Sphaeroceridae (Diptera) collected in the Forest Reserve Sihlwald (Kt. Zurich)

Autor(en): **Schiegg, Karin / Munari, Lorenzo**

Objekttyp: **Article**

Zeitschrift: **Mitteilungen der Schweizerischen Entomologischen Gesellschaft = Bulletin de la Société Entomologique Suisse = Journal of the Swiss Entomological Society**

Band (Jahr): **72 (1999)**

Heft 1-2

PDF erstellt am: **23.05.2024**

Persistenter Link: https://doi.org/10.5169/seals-402740

MITTEILUNGEN DER SCHWEIZERISCHEN ENTOMOLOGISCHEN GESELLSCHAFT
BULLETIN DE LA SOCIÉTÉ ENTOMOLOGIQUE SUISSE
72, 65 – 73, 1999

Sphaeroceridae (Diptera) collected in the Forest Reserve Sihlwald (Kt. Zurich)

KARIN SCHIEGG[1] & LORENZO MUNARI[2]

[1] Professur für Natur- und Landschaftsschutz, Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft, CH-8903 Birmensdorf; schiegg@wsl.ch

[2] c/o Laboratory of Entomology, Municipal Museum of Natural History, Fontego dei Turchi, S. Croce 1730, I-30135 Venezia

During a study of saproxylic Diptera and Coleoptera, 26 species of Sphaeroceridae (lesser dung flies) have been collected in the Forest Reserve Sihlwald (Kt. Zurich, Switzerland). Most species were caught in spring and early summer. Emergence traps yielded significantly higher numbers of both species and individuals than trunk-window traps. Comparing our species list with lists obtained in other studies, a few more sphaerocerid records can be expected in the Sihlwald.

Keywords: Sphaeroceridae, Diptera, faunistics, Switzerland

INTRODUCTION

Sphaeroceridae (lesser dung flies) are medium sized to very small and darkish acalyptrate flies usually running and jumping on decaying substrates. They are easily distinguished from other flies by their characteristic thick and shortened basitarsomere of the hind leg. The larvae breed in various kinds of decaying organic matter and in animal droppings. In Switzerland, 108 species have been recorded so far (PAPP, 1998). No study has focused on the Swiss sphaerocerid fauna yet, which is therefore insufficiently known. The species already recorded in Switzerland were trapped in the course of faunistic surveys in nature reserves (GONSETH *et al.*, 1985; REDARD, 1985; MEIER & SAUTER, 1989) using pitfall traps, sweep nets, beating trays and sifting. Other species were mentioned by PAPP (1982, 1985) in his studies of cavernicolous Diptera and acalyptrate flies from sifted materials in the collection of the Geneva museum. In this paper we report the sphaerocerids collected in the Forest Reserve Sihlwald (Kt. Zurich) together with the trap types used and discuss them based on the available faunistic information. The records presented were obtained as a by-product of an extensive ecological investigation into saproxylic Diptera and Coleoptera carried out by the senior author.

METHODS

The study was conducted in the Forest Reserve Sihlwald (Kt. Zurich, 47°15'; 8°33'), a 10 km^2 large woodland dominated by beech (*Fagus sylvatica*) and spruce (*Picea abies*), situated on a north-east orientated slope at 400–700m a.s.l. The flies were collected by two trap types: trunk-window traps (TWT, KAILA, 1993) and photo-eclectors (emergence traps, ET, modified after FUNKE, 1971). All ET were placed on wood of beech at a medium stage of decay. TWT were filled with a solution of 4 %, ET with 2 % formaldehyde, and some drops of a detergent to lower

surface tension were always added. TWT were emptied every two weeks, ET every four weeks from April 24th to November 6th 1996. The material is deposited in the entomological collection of the Swiss Federal Institute of Technology, Zurich and in the collection of the junior author.

RESULTS

Trap types and phenology

We recorded a total of 269 specimens belonging to 28 species. With 65 individuals, *Spelobia (Spelobia) palmata* (RICHARDS, 1927) was the most abundant species. It appeared throughout the whole sampling period and in 13 of the 14 sampling sites. Significantly more species and individuals of Sphaeroceridae were caught by ET than by TWT (Tab. 1).

Only two species from the TWT were not found in the ET: *Crumomyia glabrifrons* (MEIGEN, 1830) and *C. nigra* (MEIGEN, 1830). Most species were collected in the ET from late May until early June whereas in the trunk-window traps the species numbers were distributed more evenly over the season. On July 18th already 25 species were recorded and the following samples added only another three species.

