



The *Cheilosia canicularis* group (Diptera: Syrphidae): species delimitation and evolutionary relationships based on wing geometric morphometrics

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Abstract

A landmark-based geometric morphometric approach was used to assess differences in the size and shape of wing among/within three species of the *Cheilosia canicularis* group (Diptera: Syrphidae): *C. canicularis*, *C. himantopus* and *C. orthotricha*. Wing size and shape variation was observed from 25, 176 and 41 specimens of *C. canicularis*, *C. himantopus* and *C. orthotricha*, respectively, collected from six localities on the Balkan Peninsula. Significant differences in wing size were obtained among the analysed species and canonical variate analysis showed that wing shape was sufficiently different to allow the correct classification of 73% individuals of *C. canicularis*, 80% of *C. orthotricha* and 94% of *C. himantopus*, and clear delimitation of the species pairs *C. canicularis*/*C. orthotricha* and *C. himantopus*/*C. orthotricha*. In all analysed species, the consistent sex dimorphism in wing shape was observed indicating that female specimens had shorter and broader wings than males. The UPGMA cluster analysis based on squared Mahalanobis distances revealed close accordance with previously published phylogenetic relationships of these species indicated by allozyme and DNA sequence data analysis. Our results suggested that wing parameters contain useful information in quantification phenotypic variation and identification of species in this challenging group for taxonomy and systematics.

Key words: *Cheilosia canicularis*, *C. himantopus*, *C. orthotricha*, species identification, phenotypic variability, wing geometric morphometrics

Introduction

The genus *Cheilosia* Meigen, 1822 (Syrphidae, Diptera) is the largest genus of European hoverflies with more than 175 European species (Speight 2007). It is primarily distributed in the Palearctic, with the highest diversity in the forest habitats, especially in broad-leaved woodlands (Vujić 1996). This paper focused on *Cheilosia canicularis* (Panzer), *C. himantopus* (Panzer) and *C. orthotricha* Vujić & Claussen, a group of species belonging to a broadly defined the *C. canicularis* group that comprises two additional species, *C. japonica* Herve-Bazin and *C. yesonica* Matsumura (Barkalov 2002). The species *C. canicularis*, *C. himantopus* and *C. orthotricha* have throughout Palearctic distribution, while the other two occur only in Japan (Peck 1988).

The taxonomy of the *C. canicularis* group was a matter of disagreement. The complex relationship between *C. canicularis* and *C. himantopus* has generated controversy regarding taxonomic rank. Since it was described in 1801, the *C. canicularis* species has been known under number of synonyms (Vujić & Claussen 1994; Stuke & Claussen 2000). Taxonomic difficulties in the correct identification of these two species were caused by low levels of phenotypic variation and the great similarity in larval development (Stuke & Claussen 2000; Stuke 2000). Due to these, it has been hypothesized that the taxon is one species with two generations (Vujić & Claussen 1994) or it is indeed two evolutionary independent units (Stuke & Claussen 2000). The nomenclatural status of *C. himantopus* was recently clarified by Stuke & Claussen (2000) based on detailed