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LONG-LEGGED FLIES FROM CO₂-BAITED TRAPS: NEW FAUNISTIC RECORDS AND INSIGHTS FROM BYCATCH ANALYSIS IN SLOVAKIA

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Oboňa J., Loziaková Peňazziová K., Csank T., Pačanská Z., Pivka S., Manko P. - Long-legged flies from CO₂-baited traps: new faunistic records and insights from bycatch analysis in Slovakia

Although CO₂-baited BG-Sentinel traps are widely used for mosquito surveillance, their non-target bycatch can yield valuable faunistic information. We present the first assessment of Dolichopodidae (Diptera) collected incidentally using CO₂ traps across Slovakia in 2025. Of 290 weekly trap samples obtained at 16 localities, 45 (16%) contained dolichopodid specimens, representing a total of 400 specimens belonging to 13 species in five genera. Two species (*Syristoma impar* (Rondani, 1843) and *Systemus bipartitus* (Loew, 1850)) are reported here for the first time in Slovakia. The most frequently recorded species were *Systemus leucurus* Loew, 1859, *Medetera truncorum* Meigen, 1824, and *Sciapus platypterus* (Fabricius, 1805), although their occurrence varied considerably among sites. The assemblage was dominated by species associated with arboreal and humid microhabitats, suggesting that CO₂-baited traps selectively capture only a subset of the local dolichopodid fauna. In addition, only male specimens were identified to species level, and therefore the reported species composition should be interpreted with caution. Our findings demonstrate that mosquito surveillance networks can provide valuable complementary faunistic information on non-target Diptera, including rarely recorded species. However, CO₂-baited traps do not yield a representative sample of the dolichopodid fauna and should be considered as supplementary to targeted sampling methods. Integrating the analysis of bycatch into vector surveillance programs represents a low-effort approach to enhancing faunistic knowledge on Diptera in human-modified environments.

KEY WORDS: biodiversity monitoring, bycatch, CO₂ trap, Diptera, Dolichopodidae, new records, Slovakia

INTRODUCTION

Continuous monitoring of hematophagous Diptera using CO₂-baited traps, such as the BG-Sentinel 2 (Biogents, Germany; hereafter referred to as CO₂ traps), has become a standard tool in vector surveillance programs worldwide (e.g., FARAJOLLAHI *et al.*, 2009; CILEK *et al.*, 2024). While primarily targeting host-seeking mosquitoes, these traps routinely intercept a diverse array of non-target insects. Such bycatch has traditionally been overlooked or discarded, despite its considerable faunistic and ecological potential (GROOTAERT *et al.*, 2025; GRUNDMANN *et al.*, 2025, 2026; KURINA *et al.*, 2025; OBOŇA *et al.*, 2025a,b). Analyses of bycatch material from mosquito surveillance networks in Slovakia have already yielded several first records for the country, along with rarely recorded species of Phoridae and Bibionomorpha, highlighting the untapped faunistic potential of these incidental catches.

The family Dolichopodidae (long-legged flies) is one of the most species-rich and ecologically significant

groups, comprising more than 8,400 species and over 240 genera worldwide (BICKEL, 2009; GRICHANOV, 2006, 2017; POLLET *et al.*, 2025b). Adults are typically predatory and occur in a wide range of habitats, including forest floors, riparian zones, wetlands, and other humid environments (PARENT, 1938; VAILLANT, 1978; WÉBER, 1989; POLLET and GROOTAERT, 1999; POLLET, 2009; POLLET and MEUFFELS, 2023; TONGUÇ, 2023); while larvae inhabit substrates such as aquatic-marginal environments, damp soils and decaying vegetation, but other species can be found also under tree bark and in arboreal microhabitats (e.g. OBOŇA *et al.*, 2021; POLLET *et al.*, 2025a). Despite their ecological importance and high diversity, Dolichopodidae had not yet been systematically studied in the context of mosquito-trap bycatch, and their representation in samples from CO₂ traps from Slovakia has not yet been investigated.

In this study, we present (i) updated records of Dolichopodidae species captured incidentally in CO₂ traps across human-modified environments in Slovakia in 2025; and (ii) a discussion of the broader implications of

integrating non-target Diptera into biodiversity surveillance frameworks.

