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A COLLAPSIBLE, SEMI-AUTOMATIC, TENT-TYPE, EMERGENCE TRAP, SUITABLE FOR SAMPLING *CULICOIDES* (DIPTERA: CERATOPOGONIDAE) FROM A WIDE RANGE OF HABITATS

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ABSTRACT

PAJOR, I. T. P., 1987. A collapsible, semi-automatic, tent-type, emergence trap, suitable for sampling *Culicoides* (Diptera: Ceratopogonidae) from a wide range of habitats. *Onderstepoort Journal of Veterinary Research*, 54, 99–101 (1987).

A lightweight, collapsible, tent-type, trap of 1 m² floor-area was developed for the collection of emerging *Culicoides* from a wide range of habitats. It is cheap; easy to build, transport and erect; withstands adverse climatic conditions well; affects the covered habitat only slightly; and needs little attention. Insects are trapped into 0,5 % aqueous "Savlon" solution in a removable, modified, 2 litre plastic bottle. In this, the catch remains fresh for up to 2 weeks and is still suitable for identification and mounting for taxonomic purposes. Emergence numbers of 100 or more *Culicoides*/m²/day are quite common with this trap.

INTRODUCTION

During a study of the larval habitats of *Culicoides* in South Africa the need arose for an emergence trap which would sample a relatively large standard unit area (1 m²); be lightweight, portable, cheap and easy to construct; which could be used over a variety of surfaces and niches; be semi-automatic and require infrequent attention; collect specimens in a condition suitable for identification and taxonomic study; and which would not significantly alter the habitat which it covered.

In a recent WHO/FAO Working Team Report on the entomological aspects of bluetongue research, Jones (1985) and his team drew attention to the comparitive lack of publications on methods suitable for investigating the many different larval habitats of *Culicoides* midges. The traps that have been designed are those of the box-type (Cameron, 1947; Davies, 1966), the cone-type (Bidlingmayer, 1961; Braverman, 1970) or of the flower-pot design (Nielsen, 1963). These are either very rigid; shade the ground surface too much; have condensation problems; or make use of a sticky surface to collect the midges. They are therefore limited in their use.

Mosquito workers have also designed emergence traps suitable for their purposes. Unlike the designs for *Culicoides*, many mosquito emergence traps have a pyramidal shape (Aubin, Bourassa & Pellissier, 1973; LeSage & Harrison, 1979; Slaff, Haeffner, Parsons & Wilson, 1984). Of necessity, these traps are lightweight and designed to operate over semi-aquatic or aquatic surfaces. Except for the float structures along their bases, they are therefore also suitable for the semi-aquatic situations in which many *Culicoides* breed. The trap described in the present paper was based on these pyramidal- or tent-shaped traps. Many of the structural features of the canopy trap for collecting Tabanidae (Catts, 1970) have been incorporated into the final design.

MATERIALS AND METHODS

General features of the trap (Fig. 1–4)

The trap is pyramidal in shape, with a floor area of 1 m², a maximum height of 800 mm and a collecting bottle at the top (Fig. 1). It has 4 almost equilaterally triangular net sides, approximately 1 m long. The angle between the ground and the side of the tent is 55–60°.

Half of the 150 mm wide cloth base forms a skirt with which the trap can be closed off more effectively towards the outside, especially on uneven terrain. The trap is fixed to the ground by 8 small tent pegs, 1 at each corner and 1 in the middle of each side. These pegs pass through eyelet-protected holes in small projecting tags.

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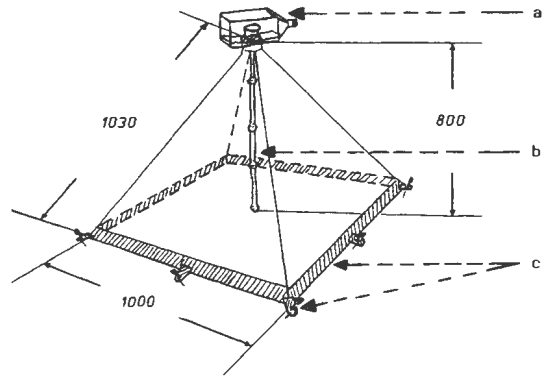

FIG. 1 The erected tent-trap with net sides and removable collecting bottle:
a = collecting bottle; b = centre pole; c = gaberdine skirt with side tags and tent pegs (lower half of skirt not visible here). All measurements are in millimetres.

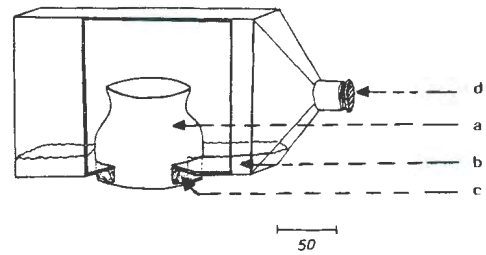

FIG. 2 The removable collecting bottle with window cut out to illustrate emergence chimney:
a = emergence chimney of the bottle; b = collecting fluid; c = collar of silicone sealant; d = neck of the bottle. Scale in millimetres.

