

New and interesting records of Diptera on glacial sand deposits in Silesia (NE Czech Republic). Part 4 – Calyptratae

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Abstract: Records of 15 interesting species belonging to four families of Diptera Calyptratae, viz., Anthomyiidae (4 species), Muscidae (3 species), Sarcophagidae (3 species) and Tachinidae (5 species) from glacial sand deposits in the Czech Silesia (NE Czech Republic) and S Poland are presented and their association with sandy habitats discussed. A total of 14 species are recorded from the Czech Silesia for the first time, 10 are new additions to the fauna of Moravia of which 6 are also new for the whole of the Czech Republic. Two species (both Tachinidae) represent first records from Poland and *Egle anderssoni* Michelsen, 2009 from the Závada sand-pit is the first from Central Europe. The affinity of the recorded species to sandy habitats is discussed. One of the here reported species is classified as psammobiont (*Delia coarctoides* Michelsen, 2007, Anthomyiidae) and 6 species are considered psammophilous or probably psammophilous, viz., *Coenosia strigipes* Stein, 1916 (Muscidae), *Metopia argentata* Macquart, 1850, *M. staegerii* Rondani, 1859, *M. tshernovae* Rohdendorf, 1955 (all Sarcophagidae), *Labigastera pauciseta* (Rondani, 1861) and *Thecocarcelia acutangulata* (Macquart, 1850) (both Tachinidae).

Keywords: Diptera, Anthomyiidae, Muscidae, Sarcophagidae, Tachinidae, new records, psammophily, glacial sand deposits, Czech Republic (Moravia/Silesia), S Poland

Introduction

This study represents the fourth contribution to the knowledge of Diptera on glacial sand deposits in the Czech Silesia. It is aimed at the presentation of new, interesting or otherwise important records of species of four families of Diptera Calyptratae.

The Czech Silesia is a north-eastern region of the Czech Republic (see maps, Figs 1–3) distinguished (among others) by glacial sand and gravel deposits. These were formed in the Pleistocene when glaciations reached their southernmost limit in this area. The largest and most southerly situated sand beds arose as a result of the Saalian glaciation about 160 000 years ago (see Růžicka 2004; Růžicková et al. 2009; Nývlt 2011). However, the majority of these deposits are now covered by recent or subrecent layers of soil so that the natural outcrops of exposed glacial sand sediments are rare and limited in extent. On the other hand, exposed sands occur more commonly in sand pits, both active and abandoned. Nevertheless, the glacial sand habitats (both natural and artificial) are generally small and very fragmentary in the study area. Despite this fact, a distinctive albeit insular ecosystem persisted on these sandy spots, being markedly dissimilar to those on surrounding agricultural or forestry landscapes (Roháček 2020; Roháček et al. 2020, 2021).

This sandy ecosystem is distinguished by a characteristic sand-loving or psammophilous flora and fauna, including that of Diptera. In the past the psammophilous dipterous fauna has largely been studied in maritime areas on coastal sand dunes (cf. Karl 1930, Krogerus 1932, Kröber 1935, Ardö 1957, Howe 2010, Nielsen et al. 2016, 2019), while that on inland sands has been practically neglected. Therefore, a biodiversity project with focus on Diptera on glacial

sand deposits in the Czech Silesia was designed in 2013 to recognize the composition of the local fly communities and to evaluate the degree of association of the recorded species to sandy habitats.

Based on older occasional records the first data on a few species of Diptera living in sand-pits in Silesia were presented by Roháček & Ševčík (2013) in the popular book *Příroda Slezska* (Nature of Silesia). The more systematic field work achieved since 2013 and the subsequent study of the obtained material within the above project resulted in more detailed information on flies inhabiting inland sandy habitats. Hitherto, only part of the results has been published, mostly dealing with the faunistically and otherwise interesting species. These studies were mainly devoted to Diptera Acalyptratae (Roháček 2015a,b, 2016a,b Roháček et al. 2020, 2022), but also to several groups of Brachycera except for Schizophora (Roháček et al. 2021). In addition, some preliminary results on psammobiont and psammophilous species of Diptera were given in a conference paper (Roháček 2020).

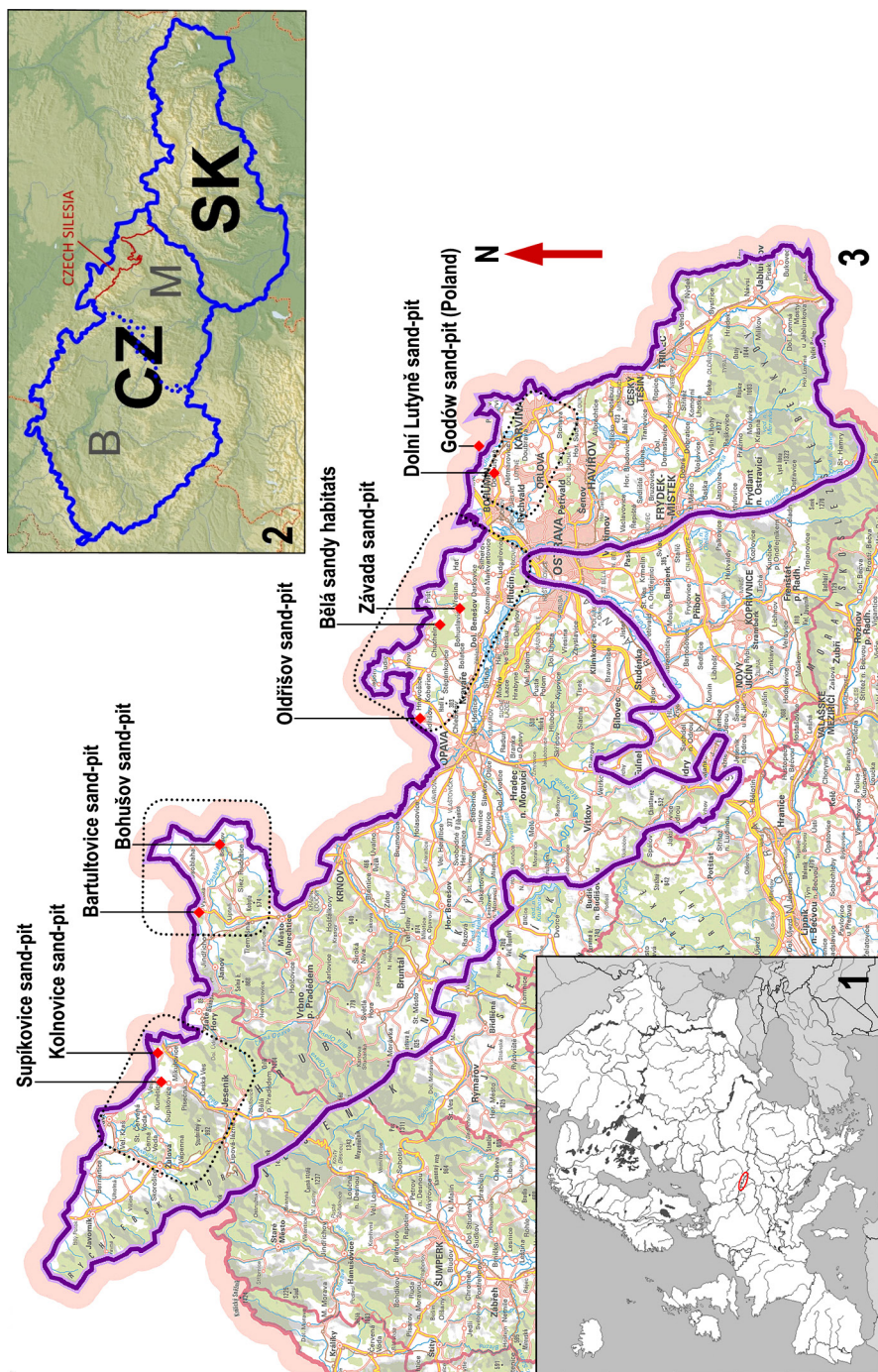
The field work was carried out in nine localities in four parts of the Czech Silesia, viz. in the Jesenicko, Osoblažsko, Hlučínsko and Karvinsko regions (see map on Fig. 3) in 2013–2020. However, also some material obtained formerly (1995–1997, 2004) in a few sand-pits and other sandy sites in the Hlučínsko and Osoblažsko regions (deposited in SMOC) has been included.

