First cavernicolous population of *Crumomyia parentela* (Séguy, 1963) and a review of cave-dwelling fauna of Sphaeroceridae (Diptera) in the Czech Republic

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**Abstract:** *Crumomyia parentela* (Séguy, 1963) (Sphaeroceridae) is recorded from the Czech Republic for the first time, based on specimens collected in the cave Cyrilka in the Moravskoslezské Beskydy Mts. They are affiliated to subspecies *C. p. alpicola* (Roháček, 1980) but because of more reduced eyes and shorter wings than have other specimens known from the Alps and Carpathians this population is concluded to have survived as a glacial relict in the cave habitat for a long time. The cavernicolous fauna of Sphaeroceridae in the Czech Republic is surveyed and its members (15 species) are classified according to their affiliation to the cave milieu. No trogloxenous or troglobiont species were found; most species (12) are hemitroglophilous and only 3 are troglophilous, viz. *Crumomyia p. alpicola*, *Herniosina bequaerti* (Villeneuve, 1917) and *Terrilimosina racovitzai* (Bezzi, 1911). It is presupposed that some additional hemitroglophilous, possibly one more troglophilous but no troglobiont species could be found in cave systems in the Czech Republic in the future.

**Key words:** Diptera, Sphaeroceridae, *Crumomyia parentela alpicola*, new record, systematics, morphology, habitat association, distribution, cavernicolous fauna, Czech Republic

**Introduction**

*Crumomyia* Macquart, 1835 is a relatively rich genus of the subfamily Copromyzinae. At present, a total of 35 species (plus 3 additional subspecies) are recognized in the world fauna of Sphaeroceridae, see Roháček et al. (2001) and Marshall et al. (2011). The majority of representatives of *Crumomyia* are distributed in the boreal and temperate belts of the Holarctic Region; only a few species are known to occur in high-montane ranges in more southern areas of the Palaearctic and Nearctic Regions or even in the Oriental Region where 3 species have been recorded (Hackman 1965; Papp 2003; Hayashi 2009). Because *Crumomyia* species are usually distinctly psychrophilous they preferentially live in cold and humid habitats (Roháček 1991). Apart from several silvicolous species occurring on wet forest litter and other rotting organic debris on the woodland floor most other *Crumomyia* species utilize underground habitats, living either in runs and burrows of small mammals (Hackman 1965; Roháček 1976, 1991) or in caves (Roháček & Papp 2000; Roháček & Košel 1993, 2003). These (micro- and macro-) cavernicolous species are also able to inhabit deforested habitats, particularly in mountains, provided that there are suitable conditions (humid, cold and supplied by decaying matter) in underground habitats. The cave-dwelling European species of *Crumomyia* were discussed in detail by Roháček & Papp (2000) including their ecological classification (to 4 groups: trogloxenes, hemitroglophiles, troglophiles and troglobionts) and the origin and probable evolution of true troglobiont taxa.

The faunistics, biology and distribution of the Czech and Slovak species of *Crumomyia* were reviewed by Roháček (1991) who recorded 11 species (9 in the Czech Republic, 11 in Slovakia) but since that paper an additional species was described, viz. *C. tyrphophila* Roháček, 1999, from peat-bogs in the Šumava Mts. (Czech Republic: Bohemia) and one species each was added to the fauna of the Czech Republic [*C. setitibialis* (Spuler, 1925), by Roháček 2006, 2007) and Slovakia [*C. glacialis* (Meigen, 1830), by Roháček & Košel 2003).
Consequently, a total of 11 *Crumomyia* species has been known from the Czech Republic and 12 from Slovakia up to the present (Roháček 2009).

Recently (2013) I have had an opportunity to study some material of Sphaeroceridae collected in caves, cellars and mine galleries in various parts of the Czech Republic, among them also three specimens of *Crumomyia* from the Cyrilka cave near Pustevny (Moravskoslezské Beskydy Mts). To my surprise they proved to belong to a species hitherto unknown from the Czech Republic, *C. parentela* (Séguy, 1963). Because closer examination of these specimens revealed some morphological differences compared to specimens of this species recorded as *C. parentela* ssp. *alpicola* (Roháček, 1980) from montane ranges of Central Europe this interesting new record is treated in more detail in this paper.