List of species

Subfamily COPROMYZINAE

Crumomyia fimetaria (MEIGEN, 1830)

Distribution: Widespread and common in Europe but limited to highlands in southern areas. The southernmost records are from highland biotopes of Romania (VANSCHUYTBROECK, 1943) and Israel (PAPP & ROHÁČEK, 1987).

Biology: A polysaprophagous woodland species recorded from wet deciduous forests, mountain birch forests, peat bog, marshes, moose dung, sap runs, kitchen refuse, pastures, and on snow (FLORÉN, 1989).

Material examined: 11 ♂♂, 11 ♀♀ (incl. 2 cf.).

Crumomyia glabrifrons (MEIGEN, 1830)

Distribution: Widespread in the West Palaearctic Region. In southern areas the species only occurs in highland biotopes.

Biology: Found mainly in cold forests and above the timberline in the alpine zone. The species is also recorded from wet meadows, the entrance region of caves, on decayed vegetation, on roe droppings, and from collections by Malaise traps and ET in the Alps (TROGER & ROHÁČEK, 1980).

Material examined: 1 ♀.

Tab. 1. Number of sphaerocerid species and individuals collected by ET and by TWT, n = 14 sites.

	ET	TWT	U statistics	p
species	27	11	314	< 0.05
individuals	253	16	180	< 0.05

Crumomyia nigra (MEIGEN, 1830)

Distribution: Predominantly West Palaearctic, widely distributed from Iceland to Italy and Romania, eastwards as far as Central Asia.

Biology: Coprophilous, usually occurring in association with dung of sheep, cattle and horses. It is also reported from dead leaves and from caves, where usually the entrance region is inhabited.

Material examined: 1 ♂.

Crumomyia nitida (MEIGEN, 1830)

Distribution: Widespread in Europe.

Biology: A woodland species usually occurring in shady places. It is also recorded from damp deciduous forests, streams, wooded marshland, especially from moist, rotting vegetation, on snow, near the entrance of caves, from mole burrows inhabited by mice. *C. nitida* is less commonly associated with excrements or carrion than other congeners.

Material examined: 1 ♂, 2 ♀♀.

Crumomyia notabilis (COLLIN, 1902)

Distribution: Europe, from Fenno-Scandinavia to Northern Italy.

Biology: A psychrophilous species occurring in the burrows of small mammals, on rotting fungi, dead mice, cow bones, and in caves. It is also reported from collections by soil traps left in rodent burrows through the winter.

Material examined: 2 ♂♂ (incl. 1 cf.), 1 ♀.

Crumomyia rohaceki NORRBOM AND KIM, 1985

Distribution: An uncommon species recorded (in most cases as *C. glacialis* (MEIGEN, 1830)) from Germany, Hungary, France, former Czechoslovakia, Italy, and from places over 1400 m a.s.l. in Israel. It was also found in the lowlands of Central Europe in autumn and winter (PAPP & ROHÁČEK, 1987). The distribution of *C. rohaceki* is rather unclear because of its former confusion with *C. notabilis* (COLLIN, 1902) and *C. glacialis*.

Biology: Strongly psychrophilous, chiefly collected on decaying fungi and leaves as well as on moss in damp meadows. It is also found in the burrows of small mammals and in the entrance region of caves.

Material examined: 1 ♀.

Subfamily LIMOSININAE

Apteromyia claviventris (STROBL, 1909)

Distribution: Holarctic, particularly common and widespread in the West Palaearctic Region from Iceland to Italy, the southernmost record is from Sicily.

Biology: Polysaprophagous, occurring in damp and shady habitats. It is also reported from damp mixed deciduous forests, elk droppings, sap runs, grass compost, potato and oat fields as well as from cow stables (FLORÉN, 1989).

Material examined: 6 ♂♂, 8 ♀♀.

Herniosina bequaerti (VILLENEUVE, 1917)

Distribution: Widespread in Europe, particularly throughout the north and central regions.

Biology: Troglophilous, occurring in caves, cellars and in burrows of small mammals and also in potato fields (FLORÉN, 1989).

Material examined: 1 ♂.

Terrilimosina schmitzi (DUDA, 1918)

Distribution: Widespread throughout the Holarctic Region.

Biology: Common on rotting litter in damp forests. It is also reported from cow stables, sheep droppings, damp deciduous forests with running water, boggy pastures, a watered pile of pulp-wood, and from potato fields (FLORÉN, 1989).

