

## Sensilla coeloconica ringed by microtrichia in host-seeking biting midges

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**Abstract.** The distribution and morphology of antennal sensilla coeloconica in parasitic and predaceous biting midges were studied in females of *Forcipomyia* (feeding on the blood of frogs), *Atrichopogon* (feeding on haemolymph), *Austroconops*, *Culicoides* (feeding on the blood of birds and mammals) and *Brachypogon* (feeding on haemolymph and dissolved tissues of insects) (all: Diptera: Ceratopogonidae). A Lower Cretaceous female of *Archiculicoides* (Diptera: Ceratopogonidae) from Lebanese amber, which fed on the blood of unknown vertebrates, was also examined. In sensilla coeloconica ringed by microtrichia, the peg is grooved longitudinally and protrudes distinctly from the pit. We suggest that the microtrichia encircling the protruding peg form a structure resembling a picket fence in order to maintain a higher level of humidity, which facilitates the capture and transport of odour molecules through the channels in the peg wall. Sensilla coeloconica ringed by microtrichia function as very effective chemoreceptors in host- and prey-seeking activity. During the evolution of Ceratopogonidae, sensilla coeloconica with a fence of microtrichia have evolved twice in groups feeding on the blood of vertebrates (i.e. in the basal lineage: Lower Cretaceous or earlier) and in the subgenus *Lasiohelea* of *Forcipomyia* (Palaeogene). Sensilla coeloconica ringed by microtrichia are described for the first time in the relict genus *Austroconops*.

**Key words.** Ceratopogonidae, chemoreceptors, Diptera, evolution, haematophagy, microtrichia, sensillum coeloconicum.

### Introduction

The biting midges (Diptera: Ceratopogonidae) are highly significant disease vectors of great medical importance. The breadth of the range of habitats in which haematophagous biting midges develop makes these midges predominant vectors of pathogens (Campbell & Wilson, 2002). They transmit a number of arboviruses, trypanosomids and filarial nematodes to humans, as well as to domestic and wild animals (Mellor *et al.*, 2000; Carpenter *et al.*, 2008; Sperlova & Zendulkova, 2011; Seblova *et al.*, 2012). The risk for infection with bluetongue virus continues to increase because biting midges of the genus *Culicoides* are easily transported via trade networks (Napp *et al.*, 2013). Moreover, the salivary proteins of some Ceratopogonidae induce severe allergic dermatitis (Yeruham *et al.*, 2004; Langner *et al.*, 2008).

The basic diet of biting midges includes carbohydrates (honeydew, sap or nectar) and obviously water, but as these are usually insufficient for oogenesis, most females require protein-rich meals (blood, haemolymph, dissolved tissues or pollen) to initiate the second and additional ovarian cycles (Szadziewski *et al.*, 1997). Antennal sensory organs are involved in complex host-seeking behaviour, which determines breeding and survival (Braverman *et al.*, 2012). The antennae of biting midges bear five types of sensillum: sensillum chaeticum; sensillum trichoideum; sensillum basiconicum; sensillum coeloconicum, and sensillum ampullaceum (Blackwell *et al.*, 1992; Kline & Axtell, 1999). In crepuscular and nocturnal Ceratopogonidae, some sensilla coeloconica can be easily recognized by the presence of microtrichia, which form a ring around the sensory peg (Blackwell *et al.*, 1992; Blackwell, 2004; Glukhova, 2005).

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