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### Authors

Linley, J. R.  
Cheng, L.

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## THE GROOMING ORGANS OF *CULICOIDES* (DIPTERA: CERATOPOGONIDAE).

J. R. LINLEY<sup>1</sup> and L. CHENG<sup>2</sup>

**ABSTRACT.** The fore tibial and hind tibio-tarsal grooming apparatus of *Culicoides melleus* and *C. furens* is described. The hind organ is more complex. The fore organ consists of a single comb of closely spaced spines supplemented by a few adjacent thickened setae, the whole complex being situated at the inner tibial apex. The portion at the inner distal end of the tibia consists of four major

spines just proximal to which is a comb of closely spaced spines adjoined dorsally by another complex comb made up of two superimposed rows of yet smaller spines. Thickened setae, considered part of the grooming apparatus, are found over a small region adjacent to the tibial combs, and along almost the entire inner surface of the first tarsal segment.

### INTRODUCTION

In *Culicoides melleus* (Coquillett) the grooming organs of the hind legs, particularly of the female, perform important functions in the sexual behavior. They assure engagement of the female legs on the male as she assumes the active role during separation from copulation and, in both sexes, they are used to remove the adherent spermatophore (Linley and Adams, 1972). In this paper we describe the grooming apparatus of *C. melleus* and *C. furens* (Poey) as representative of the genus. Grooming appears to be an important activity for these small flies, if one judges by the amount of time devoted to it. The same is probably true of other Diptera, yet grooming behavior in this group has received very limited study (Szebenyi, 1969). Even mosquitoes were neglected in this respect until Goldman *et al.* (1972) recently described the grooming organs of *Aedes aegypti* (L.).

### MATERIALS AND METHODS

Adult *C. melleus* were obtained from pupae; *C. furens* were collected from Isla San Jose, Baja California, Mexico. For conventional microscopy, material was prepared and glycerine mounted between double coverslips on aluminum slides, according to the methods of McIver (1969). There was a

slight departure from McIver's procedure in that the appendages were removed in a small drop of glycerine on one of the coverslips, just before the other was lowered into position. This method was excellent for examination of the legs and is very good also for the antennal sensilla. Wherever the average numbers of spines in grooming combs are given, determinations were based on 8 counts for each sex.

Specimens used for scanning electron microscope (SEM) studies were dehydrated in ethanol, freeze-dried by using the Freon critical point drying method, and then mounted on specimen stubs and coated with gold-palladium in the usual way. All the illustrations are scanning electron micrographs taken with a Cambridge S-4 SEM.

### DESCRIPTION

In *Culicoides*, there are grooming organs only on the fore and hind legs. No such structures are to be seen on the middle legs and, from cursory observation, the middle legs do not appear to be used for bodily cleansing. The points raised in the description refer to both species and both sexes unless otherwise indicated.

**THE FORE TIBIAL GROOMING ORGAN.** The organ of each fore leg is situated at the distal end of the tibia, on the inside of the leg. The primary component is a comb of spines, very closely spaced, and diagonally positioned with respect to the long axis of the leg (Fig. 1), so that the anterior end of the comb is more distally situated. Also at the anterior end is a large spur (large arrow,

<sup>1</sup> Florida Medical Entomology Laboratory, Florida Division of Health, P. O. Box 520, Vero Beach, Florida, 32960

<sup>2</sup> Scripps Institution of Oceanography, P. O. Box 1529, La Jolla, California, 92037

