



Diptera species recorded for the first time in Slovakia found along the Danube floodplain

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Abstract. Four species of Diptera are recorded as new for the fauna of Slovakia: *Acrocer orbiculus* (Fabricius, 1787) (Acroceridae), *Conops insignis* Loew, 1848 (Conopidae), *Hermetia illucens* (Linnaeus, 1758) (Stratiomyidae), and *Tolmerus cowini* (Hobby, 1946) (Asilidae). The specimens were collected by means of Malaise trap, yellow pan trap, and sweep nets, in the years 2019–2022. Our findings highlight the value of the Danube floodplain from a conservation point of view. The appearance of *H. illucens* in Bratislava fits well with what is known about this syn-anthropic species.

Keywords. Acroceridae, Asilidae, Conopidae, flies, new record, Palearctic, Stratiomyidae

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Introduction

Larger Brachycera comprise popular fly families such as Acroceridae, Asilidae, Bombyliidae, Stratiomyidae, and several others. Among their species are those that have important ecological functions as pollinators, predators, parasitoids, parasites, vectors of diseases, or decomposers of organic matter. Thanks to their fairly large size, conspicuous appearance, day-time activity, and interesting life history, they are among the popular and fairly well studied flies (Stubbs and Drake 2014).

Thanks to the LIFE Programme, several restoration programs are underway in Slovakia, aiming at the restoration of the water regime, removal of invasive tree species, and restoration of traditional grazing and willow pollarding in the Slovak section of Danube floodplain (LIFE Restoration and management of Danube floodplain habitats, LIFE BeeSandFish, etc.). Alongside these management measures, monitoring of invertebrates has been carried out. Our research group has focused on larger Brachycera and Conopidae. During

this monitoring, several species of insects were identified, which are represented here as new for Slovakia.

Methods

The insects were collected by means of Malaise trap (Virt) in 2019, as individual specimens along an established transect using an insect net in 2020–2022 (Apálsky ostrov, Bodíky, Číčov, and Veľký Lél), or by yellow pan trap (Bratislava-Karlova Ves) in 2022. The specimens collected by netting were preserved in 70% ethanol directly in the field. The specimens were pinned (pin size 1 or 000) or were glued to cardboard triangles. The collected materials were identified using the following keys: Acroceridae: Weinberg and Bächli (1997) and Chvála (1977); Asilidae: Wolff et al. (2018); Weinberg and Bächli (1995); Conopidae: van Veen (2010). Specimens were photographed using a Leica M205C binocular microscope or directly in the field. The materials are deposited in collection of the first author at the Institute of Zoology SAS (voucher numbers with the abbreviation UZSAV).

Results

Family Acroceridae

Acrocera orbiculus (Fabricius, 1787)

Material examined. SLOVAKIA – Nitra Region • Virt; 47°45'37.9"N, 018°20'20.2"E; 114 m alt.; 29.VII.2019; A. Purkart leg.; sand dune, Malaise trap; 1♂, pinned, UZSAV 309.

Identification. The genus *Acrocera* Meigen, 1803, has the antennae placed on the dorsal side of the head, in contrast to visually similar genus *Ogcodes* Latreille, 1796, which has them placed on the ventral side.

Acrocera orbiculus was formerly placed in *Paracrocer* Mik, 1886, but Nartshuk (2000) has shown that to be a synonym of *Acrocera*. From related species, *A. orbiculus* differs in missing vein R_{2+3} and in having a largely yellowish abdomen with distinct transverse to triangular bands (Weinberg and Bächli 1997). According to Stubbs and Drake (2014), this species should have whitish postpronotal lobes and postalar calli and a line connecting them. However, in our specimen, the postalar calli are brownish, but this is likely a postmortem change partly caused by preparation of the specimen. Photographs of our specimen prior to preparation (not included here) show it to have the distinctive pattern as described by Stubbs and Drake (2014).

