DETECTING FINE-SCALE TEMPORAL DISTRIBUTIONS OF BITING FLIES: A NEW TRAP DESIGN

DAVID W. TRUEMAN AND SUSAN B. McIVER
Department of Zoology, University of Toronto, Toronto, Ontario, Canada M5S 1A1

ABSTRACT. As part of a study on temporal distributions of biting flies, a trap was designed that attempts to maximize both number of individuals and number of species caught. It incorporates multi-directional ramps, radiating baffles and CO_2 attraction. A turntable fitted with 30 sample bags is used to segregate catches into 30 minute intervals. A single field season has proven the trap effective both in maximizing catches and in reliability.

INTRODUCTION

Our ongoing study aims to document the fine-scale temporal distributions of the many species of biting flies found in a mixed temperate forest in Algonquin Park, Ontario, Canada. To achieve this goal it was necessary to design a trap which would segregate catches into small time intervals while obtaining sufficient numbers of most species for statistical analysis. Furthermore, since identification of many mosquito species is dependent on the patterns of easily removed scales, it was a necessary condition that the trap cause minimal damage to the specimens.

Owing to their medical and economic importance many sampling methods have been devised for biting flies as evidenced by a large volume by Service (1976). Our aim was to incorporate many of the successful features of past designs into a trap suited to our requirements. The design which resulted from this synthesis is an essential part of our study and has proven reliable in over 4,000 hours of field use.

DESCRIPTION OF THE TRAP

Externally (Figure 1), the trap is seen as a pyramid with radiating baffles. The pyramid itself is 4 ft. high and 8 ft. wide at

Fig. 1. Photograph of a trap in operation. Note the ramps and radiating baffles.

the base. It consists of a wooden frame covered with heavy black plastic. The baffles extend out 8 ft. from the base of the pyramid and consist of burlap fabric held in place by wooden stakes. At the apex of the pyramid is mounted a 12″ Vent-Axia® fan (not visible externally). Eight inches above this is the overhanging roof made of a 4 foot square of particle board.

Internally (Figure 2) the fan is connected to a fine-mesh nylon funnel tapering to a collar which is attached to the top plate of the box containing the segregation mechanism. In previous designs, temporal segregation of samples has been accomplished either by dropping disks as in the 'Johnson-Taylor' trap (Johnson 1950) or by sample containers mounted on a rotating turntable (Bouchery 1979, Koch et al. 1977). The latter method has been used in this design.

Rotation of the turntable at desired intervals is controlled by a timer, a microswitch, and notches around the perimeter of the turntable (Figs. 3a and 3b). In our work, the timer is set to momentarily override the microswitch every 30 minutes, initiating rotation of the turntable. When the microswitch rides out of a notch on the edge of the turntable it maintains rotation until a new collection bag comes into position. The motor is then turned off as the microswitch enters another notch. The insects within the bag which has just left the airstream are exposed to a high concentration of dichlorvos in the turntable box which kills most of them within 30 minutes. This fast killing helps minimize damage to the specimens.

Biting flies are attracted to the trap by CO_2 released from tanks at a rate of 700 ml/min. From the outlet on the roof, some of the CO_2 escapes directly into the surrounding environment, while some is blown through the trap and escapes from under the bottom edges (Figure 2).

The black plastic ramps and burlap baffles both converge to the fan intake

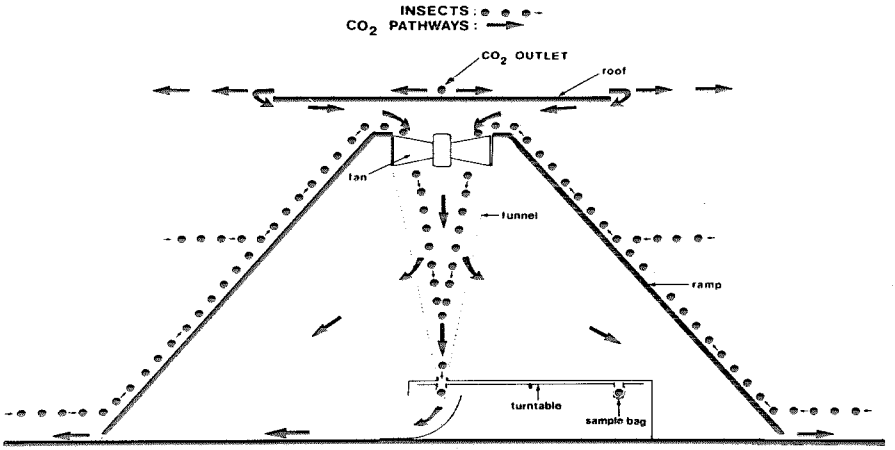

Fig. 2. Diagram of the trap showing pertinent internal features and illustrating CO_2 and insect pathways.

and concentrate the incoming insects (Figures 1 and 2). The ramps increase the vertical dimension of sampling, while the baffles, suggested by the Malaise trap, increase the effective trap area from approximately 64 to 400 square feet. The use of multi-directional ramps was inspired by the unidirectional ramp trap of Gillies (1969), later modified to include a suction fan (McIver et al. 1980).

