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RECENT DATA ABOUT PSEUDOSCORPION (PSEUDOSCORPIONES) PHORESY FROM SLOVAKIA WITH NEW HOST AND PHORONT RECORDS

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Abstract: New cases of phoresy by cheliferid and chernetid pseudoscorpions (Pseudoscorpiones: Cheliferidae, Chernetidae) are documented in Slovakia. New hosts and phoronts are recorded for the first time in that country. Pseudoscorpion phoresies involving Plecoptera and the families Clusiidae and Chyromyidae (Diptera) as hosts are documented for the first time worldwide.
Key words: Pseudoscorpiones, Plecoptera, Diptera, phoresy association, central Europe, Slovakia.

Datos recientes sobre foresis en pseudoscorpiones (Pseudoscorpiones) en Eslovaquia, y primeras observaciones de relaciones foréticas, con nuevos huéspedes y forontes
Resumen: Se documentan nuevos casos de foresis de pseudoescorpiones queliféridos y quernétidos (Pseudoscorpiones: Cheliferidae, Chernetidae) de Eslovaquia, con las primeras citas eslovacas de ciertas asociaciones entre huéspedes y forontes. Se documentan por primera vez a nivel mundial casos de foresis de pseudoescorpiones por huéspedes del orden Plecoptera y de las familias Clusiidae y Chyromyidae (Diptera).
Palabras clave: Pseudoscorpiones, Plecoptera, Diptera, relaciones foréticas, Europa central, Eslovaquia.

Introduction

Phoresy is a temporary interspecies interaction between a moving vector (host) and its caught passenger (phoront) that is necessary for migration from one habitat to another and it serves as the primary result of dispersion (Camerik, 2010). Expansion with the help of phoresy has been observed on animals that belong to 13 phyla, 25 classes and 60 orders. Mostly they are small invertebrates (Bartlow & Agosta, 2020).

As mentioned above, phoresy is used by different taxonomic groups, although there are several characteristics common for phoronts. First, most cases of phoresy include some form of active searching and attaching to the host. Second, the phoront inhabits unstable habitats (such as animal excrements, fungi or composts). Third, most phoronts are small and lack a highly mobile life stage, which causes their disability of dispersion to distant habitats (Bartlow & Agosta, 2020). Pseudoscorpions fulfil these conditions. The main advantage of phoresy for pseudoscorpions is the occupation of new, even unstable habitats, where they have more opportunities for reaching food resources (Poinar *et al*., 1998).

Pseudoscorpions are able to attach to appendages of the moving hosts using one (Christophoryová *et al*., 2011a, 2017a, 2017b, 2018, 2021; Červená *et al*., 2019) or both pedipalps (Jones, 1978, Lira *et al*., 2014) or they hide under the elytra of beetles (Beck, 1968; Muchmore, 1971, 1972). Hosts are representatives of arthropods, especially insects (Odonata, Orthoptera, Hemiptera, Mecoptera, Coleoptera, Diptera, Lepidoptera, Hymenoptera) and arachnids (Araneae, Opiliones), but also of birds or small mammals (Poinar *et al*., 1998, Christophoryová *et al*., 2017b). As regards to developmental stages, mainly females are phoretic, scarcer males and the nymphal stages were attached only minimally (Poinar *et al*., 1998). Females are adapted for dispersion by having spermathecae that allow them to store sperm for prolonged periods and by that enable them to establish a new population after they move to another habitat (Legg, 1975).

Several new pseudoscorpions associations have been observed in Slovakia and they introduce new data about this still fully not understood phenomenon.

Material and Methods

All pseudoscorpions were studied on temporary slide mounts prepared by immersing the specimens in lactic acid for clearing. After the study, they were rinsed in water and returned to 75% ethanol. Morphological and morphometric analyses were performed using a Leica DM1000 compound microscope with an ICC50 Camera Module (LAS EZ application, 1.8.0). Digital photographs were taken using a Canon EOS 5D Mark II camera attached to a Zeiss Axio Zoom V16 stereomicroscope. Image stacks were produced manually, combined using Zerene Stacker software and edited in Adobe Photoshop CC. The pseudoscorpion specimens were identified using the key in Christophoryová *et al*. (2011b). The details about collecting the specimens are shown in the results. The hosts were identified by specialists mentioned also in the results. The material is deposited in the collection of the second author at the Department of Zoology, Comenius University in Bratislava. Only one host, *Clusiodes albimanus*, is deposited in the collection of Jindřich Roháček in the Silesian Museum, Opava, the Czech Republic.