A number of species of interest, including faunistic novelties, psammobiont or psammophilous, xerophilous and/or thermophilous species have been recorded during the above research project. As in previous studies (see above) this paper also presents faunistically important records, now from the calyptrate families Anthomyiidae, Muscidae, Sarcophagidae and Tachinidae. Some of the species listed below represent first records from the Czech Republic, others are first from Moravia and the remaining from the Czech Silesia, but there are also several species first reported from Poland. For each species here recorded, information on its biology and distribution (both from the literature and from personal experience and field work) is summarized, and, based on this, we have attempted to classify their affinity to sandy habitats.

Material and methods

The material examined is deposited in the collection of the Silesian Museum, Opava, Czech Republic (SMOC) unless mentioned otherwise. The collected specimens were air-dried and mounted on pinned triangular cards in the course of the study, but some of them were retained alive in plastic tubes for a while to be photographed by means of a digital camera (Canon EOS 60D) with a macro lens (Canon MP-E 65 mm 1–5×) and ring macro flash (Canon MR-14EX). After photography these specimens were killed and mounted for subsequent identification in the same way as the other specimens. Some voucher specimens were photographed by digital camera Canon EOS 5D Mark III with a Nikon CFI Plan 4× /0.10NA 30 mm WD or Nikon CFI Plan 10× /0.25NA 10.5 mm WD objective attached to Canon EF 70–200 mm f/4L USM zoom lens. The specimens photographed by means of the latter equipment was repositioned upwards between each exposure using a Cognisys StackShot Macro Rail and the final photograph was compiled from multiple layers (35) using Helicon Focus Pro 7.0.2. The final images were edited in Adobe Photoshop CS6. The voucher specimen of *Metopia argentata* was photographed by Z. Kejval by means of a Canon EOS 50D attached to a Leica MZ 9.5 trinocular stereomicroscope. Where necessary, male genitalia or female postabdomina were examined after detachment and dissection of the whole abdomen. After examination, all parts were transferred to polymer microvials, which were pinned below the respective specimens. Habitat photographs were taken in the field by digital cameras Canon EOS 60D and/or Sony NEX-7.

The historic region of Silesia (the Czech part of Silesia), as delimited in *Příroda Slezska* (see Fig. 3 and/or Roháček et al. 2013, map on pp. 10–12), is treated within (the historical country) Moravia in all checklists of Diptera of the Czech Republic and Slovakia, including the most recent one (Jedlička et al. 2009). To display its location, this region is depicted on a map of the Czech and Slovak Republics (see Fig. 2) used in Jedlička et al. (2009). Because the



Figs 1–3: Maps. 1 – location of the Czech Silesia in Europe (red ellipse); 2 – situation of the Czech Republic and Moravia; 3 – Localities of glacial sand deposits under study. Abbreviations used in maps: B – Bohemia, CZ – Czech Republic, M – Moravia, N – north, SK – Slovak Republic. Study sites are in the regions marked by dotted lines: Jeseníko (Supíkovice, Kolnovice), Osoblažsko (Bartulovice, Bohušov), Hlučínsko (Oldřišov, Bělá, Závada), Karvinsko (Dolní Lutyně) and S. Poland (Godów). Map sources: Fauna Europaea (Fig. 1), <http://www.edvis.sk/diptera2009/mapCZSK.htm> (Fig. 2) and orig. (Fig. 3).

Czech Silesia has been considered a part of Moravia in these checklists, the area under study is listed as “N Moravia” in the material examined below to conform to previous faunistic studies.

Localities under study. Field work was performed in 2013–2020 in four regions of the Czech Silesia (cf. Roháček et al. 2020, 2021). Sand-pits were paired by proximity with one being actively utilized for sand extraction and the other left abandoned. A large, abandoned sand-pit in Godów in S. Poland was also included in the project to complement the active sand-pit in Dolní Lutyně. The only sites with natural occurrence of glacial sand in the Czech Silesia (Bělá nr. Chuchelná, “Buben” sand-hill and Bělá nr. Chuchelná, natural outcrop of sand at holt) have also been included in the study (see below). For landscape photographs of all localities see Roháček (2020: figs 6–18). Localities are listed below according to these regions and arranged from west to east (see Fig. 3).

Jesenícko region:

- (1) **Supíkovice** 1.1 km NE, 50°18'22"N, 17°15'43"E, 380 m, large abandoned sand-pit;
- (2) **Kolnovice**, active sand-pit, two plots – Kolnovice 1 km SW, 50°18'55"N, 17°18'45"E, 385 m (C part); Kolnovice 1.2 km WSW, 50°18'59"N, 17°18'35"E, 390 m (W part).

Osoblažsko region:

- (3) **Bohušov** 0.7 km S, 50°14'14"N, 17°42'58"E, 250 m, abandoned sand-pit;
- (4) **Bartultovice** 0.5 km SW, 50°16'13"N, 17°35'00"E, 315 m, small abandoned sand-pit.

