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SOME FAMILIES OF DIPTERA FROM BEER TRAPS IN BALATON HIGHLAND, HUNGARY

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Abstract – Faunistic records for 41 Diptera species from nine families (Anisopodidae, Drosophilidae, Dryomyzidae, Heleomyzidae, Lauxaniidae, Platystomatidae, Sciomyzidae, Syrphidae and Ulidiidae) collected at six sites at Felsőörs and Lovas in the Balaton Highland, Hungary are presented. Amongst the material, the species *Drosophila suzukii* (Matsumura, 1931) (Drosophilidae) and *Callopistromyia annulipes* (Macquart, 1855) (Ulidiidae) belong to invasive pest species. Thermophilous species are represented by interesting records, namely *Suillia gigantea* (Meigen, 1830), *S. lurida* (Meigen, 1830), *S. variegata* (Loew, 1862) (all Heleomyzidae), *Minettia subvittata* (Loew, 1847), *Peplomyza discoidea* (Meigen, 1830) (both Lauxaniidae), and *Otites lamed* (Schrank, 1781) (Ulidiidae). Furthermore, the disease vector role of *Phortica variegata* (Fallén, 1823) (Drosophilidae) is also discussed.

KEY WORDS: beer traps, Diptera, faunistics, Hungary

Izvleček – NEKAJ DRUŽIN DVOKRILCEV IZ PIVSKIH PASTI NA BALATONSKEM VIŠAVJU NA MADŽARSKEM

Predstavljeni so favnistični podatki o 41 vrstah dvokrilcev iz devetih družin (Anisopodidae, Drosophilidae, Dryomyzidae, Heleomyzidae, Lauxaniidae, Platystomatidae, Sciomyzidae, Syrphidae in Ulidiidae), zbranih na šestih krajih pri vaseh Felsőörs in Lovas na Balatonskem višavju na Madžarskem. Med temi sta vrsti *Drosophila suzukii* (Matsumura, 1931) (Drosophilidae) in *Callopistromyia annulipes* (Macquart, 1855) (Ulidiidae), ki sta invazivni vrsti škodljivcev. Toploljubne vrste so

zastopane z zanimivimi najdbami, kot so *Suillia gigantea* (Meigen, 1830), *S. lurida* (Meigen, 1830), *S. variegata* (Loew, 1862) (vse Heleomyzidae), *Minettia subvittata* (Loew, 1847), *Peplomyza discoidea* (Meigen, 1830) (obe Lauxaniidae) in *Otites lamed* (Schrank, 1781) (Ulidiidae). Poleg tega je obravnavana vloga vrste *Phortica variegata* (Fallén, 1823) (Drosophilidae) kot prenašalke bolezni.

KLJUČNE BESEDE: pivske pasti, Diptera, favnistika, Madžarska

Introduction

Many Diptera species are important pests and disease vectors. While climate change triggers the northward spread of mosquito (Medlock et al. 2012) and sandfly vectors (Fischer et al. 2011), long-distance transport results in the rapid, intercontinental spread of such invasive agricultural pest taxa as e.g., *Drosophila suzukii* (Walsh et al. 2011, Örsted & Örsted 2019). Many species, especially of Anisopodidae, Dryomyzidae, Heleomyzidae, Lauxaniidae, Platystomatidae and Ulidiidae, prefer the moist, shady habitats, because larvae most of them develop in such decaying materials as rotten fruits and fungi or carrion, so that they play an important role in decomposition. Sciomyzidae larvae are aquatic predators or terrestrial parasitoids of moluscs. Although most species breed in a decaying plant and fungal material, larvae of a few species, such as *D. suzukii*, can also feed on fresh fruits. *Drosophila* species can act as passive vectors of various pathogenic bacteria and fungi (Gilbert 1980).

The aim of the study was to study the Diptera assemblages of the Balaton highland using simple method (beer trap) which can bring interesting results differing from those obtained by more standard methods, such as sweeping and using Malaise or Moericke traps.

Methods

Study area. The Balaton Highland is the southern part of the Bakony Mountain Range which is bordered by the lake Balaton from the south. The distance of the collecting sites from lake Balaton is 3 to 4 km. The bedrock is composed of Triassic-age carbonates. There are several karst springs in the area. Mesophilous oak-forest communities form the characteristic vegetation (Fig.1).