Discovery of this species (the first truly troglophilous *Crumomyia* in caves of the Czech Republic) also initiated an attempt to review the cavernicolous fauna of Sphaeroceridae formerly found in the country and classify it into ecological categories as given by Roháček & Papp (2000) for *Crumomyia* species. This survey resulted in finding that except the Moravský kras (Moravian karst) the sphaerocerid fauna of caves in other regions of the Czech Republic is practically unknown.

**Material and methods**

All the material examined is deposited in the collection of Slezské zemské muzeum, Opava, Czech Republic (SMOC). The majority of specimens were originally preserved in ethanol but were dried and mounted on pinned triangular cards in the course of the study. In a number of specimens the entire abdomen was detached, cleared by boiling several minutes in 10% solution of potassium hydroxide (KOH) in water, then neutralized in 10% solution of acetic acid (CH₃COOH) in water, washed in water and subsequently transferred to glycerine. Postabdominal structures were examined in a drop of glycerine under binocular microscopes (Reichert, Olympus). After examination, all parts of the abdomen were transferred to a small plastic tube containing glycerine, sealed with hot forceps and pinned below the respective specimen. Morphological terminology used here follows that by Roháček (1998), the nomenclature that by Roháček et al. (2001) and Marshal et al. (2011).

**Locality**

All specimens of *C. parentela* examined from the Czech Republic (Fig. 1) were collected by Jiří Kupka in the Cyrilka cave (near Pustevny, cadastre Prostřední Bečva, Moravskoslezské Beskydy Mts). Cyrilka is the longest cave in this montane range, being 535 m long and 16 m deep (Wagner & Lenart 2012). It is a crevice-type cave situated at cca 1005 m (entrance) to 1015 m on the SE slope below the Pustevny saddle below the Tanečnice Mt. (1084 m), see Wagner at al. (1990). Cyrilka cave lies in the upper part of an extensive deep-seated gravitational slope deformations, just below the ridge formed by monoclinally arranged Malinów sandstone and Upper Godula Beds (Godula Formation, Silesian Unit). The flysch massif incorporates coarse-grained sandstones and conglomerates. The cave system is predominantly formed by long, sub-parallel galleries organized chiefly along the strike of the slope. In planform view (Fig. 2), the cave is divided by two strike-slip faults into three zones with different characters. The southern, deepest segment of the cave is created by the crevices narrowing to the south. The central segment includes the system's most extensive crevices and wide chambers. The northern segment is formed by the parallel crevices, each terminating in the north within collapsed blocks (for more detail see Lenart et al. 2014). The temperature in the aphytic part of the cave ranges from 6.9°C (in winter) to 8.8°C (in summer), see Lenart (2011).

The flies were collected in the aphytic zone (in this cave being about 5 m from entrance) of the „old part“ (Stará část) of the Cyrilka cave in the chamber called „Vstupní dóm“. The collecting site is situated about 5 m below ground, some 20 m (total length of galleries measuring) from entrance, as indicated on Fig. 3. Flies were caught on a wall above a scree pile (Fig. 4). On the bottom of the cave there are wet places including a few small shallow pools. Near the collecting spot, below the wall, there are remains of burnt wood and some other rotting plant matter (mainly leaves). The cave is inhabited by overwintering bats (regularly several dozens of *Rhinolophus hipposideros* and about two dozens of *Myotis myotis*) producing only a little guano (J. Kupka, personal communication, 2014).
Figs 1-3: Maps. 1 – Europe (west part) showing the position of the cave Cyrilka in NE of the Czech Republic (solid red circle); 2 – planform view of the Cyrilka cave (yellow), with profiles of the galleries (blue-grey); 3 – same, central par of the cave with location of the finding of *C. parentela* (red circle and arrow). Sources: Fauna Europaea (Fig. 1); orig. by courtesy of J. Lenart (Figs 2, 3).
Results


(Fig. 5)

**Material examined:** CZECH REPUBLIC: N Moravia: Beskydy Mts., Prostřední Bečva, Pustevny, Cyrlka cave, 49°29'2.5"N, 18°15'42.5"E, 1010 m, singled on cave wall in aphotic part, 5.iv.2013, 1♂ 2♀ J. Kupka leg. (J. Roháček det. 2013, SMOC, 1♂ 1♀ genit. prep.) – first record from the Czech Republic.