Hlučínsko region:

- (5) **Oldřišov** 0.7 km N, sand-pit, 49°59'51"N, 17°57'48"E, 280 m, abandoned sand-pit;
- (6) **Bělá** (nr. Chuchelná), three plots – Bělá 0.5 km E, 49°58'26"N, 18°09'05"E, 250 m, small abandoned sand-pit; Bělá 0.4 km NE, “Buben” sand-hill, 49°58'29"N, 18°09'01"E, 260 m (natural outcrop of sand); Bělá 0.6 km N, 49°58'39"N, 18°08'49"E, 265 m (holt on natural outcrop of sand);
- (7) **Závada**, active sand-pit, three plots – Závada 1.8 km SE, 49°56'19"N, 18°10'28"E, 260 m (SE part, partly recultivated); Závada 2 km S, 49°56'09"N, 18°10'04"E, 270 m (SW part, not excavated but regularly disturbed); Závada 1.6 km S, 49°56'25"N, 18°09'56"E, 265 m (NW part, with active excavation).

Karvinsko region:

- (8) **Dolní Lutyně** 1.2 km N, 49°54'34"N, 18°25'33"E, 210 m, active sand-pit with two artificial lakes after excavation.

S. Poland:

- (9) **Godów** 1.3 km ESE, 49°55'13"N, 18°29'41"E, 230 m, large, abandoned sand-pit (close to Czech-Polish borders).

Collecting methods. Specimens were collected by sweeping over sparse low vegetation or bare sand, sweeping and beating bushes (e.g. of broom), netting of individually observed specimens and hand or aspirator collecting on flowering plants, decaying substrates and sandy ground.

Nomenclature. Botanical nomenclature follows that used in the Checklist of vascular plants of the Czech Republic (Danihelka et al. 2012). Nomenclature of flies follows the most recent catalogues, checklists, monographs and/or revisions of the groups recorded here and *Systema Dipteriorum* (<http://www.diptera.org/>).

Assessment of the affinity of species to sandy habitat. The affinity of a species to sand has been judged by the corresponding taxonomic expert based on his knowledge of the biology, autecology and distribution of the species. Four categories are differentiated according to the degree of association with sandy habitats:

- (1) **psammobiont** – species strictly associated (including reproduction and entire life-cycle) with sandy habitats.
- (2) **psammophilous** – species preferably associated with sandy habitats but also living in related xerothermic habitats like various types of xeric steppe and rocky grassland.
- (3) **psammoneutral** – species with a wide habitat tolerance utilizing various habitats and successfully also living in habitats on sandy soils.
- (4) **psammoxenous** – species coincidentally encountered in sandy habitats only by chance, not developing there.

These categories can be compared with those generally used in North Europe (e.g. Krogerus 1960) as follows: psammobiont = eucoenic (euzön), psammophilous = tychocoenic (tychozön), psammoneutral = acoenic (azön), psammoxenous = xenocoenic (xenzön).

Author contributions. J. Roháček (corresponding author) conceptualized the study, performed the field work, designed the manuscript and wrote all general parts of this paper; co-authors identified material and prepared sections on the families as follows: M. Barták (Muscidae), Z. Kejval (Sarcophagidae), E. Lutovinovas (Tachinidae) and V. Michelsen and M. Barták (Anthomyiidae).

Results

ANTHOMYIIDAE

Delia coarctoides Michelsen, 2007 – psammobiont

Material examined: CZECH REPUBLIC: N Moravia: Bělá nr. Chuchelná 0.5 km E, sand-pit, 49°58'26"N, 18°09'05"E, 250 m, sweeping undergrowth of steppe forest, 13.vii.1995, 1♂; Závada 2 km S, sand-pit, SW part, 49°56'09"N, 18°10'04"E, 270 m, sweeping over sand and sparse vegetation on sand, 10.ix.2015, 2♀, J. Roháček leg. (SMOC).

Biology: The known collecting sites in Denmark and Sweden are all from sandy coasts with white dunes or similar sandy, sparsely vegetated areas dominated by marram (*Ammophila arenaria*) and lymegrass (*Leymus arenarius*). A likely possibility is therefore that either of these coarse grasses is favoured as a host plant for the larva of *D. coarctoides* (see Michelsen 2007). Because none of these grasses occur in the Czech Silesia, it is presupposed that this fly is associated with some other large grasses growing on the glacial sands under study, most probably *Calamagrostis epigejos* or other species of this genus, as has also been hypothesized for *Tetanops myopina* Fallén, 1820 (Ulidiidae) (Roháček 2015a, 2016a).

Distribution: Known so far only from a few localities in southern Fennoscandia (Denmark, Sweden, Finland) and a single record from the Czech Republic (N Bohemia: Bílina, Vršíček, mixed wood, 420 m, Malaise trap, 1♂, 25.vi.-23.vii.1998, M. Barták leg.), see Michelsen (2007). The above records are the first from Moravia.

Comments: Michelsen (2007) considered this species a member of sand dune communities on sea coasts in N. Europe. Consequently, its occurrence on the inland glacial sands under study can be a case similar to that of the another dune species, the ulidiid *Tetanops myopina*. The latter species is considered a postglacial relict in Central Europe, for detail see Roháček (2015, 2016, 2020). If so, *D. coarctoides* should be classified as a psammobiont species.

Delia diluta (Stein, 1916) – (probably) psammoneutral

Material examined: CZECH REPUBLIC: N Moravia: Kolnovice 1 km SW, 50°18'55"N, 17°18'45"E, 385 m, sand-pit C part, sweeping over sand and sparse vegetation on sand, 16.v.2018, 1♂; Dolní Lutyně 1.2 km N, sand-pit, 49°54'34"N, 18°25'33"E, 210 m, sweeping over sand & vegetation on sand, 8.vii.2019, 1♂, all J. Roháček leg. (SMOC).

Biology: unknown.

Distribution: Great Britain, Spain, Italy, Germany, Hungary, Denmark, Norway, Austria (Wyatt 2014, Schlüsslmayr 2018). First records for the Czech Republic.

Comments: Its affinity to sandy habitats is unknown and, therefore, *D. diluta* is classified as a probably psammoneutral species.

Delia silenii Michelsen, 2012 – psammoneutral

(Fig. 4)

Material examined: CZECH REPUBLIC: N Moravia: Supíkovice 1.1 km NE, 50°18'22"N, 17°15'43"E, 380 m, abandoned sand-pit, S part, sweeping over sand and vegetation on sand, 27.v.2020, 2♂, J. Roháček leg. (SMOC).

Biology: The species was reared from seed capsules of the Eurasian catchfly (*Silene nutans*) (Michelsen 2012). This plant also grows in the abandoned sand-pit Supíkovice (Fig. 5) where *D. silenii* was found.



Figs 4–5: *Delia sileni* Michelssen and its habitat. 4 – *Delia sileni*, male, left lateral, voucher specimen from Supíkovice sand-pit (27.v.2020), with terminalia detached; 5 – habitat where this specimen was collected, slope of abandoned sand-pit with rich herbaceous vegetation (Supíkovice, 27.v.2020). Photos by J. Roháček.

Distribution: Czech Republic, Denmark, Estonia, Finland, Italy, Spain, Turkey (Michelsen 2012). The only previous record from the Czech Republic (Michelsen 2012) was based on a single female from C. Moravia (Mrsklesy, 15.v.1974, Barabás leg.). Thus, the above record is the second from the Czech Republic and first from the Czech Silesia.