The description of the environment of the trapping sites is as follows:

All localities are wet and shaded, they were chosen because of preferences by studied families.

1. Alkút spring: a cold headspring (helocren) with an associated marsh at the north-east slope of the Kereszt hill, 47°0'31"N, 17°57'16"E. *Eriophorum angustifolium* (Honck., 1782) as glacial relict species can be found in this refuge.

2. Watercourse of Alkút spring at the north slope of the Kereszt hill; the direction of the valley is east to west, 47°0'31"N, 17°57'8"E. *Carpinus betulus* (L.) can be

Fig. 1: Position of the studied area in Central Europe (yellow spot) and the localities of the trapping points in Felsőörs and Lovas.

found at this site; some orchid species are represented, however *Pulmonaria officinalis* (L.) is a common herbaceous species.

3. Stream of Malom spring, site I; *C. betulus*, *Staphylea pinnata* (L.) and *Acer campestre* (L.) are characteristic tree species; the direction of the valley is north to south, 47°0'34"N, 17°56'59"E. A cold and shaded biotope in the bottom of the valley. *Asarum europaeum* (L.) occurs in the undergrowth.

4. Stream of Malom spring, site II; a much more open and warmer part of the Malom valley than the Malom I site, 47°0'41"N, 17°56'51"E. With a row of buildings at the right and broad meadow at the left side of the stream; *Salix* species occur at the stream coasts.

5. Stream of Király-kút spring; this site lies at the eastern slope of a hill, on the borderline of a forest and a cattle pasture, 47°0'18"N, 17°56'58"E. The forest is rather mesophilic (*Acer* species are common trees). Planted stands of *Pinus nigra* (J.F. Arnold, 1785) can be found in the higher parts of the hill on the western side of the broad valley.

6. Aranyos spring: similar to the previous site, 47°0'12"N, 17°56'59"E. A bit more humid – *Equisetum arvense* (L.) and *Petasites hybridus* ((L.) Gaertn. & al., 1801) can be found there. Cows come to drink water from the spring.

In the Result section, the localities are abbreviated by the above-mentioned six numbers (1–6).

Respective parts of Figure 2 show the vegetation habitus pictures of Alkút spring, stream of Király-kút spring, stream of Malom spring and Aranyos spring.

Trapping method. We used the fermented mixture of beer and sugar, which contained about four teaspoons of sucrose (~24 g), a 1/2 can of light beer (0.25 l) and about 1 coffee spoon of yeasts (~5-8 g). The material was inoculated with yeast. The fermented material was filled into uncapped plastic bottles and they were hung in the woods at head height. Traps were operated at the six sites of Felsőörs and Lovas (about 47.00° N, 17.95° E). All traps were installed in three periods. In the Result

section, these periods are abbreviated as A (29. 4. 2017–16. 5. 2017), B (13.–22. 7. 2017), and C (23.–30. 8. 2017). The trapped flies were conserved in ethyl-alcohol in plastic vials.