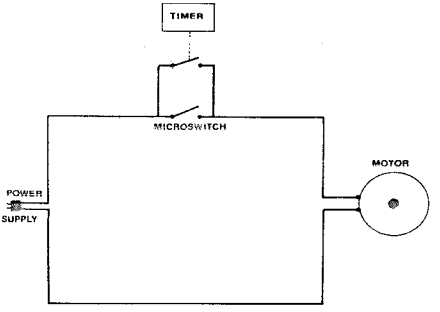

Fig. 3. a) Diagram of the functional circuitry of the segregation mechanism.

As incoming insects approach the fan intake, they are stopped by the overhanging roof (Figure 2). The roof functions additionally to keep rain and debris out of the fan intake. The airstream of the fan drives the insects downward through the funnel and into one of the gauze sample bags (Figure 2).

Twice a day at random intervals the bags on the turntable are removed, fastened to a "multi-clip-board" composed of 30 spring clips mounted on a piece of plywood, and taken to the laboratory for identification.

DISCUSSION

Two of the traps described were operated continuously from mid-May through August 1980, representing over 4,000 hours of field use. During this period no mechanical problems were encountered.

Twenty species of mosquitoes were collected, approximately half of these in sufficient numbers for detailed statistical analyses. This represents a large proportion of an estimated 26 species which

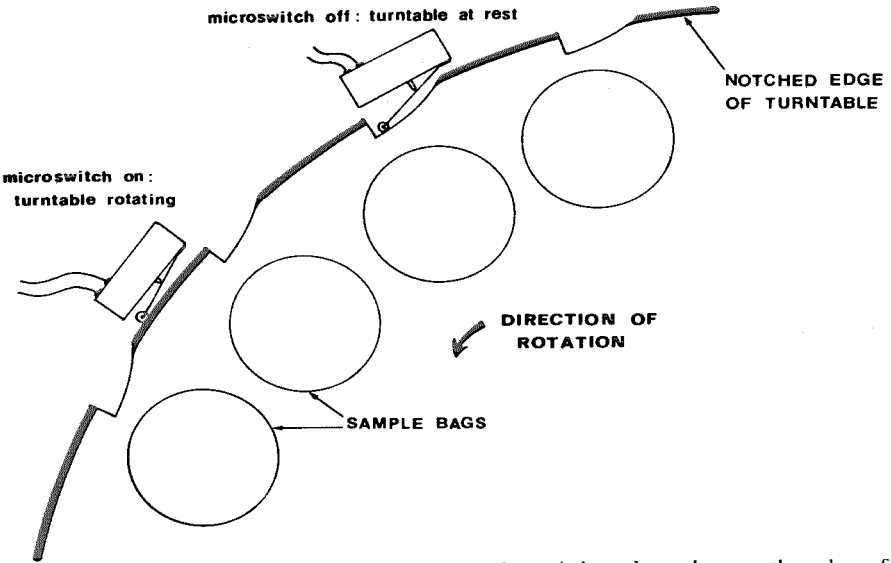

Fig. 3. b) Diagram illustrating operation of the microswitch and notches on the edge of the turntable.

might be expected in this locality. Mechanical damage to the specimens was not a problem. Twenty-nine species of tabanids were collected in the trap. Thirty-five species were previously found in this area in a study which employed a variety of sampling methods in several habitats (Smith et al. 1970). Large numbers of black flies were collected, but identification to species is incomplete. In addition, over 100 other insect families were represented in the collections. Most abundant among these were the Tipulidae, the Chironomidae, the Mycetophilidae, the Cecidomyiidae, the Aphidae and the Cicadellidae.

Maintenance of the traps is minimal, involving monthly replacement of dichlorvos strips, cleaning of the funnel, oiling of the fan and turntable motors, and bi-weekly replacement of the CO_2 cylinders.

ACKNOWLEDGMENTS

This work was supported by the Natural Sciences and Engineering Research Council of Canada grant A7243, the Medical Research Council of Canada grant MA2707, and the Canadian National Sportsmen's Fund grant 3-R 11. We wish to thank the Zoology workshops for assistance in the design and construction of the traps and Mr. Trevor Friesen for his invaluable help in the field.

References Cited

Bouchery, Y. 1979. Description d'un collecteur utilisable à l'extérieur, destiné à recueillir automatiquement les captures d'Arthropods d'un piège à succion. Ann. Zool. Ecol. Anim. 11:113–117.

Gillies, M. T. 1969. The ramp-trap, an unbaited device for flight studies of mosquitoes. Mosq. News 29:189–193.

Johnson, C. G. 1950. A suction trap for small

airborne insects which automatically segregates the catch into successive hourly samples. Ann. Appl. Biol. 37:80–89.

Koch, H. G., R. C. Axtell and G. R. Baughman. 1977. A suction trap for hourly sampling of coastal biting flies. Mosq. News 37:674–680.

McIver, S. B., T. J. Wilkes and M. T. Gillies. 1980. Attraction to mammals of male *Mansonia (Mansonioides)* (Diptera: Culicidae). Bull. Entomol. Res. 70:11–16.

Service, M. W. 1976. Mosquito ecology: field sampling methods. 583 pp., Liverpool. Applied Science Publishers.

Smith, S. M., D. M. Davies and V. I. Golini. 1970. A contribution to the bionomics of the Tabanidae (Diptera) of Algonquin Park, Ontario: seasonal distribution, habitat preferences, and biting records. Can. Entomol. 102:1461–1473.