Comments: The host plant of the species, *Silene nutans*, is a rather habitat-tolerant species, growing in dry meadows but also in open deciduous forests including those on sands. Therefore *D. silenii* is classified here as a psammoneutral species.

***Egle anderssoni* Michelsen, 2009 – (probably) psammoneutral**

(Fig. 6)

Material examined: CZECH REPUBLIC: N Moravia: Závada 1.6 km S, sand-pit NW part, 49°56'25"N, 18°09'56"E, 265 m, sweeping over sand & sparse vegetation on sand, 12.iii.2020, 1♂, J. Roháček leg. (SMOC).

Biology: A rare, early vernal species with adults occurring on flowering *Salix* species. According to Michelsen (2009) the larval development certainly takes place in the female catkins of this plant (as in related *Egle* species). In Sweden (southern Skåne) three males were found on flowering *Salix* near the coast and in Spain on a stream bed (Michelsen l.c.). In the NW part of the Závada sand-pit (see Fig. 7) only a single male was swept from vegetation (including young *Salix caprea* and possibly other *Salix* spp.), together with several specimens of *Egle parva* Robineau-Desvoidy, 1830.

Distribution: The species was described from a few specimens from S. Sweden, Spain and Morocco and Michelsen (2009) suggested it is mainly distributed in the western Mediterranean basin. First record from the Czech Republic and the whole of Central Europe.

Comments: The host plants (*Salix* spp.) grow in various (mainly humid) habitats including those on sands. Although *E. anderssoni* is a thermophilous species and can have preference for warm habitats (such as are sand-pits) in C. Europe it surely is not strictly associated with sands and, therefore, it is classified as probably psammoneutral here.

MUSCIDAE

***Coenosia strigipes* Stein, 1916 – psammophilous**

(Fig. 8)

Material examined: CZECH REPUBLIC: N Moravia: Supíkovice 1.1 km NE, 50°18'22"N, 17°15'43"E, 380 m, abandoned sand-pit, S part, sweeping over sand and sparse vegetation on sand, 7.vi.2017, 1♂1♀; 16.v.2018, 1♀; 11.ix.2019, 1♀; 27.v.2020, 1♀; 17.vi.2020, 1♂; Kolnovice 1 km SW, 50°18'55"N, 17°18'45"E, 385 m, sand-pit C part, sweeping over sand and sparse vegetation on sand, 6.viii.2019, 1♀; Oldřišov 0.7 km N, sand-pit, 49°59'51"N, 17°57'48"E, 280 m, sweeping over sand & vegetation on sand, 11.vi.2019, 1♂, 4.ix.2019, 1♂; Závada 1.6 km S, sand-pit NW part, 49°56'25"N, 18°09'56"E, 265 m, sweeping over sand & sparse vegetation on sand, 29.viii.2018, 2♀; 13.viii.2020, 1♀; Závada 2 km S, sand-pit SW part, 49°56'09"N, 18°10'04"E, 270 m, sweeping over sand & sparse vegetation on sand, 29.viii.2018, 2♀, all J. Roháček leg. (SMOC).

Biology: A local and uncommon species. Representatives of the genus *Coenosia* are obligatory predators, and several species have been used for biological control of pests (e.g. Kühne 2000, Pohl et al. 2012). *C. strigipes* seems to be a regular member of dipterous communities on glacial sands in the Czech Silesia: it was ascertained in four (two active and two abandoned) sand-pits under study. For its habitat in the abandoned sand-pit Oldřišov see Fig. 9.

Distribution: Palaearctic, Afrotropical and Oriental (South China), in Europe from southern parts to Germany and Poland; from the Czech Republic and Slovakia recorded by Gregor et al. (2002, 2003). In Asia known from Siberia, the Far East of Russia and China. Recorded from the Czech Republic by Gregor et al. (2003) based on a single specimen from N Bohemia: Dřemčice, vi.1921, 1♂, Binder leg. First records from Moravia.

Comments: All our (unpublished, coll. Barták) findings of this species from Central Europe originate from sandy localities and, therefore, *C. strigipes* is here considered a psammophilous species. However, in southern Europe, it can also occur on xerotherm limestone forest-steppe habitats (Barták, unpublished).



Figs 6–7: *Egle anderssoni* Michelsen and its habitat. 6 – *Egle anderssoni*, male, left lateral, voucher specimen from Závada sand.pit (12.iii.2020), with terminalia detached; 7 – habitat where this specimen was collected in NW part of the active sand-pit, with shrubby vegetation on margin (Závada 1.6 km S, 12.iii.2020). Photos by J. Roháček.



Figs 8–9: *Coenosia strigipes* Stein and its habitat. 8 – *Coenosia strigipes*, male, left lateral, voucher specimen from Oldřišov sand-pit (11.vi.2019); 9 – habitat of the species in abandoned sand-pit, with herbaceous (mainly graminoid) vegetation on bottom (Oldřišov, 11.vi.2020). Photos by J. Roháček.

***Limnophora nigripes* (Robineau-Desvoidy, 1830) – psammoneutral**

Material examined: CZECH REPUBLIC: N Moravia: Dolní Lutyně 1.2 km N, sand-pit, 49°54'34"N, 18°25'33"E, 210 m, sweeping over sandy lake shore, 25.iv.2019, 1 ♀, J. Roháček leg (SMOC).

Biology: Larvae of *Limnophora* are aquatic or semiaquatic and predaceous (mostly on simuliid larvae), also adults were observed to catch living prey (Werner & Pont 2006). This is also true for this relatively common species. Not surprisingly, it was collected on the sandy bank of an artificial lake in the active sand-pit Dolní Lutyně (cf. Fig. 14).

Distribution: Holarctic, in Europe ranging from Spain, Italy and Bulgaria to northern Lapland, in Asia east to China. In the Czech Republic *L. nigripes* has only been recorded from Bohemia (Gregor & Rozkošný 2009). First record for Moravia.

Comments: Because it is associated with shallow waters in various habitats, *L. nigripes* is to be treated as a psammoneutral species.

***Limnophora scrupulosa* (Zetterstedt, 1849) – psammoneutral (Fig. 10)**

Material examined: CZECH REPUBLIC: N Moravia: Dolní Lutyně 1.2 km N, sand-pit, 49°54'34"N, 18°25'33"E, 210 m, sweeping over sand & sparse vegetation on sand, 13.vi.2019, 1♂; sweeping over sandy lake shore, 16.v.2019, 1♂, J. Roháček leg. (SMOC).

Biology: Similar to that of other *Limnophora* species (see above under *L. nigripes*). A rather rare species in Central Europe. Both males recorded above were found in the active sand-pit Dolní Lutyně, either swept from vegetation close to an artificial lake created after sand mining (Fig. 11) or directly on its flat sandy shore (see Fig. 14).