Material examined: 12 ♂♂, 11 ♀♀.

Minilimosina (Minilimosina) fungicola (HALIDAY, 1836)

Distribution: Holarctic, common.

Biology: A synanthropic, chiefly phytosaprophagous species reported from meadows, deciduous forests, grass compost, cow stables, potato and rape fields, and from piles of wood in a coniferous forest (FLORÉN, 1989).

Material examined: 21 ♂♂, 9 ♀♀.

Minilimosina (Minilimosina) parvula (STENHAMMAR, 1855)

Distribution: Europe and North America.

Biology: Chiefly necrophagous. FLORÉN (1989) records it also from excrement, rotting fungi and decaying vegetation, pastures, mixed forest, peat bog, grass compost, bird's nests, elk droppings, cow stables, potato and rape fields.

Material examined: 3 ♂♂, 1 ♀.

Puncticorpus cribratum (VILLENEUVE, 1918)

Distribution: Europe, Turkey, Cyprus and Israel.

Biology: Strictly terricolous. The species is common in wet lowland forests. Preimaginal stages develop in sporophores of fungi and mycelia in forest litter as well as in burrows of small mammals.

Material examined: 3 ♀♀ (shorter winged to longer winged brachipterous forms). PAPP & ROHÁČEK (1987) state that "while the specimens from the northern latitudes are distinctly brachypterous, the southern populations have longer wings, the specimens from Israel are fully winged". MUNARI (in press) points out that the populations from Central Italy exhibit all the stages of wing development, from brachypterous to fully winged individuals.

Spelobia (Spelobia) clunipes (MEIGEN, 1830)

= *S. manicata* (RICHARDS, 1927)

Distribution: A very common species widespread throughout the Holarctic region.

Biology: Polysaprophagous with very large ecological tolerance.

Material examined: 10 ♂♂, 8 ♀♀ (incl. 1 cf.).

The presence of two different phenotypes has been observed: one of these quite agrees with the typical individuals of *S. clunipes* while the second phenotype ("S. manicata") exhibits in both sexes a longer mid basitarsomere which is distinctly longer than the 2nd tarsomere (as in *S. palmata* (RICHARDS, 1927)). Thin, short prescutellar acrostichals are present. Furthermore, one male specimen belonging to the latter phenotype has the 5th sternite and genitalia quite identical to the ones figured by ROHÁČEK (1983b, p. 222, figs. 458–460) for *S. faeroensis* (DEEMING, 1966). ROHÁČEK (1983a) felt that "the possibility that *S. faeroensis* is only an atavistic male of *S. clunipes* with simple t1 occurring rarely among normal specimens is not wholly eliminated although not confirmed". Additionally, FLORÉN (1989) pointed out that *S. clunipes* seems to be variable in its morphological characters and is therefore difficult to distinguish from its closest congeners.

Spelobia (Spelobia) sp. prope clunipes (MEIGEN, 1830)

Material examined: 1 ♂, 7 ♀♀.

Most specimens studied exhibit the syntergite 1+2 not homogeneously sclerified. An extremely faint antero-medial hemicircular mark can be observed (as in *S. palmata* (RICHARDS, 1927) although more pigmented there). The postabdomen of the female is quite similar to that of *S. palmata* except for the absence of the distinctive short, slightly curved and thickened dorsopreapical seta of cercus. The surstylus of the one male specimen examined is strongly similar to that in *S. clunipes* only differing in the presence of a very long ventro-caudal pubescence formed by several strongly wavy setulae. The mid basitarsomere is markedly longer than in *S. clunipes* (as in *S. palmata*). The acrostichal prescutellars are short and thin. In addition, all specimens examined are characterized by lighter, red-brownish, vibrissal tubercles as well as by parts of the anterior surface of cheek. It is still possible that these specimens belong either to an undescribed sibling species of *S. clunipes* or to hybrid individuals (for example between *S. clunipes* and *S. palmata*).

Spelobia (Spelobia) palmata (RICHARDS, 1927)

Distribution: Widespread and common in the West Palaearctic Region.

Biology: A chiefly necrophagous species reported from wet biotopes in forests, meadows with bushes, from runs and nests of small mammals, from decayed fungi, marl pit, rotting apples, sap runs, grass compost, and from ungulate droppings. It is frequently captured by soil traps.

Material examined: 38 ♂♂ (incl. 2 cf.), 27 ♀♀.