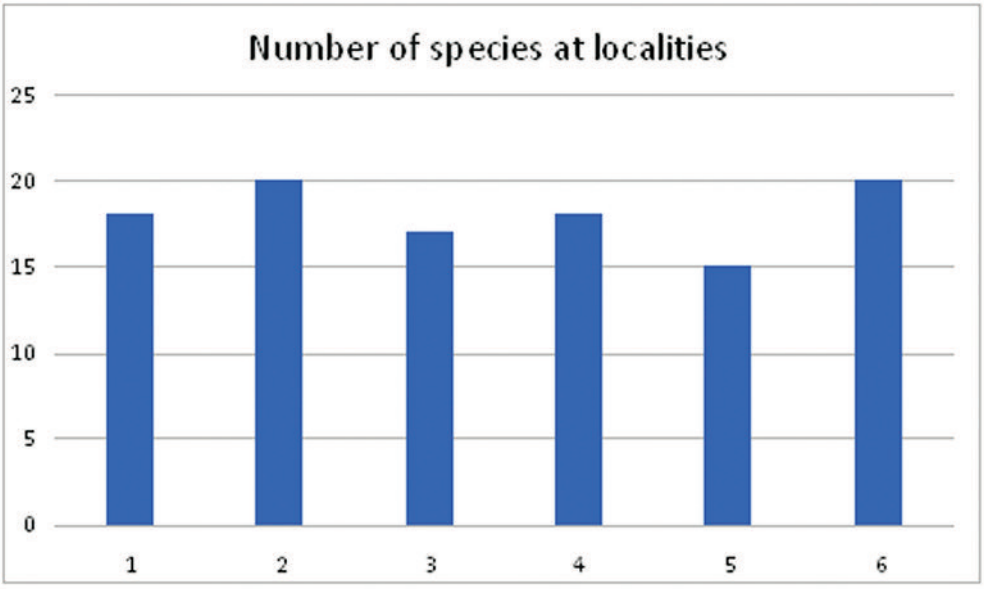
Proceeding of the paper. All the material was collected by A. J. Trájer, L. Dvořák sorted out the material. The following families were identified and commented by L. Dvořák (Anisopodidae, Platystomatidae, Syrphidae, and Ulidiidae), K. Dvořáková

Fig. 2: Vegetation habitus of four collecting sites. Photo: A. J. Trájer.

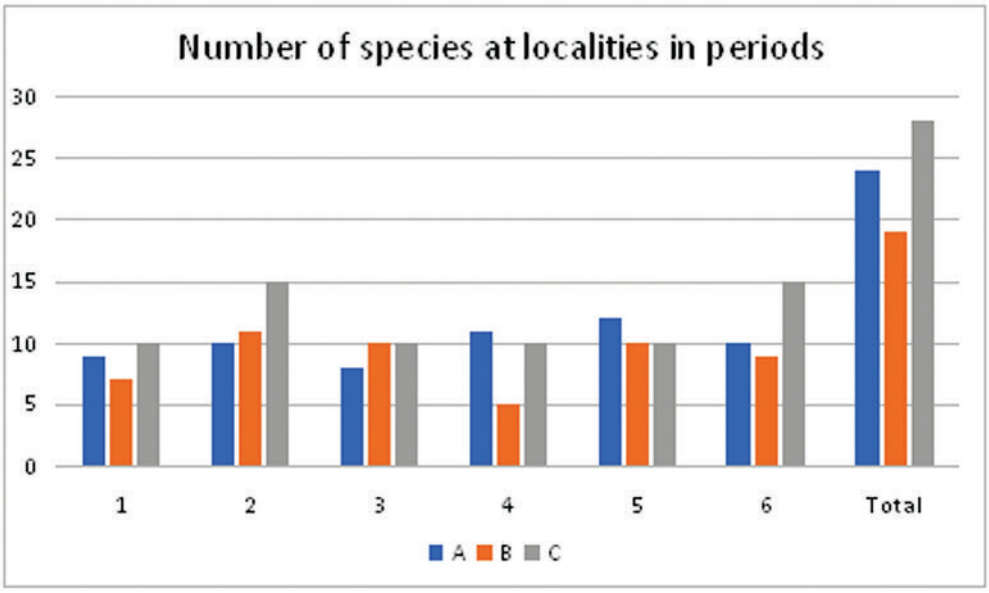
(Dryomyzidae, Heleomyzidae, Lauxaniidae, and Sciomyzidae) and J. Máca (Drosophilidae). The voucher specimens are deposited in the private collections of the authors who made the identification. In the Discussion, comments were made for the species not listed in the Checklist of the Diptera of Hungary (Papp 2001) and for some remarkable species. We are using the nomenclature of the portal https://fauna-eu.org, with following exceptions: the genus *Otites*, family Dryomyzidae, and family Lauxaniidae, where we comply to the newest papers of Kameneva & Korneyev (2019), Semelbauer (2016), and Mathis & Sueyoshi (2011), repectively.

