their uptake by the mosquito larvae limited only by the larval instar exposed (Dadd 1971) and the temperature (Webster 1973). However, the results shown in Table 3 quite clearly

Table 3. Effect of substrate on nematode uptake by 4th instar *Aedes aegypti*.

Test condition	% 48 h mortality[1]
No substrate	61
Sand	3
Leaves	15
Controls	0

[1] 50 larvae exposed to 37,500 nemas in 250 ml of water (2 replications).

indicate that the availability of the nematodes to the host is markedly decreased when a substrate is present. So that although smooth-bottomed containers can be used successfully for susceptibility testing of mosquito larvae, care must be taken in the extrapolation of laboratory results for the determination of effective field doses for mosquito control. Obviously special attention will have to be paid to the nature of the natural habitat(s) of the target species. Economic use of the nematode may be limited to artificial containers or rock pools as it will be necessary to vastly increase the dose of nematodes applied to a pool with a high degree of substrate uneveness or porosity. Alternatively, the nematode could be applied in a formulation that would ensure that it remained available to the mosquito for a sufficiently lengthy period of time by decreasing the settling rate.

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AN ARTIFICIAL ATTACHMENT MEDIUM AND SUBMERGED AIR SOURCE FOR LARVAE AND PUPAE OF *MANSONIA* AND *COQUILLETTIDIA*.

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Three species of mosquitoes, *Mansonia titillans* (Walker), *Ma. dyari* Belkin, Heinemann and Page, and *Coquillettidia perturbans* (Walker), occurring in Florida are characterized by modified air-tubes which allow their insertion into stems and roots of aquatic plants through which they obtain air. While air may be obtained at the water surface or from that dissolved in the water, successful development requires air from cells in submerged plant parts. Thus, in nature, there is always an association between these species and plants having submerged parts with air cells that may be penetrated by the modified larval siphon and the pupal trumpets.

Because of these specialized habitats, the developmental stages of *Mansonia* and *Coquillettidia* have been difficult to locate and retrieve under natural conditions and even more difficult to manage in the laboratory. Thus, there are gaps in our knowledge of the basic biology of this group of mosquitoes, especially in terms of measuring natural populations and in determining life cycles and seasonal histories. Development of an understanding of the population dynamics of these species for improved control will require new methodology for precise observations of field and laboratory populations.

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Polk County abounds with aquatic situations which are lush with submerged vegetation favoring widespread habitat availability to this specialized group of mosquitoes. Control problems are unique and challenging in that changing population patterns in relation to land use have increased the need for mosquito control. Meanwhile, increased environmental concerns, legal considerations and economics have resulted in a diminution of acceptable and efficacious mosquito control resources.

Increased emphasis on research and development in the area of mosquito control by Polk County Environmental Services is a reflection of the needs generated by the conditions outlined above together with the fact that research applicable to the mosquito control situation in Polk County is not being adequately pursued elsewhere.

Laboratory and field research in progress on *Mansonia* and *Coquillettidia* in Polk County has resulted in the identification of a much needed method that offers considerable promise for further development here and elsewhere, viz., the demonstrated utility of styrofoam[3] in the laboratory as an artificial substitute for submerged plant parts for attachment of the specialized larvae and pupae (Fig. 1). Preliminary experiments indicate that the material in various forms meets the tactile and air-source requirements of *Mansonia* and *Coquillettidia*.

Earlier work in Florida by Haeger (1960) showed the feasibility of using artificial materials for larval attachment. He supplied *Ma. titillans* with non-absorbent cotton packing twine which was found to be superior to various types of wet-resistant paper and cardboard. In a subsequent report Haeger (1961) compared cotton twine and 13 different plants as larval attachment media for *Cq. perturbans*. In this case, one of the plants, *Commelina* sp., was favored over the string as a routine rearing medium in the laboratory. We know of no other work with strictly artificial materials for larval attachment for Florida species of *Mansonia* or *Coquillettidia*. Rearing and experimental techniques for this group of mosquitoes are reviewed more fully by Gerberg (1970).

LABORATORY OBSERVATIONS

Preliminary observations to determine the utility of styrofoam as an artificial attachment medium and air-source for *Cq. perturbans* larvae and pupae were begun in the laboratory of Polk County Environmental Services on April 22, 1981 and continued on an intermittent basis until they were terminated on June 29, 1981.

In a preliminary test begun on April 22, six 4th instar field-collected larvae of *Cq. perturbans* were placed in a 500 ml glass beaker with tap and field water and a 7.5 cm × 10 cm × 2 cm piece of styrofoam. Observations were made through May 18. Five of the 6 larvae attached to the styrofoam. One larva attached on April 23, pupated on April 27 and produced an adult male on May 15. Another specimen attached as a 4th instar larva on April 23, pupated on May 11 and produced an adult male on May 15. The remaining larvae failed to moult and were dead on May 18.

