

Collembola (Hexapoda) of the Slovak Paradise National Park associated with forest sites and caves

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Slovak Paradise National Park is an area with specific type of plateau karst located in the Western Carpathians, Slovakia. The area is characteristic by high diversity of flora and fauna due to diverse geomorphological and microclimatic conditions, and also by high number of caves, where especially Stratenská cave-system involves valuable underground spaces. Forest habitats were sampled in 1997-1998. Samples of 500 cm³ were taken from litter and humus, moss on rocks and rotten wood. The number of species encountered was 88. Species richness ranged between 20-41 in different microhabitats, being the highest in organic profile of forest soil. Cluster analysis based on qualitative similarity exhibited the effect of site on species community composition. 15 boreo-montane or montane species were registered, 5 of them classified as Carpathian endemics or subendemics. The present study confirmed previous data on occurrence of *Hypogastrura crassaegramulata dobsinensis* (Stach, 1949) limited to inverse site at the mouth of Dobšinská Ice Cave. *Micranurida* sp. 1 and *Endonura* sp.1 are newly identified species. Research on cave Collembola was carried out in 1981 - 1998. Pitfall trapping was the main sampling method and 28 species were recorded in total. *Pseudosinella paciti* Rusek, 1961, *Arrhopalites aggtelekiensis* Stach, 1945, *Protaphorura janosik* Weiner, 1990, *Deuteraphorura* sp. 1 and sp. 2 represent characteristic cavernicolous species of the area, all regarded as troglobites and belonging to valuable Carpathian subendemics. High proportion of troglobites was connected with large caves. Community of Stratenská Cave was characterised by low diversity in spite of more intensive sampling and combination of different sampling methods.

Keywords: Collembola, endemic species, Slovak Paradise National Park, caves, forests.

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Introduction

Slovak Paradise National Park is a small karstic area of 142 square kilometres located in the Western Carpathian Mountains, Slovakia. Karstic character of the area is reflected in high number of caves, of which Stratenská Cave - system and Dobšinská Ice Cave being the most conspicuous. Diverse

geomorphological and microclimatic conditions are reflected by vegetation and animal diversity.

Soil fauna of the Slovak Paradise was poorly investigated. More extensive studies were concentrated on earthworms (Zajonc, 1987) and free living nematodes (Šály, 1985). From Acarina cave Rhagidiidae were explored (Zacharda, 1988).

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Table 1. Sampling scheme for cave Collembola of the Slovak Paradise (Abbr. - abbreviations, for Method see chapter „Methods“, Samp. - number of sampling occasions).

Abbr.	Cave	Length (m)	Period	Method	Samp.
Ce	Čertova Cave	257	1998-1999	B	2
Du	Duča Cave	136	1997-1998	PT, B, E	9
Na	Na skale Cave	100	1994	PT	1
Kl	Kláštorná Cave	85	1997-1998	PT	3
Ko	Koniarova Cave	180	1998	PT, B	4
Me	Medvedia Cave	487	1990-1998	PT, B	7
Ps	Psie diery Cave	2,584	1981-1998	PT, B	6
Ru	Ružová Cave	57	1998	PT	1
St	Stratenská Cave	18,901	1984-1997	PT, B, E	18
Vl	Vlčia Cave	121	1994-1997	PT	9
Vo	Vojenská Cave	53	1996-1998	PT, B	3

Data on Collembola are based on single investigations. Stach (1949) described an endemic form *Hypogastrura crassaegranulata dobsinensis*, collected at the entrance to Dobšinská Ice Cave. The same site was the subject of Nosek's investigations (Nosek, 1967). The author confirmed the existence of this form and recorded additional 37 species. Preliminary list of cave Collembola of the Slovak Paradise was elaborated by Kováč and Košel (1998).

The aim of the present study is to give more complex survey of Collembola assemblages from selected forest sites and caves in the Slovak Paradise with special attention to rare and endemic species.

Study area and research sites

The territory of the Slovak Paradise may be defined by the co-ordinates 20°12'-20°32' E and 48°50'-49°00' N and altitude range between 450 m (Spišská Nová Ves) and 1545.6 m (Predná hoľa Peak). Geologically it belongs to plateau karst composed of Triassic limestones and dolomites with rendzinas, protorendzinas and cambisols. Fluvisols are limited to alluvium of the Hornád River. Mean annual temperature ranges from 4.7°C to 6.4°C

and annual precipitation from 648 mm (Podlesok) to 954 mm (surroundings of Dobšinská Ice Cave). Spruce forests with fir and maple, and limestone beech forests of various types are the most widespread over the area.

