materials. We also thank Dr. L. A. Lacey and two anonymous reviewers for their comments on an earlier version of this manuscript.

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A LIGHTWEIGHT, HAND-PORTABLE VEHICLE-MOUNTED INSECT TRAP[1]

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Vehicle-mounted traps are one of several methods of non-attractant sampling of flying insects (Bidlingmayer 1961). A history of this method was provided by Bidlingmayer (1966) and reviewed by Barnard (1979). We required a vehicle-mounted trap that could be mounted at the front of the vehicle to avoid the turbulence caused by air passing over the hood and windshield (Bidlingmayer 1969), that could be adapted to a variety of motor vehicles, and that could be taken apart and fitted into a case for hand transport. Our trap consists of 3 main parts: (1) a trap bag of lightweight canvas and nylon insect netting; (2) a lightweight but sturdy inner framework to support the bag; and (3) an outer framework to hold the bag in place. The longest individual part is 112 cm, and the weight of all trap parts and the carrying case is 19 kg.

This trap is being used to monitor adult populations of *Culicoides variipennis* (Coquillett) as part of field studies on the control of bluetongue disease in ruminant livestock through vector suppression.

OUTER FRAMEWORK. The outer framework of the trap has 6 elements: 2 interchangeable front bumper supports (Figs 1.1 and 3A); an inverted U-shaped front mount that fits into the front bumper supports and to which the leading edge of the trap bag is fastened (Figs. 1.2 and 3B); a rear mount above the passenger compartment

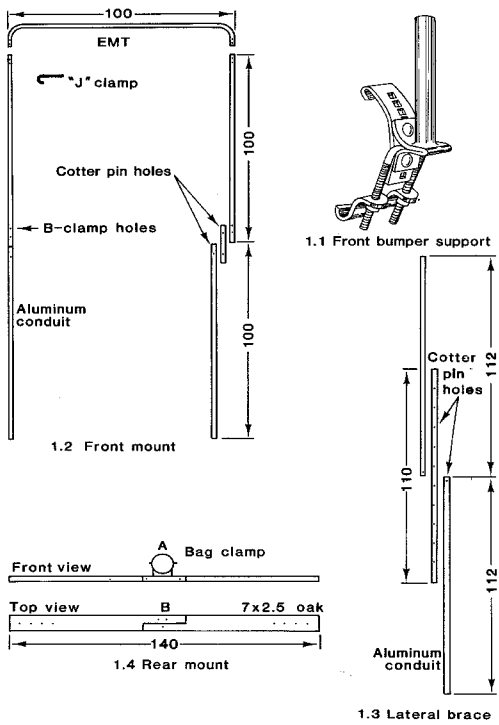

Fig. 1. Outer framework elements, dimensions in cm.

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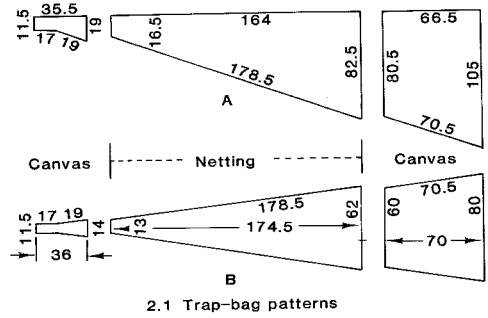
with a clamp to hold the rearward end of the trap bag (Figs. 1.4 and 3C); and 2 interchangeable lateral braces to provide rigidity to the framework and to hold the trap bag taut (Figs. 1.3 and 3D). Each front bumper support is an adjustable bumper hitch (No. 228.80, Valley Manufacturing Co., Lodi, CA 95240) with a 20 × 2.5 cm I.D. pipe welded upright to provide a socket for an upright of the front mount.

The inverted U-shaped front mount has an upper portion of 1.9 cm O.D. galvanized electrical metallic tubing (EMT) bent so that its legs are 100 cm apart and extend 20 cm from the curve at the corners of the U. Each leg is inserted into an interchangeable extension of two 100 × 2.2 cm O.D. lengths of thin-walled[3] aluminum electrical rigid conduit joined by a 20 × 1.9 cm O.D. insert of the electrical metallic tubing (Fig. 1.2 left). All adjacent pieces of the front mount are joined with cotter pins. Holes 0.6 cm in diam. are drilled 111 cm and 198 cm from the base of each upright, for the 4 clamps used to fasten the trap bag to the front mount. On our vehicles, this height is such that the lower leading edge of the trap bag does not interfere with the driver's vision, but additional holes can be drilled as needed. Each bag clamp is of 0.6 cm (¼ in.) diam. threaded metal rod bent into a J-shape with a 10 cm finished length (Fig. 1.2). A piece of latex rubber tubing is placed over the curved portion of the clamp to protect the leading edge of the trap bag. The clamp is tightened by a wing nut. The uprights of the front mount are fastened to their respective front bumper supports with bolts or cotter pins to prevent separation when collecting.

