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Revision and phylogeny of the caddisfly subfamily Protoptilinae (Trichoptera: Glossosomatidae) inferred from adult morphology and mitochondrial DNA

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ABSTRACT

Protoptilinae Ross, 1956, is the most diverse subfamily belonging to the saddle- or tortoise-case-making caddisfly family Glossosomatidae Wallengren, 1891. The subfamily has a disjunct distribution: 5 genera are known from the East Palaearctic and Oriental regions; the remaining 13 are restricted to the Nearctic and Neotropical regions. Monophyly of Protoptilinae and each of 17 genera was tested using 80 taxa, 99 morphological characters, and mitochondrial DNA (COI). Additionally, homologies of morphological characters were assessed across genera and a standardized terminology for those structures was established. Mitochondrial DNA data were unavailable for 55 of the 80 taxa included in this study. To test the effects of the missing molecular data, 5 different datasets were analyzed using both parsimony and Bayesian methods. There was incongruence between the COI and morphological data, but results suggest the inclusion of COI data in a combined analysis, although incomplete, improved the overall phylogenetic signal. Bayesian and parsimony analyses of all 5 datasets strongly supported the monophyly of Protoptilinae. Monophyly of the following genera was also supported: *Canoptila* Mosely, 1939; *Culoptila* Mosely, 1954; *Itauara* Müller, 1888; *Mastigoptila* Flint, 1967; *Mortoniella* Ulmer, 1906; *Protoptila* Banks, 1904; and *Tolhuaca* Schmid, 1964. Several taxonomic changes were necessary for classification to reflect phylogeny accurately. Accordingly, *Matrioptila* Ross, 1938; *Poeciloptila* Schmid, 1991; *Temburongpsyche* Mal-

icky, 1992; and *Nepaloptila* Kimmins, 1964, are designated new junior synonyms of *Padunia* Martynov, 1910. Additionally, the endemic Caribbean genera *Campsiophora* Flint, 1964, and *Cubanoptila* Sykora, 1973, are designated new junior synonyms of *Cariboptila* Flint, 1964. Diagnoses and a key to the subfamilies of Glossosomatidae and world genera of Protoptilinae incorporating these taxonomic changes are provided.

Key words: taxonomy, identification key, male genitalia, female genitalia, morphology, COI, missing data, combined analyses

INTRODUCTION

Protoptilinae Ross, 1956, is 1 of 3 subfamilies belonging to the saddle-, or tortoise-case-making caddisfly family Glossosomatidae Wallengren, 1891. The other 2 subfamilies are Agapetinae Martynov, 1913 [1912] (~200 species), containing *Agapetus* Curtis, 1834; *Catagapetus* McLachlan, 1884; and *Electragapetus* Ulmer, 1912 (6 spp.), and known from the Nearctic, East and West Palaearctic, Australasian, Oriental, and Afrotropical biogeographic regions; and Glossosomatinae Wallengren, 1891 (~100 spp.), consisting of *Anagapetus* Ross, 1938, and *Glossosoma* Curtis, 1834, and known from the Nearctic, East and West Palaearctic, and Oriental regions (Morse 2013). Protoptilinae is the most diverse subfamily with 310 species (including 5 fossil spp.) and 17 genera (Holzenthal *et al*. 2007b, Morse 2013). The subfamily has a disjunct distribution (Fig. 1): 4 genera are known from the East Palaearctic and Oriental regions; the remaining 13 are restricted to the Nearctic and Neotropical regions (Morse 2013). Protoptilinae is the only glossosomatid subfamily to occur in the Neotropics, and it is there where the subfamily reaches its greatest diversity (280 species) and also exhibits a high degree of endemism at both the species and genus levels.

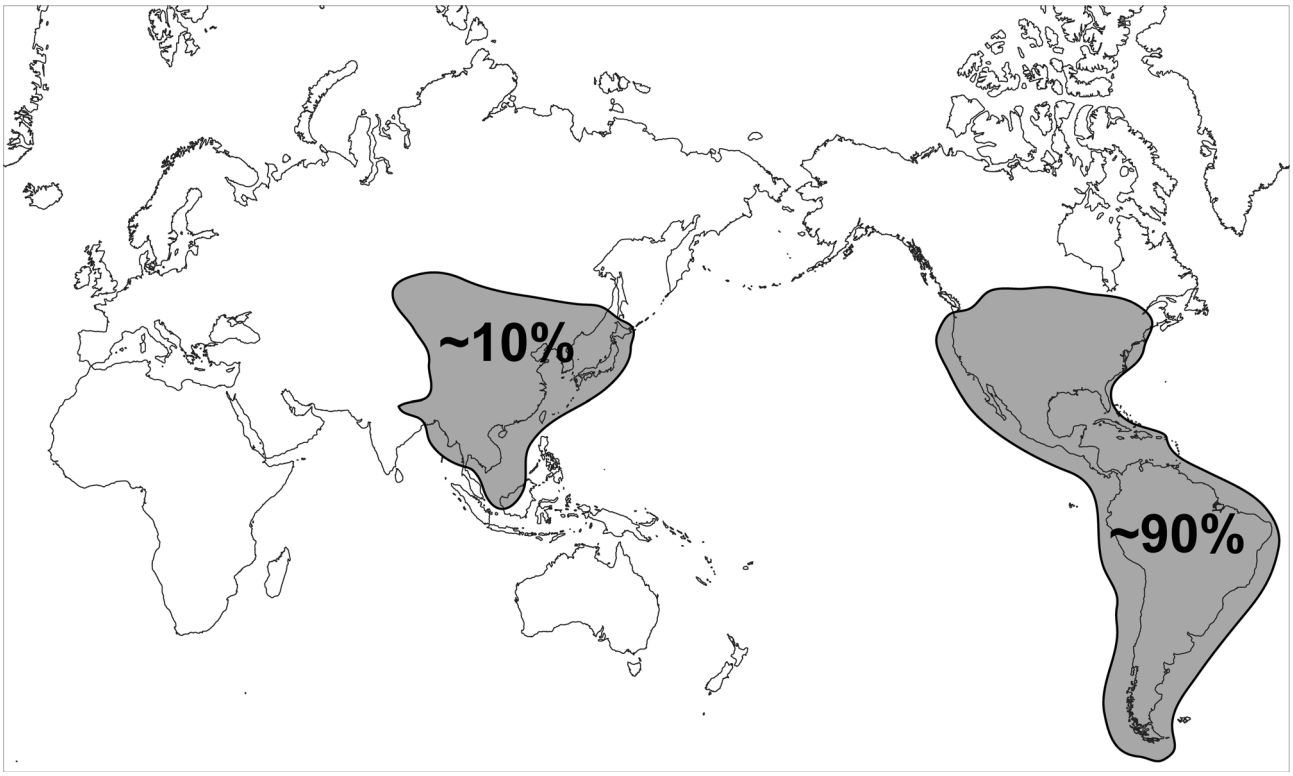

FIGURE 1. Approximate known distribution of Protoptilinae. The Neotropical region is the most diverse for this subfamily, with 280 out of 310 described species.

The objectives of this study were to 1) test the monophyly of Protoptilinae, 2) evaluate the monophyly of individual genera traditionally placed in Protoptilinae, and 3) infer relationships among genera. Additionally, homologies of morphological characters were assessed across genera and a standardized terminology for those structures was established. Generic boundaries were also delimited, resulting in new diagnoses and a key to the adults of world Protoptilinae. This was the first study to use modern cladistic and Bayesian methods in a