Acta Parasitologica, 2005, 50(3), 228–234; ISSN 1230-2821

Mesostigmatic mites (Acari) and fleas (Siphonaptera) associated with nests of mound-building mouse, *Mus spicilegus* Petényi, 1882 (Mammalia, Rodentia)

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Abstract

Altogether 27,097 individuals and 56 species of mesostigmatic mites, and 169 individuals and 6 species of fleas, were found in 14 subterraneous nests of mound-building mouse *Mus spicilegus* in Slovakia. The mites were found in all nests examined (200–5,200 individuals and 8–31 species in one nest). The most abundant and frequent species were edaphic *Proctolaelaps pygmaeus* (536 ind. per one nest), coprophilous *Alliphis halleri* (471 ind.), ectoparasites *Androlaelaps fahrenholzi* (350 ind.), *Laelaps algericus* (287 ind.), *Haemogamasus nidi* (94 ind.), and nidicolous *Vulgarogamasus remberti* (79 ind.). Occurrence of other mite species was considerably lower (less than 14 ind. per one nest). The most common flea species was *Ctenophthalmus assimilis* (9 ind. per one nest), which represented almost 80% of all individuals collected. According to trophic relations and habitat requirements, the recorded mite species were classified into ecological groups, which were used for a more detailed analysis of their relationships to the host and its nests. Parasitic mites were predominant (41.6% of individuals). Representation of other ecological group was as follows: edaphic species – 28.5%, coprophiles – 24.5%, nidicoles – 5.4%. Ectoparasites and nidicoles specific for the acarinium and siphonapterium of mole *Talpa europaea*, which constructs similar subterranean nests for overwintering as *M. spicilegus*, were not recorded.

Key words

Acari, Siphonaptera, parasites, nest fauna, *Mus spicilegus*, Slovakia

Introduction

Mound-building mouse *Mus spicilegus* Petényi, 1882 inhabits natural steppes and arable land along water streams, rarely also open woods out of human settlements. In Slovakia it rarely occurs in sites situated at altitudes exceeding 200 m above sea level (Krištofík and Danko 2003). It is difficult to distinguish morphologically this species from related synanthropic *Mus musculus* (it is often misidentified as *M. musculus hortulanus* Nordmann, 1840), but in late summer *M. spicilegus* shows a typical ethological feature, i.e. building of loamy mounds to overwinter and to hide food reserves consisting of weed and grass seeds. At present, the differential diagnostic characters of individual European species of the genus *Mus* have been reliably established on the base of biochemical (Bonhomme *et al*. 1984) and morphological methods (Auffray *et al*. 1990, Macholán 1996).

Specific nidobiology and subterranean placement of nests of *Mus spicilegus* differ from other Central European rodents. This fact may considerably affect composition of mesostigmatic mite and flea fauna in their nests. Therefore, the aim of this paper is to analyse the community composition and structure of fleas and mesostigmatic mites in formerly used nests of the mound-building mouse and to compare it with the flea and mite communities in nests of other small mammals with similar nidobiology.

The wild mouse-like rodents and other small mammals together with arthropod ectoparasites can play an important role in distribution of the arboviruses, streptococcal infections, choriomeningitis, plague, tularemia, leptospirosis, spirochaetosis, etc. (Zemskaya 1973, Tagiltsev and Tarasevich 1982). Although the acarocoenoses in the nests of small terrestrial mammals were in the focus of more studies, only little attention has been paid to the parasitic fauna associated with *Mus spicilegus* (Solomon 1968, Popescu *et al*. 1974) or its nests (Mikeš 1966). Similarly, there are no data on epidemiological role of *M. spicilegus* in natural foci of diseases as potential reservoir of some infections. A small sample,

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eight individuals caught near the Kechnec village had no antibodies against *Chlamydia* spp. (Čisláková *et al*. 2004) and *Leptospira* spp. (unpubl. data).

This is the first published study dealing with community structure of non-parasitic mites in mound-building mouse nests. The significance of this analysis is accentuated by the fact that populations of *M. spicilegus* in Austria and Slovakia occur near to boundary of its distribution range (Bauer 2001, Krištofík and Danko 2003).