Results

During the 2017 season, 1229 specimens of 41 species were captured of studied families of Diptera. The number of species at localities was rather similar and varied between 15 and 20 species (graph 1), unlike the number of species in three periods (graph 2). 28 species were identified in the third period (=C, 23.–30. 8.), 24 in the first period (=A, 29. 4.–16. 5.), and only 19 in the second period (=B, 13.–22. 7.). The highest numbers of species were found in the localities and periods 2C and 6C followed by 5A, 2B, and 4A (all more than 10 species). In contrast with this, the most of specimens (692) were trapped in the period B, (300 in C and 237 in A), in individual localities and periods (graph 3), the highest numbers were identified from 3B (243 specimens), 2B (171 spec.), 2C (122 spec.), and 6B (112 spec.); the numbers were lower than 100 specimens in other localities and periods. Nine species (Drosophilidae and Heleomyzidae) were found in all localities, *Dryomyza anilis* in

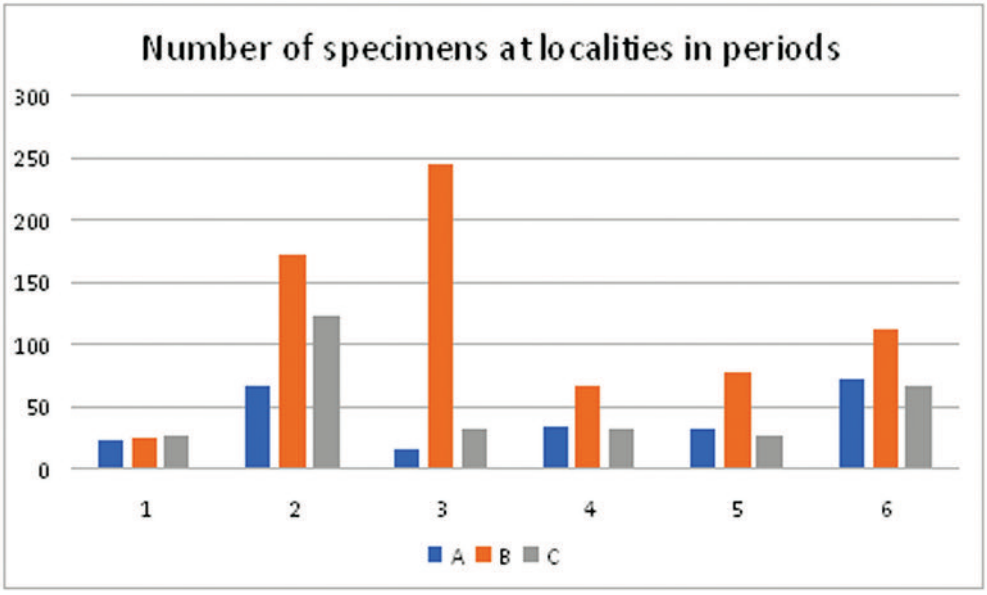


Graph 1: Number of species at localities 1–6.



Graph 2: Number of species at localities 1–6 in the periods A, B and C.

all traps. *Suillia affinis* has the most of specimens (280), of which 87 in one trap (3B). Some other species from families Dryomyzidae, Drosophilidae and Heleomyzidae were also caught in the mass numbers.



Graph 3: Number of specimens at localities 1–6 in the periods A, B and C.

List of species

Anisopodidae
Sylvicola punctatus (Fabricius, 1787)
Material examined – 4A: 1♂, 1♀; 5A: 3♀♀.

Drosophilidae
Drosophila histrio Meigen, 1830
Material examined – 2C: 1♀; 6A: 1♂, 3♀♀.

Drosophila immigrans Sturtevant, 1921
Material examined – 2C: 2♂♂, 1♀; 3C: 1♀.

Drosophila kuntzei Duda, 1924
Material examined – 1A: 1♀; 1B: 1♀♀; 2A: 2♂♂; 2B: 22♂♂, 7♀♀; 2C: 4♂♂, 1♀; 3A: 1♂; 3B: 38♂♂, 11♀♀; 3C: 1♀; 4C: 2♂♂; 5A: 1♂, 1♀; 5B: 12♂♂, 1♀; 5C: 1♂, 1♀; 6A: 10♂♂, 2♀; 6C: 4♂♂, 6♀♀.

Drosophila melanogaster Meigen, 1830
Material examined – 1C: 1♀; 3C: 2♂♂, 9♀♀.

Drosophila obscura Fallén, 1823
Material examined – 4A: 1♀; 6C: 3♂♂, 2♀♀.