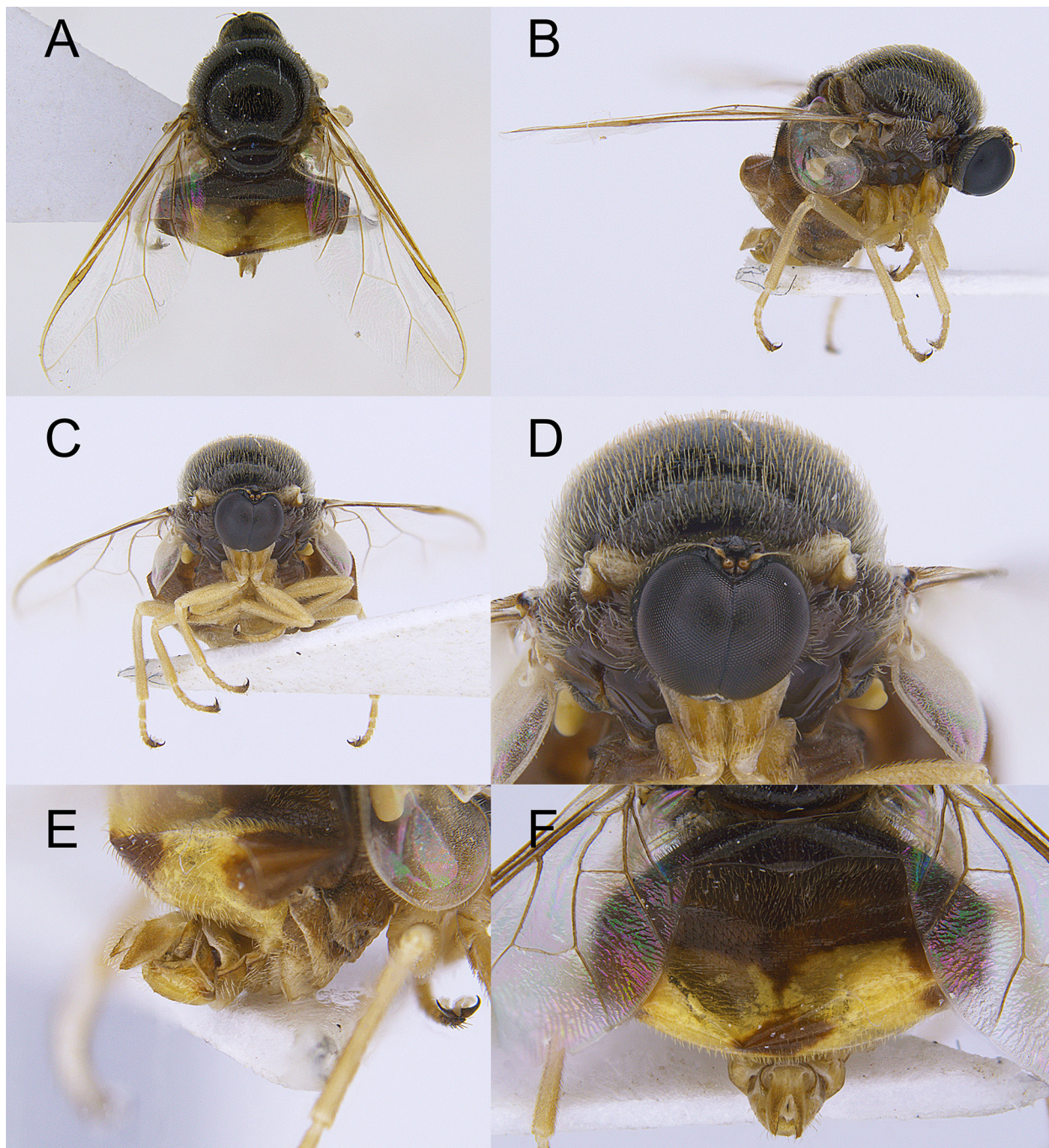


Figure 1. *Acrocera orbiculus*, male. **A.** Dorsal view. **B.** Lateral view. **C.** Frontal view. **D.** Head. **E.** Terminalia, lateral view. **F.** Terminalia, dorsal view.