**Comparative material examined:** AUSTRIA: Tirol, Obergurgl Mt., 1980 m, Malaise trap, 31.vii.1976, 1♂, H. Stockner leg. (holotype, Mus. Silesiae Opava, typ. č. 757); same locality, 1980 m, Malaise trap, M III 77/09/08 12°0'-15°0', 8.ix.1977, 1♀, H. Stockner leg. SLOVAKIA: Malá Fatra Mts, Stoh Mt., 20.vi.1973, 1♂, Čepelák leg.; Slovenský raj Mts, Koniarova cave, 10-15 m, 18.viii.1976, 1♂; same, 5-10 m, 18.viii.1976, 1♀; same, 20-25 m, 1.xi.1976, all V. Košel leg.; Slovenský raj Mts, Strateneská cave, 5-10 m, 29.vii.1987, 1♀, V. Košel leg.; Slovenský raj Mts, Vlčia cave, 5-10 m, 21.iv.1975, 1♂ 1♀; 5-10 m, 8.viii.1986, 1♂ 1♀; 5-10 m, 28.7.1987, 1♂; 15-20 m, 21.iv.1988, 1♂ 1♀; 20-25 m, 21.iv.1988, 1♀; Vysoké Tatry Mts, Velická dolina valley, Kvetnica, 1800-1850 m, mouth of burrow of *Marmota marmota*, 26.vi.2002, 1♀, J. Roháček leg. (all in SMOC).

**Systematics, nomenclature:** Detailed study of the structures of the male genitalia and female terminalia of the above Moravian specimens resulted in finding that they undoubtedly belong to subspecies *C. parentela alpicola* (Roháček in Troger & Roháček 1980). This taxon was originally described as a species named *Copromyza (Crumomyia) alpicola* Roháček, 1980 from alpine meadows on Obergurgl Mt. (1980 m) in the Central High Alps, Austria (see Troger & Roháček 1980). However, Norrbom & Kim (1985) found it to be conspecific with *Speomyia parentela* Séguy, 1963 from the cave Špela Maja Hajne on the southwest side of a lesser peak of Topola Mt. nr. Sjenica (SW Serbia) and placed it in the genus *Crumomyia* as a synonym of the latter species. Later on, Papp & Roháček (1983) suggested to treat the alpine taxon as a subspecies of *C. parentela* because they found it differing from the troglobiont nominate subspecies by larger eyes, longer wings and shorter legs. Roháček & Papp (2000: pp. 222-223) corroborated this finding and stated that *C. p. alpicola* also differs from *C. p. parentela* by the male gonostylus being more broadened in the distal half. Consequently, *Crumomyia parentela* is since considered to have the nominate subspecies (known only from two caves in Serbia) distinctly modified by the cavernicolous way of life (i.e. with eyes reduced, legs elongate and slender, wings slightly shortened) while the high-montane ssp. *alpicola* has eyes larger, legs shorter and wings normal. However, the species was later discovered also in three caves in Slovakia (Slovenský raj Nantional Park: Strateneská cave, Vlčia cave, Koniarova cave) but all specimens found in these caves proved to be morphologically identical to those from the Alps and were therefore treated as *C. p. alpicola* with conclusion that these Carpathian cave-dwelling populations have not been isolated from free-living ones long enough for morphological adaptations to the cavernicolous life habit to have been developed (Roháček 1991; Roháček & Košel 1993). This also seems to be confirmed by finding a few specimens in alpine habitats of the Western Carpathians (Malá Fatra Mts – Roháček 1983a, 1991; Vysoké Tatry Mts-Velická dolina valley – Roháček & Košel 2003).