Drosophila phalerata Meigen, 1830
Material examined – 1B: 1♂; 2A: 9♂♂, 4♀♀; 2B: 20♂♂, 11♀♀; 2C: 2♂♂, 5♀♀; 3A: 1♀; 3B: 32♂♂, 22♀♀; 3C: 2♀♀; 4A: 7♂♂, 1♀; 4C: 2♀♀; 5A: 2♂♂; 5B: 24♂♂, 7♀♀; 6A: 4♂♂, 2♀♀.

Drosophila simulans Sturtevant, 1919
Material examined – 3C: 1♂, 5♀♀; 6C: 1♀.

Drosophila subobscura Collin in Gordon, 1936
Material examined – 1A: 4♂♂, 1♀; 2A: 1♂; 3A: 2♂♂; 3C: 1♂, 3♀♀; 4A: 2♀♀; 4C: 1♂; 5A: 1♂, 3♀♀; 6A: 1♂, 1♀; 6C: 1♀.
A west-Palaearctic species with a globally increasing range due to international transport of goods. It is habitat-tolerant, occurring at forest edges, wetlands, bushes etc., also in gardens, houses and canning factories, where it supports spreading of decay; it can develop in the sap flow of injured trees as well as in decaying fruit.

Drosophila suzukii (Matsumura, 1931)
Material examined – 1C: 1♀; 4C: 1♂.
The Asian cherry fly, which infests ripening cherries and other soft-skin fruits, is native roughly to the south-eastern half of Asia. Recently – mostly after the onset of

this millenium – it has invaded Europe (also reached Turkey, NW Iran and Morocco), North and South America, Kenya, and some oceanic islands such as Hawaii, French Polynesia, Madeira, Azores and Réunion (Calabria et al. 2012, Chabert et al. 2012, Poyet et al. 2014, Örsted & Örsted 2019). *D. suzukii* causes severe economic losses (Cini et al. 2012). In Hungary, it was first recorded in the year 2012 from the locality Táska, some 10 km to the south of Balaton lake (Kiss et al. 2013); several Hungarian localities are known at present.

Drosophila testacea von Roser, 1840
Material examined – 1A: 1♀; 1B: 1♀; 1C: 1♂; 2A: 3♂♂, 1♀; 2B: 20♂♂, 11♀♀; 2C: 4♂♂, 9♀♀; 3A: 1♂; 3B: 10♂♂, 4♀♀; 4A: 1♀; 4C: 1♂; 5A: 1♀; 5B: 4♂♂; 6A: 2♂♂; 6C: 3♂♂.

Drosophila transversa Fallén, 18230
Material examined – 2B: 1♀; 2C: 1♂; 3B: 1♂, 1♀; 4C: 1♀.

Drosophila unimaculata Strobl, 1893
Material examined – 3A: 2♂♂; 3B: 2♀♀.

Hirtodrosophila confusa (Stžger, 1844)
Material examined – 3B: 3♀♀; 5A: 1♂, 1♀; 5B: 1♀; 5C: 1♂.

Leucophenga maculata (Dufour, 1839)
Material examined – 5B: 1♂, 2♀♀; 5C: 1♂; 6A: 1♀; 6C: 1♂.

Phortica variegata (Fallén, 1823)
Material examined – 4A: 1♀.
West-Palaearctic species, recently introduced to North America. It is an intermediate host of the nematode *Thelazia callipaeda* (Railliet and Henry, 1910) under natural conditions (Otranto et al. 2006a). This zoophilic fruit fly can be collected in the highest number during July to August in Europe (Otranto et al. 2006b). Larvae of the nematode are transmitted by secretophagous flies into the conjunctival sac and surrounding tissues of wild and domestic mammals, as well as humans (reviewed in Otranto & Traversa 2005). Thelaziasis occurred originally in southeast Asia (e.g., Yang et al. 2006; Krishnachary et al. 2014; Kosin et al. 1989); more than thirty years ago it was first observed in Europe and now it has been recorded from many European countries including Hungary (Otranto & Dutto 2008, do Vale et al. 2020).

Scaptodrosophila deflexa (Duda, 1924)
Material examined – 1A: 1♀; 1B: 1♂.