Materials and methods

Altogether 14 nests of the mound-building mouse were examined. The nests were collected in two geomorphologic complexes of South-East Slovakia: Košická kotlina basin (11 nests) and Východoslovenská rovina plain (3 nests). All nests from Košická kotlina basin were collected near the Kechnec village (21°14´E, 48°33´N) in April 10, 2003 (nests No. 1–8), and in November 13, 2003 (nests No. 12–14). Three nests from Východoslovenská rovina plain were sampled in April 23, 2003, from following localities: vicinity of the villages Strážne (nest No. 9), Streda nad Bodrogom (nest No. 10), Svätuše (nest No. 11) (all 21°45´–21°50´E, 48°22´–48°25´N).

The subterranean nests were obtained by excavation of the mounds. Spherical nests of 15–20 cm in diameter were usually situated in a depth of 30–50 cm under the ground. The mounds with nests occurred on the stubbles and weedy fields grown with *Setaria* sp., *Stipa* sp. and *Amaranthus* sp. In surroundings there were fields with small representation of windbreaks and drainage canals.

The mites and fleas were extracted from the nest material by the Tullgren's funnels and mounted by usual methods into permanent microscopic slides. All material examined has been deposited in the collections of the Institute of Zoology, Slovak Academy of Sciences in Košice.

Results

Mites

A total of 27,097 individuals belonging to 56 mesostigmatic mite species were obtained from 14 examined nests of mound-building mouse (Table I). The mites were present in all nests examined, their abundance fluctuated between 200 and 5,200 individuals in one nest. The average number of mites per one nest was 1,935.

The most frequent species were *Eulaelaps stabularis* and *Proctolaelaps pygmaeus* (both species occurred in all nests); *Androlaelaps fahrenholzi*, *Alliphis halleri* and *Vulgarogamasus remberti* (present in 92.9% of nests); *Haemogamasus nidi* and *Laelaps algericus* (present in 85.7% of nests); *Hirstionyssus isabellinus*, *Hypoaspis aculeifer* and *Vulgarogamasus oudemansi* (present in 71.4% of nests); *Macrocheles matrius* (present in 64.3% of nests); *Parasitus fimetorum* and *Veigaia nemorensis* (present in 50% of nests). Other mite species recorded infested less than 50% of nests. The most abundant species were *P. pygmaeus* (536 individuals per one nest), *A. halleri* (471 ind.), *A. fahrenholzi* (350 ind.), *L. algericus* (287 ind.), *H. nidi* (94 ind.), *V. remberti* (79 ind.), *E. stabularis* (62 ind.) and *M. matrius* (13 ind.).

The values of abundance and dominance of the most abundant species markedly varied in individual nests (Table II), according to microhabitat condition at individual collection sites and a strong aggregation of mites in some nests.

The mite species found in the nests belonged to different ecological groups. On the basis of the trophic relations to the host and habitat requirements to their nests, they were classified into following four groups (ordered according to the level of positive affinity to the host):

(1) Ectoparasites (representing 12.5% of species and 41.6% of individuals). The ectoparasitic mites represent a significant quantitative component of acarocoenoses studied. They include obligate or facultative ectoparasites of small mammals and the species living in the hair or nests. The hair ectoparasites (*Laelaps* and *Hirstionyssus*) are often specialised to a concrete host species or genus and their occurrence in the nests is relatively low. The host specialisation of the nest ectoparasites (*Androlaelaps*, *Eulaelaps* and *Haemogamasus*) is low and they occur as on the mammals body as in their nests. The high relative abundance of the hair ectoparasites (36.9% of all ectoparasitic mites and mostly represented by *Laelaps algericus* – 35.7% of individuals) in the nests of *M. spicilegus* was atypical.

(2) Nidicoles (17.9% of species and 5.4% of individuals). The group of the true nidicolous species includes free living mites with the topic relation to mammal nests and some types of bird nests. They find there food and favourable microclimatic conditions (temperature, humidity) for their reproduction and development. The high portion (63.9%) of immature stages gives an evidence of this. They are mostly predators eating abundant microfauna living in the nests. They have not a direct trophic relation to the host. Most of nidicoles recorded (*Cyrtolaelaps* spp., *Euryparasitus emarginatus*, *Hypoaspis heselhausi*, *Vulgarogamasus oudemansi* and *Vulgarogamasus remberti*) prefer nests of mammals but some of them (*Androlaelaps casalis*) exhibit a special affinity to bird nests or have not any special preference for the nests of birds or mammals (*Hypoaspis aculeifer*, *Macrocheles matrius* and *Uroseius hunzikeri*). The mites of this group were little represented in the nests studied.

