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The hypogean Iberian genus *Typhlopsychrosoma* Mauriès, 1982 (Diplopoda, Chordeumatida, Vandelematidae): distribution map, key to species, first record in a Mesovoid Shallow Substratum (MSS) and detailed iconography of *T. baeticaense* (Mauriès, 2013)

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Abstract

The troglobiont millipede *Typhlopsychrosoma baeticaense* (Mauriès, 2013) is recorded in the Mesovoid Shallow Substratum (MSS) of two screes in the Aitana and Bernia mountains (Eastern Iberian Peninsula), far away from its known distribution area. A detailed Scanning Electron Microscopy iconography provides additional information on gonopod morphology, as well as other details such as the inconspicuous evaginations of the cuticle at the place of the eyes in the anophthalmous specimens. We present an updated distribution map and a key to species of the genus, with illustrations of the gonopods of all species described so far. The implications of the appearance of this hypogean species in an MSS are discussed.

Key words: hypogean millipedes, troglobiont, Baetic System, superficial subterranean habitats

Introduction

The Iberian genus *Typhlopsychrosoma* Mauriès, 1982, includes four species: *T. breuili* (Mauriès, 1971), *T. tarraconense* (Mauriès, 1971), *T. fadriquei* (Mauriès & Vicente, 1978) and *T. baeticaense* (Mauriès, 2013) (Table 1). Although Mauriès (1971) stated that *T. tarraconense* and *T. breuili* might be troglaphiles and not troglobionts, all the species present troglobiomorphic traits (*sensu* Christiansen 1962; Pipan & Culver 2012) such as body depigmentation and ocular reduction to a higher or lower degree. However, some species or populations maintain slightly pigmented eyes, others barely retain external traces of the presence of eyes, and others again show no traces of eyes at all (Mauriès & Vicente 1978). Although *T. baeticaense* was described after studying more than 100 specimens (Mauriès 2013), the other three species have been rarely captured, with few records since their description, *T. breuili* even being known only from the type series (Mauriès 1971).

The genus was originally (Mauriès 1971) described as *Psychrosoma*. Realising that this name was preoccupied (see below) Mauriès (2013) proposed the replacement name *Psichrosoma*. However, Mauriès (1982) proposed a new subgenus, *Typhlopsychrosoma* for a species of ‘*Psychrosoma*’, and according to the rules of priority in the International Code of Zoological Nomenclature (International Commission on Zoological Nomenclature 1999), *Typhlopsychrosoma* is the valid name for the genus under consideration here.

All *Typhlopsychrosoma* specimens have been found in caves so far (Mauriès 2013), but the subterranean environment is not restricted to caves. The subterranean spaces in the rocky debris with different lithologies and different origins of the deposits are called the Mesovoid Shallow Substratum (or MSS) and fulfill the characteristics of a hypogean environment, such as the absence of light, moderation of the fluctuations of humidity and temperature etc., and they are known to be populated by troglobiont fauna (Juberthie *et al.* 1980, 1981; Oromí

disperse over large distances, or at least to maintain the gene flow among its several subterranean populations. However, the fact that it only appeared occasionally in two out of forty SSD, in only two localities of eight mountain massifs sampled, does not support that idea. In any case, there are too many pieces of the puzzle missing yet, and only future research would help to elucidate the reasons for this wide distribution of a subterranean species.

The finding of *T. baeticaense* in these MSS's constitutes the second record of a subterranean millipede in MSS of the Iberian Peninsula, after *Acipes andalusius* Enghoff & Mauriès, 1999, published by Enghoff & Reboleira (2013) from samples from Aitana mountains. The new record of *T. baeticaense* indicates a higher ecological amplitude, since it had been previously recorded only in caves. However, this is not surprising, since it is expected that many (if not most) troglobionts do not live in "caves" or "macrocaverns" (*sensu* Howarth 1983), but in the cracks, fissure networks and other small subterranean spaces ("mesocaverns" *sensu* Howarth 1983), as already proposed by Racovitza (1907) more than 100 years ago, and supported by the findings of many other authors after him (Karaman 1954; Bucciarelli 1960; Vailati 1988; Růžička 1999; Giachino & Vailati 2010). On one hand, the macrocaverns fulfill the characteristics of an ecotone between the fissure network and the exterior (Moseley 2009); on the other hand there are also regions without proper caves but with MSSs inhabited by troglobionts (Juberthie *et al.* 1980, Ortuño *et al.* 2014b). Thus, caves should be considered as an avenue for humans to reach the subterranean environment, and not as the main habitat of troglobionts. Nevertheless, this idea is still rooted in the mind of subterranean biologists (some of them still calling themselves "biospeleologists"), as reflected in the widely used terminology as "cave fauna" or "cavernicolous" and the scope and approach of many research works (see for example Kane & Ryan 1983; Zaragoza & Sendra 1988; Peck *et al.* 1998; Tinaut 2001; Sendra 2003; Barranco 2008, 2012; Drescher 2012; Mauriès 2013, 2014).

As a conclusion, these results indicate that some subterranean species, such as *T. baeticaense*, may have surprisingly wide distribution areas, and the study of the MSS will surely improve our poor knowledge on the subterranean diversity of millipedes in the Iberian peninsula. These data may change our current view of the subterranean fauna and their relation with their ecosystems.

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