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SHORT COMMUNICATION

The species referred to as *Eurypelma californicum* (Theraphosidae) in more than 100 publications is likely to be *Aphonopelma hentzi*

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Abstract. Despite the fact that taxonomically the name *Eurypelma californicum* (Ausserer 1871) has been regarded as a *nomen dubium* and thus invalid for several decades, it is increasingly used in non-taxonomic publications and on the internet. This makes it necessary to trace back the identity of the spiders involved. The taxonomy of *Eurypelma californicum* and *Aphonopelma hentzi* (Girard 1852) was investigated, and it is concluded that the spiders referred to as *Eurypelma californicum* in physiological publications of the last 35 years belong to an *Aphonopelma* species, most likely *A. hentzi*.

Keywords: Taxonomy, *nomen dubium*, synonymy, physiological research

Due to its size, longevity and easy maintenance, the North American theraphosid *Eurypelma californicum* (Ausserer 1871) has been used as a spider model to investigate the structure and function of hemocyanin (e.g., Schartau et al. 1983) and the circulatory system, including hemolymph and book lungs, venom biochemistry (e.g., Savel-Niemann & Roth 1989), and water and temperature-dependent aspects of physiological adaptations. The Web of Knowledge (online at http://webofknowledge.com) lists 139 publications (search term "*Eurypelma californicum*", accessed 22 July 2011) between 1977 and 2011, which have been cited more than 3200 times in more than 1500 other articles (Fig. 1). The most cited publications are reviews on hemocyanin by Van Holde & Miller (1995) and by Magnus et al. (1994), which were cited 263 and 259 times, respectively. A search on Google (accessed 22 July 2011) resulted in 4610 hits for the term "*Eurypelma californicum*". This indicates the importance of *Eurypelma californicum* and the results obtained by studying these spiders for science.

Unfortunately, today there is no valid species named *Eurypelma californicum*, which is a *nomen dubium*, a name of doubtful origin that cannot be traced back to a valid species. Certain scientists, mainly physiologists and molecular biologists, however, increasingly continue using this invalid name, and so we face the fascinating question as to which species these publications might actually relate.

Eurypelma californicum was first described by Ausserer (1871). In his species description, however, he referred to Doleschall (1852), which is an unpublished manuscript that includes a description of a female of this species as *Theraphosa californica.* According to Article 8 of the International Code of Zoological Nomenclature (ICZN 1999), Doleschall's (1852) manuscript does not represent a valid species description and, therefore, Ausserer is the author of this species. Nevertheless, Ausserer referred to Doleschall's manuscript and consequently named the spider *Eurypelma californica* Dol. Ausserer's species description was probably copied from Doleschall, as he placed it in citation marks and ends with "(trk.) Dol.", which probably means "*transkribit* (Latin, copied) from Doleschall". Although Ausserer called this species *Eurypelma californica*, most subsequent authors modified the name to *Eurypelma californicum*, which is grammatically correct (*Eurypelma*, Greek, neuter, means "broad foot").

The species description is as follows (translated from Latin): "brown, long cephalothorax, approximately parallel margins, head area well separated, strong and large chelicerae, considerably bent, hind part of the abdomen broader, slim legs of medium length, with broad tarsi. Length 15″, length of the legs 4, 1, 2, 3." The second part (translated from German) is: "The prosoma is longer than broad, very elevated, nearly parallel lateral margins, only in the back third broader, with short woolly hairs. The head is high, dorsal pit deep, transverse. Eye hump flat, limited by a furrow. Thick chelicerae, strongly bent, half the length of the prosoma, very hairy at the end and at the inner edge of the first segment. Thorax narrow, elongate. Opisthosoma as long as prosoma, broader towards the end; spinnerets bulkily elongated. Legs thin, short, woolly haired, with broad tarsi. Uniformly brown, venter darker, black to brown. California."

By modern standards Ausserer's description is poor and fits too many theraphosid species, although it was typical for its time. He did not provide any illustrations and did not mention a type specimen. It is also unclear whether he actually saw any specimens of this species. A further mistake happened when Ausserer attributed Doleschall's species to the genus *Eurypelma*, which had been erected by C.L. Koch (1850) for *Mygale avicularia* C.L. Koch 1842. Koch (1850) provided the first more or less useful description of this species and undoubtedly had examined some specimens. Due to the poor quality of earlier descriptions for *Mygale* and *Theraphosa* species from Linnaeus, Walckenaer and Hahn, their identity was very difficult to assess. Ausserer thus assumed that Koch misidentified *Mygale avicularia* and described it as *Eurypelma rubropilosa* Ausserer 1871. He also provided a (poor) definition of this genus, which was characterized (among others) by two spurs on the first tibiae of the male (Ausserer 1871). Simon (1892) assigned *Eurypelma rubropilosa* as the type species of *Eurypelma*. A few years later, Pocock (1901) detected in Koch's original description of *Mygale avicularia* the presence of only one male tibial spur. So the descriptions of *Mygale avicularia* and of *Eurypelma rubropilosa* and the transfer to *Eurypelma* excluded each other. Therefore, Pocock called *Eurypelma* a "*genus ignotum* at all events for the time being".