(3) Edaphic species (62.5% of species and 28.5% of individuals). This group of mites includes free living and ubiquitous soil species (see Table I) without any trophic (parasitic) or topic (microhabitat: host hair, body or nest) relation to their host. In nests they find optimal conditions for their reproduction and development only occasionally. They mostly eat the abundant nest microfauna. In some types of nests they can occur very abundantly. In the nests studied, a high number of species (the richest group in species) and individuals were

Table I. Representation of mesostigmatic mites in nests of *Mus spicilegus*

Species	S (f)	S (m)	S (s)	S (i)	D (%)	I_R	I_A	F (%)
Alliphis halleri G. et R. Canestrini, 1881[/4]	5,141	1,188	271	6,600	24.36	507.69	471.43	92.86
Amblygamasus mirabilis Willmann, 1951[/3]	1	3	–	4	0.01	2.00	0.29	14.29
Amblyseius bicaudus Wainstein, 1962[/3]	16	–	–	16	0.06	2.67	1.14	42.86
Amblyseius gracilentus Bernhard, 1963[/3]	15	–	–	15	0.06	3.75	1.07	28.57
Ameroseius corbiculus (Sowerby, 1806)[/3]	25	1	–	26	0.10	4.33	1.86	42.86
Androlaelaps casalis (Berlese, 1887)[/2]	1	–	–	1	<0.01	1.00	0.07	7.14
Androlaelaps fahrenholzi (Berlese, 1911)[/1]	2,062	782	2,065	4,909	18.12	377.62	350.64	92.86
Antennoseius sp.[/3]	1	–	–	1	<0.01	1.00	0.07	7.14
Arctoseius cetratus (Sellnick, 1940)[/3]	4	–	–	4	0.01	1.33	0.29	21.43
Arctoseius semiscissus (Berlese, 1892)[/3]	9	1	–	10	0.04	5.00	0.71	14.29
Arctoseius venustulus (Berlese, 1917)[/3]	2	2	–	4	0.01	2.00	0.29	14.29
Asca bicornis (Canestrini et Fanzago, 1887)[/3]	2	–	–	2	<0.01	1.00	0.14	14.29
Cheiroseius viduus C.L. Koch, 1839[/3]	3	–	–	3	0.01	1.50	0.21	14.29
Cyrtolaelaps chiropterae Karg, 1971[/2]	13	16	32	61	0.23	15.25	4.36	28.57
Cyrtolaelaps mucronatus (G. et R. Canestrini, 1881)[/2]	–	1	15	16	0.06	4.00	1.14	28.57
Dendrolaelaps zwoelferi Hirschmann, 1960[/3]	10	3	6	19	0.07	6.33	1.36	21.43
Discourella modesta (Leonardi, 1899)[/3]	1	–	–	1	<0.01	1.00	0.07	7.14
Eulaelaps stabularis Vitzthum, 1925[/1]	557	111	211	879	3.24	62.79	62.79	100.00
Euryparasitus emarginatus (C. L. Koch, 1839)[/2]	1	–	–	1	<0.01	1.00	0.07	7.14
Geholaspis hortorum (Berlese, 1904)[/3]	3	–	–	3	0.01	1.50	0.21	14.29
Haemogamasus nidi Michael, 1892[/1]	577	325	425	1,327	4.90	110.58	94.79	85.71
Halolaelaps bacchusi (Hyatt, 1956)[/4]	3	1	12	16	0.06	16.00	1.14	7.14
Hirstionyssus isabellinus Oudemans, 1913[/1]	81	–	–	81	0.30	8.10	5.79	71.43
Hirstionyssus latiscutatus (Meillon et Lavoipierre, 1944)[/1]	40	–	–	40	0.15	10.00	2.86	28.57
Hypoaspis aculeifer (Canestrini, 1883)[/2]	19	14	2	35	0.13	3.50	2.50	71.43