**Morphology:** As stated above, the nominate *C. p. parentela* differs from *C. p. alpicola* largely by more reduced eyes, somewhat shortened wings and more elongate legs in addition to a more slender gonostylus. Because the specimens from the Cyrlka cave proved to also have smaller eyes I have measured them as well as all specimens of *C. p. alpicola* deposited in SMOC and compared the eye/gena ratio (= length of longest eye diameter : length of shortest genal height) of them with that known in *C. p. parentela* (according to Norrbom & Kim 1985), see Tab. 1. Interestingly, the 3 specimens from the Cyrlka cave were found to have eyes (Fig. 5) as small as has the paratype female of *C. p. parentela* (eye/gena ratio 1.24-
1.40 vs 1.40 in the latter) but larger than is known in the male holotype of the latter subspecies (cca 1.0 following Norrbom & Kim l.c. but possibly even less /0.93 / according to Séguy 1963: Fig. 6). All other specimens from the Alps and Carpathians I measured have eyes distinctly larger (with the ratio ranging from 1.59 to 1.88, see Tab. 1). Also the relative length of wing was tested in the material listed above using the ratio wing length/body length. Again, the three specimens from the Cyrialka cave seem to have wings somewhat shorter than is usual in other material from the Alps and Carpathians where wing/body ratios range between 0.80 and 0.98 (see Tab. 1), thus more resembling the female paratype of C. p. parentela (ratios 0.72-0.75 vs 0.68). On the other hand the holotype male of C. p. parentela has the wing distinctly shorter (only 0.56 times as long as body length, according to measurements by Séguy 1963). However, although in these two external characters the population of of C. parentela from the Cyrialka cave most resembles the female paratype of the nominate subspecies, examination of the male genitalia clearly demonstrated they belong to C. p. alpicola. On the other hand, the the female paratype of C. p. parentela (where the precise geographical position of locality is somewhat doubtful – see below) seems to differ (in these characters) from the holotype more than one would expect (cf. Tab. 1) which indicates that these two populations are possibly different or even not consubspecific, particularly when their host caves are very distant.

Tab. 1: Ratios of the longest eye diameter : shortest height of gena and of wing length : body length in specimens of Crumomyia parentela from various populations of both subspecies. Those of C. parentela parentela are based on data provided by Norrbom & Kim (1985) and Séguy (1963), those of C. parentela alpicola were obtained from specimens deposited in SMOC.

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<tr>
<th>Taxon</th>
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<th>C. parentela alpicola</th>
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<td>locality</td>
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<td>Hajne cave</td>
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<td>1♂ 2♀</td>
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<td>Mts Cyrialka cave</td>
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<td>Slov. Raj Mts Všilá cave</td>
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<td>V. Tatry Mts Velická dolina</td>
<td>2♀ (HT, PT)</td>
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<td>Austria</td>
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<td>specimens measured</td>
<td>1.0 1.4</td>
<td>1.24-1.40 1.73 1.61-1.73 1.67 1.59-1.88 1.72 1.60-1.70</td>
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<tr>
<td>ratio eye/gena</td>
<td>0.56 0.68</td>
<td>0.72-0.75 0.87 0.80-0.83 0.92 0.84-0.98 0.83 0.87-0.97</td>
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<td>ratio wing/body</td>
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Nevertheless, it could be concluded that the cavernicolous population in the Cyrialka cave was obviously isolated a long time from the Carpathian alpine populations of C. p. alpicola which seem to be extinct in the (relatively low) Moravskoslezské Beskydy Mts and may survive in this cave as a glacial relict up to the present. The long impact of cavernicolous conditions (complete darkness, high humidity) on this population probably resulted in the reduction of eyes as well as some shortening of wings.

**Habitat association:** The nominate subspecies is only known from caves and is considered troglobiont (Roháček & Papp 2000). On the other hand, C. p. alpicola occurs in open alpine habitats above the timber line, living there in runs and burrows of mammals (Roháček & Košel 2003 recorded a female from a burrow of Marmota marmota) in addition to montane caves. Adults surely migrate out of them as specimens were collected by means of Malaise and emergence traps in alpine meadows (Troger & Roháček 1980; Stockner 1982). In caves the adults of this subspecies inhabit deeper, aphytic, cold and humid parts (Roháček & Košel 1993), where the larvae obviously consume remnants of various organic matter (bat
guano, carrion of animals, rotting leaves or wood). All these conditions are found in the Cyrilka cave (Figs 2-4) and in other Carpathian caves but because the supply of larval food in these caves is very limited the abundance of flies is usually very low in these sites (see Roháček & Košel 1993, 2003).

**Distribution:** The nominate subspecies *C. p. parentela* was described from only 2 specimens collected in two caves in Serbia, viz. the holotype male found in Špela Maja Hajne (at Ugao village near Tutin and Sjenica, distr. Novi Pazar, SW Serbia) and the paratype female from „grotte 34 bis” at „Stajevac“ (Séguy 1963; Norrbom & Kim 1985). However, the position of the latter locality is unclear; possibly it is a misspelled name of the village Stajevec (Donji or Gornji Stajevec, SE Serbia). These localities (the latter mapped as Stajevac) are far separated from the known distribution of the ssp. *C. p. alpicola*, cf. Fig. 6.