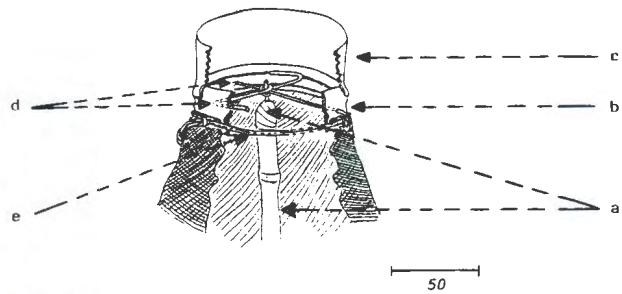

FIG. 3 The top of the trap, onto which the collecting bottle fits, cut away to show internal structure:
a = centre pole with pointed metal tip; b = metal ring; c = plasting supporting collar; d = double metal loop; e = wire and rubber band to attach tent to metal ring. Scale in millimetres.

FIG. 4 Side view of the collecting bottle and upper half of a tent trap in the field.

A central pole keeps the tent upright. The top of the trap ends in a metal ring 90 mm in diameter (Fig. 3 b). This ring has 2 important functions: (1) by means of a double loop in its centre (Fig. 3 d) it keeps the central pole (Fig. 3 a) in position, and (2) an extra plastic cylinder (Fig. 3 c), strongly glued to it, holds the removable collecting bottle (Fig. 2).

Technical details of the trap (Fig. 1–4)

(a) The upper, and biggest, part of the tent-trap is of fine white terylene netting, as used for curtains, with a mesh-aperture of 0,25 mm. For 1 trap, 2,2 m^2 of this material is required (Fig. 1 & 4).

(b) The lower part of the trap consists of a 150 mm wide skirt, made from strong synthetic gaberdine material (to resist rotting), onto which the 8 side tags with eyelets are sewn. At each corner, a 75 mm-deep slit is made in the skirt to allow it to be buried in the ground, folded inwards, or adjusted to seal off any uneven or vegetated surface on which the trap may be set. For 1 trap 0,8 m^2 gaberdine is required (Fig. 1 c).

(c) The eyelets are of brass with an internal diameter of 13 mm. The pegs are of 4,0 mm gauge wire, 150 mm long, with a hook at 1 end.

(d) The sewing is done with polyester thread to prevent rotting and disintegration of the trap in wet surroundings.

(e) The metal ring at the top of the trap (Fig. 3 b) is a shallow screw-ring 80 mm in internal diameter, originally designed for preserve jars with loose metal dome lids. The upper rim is straightened to provide more support for the plastic collar (Fig. 3 c), which in turn supports the collecting bottle. This transparent plastic collar, 50 mm high, with internal diameter of 87 mm, is cut from a suitable commercially available plastic bottle. It is glued to the metal ring with a strong contact adhesive and, after drying, the edges of the contact surfaces are further sealed off with a silicone sealant to give the system some elasticity.

(f) The 2 metal loops within the metal ring are made of 2,5 mm gauge wire (Fig. 3 d).

(g) The metal ring is fixed to the tent in such a way that the terylene, which for extra strength is folded double along its top 20 mm, is pulled over the ring. It is temporarily held in place with an elastic band, then finally attached with 2 mm gauge wire (Fig. 3 e). The end of the wire is covered with masking tape to prevent it from piercing and damaging the tent.

(h) The central pole is a stick or bamboo 0,9–1 m in length, with a headless nail or a 2,5 mm gauge wire pushed into its upper end. In the case of bamboo, this wire is held by masking tape wrapped around it (Fig. 3 a).

(i) The removable collecting bottle (Fig. 2) is made from a 2 or 2,5 ℓ transparent plastic bottle, as commonly used for fruit juices or cooking oil. In the side of this bottle a hole is cut and an emergence-chimney (Fig. 2 a), 95 mm high with a diameter of 90 mm at its base, 75 mm at its apex and 55 mm at its narrowest part, is fitted. At least 80 mm of this emergence-chimney projects into the bottle. It is made from a 1 litre translucent soft plastic bottle, as used for juices and milk. This emergence-chimney is glued to the bottle with contact adhesive and, after it has dried, a collar of flexible silicone sealant is glued around its base (Fig. 2 c).

(j) When the trap is operated, collecting-fluid (Fig. 2 b), consisting of a 0,5 % aqueous solution of "Savlon"[1], is poured into the bottle. "Savlon" is a disinfectant that contains 30 mg/mℓ cetrimide, a germicide and 3 mg/mℓ chlorhexidine gluconate (a detergent). It serves to both break down the surface tension of the water and act as a preservative (Walker & Boreham, 1976).

The mass of the whole trap, with the central pole, 8 pegs and the collecting bottle, is 680–730 g. At the time of writing, each costs about R10,80 for the fabric plus R2,40 for all the other components @ R1 = 0,40 U.S. dollars). It takes about 5 h to make.

Operation of the trap

(a) *Erection*

The central pole is pushed slightly into the ground and the tent is placed over it, with the metal end of the pole through the double loop in the top of the ring; the trap is then fixed to the ground with the pegs. The skirt is either pushed into the ground, if it is muddy, sandy or very soft, or otherwise arranged in such a way that the trap is well closed off.