Petrunkevitch (1939a) pointed out that Ausserer's *Eurypelma rubropilosa* was not Koch's *Eurypelma avicularia*, whose identity was impossible to determine. Koch's genus description (prosoma more elongate, opisthosoma moderately thick, legs equally thick, whole body densely covered with long hairs, velvet brush of feet broad) was very broad, and today most theraphosids would fit into his genus *Eurypelma*. Since the type species is probably lost, a redescription is impossible. Petrunkevitch concluded that "the genus *Eurypelma* must remain a *genus incertum* and *invalidum*". He proposed to transfer all *Eurypelma* species into other genera, where they best fit. Accordingly, Raven (1985) synonymized *Eurypelma* C. L. Koch 1850 with *Avicularia* Lamarck 1818 (see Platnick 2011).

For the identity of *Eurypelma californicum* this means that a species of which the type is lost, had been attributed to a doubtful genus.

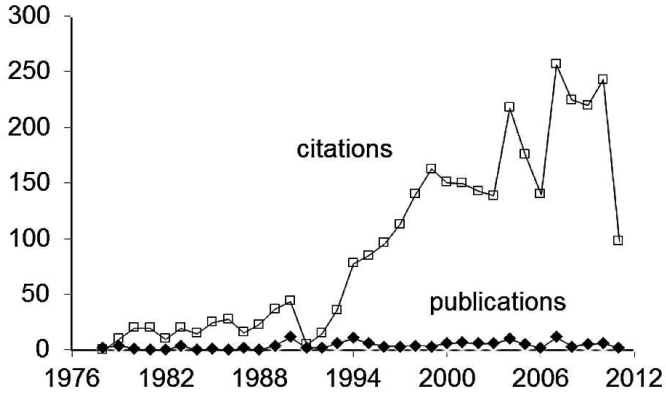

Figure 1.—Number of publications (black symbols, range 0–12 per year) and the number of citations (open symbols, range 0–257 per year) according to the search term "*Eurypelma californicum*" in the Web of Knowledge. Data cover the period 1978–2011, but in 2011 only half a year is covered (accessed 22 July 2011).

Petrunkevitch first proposed a position in his new genus *Delopelma*, but later he transferred it into the genus *Dugesiella* (also misspelled as *Dugisiella*) (Petrunkevitch 1939a, b). Schmidt (1993) transferred *D. californica* to the genus *Aphonopelma*, but stated that it cannot be traced back to a valid species and, therefore, should be considered a *nomen dubium*, an opinion that is still accepted (Platnick 2011).

In his book on North American theraphosids, Smith (1995) described how he tried to locate the type of *Eurypelma californicum.* He could not detect it in major German museum collection lists and noted that the inadequate description by Ausserer makes it impossible to attribute this species to any known species or genus. Consequently, as no type specimen exists, and it seems to be impossible to positively identify any species from Ausserer's description, he also came to the conclusion that this name should be suspended.

From a taxonomic point of view, these analyses show that it is currently not possible to match a living species with the enigmatic specimen that Doleschall (1852) and Ausserer (1871) described more than 150 years ago. Unfortunately, the name *Eurypelma californicum* continues to be used in non-taxonomic publications and on the internet. This begs the question as to which valid species do the spiders belong that have erroneously been labeled as *Eurypelma californicum* over the past 50 years? I asked some research groups that had studied "*Eurypelma californicum*" for the origin of their spiders. It turned out that the spider stock at the University of Munich, from where most of this research originated, had been purchased from Carolina Biological Supply Company (Burlington, North Carolina, USA). Also many *Eurypelma californicum* spiders in other laboratories can be traced back to Munich or to this company. On request, the company communicated that "the tarantula species we were shipping in the 1980's were *Brachypelma smithi* (Mexican redknee) and *Aphonopelma hentzi* (Texas Brown)". The origin of these spiders (Texas) and a few pictures available from publications and researchers clearly indicate that the species in question is likely to be *Aphonopelma hentzi* (Girard 1852), which is commonly known as the Oklahoma brown or the Texas brown.

In recent years, several investigations were performed to analyze the taxonomy and distribution of this species. Smith (1995) summarized the taxonomic situation, discussed the identity of *Aphonopelma hentzi* in detail, designed a neotype and described, for the first time, both sexes following modern standards. He also gave valuable information on the kind of habitat where this species occurs and further ecological data. Later, Murray (2006) and Hamilton (2009) carried out comprehensive analyses on species boundaries and their geographic distribution in the *Aphonopelma hentzi* complex and the separation of neighboring taxa. Based on their morphological and molecular assessments, both Murray (2006) and Hamilton (2009) concluded that the distribution of *Aphonopelma hentzi* comprised large parts of Colorado and New Mexico, Oklahoma, southern Kansas, southern Missouri, Arkansas, northern Louisiana, and a major part of Texas.

The problem inherent to these findings is that *Aphonopelma hentzi* is apparently a wide-ranging species and it shows considerable morphological variation. Geographically, it overlaps with type locations and distribution areas of other *Aphonopelma* species (*A. anax* (Chamberlin 1940), *A. armada* (Chamberlin 1940), *A. moderatum* (Chamberlin & Ivie 1939), as well as some potentially undescribed species). Whether these species are valid species or synonyms needs to be clarified in subsequent investigations.

In conclusion, it is clear that the bulk of physiological, biochemical, toxinological and molecular biological publications on *Eurypelma californicum* refers to an *Aphonopelma* species, most likely to be *A. hentzi*. It is highly recommended to keep voucher material (if possible, one well preserved male and female as well as tissue stored for DNA analysis), to specify the geographic origin of the specimens used, and to mention this in future publications. Once the separation of closely related *Aphonopelma* species has been completed and published, a suitable identification key should become available to properly confirm the species identity. "*Eurypelma californicum*", however, remains a *nomen dubium* and should not be used.

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