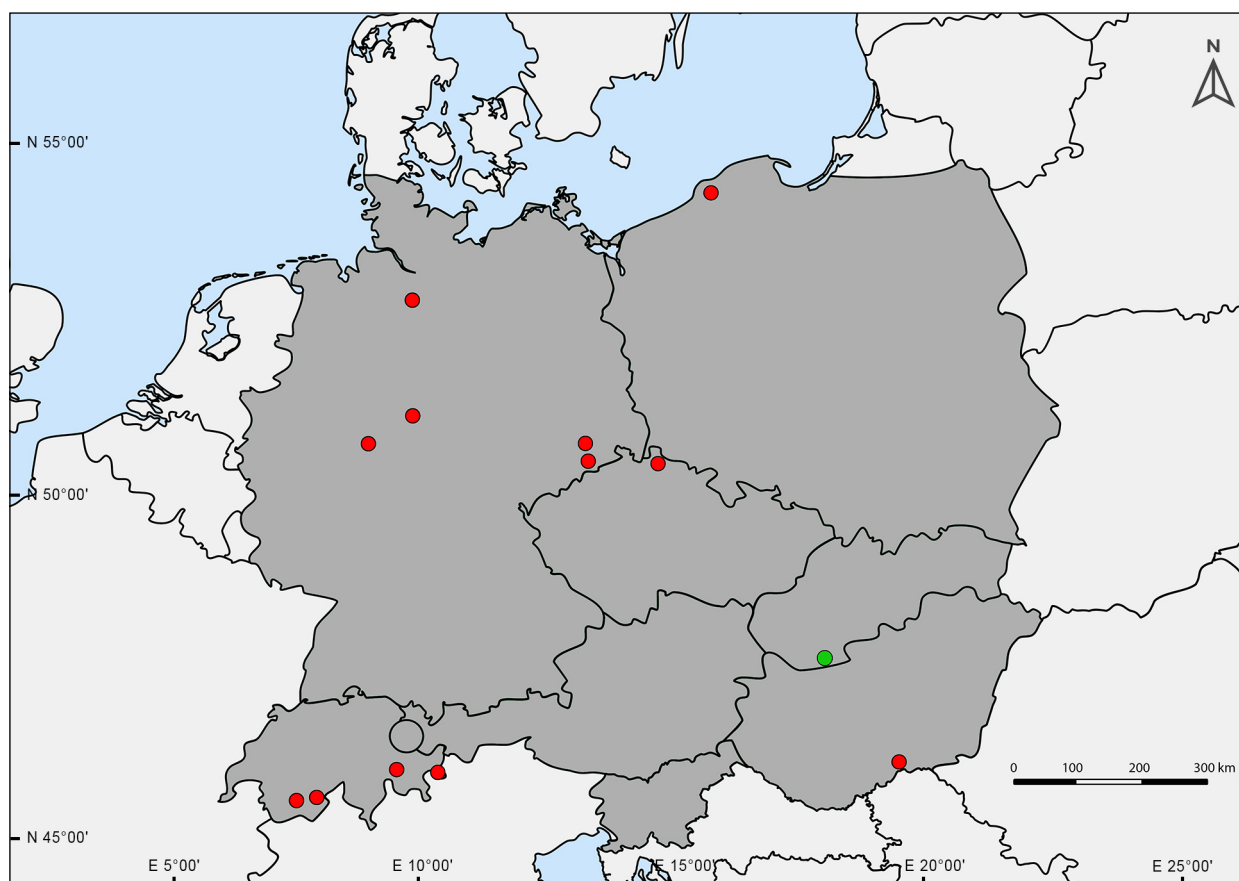


Figure 2. Geographic distribution of *Acropera orbiculus* in Central Europe. Known occurrence (red circle). New records (green circle). Data from: Chvála and Vonička (2008); Majer (1977); Kehlmaier and Almeida (2014); Kehlmaier (2003); Stuke (2008); Trojan (1956); Weinberg and Bächli (1997).

Family Conopidae

Conops insignis Loew, 1848

Observation. SLOVAKIA – Nitra Region • Zlatná na Ostrove, Veľký Lél Island; 47°45'07.90"N, 017°56'23.83"E; 110 m alt.; 19.7.2022; J. Zavřel obs.; pasture of domestic animals, on flowers of *Pulegium vulgare*, photographic record (Figs. 3, 4).

Identification. This species can be identified by following combination of characters: silvery stripe at the sides of thorax, black to brown scutellum, yellow face with small brown spot above antennal implant, and abdomen black with yellow dust bands (van Veen 2010) (Figs 3, 4).

Family Stratiomyidae

Hermetia illucens (Linnaeus, 1758)

Materials examined. SLOVAKIA – Bratislava Region • Bratislava-Karľova Ves, Institute of Zoology SAS; 48°10'18.3"N, 017°04'03.2"E; 193 m alt.; 21.VII.2022; J. Samay leg.; building interior, sweeping net; 1♀, pinned, UZSAV 310 • Bratislava-Karľova Ves, Kindergarten on Kolískova; 48°09'03.6"N, 017°03'19.5"E; 188 m alt.; 30.VIII.2022; M. Semelbauer leg.; yellow pan trap; 1♂, 1♀, pinned, UZSAV 311 • Bratislava Old Town; 48°08'57.9"N, 017°05'57.7"E; 8.X.2023; L. Činová leg.; reared from larvae found in compost heap on 24.VII.2023; 3♀, pinned, UZSAV312.



Figure 3. *Conops insignis*, female. Photo credit: Jan Zavřel.

Identification. *Hermetia illucens* is unique among Slovak species by its fairly large size, black body, very long antennae, and, in living specimens, intricate pattern on



Figure 4. Geographic distribution of *Conops insignis* in Central Europe. Known occurrence (red circle). New records (green circle). Data from: izeltlabuak.hu

compound eyes, brown-tinted wings, and two pale spots at the base of abdomen (Zeegers and Schulten 2022) (Figs 5, 6).

Family Asilidae

Tolmerus cowini (Hobby, 1946)

Materials examined. SLOVAKIA – **Nitra Region** • Komárno, Apálsky ostrov Island; 47°47'14.4"N, 018°07'42.8"E; 109 m alt.; 15.VII.2020; M. Semelbauer leg.; alluvial meadow, sweeping net, 1♂, pinned, UZSAV 312 – **Trnava Region** • Bodíky; 47°54'27.0"N, 017°28'00.3"E; 116 m alt.; 13.VIII.2021, 24.VI.2022; M. Semelbauer leg.; cattle pasture in Danube inland delta, sweeping net; 2♀, 1♂, pinned, UZSAV 313 – **Nitra Region** • Číčov; 47°47'04.4"N, 017°44'06.6"E; 109 m alt.; 15.VII.2020, 17.VI.2021; M. Semelbauer leg.; alluvial meadow surrounded by fields, sweeping net; 3♀, 1♂, pinned, UZSAV 314 (Figs 7–9).