Through this contribution, we expand national faunistic knowledge and demonstrate how existing vector surveillance infrastructure can be harnessed to obtain valuable data on non-target Diptera.

MATERIAL AND METHODS

SAMPLING

The bycatch analyzed in this study was collected during mosquito surveillance surveys using BG-Sentinel 2 traps (Biogents, Germany) baited with CO₂ cylinders. We deployed traps across 16 localities in Slovakia during 2025. Traps were operated from June to mid-October 2025, covering the main mosquito activity season, with collection nets replaced on a weekly twice. Samples were initially stored at -20 °C and subsequently at -80 °C until laboratory processing.

After removing mosquitoes, the remaining material was preserved in 70% ethanol. The collected material was first sorted to family level, after which specimens of Dolichopodidae were selected and identified to species level (males only) using the following keys: PARENT (1938), WÉBER (1989), GRICHANOV (2006), taking into account VAILLANT (1978), MEUFFELS and GROOTAERT (1990), GRICHANOV and KAZERANI (2014), NAGLIS (2014), GRICHANOV and NEGROBOV (2014), NEGROBOV and NAGLIS (2016), NEGROBOV *et al.* (2020), and POLLET and MEUFFELS (2023). Only male specimens were identified to species level due to the higher reliability of species-specific male genital characters. Female Dolichopodidae often lack sufficiently diagnostic morphological features for reliable species-level identification, particularly in preserved trap material. In addition, a proportion of the specimens recovered from CO₂-baited traps showed varying degrees of physical damage, which further reduced the reliability of species determination in females. To avoid potential misidentifications, species-level analyses were therefore restricted to males.

LOCALITIES

Sampling was conducted at 16 sites across Slovakia (see OBOŇA *et al.*, 2025b for a map of sampling sites). Below, we list only the localities where Dolichopodidae were recorded. The species records under “Material examined” consist of location name, latitude, longitude, sampling period, and the number of collected males. Species with first records for Slovakia are briefly commented upon.

RESULTS

Across all 16 monitored localities, 290 weekly trap samples were examined. Of these, 45 (16%) contained Dolichopodidae. In total, 400 specimens (207 males and 193 females) were collected and assigned to 13 species belonging to five genera.

ANNOTATED LIST OF RECORDED SPECIES

Chrysotus gramineus (Fallén, 1823)

Material examined: Farma Stará Ľubovňa, 49°15'43"N 20°41'20"E, 07-15.07.2025, 1 ♂.

Medetera truncorum Meigen, 1824

Material examined: Rakytovce, 48°40'39"N 19°07'27"E, 07-13.07.2025, 1 ♂; 14-20.07.2025, 1 ♂; 28.07.-03.08.2025, 3 ♂; 18-24.08.2025, 2 ♂♂; 25-31.08.2025, 2 ♂♂; Senianske rybníky ponds, 48°40'11"N 22°01'54"E, 01-08.06.2025, 1 ♂; 09-15.06.2025, 1 ♂; 16-22.06.2025, 1 ♂; 14-20.07.2025, 2 ♂♂; 21-27.07.2025, 1 ♂; 04-10.08.2025, 3 ♂♂; 11-17.08.2025, 1 ♂; Lesenice, 48°06'18"N 19°14'57"E, 28.07.-03.08.2025, 1 ♂; Mojšova Lúčka, 49°11'33"N 18°49'15"E, 07-13.07.2025, 1 ♂.

Sciapus albifrons (Meigen, 1830)

Material examined: Potônské Lúky, 48°05'43"N 17°35'22"E, 02-08.06.2025, 4 ♂♂.

Sciapus flavicinctus (Loew, 1857)

Material examined: Veľký Lél, 47°45'23"N 17°56'30"E, 08-14.09.2025, 1 ♂.

Sciapus gracilipes (Loew, 1871)

Material examined: Farma Stará Ľubovňa, 49°15'43"N 20°41'20"E, 04-10.08.2025, 1 ♂.

Sciapus heteropygus Parent, 1926

Material examined: Sokoliareň of the Slovak University of Agriculture in Nitra, 48°18'13"N 18°05'51"E, 07-13.07.2025, 2 ♂♂; 21-27.07.2025, 3 ♂♂.

