

Table 2. Comparison of communities as a seasonal total of all mosquitoes captured.

Communities	Number	% Yearly Total
Greenfield	2257	13.63
Moreau	3741	22.59
Wilton	2295	13.86
Saratoga Springs	2433	14.69
Milton	1272	7.68
Saratoga Town	947	5.72
Malta	1395	8.43
Ballston Spa	1529	9.23
Clifton Park	668	4.16

5343 and 6263 mosquitoes respectively. These collections represented 32.27% (May) and 37.83% (June) of the 1979 populations.

*Aedes communis* (DeGeer) the predominant species in the May population (61.26%, Table 1), was also the greatest contributor to the 1979 total mosquito population (30.83%) and was recovered largely from the Greenfield and Wilton areas (Table 2). However, later in the month of June (Table 1), *Ae. communis* was replaced by *Ae. stimulans* (Walker) as the major contributor to the total mosquito population (31.95%) and remained so through the first 2 weeks of August. Most of the latter specimens were collected from the Moreau area (Table 2). By the end of August, trap collections were yielding primarily *Ae. vexans* (Meigen) specimens (59.81%, Table 1), the majority obtained from the Ballston Spa, Saratoga Springs areas (Table 2).

These observations clearly indicate the seasonal distribution of adult mosquito species by municipality in Saratoga County. Although, there is no way of determining the actual numbers of individual species in a given area, an attempt was made to systematically determine the mosquito population in 1979.

It is apparent that the data provided by this survey will be useful as a long range index of the mosquito population fluctuations in Saratoga County. However, several seasons using the above approach will be necessary before generalizations and predictions pertaining to the pattern development of native mosquito populations and subsequent control efforts can be clearly stated.

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#### OBSERVATIONS ON THE DEVELOPMENT OF THE NEMATODE PARASITE *ROMANOMERMIS CULICIVORAX* IN PUPAL AND ADULT *CULEX PIPIENS MOLESTUS* MOSQUITOES

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*Romanomerms culicivoxax* Ross and Smith parasitizes mosquito larvae, killing the host on emergence. Cultures are maintained by exposing early-instar mosquito larvae to preparasities (Petersen and Willis 1972). Parasitism of 4th-instar larvae is also known, more especially in the younger ones, but pupae and willis rarely exhibit this worm (Petersen and Willis 1970). Observations on the fate of *R. culicivoxax* persisting beyond the 4th instar, are now reported.

#### MATERIALS AND METHODS

Cultures of *R. culicivoxax* used in this study were initially supplied by Dr. J. J. Petersen, Gulf Coast Mosquito Research Laboratory, Science and Education Administration, USDA, Lake Charles, Louisiana, USA, and are maintained in our laboratory. *Culex pipiens molestus* Forskål (autogenous) from a colony maintained in our laboratory served as the host. All the experiments were carried out at 25°C.

EXPERIMENT 1. Fourth instar mosquito larvae were placed in 3 ml of water in a 2 cm diameter plastic cell 1 cm deep, containing 10

preparasites. In the 1st series, larvae 3 days beyond the 3rd molt served as the host; in the 2nd series the larvae were 4 days beyond this molt. Both series were replicated 12 times. The adults which developed from these larvae were kept in a cage 30×30×30 cm, and were provided with 2% sugar solution. All mosquitoes that died were dissected under the microscope and examined for parasitism.

**EXPERIMENT 2.** Fifty 4th-instars 4 days old and 250 preparasites were exposed in a 9 cm diameter vessel containing 100 ml water, at day 0. Pupae found on day 1 were removed and placed in distilled water; these constituted the 24-hr exposure group. Pupae found on day 2 (exposed for more than 24 hr but less than 48 hr) were also separated; these constituted the 48-hr exposure group. The remainder of the larvae were discarded. Adult mosquitoes emerging from each group were released in separate cages with sugar solution for 24 hr, following which the individual mosquitoes were isolated in test tubes with 3 ml of water and sugar solution. The mosquitoes were observed daily, death and emergence of postparasites being recorded. On day 17 all surviving mosquitoes were dissected and examined for parasitism.

**EXPERIMENT 3.** Ten 4-day-old 4th instars and 100 2nd-instar (the latter being the stage usually adopted for *R. culicivora* colony maintenance) were exposed to 500 preparasites in 100 ml water. Adults emerging from the 4th instars were separated in the same way as in Experiment 2. The 100 2nd instars were reared to the 4th instar, and the infection rate determined.

Both experiments 2 and 3 were repeated twice. Also, all the postparasitic nematodes recovered from adult mosquitoes were sexed, then placed in a petri dish with 3 ml water. Later, as eggs began to be deposited in the dish, all the female nematodes were individu-

ally transferred to 1 ml of water in a watch-glass. The number of eggs laid in 24 hr was counted, and it was noted whether or not the eggs hatched.