Dryomyzidae
Dryomyza anilis Fallén, 1820

Material examined – 1A: 1♂; 1B: 9♂♂, 5♀♀; 1C: 3♀♀; 2A: 3♂♂, 14♀♀; 2B: 6♂♂, 9♀♀; 2C: 8♂♂, 14♀♀; 3A: 4♂♂, 2♀♀; 3 B: 7♂♂, 5♀♀; 3C: 1♂, 1♀; 4A: 5♂♂, 3♀♀; 4B: 11♂♂, 9♀♀; 4C: 11♂♂, 4♀♀; 5A: 3♂♂, 4♀♀; 5B: 7♂♂, 3♀♀; 5C: 2♂♂, 1♀; 6A: 3♂♂, 1♀; 6B: 10♂♂, 12♀♀; 6C: 10♂♂, 7♀♀.

Dryope flaveola (Fabricius, 1794)
Material examined – 2A: 1♂; 2C: 1♂; 4A: 1♂; 6B: 2♂♂; 6C: 3♂♂, 1♀.

Heleomyzidae
Suillia affinis (Meigen, 1830)
Material examined – 1B: 1♂, 2♀♀; 1C: 3♂♂, 4♀♀; 2A: 1♂, 1♀; 2B: 23♂♂, 7♀♀; 2C: 31♂♂, 13♀; 3A: 1♀; 3 B: 47♂♂, 40♀♀; 4B: 22♂♂, 11♀♀; 4C: 5♂♂, 1♀; 5A: 1♂; 5B: 6♂♂, 6♀♀; 5C: 1♂; 6A: 5♂♂, 6♀♀; 6B: 24♂♂, 9♀♀; 6C: 6♂♂, 3♀♀.

Suillia bicolor (Zetterstedt, 1838)
Material examined – 3 C: 1♀.

Suillia gigantea (Meigen, 1830)
Material examined – 1B: 2♀♀; 1C: 1♀; 2A: 1♂; 2B: 14♂♂, 13♀♀; 2C: 4♂♂, 2♀♀; 3 B: 6♂♂, 7♀♀; 3C: 1♂, 1♀; 4B: 3♂♂, 4♀♀; 4C: 1♀; 5A: 2♂♂, 1♀; 5B: 1♂; 5C: 3♂♂, 2♀♀; 6A: 25♂♂, 3♀♀; 6B: 15♂♂, 17♀♀; 6C: 4♂♂.
Thermophilous species, common in Hungary in suitable conditions.

Suillia lurida (Meigen, 1830)
Material examined – 6B: 1♂, 1♀.
Larvae develop in garlic, onion, and other related plants, they are ranked as not important agriculture pests.

Suillia pallida (Fallén, 1820)
Material examined – 2C: 1♂, 2♀♀; 6B: 2♂♂, 5♀♀; 6C: 1♂.

Suillia ustulata (Meigen, 1830)
Material examined – 2C: 1♂.
This species is known from several European countries, but it is collected only individually; the larvae develop in dead alder stems.

Suillia variegata (Loew, 1862)
Material examined – 1A: 1♂; 1C: 6♂♂, 1♀; 2B: 1♂, 2♀♀; 2C: 6♂♂, 5♀♀; 3 B: 3♂♂, 4♀♀; 4B: 1♂, 2♀♀; 5B: 1♂; 5C: 4♂♂, 2♀♀; 6B: 1♀; 6C: 4♂♂, 2♀♀.
Thermophilous species, common in Hungary in suitable conditions.

Tephrochlamys flavipes (Zetterstedt, 1838)
Material examined – 6C: 1♂.

Lauxaniidae

Meiosimyza decempunctata (Fallén, 1820)

Material examined – 1C: 1♂, 1♀; 2B: 1♂, 1♀; 2C: 3♀♀; 3C: 1♀; 4B: 1♂, 1♀; 4C: 1♂; 5B: 1♀; 5C: 2♂♂, 1♀; 6B: 5♂♂, 7♀♀; 6C: 1♀.

Meiosimyza rorida (Fallén, 1820)

Material examined – 5C: 3♀♀; 6C: 1♂.

Minettia subvittata (Loew, 1847)

Material examined – 1B: 2♂♂.

