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Ultrastructure of antennal sensilla in *Hydrotaea armipes* (Fallén) (Diptera: Muscidae): New evidence for taxonomy of the genus *Hydrotaea*

QI-KE WANG[1], XIAN-HUI LIU[1] PENG-FEI LU[2,3] & DONG ZHANG[1,3]

[1]*College of Nature Conservation, Beijing Forestry University, Beijing 100083, China*
[2]*The Key Laboratory for Silviculture and Conservation of Ministry of Education, College of Forestry, Beijing Forestry University, Beijing 100083, China*
[3]*Corresponding author. E-mail: ernest8445@163.com (D. Z.); lpengfei@126.com (P.-F. L.)*
Qi-ke Wang and Xian-hui Liu contributed equally to this work.

Abstract

The morphology and ultrastructure of the antennal sensilla of male *Hydrotaea* (*Hydrotaea*) *armipes* (Fallén) are examined via scanning electron microscopy in order to highlight the importance of antennal sensilla as a source of morphological characters for taxonomy and phylogeny of *Hydrotaea*. Antennal scape and pedicel have only one type of sensilla, the sharp-tipped chaetic sensilla, whereas antennal funiculus possesses several types of sensilla, including trichoid sensilla, two subtypes of basiconic sensilla, coeloconic sensilla and clavate sensilla. These results are compared with previously published studies on other fly species, especially on *H.* (*H.*) *irritans* (Fallén) and *H.* (*Ophyra*) *chalcogaster* (Wiedemann), and there are possible uniquely derived characters or diagnostic characters examined on antennal pedicel and antennal funiculus, which suggests either affinities and divergence between species at subgenus level. Thus, new morphological evidence is provided, which might help to develop the much disputed taxonomy of genus *Hydrotaea* Robineau-Desvoidy in future.

Key words: *Hydrotaea armipes*, antenna, sensilla, scanning electron microscopy

Introduction

The genus *Hydrotaea* Robineau-Desvoidy is the largest and most diverse within the azeliine genera, with over 100 described species (Savage & Wheeler 2004). According to classification proposals of different taxonomists, there is still a controversy over the taxonomy of the genus *Hydrotaea*, for the morphological and biological characters of larvae and adults in *Hydrotaea* are extremely similar to those in *Ophyra* Robineau-Desvoidy. Some taxonomists suggested that *Ophyra* and *Hydrotaea* are synonyms (Pont 1989; Savage & Wheeler 2004), but others did not recognize that synonymy and treated the former as a separate genus (van Emden 1965; Skidmore 1985; Carvalho *et al.* 1993; Carvalho & Couri 2002).

Although molecular characters are nowadays widely used to reconstruct phylogenetic relationships of Diptera, novel morphological characters were recently applied with varying degrees of success as well (Yeates & Wiegmann 2005; Giroux *et al.* 2010). As the main olfactory sense organs of flies, antennae play an important role in their life history (Fernandes *et al.* 2005; Smallegange *et al.* 2008) and manage to evolve particular characters to improve their fitness in environment (Ross 1992; Sukontason *et al.* 2004; Zhang *et al*. 2012a; Zhang *et al*. 2012b). Therefore, the variety of sensilla in different species examined might be shared by groupings according to taxonomic classifications (Marshall & Lewis 1971), which indicates that antennal sensilla could serve as a source of morphological characters for taxonomy and phylogeny, and more attention should be given to sensory structures.

Hydrotaea (*H.*) *armipes* (Fallén) is a fly species of medical and forensic importance in many parts of the world (Xue & Zhao 1998), and previously, the antennal sensilla of two other species in the genus, *H.* (*H.*) *irritans* (Fallén) (Been *et al.* 1988) and *H.* (*Ophyra*) *chalcogaster* (Wiedemann) (Sukontason *et al.* 2007), have been studied. Thus,

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more morphological information of re-evaluating their taxonomy, detailed comparisons are made on the antennal sensilla among *H.* (*H.*) *armipes*, *H.* (*H.*) *irritans* (Been *et al.* 1988) and *H.* (*O.*) *chalcogaster* (Sukontason *et al.* 2007).

Although no sensilla other than Ch is found on antennal pedicel of *H. armipes*, a group of quite similar unidentified sensilla are separately discovered on those of *H. irritans* and *H. chalcogaster* (Been *et al.* 1988, Sukontason *et al.* 2007). On some extent, these structures can be recognized as one type of plaques disclosed by Greenberg (1970) and Greenberg & Ash (1972), which commonly occur in Calyptratae. Nevertheless, these structures in *H. irritans* and *H. chalcogaster* differs from all the plaques described before (Greenberg 1970; Greenberg & Ash 1972; Been *et al.* 1988; Sukontason *et al.* 2007), implying that they might serve as derived character in genus *Hydrotaea* and species in two subgenera have close affinities with each other.

Among funicular sensilla, there are three distinctive features that differentiate flies in subgenus *Hydrotaea* from that in *Hydrotaea Ophyra*. More types of Ba are detected in *H. armipes* (two types) and *H. irritans* (three types) (Been *et al.* 1988) than in *H. chalcogaster* (only one type) (Sukontason *et al.* 2007). Unlike the Co with a smooth peg described in the antennal sensory complex of *H. chalcogaster* (Sukontason *et al.* 2007), the Co in *H. armipes* and *H. irritans* (Been *et al.* 1988) are characterized by deep longitudinal grooves in their walls. Besides, Cl are discovered in two species of *Hydrotaea s. str.* (Been *et al.* 1988), while none exists in the species of subgenus *Ophyra* (Sukontason *et al.* 2007).

This research provides additional information that will enhance future developments in taxonomy of the genus, except for the traditional distinction that these two subgenera of *Hydrotaea* can only be distinguished from each other by male fore femur with distinctly indentation on ventral surface facing the ventral projection on basal part of fore tibia (Savage & Wheeler 2004). However, the sensillar morphology of the taxon sample alone is far from a perfect predictor for success in phylogenetic analyses. Therefore, an exhaustive study of structural variations in the Calyptratae would probably provide more useful information for its phylogeny, and further research on the morphology of more species of the two subgenera, *Hydrotaea s.str.* and *Ophyra*, will be especially important to improve our understanding of *Hydrotaea*.

Phylogeny is always absorbing the latest technologies to solve some of the oldest problems throughout history, especially when there is a controversy over taxon relationships. The widely used molecular tools are the perfect example of this trend (Bernasconi *et al.* 2000; Kutty *et al.* 2008; Kutty *et al.* 2010; Wiegmann *et al.* 2011). However, it raises as much questions as it solves (Nirmala *et al.* 2001; Dittmar *et al.* 2006; Petersen *et al.* 2007; Kutty *et al.* 2008), leaving the classical morphological study the mainstream tool for phylogeny even today. Because of the disability in high resolution, microscopes are crippled in cases like this. As an economical, convenient, fast and precise way to observe fine structure on surface, SEM could be a valuable increment in phylogenetic analysis.

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