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La araña toro, *Macrothele calpeiana*, repeatedly imported to Germany (Araneae: Macrothelidae)

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Abstract
Macrothele calpeiana (Walckenaer, 1805) is among the largest and most remarkable European spiders. The species is frequently introduced to areas outside its natural distribution by the ornamental plant trade, a major vector for alien species. Two further imports of this species are presented in this paper, which were both found in Germany (Central Europe). While one specimen was collected from an olive tree that has been described to be from Crete, the other spider was found in a potted citrus tree from Andalusia. Several postings on online spider boards and available press articles about introduced *M. calpeiana* suggest that both records probably represent only a part of the specimens recently introduced to Germany (and Central Europe).

Key words: alien, Iberian Peninsula, invasive species, olive, spider, vector.

Introduction

Ornamental plants are a major vector for the distribution of alien spiders (e.g., Bauer et al. 2019; Nentwig 2015; Huber et al. 2015), and *Macrothele calpeiana* (Walckenaer, 1805) is one of the largest and most noticeable spider species frequently transported by this means to areas outside its natural distribution (e.g., Jiménez-Valverde et al. 2011; Isaia et al. 2019; Pantini & Isaia 2008; Pantini et al. 2016). In the Western Palearctic, *M. calpeiana* is one of currently three known members of the mygalomorph family Macrothelidae (World Spider Catalog 2021). The other two congeneric species, *M. cretica* Kulczyński, 1903 and *M. drolshageni* Özkütük, Elverici, Yağmur & Kunt, 2019 are distributed in the eastern part of the Mediterranean region (Ozkütuk et al. 2019; Chatzaki & Komnenov 2019), the former being known from the island of Crete, and the latter from its type locality in Turkey. *M. calpeiana* is reported from a comparatively large area in Southern Spain and Portugal, but also from adjacent North Africa (e.g., Snazell & Allison 1989; Jimenéz-Valverde et al. 2011). In its native area, the spider is known to inhabit a wide range of different habitats, which can also be modified by human activities (van Helsdingen 1991). Further, the species is known to be accidentally distributed to other countries by international trade (Jiménez-Valverde et al. 2011). Recent findings in Catalonia (northeastern Iberian Peninsula) suggest an established population of alien origin (Bellvert & Arnedo 2016). Most of these accidental imports were associated with ornamental olive trees, and it is believed that, due to the spider's habit to spin its web on tree trunks, under bark and between roots (Gallon 1994), that *M. calpeiana* frequently "hitchhikes" with old, Iberian olive trees that are exported to other countries (Jiménez-Valverde et al. 2011).

If an alien predatory arthropod species can establish, it may become invasive, often with detrimental effects on native species and food chains (Snyder & Evans 2006). Knowing about vectors and import routes of alien species, even if they are not widely established in areas outside its natural distribution, is therefore crucial for a fast and appropriate response, especially given the current climate change (Faulkner et al 2020; Robinson et al. 2020). Our herein presented findings give further insights into the accidental introduction of *M. calpeiana* to Central Europe and, more importantly, the responsible vectors for the long-distance transport of living alien spider specimens.

Material and identification

The specimens listed in this paper represent single accidental introductions with ornamental trees. Because of the protected status of the species the specimens were not killed, but kept in captivity at the State Museum of Natural

History Karlsruhe (SMNK) and the Stuttgart State Museum of Natural History (SMNS). The juvenile specimen at the SMNK died for unknown reasons some days after its introduction and was preserved in 75-80% Ethanol. Unfortunately, the natural death of the adult specimen at the Stuttgart State Museum of Natural History (SMNS) had not been noticed for some weeks and the spider was destroyed by introduced feeder insects. However, an exuvia has been preserved at the SMNS, which allows for identification by the presence of the lyra organ and other characters. Specimens were determined and/or differentiated from *Macrothele cretica* and *M. drolshageni* using the descriptions in Snazell & Allison (1989), Chatzaki & Komnenov (2019) and Özkütük et al. (2019).

Abbreviations

SMNK: State Museum of Natural History Karlsruhe
SMNS: Stuttgart State Museum of Natural History

Results

Macrothele calpeiana (Walckenaer, 1805)
For a complete list of taxonomic references, see World Spider Catalog (2021)

Material:

Germany: Baden-Württemberg, Ortenaukreis, imported in potted citrus tree from Andalusia, 15 Aug 2016, leg. anonymous, 1 juvenile (SMNK-ARA 13076); Baden-Württemberg, Landkreis Ludwigsburg, Remseck am Neckar, 17 Jul 2019, imported in potted olive tree from Crete, obtained from land for real estate development (according to the tree owner), leg. Giulia Bianconi & Ingo Wendt, 1 exuvia (SMNS-Aran-003890).