The high-montane *C. p. alpicola* seems to be widespread in the Alps and Carpathians (see Fig. 6). In the Alps it was recorded from Austria: Tiroler Zentralalpen: Obergurgl Mt. (Troger & Roháček 1980; Stockner 1982) and Karnischen Alpen Mts: Obstans cave (Roháček & Papp 2000; Kofler 2009), from Switzerland: Uri: Oberalppass and Fribourg: Moléson (Papp 1985) and from Italy: Cuneo: Valcasotto, Grotta dell Turbiglie (Papp 1985). In the Carpathians there are records from the Czech Republic: Moravskoslezské Beskydy Mts: Cyrilka cave (recorded above) and Slovakia: Malá Fatra Mts: Stoh Mt. (Roháček 1983a, 1991), Slovenský raj Mts: Stratenská cave, Vlěa cave, Koniarova cave (Roháček 1991; Roháček & Košel 1993), Vysoké Tatry Mts: Velická dolina valley (Roháček & Košel 2003) and Belianské Tatry Mts: Alabastrová cave (Roháček & Košel 2003). Importantly, all records of this subspecies from caves are from relatively high altitudes (cca 1000–2000 m, the lowest is from Vlěa cave, 991 m).

The cavernicolous fauna of Sphaeroceridae in the Czech Republic

Although the study of the insect fauna of caves in the Czech Republic (particularly in the Moravský kras (= Moravian carst) has had a history more than 100 years long, the information about Diptera (and Sphaeroceridae particularly) remains rather limited up to the present. The first records of Sphaeroceridae from Moravian caves (based on collections made by K. Absolon, thus probably from the Moravský kras = Moravian carst) were given by Bezzi (1907) who listed 3 species: *Limosina ciliosa* Rond. = probably *Leptocera caenosa* (Rondani, 1880), *Limosina silvatica* Fall. = *Limosina silvatica* (Meigen, 1830) and *Borborus nigriceps* Rond. = *Crumomyia nitida* (Meigen, 1830). More numerous data from the Moravský kras were published by Czižek (1916) on flies he and K. Absolon collected in the caves Výpustek, Ochozská cave, Býčí skála and in Macocha chasm. Sphaeroceridae for his study were identified by O. Duda, who later listed these records in his taxonomic papers (Duda 1918, 1923). In the years 1973-1975 I revised the voucher specimens in the collection of K. Czižek (Moravian Museum, Brno, Czech Republic) and revised their identification (published by Roháček 1976, 1991 – *Crumomyia* species, Roháček 1983b – species of Limosininae). Based on papers quoted above and subsequent revision of voucher specimens, the following 11 species were known from caves in the Moravský kras towards 1916: *Crumomyia glabrifrons* (Meigen, 1830) (Výpustek cave), *C. nigra* (Meigen, 1830) (Výpustek, Býčí skála and Ochozská caves), *C. nitida* (Meigen, 1830) (Výpustek, Ochozská caves), *C. notabilis* (Collin, 1902) (Výpustek, Ochozská caves, added by Roháček 1976), *C. rohaceki* Norrbom & Kim, 1985 (Výpustek, Ochozská caves), *Apertomyia claviventris* (Strobl, 1909) (Výpustek, Býčí skála caves), *Herniosina bequarti* (Villeneuve, 1917) (Výpustek cave), *Limosina silvatica* (Meigen, 1830) (Výpustek, Ochozská, Býčí skála caves, Macocha chasm), *Spelobia clunipes* (Meigen, 1830) (Výpustek, Býčí skála caves), *Spelobia cizikei* (Duda, 1918) (Výpustek, Ochozská, Býčí skála caves) and *Terrilimosina racovitzai* (Bezzi, 1911) (Ochozská cave).
Figs 4-5: *Crumomyia parentela alpicola*. 4 – Interior of the Cyrilka cave showing the wall (red arrow) where all specimens were found; 5 – Head and anterior part of thorax of female *C. p. alpicola* laterally. Photo by J. Lenart (Fig. 4) and M. Deml (Fig. 5).