Identification. *Tolmerus cowini* is very similar to *T. cingulatus* (Fabricius, 1781) and *T. atricapillus* (Fallén, 1814). While males of *T. atricapillus* are easily distinguishable by their terminalia, females are problematic. *Tolmerus cowini* differs from these other species in having the dark hind femora with only an orange ring at the apex or sometimes an indistinct orange patch near the base, while *T. atricapillus* and *T. cingulatus*, a distinct orange stripe is present along the posterior side of hind

femora. On the other hand, Smart (2005) used colour patterns of the fore- and mid-femora in a revised key largely based on specimens from British Isles. Males of *T. cingulatus* and *T. cowini* also differ in shapes of their gonostylus; in *T. cingulatus* the gonostylus is narrower and less angled at its base, while in *T. cowini* the gonostylus is broader and angled at base (Wolff et al. 2018; Speight 1987) (Figs 7, 8). Our specimens were identified by external morphology (colour pattern of hind femora), and a single male was dissected.

Discussion

Altogether, we record four species from four families as new to Slovakia. The family Acroceridae was represented in Slovakia by nine species (Roller 1997; Chvála 2009a), and our find of *Acrocer orbiculus* increases this number to 10. *Acrocer orbiculus* is distributed throughout Europe, including all countries neighbouring Slovakia, although exact localities from Austria are not known (Chvála 2009a; Nartshuk 2013). Therefore, the presence of this species in Slovakia is not surprising (Fig. 2).

The conopid genus *Conops* Linnaeus, 1758 was represented in Slovakia by nine species (Chvála 2009b; Semelbauer and Grechová 2019), and our record of *C. insignis* increases this number to 10. *Conops insignis* occurs in several European countries, including Spain, France, Italy, Sicily, Hungary, and Ukraine (Clements

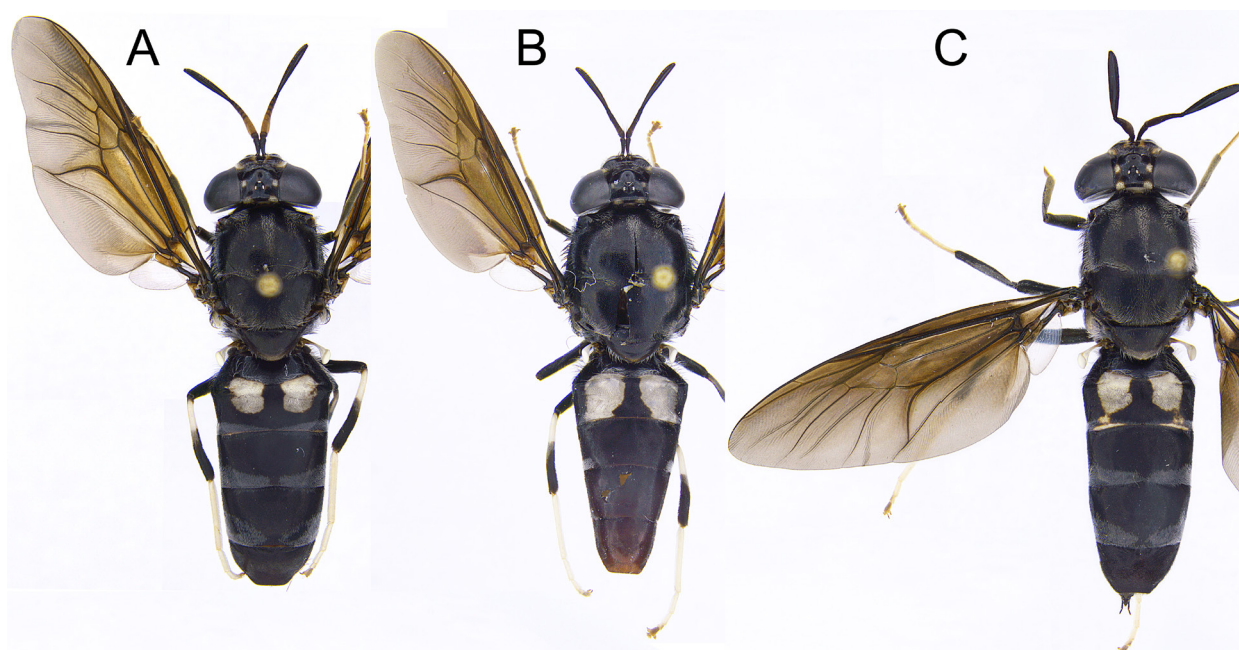


Figure 5. *Hermetia illucens*, habitus in dorsal view. **A.** Female, Kolískova. **B.** Male, Kolískova, **C.** Female, Institute of Zoology.

