OPERATIONAL AND SCIENTIFIC NOTES

A LIGHT TRAP FOR BITING NEMATOCERA IN MOIST ENVIRONMENTS

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During the course of research on biting Nematocera in central Panama, we found various standard light traps unsuitable in the moist-forest and rain-forest climatic conditions. Heavy rainfall wetted the catch regardless of the measures taken to avoid this problem. In addition, metal trap parts corroded in the high humidity causing frequent electrical failures. To avoid these and other problems we constructed and tested a modified Chaniotis trap (Chaniotis and Anderson 1968), designed specifically for wet environments. The following narrative includes a description, components and materials list and construction directions for this new trap. Data on its uses and comparative effectiveness are published elsewhere or are in preparation (Chaniotis 1983).

The trap consists of 3 major parts (Figs. 1–5): the trap head (Figs. 1A, 2, 5A), holding cage (Figs. 1B, 3, 5B), and bottom (Figs. 1C, 4, 5C). The materials and specifications for the components required for each major part are listed in Table 1. Each component has been assigned a lower-case letter which identifies it in both Fig. 5 and Table 1. Insects are attracted by the light (h) at the bottom of the trap. The air flow caused by the negative pressure generated by the fan (a) draws insects attracted to the light, through the port (1) and into the holding cage (Fig. 5B). Most of the trap is constructed from Plexiglas; the cylinders that constitute the head and cage are cut from Plexiglas pipe.

In addition to the propeller (a) and motor (b), the trap head houses the air-current baffle (c) and electrical connections, and has a rain cover (d) permanently bolted to the top. A standard CDC light trap motor (Hausherr's Machine Works, Old Freehold Road, Toms River, NJ 08753) is held by a bracket (e) bonded to the underside of the rain cover. The baffle, located immediately below the fan, suppresses vortexing and thus reduces damage to fragile nematocerous insects. All power connections (6VDC), including those for the fan, motor and light, originate at 2 banana jack solder terminals (f). The light socket (h) is connected to the terminals by a length of cable (g) and clips to the bottom of the holding cage. Connectors to the battery are plugged into the banana jacks.

The upper rim of the holding cage fits into the bottom of the trap head and is held in place by masking tape or Plexiglas brackets and rubber bands. The top of the cage consists of a hardware cloth disk (i) held in place above a Danon-Dacron organdy disk (i) by a removable Plexiglas ring (j) which fits inside the holding cage. The hardware cloth provides support and protection for the organdy; the latter retains the insects in the holding cage. The bottom of the holding cage (Fig. 5C) is removable and fits tightly into the cage body. The bottom under surface has a bracket (k) for the light socket and is spray painted black to adsorb light that would otherwise diffuse up through the trap. The central port in the bottom of the holding cage channels the insects from the light through a short pipe (1), into the trap.

The trap head is constructed in the following way. Ring (m) is bonded coaxially to the outer surface of ring (n) (trap body) such that 1.54 cm of ring (m) extends over the edge of ring (n) (bottom), furthest from the edge with two 0.8 cm holes (top). The 2 halves of ring (o) and rectangle (c) (baffle) are bonded to the inner surface of the ring (n) 2.8 cm from the top edge. Disk (q) is bonded to the shelf formed by the baffle and ring (o). Ring (p) is bonded concentrically to the top surface of disk (q); the inner surface of this ring must be continuous with inner surface of the hole centered in the disk. Rectangles (r) are bonded vertically to the disk, each centered on one of three equidistant axial radii (fig 5D). These support rectangles should contact and bond laterally to ring (n) and ring (p). Rectangles (s) are bonded in pairs to the top of the support rectangles (r). Cylinder (e) (motor bracket) is bonded by its flat edge concentrically to disk (d). The eye bolt (u) is bolted in the center hole of disk (d) with the eye on the surface opposite the cylinder (top). The two nuts are cemented in place with epoxy on the shaft of the bolt, one above the disk and one below; the upper one is covered with silicon sealant.

All the electrical connections in the trap head are soldered and electrical connectors are color coded, red for positive and black for negative. Soldered to the jack terminals (f) are the 24 gauge wires (v), which are connected to the motor (b) and the 60 cm speaker cable (g), which is connected to the light socket (h). Each jack is bolted and cemented with epoxy into one of the 2 holes in the top edge of ring (n).