Hypoaspis austriaca Sellnick, 1935[/3]	1	–	–	1	<0.01	1.00	0.07	7.14
Hypoaspis heselhausi Oudemans, 1912[/2]	11	2	1	14	0.05	4.67	1.00	21.43
Hypoaspis miles (Berlese, 1982)[/3]	27	4	1	32	0.12	8.00	2.29	28.57
Hypoaspis praesternalis Willmann, 1949[/3]	1	–	–	1	<0.01	1.00	0.07	7.14
Hypoaspis similisetae Karg, 1965[/3]	2	–	–	2	<0.01	2.00	0.14	7.14
Iphidozercon gibbus Berlese, 1903[/3]	2	1	–	3	0.01	3.00	0.21	7.14
Laelaps algericus Hirst, 1925[/1]	1,654	626	1,748	4,028	14.87	335.67	287.71	85.71
Laelaps hilaris C.L. Koch, 1836[/1]	7	–	–	7	0.03	2.33	0.50	21.43
Leptogamasus sp.[/3]	3	1	–	4	0.01	2.00	0.29	14.29
Macrocheles matrius (Hull, 1925)[/2]	158	5	24	187	0.69	20.78	13.36	64.29
Nenteria breviunguiculata (Willmann, 1949)[/3]	1	–	3	4	0.01	4.00	0.29	7.14
Neojordensia levis (Oudemans et Voigts, 1904)[/3]	1	–	–	1	<0.01	1.00	0.07	7.14
Olopachys suecicus Sellnick, 1950[/3]	3	–	–	3	0.01	1.00	0.21	21.43
Pachylaelaps brachyperitrematus Koroleva, 1977[/3]	1	–	–	1	<0.01	1.00	0.07	7.14
Pachylaelaps ineptus Hirschmann et Krauss, 1965[/3]	1	–	–	1	<0.01	1.00	0.07	7.14
Pachylaelaps sp.[/3]	1	–	–	1	<0.01	1.00	0.07	7.14
Paragarmania dentritica (Berlese, 1918)[/3]	1	–	–	1	<0.01	1.00	0.07	7.14
Parasitus beta Oudemans et Voigts, 1904[/3]	1	–	–	1	<0.01	1.00	0.07	7.14
Parasitus coleoptratorum (Linnaeus, 1758)[/4]	–	1	–	1	<0.01	1.00	0.07	7.14
Parasitus fimetorum (Berlese, 1903)[/4]	1	–	24	25	0.09	3.57	1.79	50.00
Pergamasus crassipes (Linnaeus, 1758)[/3]	13	4	4	21	0.08	3.50	1.50	42.86
Proctolaelaps pygmaeus (J. Müller, 1860)[/3]	7,477	2	26	7,505	27.70	536.07	536.07	100.00
Punctodendrolaelaps strenzkei (Hirschmann, 1960)[/3]	1	1	1	3	0.01	3.00	0.21	7.14
Rhodacarellus silesiacus Willmann, 1935[/3]	8	–	–	8	0.03	1.60	0.57	35.71
Saprosecans baloghi Karg, 1964[/3]	–	–	1	1	<0.01	1.00	0.07	7.14
Uroseius hunzikeri (Schweizer, 1922)[/2]	–	1	1	2	<0.01	1.00	0.14	14.29
Veigaia exigua (Berlese, 1917)[/3]	2	–	–	2	<0.01	1.00	0.14	14.29
Veigaia nemorensis (C.L. Koch, 1839)[/3]	17	–	–	17	0.06	2.43	1.21	50.00
Vulgarogamasus kraepelini (Berlese, 1905)[/3]	–	1	–	1	<0.01	1.00	0.07	7.14
Vulgarogamasus oudemansi (Berlese, 1903)[/2]	11	6	13	30	0.11	3.00	2.14	71.43
Vulgarogamasus remberti (Oudemans, 1912)[/2]	149	119	847	1,115	4.11	85.77	79.64	92.86
Total	18,142	3,222	5,733	27,097	100	1,935.5	1,935.5	100

Explanations: D – dominance, f – females, F – infestation extensity (frequency), i – individuals, I_A – absolute infestation intensity (per all nests), I_R – relative infestation intensity (per positive nests), m – males, s – subadults, [/1–4]ecological groups: [/1]parasite, [/2]nidicole, [/3]edaphic species, [/4]coprophilous species.

