EFFICACY OF THE ASSATEAGUE INSECT TRAP IN COLLECTING MOSQUITOES[1] AND BITING FLIES[1] IN A MARYLAND SALT MARSH[2],

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ABSTRACT. Many more male than female *Tabanus lineola* F. and many more female than male Culicidae were captured in newly designed UV-lighted insect traps. Generally, the traps were most effective from dusk to dawn, but the majority of the male tabanids and the female mosquitoes were captured between midnight and dawn. Captures of large numbers of male tabanids with UV-lighted traps have not been previously reported.

Frost (1953) listed several species of Tabanidae attracted to electric lamps and agreed with Haddow *et al.* (1950) that many tabanids are nocturnal in habit. Also, several species of Tabanidae attracted to UV lamps were listed by Anthony (1960). More recently, lamps emitting ultraviolet (UV) radiation have shown potential in studies of the seasonal fluctuations of fly populations (Pickens et al. 1972).

Therefore, in 1970, we made a preliminary survey of the biting flies on Assateague Island, Maryland, with UV-lighted traps. These traps were designed for trapping moths. The attractant was a 15-watt blacklight fluorescent lamp positioned vertically at the intersection of four 8.5 × 19.5-inch galvanized baffles secured above an 18-inch diameter cone. Insects attracted to the lamp collided with a baffle and fell through the funnel into a can containing a wick of dichlorvos. Unfortunately, many of the characteristic species of small flies were obliterated or demolished by the beating wings of captured large Lepidoptera. Nevertheless, we did observe vast differences in the sex ratios of the Tabanidae and Culicidae collected by the survey traps. Male tabanids outnumbered female tabanids 10:1, and female mosquitoes outnumbered male mosquitoes 8:1.

Therefore, a special UV-lighted trap for capturing Diptera was designed and used in subsequent surveys conducted in 1971 to study the seasonal distribution and variation in numbers of flies captured at 3 sites on Assateague Island with vastly different vegetation. In 1972, a second similar study was conducted to determine the hours when most tabanids and mosquitoes were captured in these traps.

DESIGN OF THE TRAP. The trap was designed to collect small insects intact and to exclude large insects (Fig. 1). It was, therefore, a 30-cm cube. After some experimentation, the four sides of the cube were made of aluminum screen, the top and bottom were solid wood, and 2-cm² wood braces joined the top and bottom at the corners. (The prototype trap had opaque-plastic-coated fiberglass screen that insectivorous birds and predaceous beetles easily destroyed while attempting to feed on captured insects.) Each side had an insect entrance cone that was made of aluminum screen and had an inner opening of about one cm that pointed at a 6-watt blacklight blue (BLB) fluorescent lamp positioned vertically in the center of the cube. The inner cone opening was thus 10 cm from the lamp. The other electrical components were attached outside to the trap bottom. Access to the trap for servicing and removal of insects was provided by opening one side of the cube as follows: the side had one edge permanently anchored along a corner brace; the other 3 edges were held tightly closed via strips of Velcro® hook and fastener

[1] Diptera: Culicidae and Tabanidae, respectively.

[2] Mention of a pesticide or a proprietary product in this paper does not constitute a recommendation or an endorsement of this product by the USDA.

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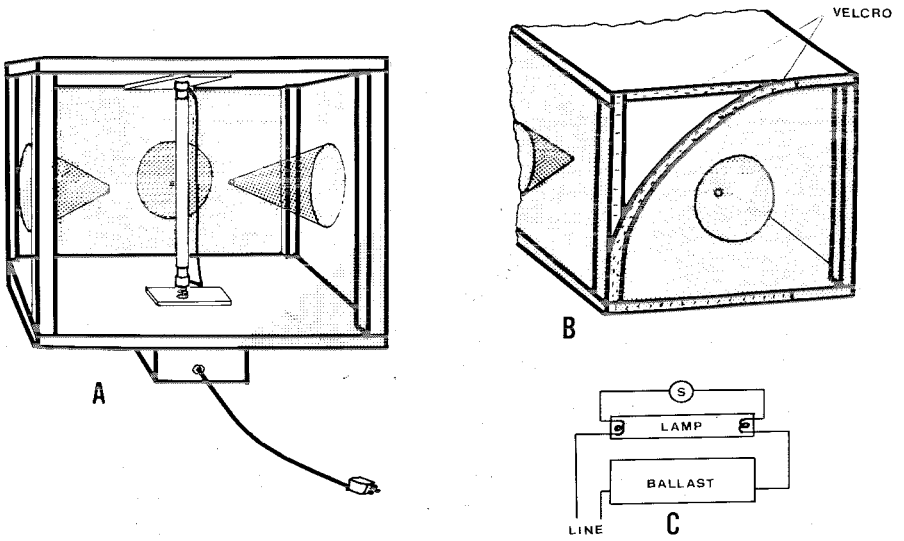