Thermophilous species, common in Hungary in suitable conditions.

Peplomyza discoidea (Meigen, 1830)

Material examined – 2B: 1♂.

Thermophilous species, common in Hungary in suitable conditions.

Pseudolyciella sp.

Material examined – 1C: 1♀.

There are three species of the genus *Pseudolyciella* known from Hungary, all identifiable according to the male terminalia only. However, there are crosses between these taxa and also according to the wing shape morphometric analyses it is probable that the genus *Pseudolyciella* includes only one morphoplastic species (Semelbauer 2016).

Tricholauxania praeusta (Fallén, 1820)

Material examined – 5C: 1♂.

Platystomatidae

Platystoma seminatione (Fabricius, 1775)

Material examined – 1A: 7♂♂, 3♀♀.

Sciomyzidae

Euthycera chaerophylli (Fabricius, 1798)

Material examined – 1C: 1♀; 2C: 1♂.

Syrphidae

Volucella inflata (Fabricius, 1794)

Material examined – 4A: 2♀♀; 5A: 1♀.

Ulidiidae

Callopistromyia annulipes (Macquart, 1855)

Material examined – 1A: 1♀.

This species was not included in the checklist of Papp (2001), its first records from Hungary were published by Kameneva & Pekarsky (2016). It is an invasive

species in Europe, first published from Europe by Merz (2007). For the present distribution see e. g., Dvořák et al. (2019).

Otites lamed (Schrank, 1781)
Material examined – 1A: 1♀.

Otites levigata (Loew, 1873)
Material examined – 2A: 19♂♂, 4♀♀; 4A: 2♂♂, 1♀.
A species known mainly from south-eastern Europe – in a relatively small area bordered by Italy, Slovakia, and Bulgaria.

Otites ornata (Meigen, 1826)
= *O. bacescui* (Gheorghiu, 1987)
Material examined – 4A: 3♂♂, 1♀; 5A: 4♂♂, 1♀.
A south European species occurring from France to Bulgaria. This species was not included to the Hungarian checklist (Papp 2001), although Kameneva (1997) reported the material from Hungary. We confirm the occurrence for Hungary.

Otites ruficeps (Fabricius, 1805)
= *O. formosa* (Panzer, 1798)
Material examined – 2A: 1♂; 3A: 1♂; 6A: 1♂.

Discussion

Many of studied species are psychrophilous or rather psychrophilous, so that they can occur more often at the beginning and the end of season, which explains the smaller number of species in the middle of the season. Moreover, in August, the summer and autumn aspects meet. The mass occurrence of some species in the middle of the season can be explained by their retreatment to the shaded valleys during the hottest time of the year.

The beer traps are catching different species spectrum than other traps or sweeping, as we found in previous surveys (for example Dvořáková 2008, Dvořák et al. 2019). It is not always clear why this is the case. For example, regular high incidence of mycetophagous *Suillia* species is surprising. Adults, in contrast with larvae, probably prefer fermenting juice. More detailed comparison of various types of traps would require special research in terrain or meta-research of published results.

Conclusions

During the survey using beer traps in Balaton highlands in 2017, altogether 41 Diptera species from nine families were identified: Anisopodidae (one species), Drosophilidae (16 species), Dryomyzidae (two species), Heleomyzidae (eight species), Lauxaniidae (six species), Platystomatidae (one species), Sciomyzidae (one species), Syrphidae (one species), and Ulidiidae (five species).

Common and widespread species prevailed in the material. Among others, we caught several thermophilous species, as *Suillia gigantea*, *S. variegata* (Heleomyzidae), *Minettia subvittata*, *Peplomyza discoidea* (Lauxaniidae) and *Otites lamed* (Ulidiidae).

The species *Callopistromyia annulipes* (Ulidiidae) and *Drosophila suzukii* (Drosophilidae) are imported invasive fly species. The second one, as well as *Suillia lurida* (Heleomyzidae), are ranked as agriculture pests.

Some species of *Drosophila* (e. g. *D. immigrans*, *D. melanogaster*, *D. subobscura*) are noxious in the food industry.

One species, *Phortica variegata*, is a species of medical importance.

Acknowledgement

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