Distribution: Palaearctic. In Europe widespread from the Pyrenees to England and southern Sweden, eastwards to the Urals, in Asia to China. From the Czech Republic formerly recorded only from several localities in N and C Bohemia (Gregor & Barták 2001, Barták et al. 2004). First records from Moravia.

Comments: Because it is not strictly bound to sand but lives alongside water, and also in other habitats, *L. scrupulosa* is considered a psammoneutral species.

SARCOPHAGIDAE

***Metopia argentata* Macquart, 1850 – psammophilous (Fig. 13)**

Material examined: CZECH REPUBLIC: N Moravia: Supíkovice 1.1 km NE, 50°18'22"N, 17°15'43"E, 380 m, abandoned sand-pit, S part, sweeping over sand and vegetation on sand, 9.vii.2019, 1♂; Oldřšov 0.7 km N, sand-pit, 49°59'51"N, 17°57'48"E, 280 m, sweeping over sand and vegetation on sand, 11.vi.2019, 1♂; Dolní Lutyně 1.2 km N, sand-pit, 49°54'34"N, 18°25'33"E, 210 m, sweeping over sand and vegetation on sand, 13.vi.2019, 1♂; same locality, 11.vii.2019, 2♂ 1♀; sweeping vegetation on sandy lake shore, 11.vii.2019, 1♂ (PHOTO). POLAND: Godów 1.3 km ESE, sand-pit, 49°55'13"N, 18°29'41"E, 230 m, sweeping over sand and vegetation on sand, 11.vii.2019, 1♂, all J. Roháček leg. (SMOC, except for 1♂ from Dolní Lutyně in Muzeum Chodska, Domažlice, Czech Republic).

Biology: Poorly known; a kleptoparasitic and psammophilous species, with only one species of pompilid wasp, *Batozonellus lacerticida* (Pallas, 1771) recorded as a host so far (Rohdendorf & Verves 1980, Szpila & Pape 2005). Inasmuch as this host species is associated with warm alluvial sands on river banks and has been unrecorded from the Czech Republic for more than 40 years (Macek et al. 2010), we can presuppose that *M. argentata* also has some other host species of sand-associated Pompilidae (or Crabronidae) in the glacial sand deposits under study. In the target area, only a few specimens of *M. argentata* were collected in four sand-pits (all in June and July), usually directly swept from sand and often together with more numerous specimens of *M. argyrocephala* (Meigen, 1824). Most specimens were found in the active sand-pit Dolní Lutyně (Fig. 12), including one male from the sandy shore of the artificial lake (Fig. 14).

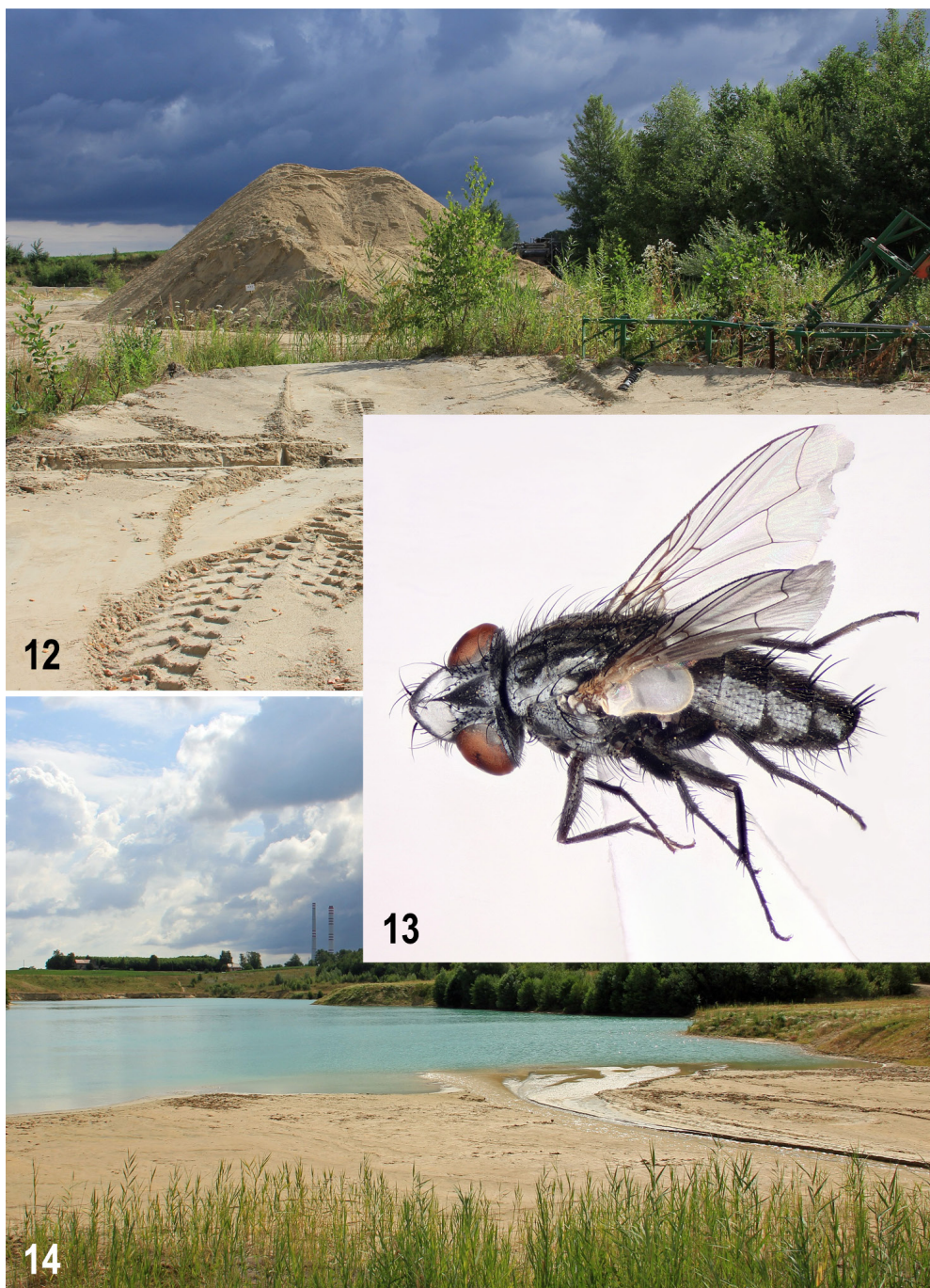
Distribution: Widespread in the Palaearctic Region and some parts of the Oriental Region (Povolný & Verves 1997, as *Metopia roseri*). First reliable records from the Czech Republic (see comment below).