Following forest sites were selected for the study (microhabitats: a - litter, humus and mineral soil, b - moss on rocks, c - rotten wood, number of collected samples in parenthesis):

1. Duča Mt., NW slope, 800 m a.s.l., *Fageto-Piceetum*, a (6), b (2), c (3), 25.7.1998,
2. Duča Mt., NW slope, .in front of entrance to the Dobšinská Ice Cave, 970 m a.s.l., *Fageto-Piceetum*, b (5), 23.7.1997
3. Duča Mt., bottom of Duča Hollow, 1000 m a.s.l., *Fraxineto-Aceretum*: a (3), b (3), 10.10.1997.
4. Zejmarská Gorge, 950 m a.s.l., *Fraxineto-Aceretum*: a (4), b (1), 2.8.1998.

Sampling scheme for cave Collembola is given in Table 1.

Methods

At forest sites 500 cm³ samples of organic soil, moss from rocks and rotten wood were randomly collected and subsequently extracted

in high-gradient apparatus.

In caves following collecting methods were used (see also Table 1):

- 1) pitfall trapping with 4 % formaldehyde as fixation liquid (PT),
- 2) hand collecting on baits: organic debris (B),
- 3) extraction of bat guano and rotten wood in high-gradient apparatus (E).

Results and discussion

The number of Collembola species encountered was 88 for the forest sites (Table 2). 15 species may be regarded as montane or boreo-montane, 5 of them restricted with their distribution to Carpathian Mountains: *Morulina verrucosa* (Börner, 1903), *Neanura pseudoparva* Rusek, 1963, *Orthonychiurus rectopapillatus* (Stach, 1933), *Lepidocyrtus serbicus* Denis, 1936 and *Plutomurus carpathicus* Rusek and Weiner, 1978. Special attention is paid to *Hypogastrura crassaegranulata dobsinensis* (Stach, 1949) that is known up till now just from type locality and represents well differentiated form of the *H. crassaegranulata*-complex. Taxonomic status of *Superodontella* cf. *pseudolamellifera* (Stach, 1949) and *S.* cf. *montemaceli* Arbea and Weiner, 1992 is not clear and the material needs further study, similarly as *Pseudachorutes* cf. *parvulus* Börner, 1901. Of the species, two were newly identified: *Endonura* sp.1 and *Micranurida* sp.1. *Desoria ruseki* (Fjellberg, 1979), *D. tenuicornis* (Axelson, 1903) and *Karlstejnina annae* Rusek, 1974 are the species detected in Slovakia for the first time. Nosek (1967) noted rare *Appendisotoma absoloni* (Rusek, 1966) from organic soil and moss on rocks at cold, inverse site in front of Dobšinská Ice Cave, but this species was not confirmed in the present study.

Generally, species rich assemblages occurred at sites in organic soil. Moss growths on rocks of *Fraxineto-Aceretum* in Duča Mt. similarly revealed high species number (Tab. 2). At forest sites the highest numbers

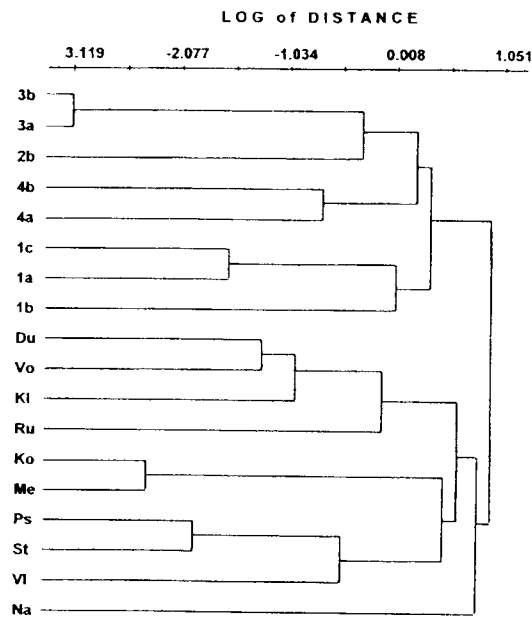


Fig. 1. Qualitative similarity (Sørensen index, Ward's method) of Collembola assemblages at forest sites and caves in the Slovak Paradise (for abbreviations see text and Table 1).