Table II. Quantitative indices of occurrence of the most abundant Mesostigmata species in individual *Mus spicilegus* nests

Nest No.	S of all mites	*Alliphis halleri*		*Androlaelaps fahrenholzi*		*Eulaelaps stabularis*		*Haemogamasus nidi*	
		S (n)	D (%)	S (n)	D (%)	S (n)	D (%)	S (n)	D (%)
1	1,063	258	24.27	464	43.65	22	2.07	71	6.68
2	1,349	488	36.17	539	39.96	92	6.82	64	4.74
3	3,082	365	11.84	533	17.29	48	1.56	155	5.03
4	1,733	293	16.91	549	31.68	75	4.33	76	4.39
5	2,011	1,739	86.47	2	0.10	21	1.04	–	–
6	2,326	191	8.21	860	36.97	95	4.08	192	8.25
7	4,477	85	1.90	675	15.08	118	2.64	346	7.73
8	200	56	28.00	19	9.50	20	10.00	7	3.50
9	1,612	58	3.60	189	11.72	179	11.10	171	10.61
10	1,277	38	2.98	27	2.11	16	1.25	12	0.94
11	5,200	2,583	49.67	340	6.54	81	1.56	96	1.85
12	562	443	78.83	–	–	1	0.18	–	–
13	1,167	3	0.26	370	31.71	76	6.51	38	3.26
14	1,038	–	–	342	32.95	35	3.37	99	9.54

Nest No.	S of all species	*Laelaps algericus*		*Macrocheles matrius*		*Proctolaelaps pygmaeus*		*Vulgarogamasus remberti*	
		S (n)	D (%)	S (n)	D (%)	S (n)	D (%)	S (n)	D (%)
1	17	37	3.48	5	0.47	153	14.39	35	3.29
2	17	85	6.30	2	0.15	35	2.59	21	1.56
3	19	350	11.36	6	0.19	1,575	51.10	3	0.10
4	15	614	35.43	6	0.35	95	4.48	7	0.40
5	18	–	–	9	0.45	22	1.09	171	8.50
6	20	215	9.24	28	1.20	658	28.29	65	2.79
7	21	721	16.10	7	0.16	2,457	54.88	16	0.36
8	14	1	0.50	4	2.00	5	2.50	39	19.50
9	21	495	30.71	–	–	229	14.21	190	11.79
10	15	1	0.08	–	–	1,063	83.24	99	7.75
11	31	341	6.56	120	2.31	1,170	22.50	360	6.92
12	8	–	–	–	–	1	0.18	108	19.22
13	13	621	53.21	–	–	38	3.26	1	0.09
14	10	547	52.70	–	–	4	0.39	–	–

For explanations see Table I.

also found. Representatives of this group can be subdivided into subgroups like humicolous species (*Arctoseius* spp., *Dendrolaelaps zwoelferi*, *Parasitus beta* and *Punctodendrolaelaps strenzkei*), myrmecophilous species (*Hypoaspis austriaca* and *Hypoaspis miles*), phytobiont species (*Amblyseius* spp.), etc. They penetrate the nests actively from the soil. Among the edaphic species *Proctolaelaps pygmaeus* highly predominated (97.2% of individuals).

(4) Coprophilous species (7.1% of species and 24.5% of individuals). They include species with a strong affinity to excrements of large herbivores, dunghills and manure, i.e. unstable and temporal microhabitats. They also occur facultatively in other substrates containing a portion of excrement or strongly decaying organic matter (manured arable soils, heterogeneous organic refuses, nests, etc.). Many of these species show a high phoretic activity. Therefore it is possible

Table III. Representation of fleas in nests of *Mus spicilegus*

Species	S (f)	S (m)	S (i)	D (%)	I_R	I_A	F(%)
Ctenophthalmus agyrtes kleinschmidtianus Peus, 1950	7	2	9	5.33	2.25	0.64	28.57
Ctenophthalmus assimilis assimilis (Taschenberg, 1880)	89	46	135	79.88	11.25	9.64	85.71
Ctenophthalmus solutus solutus Jordan et Rothschild, 1920	6	1	7	4.14	1.75	0.50	28.57
Hystrichopsylla orientalis orientalis Smit, 1956	2	–	2	1.18	2.00	0.14	7.14
Megabothris turbidus (Rothschild, 1909)	4	1	5	2.96	2.50	0.36	14.29
Nosopsyllus fasciatus (Bosc, 1801)	5	6	11	6.51	2.75	0.79	28.57
Total	113	56	169	100	14.08	12.07	85.71

For explanations see Table I.

that they got in the nests in this way. An example of coprophiles recorded is *Alliphis halleri* (99.4% of individuals of the coprophiles), *Halolaelaps bacchusi*, *Parasitus coleoptratorum* and *Parasitus fimetorum*.