Results

14th May 2022: One phoretic female of *Mesochelifer ressli* Mahnert, 1981 was attached to the tibia of the first leg of the stonefly *Perlodes microcephalus* (Pictet, 1833) (Plecoptera, Perlodidae; det. Matej Žiak; Fig. 1A). Specimens were col-

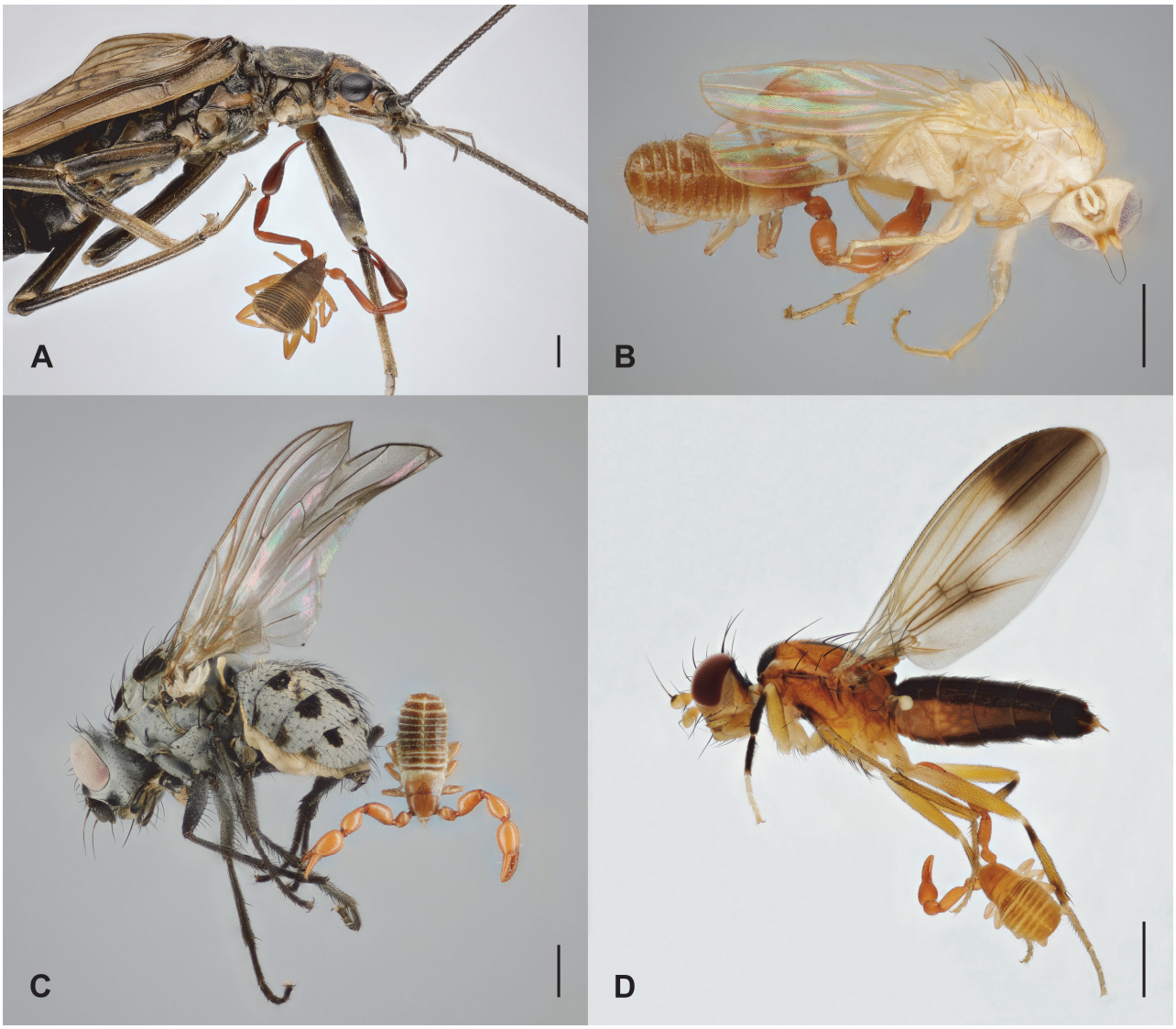


Fig. 1. Cases of pseudoscorpion phoresy from Slovakia. **A.** *Mesochelifer ressli* attached to the first leg of *Perlodes microcephalus* (one first leg was removed). **B.** *Lamprochernes* cf. *chyzeri* attached to the third leg of a fly belonging to the family of Chyromyidae. **C.** *Lamprochernes* cf. *chyzeri* attached to the third leg of *Anthomyia pluvialis*. **D.** *Pselaphochernes scorpioides* attached to the third leg of *Clusiodes albimanus*. Scale lines: 1 mm.

lected by individual sampling on a window of a block of flats at the locality of Kežmarok (49.13599°N, 20.42465°E; 621 m a.s.l.; leg. Ema Hetešová).

14th June 2019: One female of *Lamprochernes* cf. *chyzeri* (Tömösváry, 1883) was phoretic on species from the family of Chyromyidae (Diptera; det. Marek Semelbauer; Fig. 1B). The pseudoscorpion was attached to the femur of the host's third leg. Specimens were collected using a Malaise trap in the garden of the family house in Vinohrady nad Váhom (48.30913°N, 17.76117°E; 167 m a.s.l.; leg. Ľubomír Vidlička).