(ind./sample) reached *Folsomia manolachei* Bagnall, 1939, *Isotomiella minor* (Schäffer, 1896), *Parisotoma notabilis* (Schäffer, 1896), *Tomocerus minor* Lubbock, 1802) and *Pseudosinella horaki* Rusek, 1985. Qualitative similarity of communities was tested for each microhabitat separately. Obviously, the site was the main factor for grouping of the communities (Fig. 1).

In caves 28 Collembola species were collected (Table 3). *Arrhopalites aggtelekiensis* Stach, 1945, *Deuteraphorura* sp. 1 and sp. 2, *Protaphorura janosik* Weiner, 1990 and *Pseudosinella paclti* Rusek, 1961 may be classified as troglobites, regarding their restricted distribution to caves and their troglobiomorphy. They all belong to Carpathian subendemics (Kováč, in press). *Deuteraphorura* sp. 1 and sp. 2 are the newly

identified species, both taxonomically related to *Deuteraphorura fimetaria*-group. From Table 2 trogliphily of Carpathian endemic *P. carpaticus* is obvious. *Oncopodura reyersdorfensis* Stach, 1936 is reported from Slovakia for the first time.

The sampling scheme for caves was not uniform (Table 1), therefore it is difficult to compare species number between caves. However, in spite of more extensive sampling in Stratenská Cave, 5 species only were collected, 3 of them being troglobites. Low diversity was stressed as an essential feature of cave-dwelling communities with little human intervention (Hajdu, 1977). Higher number of troglobite species (3-4) was interestingly associated with larger caves or cave systems: Medvedia Cave, Stratenská Cave and Psie diery Cave (Tables 1 and 3). They are grouped together with two other caves in qualitative cluster analysis (Fig. 1). In the analysis only data from pitfall traps were used to make comparison more objective. Similarity between short caves is also observed. The results indicate the importance of the cave size for Collembola community composition.

Totally, 11 from the whole set of 102 species from forest sites and caves may be classified as Carpathian endemics or subendemics. They are considered as the most valuable and vulnerable components of biota (Deharveng, 1996). The presence of these species and forms newly identified indicates high biodiversity and conservation value of the Slovak Paradise National Park.

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References

- Deharveng, L., 1996. Soil Collembola diversity, endemism and reforestation, a case study in the Pyrenees (France). *Conservation Biology*, 10: 74-84
- Hajdu, L., 1977. The flora of Hungarian caves. *Karszt és Barlang*, special issue: 39-42
- Kováč, L., in press. Review on the distribution of cave Collembola in the Western Carpathians. *Proc. 5th Int. Seminar on Apterygota*, Córdoba, Pedobiologia
- Kováč, L., Košel, V., 1998. Chvostoskoky (Hexapoda, Collembola) jaskýň Národného parku Slovenský raj. *Zbor. konf. „Výskum využívanie a ochrana jaskýň“*, Liptovský Mikuláš, p. 67-69
- Nosek, J., 1967. The investigation on the apterygotan fauna of the Low Tatras. *Acta Universitatis Carolinae - Biologica*, 5/6: 349 - 528
- Stach, J., 1949. The apterygotan fauna of Poland in relation to the world-fauna of this group of insects. Families: Neogastruridae and Brachystomellidae. *Polska Akademia Umiejetnosci*, Kraków, 341 pp.
- Šály, A., 1985. Production of free living nematodes in the protected landscape area of the Slovak paradise. *Ekológia (ČSSR)*, 4: 185-209
- Zacharda, M., 1988. *Foveacheles troglodyta* sp. n., subgen. n. (Acari: Prostigmata: Rhagidiidae) from Stratenská Cave, The Western Carpathians, Slovakia. *Věst. čs. Společ. zool.*, 52: 75-78
- Zajonc, I., 1987. Dážďovky (Oligochaeta, Lumbricidae) Slovenského raja. *Biológia (Bratislava)*, 42: 945-953

Table 2. List of Collembola at forest sites of the Slovak Paradise (ind./sample, for numbers of sites and letters of microhabitats see text).