However, Roháček (1983b) supplemented this list by two more species when recording some Limosininae from two additional caves in the Moravský kras, viz. *Apteromyia claviventris*, *Limosina silvatica* and *Spelobia pseudosetaria* (Duda, 1918) from the Pekárna cave (J. Roháček leg.) and *Apteromyia claviventris* and *Telomerina flavipes* (Meigen, 1830) from the Evina cave (B. Mocek leg.). In the Moravský kras the Sphaeroceridae were also collected in the Svážná studna cave (nr. Jedovnice) by K. Marsová on 12.vi. and 18.ix.2004 where 6 species were found, viz. *Crumomyia glabrifrons*, *C. nitida*, *C. notabilis*, *C. rohaceki*, *Limosina silvatica* and *Spelobia clunipes* but these unpublished records did not add any species
to the list of cavernicolous flies of the area. It is also noted that a total of three species were
described from caves in the Moravský kras by Duda in Czišek (1916) and Duda (1918), viz. 
*Limosina mikrops* Duda, 1916 (= synonym of *Terrilinosina racovitzai*), *Limosina* 
(*Scotophilella*) *herniata* Duda, 1918 (= synonym of *Herniosina bequaerti* and *Limosina* 
(*Scotophilella*) *czizeki* Duda, 1918, a valid species now known as *Spelobia czizeki* (see 
Roháček 1983a; Šťastná et al. 2003).

The only other caves searched for Diptera in the Czech Republic, with records of 
Sphaeroceridae are those in the Králický Sněžník Mts. Pax & Maschke (1935) studied the 
cavernicolous fauna in the caves, mine galleries and also cellars both on the Polish and Czech 
(Moravia) sides of these mountains. Sphaeroceridae were recorded from only two caves lying 
in the Czech Republic: N. Moravia, viz. Tvarožné díry and Velká Morava. The specimens 
collected in them were identified by O. Duda; consequently, the records of Pax & Maschke 
(1935) of two species from these caves are reliable: *Crumomyia nigra* was found in both the 
above caves, *Crumomyia glabrifrons* in the cave at Velká Morava only.

No other records of Sphaeroceridae from caves of the Czech Republic have been 
published up to the present; thus there is no information from the Český kras (Bohemian 
karst) cave system and/or other regions of the country. The invertebrate fauna in the crevice 
type caves in the flysch area of the Outer Western Carpathians in the NE part of the Czech 
Republic (including those in the Moravskoslezské Beskydy Mts, and also the Cyrilka cave) 
has recently been explored by Lenart (2011), but no Sphaeroceridae were found. The above 
record of *Crumomyia parentela alpicola* from the Cyrilka cave is thus the first from this area.

Sphaeroceridae are known to form a regular component of the dipterous cave-dwelling 
fauna, but the majority of species found in caves belong to the so-called “parietal fauna” 
habiting largely the entrance zones and only temporarily penetrating into the deeper parts of 
caves. However, a limited number of species are adapted to life in the deep, aphotic zone of 
caves and complete their whole life-history in this habitat. These two main groups of cave-
dwelling fauna can be ecologically classified according to their affinities to cave habitats 
(using the quadripartite system originally proposed by Dudich 1932), see also Papp & 
Plachter (1976), Roháček & Papp (2000) as follows:

(i) *trogloxenous* – a species originating from outside, occurring in caves among the 
parietal fauna only by chance

(ii) *hemitroglophilous* – a species originating from outside, living (usually among the 
parietal fauna) in caves temporarily, and visiting this habitat chiefly because of convenient 
conditions during the season (e.g. psychrophilous species in summer). They are not 
morphologically modified in contrast to the following two groups.

(iii) *troglophilous* – a species residential in the aphotic zones of caves, which can also 
live in other subterranean habitats (e.g. burrows of mammals). They can migrate from and to 
caves but in contrast to the hemitroglophilous species can complete their life history in the 
aphotic cave habitat and occur in caves also in winter. Their morphology is slightly modified 
due to the subterranean way of life, having somewhat reduced eyes, prolonged arista or 
shorter wings.

(iv) *troglobiont* – a true cavernicolous taxon which has evolved in caves in the course of 
its adaptation to the cave habitat and specialization to the cavernicolous way of live and are 
unable to live outside them. Their morphology is more modified: eyes strongly reduced, ocelli 
sometimes absent, arista very long, thoracic spiracles slot-like, legs prolonged, wings often 
shortened, abdomen dilated.

