Biologia, Bratislava, **59/Suppl. 15**: 35—40, 2004

Mites (Acarina: Mesostigmata) inhabiting caves of the Belianske Tatry Mts (Northern Slovakia)

Peter Fenďa & Vladimír Košel

Department of Zoology, Comenius University, Mlynská dolina B–1, SK–84215 Bratislava, Slovakia; e-mail: fenda@fns.uniba.sk

Fenďa, P. & Košel, V., Mites (Acarina: Mesostigmata) inhabiting caves of the Belianske Tatry Mts (Northern Slovakia). Biologia, Bratislava, **59/Suppl. 15**: 35—40, 2004; ISSN 0006-3088.

Three caves in the Belianske Tatry Mts (N Slovakia) were investigated for mites (Acarina, Mesostigmata). Altogether, 19 species were collected in the caves by bait exposure. The mass of the bait material had no direct impact on the quantity or quality of the mesostigmatid mites caught. The diversity of the mesostigmatid mite fauna in these cold caves was high. The species *Vulgarogamasus maschkeae* is known only from caves of the Belianske Tatry Mts in Slovakia

Key words: Slovakia, caves, fauna, Mesostigmata, the Belianske Tatry Mts.

Introduction

Biospeleological investigations have a long tradition in Central Europe. There are data available on mesostigmatid mites from caves in the Aggtelek Karst in Hungary (Szalay, 1931; Dudich, 1932), the Moravský kras karst in the Czech Republic (Wankel, 1861; Willmann, 1954), and caves in Austria (Strouhal, 1939). However, in recent decades new data from these countries are absent. Unlike its neighbouring countries, the first data about mesostigmatid mites from caves in Slovakia appeared as late as in the second half of the 20th century. The first data from Slovakia came from Brázda abyss in the Slovenský kras karst (Košel, 1975), the Medvedia jaskyňa cave in Slovenský raj (Košel, 1976), and from the caves of the Slovenský kras karst (Košel, 1994). Later, Fenďa & Košel (2000) published a review on the fauna of mesostigmatid mites of five caves in the National Park Slovenský raj, Mašán (2001, 2003) mentioned the occurrence of uropodid and macrochelid mites in caves of the Slovenský kras National Park and Fenďa (2002) published the first discovery of *Vulgarogamasus maschkeae* in the Alabastrová jaskyňa cave in the Belianske Tatry Mts. Further data on Mesostigmata in underground ecosystems were published by Kováč et al. (2002a) from the Demänová cave system (the Nízke Tatry National Park), Kováč et al. (2002b) from the Belianska jaskyňa cave (the Belianske Tatry Mts) and Mock et al. (2002, 2004a) from the caves of the Važecký kras karst. The lastest data are from the Ochtinská aragonitová jaskyňa cave (Kováč et al., 2004a), the caves of the Slovenský kras National Park (Kováč et al., 2004b) and from the caves of the Čierna hora Mts (Mock et al., 2004b). In this study, we present the first data about the fauna of mesostigmatid mites

from Alabastrová jaskyňa and Ľadová pivnica caves in the Belianske Tatry Mts.

Materials and methods

The research was carried out in three caves situated in the Belianske Tatry Mts from June 1999 to October 2003. Terrestrial invertebrates were collected by bait exposure. The bait consisted of sawdust or wood shavings (about 1 litre per bait) sprinkled with oat flakes, cereals, flour, and meat-based fish food. Before exposure, the bait was sterilised and subsequently exposed at each site for the entire investigation period. After exposure, the substrate of the bait was put in polyethylene bags and immediately transported to the laboratory (or stored in a cold place for a few days). The temperature was taken by a thermometer placed in the cave during the whole investigation period. Mites were extracted from the baits by Tullgren's apparatus with a 40W light bulb as a heat source into 70% ethyl alcohol. The mites were processed and mounted in permanent microscopic preparations using chloral hydrate medium (Liquid de Swan).