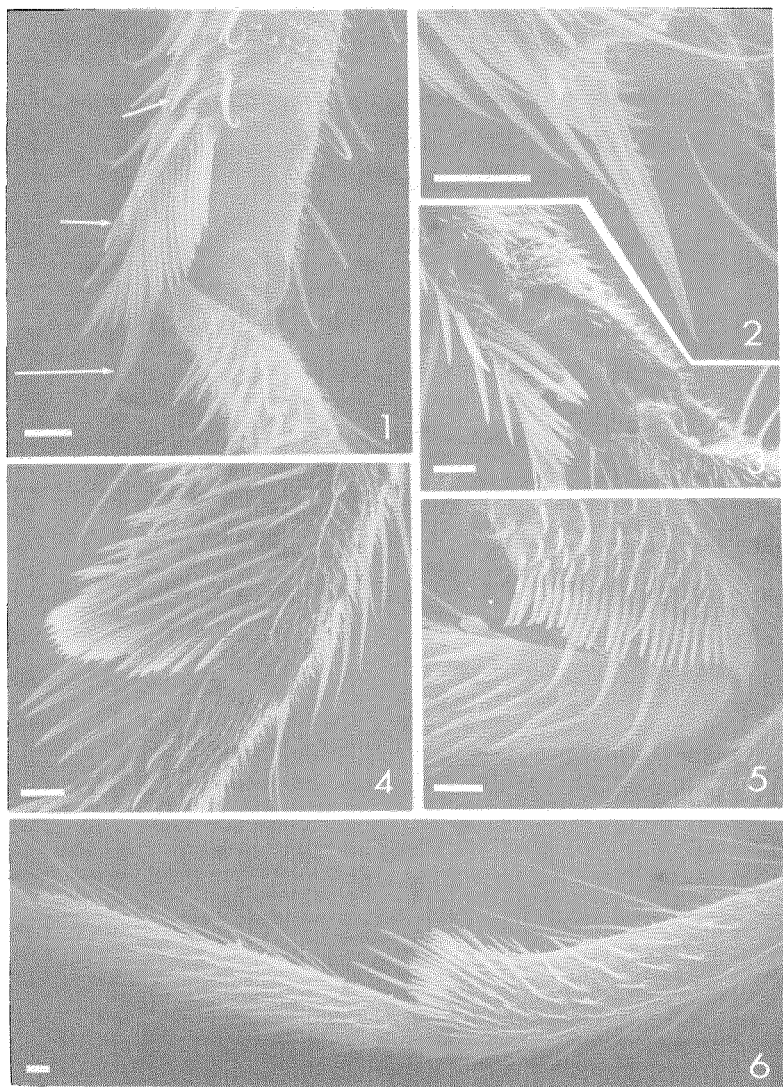


FIG. 1. *C. furens* : entire fore tibial grooming organ. FIG. 2. *C. furens* : single composite spur of fore tibial grooming organ. FIG. 3. *C. mellesus* : four-spined spur of fore tibial grooming organ. FIG. 4. *C. mellesus* : entire hind tibial grooming organ. FIG. 5. *C. furens* : entire hind tibial grooming organ. FIG. 6. *C. mellesus* : entire hind tibio-tarsal grooming apparatus.

White bars correspond to 10  $\mu$ m.

Fig. 1). In the *furens* female this is seen to consist of one large composite spine (Fig. 2) and, in the *melleus* female, of a group of four separate bunched spines (Fig. 3). All spines in the combs have a slightly spiral fluting, which is not continuous around the entire spine, but bilateral, as may be detected in Fig. 5.

There was an average of 17 spines (range 17-18) in the comb (excluding the spur group) of both male and female *furens*, consistently 12 in the male *melleus*, and an average of 13 (range 12-14) in the female *melleus*. The grooming function of the comb is supplemented by a small array of proximally adjacent spines (e.g. small arrows, Fig. 1), which are somewhat thicker than those farther up the tibial shaft.

**THE HIND TIBIO-TARSAL COMPLEX GROOMING ORGAN.** The apparatus on each hind leg is considerably more complex. Elements of the hind organ are found at both the extreme inside distal portion of the tibia and along almost all of the first tarsal segment. The tibial array consists most prominently of four major spines (Fig. 4, Fig 5). Just proximal to the large spines is a comb composed of very closely spaced smaller spines (Fig. 4, Fig. 5). These averaged 19 (range 18-20) in number in the *furens* male, 18 (range 16-22) in the female, and 20 (range 20-21) in the *melleus* male, 20 (range 18-21) in the female. Dorsally adjacent to this comb is a more compact one (Fig. 4, Fig. 5), consisting of 13-16 very closely packed and somewhat smaller spines upon which are superimposed between four and seven more of shorter length (Fig. 4, Fig. 5).

In addition to the distinct combs, the setae of the inner distal portion of the tibia are stouter and more densely arrayed than farther up the leg (Fig. 4, Fig. 6), and are obviously functional with respect to grooming. Below the tibia, almost the entire inner aspect of the first tarsal segment bears thickened setae, giving the appearance of a brush (Fig. 6). When viewed at low magnification, the appearance of the stout setae in the entire region of the tibial and first tarsal segments indicate that the whole of this length of the leg is adapted for bodily cleaning (Fig. 6).

## DISCUSSION

Although Goldman *et al.*, 1972 quite properly proved the grooming function of the fore tibial combs in *Aedes aegypti*, we feel that no observer, having seen the behavior in question, could doubt that the function of both the fore and hind apparatus in *Culicoides* is similar. Both male and female *C. melleus* have been observed for many hours in connection with other work. The organs of the hind legs in both sexes, particularly the four major spines, are used to groom off the spermatophore after copulation. The female has been photographed at the point of doing this (Linley and Adams, 1972). Moreover, it is with the comb complex of the hind legs that the female thrusts at, or attempts to "groom off" a second mate when she becomes unreceptive after a first mating (Linley and Adams, in press). The fore tibial organs are used principally to groom the head region, especially the antennae and mouthparts.

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