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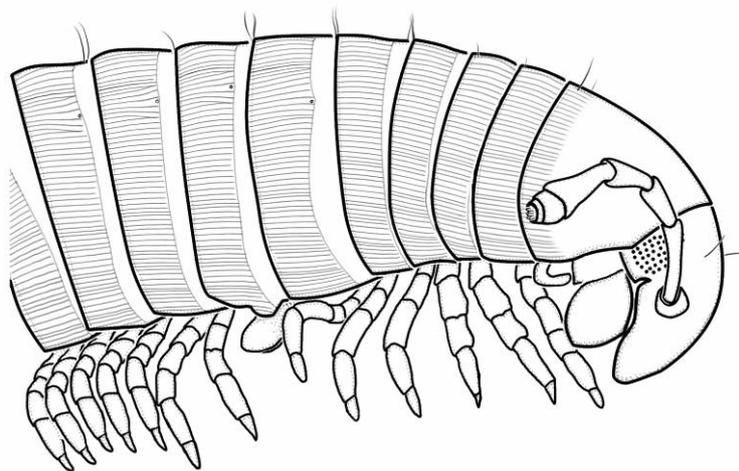
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## **TAXONOMIC REVISION OF EUROPEAN SPECIES OF THE MILLIPEDE**

**GENUS *MEGAPHYLLUM* VERHOEFF, 1894**

**(DIPLOPODA: JULIDA: JULIDAE)**

### **Summary of PhD Thesis**



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## INTRODUCTION

The millipede genus *Megaphyllum* VERHOEFF, 1894 with its 49 species is one of the most species-rich julid genera (fam. Julidae) in Europe (ENGHOFF & KIME 2009). More than a century has passed since its original description while its taxonomic concept changed many times; and its content is still debated. In the meantime, species number increased, more and more demanding a thorough revision. The last overview of the genus was published by ATTEMS (1940) who has dealt with all subgenera but not all species of that time. Later some authors published partial revisions, dealing with one or two subgenera only (e.g. STRASSER 1974, GOLOVATCH *et al.* 2004), but in most cases newly described species were not allocated to any subgenera.

*Megaphyllum* species are distributed not only in Europe: together with the Caucasian and Anatolian species the genus contains at least 70 species and subspecies (GOLOVATCH *et al.* 2004). The highest species and subgenus number in Europe can be found in the Balkan Peninsula, especially in Greece (33 species, 22 endemic—8 living only on separate Greek islands). Descriptions of species and subgenera have in most cases been based solely on the structure of male gonopods, which resulted in overlapping subgenera. Numerous species are represented only by their type material, some species have been described on the basis of females only (unfortunately in these cases without investigation of vulvae), and new material has rarely been collected. The lack of samples makes morphological as well as molecular investigations difficult, for the latter freshly collected, specially conserved individuals are needed—at least according to the current techniques. Thus, the present thesis is based exclusively on morphological investigations. The aims are according to the followings:

- revision of the European *Megaphyllum* species—Caucasian and Anatolian species form distinct, already revised groups;
- further taxonomical and faunistical exploration of the Balkan Peninsula, on the basis of unidentified collection materials;
- to test the taxonomical value of other male characters than gonopods (e.g. penis and legs);
- to involve females in the taxonomical studies, to test the taxonomical value of the vulvae, and to discuss the importance and usefulness of the method;
- to classify the genus *Megaphyllum* with the new traits, and to revise and redefine previously described subgenera.

## MATERIAL AND METHODS

Investigation of the genus was based first of all on the material deposited in the Myriapoda Collection of the Hungarian Natural History Museum (HNHM): a.) large part deriving from collecting trips made to the Balkan Peninsula by the Systematic Zoology Research Group, Hungarian Academy of Sciences (HAS) (OTKA 72744) (FEHÉR *et al.* 2008); b.) additional identified and unidentified *Megaphyllum* material from the collection. Further species and type material were borrowed from the following museums, or have been investigated on the spot: Museum für Naturkunde Berlin (MNB); Zoologische Staatssammlung München (ZSM); Naturhistorisches Museum Wien (NHMW); Statens Naturhistoriske Museum, Zoologisk Museum, University of Copenhagen (ZMUC); National Museum of Natural History, Sofia (NMNH).

Individuals were kept and examined in 70% ethanol. Identification and processing took place in the Myriapoda Collection, Department of Zoology, HNHM, with Nikon SMZ800 and Leica M125 stereo microscopes, and Wild M20 and Leica DM-1000 light microscopes. Drawings were made with Nikon, Leica and Wild microscope drawing apparatuses. Female vulvae were dissected (and prepared in Faure-Berlése medium) only in those cases when adult males were found in the same vial. Scanning electron micrographs of selected species were made in the HNHM with Hitachi SN 2600 scanning electron microscope; the specimens investigated were sputter-coated by gold-palladium. In other institutes I was working with Leica MZ125 (NHMW, MNB) and Leitz Diaplan (NHMW) stereo microscopes.