The abundance of mites (percentage of specimens) and frequency (percentage of positive baits) were evaluated. Regression analysis was carried out, as by Zar (1996) and significance was tested by Student's *t*-test (Poole, 1974).

Alabastrová jaskyňa cave is situated at an altitude of 1,390 m a.s.l. (49°14' N, 20°17' E) and the main horizontal corridor is 212 m long. The total length of the cave is 300 m. The big entrance (8 x 3 m) has a NE exposure. The atmosphere has a dynamic character: in summer cold air flows out, in winter it comes from the outside. The cave is situated in the forest zone with *Picea excelsa* and *Pinus mugo*. The temperature in the hindmost part is stable: 3.8–4.0 °C. The cave was investigated from June 1999 to June 2002 for a minimum of three times a year – altogether 12 visits and four stations with bait (AC1-AC4).

Belianska jaskyňa cave is a show cave, 2,230 m long and the main entrance is at an altitude of 890 m a.s.l. (49°13' N, 20°18' E). Communication between the cave and the surface environment is very limited, through a small artificial opening with a diameter of ca 0.4 m. The inner temperature is relatively stable and varies around ±5.8 °C. The cave complex is in the forest zone with *Picea excelsa*. The cave was investigated from June 2001 to October 2003 – 7 visits, five stations with bait (BC1-BC5).

Ľadová pivnica cave is 60 m long, with a big entrance (8.5 x 6.5 m) at an altitude of 1,433 m a.s.l. (49°14' N, 20°16' E). It consists of a simple corridor moderately descending with a coarse stony bottom without clay and the lowest part of the cave is covered with ice the whole year round. The air temperature in the middle part varies from –4.5 °C in winter to 6.2 °C in summer, in the lowest part (covered with ice) from –4.2 to 1.6 °C and in the rear upper part (with bait) from 0.8 to 3.6 °C. The cave was investigated from January 2001 to June 2002 – 5 visits, one station with bait.

Results and discussion

In total, 24,148 individuals of 19 mesostigmatid mite species were collected during the investigation (Tab. 1). The most abundant species were *Cyrtolaelaps mucronatus* (39.4%), *Vulgarogamasus remberti* (21.8%), *V. oudemansi* (16.8%), and *Parasitus loricatus* (10.4%). The most frequent species were typical cave dwellers, such as *C. mucromatus* (91.4%), *V. remberti* (86.2%), *V. oudemansi* (72.4%), *C. chiropterae* (51.7%), and *P. loricatus* (44.8%).

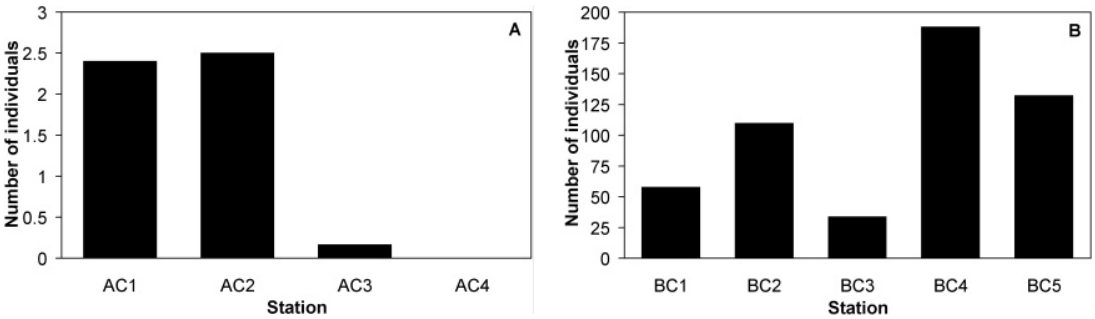

Fig. 1. Average number of *Parasitus loricatus* per station in the Alabastrová jaskyňa cave (A) and Belianska jaskyňa cave (B).