Hitherto, there is not a consensus about the classification of some European 
cavernicolous species of Limosininæ. For example, Papp & Plachter (1976) affiliated 
*Herniosina bequaerti* and *Terrilinosina racovitzai* with the troglophilous species, arguing 
that they can develop in deeper zones of caves for generations. Although both these species
(and also *Spelobia czizeki*) were originally described from caves they are frequent inhabitants of cellars, mine galleries, and burrows and runs of small mammals (where they can be more abundant due to a richer supply of breeding substrates for the larvae, see Roháček 1982) also in lowlands and, hence, they are not glacial relicts in contrast to some high-montane *Crumomyia* species. For this reason Roháček (2011) also classified these species as hemitroglophilous.

To conform with previous studies of the cavernicolous Sphaeroceridae in Central Europe, *Herniosina bequaerti* and *Terrilimosina racovitzai* are treated as troglophilous species here, as Papp & Plachter (1976) suggested, but stressing the fact that the affinity of the troglophilous glacial relicts (some *Crumomyia* species as listed by Roháček & Papp 2000) to caves is markedly stronger (see also in Roháček & Košel 1993, 2003).

**Fig. 6:** Distribution of *Crumomyia parentela parentela* (squares, solid line ellipse) and *Crumomyia parentela alpicola* (solid circles, dotted line ellipses) in Europe. Map source: Fauna Europaea.
Classification of the Czech cavernicolous Sphaeroceridae

Areas and localities (in parentheses) behind names of species are abbreviated as follows:

**Areas:** KS – Kralický Sněžník Mts, MB – Moravskoslezské Beskydy Mts, MK – Moravský kras (Moravian karst).

**Caves:** 0 – unknown, 1 – Tvarožné díry, 2 – Velká Morava, 3 – Cyrilka, 4 – Výpustek, 5 – Ochozská jeskyně, 6 – Býčí skála, 7 – Macocha chasm, 8 – Pekárna, 9 – Evina jeskyně, 10 – Svážná studna.

(1) Trogloxenous species
None

(2) Hemitroglophilous species

- *Crumomyia glabrifrons* (Meigen, 1830) – KS (2), MK (4, 10)
- *Crumomyia nigra* (Meigen, 1830) – KS (1, 2) MK (4, 5, 6)
- *Crumomyia nitida* (Meigen, 1830) – MK (0, 4, 5, 10)
- *Crumomyia notabilis* (Collin, 1902) – MK (4, 5, 10)
- *Crumomyia rohaceki* Norrbom & Kim, 1985 – MK (4, 5, 10)
- *Apteromyia claviventris* (Strobl, 1909) – MK (4, 6, 8, 9)
- *Leptocera caenosa* (Rondani, 1880)? – MK (0)
- *Limosina silvatica* (Meigen, 1830) – MK (0, 4, 5, 6, 7, 8, 10)
- *Spelobia clunipes* (Meigen, 1830) – MK (4, 6, 10)
- *Spelobia czizeki* (Duda, 1918) – MK (4, 5, 6)
- *Spelobia pseudosetaria* (Duda, 1918) – MK (8)
- *Telomerina flavipes* (Meigen, 1830) – MK (9)

(3) Troglophilous species

- *Crumomyia parentela alpicola* (Roháček, 1980) – MB (3)
- *Herniosina bequaerti* (Villeneuve, 1917) – MK (4)
- *Terrilimosina racovitzai* (Bezzi, 1911) – MK (5)

(4) Troglobiont species
None

Discussion and conclusions

(1) *Crumomyia parentela alpicola* (Roháček, 1980), found in the Cyrilka cave in the Moravskoslezské Beskydy Mts., is recorded from the Czech Republic for the first time. It is also the first troglophilous species of the genus *Crumomyia* (and the whole subfamily Copromyzinae) found in the country.

(2) The population of *Crumomyia parentela alpicola* in this cave displays stronger morphological modifications (more reduced eyes, shorter wings) to the cavernicolous milieu than hitherto known in other populations of this subspecies, and hence resembling somewhat the nominate *C. parentela parentela*. Despite this the specimens from the Cyrilka cave are affiliated to *C. p. alpicola* on the basis of the form of male gonostylus and the above modifications are considered to have evolved due to long isolation of the population in this cave.

