A CAGE TO ISOLATE INDIVIDUAL OVIPOSITING *CULEX* SPP. FEMALES (DIPTERA: CULICIDAE) IN THE FIELD[1]

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ABSTRACT: We describe and illustrate a small floating cage for isolating individual female *Culex* spp. mosquitoes while they oviposit in the field. The cage allows a female to finish her egg raft without escaping. Her species is determined by first instar larvae hatched from the raft, and she may be dissected or maintained alive for other purposes.

During field studies of oviposition behavior by *Culex pipiens* L. and *C. restuans* Theobald (Weber *et al.* 1991, Weber and Tipping 1990a, Weber and Tipping 1990b), we needed to isolate individual wild females as they oviposited on artificial ovisites containing dyed water. We also wanted to investigate the possible relationships between female age and egg raft size or choice of ovisite. To help us in these studies we developed a small floating, oviposition cage (Fig. 1) that allowed us to associate a particular female with her most recent egg raft and thus identify her to species by characters of the resulting larvae.

The ability to identify individuals to species by characters of their larvae is important because females of these two species can not be separated with certainty by visual characters, especially if they have lost many body scales (Madder *et al.* 1980). They can be identified by electrophoresis (Bartholomew and Munstermann 1984). Our research sometimes requires dissection of captured females to find whether they have retained eggs and to check their gonotrophic age by examining ovarioles (Small and Weber 1992). For this reason electrophoresis is inconvenient and we instead rely on characters of the first instar larval head (Dodge 1966, Reiter 1986) for identification.

Female *Culex pipiens* and *C. restuans* can be approached closely when they are ovipositing (Weber and Tipping 1990a). Females will tolerate considerable manipulation without ceasing oviposition or abandoning the site after they have placed ca. 10-15 eggs in a raft (our personal observations and Mattingly 1970). Because ovipositing females are so tolerant, the floating oviposition cage has proven to be a useful research tool. Females usually continue ovipositing and lay their complete clutch after they have been caged.

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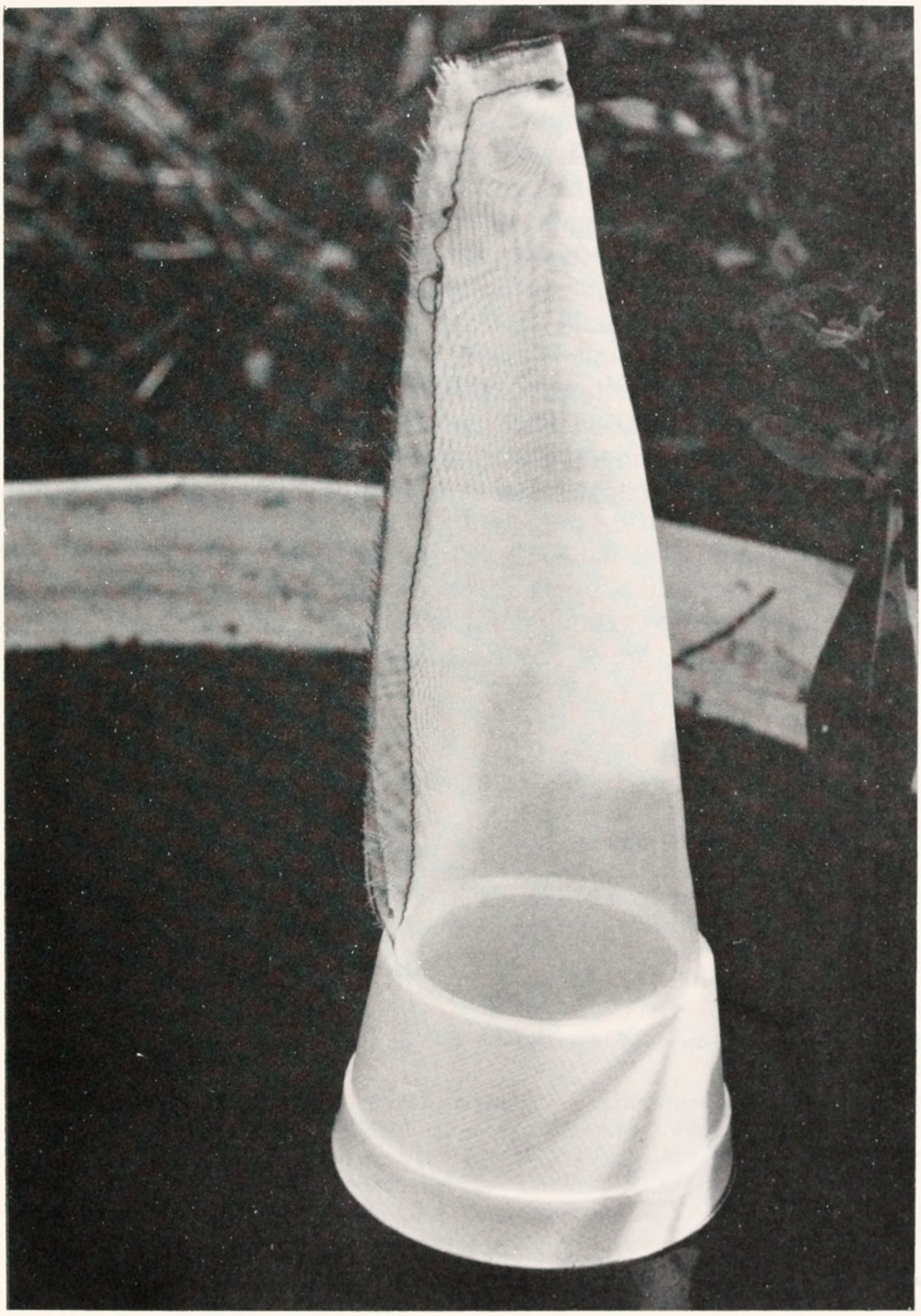

