having been given ample opportunity to escape after engorging a bloodmeal. No blood-engorged mosquitoes were recovered in the unbaited trap. So it would appear that the presence of a suitable host is the only attractant and that mosquitoes enter these traps to seek a host and not shelter.

The other advantage of the present trap apart from shelter from the rain, is that the overall design is based on observations (Snow 1979) that a large proportion of unfed female mosquitoes, including members of the *An. gambiae* Giles complex, can be caught by suction traps below a height of 1 m from the ground. For this reason, the net is slightly raised above ground level so that unfed mosquitoes are not restricted entry into the net to feed. We have found that after engorgement, mosquitoes are guided upwards by the apical shape of the net. Immediately after a blood meal, the engorged mosquitoes are sluggish and rest on the trap walls. They can then be aspirated at periodic intervals during the night. We have not determined the duration of mosquito-retention after successful engorgement but we assume some loss in the total catch. This would be more so if the gap between the bottom seams of the trap and the ground level is very wide. The location of the trap(s), especially in relation to mosquito breeding sites, should take into account that the adult mosquitoes (both parous and nulliparous) fly upwind in the absence of visual cues in search of blood (Gillett 1979).

We have been using the above trap in our routine surveys for malaria vectors, in particular those of the *An. gambiae* complex, and have found it very productive in terms of relating seasonal densities of mosquitoes to malaria incidence (Mpofu 1985). *Anopheles gambiae* s.s. Giles and *An. arabiensis* Patton, the most important vectors of malaria in most of Africa including Zimbabwe, were captured from man baited traps of the type described here. Over a 3-month period, longitudinal captures yielded a total of 147 specimens (*An. gambiae* 7.5%; *An. arabiensis* 48.9% and *An. quadriannulatus* 43.6%) and this period coincided with peak malaria transmission. The trap was most useful in the sense that no mosquito biting activity was demonstrated in nearby inhabited huts, nor were indoor resting mosquitoes recovered by aerial spray knockdowns in huts. Despite the absence of indoor biting activity, malaria cases were still being reported. This observation could indicate an exophagic malaria vector population in the study area which would account for malaria transmission through outdoor man-biting but which can only be sampled effectively by the trap described above.

In the same study, the trap showed its potential usefulness in assessing host preferences within a group of sibling species. Over a 12-month period, a sheep baited trap consistently yielded the zoophilic sibling species *An. quadriannulatus* indicating that such traps, suitably baited, could be used to sample exclusively for one species. This is already being done in a study which is attempting to colonize *An. quadriannulatus* by capturing large batches using an ox-bait. We have consistently collected over a 95% proportion of this species to the near total exclusion of its siblings which would otherwise interfere with our mass-breeding program.

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NOTES ON DEER FLIES AND HORSE FLIES (DIPTERA: TABANIDAE) FROM SOUTHERN VERMONT

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Deer flies and horse flies in the family Tabanidae are pests of man and livestock in Vermont. This paper provides a list of 29 species of Tabanidae collected with insect nets near Laurel Lake, Jacksonville, Windham County, Vermont since 1965. Most specimens were netted as they attempted to bite people, but some were collected from flowers as described in a previous paper (Pratt and Pratt 1972). This part of Windham County lies at an elevation of 500 to 600 meters in what Johnson (1925) describes as the "The Lower 'Green Mountains' area." Jacksonville is near the southern border

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of the Canadian life zone on his map of New England (Text-Fig. 1). Typical vegetation includes balsam fir (*Abies balsamea* (Linnaeus)), red spruce (*Picea rubens* Sargent) and clintonia (*Clintonia borealis* (Aiton)).

Many of the species we collected are included in Johnson's (1925) list, but there have been changes in the nomenclature of a number of species as reported by Pechuman (1981). We have added the rare *Goniops chrysocoma* (Osten Sacken) to the fauna of New England. Further, none of the following were reported from Vermont in the lists of either Johnson (1925) or Knutson et al. (1954): *Chrysops ater* (Macquart), *C. calvus* Pechuman and Teskey, *C. macquarti* Philip, *C. univittatus* Macquart, *Hybomitra nitidifrons nuda* (McDunnough), and *H. pechumani* Teskey and Thomas.

The principal man-biting species are deer flies in the genus *Chrysops*. They occur from late May until the middle of September. Our collecting shows a similar distribution noted for tabanids in New York by Pechuman (1981), in the Mount Desert Region of Maine by Procter (1938), and for Vermont and other parts of New England by Johnson (1925) and Knutson et al. (1954). There is a seasonal succession of *Chrysops* species which falls roughly into two groups. The first group is most active from late May until mid-July and includes *C. indus* Osten Sacken, and species with clear wing tips and largely black bodies: *C. carbonarius* Walker, *C. cuclux* Whitney, *C. excitans* Walker, *C. niger* Macquart, and *C. cincticornis* Walker. The first four are most abundant in June, while the last two usually bite most frequently from mid-June to mid-July. A second group of deer flies with dark wing tips and bodies variously marked with yellow and black is most annoying in July and August and includes *C. geminatus* Wiedemann, *C. lateralis* Wiedemann, *C. macquarti* Philip, *C. univittatus* Macquart, and *C. vittatus* Wiedemann.

Species of horse flies in the genera *Tabanus* and *Hybomitra* also are found in Vermont but bite livestock more frequently than man.

Another group of tabanids is found chiefly on flowers, particularly meadowsweet (*Spirea latifolia* Aiton). This group includes *Goniops chrysocoma* (Osten Sacken), *Stonemyia rasa* (Loew), *S. tranquilla* (Osten Sacken), and *Hybomita sodalis* (Williston) (Pratt and Pratt 1972).