(b) *Attaching the collecting bottle*

The bottle is filled with about 170 mℓ of the collecting-fluid, then placed on top of the trap with the plastic supporting collar (Fig. 3 c) pushed as far as possible into the emergence-chimney. It is advisable to incline the bottle at about 20–40° for condensate runoff, either by tilting the central pole slightly before the trap is fixed to the ground, or by placing the bottle at a slight angle onto the plastic collar (Fig. 1, 4).

[1] "Savlon", ICI (South Africa) Ltd.

(c) *Collection of insects*

All positively phototactive insects will fly or crawl to the top of the tent; once through the collar and the emergence-chimney they enter the collecting bottle and move further upwards towards the light. The collecting fluid condenses inside the bottle, forming a permanent moist layer on the inside of the bottle. Insects either get trapped in this moist layer and slide downwards into the collecting fluid, or fall directly into it.

(d) *Removing the catch*

The upper part of the tent is tapped to get the insects from this part either to move into the bottle or fall to the ground. The bottle is removed with a slight twisting movement and the opening at the top of the trap is quickly covered to prevent insects from escaping. The collecting fluid in the bottle is gently swirled to trap living insects and concentrate all the catch in the fluid, which is then quickly poured through the neck of the bottle (Fig. 2 d) into an empty container. If insects are still stuck in the catching bottle they are gently washed off with a fresh rinse of about 25 mℓ of catching fluid. The collecting bottle is refilled with collecting fluid and replaced on top of the trap.

Results and Discussion

The trap was tested and used successfully under very different climatic conditions for more than a year in parts of South Africa and for 3 weeks in Germany. Emergence numbers of more than 100 *Culicoides*/m^2/day were quite commonly achieved. The best result to date was 326 *Culicoides*/m^2/day. Because of the minimal shading effect of this trap the area covered was not seriously altered ecologically and continuous breeding of *Culicoides* at 1 site usually went on for months. One trap caught 4 305 *Culicoides* in 74 days, and this was not even at the height of the *Culicoides* season.

If fixed onto solid ground, this trap can withstand storms of grade 7–8 (Beaufort) and even sudden floods up to 0,8 m. However, it does not withstand the inquisitiveness of larger animals. Where this problem exists a protective fence should be erected around the trap.

In contrast to traps with the smaller top openings, such as the "Model Week" of LeSage & Harrison (1979) of those of Aubin *et al.* (1973), the relatively wide opening at the top of this trap, especially that of the emergence-chimney, assists the emergence of insects into the collecting bottle. It is also less likely to be closed off by spider webs.

The shape of this chimney also ensures that everything that has been caught in the bottle stays there. Even if the trap is destroyed and the bottle has fallen to the ground and rolled around, the collecting fluid will not leak out through the emergence-chimney which projects into the bottle. It is thus possible to make a collection and calculate the relative species abundance even if the trap itself has been demolished during that collecting period.

Instead of using relatively volatile, expensive alcohol (LeSage & Harrison, 1979) or formalin (Aubin *et al.*, 1973), the cheaper "Savlon" plus water is used. Dishwashing detergent (LeSage & Harrison, 1979) is unsuitable, as smaller insects, especially newly emerged *Culicoides*, disintegrate even after 1 day. Contrary to the finding of LeSage & Harrison (1979), condensation is not a problem in the head of this trap, but is actually useful because it helps to trap the insects as they enter the collecting bottle. Consequently, only infrequent visits to the trap are necessary to collect the catch.

This emergence trap can therefore be regarded as semi-automatic. Furthermore, one can collect the catch at any time of the day, irrespective of light, temperature or other weather conditions. There are also no problems, such as aspirating single insects or transporting sticky panels to the laboratory and there detaching damaged insects.

The tent trap can equally well be erected over a variety of different niches (e.g. fresh water or acid, alkaline or organically polluted water or soil), on uneven terrain, on slopes, over river banks, standing or slowly flowing waters, as well dung-pats or over vegetation up to a height of 0,8 m.

Under the hot weather conditions of the Afrotropical Region, where temperatures in direct sunshine, i.e., also in the catching bottle, may rise to well over 40 °C, captured insects can stay up to 2 weeks in the bottle before being removed. The "Savlon" solution preserves the midges in good enough condition for both identification and mounting purposes.

Under the climatic conditions of the South African highveld, with over 4 500 h of sunshine per annum, the stretched terylene netting has a lifespan of 10–11 months when exposed continuously. The plastic collecting bottles do not last much longer as they get dark and very brittle as a result of the high UV-radiation. After every 2–3 months the emergence-chimney of the collecting bottle must be partially re-glued. The central bamboo pole will also last about 1 year.

This collapsible tent trap was originally designed to catch emerging *Culicoides*, but it is equally effective for catching a variety of other Arthropoda that are associated with the larval habitats of *Culicoides*, e.g. Coleoptera, Diptera, Hemiptera, Odonata, Orthoptera, Neuroptera, Thysanoptera, and even Collembola and Arachnida (Araneae and Acari).

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