Out of the 19 species, *Cyrtolaelaps mucronatus* and *Parasitus loricatus* are typical representatives of the Slovak cave fauna. They prefer subterranean conditions, where they find food and reproduce, but they also inhabit surface habitats (forest litter, nests of mammals, etc.). We can classify them as eutroglophiles (Mock et al., 2004b). *Cyrtolaelaps mucronatus* was the most abundant species in the caves of the Slovenský raj National Park (Fenďa & Košel, 2000) and in the caves of the Slovenský kras karst National Park. The species was also the most abundant in large guano heaps (Kováč et al., 2004b). *Parasitus loricatus* is a common species in European caves [see Willmann's comment (Willmann, 1936) – "widespread cave mite, absent from scarcely any cave"]. Actually, the species is known in caves from Sweden (Lundqvist et al., 1999) to Morocco (Boutin et al., 1996). *Parasitus loricatus* prefers deep places in caves (Fenďa & Košel, 2000), but we did not confirm this observation in the Alabastrová jaskyňa cave (Fig. 1A). The situation in the Belianska jaskyňa cave is different (Fig. 1B). Thus far, we have not found this species in Slovak ice caves; and the species is also absent from the Ľadová pivnica cave, where the lowest part is covered with ice the whole year round.

Vulgarogamasus maschkeae has been described in mines in the Czech Republic. In Poland, it is known from the Szczelina Chocholowska cave, the Tatra Mts (Skalski, 1967), and in Slovakia only from caves in the Belianske Tatry Mts.

The other mite species comprise surface forms that temporarily migrated into subterranean habitats, mainly from various immediate surrounding sites. Many of them are present in other Slovak caves – *Arctoseius pristinus* and *Saprosecans baloghi* in the Demänová cave system (Kováč et al., 2002a), *Vulgarogamasus oudemansi*, *V. remberti* and *Cyrtolaelaps chiropterae* were found in all caves investigated in the Slovenský raj National Park (Fenďa & Košel, 2000) and *C. chi-*

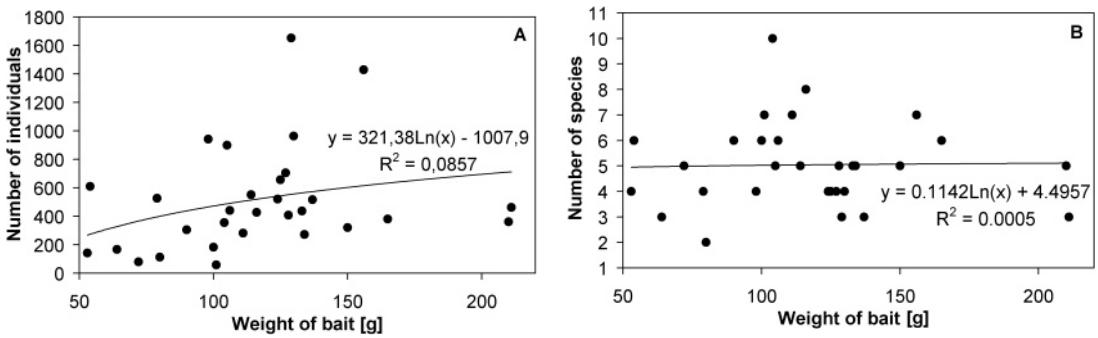

Fig. 2. Dependence of the weight of dry bait and the number of mite individuals (A) and number of species (B).

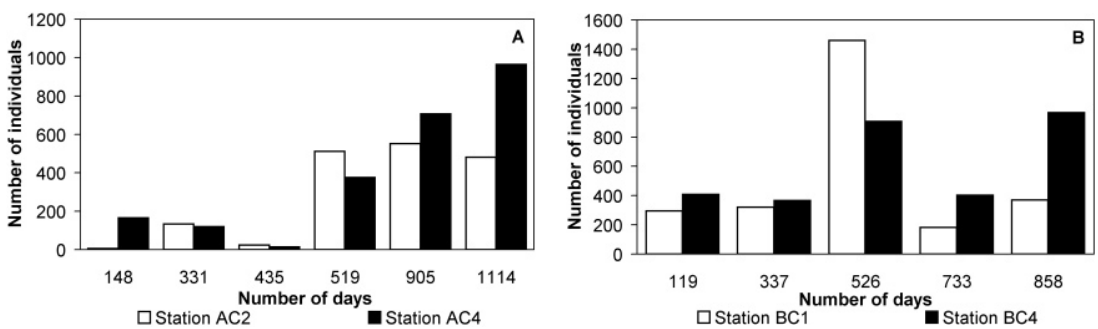

Fig. 3. Dependence of the age of bait and the abundance of mites in the Alabastrová jaskyňa cave (A) and the Belianska jaskyňa cave (B).