Fig. 1 The oviposition cage floating on the surface of an artificial oviposition site.

The cage is constructed from 261 ml (8.6 oz) styrofoam cups and fine-mesh nylon fabric (Figs. 1 & 2). Cups forming the base were 8 cm (35/32") in diameter at the top. The nylon fabric was cut to shape (Fig. 2a), then folded and sewn along one edge and across the tip to make it cone-shaped. Mesh size of the fabric is not critical, but the fabric should be stiff enough to remain upright. To form the base, we nest three cups and place them opening-downward on a smooth surface (Fig. 2b). The two inner nested cups are cut cleanly below the lip of the outer cup and the entire assembly is cut again 4.6 cm above the first cut, leaving the nested parts of the three cups as a set. The two inner cup sections are cemented together with several dabs of silicon adhesive ("Permatex Flowable Silicone Windshield & Glass Sealer", Loctite Corporation, Cleveland, Ohio 44128), which is waterproof and does not soften styrofoam. When the adhesive has cured for ca. 30 min., this subassembly is ringed with a line of adhesive and the base of the nylon top is pulled down over it. A second line of adhesive is placed around the fabric near the base and the outer cup section is pushed down over the fabric and

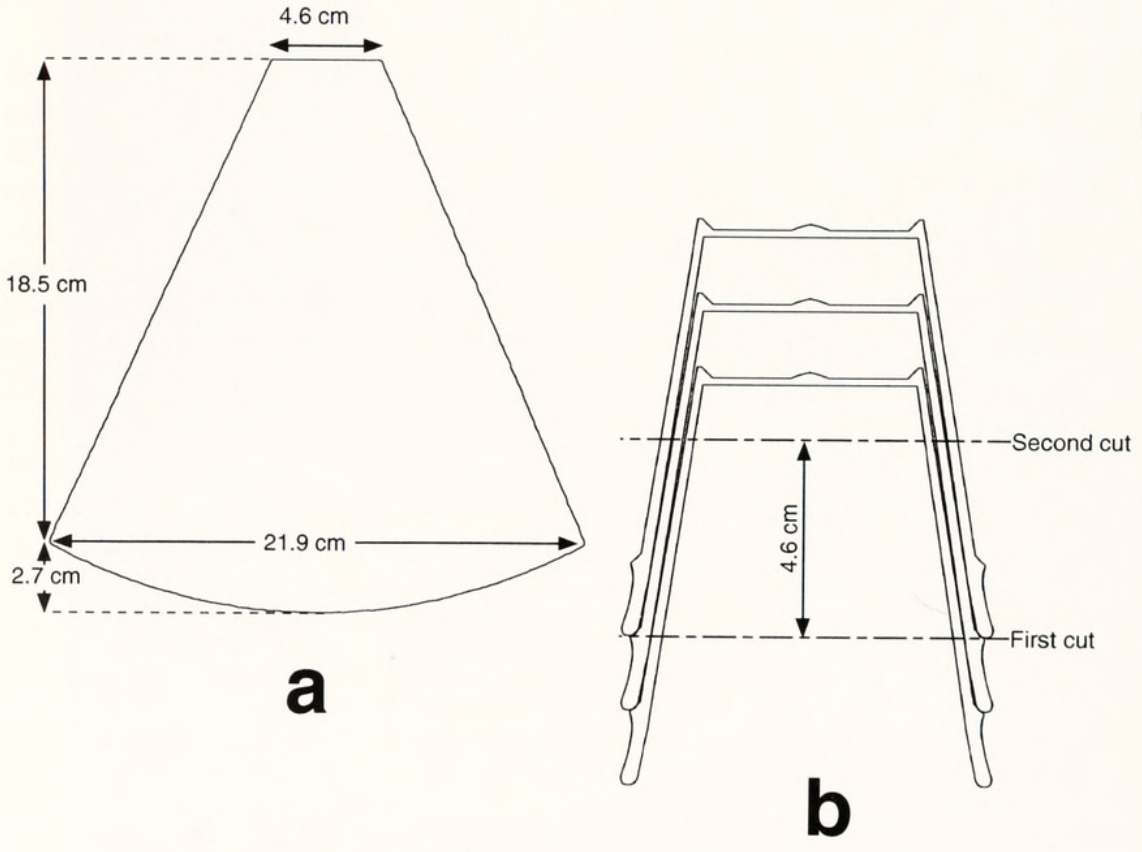

Fig. 2a: Dimensions and shape of the nylon fabric used to make the cage tops.
2b: Floating base of cage made from cut, nested styrofoam cups. (Illustrations not drawn to same scale.)

two inner cups. Silicon adhesive smells mildly of acetic acid as it cures, so we allow several days between cage assembly and use.

In use, we first locate a female with a partially completed raft. Using a flashlight with a red lens decreases chances of disturbing females (Weber and Tipping 1990a). The cage, held by its top, is centered above the female, then lowered gently to the water. Each cage is checked at ca. 5 min intervals to determine when the female has finished her raft and flown into the mesh tip. She is confined there by pinching the mesh together between first and second fingers. The cage is lifted from the surface and the raft is collected for egg counting, hatching and larval identification. The female is removed from a cage by placing a 2.4 cm diameter shell vial into the mesh top to enclose her. After she enters the vial a finger is used to evert the mesh tip into it, thus capturing her. Then the vial and mesh is everted out the bottom of the cage. The vial is plugged using a tuft of cotton which is then moistened with 10% sucrose solution. Storing vials on their sides reduces chances of a female becoming stuck in sucrose solution. In this way we have been able to maintain females alive in shell vials for over 55 hours at normal room temperatures. In time the nylon fabric becomes somewhat limp and the tops droop, interfering with proper operation. We remove limpness by suspending a cage from its tip and spraying the fabric lightly with hair spray ("Rayette Aqua Net", Faberge Incorporated, New York, N.Y. 10019).