Out of all ectoparasites, nidicolous *Macrocheles matrius* and *Vulgarogamasus remberti*, edaphic *Proctolaelaps pygmaeus* and coprophilous *Alliphis halleri*, all other species can be considered to be ubiquitous (42 spp., 75% of species) and to occur in the nests occasionally and rarely (less than 2 individuals per nest examined). Most of them were predators among which 34 species (81% of ubiquists) are typical of soil microhabitats.

Fleas

Altogether we obtained 169 fleas belonging to 6 species (Table III). Most of individuals (79.9%) belonged to the single highly eudominant species *Ctenophthalmus assimilis*. The fleas were found in 12 (85.7%) nests examined and 1–5 species were recorded in one nest. As to the species dominance, *Ctenophthalmus agyrtes* and *Nosopsyllus fasciatus* were dominant (5.3–6.5%). *Ctenophthalmus solutus*, *Hystrichopsylla orientalis* and *Megabothris turbidus* were subdominant or recedent (1.2–4.1%). The abundance of fleas fluctuated between 1 and 39 individuals in one nest. The average number of fleas per one nest examined was 12.

Discussion

The parasitic mite communities in our material from Slovakia and material from Slovenia (Mikeš 1966) were similar, particularly from the viewpoint of representation of predominant species. This author analysed 1,638 individuals of "parasitic" mesostigmatic mites belonging to 17 species (7 of them found also on the host's body) found in 45 nests of *Mus spicilegus*. These species showed similar ecological features as those in our material. In contrast to our material, the recorded parasitic species showed a considerably lower intensity of infestation: 4.3-times in *Eulaelaps stabularis*, 23.9-times in *Laelaps algericus*, 31.4-times in *Haemogamasus nidi* and 297.2-times in *Androlaelaps fahrenholzi*.

In Romania, Popescu *et al*. (1974) studied representation of Acari in hair of trapped *M. spicilegus*. They examined 370 specimens of mound-building mouse and recorded 14 species of mesostigmatic mites and 6 species of fleas.

The comparison of mite communities from subterraneous nests of mound-building mouse with those from winter nests of common mole *Talpa europaea* L., 1758 nests collected in Slovakia (Mašán *et al*. 1994) shows that the communities of Mesostigmata in the nests of common mole are very similar in number of species (58 spp.) and presence of ecological groups, but cumulative and relative abundance of individual ecological groups differs in some aspects. For example, average number of parasitic mites per one nest of common mole was 13.3-times lower than in nests of mound-building mouse. In contrast, a mass occurrence of free living species *Alliphis halleri* and *Proctolaelaps pygmaeus* was not observed in the nests of common mole.

In Sweden, Lundqvist (1974) found 2,040 individuals and 31 species of gamasid mite in 51 nests of common mole nests. When compared with his results, we have not found some edaphic predators (e.g. species of the genera *Parasitus*, *Veigaia*, *Macrocheles* and *Hypoaspis*), but the species composition of the nidicolous and parasitic species was very similar in both cases. The community of Gamasida in the common mole nests studied by Lundqvist (1974) was characterised by Haemogamasinae – *Euryparasitus emarginatus* – *Myonyssus rossicus* Bregetova, 1956 (the highly dominant was *Haemogamasus hirsutus* Berlese, 1889). In our material, *H. hirsutus* and *M. rossicus* were absent (but *H. hirsutus* was eudominant and *M. rossicus* subrecedent in the common mole nests studied by us earlier), while *E. emarginatus* was recedent (or subdominant in the common mole nests). According to Mašán *et al*. (1994), the community of Mesostigmata of common mole nests consisted of species of the subfamilies Haemogamasinae (mostly *H. hirsutus*) and Gamasellinae (genera *Euryparasitus* and *Cyrtolaelaps*) and species *Hypoaspis heselhausi*, *Uroobovella rackei* (Oudemans, 1912), *Proctolaelaps pygmaeus* and *Vulgarogamasus oudemansi*. We have not also found some of the important fur parasites of the genus *Laelaps* [e.g. *L. muris* (Ljungh, 1799); *L. agilis* C.L. Koch, 1836 and *L. hilaris* C.L. Koch, 1836] and *Androlaelaps fahrenholzi*, whose abundant occurrence in the common mole nests was confirmed by Mrciak *et al*. (1966) in Moravia and Kocianová and Kožuch (1988) in Slovakia.