ropterae was also found in the Domica cave (Kováč et al., 2004b). *Proctolaelaps pygmaeus*, *Uropoda minima*, and *V. remberti* have stable populations in the Belianska and Alabastrová jaskyňa caves. Rich and stable populations of *P. pygmaeus* are known from caves of the Slovenský raj National park and from the Demänová cave system (Fenďa & Košel, 2000; Kováč et al., 2002a). *Vulgarogamasus remberti* is known from caves in the Slovenský raj National park, the Slovenský kras karst National Park, and caves of the Čierna hora Mts (Fenďa & Košel, 2000; Kováč et al., 2002b; Mock et al., 2004b).

The remaining taxa (*Crassicheles holsaticus*, *Euryparasitus emarginatus*, *Hypoaspis pini*, *Leptogamasus* sp., *Trachytes aegrota*, *Trichouropoda structura*, *Urodiaspis tecta*, *Veigaia nemorensis*, *Zercon triangularis*) are dwellers of the forest soils and litter, occasionally penetrating into underground spaces (actively or as phoretic on insects or mammals).

Fenďa & Košel (2000) compared several sampling methods used in the caves of the Slovenský raj National Park: bait exposure seems to be more effective than pitfall traps from the point of view of quantity, but spe-

Table 1. List of mesostigmatid mite species found in caves of the Belianske Tatry Mts and their abundance.

Species	Alabastrová jaskyňa	Belianska jaskyňa	Ľadová pivnica
Ascidae			
Arctoseius pristinus Karg, 1962		+	
Proctolaelaps pygmaeus (J.Müller, 1860)	+++	++	
Halolaelapidae			
Saprosecans baloghi Karg, 1964		+++	
Eviphididae			
Crassicheles holsaticus Willmann, 1937			+
Laelapidae			
Hypoaspis pini Hirschmann, 1969	+		
Parasitidae			
Leptogamasus sp.	+		
Parasitus loricatus (Wankel, 1861)	++	+++	
Vulgarogamasus maschkeae (Willmann, 1936)	+	++	+
Vulgarogamasus oudemansi (Berlese, 1903)	+++	+++	++
Vulgarogamasus remberti (Oudemans, 1912)	+++	+++	+++
Rhodacaridae			
Cyrtolaelaps chiropterae Karg, 1971	++	+++	+
Cyrtolaelaps mucronatus (G.et R.Canestrini, 1881)	+++	+++	+++
Euryparasitus emarginatus (C.L.Koch, 1839)	+	+	
Trachytidae			
Trachytes aegrota (C.L.Koch, 1841)	+	+	
Trematuridae			
Trichouropoda structura Hirschmann et Zirngiebl-Nicol, 1961	+		
Urodinychidae			
Urodiaspis tecta (Kramer, 1876)	+		
Uropodidae			
Uropoda minima Kramer, 1882		++	
Veigaiaidae			
Veigaia nemorensis (C.L.Koch, 1839)	+		
Zerconidae			
Zercon triangularis C.L.Koch, 1836			+
Average number per bait	397.3	447.7	376.4

Key: Abundance: + less than 10 individuals; ++ 11 to 200 individuals; +++ more than 200 individuals.