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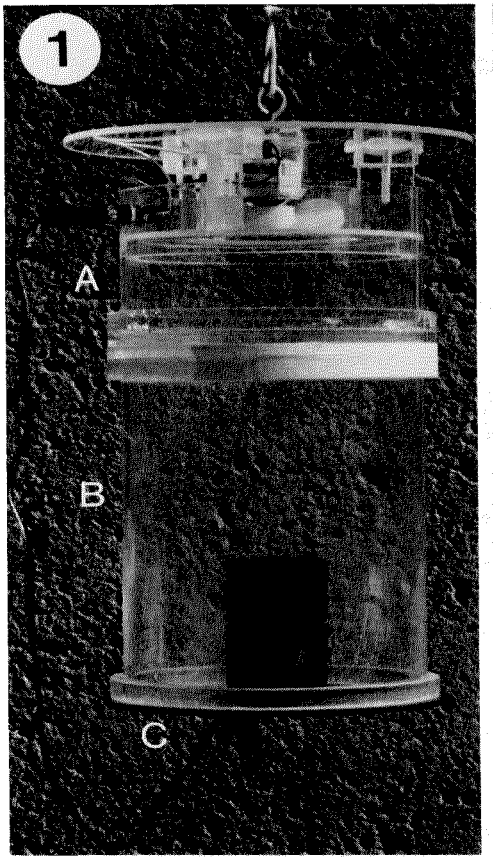

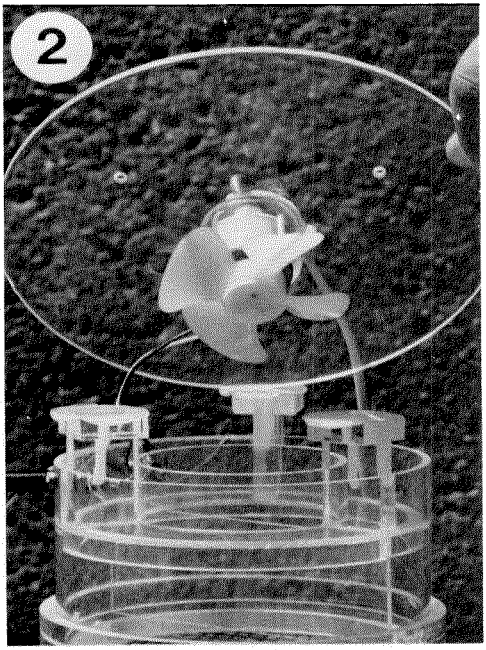

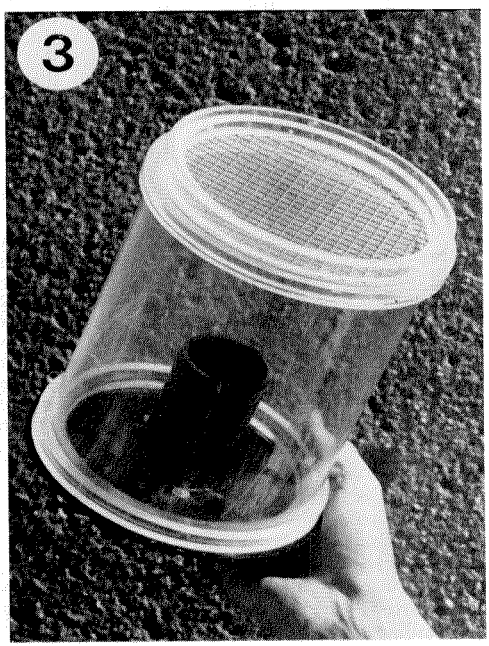

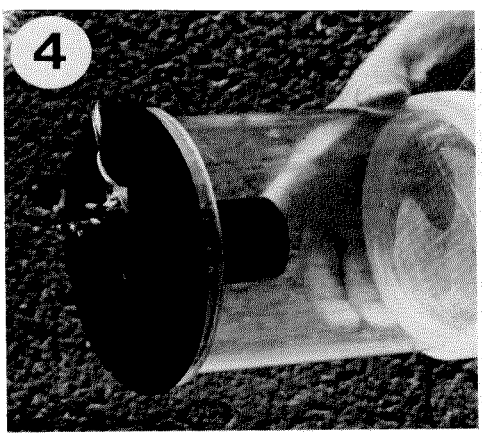

Fig. 1. Photograph of assembled trap and the three individual parts: A) trap head, B) trap cage, C) trap bottom. Fig. 2. View of trap head with rain cover unbolted and removed. Fig. 3. Lateral view of holding cage. Fig. 4. Trap bottom.