The following list of 29 species of Tabanidae from southern Vermont includes specimens collected within a mile or two of Laurel Lake, Jacksonville, Windham County, and specific data for additional specimens from other locations nearby. The arrangement follows that of Pechuman (1981).

Stonemyia rasa (Loew)—July 10 to August 10, on flowers of foxglove (*Digitalis*) and meadowsweet; 1 female, Jamaica.

Stonemyia tranquilla (Osten Sacken)—July 14 to August 10, on meadowsweet flowers; also Jamaica, Readsboro, and Searsburg, Windham Co.

Goniops chrysocoma (Osten Sacken)—1 male, 6 km north of Jamaica, on State Route 100, July 28, 1972, on flowers of meadowsweet.

Chrysops ater Macquart—May 30 to June 29.

Chrysops calvus Pechuman and Teskey—June 14–28.

Chrysops carbonarius Walker—June 4 to July 4, often a serious pest.

Chrysops cincticornis Walker—June 15 to July 15, usually a serious pest in early July.

Chrysops cuclux Whitney—June 5–11.

Chrysops excitans Walker—June 4 to September 1, often a serious pest in June.

Chrysops frigidus Osten Sacken—July 5–28.

Chrysops geminatus Wiedemann—July 4 to August 3; also West Halifax.

Chrysops indus Osten Sacken—May 28 to July 24, a serious pest in June and early July.

Chrysops lateralis Wiedemann—July 3–30; also Readsboro, Searsburg, and West Halifax, a serious pest in July.

Chrysops macquarti Philip—July 2–30; also Heartwellville.

Chrysops mitis Osten Sacken—May 31 to June 17.

Chrysops montanus Osten Sacken—July 19—23.

Chrysops niger Macquart—June 28 to July 28, a serious pest in early July.

Chrysops sackeni Hine—July 8–23.

Chrysops shermani Hine—June 17 to August 10; also Jamaica and West Halifax.

Chrysops univittatus Macquart—July 15 to September 4, a serious pest in August.

Chrysops vittatus Wiedemann—July 16 to September 12, a serious pest in July and August.

Hybomitra cincta (Fabricius)—July 23–28, 2 males on meadowstreet flowers.

Hybomitra epistates (Osten Sacken)—June 28 to July 12, on meadowsweet flowers.

Hybomitra illota (Osten Sacken)—June 17 to July 8.

Hybomitra lasiophthalma (Macquart)—June 28 to July 1; 1 female, Weston, July 29.

Hybomita nitidifrons nuda (McDunnough)—June 4–12.

Hybomitra pechumani Teskey and Thomas—July 9, 1 female on meadowsweet flowers.

Hybomita sodalis (Williston)—June 22 to August 3, on meadowsweet flowers.

Tabanus marginalis Fabricius—July 15–22.

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or checked our identifications of, at least one specimen of each species included in this list.

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OBSERVATIONS ON THE EFFECT OF CYROMAZINE ON INHIBITION OF LARVAL MOSQUITO DEVELOPMENT IN DILUTED WASTEWATER

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Cyromazine belongs to the group of compounds known as insect growth regulators (IGRs). These compounds affect only dipterous insects such as flies and mosquitoes and prevents the emergence of the adults by inhibiting the development of the larvae and the transformation of pupae to adults. High susceptibility is particularly noted in the first larval instar and to a lesser extent in the other instars. In addition to their low mammalian toxicity, these compounds are innocuous to aquatic insects, Hymenoptera, Coleoptera and other natural enemies of flies and mosquitoes.

During 1983–84, laboratory observations and field experiments were conducted to determine the effect of cyromazine on larvae of house flies and mosquitoes. The results were compiled and analyzed by Avi Lev (unpublished data, 1985). Trials were also conducted on leafminers on flowers grown for export.[2] This compound was found to be useful and of long residual activity when spread or sprayed on chicken droppings or manure piles. It prevented the development of house fly maggots and adult eclosion over a long period of time.

In field trials cyromazine was found to inhibit development of mosquito larvae and emergence of adults in wastewater canals and oxidation ponds for a period of 5–8 weeks (depending on the rate of water cycling). The compound was effective for more than two months in simulated tests using 200 liter drums.[3] Due to the encouraging results obtained in the above mentioned trials, experiments were conducted under more difficult and problematic situations, in a drainage ditch polluted by wastewater.

Observations were made in a stagnant water drainage ditch polluted by wastewater in Kfar Masaryk, situated in the north of Israel. The ditch was surrounded by heavy growth of several types of weeds and brush which provided a habitat for a high density of *Culex pipiens* Linnaeus. The volume of water in the ditch was approximately 100 m^3 wastewater after primary treatment. Physical properties of the wastewater were: C1–900 mg/liter, NO_2–O mg/liter, C.O.D.—260 mg/liter, B.O.D.—120 mg/liter and pH 7.5. During March, water temperature was 13–19°C in the ditch and 14–21°C during April 1985. Rainfall was 2 mm in March and 65 mm in April 1985. In the laboratory, the water temperature was 15–21°C during March and 17–23°C during April 1985.

The water was treated with 2% granular cyromazine at a rate of 25 gm granules per 1 m^3 water (0.5 gr AI/m^3) as recommended by the manufacturer, Ciba Geigy, Basel, Switzerland. Larval counts were made before and after treatment by the dip method, taking 5 dips per trial and averaging the counts. The larvae were segregated according to instars and transferred to the laboratory in the same wastewater. They were held in 1,500 ml glass jars for further observation on larval development, pupation and adult emergence. Observations were made for 44 days after treatment or until sufficient number of adults emerged from the pupae. During the period of observation there was a great potential for egg laying and for the development of large numbers of *Culex pipiens* (Table 1). The results show that the use of cyromazine in the given concentration prevented larval development, pupation and adult emergence for approximately 40 days. It is also evident that the 10-day period of

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