A more detailed analysis of the mesostigmatic mites of the group Uropodina in the common mole nests in Poland was made by Błoszyk (1985). In 44 nests he found 18 species. Highly dominant species were *Uropoda minima* Kramer, 1892 (46.3%) and *Uroobovella rackei* (29.2%). They were not found in our material. Generally, the representation of uropodine mites in nests of mound-building mouse was negligible (viz. *Discourella modesta*, *Nenteria breviunguiculata* and *Uroseius hunzikeri*).

Fleas are characteristic parasites of mammals and partially also birds. Their larvae are nonparasitic and develop out of the host's body. The size of flea population on host's body is generally supposed to be not directly correlated with the flea population size in free nature. But Krasnov *et al*. (2004) analysed 55 flea species and found out that mean number of fleas on host bodies and mean number of fleas in nests were positively correlated. In this way, mean number of fleas in nests or on body of two typical species of lowlands and folds – *T. europaea* and *Microtus arvalis* (Pallas, 1779) can be very high. For example Němec (1989, 1993) found 42–53 fleas per host and rich flea communities in nests (15 flea species in both species). In contrast it seems that *M. spicilegus* belongs to host species parasitised by a low number of species and individuals of fleas.

During the two-year investigation (2003–2004) we examined parasitologically 216 individuals of *M. spicilegus* caught in surrounding of the Kechnec village where in a part of the nests studied was collected. Prevalence of host infestation was very low (only 6 mice with fleas, i.e. only 2.8% of mice). Eight fleas found in hair belonged to 4 species: *Ctenophthalmus assimilis*, *C. solutus*, *Megabothris turbidus* and *Nosopsyllus fasciatus* (unpubl. data). Similarly, Mikeš (1966) recorded low flea densities in nests of *M. spicilegus* (0.26 ind. per nest) and a little higher infestation of hosts (3.19 ind. per host), but the material examined by him was small (16 mice). The large differences between abundance of fleas in nests or hair of mole and common vole, and mound-building mouse can be probably influenced by the grooming effect. Some studies (e.g. Eckstein and Hart 2000) showed that many mammals living in communities control ectoparasites by grooming and this activity has been proved to be effective for removing parasites. Unlike of moles and common vole, mound-building mouse lived in association (called simpedium) of usually 5–6 (but sometimes up to 14) individuals in a mound during wintering (October to March or April) (Macholán 1999).

Predominance of *Ctenophthalmus assimilis* is typical of nests of moles or many rodents (Rosický 1957; Mikeš 1966; Němec 1989, 1993). The main difference between flea communities in nests collected in Slovenia (Mikeš 1966) and our data is absence of *Stenoponia tripectinata* and *Leptopsylla segnis* and occurrence of *Ctenophthalmus agyrtes*, *C. solutus* and *Hystrichopsylla orientalis* in our material. In Slovakia *L. segnis* predominates in siphonapterium both synanthropic rodents *Mus musculus* L., 1758 and *Rattus norvegicus* (Berkenhout, 1769), but in free nature it mostly does not occur (Cyprich 1984). *S. tripectinata* is a Mediterranean faunistic element whose adults occur only during cool months (Krasnov *et al*. 2002), similarly as *Hystrichopsylla* spp. in Slovakia (e.g. Dudich 1991). No data about occurrence of *S. tripectinata* in Slovakia have been published so far, but recently several individuals were found on *M. spicilegus* in south-western Slovakia (A. Dudich, personal commun.).

Absence of ectoparasites and nidicoles being specific for the host acarinium and siphonapterium of mole *T. europaea* [*Uroobovella rackei*, *Hystrichopsylla talpae* (Curtis, 1826); *Hirstionyssus carnifex* (C.L. Koch, 1839); *Haemogamasus horridus* Michael, 1892; *Hirstionyssus talpae* Zemskaya, 1955; etc.] that builds up a similar subterranean nests for wintering as *M. spicilegus*, can be regarded as one of main attribute of host-parasite associations investigated and an example of evolutional non-adaptation parasites to different hosts with analogical nidobiology.