Subsequently, in 3 sets of observations involving 2nd, 3rd, and 4th instar larvae, respectively, the following results were recorded:

SECOND INSTAR. Two specimens of *Cq. perturbans* in this larval instar were placed in a 2.5 cm diam × 7 cm vial containing tap and field water and a 1 cm × 1 cm × 6 cm strip of beadboard-type styrofoam on May 21. The larvae readily attached to the styrofoam, but died on June 4 without moulting.

THIRD INSTAR. On May 21, one specimen of this instar of *Cq. perturbans* was placed in a vial as described above. The larva moulted to the 4th instar on June 1 and remained attached until it died on June 16.

FOURTH INSTAR. Approximately 20 4th instar larvae of *Cq. perturbans* were placed in each of two 500 ml beakers containing the tap and field water on May 21, 1981, (Fig. 1). Each beaker contained a block of styrofoam. In one beaker, designated A, the styrofoam had smooth surfaces and extended the length of the beaker touching the bottom. In the second beaker, B, the styrofoam did not reach the bottom of the beaker and there was more rough surface exposed. Observations continued through June 29, with the following results:

In *Beaker A* (Styrofoam extended to bottom, smooth surface), only 3 of 20 larvae attached, there was no moulting and all larvae were dead on June 5.

In *Beaker B* (Styrofoam not extended to bottom, rough surfaces), 18 of 20 introduced larvae attached. Of these, 11 eventually pupated. One female emerged on June 2 and one male on June 4 from two pupae which were first observed on June 1. By June 17, there were 9 additional pupae, but none produced adults and all had died by June 22. Of the 7 larvae

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[3] Styrofoam is a brand name for the expanded polystyrene plastic produced by Dow Chemical Company.

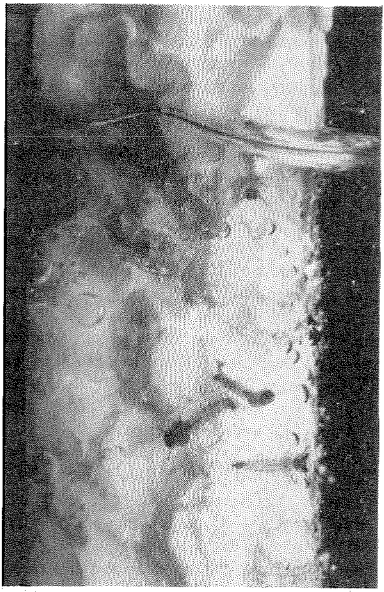

Figure 1. 4th instar larvae of *Coquillettidia perturbans* attached to styrofoam submerged in beaker.

which failed to pupate, all were still alive on June 11 (21 days), 2 survived until June 25 (35 days) and the last specimen died on June 29, after 39 days of attachment. At this point, observations were terminated.

Note: These observations were opportunistic and made with little deliberate care and under less than ideal experimental conditions. However, because of the relative success in attachment, survival and development of the specimens in Beaker B when compared to Beaker A, it seems possible that differences between shape, form and position of the styrofoam might have been significant.

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LEG FRACTURE IN ADULT MOSQUITOES INDUCED BY BIORESMETHRIN[1]

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The efficacy of mosquito adulticides is usually evaluated on the basis of their acute toxicity. However, toxicants may cause ancillary effects which, though non-lethal, may be detrimental to the target species. Recently this vividly came to our attention, when topical application of bioresmethrin (*trans*-resmethrin) to adult mosquitoes caused the complete fracture of one or more legs. Conceivably individuals with multiple leg fracture may be unsuccessful in flight, host seeking, and oviposition, especially those with one or no leg at all. The purpose of this communication is to describe this phenomenon and alert others to its possible significance.

Leg fracture occurs at the trochanterofemoral joint, which is similar to a ball and socket type (Christophers 1960). It has been observed in both sexes of the following species: *Aedes aegypti* (Linnaeus), *Ae. triseriatus* (Say), *Ae. sollicitans* (Walker), *Ae. canadensis* (Theobald), *Anopheles quadrimaculatus* Say, *Culex pipiens* Linnaeus, *Cx. salinarius* Coquillett and *Culiseta melanura* (Coquillett). Fracture occurs as early as 2 min posttreatment; it appears to be a consequence of strained leg flexion, because treated mosquitoes without leg-substrate contact also lose their legs.

In these current studies topical application

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