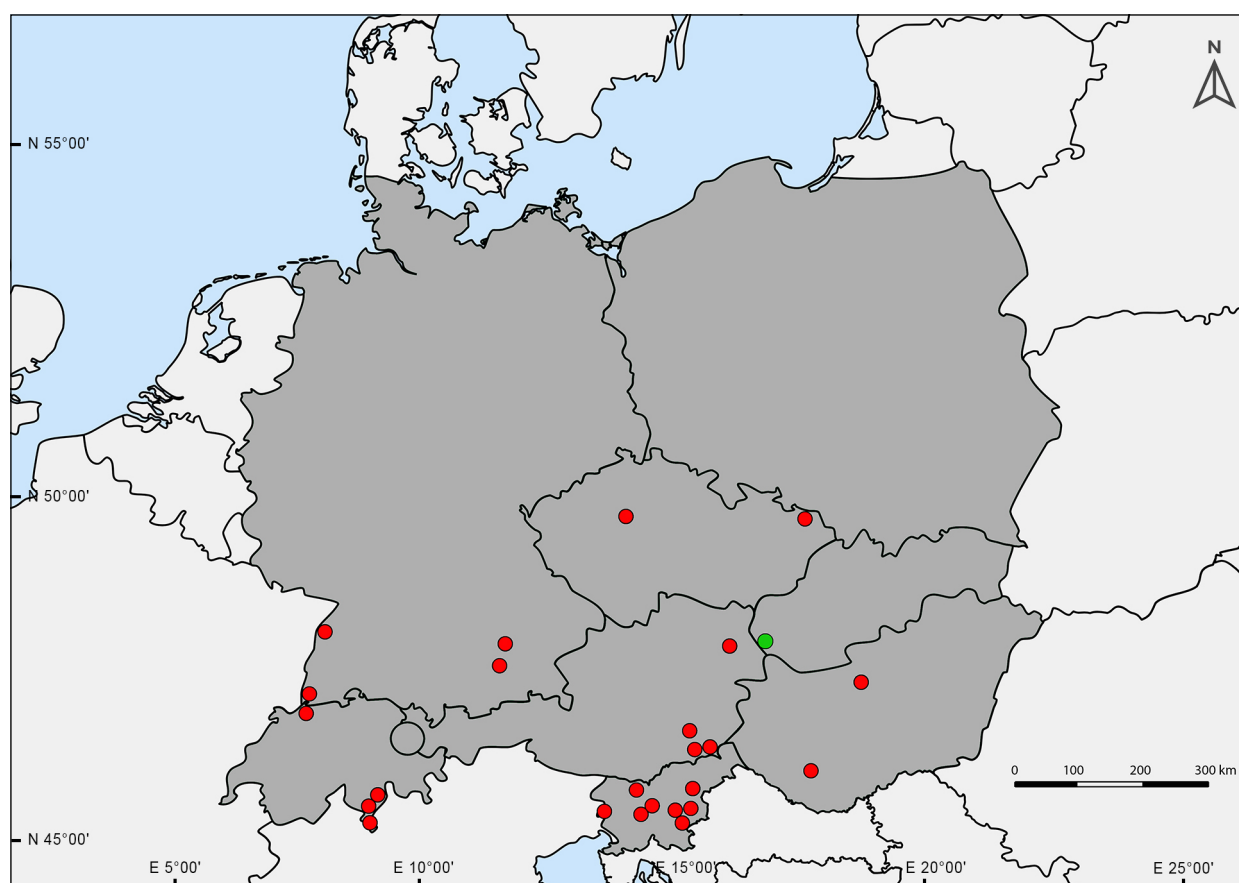


Figure 6. Geographic distribution of *Hermetia illucens* in Central Europe. Known occurrence (red circle). New records (green circle). Data from: Roháček and Hora (2013); Demetriou et al. (2022); GBIF.org; iNaturalist.org.

2013) (Fig. 4). Outside Europe, it is known from North Africa, Turkey, Iran, and Mongolia (Stuke et al. 2008; Khaghaninia and Kazerani 2014). The Slovakian site is used as pasture for domestic animals (cattle, horse, sheep, and goats) and is part of a valuable mosaic of alluvial meadows, pastures, and alluvial forests (Šibíková

and Šibík 2021). Several specimens were observed and photographed on flowers of *Pulegium vulgare*.

The family Asilidae was represented in Slovakia by 101 species (Bosák 2009), which is now raised to 102. *Tolmerus cowini* is known from the British Isles (Cumbrian coast of Britain, Ireland, Isle of Man: Harvey 2018),