Sciapus platypterus (Fabricius, 1805)

Material examined: Rakytovce, 48°40'39"N 19°07'27"E, 16-22.06.2025, 1 ♂; 23-30.06.2025, 1 ♂; Ronava, 48°18'25"N 17°32'32"E, 02-08.06.2025, 4 ♂♂; 09-15.06.2025, 3 ♂♂; 16-22.06.2025, 3 ♂♂; 23-29.06.2025, 6 ♂♂; Senianske rybníky ponds, 48°40'11"N 22°01'54"E, 01-08.06.2025, 1 ♂; 23-29.06.2025, 1 ♂; 30.06.-07.07.2025, 1 ♂; 04-10.08.2025, 2 ♂♂; Mojín 48°20'17"N 19°58'20"E, 03-08.06.2025, 5 ♂♂; 09-15.06.2025, 3 ♂♂; Lesenice, 48°06'18"N 19°14'57"E, 09-15.06.2025, 2 ♂♂; 30.06.-06.07.2025, 1 ♂; 28.07.-03.08.2025, 3 ♂♂.

Sybistroma impar (Rondani, 1843)

Material examined: Lesenice, 48°06'18"N 19°14'57"E, 18-24.08.2025, 1 ♂ (Fig. 1).

Comments: The species is known from Bulgaria, Greece, Hungary, Israel, Italy, Romania, Russia (Krasnodar), and Turkey (Adiyaman, Antalya) (GRICHANOV and KAZERANI, 2014). First record for Slovakia.



Fig. 1 - *Sybistroma impar* (Rondani, 1843), male

***Sybistroma obscurellus* (Fallén, 1823)**

Material examined: Rakytovce, 48°40'39"N 19°07'27"E, 01-07.09.2025, 1 ♂.

***Systemus bipartitus* (Loew, 1850)**

Material examined: Ronava, 48°18'25"N 17°32'32"E, 23-29.06.2025, 1 ♂.

Comments: The species is known from Austria, Denmark, Estonia, Finland, Germany, Great Britain, Latvia, Norway, Poland, Sweden, the Czechia and Turkmenistan (GRICHANOV, 2006; POLLET, 2011). First record for Slovakia.

***Systemus leucurus* Loew, 1859**

Material examined: ZOO Kavečany, 48°47'01"N 21°12'14"E, 23-29.06.2025, 2 ♂♂; Senianske rybníky ponds, 48°40'11"N 22°01'54"E, 01-08.06.2025, 15 ♂♂; 09-15.06.2025, 5 ♂♂ (Fig. 2); 16-22.06.2025, 17 ♂♂; 23-29.06.2025, 6 ♂♂; 30.06.-07.07.2025, 13 ♂♂; 07-13.07.2025, 1 ♂; 14-20.07.2025, 10 ♂♂; 21-27.07.2025, 1 ♂; 28.07.-03.08.2025, 9 ♂♂; 04-10.08.2025, 17 ♂♂; 18-24.08.2025, 3 ♂♂; 25-31.08.2025, 31 ♂♂; Farma Stará Ľubovňa, 49°15'43"N 20°41'20"E, 30-06.07.2025, 2 ♂♂.



Fig. 2 - *Systemus leucurus* Loew, 1859, male.

***Systemus scholtzii* (Loew, 1850)**

Material examined: Ronava, 48°18'25"N 17°32'32"E, 07-11.07.2025, 1 ♂.

***Systemus tener* Loew, 1859**

Material examined: Senianske rybníky ponds, 48°40'11"N 22°01'54"E, 25-31.08.2025, 1 ♂.

The most frequently collected species was *S. leucurus*, which occurred at multiple sites and across a broad seasonal span, especially at the Senianske rybníky ponds. *Medetera truncorum* and *S. platypterus* were also represented by relatively high numbers of individuals and were recorded from several localities.

In addition to two new species for Slovakia listed above, each represented by a singleton, several other species were detected only once or twice, including *S. gracilipes*, *S. scholtzii*, and *S. tener*.