Species	1a	1b	1c	2b	3a	3b	4a	4b
<i>Allacma fusca</i> (Linné, 1758)	-	1	-	-	-	-	-	-
<i>Arrhopalites principalis</i> Stach, 1945	-	6	-	-	-	-	-	-
<i>Arrhopalites</i> sp. juv.	-	-	-	1	1	1	1	1
<i>Caprainea marginata</i> (Schött, 1893)	1	-	-	-	-	-	3	-
<i>Ceratophysella armata</i> (Nicolet, 1841)	1	-	-	1	2	1	-	-
<i>Ceratophysella denticulata</i> (Bagnall, 1941)	-	-	-	-	1	1	1	-
<i>Ceratophysella engadinensis</i> (Gisin, 1949)	-	-	-	-	-	1	-	-
<i>Ceratophysella granulata</i> Stach, 1949	-	-	-	2	1	1	-	-
<i>Desoria divergens</i> (Axelson, 1900)	-	1	-	-	-	-	-	-
<i>Desoria hiemalis</i> (Schött, 1893)	-	109	-	18	-	1	-	-
<i>Desoria ruseki</i> (Fjellberg, 1979)	-	270	-	-	-	-	-	-
<i>Desoria tenuicornis</i> (Axelson, 1903)	-	-	-	-	1	16	-	-
<i>Desoria tigrina</i> (Nicolet, 1842)	-	-	-	-	-	-	-	2
<i>Desoria</i> sp. juv.	-	-	-	-	-	-	1	-
<i>Deutonura albella</i> (Stach, 1920)	-	-	1	-	-	1	-	-
<i>Deutonura conjuncta</i> (Stach, 1926)	1	-	-	1	-	-	1	-
<i>Dicyrtoma fusca</i> (Lubbock, 1873)	-	1	-	-	-	-	1	-
<i>Dicyrtomina ornata</i> (Nicolet, 1842)	-	-	-	1	-	-	-	-
<i>Endonura</i> sp.1	1	-	1	-	-	-	-	-
<i>Entomobrya nivalis</i> (Linné, 1738)	1	-	1	-	-	-	-	-
<i>Folsomia manolachei</i> Bagnall, 1939	47	121	5	200	30	75	430	-
<i>Folsomia penicula</i> Bagnall, 1939	1	-	-	-	-	-	9	2
<i>Friesea albida</i> Stach, 1949	1	-	-	-	1	1	7	-
<i>Friesea claviseta</i> Axelson, 1900	-	-	-	-	-	1	-	-
<i>Friesea mirabilis</i> (Tullberg, 1871)	1	-	-	-	-	1	-	23
<i>Friesea truncata</i> Cassagnau, 1958	-	4	-	-	-	1	-	1
<i>Hymenaphorura creatricis</i> Pomorski, 1990	-	-	-	1	1	1	-	-
<i>Hypogastrura</i> sp. juv.	1	-	-	-	1	1	-	-
<i>Hypogastrura crassaegranulata</i> <i>dobsinensis</i> (Stach, 1949)	-	-	-	7	-	-	-	-
<i>Isotomiella minor</i> (Schäffer, 1896)	111	1	5	-	10	6	84	-
<i>Kalaphorura paradoxa</i> (Schäffer, 1900)	-	-	-	-	1	-	-	-
<i>Karlstejnina annae</i> Rusek, 1974	-	-	-	-	-	-	2	-
<i>Lepidocyrtus lignorum</i> (Fabricius, 1775)	14	1	1	2	2	2	1	11
<i>Lepidocyrtus serbicus</i> Denis, 1936	3	-	-	-	1	-	1	-
<i>Lepidocyrtus violaceus</i> (Fourcroy, 1785)	-	-	-	1	-	-	-	-
<i>Lipothrix lubbocki</i> (Tullberg, 1872)	-	-	-	-	1	-	-	-
<i>Megalothorax incertus</i> Börner, 1903	3	10	4	-	1	-	-	-
<i>Megalothorax minimus</i> Willem, 1900	27	5	1	1	-	1	2	2
<i>Mesaphorura critica</i> Ellis, 1976	1	-	-	-	-	-	-	-
<i>Mesaphorura jirii</i> Rusek, 1982	-	-	-	-	1	-	-	-
<i>Mesaphorura krausbaueri</i> Börner, 1901	-	-	-	-	1	-	-	-
<i>Mesaphorura sylvatica</i> (Rusek, 1971)	1	-	1	-	1	1	-	2
<i>Mesaphorura tenuisensillata</i> Rusek, 1974	3	-	1	-	-	-	-	-
<i>Micranurida forsslundi</i> Gisin, 1949	1	-	-	-	-	-	-	-
<i>Micranurida granulata</i> (Agrell, 1943)	2	-	-	-	2	1	-	-
<i>Micranurida pygmaea</i> Börner, 1901	1	-	2	-	1	-	-	-
<i>Micranurida</i> sp. 1	1	-	-	-	1	-	-	-
<i>Micraphorura absoloni</i> (Börner, 1901)	8	14	7	-	-	-	-	-
<i>Morulina verrucosa</i> (Börner, 1903)	-	-	-	-	-	-	1	-
<i>Neanura pseudoparva</i> Rusek, 1963	8	-	-	6	1	1	1	-