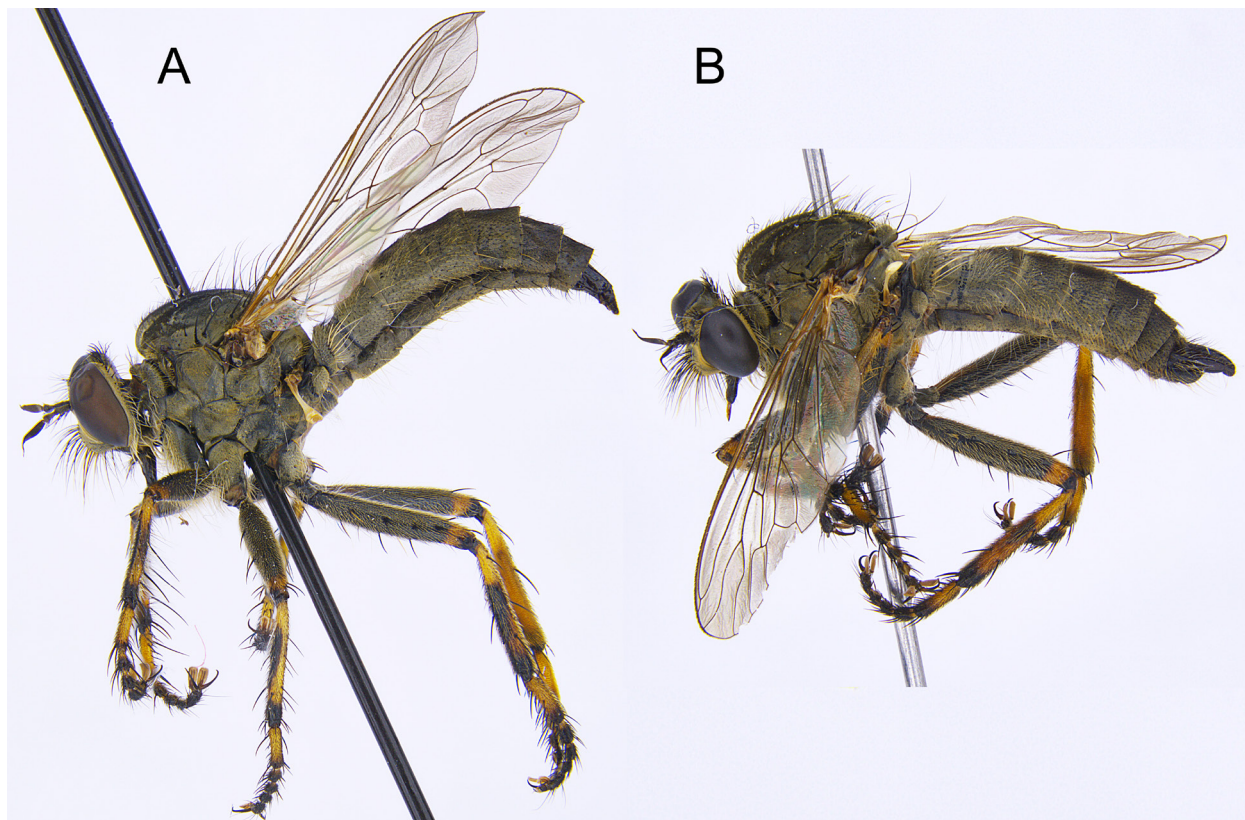


Figure 7. *Tolmerus cowini*, habitus in lateral view. **A.** Female. **B.** Male.



Figure 8. Gonostyli in lateral view. **A.** *Tolmerus cowini*. **B.** *T. cingulatus*.

France, Belgium, the Netherlands, Germany, Hungary, and Romania (Geller-Grimm 2013). In Germany, it is known from East Frisian Islands, Lower Rhine region, and Northeast German Lowland ("Seeburg am Süsen see" and Wöllnau: Wolff et al. 2018). This species inhabits coastal areas or surroundings of lowland rivers, often with bare ground and thickets of bracken and bramble (Stubbs and Drake 2014), or the contact zone between fallow fields and dry grassland (Wolff et al. 2018). An example of the habitat in the Lower Rhine region was given by Wolff et al. (2021). The sites in Slovakia mirror this general pattern, as all of them are located at

a water body and can be characterized by a combination of grasslands and fallow land/fallow or bushes and solitary trees, although the bare ground is not present on Apálsky ostrov Island (Fig. 10A–C).

High habitat heterogeneity linked to natural processes such as flooding and traditional management, like pollarding or cattle grazing, has largely disappeared from the lowland landscape over the last decades (Varga et al. 2016; Šibíková-Petrášová et al. 2017). In combination with intensification of forestry and spread of invasive species, these changes threaten the diversity of Danube floodplains (Mikulová et al. 2020). Several