FIGURE 1. The Assateague insect trap: A. shows 3 of the 4 entrance cone locations, the position of the 6-watt BLB lamp, and the electrical components; B. shows one side of trap partially opened and the edge with strips of clothing fastener; C. is a diagram of the electrical circuit.

material that were stapled to the frame. We could thus service the trap without dismantling it, and we did not have to reduce the screened area of a side by adding a wooden door frame.

Traps were positioned in the field with the bottom 37.5 cm above the ground, so the entire trap was usually above the marsh grass.

TEST 1: Test 1 was a survey of biting flies conducted from April 1 to Sept. 30, 1971. Twenty-four traps (3 groups of 8) were used. Group 1 was placed in the salt marsh with the traps 15 meters apart along a north-south line. Frequently, at high tide, this marsh was flooded with 2-4 cm of water, and the drainage ditches crossing the marsh were always more than half full of water. Bayberry and other shrubs 1-4 meters tall grew in scattered clusters, but such growth was seldom closer than 5 meters to any trap. Group 2 was placed along a north-south line in a sodded yard behind the park headquarters. There the grass was kept short by frequent mowing and the nearest bushes were 5 meters away from the traps. Group 3 was arranged as clusters of four traps each on a sand dune. These clusters were arranged in a square 3.5 meters to a side on dunes and were 45 meters apart. All trap lamps were on 24 hours a day. Traps were serviced weekly at which time the insects were removed for identification, tally, and recording.

TEST 2: Test 2 was made to determine the hours when most Tabanidae and Culicidae were trapped, thus clusters of traps were used with different on-off schedules. Three sites with similar terrain were selected in the salt marsh. The sites were 700-800 m apart along a north-south line. Two clusters of five traps each were so placed at each site that they were 10-15 m apart and screened from each other by dense vegetation. An electric cam-type sequential timer at each site was used to control the on-off sequence for the

lamps. Only one lamp in each cluster was on at any one moment. However, the timer had a zero-time lag when the circuit was switched so two lamps at each site (one in each cluster) were always on.

Trap positions within each cluster remained unchanged during the test, June 8-August 24, 1972. However, each week the circuits were unplugged and randomly replugged into the sequential timer so a different lamp in each cluster was plugged into each time position. At the same time, the traps were serviced, and trapped insects were collected for later identification and tallying at Beltsville, Md.

RESULTS AND DISCUSSION: The five hour-on intervals during a day varied between sites: at site 1, they were 0800-2400, 2400-0200, 0200-0400, 0400-0600, 0600-0800; at site 2, they were 0700-2300, 2300-0100, 0100-0300, 0300-0500, and 0500-0700; and at site 3, they were 0900-2200, 2200-2400, 2400-0300, 0300-0600, and 0600-0900. Since these intervals overlapped between sites, we could pool the season's data to produce an interpolated number of trapped insects per hour. For example: at site 1, from 2400 to 0200 hours, 26 male tabanids were trapped (13/hr); at site 2, 102 male tabanids (51/hr) were trapped from from 2300 to 0100 hours, and at site 3, 100 male tabanids (33/hr) were trapped from 2400 to 0300 hours. Therefore, 110 male tanabids were trapped from 2400 to 0100 hours during the 77-day season.

A total of ten species of biting Diptera representing three families were collected during the first test (July 1- Sept. 30, 1971). The insects were sorted as to species and sex. Tabanidae were represented by *Tabanus lineola* (F.) (4622 males, 360 females), *T. nigrovittatus* Macquart (16 males, 120 females), *T. quinquevittatus* Wiedemann (2 males) and *Chrysops atlanticus* Pechuman (30 males, 111 females). Culicidae were represented by *Aedes cantator* (Coquillett) (2 males, 27 females), *A. sollicitans* (Walker) (367 males, 6090 females), *A. taeniorhynchus* (Wiedemann) (12 males, 2007 females), *A. vexans* (Meigen) (45 males, 104 females), and *Culex salinarius* Coquillett (16 males, 13 females). Only one species of biting Muscidae was trapped, *Stomoxys calcitrans* (L.) (2