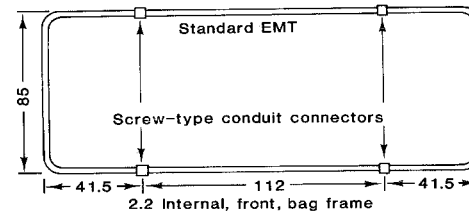
The rear mount consists of a 140 × 7 × 2.5 cm cross-bar, a clamp for the rear of the trap bag, and 2 gutter clamps to attach to the vehicle above the passenger compartment (Fig. 1.4). The cross-bar is of 2 pieces bolted together and with four 1 cm holes drilled at 5 cm intervals at each end to adjust for vehicle width. The bag clamp (No. TH-104, Four B's Bracket Co. New Brighton, MN 55112) is fastened to the center of the cross-bar with two 3.8 × 0.6 cm bolts. The 2 gutter clamps (No. IKS-2, Quick-n-Easy Products, Monrovia, CA 91016) with tube holders are fastened to the ends of the cross-bar each with a 55 × 1.0 cm bolt.

The interchangeable lateral braces (Fig. 1.3) are each made of two 112 × 2.2 cm O.D. lengths of thin-walled alumimum electrical rigid conduit joined by a 112 × 1.9 cm O.D. insert of the same material. Holes 0.3 cm diam. are drilled in adjacent ends of the outer conduits and at 10 cm intervals along the insert to adjust length. Adjoining pieces are fastened with cotter pins.

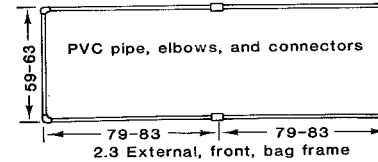
The side braces abut the appropriate upright of the U-shaped front mount as shown in Figs. 2.3 and 3.4. A 0.9 cm hole is drilled front-to-rear in each upright just above the upper trap clamp. A nut is positioned 3 cm from one end of a 15 × 0.9 cm rod and passed through the hole in the upright so that 12 cm of the rod extends to the rear. A lock washer and nut is then tightened on the end of the rod that protrudes forward beyond the upright. Immediately behind the rear nut, the rod is bent downward 10–15° to align it with the tube holder on the same side of the rear mount. When in position, the forward end of the appropriate lateral brace is passed over the portion of the rod extending behind the front mount, and the rearward end of the lateral brace is passed through the tube holder on that side. The bolt joining the tube holder to the cross-bar and gutter



2.1 Trap-bag patterns



2.2 Internal, front, bag frame



2.3 External, front, bag frame

Fig. 2. Trap bag patterns and framework for vehicle-mounted trap, dimensions in cm.

[3] Wall thickness of conduit should be such that inserts fit snugly inside.

Fig. 3. Vehicle trap mounted and ready for collecting. A. Front bumper supports. B. Front mount. C. Rear mount. D. Lateral brace. E. Internal front bag frame in sleeve. F. Leather reinforcement. G. External front bag frame in sleeve. H. Plexiglas pipe in trap bag cylinder. I. Insect collecting bag.

clamp is then used as a set screw to secure the lateral brace.

TRAP BAG AND BAG BRACES. The forward and rearward portions of the trap bag are of light canvas and the middle portion is of nylon insect netting (Nos. 250E and 250B, respectively, Bioquip Products, Santa Monica, CA 90406). The patterns and dimensions of the bag parts (A and B) are shown in Fig. 2.1. All seams are overlapped 2.5 cm and seams of netting-netting or netting-canvas are reinforced with bias tape.

The upper and lower panels of the bag require 2 each of the "A" pieces. The 3 parts of each "A" piece are sewn together positioned as shown, and then 2 each of the "A" pieces are sewn together along the straight sides. The 2 side panels of the bag require 1 each of the "B" pieces, sewn together positioned as shown. The upper, lower and 2 side panels are then sewn together to form a trap bag with a forward canvas section 64 cm. long, a middle netting section 159 cm long, and a rear canvas section 33 cm long; the perimeter of the front opening is 550 cm tapering to a 10 cm diam. cylinder at the rear. The taper of the netting is then altered to a severe concave funnel shape by sewing longitudinal tucks (darts) in the netting as needed. This shape restricts the netting from billowing outward and reduces the number of insects that may accumulate on the inside wall of the netting while collecting. All seams and tucks are on the outer surface of the bag to provide as smooth an inner surface as possible.