Spelobia (Spelobia) sp. prope talis ROHÁČEK, 1983

Material examined: 1 ♂.

The specimen examined shows the genitalia and the 5th sternite quite similar to ones in *S. talis* but principally differs in having distinctly clavate fore tibia. The antennae are strongly divergent and unusually large. The eye dimensions again are as in *S. talis*. More specimens would be necessary to establish the exact identity of the population from the area examined. It is worth mentioning that also two male specimens from Israel (PAPP & ROHÁČEK, 1987) exhibit the same characters as our specimen (except for eye dimensions and antennae).

Spelobia (Spelobia) rufilabris (STENHAMMAR, 1855)

Distribution: Mainly Eurosiberian, in Asia south to Mongolia and Nepal.

Biology: Predominantly sciaphilous, occurring in shady wooded places under decayed vegetation, on wet leaves, wood, marshes, peat bog, cattle droppings and in burrows of small mammals.

Material examined: 1 ♂, 1 ♀.

Spelobia (Spelobia) parapusio (DAHL, 1909)

Distribution: Europe, southwards as far as Tunisia and Madeira.

Biology: A parthenogenetic species usually occurring in wet and shady places under decayed vegetation. The males are extremely rare and the larvae are obligate fungivors. FLORÉN (1989) records this species also from marshes, peat bog, potato fields, cowpats, and from sap runs on maple (*Acer* sp.).

Material examined: 26 ♀♀.

Pullimosina (Pullimosina) moesta (VILLENEUVE, 1918)

Distribution: Europe, Canary Is., Russia (West Siberia), North Korea.

Biology: Terricolous, probably phytosaprophagous. FLORÉN (1989) records the species as very common in potato and rape fields. It was also frequently found in soil traps (ROHÁČEK, 1983a).

Material examined: 12 ♂♂, 13 ♀♀.

Pullimosina (Pullimosina) pullula (ZETTERSTEDT, 1847)

Distribution: Europe and North America.

Biology: A terricolous, chiefly phytosaprophagous species, occurring in wet meadows, fields, in woods and in burrows of small mammals. Most populations are parthenogenetic while the bisexual populations probably are declining. (ROHÁČEK, 1983).

Material examined: 4 ♀♀.

Pullimosina (Pullimosina) meijerei (DUDA, 1918)

Distribution: Predominantly Central European, south to the Italian Alps.

Biology: A typical terricolous, phytosaprophagous species mainly inhabiting the deeper layers of leaf litter in deciduous forests. It is rather common in submontane woodland areas and is easily collected by sifting or using soil traps.

Material examined: 3 ♂♂, 2 ♀♀ (incl. 1 cf.).

The male specimens examined show the 5th sternite notably different from that figured by ROHÁČEK (1985, p. 126, fig. 802): all stout spinulae of the posterior margin are completely substituted by more or less developed subtriangular tegumental lobes (the two median lobes are strongly protruding and with very irregular outline), each of them bearing a long and thin apical seta. This morphological pattern is very similar to that illustrated by PITKIN (1988, p. 135, fig. 421) for the populations of Great Britain.

Gonioneura spinipennis (HALIDAY, 1836)

Distribution: Holarctic.

Biology: Polysaprophagous. This very common species is found on various

decayed matter such as excrement, carrion, compost heaps, decayed vegetation and fungi.

Material examined: 1 ♂.

Telomerina pseudoleucoptera (DUDA, 1924)

Distribution: Europe.

Biology: Chiefly coprophagous on dung of large herbivores. It is also recorded from pastures, cow stables, cow droppings, faeces, grass compost, and potato fields.

Material examined: 2 ♀♀.

The specimens examined show the 8th tergite with a medially depigmented membraneous area. All other taxonomic characters of the body, legs and postabdomen quite agree with with those typical for this species.

Opalimosina (Opalimosina) mirabilis (COLLIN, 1902)

Distribution: This species seems to have a subcosmopolitan distribution, but the records outside the West Palaearctic Region need to be verified, as misidentifications with other closely related species (HAYASHI, 1989) may have occurred.

Biology: Polysaprophagous, chiefly coprophagous. FLORÉN (1989) found the species to be extremely common in cow stables.

Material examined: 1 ♀.

Elachisoma aterrimum (HALIDAY, 1833)

Distribution: Europe, Asia (Tadzhikistan, Afghanistan), Canary Is. RICHARDS (1980) also reports it from the Azores, St. Helena, Egypt and Zaire, but these records have not been verified yet. MARSHALL (1994) mentioned this species for the Canadian peatlands (Tab. 1, p. 175) but does not state it as the first record for the Nearctic region. We do not know about any previous records of the species from North America except for MARSHALL's PhD thesis (1982), which we have not been able to consult.