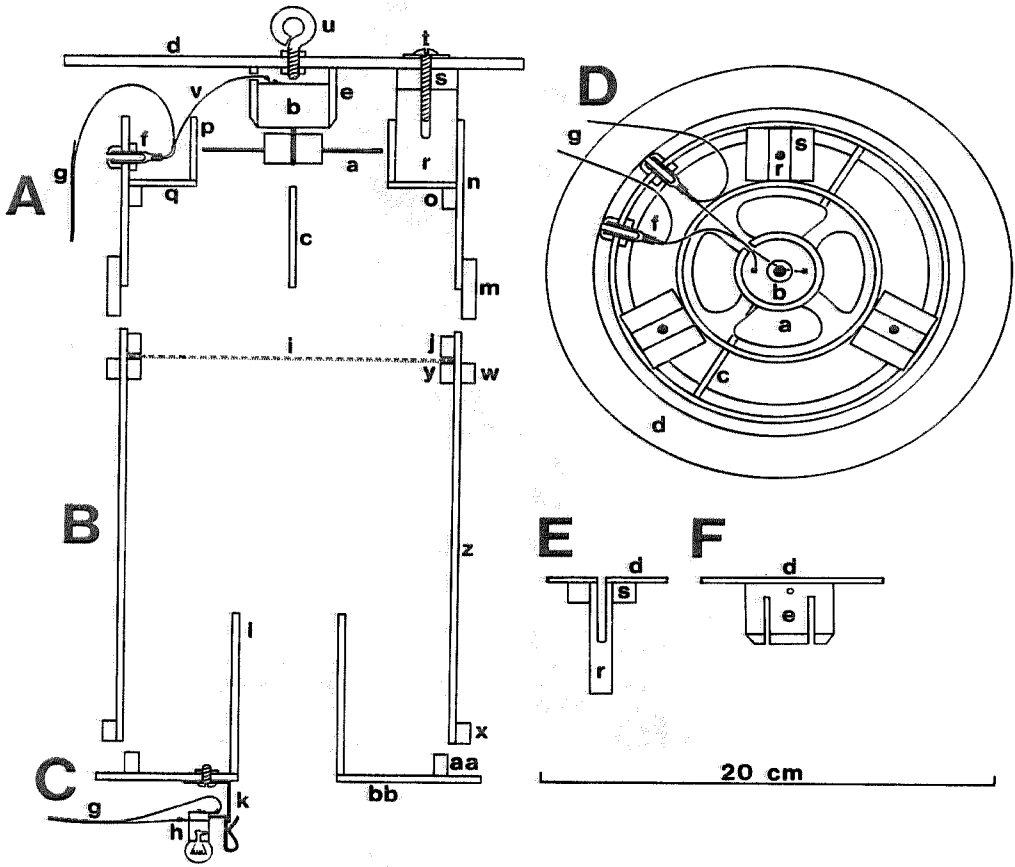

Fig. 5. Diagram of trap: a) propeller; b) motor; c) baffle; d) rain cover; e) motor bracket; f) banana jack connectors; g) wire connection to light socket; h) light socket; i) hardware cloth and organdy disks; j) removable retaining ring for the hardware cloth and organdy disks; k) bracket for removable light socket; l) channel for incoming insects and air; m) connecting and reinforcing ring between trap head and cage; n) body of trap head; o) reinforcing ring for fan housing; p) fan housing; q) support for fan housing; r) rain cover support pillar; s) reinforcing block for support pillar; t) retaining bolt for rain cover; u) eye bolt; v) power connection between motor and banana jack terminal; w,x) reinforcing rings for trap cage; y) support ring for organdy and hardware cloth disks; z) cage body; aa) fitting ring for cage bottom; bb) bottom disk. A) Vertical cross section of trap head; B) cross section of holding cage; C) cross section of bottom; D) vertical view from the top of the trap head; E) lateral view of the support pillar; F) lateral view of the motor bracket.

The motor is fitted into the bracket beneath the eye bolt; to achieve a tight fit the motor is wrapped with a layer of electrical tape. After placing the propeller on the shaft of the motor, and ascertaining that it turns freely when the motor is tested, the rain cover (d) is sealed to the support pillars (f) with silicon sealant. While the sealant is still flexible, the rain cover is aligned concentrically and coaxially to the top of the trap head body, with each of the 3 off-center holes over the center of a pillar (Fig. 5D). After the sealant has cured, holes are drilled into the support pillars coaxial to the off-center holes in the rain cover and tapped with 10–24 machine bolt threads (fig 5D). The 10–24 round headed machine bolts with washers (t) are screwed into these holes.