The leading edge of the front canvas section of the bag is folded outward and back and sewn to itself to form a ca 10 cm diam. sleeve to hold an internal front bag frame (Figs. 2.2 and 3E) of 1.9 cm O.D. standard EMT. The frame pieces (2 112 cm straight and 2 158 cm U-shaped) are inserted into the sleeve through slits cut 56 cm to either side of the center seams of the upper and lower bag panels, and fastened together (Fig. 2.2) with 4 screw-type conduit connectors. The areas around the 4 slits are reinforced with leather sewn to the canvas (Fig. 3F) where the internal front bag frame and the forward edge of the trap bag are clamped to the uprights of the front mount.

Four canvas sleeves 10 cm in diam., 1 each for the upper and lower bag panels, and the 2 side panels, are sewn to the rear edge of the forward canvas section of the trap bag. The side panel

sleeves are ca 50 cm long and the upper and lower panel sleeves ca 165 cm long. These sleeves hold the external front bag frame (Figs. 2.3 and 3G) of 1.6 cm O.D. polyvinyl chloride (PVC) pipe. The upper and lower parts of each of 2 pieces 79–83 cm long, and the side parts are 59–63 cm long. The lengths of the pieces are adjusted in the sleeves for bag rigidity and snapped together with PVC elbows and connectors without adhesive.

A 20 cm length of 0.3 cm thick Plexiglas® pipe 10 cm in diam. with the forward edge beveled inward, is inserted 15 cm into the rear canvas cylinder of the trap bag, and these are fastened together with a size 64 circular metal screw clamp (Fig. 3H). A small flange may be glued to the outside lip of the protruding end of the Plexiglas pipe to prevent the insect collecting bags from slipping off during use.

The insect collecting bags are made of the same nylon netting as is used for the trap bag. They are 30 cm long and 10 cm in diam. and are fastened over the flange of the trap cylinder either with a string tie or a Velcro® closure.

Direct costs associated with this insect trap were: outer framework, $38 for front bumper supports, $38.50 for the rear mount, $25 for tubing, and $25 for nuts, bolts, connectors and other hardware; trap bag, $21 for netting and canvas, $180 for sewing and tailoring, and $14 for tubing and Plexiglas pipe; and insect collecting bags, $2 each. The indirect cost of the labor of all those involved in the development of this trap could not be accurately estimated.

When the trap is used at intervals over an indefinite period of time, the 2 front bumper supports and the rear mount above the passenger compartment may be left on the vehicle. The trap bag with its internal and external front frames and the rear Plexiglas cylinder may also be kept assembled. One person can mount the trap for use in 15 min or less, operate it as needed, and dismount it in 10 min or less.

We have found it advisable to equip each of our vehicles used for trapping with a kit containing meteorological equipment; a ratchet wrench and sockets; an assortment of nuts, bolts and cotter pins; extra tube holders; and aluminum duct tape for temporary repairs to the netting or canvas. This vehicle-mounted trap, as shown in place in Fig. 3, has been operated 1–5 days weekly at 48 km/hr from April to October over a 3-year period with only minor, repairable damage to the nylon netting.

In one study, the trap was operated over the same set of 10 vehicle runs of 4 km each weekly during the fly seasons of 1981, 1982 and 1983. Average catches per run per year have been 24.5, 10.8 and 25.4 *C. variipennis* respectively. Comparisons of this trap with other vector surveillance methods will be published elsewhere.

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RAPID KILL OF MOSQUITO LARVAE BY HIGH CONCENTRATIONS OF *CULICINOMYCES CLAVISPORUS* CONIDIA

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Conidia of *Culicinomyces clavisporus* Couch, Romney, and Rao, a virulent fungal pathogen of mosquito larvae (Sweeney et al. 1973, Couch et al. 1974), are normally ingested during feeding, germinate in the foregut or hindgut, and cause death four or more days after ingestion when invading hyphae fill the haemocoel (Sweeney 1975). However, with high doses (10^4–10^6 conidia/ml) death can occur within 18 hr to 2 days without extensive growth of the fungus in the larvae, which has led to suggestions that a toxin may be involved (Couch et al. 1974, Sweeney 1983). This note reports on the rapid death of *Aedes aegypti* (Linnaeus) larvae exposed to conidia of the Australian strain of *C. clavisporus*.

Initial observation of rapid death was made during an experiment to determine whether dead conidia were toxic to larvae. Boiled conidia at concentrations of 10^5–10^7 conidia/ml did not kill first instar *Ae. aegypti* larvae, but live conidia at the highest concentration caused substantial kills within only 5 hr.

For further trials, the fungus was grown in shake culture at laboratory temperature (approximately 25°C) either in Nutrient Broth (Lab-Lemco, Oxoid) with 0.01% streptomycin and 0.002% neomycin or in Corn Steep Liquor Broth (1.5% or 2.0% w/v adjusted to pH7 with 10% KOH) with streptomycin and neomycin. Conidia were harvested by filtration through a milk filter to remove hyphae, then centrifuged and washed twice in distilled water prior to storage in distilled water at −70°C. Viability before