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BOOK REVIEW

HANDBOOK OF THE FRUIT FLIES (DIPTERA: TEPHRITIDAE) OF AMERICA NORTH OF MEXICO. Richard H. Foote, F.L. Blanc, and Allen L. Norrbom. Cornell University Press. 1993. 576pp., 535 illus. $105.00.

This is an impressive, detailed work of one of the most economically important families of Diptera. The authors' long experience with the family is quite apparent. The book has nine sections. After a short Introduction, the Adult Morphology section explains the structures and attributes needed in using the generic and species keys. The relationship of the Tephritidae to other acalyptrate Diptera is given a section. The 56 genera and 300 species of the North American assemblage are arrayed in 3 subfamilies and 11 tribes with 10 unplaced genera in the hierarchy, an arrangement based largely on Hering's 1947 (Siruna Seva 6) divisions. Each subfamily is discussed, and the Relationships within tribes is treated based upon hypothesized pleisomorphic and apomorphic characteristics. The generic key to U.S. and Canadian members is thoroughly illustrated and makes the key almost foolproof. The genera are arranged alphabetically with synonymy references, a recognition section, and a discussion paragraph. The species within each genus are also listed alphabetically. This is a real boon for every worker who never had enough fingers in using monographs and other handbooks to carry out description comparisons. Like the generic sections, each species has synonym citations, a recognition section, a geographic distribution section which is usually a base map with several species appearing at localities where the species have been taken are given, hosts are cited, and a discussion section pointing out pertinent details concerning the species. In addition to the distribution maps, the distinctive wing markings and patterns that characterize the Tephritidae are illustrated for "nearly every species discussed." These wing illustrations are lettered to designate "key" characters. Only a few wing illustrations are disappointing (e.g. *Eutreta* spp.), but this is just the nature of some of these wing patterns. Other features of taxonomic chaetotaxy generously illustrate all of the keys making them easy to use, even for the novice.

The authors can be proud of this Handbook which is the result of many years of study and experience, particularly the senior author. His successors and other entomologists have a work that points out problems and areas for future work. This work will serve as a model for other comprehensive handbooks of the future. It will be essential for fruit, vegetable and ornamental entomologists and should stimulate many ecology students to undertake studies of members of this important and enthralling family of flies.

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