Comments: This species (see Fig. 13) was listed from the Czech Republic (Bohemia) under the synonym *M. roseri* Rondani, 1859 by Povolný (1997) but later omitted from the checklist with respect to lack of any published record and possible misidentification (Kejval & Pape 2009). Recently, Verves & Barták (2018) questioned this opinion and published a new finding of *M. argentata* from the Šumava Mts in SW Bohemia (single female, collected in damp meadow, altitude 800 m). However, because the females of *M. argentata* can be sometimes unrecognizable from the common and less thermophilous *M. argyrocephala* (see Pape 1987) and judging from the unusual habitat from which the above female was recorded by Verves & Barták (2018), we believe that the latter record is also based on a misidentification, most probably of *M. argyrocephala*.

Judging from its xerothermic sandy habitat and sand-loving hosts, *M. argentata* is here classified at least as a psammophilous species.



Figs 10–11: *Limnophora scrupulosa* (Zetterstedt) and its habitat. 10 – *Limnophora scrupulosa*, male, left laterally, voucher specimen from Dolní Lutyně sand-pit (13.vi.2019); 11 – habitat where this specimen was collected (same date), sandy spot close to shore of artificial lake (Dolní Lutyně, 13.vi.2019). Photos by J. Roháček.



Figs 12–14: *Metopia argentata* Macquart and its habitats. 12 – habitat of the species, heap of sand in the active sand-pit Dolní Lutyně (11.vii.2019); 13 – *Metopia argentata*, male, dorsolaterally, voucher specimen from Dolní Lutyně sand-pit (11.vii.2019); 14 – habitat where this specimen was collected, sandy shore of the artificial lake (Dolní Lutyně, 11.vii.2019). Photos by Z. Kejval (Fig. 13) and J. Roháček (others).



Figs 15–16: Habitats of two *Metopia* species. 15 – habitat of *Metopia staegerii* Rondani, exposed sandy slope of small abandoned sand-pit in Bělá nr. Chuchelná (11.v.2020); 16 – habitat of *Metopia tshernovae* Rohdendorf, sandy spot on margin of a oak-pine forest (Bělá nr. Chuchelná,holt, 3.vi.2020). Photos by J. Roháček.

***Metopia staegerii* Rondani, 1859 – psammophilous**

Material examined: CZECH REPUBLIC: N Moravia: Bělá nr. Chuchelná 0.5 km E, 49°58'26"N, 18°09'05"E (small abandoned sand-pit), 250 m, sweeping over sand & sparse vegetation on sand, 11.v.2020, 1♂, J. Roháček leg., Z. Kejval det. (SMOC).

Biology: Poorly known; a kleptoparasitic and psammophilous species, with *Crabro scutellatus* (Scheven, 1781) recorded as a host species (Cross 2023). The male recorded above was swept in spring over almost bare sand in a small, abandoned sand-pit (Fig. 15).

Distribution: Widespread in the Palaearctic Region. In the Czech Republic very local, with only four reliable records from Bohemia and S Moravia (Kejval 2009), thus the new finding listed above is the first from the Czech Silesia.

Comments: *M. staegerii* develops in nests of the above crabronid species, built in loose sand in open sandy habitats (cf. Macek et al. 2010) and is therefore classified as (at least) a psammophilous species.

***Metopia tshernovae* Rohdendorf, 1955 – (probably) psammophilous**

Material examined: CZECH REPUBLIC: N Moravia: Bělá nr. Chuchelná 0.6 km N, holt, 49°58'39"N, 18°08'49"E, 265 m, sweeping along sand path & margin of oak-pine forest, 3.vi.2020, 1♂, J. Roháček leg., Z. Kejval det. (SMOC).

Biology: Essentially unknown; it probably is a psammophilous species, kleptoparasitic in nests of some solitary aculeate Hymenoptera, similarly to most of its congeners. Only a single male was swept from a sandy spot (Fig. 16) at the margin of an oak-pine forest, growing on ancient glacial sand dune, close to Bělá nr. Chuchelná.

Distribution: Widespread in the Palaearctic Region and adjacent part of the Oriental Region: Laos, Thailand and Vietnam (Pape 1986, Kano et al. 1999). In Europe recorded only from Denmark, Finland, Great Britain, Norway, Poland and Sweden, and considered a rather rarely collected species (Pape 1987, Povolný & Verves 1997, Chandler 2020). First record from the Czech Republic.

Comments: This species probably has a similar biology, including host and habitat preferences, as the above relative. Therefore, it is here treated as a probably psammophilous species.

TACHINIDAE

***Erynnia ocypterata* (Fallén, 1810) – (probably) psammoneutral**

Material examined: CZECH REPUBLIC: N Moravia: Bělá nr. Chuchelná 0.4 km NE, „Buben“ sand-hill, 49°58'29"N, 18°09'01"E, 260 m, sweeping over sand & sparse vegetation on sand, 13.viii.2020, 1♀, J. Roháček leg., E. Lutovinovas det. (SMOC).

Biology: A very rare species in Central Europe; habitats unspecified (Tschorsnig & Herting 1994). Most often reared from the leafroller moth *Sparganothis pilleriana* (Denis & Schiffermüller, 1775) (Lepidoptera: Tortricidae) in France, the Netherlands and Turkey, but also from twirler moths (Lepidoptera: Gelechiidae) *Anacamptis obscurella* (Denis & Schiffermüller, 1775) in Tunisia, and from *Gelechia senticetella* (Staudinger, 1859) from Switzerland (Tschorsnig 2017). *Sparganothis pilleriana* is a common polyphytophagous species developing also on some plants growing in sandy habitats, cf. Ellis (2001–2025). During the current project it was only collected in the naturally exposed ancient sand dune “Buben” (see Fig. 21) at Bělá nr. Chuchelná.

Distribution: Widespread in the Palaearctic Region (Herting 1984, O'Hara et al. 2009), in Europe ranging from southern (Spain, Italy and Bulgaria) to northern parts (Norway, Sweden, Finland and vicinity of St. Petersburg) but hitherto unrecorded from most central areas of Europe, including Austria, Hungary, Slovakia, Romania, Belarus and central part of European Russia (O'Hara et al. 2020, Zeegers et al. 2024). The above record is the first from the Czech Republic (cf. Vaňhara et al. 2004, Vaňhara & Tschorsnig 2009). In Central Europe it was previously reported also from Poland (O'Hara et al. 2020).

Comments: Its affinity to sandy habitats is unknown and, therefore, it is classified as a probably psammoneutral species.



Figs 17–18: *Labigastera pauciseta* (Rondani) and its habitat. 17 – *Labigastera pauciseta*, female, right laterally (Godów, 11.vii.2019); 18 – habitat of this species in abandoned sand-pit, with young shrubby vegetation (Godów, 11.vii.2019). Photos by J. Roháček.