DISCUSSION

This study provides the first overview of Dolichopodidae captured incidentally in CO₂-baited traps in Slovakia. Although long-legged flies constituted only a minor fraction of the overall bycatch (see GROOTAERT *et al.*, 2025; GRUNDMANN *et al.*, 2025, 2026; KURINA *et al.*, 2025; OBOŇA *et al.*, 2025a,b), the faunistic relevance of the material highlights the value of re-examining samples generated by mosquito surveillance networks. At the same time, it is important to note that CO₂-baited traps do not provide a representative sample of the dolichopodid fauna, and the results presented here should therefore be interpreted as complementary to data obtained through targeted sampling methods.

A limitation of this study is that only male specimens were identified to species level. Consequently, additional species may have been present among the unidentified female specimens, including species represented in the material solely by females. The reported species composition should therefore be regarded as conservative and interpreted with appropriate caution.

Two species (*Sybstroma impar* and *Systemus bipartitus*) are recorded here for the first time in Slovakia (see POLLET *et al.*, 2025b), increasing the known national species list by two until 258. These taxa represent different biogeographical elements: *S. impar* is associated mainly with southern and southeastern Europe and western Asia (GRICHANOV and KAZERANI, 2014), whereas *S. bipartitus* is predominantly northern and boreal in distribution (GRICHANOV, 2006; see also POLLET, 2011).

Notably, the majority of species recorded in this study belong to genera typically associated with arboreal or saproxylic habitats, such as *Sciapus*, *Systemus*, and *Medeterra* (GRICHANOV, 2006; OBOŇA *et al.*, 2021). This pattern suggests that CO₂-baited traps may disproportionately capture species active in shaded, humid microhabitats, possibly due to trap placement or local microclimatic conditions. In contrast, species-rich genera commonly encountered in open or ground-level habitats (e.g. *Dolichopus* or *Rhaphium*) were not recorded, further indicating that this trapping method samples only a subset of the local dolichopodid fauna.

The relatively high abundance of *S. leucurus* observed in this study is likely influenced by local conditions at a particular site rather than reflecting a general ecological dominance of the species (e.g. POLLET *et al.*, 2025a). Indeed, the majority of individuals were collected at a single locality, suggesting that trap placement in proximity to suitable microhabitats (e.g. tree-rich or humid environments) may strongly affect capture rates. Similarly, *M. truncorum* and *S. platypterus* were recorded from several sites but not consistently across all traps, indicating that their occurrence is also shaped by local habitat characteristics such as vegetation structure, presence of trees, and humidity conditions.

The detection of several species regarded as rare or of conservation concern in parts of Central Europe further underlines the faunistic value of bycatch material. Some of these species are included in regional Red Lists (e.g. POLLET, 2000; MEYER and WAGNER, 2011; MEYER and STARK, 2015; DRAKE, 2018; POLLET and MEUFFELS, 2023), although such classifications should be interpreted with caution. Indeed, conservation statuses may differ between countries and require assessment based on national data. Nevertheless, the presence of these taxa in the samples demonstrates that CO₂-baited traps can yield valuable records of faunistically important species, even when capture numbers are low, as also observed in previous studies on non-target Diptera (e.g. GRUNDMANN *et al.*, 2025, 2026; KURINA *et al.*, 2025; GROOTAERT *et al.*, 2025).

Overall, our findings highlight that mosquito surveillance infrastructure represents a useful and underutilised source of supplementary faunistic information. However, CO₂-baited traps cannot replace targeted sampling methods specifically designed for Dolichopodidae, such as Malaise traps, pan traps, sweep netting, or tree eclectors (e.g. POLLET, 2009; KECHEV, 2021; TONGUÇ, 2023; POLLET *et al.*, 2025a,b). Their primary contribution lies in capturing species that may be underrepresented or

overlooked by conventional sampling approaches. Further research integrating habitat descriptors and analysing environmental drivers of species occurrence would help to better understand the mechanisms underlying the selective capture of certain taxa in CO₂-baited trapping systems.

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CONFLICT OF INTEREST DISCLOSURE, ETHICS APPROVAL STATEMENT

The authors declare no conflict of interest. No ethics approval was required for this study.

CONTRIBUTION OF AUTHORS

Tomáš Csank conducted the fieldwork. Katarína Loziaková Peňazziová, Zuzana Pačanská, and Soňa Pivka processed and sorted the trap material. Jozef Oboňa identified the specimens. Peter Manko prepared the photographs. All authors contributed to writing and revising the manuscript.