were later found within the gut of older larvae. Two observations were made of small larvae trapped by outstretched cephalic fans, which then closed immediately, conveying the firmly-held larvae toward the mouth. The mandibles were then seen to push the intact larvae into the mouth opening.

References

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[2] This work was done while the author was assigned to the National Institutes of Health (U.S.A.)—National Institute of Health and Medical Research (Ghana) Joint Research Program, Accra, Ghana.