Drawings were finalized with Adobe Photoshop CS2, most of them with the help of a Bamboo Pen and a Touch tablet.

The following data are given for each species:

- history of the species in a synonym list with European and sometimes non-European references;
- distribution of each species by countries, listing higher geographical units or cities, referring to country-scale revisions where possible;
- taxonomic and biogeographical observations in the Remarks sections.

In addition to the European species, I investigated some other species from Anatolia and the Middle East which represented interesting subgenera missing from Europe.

After the species list follows a methodological chapter where I discussed the traits used in previous revisions (mostly based on gonopod characters), and gave details for only those which proved to be useful to support previous revisional approaches.

## RESULTS AND DISCUSSION

1. With careful investigation of literature data I compiled the total species list of the genus *Megaphyllum*, containing all the hitherto described species and subspecies, their subgeneric allocation(s), known distribution, and taxonomical remarks (e.g. possible synonymies).
2. Also on the basis of literature data I compiled the total subgenus list of *Megaphyllum*, representing the type species, the main characters used to define the subgenera, number of species within the subgenera, and possible overlaps, taxonomical comments given by previous authors.
3. Based on revisions of type and non-type materials I presented the current composition of European *Megaphyllum*, with lists of synonymies, distributional data, remarks from the literature, and my own remarks. The genus contains 57 species and subspecies (one species is in *species inquirenda* status).
4. I described the following new species:
  - *Megaphyllum chiosense* LAZÁNYI & KORSÓS, 2012
  - *Megaphyllum (Megaphyllum) cygniforme* LAZÁNYI & KORSÓS, 2012
  - *Megaphyllum danyii* LAZÁNYI & KORSÓS, 2012
  - *Megaphyllum (Cyphobrachiulus) digitatum* LAZÁNYI & KORSÓS, 2012
5. I established the following subjective synonymies:
  - Subspecies *M. austriacum dahl* (VERHOEFF, 1901) or in other opinion species *M. dahl* (VERHOEFF, 1901) is a junior synonym of *M. austriacum* (LATZEL, 1884).
  - Subspecies *M. bosniense cotinophilum* (LOKSA, 1962) is a junior synonym of *M. bosniense* (VERHOEFF, 1897).
  - Species *M. latesquamosum* (ATTEMS, 1903) and *M. macedonicum* (STRASSER, 1976) are junior synonyms of *M. montivagum* (VERHOEFF, 1901).
  - Subspecies *M. projectum alticolum* (VERHOEFF, 1897) and *M. projectum dioritanum* (VERHOEFF, 1907) are junior synonyms of *M. projectum projectum* VERHOEFF, 1894.
  - Subspecies *M. silvaticum discolor* (VERHOEFF, 1907) is a junior synonym of *M. silvaticum* (VERHOEFF, 1898).
  - Subspecies *M. transsylvanicum transdanubicum* (LOKSA, 1962) is a junior synonym of *M. transsylvanicum* (VERHOEFF, 1897).I affirmed a synonymy which was not widely used in the literature:
  - Species *M. monticola* (VERHOEFF, 1898) is a junior synonym of *M. carniolense* (VERHOEFF, 1897).

6. I suggested a new combination (*Cerabrachyiulus mueggenburgi* (VERHOEFF, 1901) = *Megaphyllum mueggenburgi* (VERHOEFF, 1901)).
7. I demonstrated that the name-bearing syntype series of *M. austriacum* (LATZEL, 1884) is not in taxonomical accord with the prevailing usage of the name. Designation of lectotype is not possible, so according to article 75.6 (ICZN 2000) we propose to designate a neotype to maintain stability of names.
8. Species new to faunas were: *M. silvaticum* (VERHOEFF, 1898) new to the fauna of Hungary; *M. montivagum* (VERHOEFF, 1901) and *M. imbecillum* (ATTEMS, 1935) new to the fauna of Macedonia; *M. bosniense* (VERHOEFF, 1897) new to the fauna of Greece; and *M. projectum* VERHOEFF, 1894 new to the fauna of Italy.
9. I sorted out and examined the *Megaphyllum* material in the Myriapoda Collection, Hungarian Natural History Museum, which resulted in a significant increase of species number: from 4 to 27, several of them representing the second or third occurrences of the species since their original descriptions.
10. I discussed the usefulness of non-gonopod traits in genus-level revisions, and having got support by these traits I redefined the genus *Megaphyllum* and the subgenera *Megaphyllum s. str.* VERHOEFF, 1894, *Italoiulus* ATTEMS, 1940, *Omoabrachyiulus* LOHMANDER, 1936, *Pontobrachyiulus* LOHMANDER, 1939, *Leptomastigoiulus* VERHOEFF, 1897, and *Donbrachyiulus* LOHMANDER, 1936.

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