Table 2. Continuation

Species	1a	1b	1c	2b	3a	3b	4a	4b
<i>Neelides minutus</i> (Folsom, 1901)	-	2	-	-	-	-	1	-
<i>Oncopodura crassicornis</i> Shoebotam, 1911	-	-	-	-	1	1	1	1
<i>Onychiuroides pseudogramulosus</i> (Gisin, 1951)	-	-	-	-	2	3	-	1
<i>Orchesella bifasciata</i> Nicolet, 1842	-	3	-	-	-	-	1	47
<i>Orchesella flavescens</i> (Bourlet, 1839)	8	8	1	-	-	-	-	-
<i>Orthonychiurus rectopapillatus</i> (Stach, 1933)	-	-	-	-	2	15	-	-
<i>Parisotoma notabilis</i> (Schäffer, 1896)	29	12	1	-	13	16	13	20
<i>Plutomurus carpaticus</i> Rusek et Weiner, 1978	16	-	1	1	4	2	-	-
<i>Pogonognathellus flavescens</i> (Tullberg, 1871)	3	3	1	1	2	5	5	6
<i>Proisotoma recta</i> Stach, 1929	-	-	-	1	-	-	-	-
<i>Protaphorura armata</i> (Tullberg, 1869)	-	-	-	200	2	-	-	-
<i>Protaphorura aurantiaca</i> (Ridley, 1880)	42	-	21	-	-	-	33	7
<i>Protaphorura cancellata</i> (Gisin, 1956)	-	-	-	-	-	-	2	1
<i>Protaphorura subcancellata</i> (Gisin, 1963)	-	-	-	-	14	6	-	-
<i>Protaphorura subuliginata</i> (Gisin, 1956)	-	-	-	-	-	-	1	-
<i>Pseudachorutes corticicolus</i> (Schäffer, 1896)	-	-	-	1	1	1	-	-
<i>Pseudachorutes dubius</i> Krausbauer, 1898	-	-	-	1	1	-	1	-
<i>Pseudachorutes parvulus</i> Börner, 1901	-	-	-	-	-	-	1	-
<i>Pseudachorutes</i> cf. <i>parvulus</i> Börner, 1901	4	-	1	1	-	-	-	-
<i>Pseudachorutes</i> sp. juv.	-	-	-	-	-	1	-	-
<i>Pseudachorutes subcrassus</i> Tullberg, 1871	-	-	-	1	-	-	-	-
<i>Pseudanurophorus binoculatus</i> Kseneman, 1934	-	-	-	-	-	2	-	-
<i>Pseudisotoma monochaeta</i> (Kos, 1942)	-	-	-	5	-	-	1	42
<i>Pseudosinella horaki</i> Rusek, 1985	67	14	1	1	3	4	51	1
<i>Schoettella ununguiculata</i> (Tullberg, 1869)	1	-	-	-	3	4	7	-
<i>Sminthurinus aureus</i> (Lubbock, 1862)	-	-	-	-	-	-	1	-
<i>Sminthurinus bimaculatus</i> Axelson, 1902	1	-	-	-	-	-	-	-
<i>Sminthurinus elegans</i> (Fitch, 1863)	-	-	-	-	-	-	-	3
<i>Sminthurus maculatus</i> (Tömösváry, 1883)	-	-	-	-	-	-	1	-
<i>Sphaeridia pumilis</i> (Krausbauer, 1898)	-	1	-	-	-	-	-	-
<i>Superodontella empodialis</i> (Stach, 1934)	1	-	-	-	-	-	-	-
<i>Superodontella lamellifera</i> (Axelson, 1903)	-	-	-	1	-	-	-	-
<i>Superodontella</i> cf. <i>pseudolamellifera</i> (Stach, 1949)	-	-	-	-	-	1	-	-
<i>Superodontella</i> cf. <i>montemaceli</i> Arbea et Weiner, 1992	-	-	-	1	-	-	-	1
<i>Tetracanthella fjellbergi</i> Deharveng, 1987	1	-	-	-	-	-	-	-
<i>Tetrodontophora bielanensis</i> (Waga, 1842)	-	-	-	-	1	1	3	1
<i>Tomocerus minor</i> (Lubbock, 1802)	66	11	11	-	1	16	11	59
<i>Vertagopus cinereus</i> (Nicolet, 1841)	1	-	-	-	-	-	-	-
<i>Willemia anophthalma</i> Börner, 1901	2	-	-	-	-	-	-	-
<i>Willemia denisi</i> Mills, 1932	1	-	32	-	1	-	1	-
<i>Xenylla brevicauda</i> Tullberg, 1869	1	-	1	-	-	-	-	-
<i>Xenylla brevisimilis</i> Stach, 1949	1	-	-	1	1	1	-	-
Species number	41	20	22	26	38	37	34	21