31st May 2019: One female of *Lamprochernes* cf. *chyzeri* (Tömösváry, 1883) phoretic on species from *Anthomyia pluvialis* complex (Linnaeus, 1758) (Diptera, Anthomyiidae; det. Miroslav Barták; Fig. 1C) was collected using a Malaise trap. The trap was situated in the garden of the family house in Vinohrady nad Váhom (48.30913°N, 17.76117°E; 167 m a.s.l.; leg. Ľubomír Vidlička). The pseudoscorpion was attached to the tibia of the host's third leg.

2nd June 2021: One female of *Pselaphochernes scorpioides* (Hermann, 1804) was phoretic on the host *Clusiodes albimanus* (Meigen, 1830) (Diptera, Clusiidae; det. Jan Máca, Jindřich Roháček; Fig. 1D). It was attached to the femur of the third leg of the host. This phoretic association was recorded from a Malaise trap situated in the Biological station in Jurský Šúr (48.22730°N, 17.20744°E; 134 m a.s.l.; leg. Oto Majzlan, Ľubomír Vidlička).

Discussion

In Slovakia, several phoretic associations between pseudoscorpions and arthropods were recorded; phoresy with birds or small mammals has not yet been observed. Altogether, 23 pseudoscorpions of six species and three families were documented (Mašán & Krištofík, 1992; Christophoryová *et al*., 2011a, 2017a, 2018, 2021; Krajčovičová *et al*., 2017; Červená *et al*., 2019). Predominantly females were involved in phoresy (19 females, 4 males). Specimens were collected using the Malaise traps or individual collecting, mainly from

May to August. Phoronts were attached mainly to the host's legs, only once to antennae and proboscis. Hosts represent three arthropod orders, Diptera, Heteroptera and Lepidoptera (Mašán & Krištofík, 1992; Christophoryová *et al*., 2011a, 2017a, 2018, 2021; Krajčovičová *et al*., 2017; Červená *et al*., 2019). The pseudoscorpion *Atemnus politus* (Simon, 1878) was recorded for the first time as a phoront from Slovakia (Christophoryová *et al*., 2021). In Slovakia, most commonly phoront were from the family of Chernetidae and the genus *Lamprochernes* (Mašán & Krištofík, 1992; Christophoryová *et al*., 2011a, 2017a, 2018, 2021; Červená *et al*., 2019). Presented results correspond with this fact, two other phoretic associations of *Lamprochernes* cf. *chyzeri* are documented here. Two *Lamprochernes* species are distributed throughout Slovakia (Červená *et al*., 2020). *Lamprochernes chyzeri* differs from *L. nodosus* (Schrank, 1803) by a few and overlapping characters, such as the length of the palpal femur, setae number on genital opercula and the shape of palpal trochanter protuberance, which may be rather subjective to interpretation (Christophoryová *et al*., 2011b). Studied females bear 25 setae on the anterior genital operculum, 12 – 13 setae on the posterior one; the palpal trochanter is conical and pointed and the palpal femur is 0.56 – 0.58 mm long. According to these characters, present females belong to *Lamprochernes chyzeri* (Christophoryová *et al*., 2011b). Currently, we are researching an integrative approach combining molecular barcoding, with cytogenetic and morphological analyses in order to assess species boundaries in European *Lamprochernes* populations. Thus the species is in the meantime identified as *Lamprochernes* cf. *chyzeri*. Both hosts from the families of Anthomyiidae and Chyromyidae are recorded for the first time from Slovakia in phoretic associations. Poinar *et al*. (1998) summarized all known pseudoscorpion phoresies, including fossil records. From the family of Anthomyiidae as a host, they mentioned associations only with *Lamprochernes nodosus* and *L. savignyi* (Simon, 1881) (Poinar *et al*., 1998). There is no record about the phoresy between pseudoscorpions and members of the family Chyromyidae.

In Slovakia, *L. chyzeri* was observed in phoresies with hosts from the families of Muscidae and Lonchaeidae (Christophoryová *et al*., 2011a, 2021).

Another chernetid species, *Pselaphochernes scorpioides*, was attached to the leg of the fly from the family of Empididae in Slovakia (Červená *et al*., 2019). There do exist several other dipteran hosts for *P. scorpioides* known from Europe (Poinar *et al*., 1998; Mederos & Zaragoza, 2017; Červená *et al*., 2019). The present paper cites the first data about phoresy between pseudoscorpion and Clusiidae worldwide.

The most interesting find was the phoresy between cheliferid *Mesochelifer ressli* and *Perlodes microcephalus*. Until now, there had been no data about Plecoptera as a host in phoretic associations with pseudoscorpions. The pseudoscorpion *M. ressli* was phoretic only once, one female was attached to the leg of *Lymantria monarcha* (Linnaeus, 1758) (Lepidoptera, Erebidae) in Austria (Hauser, 1990).

Our new findings add new data about the hosts and phoronts not only in Slovakia but also worldwide providing that we still lack knowledge about this successful way of distribution in pseudoscorpions.

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