Comments. Our records represent the first documented specimens of *Macrothele calpeiana* imported to Germany and the second (and third) to Central Europe (see Hänggi & Stäubli (2012) for an import to Switzerland). For imports to Mediterranean countries outside its native distribution see the compilation of Milano et al. (2017). Two further spider species found on the tree in Remseck were a specimen of *Leviellus kochi* (Thorell, 1870) (SMNS-Aran-003468) and a specimen of *Filistata* cf. *insidiatrix*, the latter being still alive. However, in Germany, postings on online spider boards and media articles suggest a relatively high number of imports of *M. calpeiana* over the last decades. A non-exhaustive search on the web revealed at least three potential, but unpublished records. [1],2,3

Fig. 1 – Accidentally imported *Macrothele calpeiana* found in Germany (Central Europe). **a**, Female *M. calpeiana* found in Remseck am Neckar (Photo: Frank Schneider); **b**, juvenile specimen (body length ≈ 18 mm) found in Ortenaukreis, Baden-Württemberg (Photo: Hubert Höfer).

Discussion

Given the climatic differences between their native range and Central Europe, it is unlikely that *Macrothele calpeiana* will become established in most habitats of the region (Jiménez-Valverde et al. 2011). Nonetheless, it should be noted that the specimen found in Remseck am Neckar survived the mild winter of 2018/2019[4] under a covering used for protecting the inhabited olive tree against frost.

[1] 1 https://forum.arages.de/index.php?topic=4237
2 https://forum.arages.de/index.php?topic=26105
3 https://rp-online.de/nrw/staedte/viersen viersen-giftige-spinne-in-treibhaus-gefunden_aid-4484057
4 https://www.dwd.de/DE/presse/pressemitteilungen DE/2019/20190227_deutschlandwetter_winter2018_2019_news.htm

However, a potential establishment in commercial plant nurseries or heated greenhouses of botanical collections, with many of them nursing Mediterranean plants and imitating their preferred climate, would be very problematic. The species is legally protected in the European Union (EUNIS 2021; but see also Milano et al. 2017), and the institutions would probably face huge juristic obstacles to get permission for a control or eradication. Greenhouses and garden centres are known to be frequently inhabited by numerous alien spider species from a diverse number of climate zones and to spread those accidentally to other, similar institutions and, probably, private homes (e.g. Bauer et al. 2019; Hänggi & Straub 2016; Unruh 2020). Potential further (unpublished) introductions (see above) in Germany suggest that the propagule pressure seems to be relatively high, and a large number of introduced specimens probably went completely unnoticed. In contrast to most imports (Jimenéz-Valverde et al. 2011), the specimen in the SMNK was not imported in an olive tree, but in a citrus tree from Andalusia and shows that other ornamental trees can serve as a vector for *M. calpeiana* as well.

The Cretan origin of one of the olive trees described herein raises a number of questions. Given the flourishing trade with old olive trees from Spain (Kassam 2015) and the recent trend to use them as ornamental plants all around the world, it would not be surprising if *M. calpeiana* is already locally established on Crete. Jiménez-Valverde et al. (2011) projected Crete as climatically suitable in some models, and Bellvert & Arnedo (2016) demonstrated that the species is able to establish alien populations in other areas of the Mediterranean region not projected as suitable by Jiménez-Valverde et al. Crete is inhabited by the endemic *Macrothele cretica* which is potentially restricted to undisturbed habitats in the Western part of the island (Chatzaki & Komnenov 2019) and the larger *M. calpeiana* might act as a serious competitor once established. Nonetheless, "cross-contamination" of the tree due to the specimen wandering around, e.g., while in storage with olive trees from other countries, seems also possible.

The modus of accidental introduction also differs tremendously from other alien spiders. While most alien spider species have been introduced in containers, fruits (so called "Banana spiders") or even boxes with live feeder insects (Nentwig 2015), in *M. calpeiana,* the native habitat (old olive trees or other Mediterranean trees) is introduced together with the spider. Probably, this enhances the chance of survival and subsequent establishment, and, if a female is introduced together with an egg sac, the survival of its offspring. Although the distribution of *M. calpeiana* seems to be mostly limited by precipitation and temperature (Jiménez-Valverde & Lobo 2006), these two factors are often anthropogenically influenced in urban areas, directly by artificial irrigation of green spaces and indirectly by the heat island effect (Mihalakakou et al. 2004). This may create microhabitats suitable for *M. calpeiana* and allows for an establishment of the species outside its projected suitable areas (Bellvert & Arnedo 2016), at least locally. Such local establishments outside projected or presumed suitable areas are widely known, e.g., in alien snakes (van Doorn et al. 2021) or amazon parrots (Martens et al. 2013; Martens & Woog 2017).

Given that ancient olive tree orchards are part of the cultural heritage of a country (Kassam 2015) and ornamental olive trees can be vectors of potentially invasive arthropods and pests, a trade ban for old olive trees from South Spain and Portugal seems reasonable. This would eliminate the most important vector of *M. calpeiana* and reduce the probability of further alien establishments outside the natural distribution of the species.

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