To construct the trap body, rings (w, x) are bonded coaxially to the outer surface of cylinder (z); one positioned 1.6 cm from one end

Table 1. Components and materials specifications for the construction of 1 trap.

Number required	Component/material and specification
1	Ring (m), 2.54 cm high, 16.51 cm OD, 0.64 cm thick.
1	Ring (n), 8 cm high, 15.24 cm OD, 0.32 cm thick with 2, 0.8 cm holes drilled 4 cm apart 1.0 cm from one end.
1	Ring (o), 1.0 cm high, 14.61 cm OD, 0.64 cm thick; this ring is cut in half.
1	Ring (p), 2.54 cm high, 8.89 cm OD, 0.32 cm thick.
1	Cylinder (e), 2.86 cm high, 3.81 cm OD, 0.32 cm thick, with a 45° bevel on the outer edge of one end, 4 equidistant 2.0 cm vertical cuts in the same edge, parallel to the center axis of the cylinder and a 0.32 cm dia. hole 0.32 cm from the unbeveled end centered between two vertical cuts (Fig. F).
1	Disk (q), 14.16 cm diam, 0.32 cm thick, with a centered 8.26 cm diam hole.
1	Disk (d), 20.32 cm diam, 0.64 cm thick, with three 3 0.19 cm diam holes, 6.0 cm off center, each on one of three equidistant radial axes.
1	Rectangle (c), 5.08 × 14.61 cm, 0.32 cm thick.
3	Rectangles (r), 2.86 × 5.08 cm, 0.95 cm thick.
6	Rectangles (s), 2.86 × 0.95 cm, 0.95 cm thick.
3	Bolts (t), 1.91 cm, 10–24 round headed machine bolts with 1.27 cm flat washers.
1	Bolt (u), 2.0 cm, 12–24 eye-bolt with 2 nuts.
2	Wires (v), 16.0 cm lengths of 24 gauge hookup wire, one red, one black.
1	Wire (g), 60.0 cm length of 18 gauge dual conductor speaker wire.
2	Jacks (f), H. H. Smith type 221 insulated jacks, one red, one black.
1	Motor (b), CDC light trap 6 VDC motor.
1	Socket (h), Leecraft N. J. 6 VDC light socket with clip.
1	Fan (a), CDC light trap propeller.
1	2.0 m length of nylon parachute cord.
1	Light bulb, GE-BIA
	Holding cage. (Fig. 5B)
2	Rings (w,x), 0.95 cm high, 16.51 cm OD, 0.64 cm thick.
2	Rings (j,y) 0.95 cm high, 14.61 cm OD, 0.64 cm thick.
1	Cylinder (z), 20.32 cm high, 15.24 cm OD, 0.32 cm thick.
1	Disk (i), 14.61 cm diam, of 0.64 cm mesh hardware cloth.
1	Disk (i), 14.61 cm diam, of Danon-Dacron organdy.
	Bottom (Fig. 5c)
1	Ring (aa), 1.0 cm high, 14.61 cm OD, 0.64 cm thick.
1	Disk (bb), 17.15 cm diam, 0.32 thick, with a centered 4.45 cm hole and a 0.32 cm hole, 3.35 cm off center.
1	Bracket (k), 1.27 cm length of 1.91 cm aluminum angle, 0.32 cm hole centered in one flange.
1	Cylinder (l), 7.62 cm high, 5.08 cm OD, 0.32 cm thick.
1	8-24 round head machine bolt 1.27 cm long, nut and lock washer.
1	Can of acrylic flat black spray paint.
	Connecting cable.
1	3.0 length of 18 gauge dual conductor speaker wire (g).
2	H. H. Smith type 291 insulated banana plugs, one black, one red.
2	Muller type 60 CHS insulated alligator clips, one black, one red.

(cylinder top) and the other at the edge of the other end (cylinder bottom). Ring (y) is bonded coaxially to the cylinder on its inner surface, 1.6 cm from the top. This ring forms a support-shelf for the organdy and hardware cloth disks (i). These are inserted organdy first, hardware cloth second. Ring (j) is glued on top of disks (i) with flexible silicon sealer so it can be removed to exchange the disks.

To construct the bottom, ring (aa) and cylinder (l) are bonded concentrically onto the upper surface of disk (bb). The inside surface of the cylinder should be contiguous with the center hole; the cylinder should leave an even 1.3 cm margin around the edge of the disk. The under surface of the disk and the interior of the cylinder are spray-painted black. The aluminum angle bracket (k) is bolted to the under surface.