Biology: Coprophilous on excrement of large herbivores, in cow stables and on manure-heaps. The species is also reported from decaying vegetation, pastures, grass compost and from stumps of oaks (*Quercus* sp.).

Material examined: 2 ♀♀ (incl. 1 cf.).

Coproica ferruginata (STENHAMMAR, 1855)

Distribution: Cosmopolitan.

Biology: A synanthropic species particularly common on decaying matter and excrements.

Material examined: 1 ♂.

DISCUSSION

Most species we collected are attributed to moist and shady biotopes, which reflects the conditions in the study area. Considering that the ET were designed for an investigation into saproxylic Diptera and Coleoptera, the record of 26 sphaerocerid species is remarkable. As we did not clean the dead wood before installing the ET to prevent loose pieces of bark from falling off, sphaerocerid eggs must have

been inclosed in the trap. The capture of 90 % of the species in the first half of the sampling period suggests that we collected most species that could be expected in this forest. However, this might also result from fewer species being active in late summer and autumn than in spring. ROHÁČEK (1980) recorded 50 species (1902 individuals) in his work on Sphaeroceridae collected by soil and pitfall traps in North Moravia (Czech Republic). His studies were carried out in "submountainous woodland stream valleys with rich undergrowth" and he sampled in biotopes such as stream borders and small swampy areas. As the conditions of his investigation area are similar to our study site, we think that considerably more species of Sphaeroceridae than we recorded are present in the Sihlwald. On the other hand, BUCK (1997) found in his survey on saprophagous Diptera in two forested habitats near Ulm (Germany) only 23 species despite having collected 37.959 individuals. He used 14 types of substrates exposing them in 287 samples from which he extracted the emerging insects by ET and bait traps. As he considered only one of his study sites to be "humid" the comparably low species number reflects again the preference of lesser dung flies for moist habitats.

TWT turned out to be inappropriate for collecting Sphaeroceridae. Although being able to fly (MUNARI & SCARPA, 1989), many species run or jump on the ground (FLORÉN, 1989) and can therefore not be caught by TWT. However, in a comparison of the efficiency of Malaise traps, pitfall traps and coloured water traps, VEN & DE BRUYN (1992) found Malaise traps to be most suitable for monitoring lesser dung flies. As in monitoring projects the relative species abundances over time are more relevant than a complete species list, the use of intersection traps is certainly preferable in such cases due to the low sampling effort. When focusing on species numbers or on breeding sites however, the use of ET of various kinds is more promising because the species can be collected specifically from their substrates. The major disadvantages of ET are the high costs of their material and the time consuming installation in the field.

ACKNOWLEDGEMENTS

We thank the Swiss National Foundation for the financial support of this study (Grant 31–45911.95).

ZUSAMMENFASSUNG

Im Rahmen einer Studie über totholzlebende Dipteren und Käfer im Naturwaldreservat Sihlwald (Kt. Zürich) wurden mit Fensterfallen und Eklektoren 26 Arten der Familie Sphaeroceridae (Diptera) gefangen. Die meisten Arten wurden mit den Eklektoren nachgewiesen. Da viele Arten sich auf dem Boden laufend fortbewegen, sind Fensterfallen weniger geeignet, eine möglichst vollständige Artenliste zu erstellen.

REFERENCES

BUCK, M. 1997. Sphaeroceridae (Diptera) reared from various types of carrion and other decaying substrates in Southern Germany, including new faunistic data on some rarely collected species. *Eur. J. Entomol. 94*: 137–151.

FLORÉN, F. 1989. Distribution, phenology and habitats of the lesser dung fly species (Diptera, Sphaeroceridae) of Sweden and Norway, with notes from adjacent countries. *Ent. Tidskr. 110*: 1–29.

FUNKE, W. 1971. Food and energy turnover of leaf-eating insects and their influence on primary production. *Ecol. Studies 2*: 81–93.

GONSETH, Y., SCHLAEPPY, S. & SCHNEGG, F. 1985. Contribution à la connaissance de la faune de la marnière de hauterive. *Bull. Soc. neuchâtel. Sci nat. 108*: 77–86.