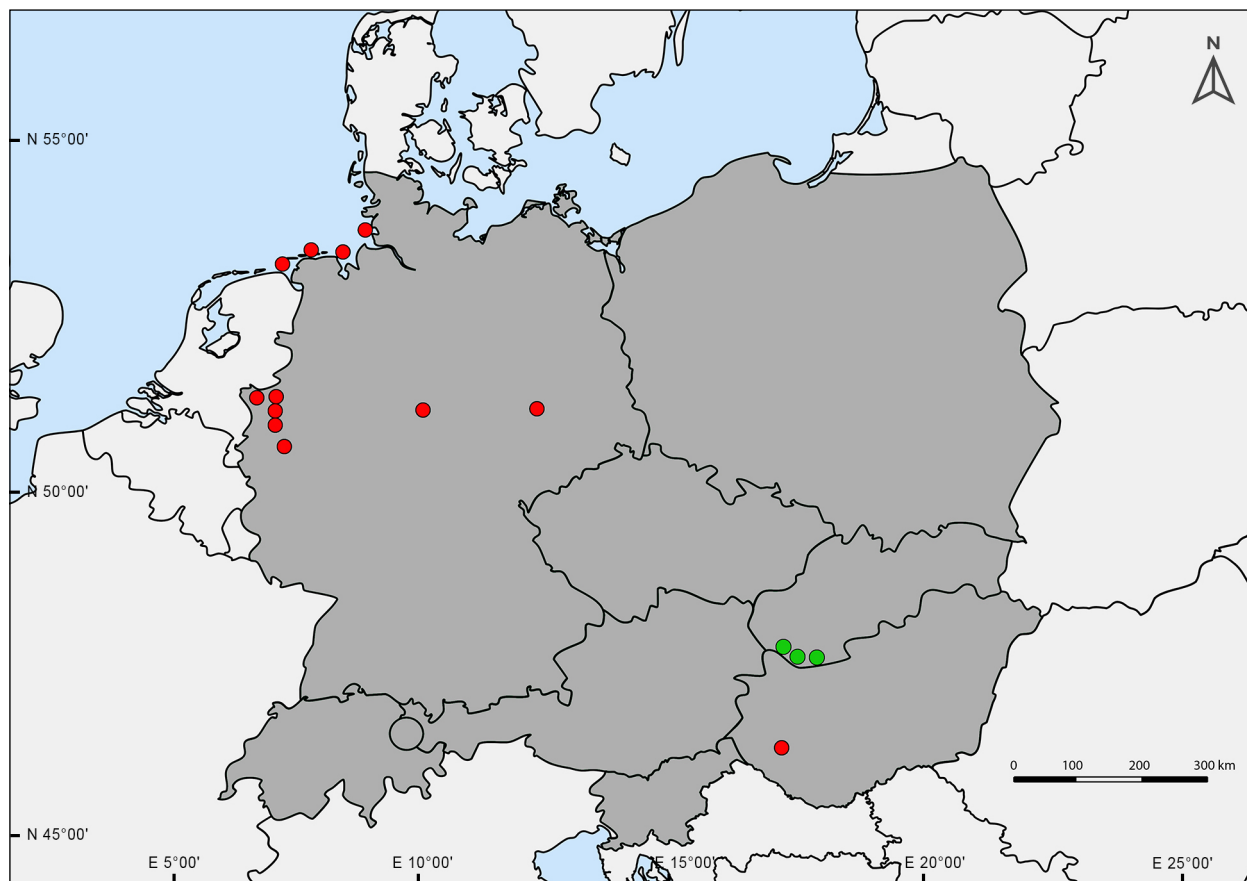


Figure 9. Geographic distribution of *Tolmerus cowini* in Central Europe. Known occurrence (red circle). New records (green circle). Data from: GBIF.org; Wolff et al. (2021); Speight (1987).

LIFE projects aim to reverse this change. The object of this article is not to evaluate the success of these projects, but thanks to these LIFE project, we can slightly add to the knowledge of the Slovak fauna. Beside several species of flies, a new scoliid wasp, *Scolia galbulla* (Pallas, 1771), was recorded recently from the Island of Veľký Lél (Semelbauer and Bogusch 2020).

Hermetia illucens, Black Soldier Fly, is now almost cosmopolitan, synanthropic, and even domesticated in tropical, subtropical, and temperate regions. It probably originated in the American tropics (Ståhls et al. 2020). In Europe, it was first reported from Malta in 1926 and spread mainly along the western European Mediterranean coast after World War II. Recent observations have reported this species from the Balkan Peninsula and north-western France, with very few records from inland areas (Switzerland and southern Germany; summarized by Roháček and Hora (2013), including unpublished observations). One surprising find was from northern Czech Republic, where adults were reared from larvae found in manure heap in 2010 (Roháček and Hora 2013), although this species has not been subsequently confirmed there. More recently, it was found in the Netherlands (Smit et al. 2019), Belgium, the United Kingdom, southern Austria (Demetriou et al. 2022), on the Russian Black Sea coast (Krasnodarski krai) (Gladun 2019), and Germany (Doczkal 2017). Unpublished records are known from Hungary (Budapest and

Kaposvár, south of Balaton, both 2022) (Fig. 6.) and Prague, Czech Republic (2020, <https://www.inaturalist.org/taxa/82177-Hermetia-illucens>).

Humans are largely responsible for the spread of *H. illucens* as a domesticated species. Although at one time considered a pest (it can cause myiasis), *H. illucens* is now widely used to recycle organic waste, to produce insect protein for pets, aquaculture, poultry, and livestock, and in research (Tomberlin and van Huis 2020). As it originated from the subtropics, this species' ability to survive in temperate regions has been questioned (Marshall et al. 2015). However, recent evidence shows that *H. illucens* is remarkably cold-resistant—flies, prepupae, and pupae can survive at 5 °C for several weeks (Spranghers et al. 2017)—and its occurrence in two or more consecutive years suggests that *H. illucens* is now established in several temperate regions of Europe (Demetriou et al. 2022). This species is expected to thrive in urban environments where it finds organic waste and a warmer microclimate. Our results are consistent with this; all specimens were caught in Bratislava, and three specimens were even reared from larvae found in a compost heap. Whether this species has become established in Slovakia is still uncertain, but considering several recent finds in western and central Europe, it seems likely that *H. illucens* will be recorded more often. As Demetriou et al. (2022) point out, this large, conspicuous species is an ideal object for citizen science.