Conclusions

Altogether 56 species and 27,097 individuals of mesostigmatic mites were collected in nests of mould-building mouse *M. spicilegus*. The mesostigmatid mite fauna analysed was dominated by *Laelaps algericus*, a specific fur ectoparasite, and unspecific nidicolous ectoparasites *Androlaelaps fahrenholzi*, *Haemogamasus nidi* and *Eulaelaps stabularis* (ectoparasitic mites represented 41.6% of individuals). Some free living predators, nidicolous *Vulgarogamasus remberti*, edaphic *Proctolaelaps pygmaeus* and coprophilous *Alliphis halleri* (56.2% of individuals), represented other significant component of the mite communities studied. Most of the recorded mites belonged to ubiquitous species, which are characteristic of soil and coprophilic microhabitats. Among the fleas (169 individuals and 6 species), the most frequent and abundant species was *Ctenophthalmus assimilis* representing almost 80% of all individuals caught. The mite fauna of winter nest of mound-building mouse is the most similar to that of common mole *T. europaea* nests, though the specific ectoparasites of both hosts have not been found in subterranean nests studied in Slovakia.

Acknowledgements. This study was sponsored by the VEGA grant agency (Research Project No. 2/5032/25 and 2/3112/23). The authors also thank to Monika Onderová for mounting mites into permanent microscopic slides and to Dr Ladislav Mošanský for his help in field.

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(Accepted May 23, 2005)

Appendix

Species representation in individual nests (numbering as in Materials and methods):

Mites. *A. halleri*: 1–13; *A. bicaudus*: 1, 3, 5, 7, 13, 14; *A. bicornis*: 9, 11; *A. casalis*: 13; *A. cetratus*: 3, 5, 11; *A. corbiculus*: 2–7; *A. fahrenholzi*: 1–11, 13, 14; *A. gracilentus*: 5, 7, 13, 14; *A. mirabilis*: 5, 6; *A. semiscissus*: 10, 11; *A. venustulus*: 9, 11; *Antennoseius* sp.: 10; *C. chiropterae*: 8–11; *C. mucronatus*: 9–12; *Ch. viduus*: 11, 12; *D. modesta*: 1; *D. zwoelferi*: 1, 9, 10; *E. emarginatus*: 9; *E. stabularis*: 1–14; *G. hortorum*: 2, 6; *H. aculeifer*: 2–9, 11, 13, 14; *H. austriaca*: 9; *H. bacchusi*: 11; *H. carnifex*: 1–9, 11; *H. heselhausi*: 6, 9, 11; *H. latiscutatus*: 7, 9, 11, 13; *H. miles*: 8–11; *H. nidi*: 1–4, 6–11, 13, 14; *H. praesternalis*: 7; *H. similisetae*: 10; *I. gibbus*: 11; *L. algericus*: 1–4, 6–11, 13, 14; *L. hilaris*: 6, 11; *Leptogamasus* sp.: 6, 11; *M. matrius*: 1–8, 11; *N. breviunguiculata*: 2; *N. levis*: 8; *O. suecicus*: 3, 5, 6; *P. beta*: 11; *P. brachyperitrematus*: 6; *P. coleoptratorum*: 1; *P. crassipes*: 1, 3–5, 7, 11; *P. dentritica*: 9; *P. fimetorum*: 1–7; *P. ineptus*: 3; *P. pygmaeus*: 1–14; *P. strenzkei*: 10; *Pachylaelaps* sp.: 11; *R. silesiacus*: 2, 7, 12–14; *S. baloghi*: 11; *U. hunzikeri*: 1, 7; *V. exigua*: 2, 14; *V. kraepelini*: 11; *V. nemorensis*: 2–7, 11; *V. oudemansi*: 1, 3–9, 11, 12; *V. remberti*: 1–13.

Fleas. *C. agyrtes*: 8, 9, 11, 13; *C. assimilis*: 1–4, 6–11, 13, 14; *C. solutus*: 3, 7, 8; *H. orientalis*: 9; *M. turbidus*: 9, 14; *N. fasciatus*: 6, 9, 13, 14.