***Labigastera pauciseta* (Rondani, 1861) – (probably) psammophilous** (Fig. 17)

Material examined: CZECH REPUBLIC: N Moravia: Kolnovice 1.2 km WSW, 50°18'59"N, 17°18'35"E, 390 m, sand-pit W part, sweeping over sand and sparse vegetation on sand, 7.vi.2017, 1♂; Bohušov 0.7 km S, 50°14'14"N, 17°42'57"E, 250 m, abandoned sand-pit, sweeping over sand and vegetation on sand, 9.vii.2019, 1♀; Oldřišov 0.7 km N, sand-pit, 49°59'51"N, 17°57'48"E, 280 m, sweeping over sand & vegetation on sand, 4.ix.2019, 1♀; Bělá nr. Chuchelná 0.4 km NE, „Buben“ sand-hill, 49°58'29"N, 18°09'01"E, 260 m, sweeping over sand & vegetation on sand, 3.vii.2017, 1♂. POLAND: S Poland: Godów 1.3 km ESE, sand-pit, 49°55'13"N, 18°29'41"E, 230 m, sweeping over sand & sparse vegetation on sand, 11.vii.2019, 1♂1♀ (1♀ PHOTO), all J. Roháček leg., E. Lutovinovas det. (SMOC).

Biology: A rare species in Central Europe; it prefers dry meadows (Tschorsnig & Herting 1994). Hosts are unknown (Tschorsnig 2017). In the study area, *L. pauciseta* was found in five localities, including three abandoned and one active sand-pit, and one natural outcrop of glacial sand. For its habitat in the abandoned sand-pit Godów see Fig. 18.

Distribution: A West Palearctic species (Herting 1984, Gilasian et al. 2014), ranging from southern (Spain, Italy, Greece and Iran) to central parts (Belgium, Germany, the Czech Republic, Slovakia and Ukraine); unknown from northern parts of Europe, including British Isles, the Netherlands, Denmark, Fennoscandia, Belarus, vicinity of St. Petersburg and central part of European Russia (O'Hara et al. 2020). First record from Poland. Previously also reported from the Czech Republic, though only from S Moravia (Vaňhara et al. 2004, Vaňhara & Tschorsnig 2009), thus the above records are the first from the Czech Silesia.

Comments: Because of its association with xerotherm habitats (see above), it could possibly be a psammophilous species.

***Neaera laticornis* (Meigen, 1824) – (probably) psammoneutral** (Fig. 19)

Material examined: CZECH REPUBLIC: N Moravia: Dolní Lutyně 1.2 km N, sand-pit, 49°54'34"N, 18°25'33"E, 210 m, sweeping over sand and vegetation on sand, 11.vii.2019, 1♂, J. Roháček leg., E. Lutovinovas det. (SMOC).

Biology: A very rare species in Central Europe with habitats unspecified (Tschorsnig & Herting 1994). It was reared from *Eucosma fulvana* Stephens, 1834 (Lepidoptera: Tortricidae) in Great Britain and from *Pexicopia malvella* (Hübner, 1805) (Lepidoptera: Gelechiidae) in Armenia (Tschorsnig 2017). Only a single male was swept from vegetation in the eastern part of the active sand-pit Dolní Lutyně (for habitat see Fig. 20).

Distribution: *N. laticornis* is widespread in the Palearctic Region (Herting 1984, O'Hara et al. 2009), in Europe recorded from southern (Spain and Italy), western (France) and central (Hungary) parts, though isolated populations are also reported from the British Isles and the vicinity of St. Petersburg; it is hitherto unknown from countries of Benelux, Germany, Denmark, Fennoscandia, Poland, Belarus and central part of European Russia (O'Hara et al. 2020). First record from the Czech Republic. Because it was recorded very close to the border of Poland it can also be expected to be found in the latter country.

Comments: Its affinity to sandy habitats is unknown and, therefore, *N. laticornis* is classified here as probably psammoneutral species.

***Siphona rossica* Mesnil, 1961 – (probably) psammoneutral**

Material examined: POLAND: S Poland: Godów 1.3 km ESE, sand-pit, 49°55'13"N, 18°29'41"E, 230 m, sweeping over sand & sparse vegetation on sand, 26.ix.2018, 1♀, J. Roháček leg., E. Lutovinovas det. (SMOC).

Biology: A very scarce species in Central Europe; its habitats remain unspecified (Tschorsnig & Herting 1994) and hosts unknown (Tschorsnig 2017). It was only found in the abandoned sand-pit Godów on flowering *Solidago canadensis* (see Fig. 22) during the glacial sand Diptera project.

Distribution: The species is widespread in the Palearctic Region (Herting 1984, Andersen 1996), in Europe ranging from southern (Spain, Italy and Greece) to northern parts (Norway, Sweden, Finland and vicinity of St. Petersburg); however, it remains unknown from western parts of Europe, including France, countries of Benelux and British Isles, as well as some areas of Eastern Europe, including Belarus and Ukraine (O'Hara et al. 2020). *S. rossica* was previously recorded from Poland from the southeastern part, Świętokrzyskie Mts (Draber-Mońko 1993), but is hitherto



Figs 19–20: *Neaera laticornis* (Meigen) and its habitat. 19 – *Neaera laticornis*, male, left laterally, voucher specimen from Dolní Lutyně sand-pit (11.vii.2019); 20 – habitat where this specimen was collected, sandy spots with low and shrubby vegetation (Dolní Lutyně, 11.vii.2019). Photos by J. Roháček.

unknown from the Czech Republic (cf. Vaňhara et al. 2004, Vaňhara & Tschorsnig 2009). Because it was confirmed here very close to the border of the Czech Republic (see record above), it is expected to occur also in the latter country.

Comments: Due to its unknown biology (host and habitat preference) its affinity to sandy habitats cannot be recognized, but *S. rossica* probably is a psammoneutral species.



Figs 21–22: Habitats of two species of Tachinidae. 21 – habitat of *Erynnia ocypterata* (Fallén), low vegetation on ancient sand-dune called Buben in close vicinity of Bělá nr. Chuchelná (13.viii.2020); 22 – habitat of *Siphona rossica* Mesnil, flowering *Solidago canadensis* on the bottom of abandoned sand-pit (Godów, 26.ix.2018). Photos by J. Roháček.



Figs 23–24: *Thecocarcelia acutangulata* (Macquart) and its habitat. 23 – *Thecocarcelia acutangulata*, male, left laterally, voucher specimen captured in Godów sand-pit (11.vii.2019); 24 – habitat where this specimen was collected, flowering vegetation in abandoned sand-pit (Godów, 11.vii.2019). Photos by J. Roháček.

***Thecocarcelia acutangulata* (Macquart, 1850) – (probably) psammophilous** (Fig. 23)

Material examined: POLAND: S Poland: Godów 1.3 km ESE, sand-pit, 49°55'13"N, 18°29'41"E, 230 m, sweeping over sand & sparse vegetation on sand, 11.vii.2019, 1♂, J. Roháček leg., E. Lutovinovas det. (SMOC).

Biology: A very rare species in Central Europe; it prefers generally warm and dry habitats (Tschorsnig & Herting 1994) and was reared from larvae of several species of Hesperidae (Lepidoptera), viz., *Thymelicus lineola* (Ochsenheimer, 1808) in Austria, and from *Pelopidas jansonis* Butler, 1878 and *Thoressa varia* Murray, 1876 in Japan (see Tschorsnig 2017). For its habitat in the abandoned sand-pit Godów see Fig. 24.