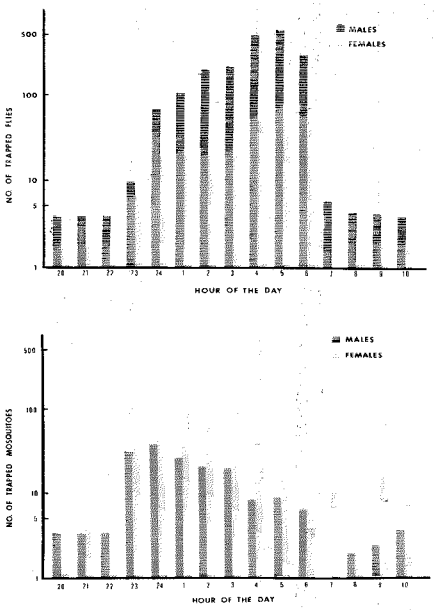

FIGURE 2. Bar graphs show the hourly variations in captures of male and female tabanids and mosquitoes during the 77-day study period in 1972 at Assateague State Park, Maryland. Assateague insect traps with 6-watt BLB lamps were used exclusively.

males, 18 females). Of the seasonal total of each species trapped, 85% of the *T. lineola* and >80% of the *C. atlanticus* were taken before mid-August. The second half of the season's trapping produced >50% of the *T. nigrovittatus,* >70% of the *A. sollicitans,* and practically all the *A. taeniorhynchus.*

The trap was therefore effective in collecting Diptera as large or larger than mosquitoes attracted to UV radiation. Few specimens were damaged beyond recognition, even after as long as 7 days in a trap. The occasional spiders that entered the trap did not destroy the diagnostic characters of the insects. The major insect damage to the trapped specimens was caused by ants that reached the traps via the electric cords or support posts. As a precaution against such depredation, the cords and posts were coated with sticky Tanglefoot®.

The hourly captures of Tabanidae and mosquitoes in test 2 are summarized as bar graphs in Figure 2. However, several other biting and non-biting families were represented in the collections. The Tabanidae collected included 1881 male and 158 female *T. lineola,* 5 male and 47 female *T. nigrovittatus,* 3 female *T. quinquevittatus,* and 19 male and 58 female *C. atlanticus.* The mosquitoes collected included 78 male and 674 female *Aedes sollicitans,* 3 male and 131 female *A. taeniorhynchus,* 3 male and 103 female *A. cantator,* 87 male and 4 female *A. vexans,* 3 female *Anopheles crucians bradleyi* King, and 9 male and 4 female *Culex* spp. As expected, most captures occurred from dusk to dawn (ca. 2000-0600), the period when the UV lamp is more noticeable. However, an appreciable increase in fly attraction to the UV, especially by males, began 2400 and extended to just before dawn. The total number of biting flies and mosquitoes trapped during the daylight hours (0600-2000) for the 77-day season was 54 male and 22 female biting flies and 49 male and 235 female mosquitoes.

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FIELD EVALUATION OF REPELLENTS AGAINST MOSQUITOES IN ISRAEL

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ABSTRACT. A number of repellents which were found effective in the laboratory against *Culex pipiens molestus* were tested on humans under natural field conditions against *Culex* mosquitoes (mostly *C. pipiens molestus*) in Israel. Six repellents: 2-ethoxy-N, N-diethylbenzamide (20297), o-chloro-N, N-diethylbenzamide (17586), l-acetoxy tetrahydrofurfuryl cyclopentanecarboxylate (6496), N,N-diethylbenzene sulfonamide (14913-Gb), N,N-o-triethylbenzamide (20690) and N,N-diethyl-*m*-chlorobenzamide (20701) were similar to deet. Two repellents (4, 5, 6, 7 (or 7a) tetrahydrospiro [cyclohexane-1,3'-indan] -1'-one (12166-B) and N-hexylbutyramide (15130-b) were superior to deet, but not significantly, in one set of field experiments, and significantly superior in another set of field experiments.

Evaluation of promising repellents against various mosquito species under field conditions has been conducted in various parts of the world, (Altman and Smith 1955, Gilbert and Gouck 1955, Gilbert 1957, Gerberg 1966, Gilbert *et al.* 1970). Repellents which were found effective against one mosquito species were not necessarily effective against other species (Gilbert *et al.* 1957, Bar-Zeev and Ben-Tamar 1971). It is, therefore, necessary to evaluate repellents on each species against which it is intended to be used.

The mosquito *Culex pipiens molestus* Forsk. is the most common domestic species in Israel. It is a fierce biter and is active at sunset and at night throughout the spring and sum-