(3) Following Roháček & Papp (2000) the recent populations of *Crumomyia parentela* can be considered glacial relicts of a strictly psychrophilous species that was probably widespread in Europe in the Pleistocene Ice Ages but became restricted to alpine subterranean habitats and caves during warming of the climate in the interglacial and postglacial periods. This resulted in the contemporary insular distribution of the species in the Balkan karst area (*C. p. parentela*) and in the montane ranges of the Alps and Carpathians (*C. p. alpicola*).
A detailed review of the cavernicolous Sphaeroceridae hitherto found in the Czech Republic resulted in finding that a total of only 15 species are known in caves of the country, most of them from the Moravský kras (= Moravian karst). Hitherto, no trogloxenous or troglobiont species have been found there; 12 species are classified as hemitroglophilous and only 3 as troglophilous, viz. Crumomyia parentela alpicola, Herniosina bequaerti and Terrilimosina racovitzai. The latter group is the most significant containing species that can propagate in caves for generations.

However, considering the knowledge of the cavernicolous Sphaeroceridae in Slovakia (see Roháček & Košel 1993, 2003; Roháček 2011) some additional species are presupposed to be found in caves of the Czech Republic, including the troglobilophilous Crumomyia setitibialis (Spuler, 1925) which has recently been found in the country in the Šumava Mts – Boubín Mt. and Hrubý Jeseník Mts – Velká kotlina glacial cirque (Roháček 2006, 2007). Also the hemitroglophilous taxa Crumomyia pruinosa (Richards, 1932), C. zuskai (Roháček, 1976) (both boreo-alpine or montane microcavernicolous species), Herniosina horrida (Roháček, 1978), H. pollex Roháček, 1993 (both subterranean to terricolous species) and Gigalimosina flaviceps (Zetterstedt, 1847) (a woodland psychrophilous and dark-loving species), all being known from the Czech Republic, will possibly be found there. Of course also some trogloxenous species can be recorded in entrance zones of caves but their accidental occurrence is unimportant. On the other hand no true troglobiont species of Sphaeroceridae is expected to be discovered in the Czech Republic. The only European troglobionts belonging to this family are six taxa (species or subspecies) of Crumomyia listed by Roháček & Papp (2009), which all display a high degree of morphological modification due to the cavernicolous way of life and are known from only one or two caves, mostly in the more southern areas of Europe. It is believed that in Central Europe (s. str.) the populations of Crumomyia species living in caves have not been isolated long enough for any troglobiont taxon (as defined above) to have evolved there.

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References


První kavernikolní populace mrvnatky *Crumomyia parentela* (Séguy, 1963) v České republice a přehled druhů čeledi Sphaeroceridae (Diptera) zjištěných v jeskyních na tomto území

Mrvnatka *Crumomyia parentela* (Séguy, 1963) z čeledi Sphaeroceridae je poprvé hlášena z České republiky a to na základě tří exemplářů objevených v jeskyni Cyrilka (u lokality Pustevny) v Moravskoslezských Beskydech. Bylo zjištěno, že kusy nalezené v této jeskyni J. Kupkou sice náleží k subspecii *C. p. alpicola* (Roháček, 1980), ale protože mají více redukované oči a kratší křídla než exempláře dosud známé z Alp a Karpat, přepokládá se, že tato populace zřejmě přežívá jako glacialní relikt v afotickém prostředí této jeskyně již velmi dlouhou dobu. S ohledem na tento překvapivý nález je poprvé zpracován přehled jeskynní fauny čeledi Sphaeroceridae na území České republiky a zjištěné druhy (celkem 15) jsou rozřízeny podle jejich afinity k jeskynnímu prostředí. V České republice nebyl zjištěn žádný troglobiontní taxon; většina druhů (12) je hemitroglofilní a jen 3 jsou troglofilní (tj. takové, které se mohou vyvíjet v jeskyních po více generacích): *Crumomyia p. alpicola*, *Herniosina bequaerti* (Villeneuve, 1917) and *Terrilimosina racovitzai* (Bezzi, 1911). Podle znalosti kavernikolní fauny v sousedních zemích (zejména na Slovensku) se dá předpokládat, že v jeskynních systémech České republiky bude časem nalezeno ještě několik dalších hemitroglofilních druhů, možná i jeden druh troglofilní, *Crumomyia setitibialis* (Spuler, 1925), ale určitě žádný druh troglobiontní.

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