cies composition is almost the same. Handpicking is not a good sampling method for very small arthropods (Lundqvist et al., 1999); and, based on our experience it is only of use as an additional sampling method. We also examined the dependence of dry weight of baits and the abundance of mesostigmatid mites caught. We found no relation (Fig. 2A). Similarly, no relation was observed between the dry weight of bait and the number of species (Fig. 2B). The mass of bait material had no direct impact on the quantity or quality of mesostigmatid mites caught (dry weight of our baits varied from 72 g to 200 g), but of course very small baits could be completely consumed. Another question is the dependence of the age of the bait and the abundance of mites in it. In some cases, there was an apparent tendency towards an increase in mite numbers with bait age (e.g. in Alabastrová jaskyňa cave, Fig. 3A), but in other cases there were fluctuations (Belianska jaskyňa cave, Fig. 3B). These fluctuations were not due to temperature – e.g. in bait BC1 the inner temperature was relatively stable and varied between 3.8 °C (April 2002) and 5.1 °C (September 2001) and in bait BC4 the inner temperature was even more stable during the investigation and varied between 5.1 °C and 5.2 °C.

The diversity of the mesostigmatid mite fauna in the cold caves we investigated was unexpectedly high in comparison with other Slovak caves. Low diversity is characteristic of caves in the northern part of the W Carpathians (Kováč et al., 2004b). In addition, in the caves of the Belianske Tatry Mts the mite fauna is affected by the absence of bat guano and the limited occurrence of rotten wood, both important sources of subterranean trophic webs. In cold caves with guano in the Slovenský raj National Park 12 mite species were detected (Fenďa et Košel, 2000). By contrast, 28 species are known from the caves of the Slovenský kras karst National Park, where decaying wood, bat guano, and sinter surfaces with percolating water represent the basic source of organic matter and nutrients for the fauna (Kováč et al., 2004b).

Acknowledgement

We wish to express our thanks to L. Lundqvist for his valuable suggestions on the manuscript and to A. E. Mill, Great Britain for revision of style of our article. We are grateful to P. Degma for his help with statistical tests. This study was supported by a grant from the Slovak grant agency VEGA No. 1/1276/04.

References

Boutin, C., Decu, V., Juberthie, C., Messouli, M. & Besson, J.-P. 1996. Maroc, pp. 1611–1634. In: Juberthie, C. & Decu, V. (eds) Encyclopaedia Biospeologia Tome III, Société internationale de Biospéologie, Moulis – Bucarest.

Dudich, E. 1932. Biologie der Aggteleker Tropfsteinhöhle „Baradla“ in Ungarn. Verlag Speläologisches Institut, Wien, 246 pp.

Fenďa, P. 2002. First records of mites (Acarina, Mesostigmata) from Slovakia. Biologia, Bratislava **57**: 234, 242.

Fenďa, P. & Košel, V. 2000. Roztoče (Acarina, Mesostigmata) jaskýň Slovenského raja, pp. 21–30. In: Mock, A., Kováč, Ľ. & Fulín, M. (eds) Fauna jaskýň (Cave Fauna), Východoslovenské múzeum, Košice.

Košel, V. 1975. Faunistický prieskum v priepasti Brázda (Barazdaláš) v Slovenskom krase. Slovenský kras **13**: 181–185.

Košel, V. 1976. Fauna Medvedej jaskyne v Slovenskom raji (Západné Karpaty). Slovenský kras **14**: 105–113.

Košel, V. 1994. Živočíšstvo jaskýň, pp. 240–245. In: Rozložník, M. & Karasová, E. (eds) Slovenský kras – Chránená krajinná oblasť – biosférická rezervácia, Osveta, Martin.

Kováč, Ľ., Hudec, I., Ľuptáčik, P., Mock, A., Košel, V. & Fenďa, P. 2002a. Spoločenstvá kavernikolných článkonožcov (Arthropoda) Demänovských jaskýň, pp. 155–164. In: Bella, P. (ed.) Výskum, využívanie a ochrana jaskýň, 3. vedecká konferencia s medzinárodnou účasťou, zborník referátov, Správa slovenských jaskýň, Liptovský Mikuláš.

Kováč, Ľ., Mock, A., Ľuptáčik, P., Hudec, I., Košel, V. & Fenďa, P. 2002b. Článkonožce (Arthropoda) Belianskej jaskyne (Belianske Tatry). Aragonit **7**: 27–29.