Table 3. List of Collembola from caves of the Slovak Paradise. Abbreviations see text (+ 1-9 ind., ++ 10-100 ind., +++ more than 100 ind.).

Species	Ce	Du	Na	Kl	Ko	Me	Ps	Ru	St	VI	Vo
<i>Anurida granaria</i> (Nicolet, 1847)	-	-	-	-	-	-	+	-	-	-	-
<i>Arrhopalites aggieletensis</i> Stach, 1945	+	-	++	-	-	++	+	-	++	+	-
<i>Arrhopalites bifidus</i> Stach, 1945	-	-	-	-	-	-	-	++	-	-	-
<i>Arrhopalites pygmaeus</i> (Wankel, 1860)	-	+	-	++	-	-	+	-	-	-	+
<i>Ceratophysella armata</i> (Nicolet, 1841)	-	-	-	-	-	+	-	-	-	-	-
<i>Ceratophysella engadinensis</i> (Gisin, 1949)	-	+	-	-	-	-	-	-	-	-	-
<i>Ceratophysella granulata</i> Stach, 1949	-	+++	-	+++	+	-	+++	++	++	++	+++
<i>Desoria propinqua</i> (Axelson, 1902)	-	-	-	-	-	-	+	-	-	-	-
<i>Deuteraphorura</i> sp. 1	+++	++	-	+	-	++	+	-	+++	-	+
<i>Deuteraphorura</i> sp. 2	-	-	++	-	-	-	-	-	-	-	-
<i>Folsomia candida</i> Willem, 1902	-	-	-	-	-	++	-	-	-	-	-
<i>Folsomia quadrioculata</i> (Tullberg, 1871)	-	-	-	-	-	+	-	-	-	-	-
<i>Heteraphorura variotuberculata</i> (Stach, 1934)	-	-	-	+	-	+	-	-	-	-	-
<i>Lepidocyrtus violaceus</i> (Fourcroy, 1785)	-	-	-	+	-	-	-	-	-	-	-
<i>Mesaphorura jirii</i> Rusek, 1982	++	-	-	-	-	-	-	-	++	-	-
<i>Oncopodura crassicornis</i> Shoebottom, 1911	-	-	-	+	-	-	-	-	-	-	-
<i>Oncopodura reyersdorfensis</i> Stach, 1936	-	-	-	-	-	+	-	-	-	-	-
<i>Orchesella flavescens</i> (Bourlet, 1839)	-	-	-	+	-	-	-	-	-	-	-
<i>Parisotoma notabilis</i> (Schäffer, 1896)	-	-	-	-	+	++	+	-	-	-	-
<i>Plutomurus carpaticus</i> Rusek et Weiner, 1978	-	++	-	++	-	+	+	+++	-	+	+
<i>Pogonognathellus flavescens</i> (Tullberg, 1871)	-	+	-	-	-	-	-	-	-	-	-
<i>Protaphorura armata</i> (Tullberg, 1869)	++	-	-	+	-	-	-	-	-	-	+++
<i>Protaphorura jamosik</i> Weiner, 1990	-	++	-	-	++	++	+++	-	+++	+++	-
<i>Protaphorura subcancellata</i> (Gisin, 1963)	-	-	-	-	-	+	-	-	-	-	-
<i>Protaphorura tricampata</i> (Gisin, 1956)	-	-	-	-	-	-	++	-	-	-	-
<i>Pseudosinella pacifi</i> Rusek, 1961	-	-	-	++	+	++	-	++	-	-	-
<i>Tetrodoniphora bielaniensis</i> (Waga, 1842)	-	+	-	-	-	-	-	-	-	++	-
<i>Tomocerus minor</i> (Lubbock, 1802)	-	-	-	-	-	-	-	-	-	+	-
Species number	5	8	2	10	4	13	10	4	5	6	5