HAYASHI, T. 1989. The genus *Opalimosina* (s.str.) ROHACEK, 1983 from Pakistan (Diptera, Sphaeroceridae). *Jpn. J. Sanit. Zool. 40 (Suppl.)*: 61–64.

KAILA, L. 1993. A new method for collecting quantitative samples of insects associated with decaying wood or wood fungi. *Ent. Fenn. 29*: 21–23.
MARSHALL, S.A. 1982. *A review of the Nearctic Limosininae (Diptera: Sphaeroceridae), with revisions of selected genera*. PhD Thesis, University of Guelph, Guelph, Ontario.
MARSHALL, S.A. 1994. Peatland Sphaeroceridae (Diptera) of Canada. *Mem. Ent. Soc. Canada 169*: 173–179.
MEIER, C. & SAUTER, W. 1989. Zur Kenntnis der Insektenfauna eines Auenwaldreservates an der Aare bei Villnachern AG. *Mitt. Aarg. Naturf. Ges. 32*: 217–258.
MUNARI, L. (in press). Sphaeroceridae and Sepsidae (Diptera) from soil traps in Central Italy. *Fragm. Ent.*
MUNARI, L. & SCARPA, G. 1989. Sphaeroceridae (Diptera) raccolti da A. Giordani Soika nell'aeroplancton del Lido di Volano (Delta del Po). *Lavori Soc. Ven. Sc. Nat. 14 (2)*: 73–90.
PAPP, L. 1982. Cavernicolous Diptera of the Geneva Museum. *Revue suisse Zool. 89(1)*: 7–22.
PAPP, L. 1985. Acalyptrate flies (Diptera) from sifted materials in the Geneva Museum. *Revue suisse Zool. 92(2)*: 481–507.
PAPP, L. 1998. 86. Sphaeroceridae. *In*: MERZ, B., BÄCHLI, G., HAENNI, J.-P. & GONSETH, Y. (eds.). *Diptera-Checklist*. Fauna Helvetica 1: 291–294.
PAPP, L. & ROHÁČEK, J. 1987. The Sphaeroceridae (Diptera) of Israel. *Israel J. Ent. 21*: 77–109.
PITKIN, B.R. 1988. Lesser dung flies (Diptera: Sphaeroceridae). *Handbk Ident. Br. Insects, 10(5)*: 1–175.
REDARD, O. 1985. Etude écofaunistique des points d'eau de la région neuchâteloise. Les mares de pâturage de la chaux-d'amin. II. La faune. *Bull. Soc. neuchâtel. Sci. nat. 108*: 87–101.
RICHARDS, O.W. 1980. 57. Family Sphaeroceridae. *In*: CROSSKEY, R.W. (ed.): *Catalogue of the Diptera of the Afrotropical Region*, London, pp. 614–626.
ROHÁČEK, J. 1980. Sphaeroceridae (Diptera) collected by the soil trap method in submountaine areas of North Moravia (Czechoslovakia). *Čas. slez. Muz. Opava (A) 29*: 145–160.
ROHÁČEK, J. 1983a. A monograph and re-classification of the previous genus *Limosina* Macquart (Diptera, Sphaeroceridae) of Europe. Part II. *Beitr. Ent., Berlin 33(1)*: 3–195.
ROHÁČEK, J. 1983b. A monograph and re-classification of the previous genus *Limosina* Macquart (Diptera, Sphaeroceridae) of Europe. Part III. *Beitr. Ent., Berlin 33(2)*: 203–255.
ROHÁČEK, J. 1985. A monograph and re-classification of the previous genus *Limosina* Macquart (Diptera, Sphaeroceridae) of Europe. Part IV. *Beitr. Ent., Berlin 35(1)*: 101–179.
TROGER, H. & ROHÁČEK, J. 1980. Über die Sphaeroceridae-Fauna (Diptera) im Raum Obergurgl (Zentralalpen, Tirol): Faunistik, Taxonomie, Ökologie. *Beitr. Ent., Berlin 30*: 15–33
VANSCHUYTBROECK, P. 1943. Etudes biospéléologiques. XXXI(1). Sphaeroceridae (Borboridae) (Diptera) de Transylvanie. *Bull. Mus. r. Hist. nat. Belg. 19(43)*: 1–12.
VEN, F. & DE BRUYN, L. (1992). *Trapping efficiency in monitoring lesser dung flies (Diptera; Sphaeroceridae)*. Proc. 4th European Congr. of Entomolgy, Gödöllö, Hungary, pp. 237–243.

(received June 8, 1998; accepted November 25, 1998)