Kováč, Ľ., Mock, A., Ľuptáčik, P., Hudec, I., Košel, V. & Fenďa, P. 2004a. Prvé údaje o bezstavovcoch Ochtinskej aragonitovej jaskyne. Slovenský kras **42**: 129–136.

Kováč, Ľ., Mock, A., Ľuptáčik, P. & Košel, V. 2004b. Terestrické článkonožce Domického jaskynného systému a Ardovskej jaskyne (Slovenský kras) – mikrohabitaty a diverzita, pp. 138–144. In: Bella, P. (ed.) Výskum, využívanie a ochrana jaskýň, 4. vedecká konferencia s medzinárodnou účasťou, zborník referátov, Správa slovenských jaskýň, Liptovský Mikuláš.

Lundqvist, L., Hippa, H. & Koponen, S. 1999. Invertebrates of Scandinavian caves IX. Acari: Me-

sostigmata (Gamasina), with a complete list of mites. Acarologia, Paris **40**: 357–365.

Mašán, P. 2001. Roztoče kohorty Uropodina (Acarina, Mesostigmata) Slovenska. Annotationes Zoologicae et Botanicae, Bratislava, No. 223, 320 pp.

Mašán, P. 2003. Macrochelid mites of Slovakia (Acari, Mesostigmata, Macrochelidae). Institute of Zoology, Slovak Academy of Sciences, NOI Press Bratislava, 149 pp.

Mock, A., Kováč, Ľ., Ľuptáčik, P., Košel, V., Hudec, I. & Fenďa, P. 2002. Bezstavovce Važeckej jaskyne a vyvieračky Teplica (Kozie chrbty). Aragonit **7**: 30–32.

Mock, A., Kováč, Ľ., Ľuptáčik, P., Mlejnek, R., Višňovská, Z., Košel, V. & Fenďa, P. 2004a. Kavernikolné článkonožce (Arthropoda) Važeckého krasu, pp. 145–154. In: Bella, P. (ed.) Výskum, využívanie a ochrana jaskýň, 4. vedecká konferencia s medzinárodnou účasťou, zborník referátov, Správa slovenských jaskýň, Liptovský Mikuláš.

Mock, A., Ľuptáčik, P., Fenďa, P. & Papáč, V. 2004b. Biologická charakteristika jaskýň Bujanovských vrchov (Čierna hora). Aragonit **9**: 35–40.

Poole, R. W. 1974. An Introduction to Quantitative Ecology. McGraw-Hill Book Company, New York – St. Louis – San Francisco, 532 pp.

Skalski, A. 1967. Charakterystyka współczesnej fauny Szczeliny Chocholowskiej w Tatrach. Prace Muzeum Ziemi, Warszawa **11**: 281–291.

Strouhal, H. 1939. Die in den Höhlen von Warmbad Villach, Kärnten, festgestellten Tiere. Folia Zool. Hydrobiol., Riga **9**: 247–290.

Szalay, L. 1931. Beiträge zur Kenntnis der Arachnoideen-Fauna der Aggteleker Höhle. Ann. Mus. Nat. Hung. **27**: 351–370.

Wankel, H. 1861. Beiträge zur österreichischen Grotten-Fauna. Sitzber. K. Akad. Wiss. Wien. Math.-naturw. Kl., Wien **43**: 251–264.

Willmann, C. 1936. Die Höhlenfauna des Glatzer Schneeberges. 7. Milben aus den Bergwerken bei Mährisch-Altstadt. Beiträge Biologie des Glatzer Schneeberges **2**: 192–199.

Willmann, C. 1954. Mährische Acari, hauptsächtlich aus dem Gebiete des mährischen Karstes. Čs. Parasitol. **1**: 213–272.

Zar, J. H. 1996. Biostatistical analysis. Third edition. Prentice-Hall International Edition, Inc., Upper Saddle River, New Jersey, 662 pp.

Received August 26, 2004