

Molecular Phylogeny of Three Soil-dwelling Species of the Genus *Mundochthonius* in Japan (Pseudoscorpiones: Chthoniidae)*

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The genus *Mundochthonius* is a group of pseudoscorpions of small body size (less than ca. 1 mm in body length). They are usually found in forest soil (litter) and occasionally in caves. Twenty-four species have been described from Asia, North America, and Europe. Three species and three subspecies endemic to Japan have been recorded: *M. japonicus japonicus* Chamberlin, 1929 (soil-dwelling), *M. japonicus scolytidis* Morikawa, 1954 (soil-dwelling), *M. japonicus imadatei* Morikawa, 1956 (cavernicolous), *M. japonicus tripartitus*, 1956 (cavernicolous), *M. kiyoshii* Sakayori, 2002 (soil-dwelling), and *M. itohi* Sakayori, 2009 (soil-dwelling). The soil-dwelling Japanese species have been classified on the basis of the following morphological characters: body length, carapacial chaetotaxy, abdominal tergal chaetotaxy, and proportions of the pedipalpal femur. These characters are, however, highly variable, and their variations overlap among species. Conversely, the three subspecies of *M. japonicus* exhibit morphological differences equivalent to those found at the species level. In the present study, we conducted a molecular phylogenetic analysis of Japanese *Mundochthonius* species and subspecies using mitochondrial cytochrome *c* oxidase subunit I (COI) and nuclear 18S rRNA genes as genetic markers and performed a principal component analysis (PCA) for 19 morphological characters to clarify the phylogeny of these species and reevaluate their taxonomy.

For use in the phylogenetic analysis and PCA, we sampled 57 specimens of soil-dwelling *Mundochthonius* species. The samples were collected from 20 localities in the distribution range of the genus in Japan [from Hokkaido to

Yakushima (Kagoshima Prefecture)].

In molecular phylogenetic trees based on COI and 18S rRNA genes, five major clades (clades 1-5) were recognized using either locus. Although the OTUs included within each clade were identical in both trees, the relationships of the major clades differed. The five clades were divided into three groups based on body size: clade 1, clades 2+5 and clades 3+4. Individuals morphologically identifiable as the three soil-dwelling species *M. japonicus scolytidis*, *M. kiyoshii* and *M. itohi* were included in each group, but the PCA did not classify these three groups as separate species. We then looked for morphological differences among the samples included in each clade. In clades 2 and 3, we found morphological characteristics qualitatively different from the samples included in clades 1, 4 and 5. The five clades can be classified into the following taxonomic groups: clade 1, *M. itohi*; clade 2, *M. sp. MA* (similar to *M. kiyoshii*, but distinguishable from *M. kiyoshii* by the number of anterior setae on the external genital pouch); clade 3, *M. sp. MB* (similar to *M. japonicus scolytidis*, but distinguishable by the shape of the knob-like protuberance on top of the cheliceral movable finger); clade 4, *M. japonicus scolytidis*; and clade 5, *M. kiyoshii*.

Wider geographical sampling of *Mundochthonius* species, as well as molecular phylogenetic analyses using additional loci and phylogenetic tree reconstruction methods, will improve our future studies and verify the phylogenetic relationships of soil-dwelling species of Japanese *Mundochthonius*.

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