rangements for sanitation, water management, and source reduction while planning any industrial establishment and township. Judicious use of insecticides is essential. Perfect maintenance of scout service to discover mosquito breeding, and filaria patients is of utmost importance. And above all, nature's role in controlling the vector population-density, transmission of the disease, parasite activities and other related problems have to be studied in depth.

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THE EASTERN MUD MINNOW, *UMBRA PYGMAEA* (DEKAY): A POTENTIAL CONTROL AGENT OF WOODLAND POOL *AEDES* SPP.

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Mosquito control agencies in the Northeast concentrate much of their efforts on the control of woodland pool *Aedes* spp. However, few attempts at the biological control of these species have been recorded.

The eastern mud minnow, *Umbra pygmaea* (DeKay), was selected as a potential control agent for the following reasons: (1) It inhabits sluggish woodland streams and ditches (Eddy 1957). (2) It feeds on crustacea and insect larvae (Hubbs and Sagler 1958). (3) The mud minnow is most active from early spring to early summer, the time of peak abundance of woodland pool *Aedes* larvae. (4) It has been taken from semi-permanent water conditions, a characteristic of most woodland pools (Westman 1941).

A related species, *U. limi* (Kirtland), consumed between 60 and 100 mosquito larvae per fish per day in the laboratory (Maw 1968). The author recorded similar results with *U. pygmaea* in the laboratory when late instar mosquito larvae were offered as the sole source of food.

Two woodland pools containing 1st to 3rd instars of *Ae. canadensis* were stocked at the rate of 1 minnow per m^2 of surface water. One pool supported large numbers of a variety of macro-invertebrates including isopods, amphipods, ostracods, copepods, and coleopterous and other dipterous larvae. Minnows in this pool were seined 1 and 2 weeks after stocking, and their gut contents were examined. Larval air tubes served as good indicators of the presence of larvae in the gut. The number of air tubes per minnow varied from 3 to 11 ($\bar{x} = 6.5$). When mosquito larvae were recovered reasonably whole, they consisted from 10 to 30 percent of the gut contents. By comparing the size of air tubes found in the gut with those of known instar larvae, it was determined that 90% of the larvae consumed were 3rd and 4th instars.

In the 2nd stocked pool, mosquito larvae and copepods were the only invertebrates observed. Emergence first occurred 9 weeks after the date of stocking. In a nearby control pool populated with larvae of the same age, emergence first occured after 5 weeks. The stocked pool dried up completely only 3 days after the first signs of emergence and it may have been that mosquitoes were able to reach the adult stage only because water in the pool was so shallow that predation was impeded.

The eastern mud minnow was reported to have survived despite the complete freezing of its habitat water (Westman 1941). Two woodland pools were stocked in the autumn with the hope that the minnows would survive and prey on the larvae as soon as the mosquito eggs hatched the following spring. The water in both pools froze completely but there was no indication that any mud minnows survived the winter.

Although *U. pygmaea* does not seem to have as voracious an appetite for mosquito larvae as certain other fish, such as *Gambusia,* the time woodland pool *Aedes* spp. spend in the immature stages (usually 4 to 10 weeks in New Jersey) may be long enough to permit effective predation.

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AN OPERATIONAL COMPARISON OF TWO GRANULE APPLICATORS

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The Seymour bucket seeder (Model 75-105 universal spreader) has become increasingly popular in re-