Distribution: The species is widely distributed in the Palaearctic Region (Herting 1984, O'Hara et al. 2009), though in Europe only known from southern (Portugal, Italy and Greece) to central parts (British Isles, the Netherlands, Germany, the Czech Republic and Ukraine) but hitherto unrecorded from northern parts of Europe, including Denmark, Fennoscandia, Belarus, vicinity of St. Petersburg and central part of European Russia (O'Hara et al. 2020). First record from Poland. The species has relatively recently also been reported from the Czech Republic – both from Bohemia and Moravia (Vaňhara et al. 2004, Vaňhara & Tschorsnig 2009). It is considered a spreading species, expanding its distribution northwards (Zeeegers 2010).

Comments: This species inhabits mainly xerotherm habitats, following its host butterflies of the family Hesperidae (see above). Consequently, *T. acutangulata* has also affinity to xeric sand deposits and, therefore, can be considered a probably psammophilous species.

Discussion and conclusions

The majority of sand deposits in the Czech Silesia are of glacial origin. They were formed during the Pleistocene glaciations, particularly in the largest ones, viz., the older Elsterian (ca 400 000 ya) and the younger Saalian (ca 160 000 ya) glaciation, for more detail see Růžicková et al. (2001), Růžicka (2004) and Nývlt et al. (2011). In Silesia, two types of glacial sediments can be recognized (Růžicková et al. 2001): the glaciofluvial sediments predominantly occurring in the Jesenícko and Osoblažsko regions, and the glaciolacustrine sediments being mainly present in the Hlučínsko and Karvinsko regions. The well developed sandy habitats can now be found almost exclusively in sand-pits, both active and abandoned. Much more rarely, natural outcrops of glacial sand occur in the Czech Silesia. Two such sites are located in the Hlučínsko region near the Bělá village (near Chuchelná): a sandhill called “Buben” (see Roháček 2020: Fig. 6) and another (unnamed) sand-hill near a holt at the northern margin of this village (Roháček 2020: Fig. 7). These glaciolacustrine sand deposits originally evolved as large sand dunes on the shore of a postglacial lake created by melting glaciers, after the Saalian glaciation (Růžicková et al. 2001, Nývlt et al. 2011). The biodiversity investigation of dipterous fauna on glacial sands was performed both in the rare natural (see above) and in the more frequent, often larger but secondarily anthropogenic (in sand-pits) sandy habitats. The main aim of this research was to reveal if a specific psammophilous fly fauna has survived in such a fragmentary ecosystem, surrounded by intensively exploited agricultural landscape.

Rather surprisingly, our results show that sand-loving communities of Diptera can survive even on small deposits of glacial sand if spots with exposed sand and sparse psammophilous vegetation have been preserved for a long time. However, only a small portion of the obtained results, i.e., those focused on the most interesting species of some families, has been published. The majority of published records treated families of Acalyptratae (Roháček 2015a, 2016a, Roháček et al. 2020, 2022); only one study was devoted to some groups of lower Brachycera (Roháček et al. 2021). In this contribution the first data on occurrence of selected species of Calyptratae on glacial sands are presented. Among the 15 species presented,

there are new additions to the fauna of Diptera of the Czech Republic, Moravia and the Czech Silesia but also of Poland (see records from abandoned sand-pit at Godów in southern Polish Silesia).

Most important among them are the following: (1) *Delia coarctoides* (Anthomyiidae), a species typically living on coastal sand dunes in North Europe (Michelsen 2007), is confirmed to occur in Central Europe (recorded from two sand-pits in the Hlučínsko region) where it could be considered a postglacial relict that immigrated during the last glaciation and survived on dunes of ancient postglacial lakes, similarly as *Tetanops myopina* (Ulidiidae) and *Anthomyza elbergi* Andersson, 1976 (Anthomyzidae) (see Roháček 2015a, 2016a,b). (2) *Egle anderssoni* (Anthomyiidae), originally probably a Mediterranean species (Michelsen 2009), first recorded here from Central Europe.

Seven of the above recorded species have a distinct affinity to sandy habitats and are classified as psammobiont (*Delia coarctoides*), psammophilous (*Coenosia strigipes*, *Metopia argentata* M. *staegerii*) or probably psammophilous (*Metopia tshernovae*, *Labigastera pauciseta*, *Thecocarcelia acutangulata*). They represent new additions to the current list of sand-loving Diptera hitherto recorded from sands in the Czech Silesia (Roháček & Ševčík 2013, Roháček 2015a,b, 2016a,b, 2020, Roháček *et al.* 2020, 2021, 2022). These species are associated with grasses growing in sand (*Delia coarctoides*), or their psammophilous prey (*Coenosia strigipes*) and/or insect hosts (all other sarcophagid and tachinid species).

These findings demonstrate again that even such insular habitats as glacial sediment deposits with exposed sands (both in natural outcrops and sand-pits) in the Czech Silesia can serve as refugia for the sand-loving fly fauna as suggested by Roháček (2020). This is particularly important because these refugial localities are situated on the southernmost limits of the Pleistocene glaciation in Central Europe.

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Nové a zajímavé nálezy dvoukřídých (Diptera) na ložiskách glaciálních písků ve Slezsku (SV České republiky). Část 4 – Calyptratae

Jsou prezentovány zajímavé nálezy celkem 15 druhů kalyptrátních much z čeledí *Anthomyiidae* (4 druhy), *Muscidae* (3 druhy), *Sarcophagidae* (3 druhy) a *Tachinidae* (5 druhů) nalezených během výzkumu fauny dvoukřídých na písčích ledovcového původu v českém Slezsku. Z nich 14 je poprvé hlášeno z tohoto území, 10 je nových pro území Moravy a 6 z nich je také nových pro území celé České Republiky. Dva druhy kuklic (čeleď *Tachinidae*) jsou poprvé hlášeny z Polska. Nález druhu *Egle anderssoni* Michelsen, 2009 v písčitém Závrati je dokonce první ve Střední Evropě. Je diskutována a hodnocena afinita všech prezentovaných druhů k písčitému biotopům. Jeden z nich je psamobiontní (*Delia coarctoides* Michelsen, 2007, *Anthomyiidae*) a 6 druhů je klasifikováno jako psamofilní nebo alespoň pravděpodobně psamofilní: *Coenosia strigipes* Stein, 1916 (*Muscidae*), *Metopia argentata* Macquart, 1850, *M. staegerii* Rondani, 1859, *M. tshernovae* Rohdendorf, 1955 (všechny z čeledi *Sarcophagidae*), *Labigastera pauciseta* (Rondani, 1861) a *Thecocarcelia acutangulata* (Macquart, 1850) (oba *Tachinidae*).

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