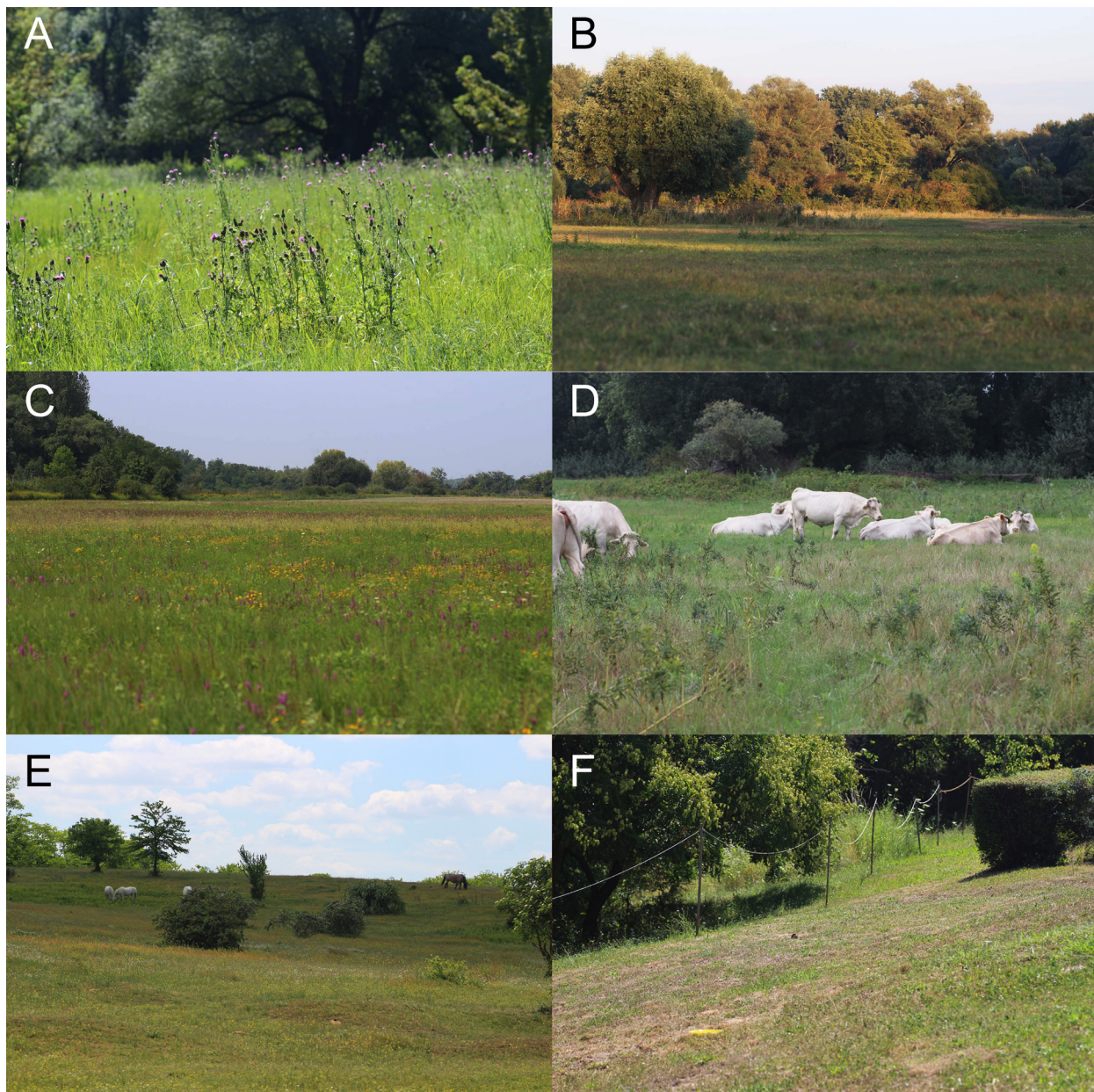


Figure 10. Habitats of the species reported. **A–C.** Habitat of *Tolmerus cowini*: **(A)** at Apálský ostrov; **(B)** at Bodíky; **(C)** at Čičov. **D.** Habitat of *Conops insignis* at Velký Lél Island. **E.** Habitat of *Acrocer orbiculus* in a horse pasture in Virt. **F.** Habitat of *Hermetia illucens* in Bratislava (Karlova Ves, Kindergarten on Kolískova).

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Authors Contributions

Conceptualization: MS. Investigation: JZ. Visualization: JS. Writing – original draft: MS. Writing – review and editing: JS.

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