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Two new species of *Zwicknia* Murányi, with molecular data on the phylogenetic position of the genus (Plecoptera, Capniidae)

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Abstract

Analyses of the nuclear DNA marker 28S confirm the distinctness of the recently erected stonefly genus *Zwicknia* Murányi 2014, which encompasses the species until recently referred to as '*Capnia bifrons*.' Two new species are described and illustrated with line drawings: *Z. westermanni* Boumans & Murányi, **sp. n.** from Germany and France, and *Z. komica* Murányi & Boumans, **sp. n.** from the Komi Republic in northwestern Russia. The intersexual communication of the former species is described in detail.

A phylogenetic analysis of 87 sequences of the mitochondrial marker cytochrome c oxidase I (COI) representing the six described European species of *Zwicknia* and outgroup taxa reveals large genetic distances within the species *Z. rupprechti* and *Z. bifrons*, while the haploclade including all specimens of the latter species also includes *Z. acuta* and *Z. westermanni*. The mitochondrial phylogeny is assumed not to represent the species phylogeny. In contrast, a phylogeny of the nuclear markers 28S and ITS reveals that *Z. rupprechti* and *Z. westermanni* are more closely related to each other than either is to *Z. bifrons*. This finding is in line with the drumming patterns of the former two species being relatively similar.

Key words: Plecoptera, Capniidae, *Zwicknia*, *Capnia*, Europe, new species, COI, 28S, ITS

Introduction

'*Capnia bifrons*' (Newman, 1838) has for some decades been suspected to refer to a species complex rather than a single species. In particular, Rupprecht (1982; 1997) already distinguished five types of mating signals for various European populations. Recently, Murányi *et al.* (2014) erected the genus *Zwicknia* Murányi, 2014 to encompass the species previously referred to as *C. bifrons* as well as the central Palaearctic species belonging to the *C. bifrons* species group sensu Zhiltzova (2001). Murányi *et al.* (2014) distinguish and describe four species until then subsumed under '*Capnia bifrons*': *Zwicknia bifrons* (Newman, 1838), originally described from Scotland, widespread in Europe, type species; *Z. acuta* Murányi & Orci, widespread in central and eastern Europe; *Z. kovacsi* Murányi & Gamboa from the Eastern Carpathians and *Z. rupprechti* Murányi, Orci & Gamboa, widespread in central and southeastern Europe.

Here, we describe two additional species of *Zwicknia* on the basis of male genital morphology and molecular markers: *Z. komica* **sp.n.** and *Z. westermanni* **sp. n.**. For the latter species, we also provide additional details on its intersexual communication signals, which were illustrated and succinctly described as the form 'Cappan' by Rupprecht (1997). Sequences of the mitochondrial gene cytochrome c oxidase I (COI) of these species are analysed together with new sequences of *Z. bifrons* and *Z. rupprechti* from western and northern Europe and the data from southeastern Europe published in Murányi *et al.* (2014).

As a first contribution towards the phylogeny of the genus, we present an analysis of nuclear DNA sequences of the large subunit ribosomal RNA (28S) and internal transcribed spacer (ITS) of four *Zwicknia* species, with an interpretation of the evolution of drumming characters. In addition, we analyse 28S sequences of *Zwicknia* species together with other West Palaearctic and Nearctic Capniidae to evaluate the position of the genus relative to *Capnia* s.s. and within the family.

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APPENDIX 1. Specimens list.

Supplement 1. Initial alignment of Capniidae 28S sequences.
Supplement 2. Final alignment of Capniidae 28S sequences. After the indel regions were removed from the initial Capniidae alignment, the resulting matrix was aligned with outgroup *Leuctra hippopus*.
Supplement 3. Initial alignment of *Zwicknia* ITS sequences.
Supplement 4. Final alignment of *Zwicknia* ITS sequences. After the indel regions were removed from the initial *Zwicknia* alignment, the resulting matrix was aligned with outgroup sequences of *Capnia* s.s. *nigra* and *Capnia* s.l. *vidua*.