The banana plugs and alligator clips are soldered to opposite ends of the two conductor cable (g), matching colored plugs and clips are soldered to opposite ends of the same conductor.

Permanent bonds between pieces of Plexiglas are made with ethylene dichloride. All soldered connections are made with a non-acid core flux and then covered with a thin coat of silicon sealant. Routine maintenance includes spraying the alligator clips, jacks, plugs and light socket

with WD–40 silicon aerosol spray lubricant after each trap-night, and keeping the apparatus as clean and dry as possible between uses.

In addition to being essentially waterproof, this trap has several other advantages over the standard CDC light trap. The failure rate is almost negligible; during an intensive census of sand flies and mosquitoes in central Panama, 4 of these traps were used for 304 trap-nights with no trap failures (1 trap-night=1 trap in 1 night; 4 traps set in one night=4 trap-nights). Because the entrance port is narrow, if the trap does fail during a trap-night, most of the catch is retained. During normal operation the catch remains alive and in excellent condition for both systematic and serologic uses.

When the trap is retrieved from the field the intake port at the bottom is first plugged with a piece of foam rubber or similar material, before turning off the trap motor. In our studies, the insects collected were killed by placing the holding cages in a freezer or an ice chest with dry ice.

References Cited

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THE EFFECT OF *BACILLUS THURINGIENSIS ISRAELENSIS* (SEROTYPE H-14) ON *AEDES SQUAMIGER* AT THE BOLSA CHICA MARSH, ORANGE COUNTY, CALIFORNIA

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Depressions in Bolsa Chica Marsh where brackish water may be found during the winter rainy season support large populations of *Aedes squamiger* (Coq.). Because of the synchronous development of this species, large numbers of adults emerge over a short period and often create havoc in the adjacent residential areas. The marsh is also a migratory bird refuge and, therefore, insecticide usage is minimized to avoid any detrimental effects on bird populations. Because of the safety of *Bacillus thuringiensis israelensis* (serotype H–14) to wildlife, this study was conducted to evaluate the effect of the bacillus against *Ae. squamiger* in the Bolsa Chica area. The information accrued from this study was to provide a basis for potential use of *B. thuringiensis* in this and other mosquito habitats in Orange County, California.

DESCRIPTION OF THE STUDY SITE. The ponds that provided the habitat for *Ae. squamiger* were located in Rattlesnake Slough in Bolsa Chica Marsh, Orange County, California and are produced by rain-water runoff. The slough is situated within a 265 ha area that is protected as a state Ecological Reserve as part of more than 400 ha of marshland located along the coast 9.7 km (6 miles) southeast of Long Beach, CA. Soil type is a mixture of coastal sand and heavy chino clay. During heavy rainfall the network of roads and dikes impedes runoff that creates temporary ponds where *Ae. squamiger* can develop. Vegetation in the study area predominantly consisted of pickleweed (*Salicornia virginica*), saltmarsh grass (*Distichlis spicata*), cord grass (*Spartina foliosa*), and several other grasses (*Bromus* spp.).

BACTIMOS WP (FIELD STUDY). Twelve sites were selected from eight large ponds where *Ae. squamiger* larvae were observed. The large ponds were subdivided into test plots and each subdivision was delineated by flagged posts and twine. Each of these test ponds was separated by an untreated area that served as a buffer zone.

Linear measurements were made and acreages were calculated for each pond. Water depth was found to range from 15 to 61 cm with an average depth of 30 cm. Application rates of Bactimos WP (50% ai, 3500 AA units) were 2, 3, and 4 oz per acre. Each pond was sprayed with a mixture of water and respective dosage of *B.t.i.* with a hand sprayer. Each treatment rate was tested in three replicates and had been selected on the basis of several preliminary experiments. Three ponds without *B.t.i.* application served as controls.

Ten larval samples were taken with a standard dipper (350 ml) in each pond including the controls before spraying the ponds with *B.t.i.* Third and 4th stage larvae of *Ae. squamiger* were also collected before spraying for later placement in sentinel traps and for laboratory bioassays.

After the ponds were treated with *B.t.i.*, three sentinel traps (1 liter plastic containers with three 1" (2.5 cm) diam screened portals around the container and one on the lid) containing 20 larvae in each trap were placed in each of the 12 study plots. Sampling of ponds with a dipper and observations of sentinel traps were made after 24 and 48 hr of *B.t.i.* treatment.