

### ***Trithemis arteriosa* (Burmeister, 1839) (Odonata: Libellulidae) in Hungary: can aquarium trade speed up the area expansion of Mediterranean species?**

As a consequence of climate change, many dragonfly species expand their distribution range northwards, for example some predominantly African species appeared and established in the Mediterranean region, and Mediterranean species became more or less widespread in the central and northern parts of Europe (Ott 2010, Boudot & Kalkman 2015, Dijkstra et al. 2020). These processes can be enhanced by anthropogenic influences, for example man-made water bodies as suitable habitats (e.g. Obregón-Romero et al. 2013, Stille et al. 2014, Uboni et al. 2015) or introduction by different human activities, especially aquarium trading (e.g. Laister et al. 2014).

The international aquarium trade can play an important role in introducing non-indigenous Odonata species to Europe, since eggs or larvae are often attached to traded aquatic plants. In the case of exotic species, this way of introduction is not ecologically relevant, because they are not able to establish viable populations in the wild due to climatic conditions (Laister et al. 2014). Species can be introduced to any parts of Europe via aquarium trade from the Mediterranean region as well, e.g. as *Orthetrum chrysostigma* was introduced to Germany (Seehausen 2018). The changing aquatic habitats due to global warming might provide with appropriate habitats for these species even in the temperate regions of the continent (Ott 2010), so the establishment of these species can not be excluded even in areas that are far from their original distribution.

At the end of October 2020, the authors received a photo of a dragonfly for identification. The photo was taken in August 2020 in a small private garden pond in the city of Pécs, Southwest Hungary. The specimen (Fig. 1) was identified according to Dijkstra et al. (2020) as a teneral female of Red-veined Dropwing, *Trithemis arteriosa* (Burmeister, 1839), which species has never been recorded before in Hungary or in the Carpathian Basin biogeographical region. The new occurrence of *T. arteriosa* in Hungary is very far from the known distributional area, suggesting that the species did not appear naturally here. The eggs or larvae were possibly transported from Cyprus to Hungary with aquatic plants (water lilies, *Nymphaea 'Cypriana'*) in January 2020. After an



Figure 1. Teneral female Red-veined Dropwing (*Trithemis arteriosa*) in Pécs, SW Hungary. The photo was taken at night by cellphone using flashlight.

approximately 13-hour long journey, the plants were placed in a garden pond where potential food sources (e.g. chironomid and culicid larvae) were available for larvae. Unfortunately, the exuvium of the emerged specimen was not taken. After the recognition of the species the pond was searched for dragonfly larvae, but only those of *Libellula depressa* Linnaeus, 1758, a common European and Hungarian species with large body size, were found.

*Trithemis arteriosa* is widespread in Africa, occurring in the eastern Mediterranean Region (Cyprus, southern coastline of Turkey and some Greek islands) too, and slowly extends its range westwards and northwards (Dijkstra et al. 2020). *Trithemis arteriosa* is usually encountered in and near a wide variety of sunny, slow-flowing and standing, permanent or intermittent aquatic habitats, including streams, rivers, lakes, marshes, irrigation canals and ditches. The species reproduces mostly in permanent water, but its rapid development allows it to reproduce in temporary ones as well (Suhling & Martens 2007, Boudot & Kalkman 2015). *Trithemis arteriosa* can tolerate biotope variability and can adapt to unfavourable conditions, e.g. they can tolerate arid environments (known as one of the „dragonflies of the desert“) as well as lower temperature (Damm & Hadrys 2012, van Schalkwyk et al. 2014). This may partly explain its success as one of Africa's most common and widespread species, and its northward range expansion during recent decades.

The Odonata fauna of Hungary consists of 65 species (Ambrus et al. 2018). In the last years some dragonfly species with southern origin appeared in the country, e.g. *Erythromma lindenii* (Selys, 1840) (Móra & Farkas 2015) and *Trithemis annulata* (Palisot de Beauvois, 1807) (Farkas 2017), which suggests that the global climate change affects the Hungarian dragonfly fauna too. These species expand their range northwards in natural ways and human activities might not play an important role in these processes. In contrast, *T. arteriosa* has been introduced to Hungary via aquarium trade, and most probably the species has not been yet able to establish wild populations in the Carpathian Basin. Accordingly, the species cannot be regarded as a member of the Hungarian fauna. However, the species is able to estab-

lish stable populations after its appearance (Kalfayan & Krieg-Jacquier 2018) and can adapt to colder climate (van Schalkwyk et al. 2014). Some details of the Hungarian occurrence and general biology of *T. arteriosa* suggest that its establishment is possible, e.g. eggs or larvae could survive the circumstances of travelling in winter (i.e. they can tolerate low temperature at least temporarily); larvae could develop to adults in an open waterbody under Hungarian climatic conditions (i.e. possible mating and reproduction); larvae could live together with those of an other large-sized dragonfly species (i.e. co-occurrence with a potential competitor and/or predator). As a conclusion, the occurrence of *T. arteriosa* in the Carpathian Basin draws the attention to the fact that, in certain conditions, the combined effects of climate change and human activities might speed up the range expansion of species.

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