## RESULTS AND DISCUSSION

**EXPERIMENT 1.** In the first series, parasitism of pupal and adult stages was not found. In contrast, 9 larvae 4-day post molt (2nd series) pupated on day 1 with the result that 3 male and 6 female mosquitoes emerged. One female among them was dissected on the 3rd day after emergence, and 2 nematodes were present in the abdominal cavity. The sex of the nematodes was undetermined. One female and one male mosquito died, and were found on the cage floor on the 5th day. Nematodes were visible coming from the abdomen of these mosquitoes (Fig. 1). The nematodes were examined and found to be female postparasites. Another female nematode escaped from one female mosquito on the 6th day. The remain-

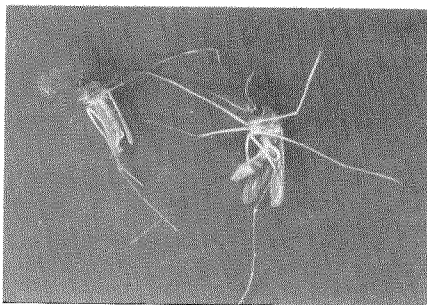


Fig. 1. Male and female mosquitoes showing postparasitic nematodes emerging.

Table 1. Results of experimental exposures of late fourth-instar *Cx. pipiens molestus* larvae to preparasitic *R. culicivora*.

	Replicate	Exposure period (hrs)	No. pupated	No. of mosquitoes				No. parasites recovered		
				Emergед		Parasitized		Sex		
				♀	♂	♀	♂	♀	♂	unknown
Exp. 2.	1.	24	23	18	3	3	1	2	0	2
		24-48	19	17	1	2	0	2	0	0
	2.	24	24	20	4	5	1	2	2	2
		24-48	20	12	5	3	0	2	2	0
Exp. 3.	1.	24	10	10	0	7	-	4	4	6
	2.	24	9	8	0	4	-	2	2	2

ing 3 mosquito larvae were parasitized with a total of 3 female and 1 male nematodes and so failed to pupate.

**EXPERIMENT 2.** A total of 80 adult mosquitoes developed successfully from 100 larvae exposed (Table 1). Slightly higher parasitism was observed in the 24 hr-exposure group (22.2%) than in the 48 hr-exposure group (14.2%). Sixteen nematodes were recovered from 13 female and 2 male mosquitoes which were parasitized. These comprised 8 female, 4 male and 4 unclassified nematodes. All the parasites emerged 6-9 days after metamorphosis of the mosquitoes on days 9-13. There appeared to be no particular relation between the sexes of the host and parasite, i.e., nematodes of both sexes occurred in both male and female mosquitoes. Only one out of 13 parasitized female mosquitoes developed gravid ovaries like unparasitized females. Yolk deposition was not visible in the ovaries of the other 12 female mosquitoes.

**EXPERIMENT 3.** A total of 18 female mosquitoes but no males developed successfully from 20 fourth-instar larvae exposed to preparasites (Table 1). Three nematodes escaped naturally from 2 mosquitoes, and 5 nematodes of undetermined sex were removed from 2 mosquitoes which had died by day 8 (i.e. 5 days after emergence). Later, on days 9 to 12, 6 female and 6 male postparasitic nematodes escaped into the water from 7 adult mosquitoes. Thus, 61% of 18 adult mosquitoes were parasitized. Ovarian development was suppressed in all the parasitized females. In the 2nd-instar larvae, exposed together in the same container, 95% became parasitized, and the nematodes emerged before pupation.

All of the nematodes recovered from adult mosquitoes in experiment 2 and 3 were pooled in distilled water. On day 15, molting of some nematodes was observed, and the 1st eggs were found on day 22. Female nematodes were then placed individually in watch glasses with water, and oviposition was noted from five out of 14 females. The number of eggs laid per day by the 5 worms was recorded for 3 days. The range was 38-128 eggs per day and the mean number was 87.7 (S.D. 27.7). The eggs were left in water and the 1st parasitic larvae hatched 10 and 11 days after oviposition. The number of infective stage nematodes hatched was 120 out of 373 eggs during the observed period of 5 days. These 120 nematodes were placed in 60 ml water containing 30 second-instar mosquito larvae and later 31 female and 33 male postparasitics were recovered.

These observations suggest that preparasitic

*R. culicivora* can infect fully grown mosquito larvae in water. Development of the mosquito larvae to the pupal and adult stages occurs only when the nematodes invade 4th-instar larvae 4 days after molting. Thus, dispersal of the nematodes to other breeding sites may occur via parasitized adult mosquitoes. Worms dispersed to new sites may then copulate and reproduce. It would be interesting to learn whether parasitism of adult mosquitoes does occur in wild populations.

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#### OPEN MARSH WATER MANAGEMENT IN CONTROL OF *Aedes sollicitans* IN BARRINGTON, R.I.

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The salt marsh mosquito, *Aedes sollicitans* is an important pest in a community surrounded by salt marsh. The females are persistent biters throughout the day (Carpenter & LaCasse 1974). Barrington, R.I. has approximately 454 acres of salt marsh in a total acreage of 5,210, hence *Ae. sollicitans* is an important species to control.

In 1975, a control project was started to deal with this species. Residents felt that adulticiding alone was inefficient and undesirable. The Barrington Mosquito Control Project was formed to identify breeding areas, larvicide, and to institute a program of Open Marsh Water Management (OMWM) (Ferrigno 1975).

The first major problem was that of receiv-