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Arthropods in the nests of marsh warblers (*Acrocephalus palustris*)

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Abstract: A total of 76 fledged nests of marsh warblers were collected in 2001–2002. A pseudoscorpion, *Neobium inaequale*, was found to occur occasionally in nests. Mesostigmatic mites were represented by 25 species among which *Ornithonyssus sylviarum* was autodominant (99.82%). Other mite species occurred in a very small number of nests. Beetles were represented by 32 species belonging to 15 families. Most of these penetrated the nests when ascending vegetation, while some were attracted by dead chicks. A considerable part of the beetles' fauna are mycetophages eating moulds growing on the nest material. No typical nidicolous species were recorded. Only one flea species, *Ceratophyllus garei*, was recorded in nests. It is a characteristic parasite of marsh warbler.

Key words: Marsh warbler, pseudoscorpions, mesostigmatic mites, beetles, fleas, Slovakia.

Introduction

Acrocephalus palustris (Bechstein, 1798) is a migratory species that arrives in Central Europe between late April to mid-May and leaves in August. It breeds once a season, but may have supplementary breeding, if the original clutch was destroyed. It constructs nests on the banks of brooks, rivers and lakes, most frequently on mettles, often mixed with other plants (reed, thistles and grasses). The number of chicks varies from one to six. Parental care of chicks in the nest lasts an average of 13 days (Hudec, 1983). There are many studies on arthropod fauna in bird nests, but the fauna in nests of marsh warbler has not been studied at all.

Pseudoscorpions were recorded in bird nests for the first time by Nordberg (1936), who found one species. Beier (1963) recorded five species and the same author (Beier, 1971) described another new species on the basis of exemplars found in nests of *Parus major* L., 1758. Krumpál & Cyprich (1988) recorded 34 pseudoscorpion species in nests of 16 bird species, among which nine species were found to occur in bird nests regularly. In contrast, pseudoscorpions in nests of different bird species studied by Krištofík et al. (1993, 1994, 1995, 1996, 2002, 2003) occurred only occasionally.

Although mites in nests of different bird species have been studied relatively frequently, there is no study dedicated to mites in nests of marsh warbler. However, there are detailed data on mesostigmatic mites in nests of other two European congeners. Schniererová (2000) recorded 23 mesostigmatic mite species in nests of *Acrocephalus arundinaceus* L., 1758 and 17 in nests of *A. scirpaceus* Hermann, 1804. Krištofík et al. (2001) found 35 species of mesostigmatic mites in nests of great reed warblers (*A. arundinaceus*) and nine species in nests of reed warblers (*A. scirpaceus*).

Beetles in the nests of marsh warbler have not been studied at all. There are, however, detailed data on beetle fauna in the nests of two congeners *A. arundinaceus* and *A. scirpaceus* (Krištofík et al., 2001).

A general review of the occurrence of fleas in bird nests was published by Hicks (1959, 1962 and 1971). Data on the occurrence of fleas in the nests of marsh warblers are very sporadic. The occurrence of *Ceratophyllus pullatus* Jordan et Rothschild, 1920 in nests of marsh warblers was published by Rolníková (2000).

The aims of the present paper are to describe the fauna of pseudoscorpions, mesostigmatic mites, beetles and fleas in the nests of marsh warblers, explain differences in the composition of arthropod fauna in nests of marsh warblers, great reed warblers and reed warblers and to compare the fauna with the arthropod fauna in nests of other birds.

Material and methods

Nests of marsh warblers were collected immediately after fledging of chicks in 2001 and 2002. They were collected at five sites in SW Slovakia, viz. Malacky-Vinohrádok at the Malina river (48°25′ N, 16°54′ E, 40 nests), Láb – canal (48°21′ N, 16°53′ E, 3 nests), Zohor at the Malina river (48°20′ N, 16°53′ E, 14 nests), Devínske Jazero at the Stupavský potok brook (48°22′ N, 16°53′ E, 6 nests), Zohor – site Piesky near the canal (48°18′ N, 16°53′ E, 13 nests).

The pseudoscorpions, mites, beetles and fleas were extracted from the nests using Tulgren's funnels. The pseu-

Table 1. Abundance (N), dominance (D) and prevalence (P) of mesostigmatic mites in nests of *Acrocephalus palustris*.

Family Species	EG	N	D (%)	P (%)	SL
Eviphididae					
Eviphis ostrinus (C.L. Koch, 1836)	EP	1	0.10×10^{-2}	1.32	M
Macrochelidae					
Macrocheles nataliae Bregetova et Koroleva, 1960	NP	2	0.19×10^{-2}	1.32	Z
Macrocheles tardus (C.L. Koch, 1841)	EP	2	0.19×10^{-2}	2.63	M
Dermanyssidae					
Dermanyssus hirundinis (Hermann, 1804)	OPB	6	0.58×10^{-2}	3.95	M, Z
Macronyssidae					
Ornithonyssus sylviarum (Canestrini et Fanzago, 1877)	OPB	103 660	99.82	73.68	M, Z, D, L
Phytoseiidae					
Amblyseius bicaudus Wainstein, 1962	PP	37	0.04	17.11	M, Z, D
Amblyseius cucumeris (Oudemans, 1930)	PP	1	0.10×10^{-2}	1.32	D
Amblyseius filixis Karg, 1970	PP	5	0.48×10^{-2}	5.26	Z, L
Amblyseius sp.	PP	3	0.29×10^{-2}	2.63	M, Z
Anthoseius rivulus Karg, 1991	PP	3	0.29×10^{-2}	2.63	Z
Dubininellus juvenis Wainstein et Arutunjan, 1970	PP	7	0.67×10^{-2}	2.63	M
Paragarmania dentritica (Berlese, 1918)	EP	5	0.48×10^{-2}	2.63	M
Ameroseiidae					
Ameroseius corbiculus (Sowerby, 1806)	EP	3	0.29×10^{-2}	2.63	M
Ascidae					
Asca bicornis (Canestrini et Fanzago, 1887)	EP	3	0.29×10^{-2}	1.32	Z
Parasitidae					
Holoparasitus calcaratus (C.L. Koch, 1839)	EP	30	0.03	13.16	M, Z
Parasitus fimetorum (Berlese, 1903)	CP	1	0.10×10^{-2}	1.32	Z
Parasitus mustelarum Oudemans, 1902	CP	1	0.10×10^{-2}	1.32	Z
Pergamasus crassipes (L., 1758)	EP	9	0.87×10^{-2}	9.21	M, Z
Pergamasus cf. *norvegicus* (Berlese, 1905)	EP	16	0.02	14.47	M
Poecilochirus carabi G. et R. Canestrini, 1882	NP	44	0.04	1.32	Z
Poecilochirus davydovae Hyatt, 1980	NP	1	0.10×10^{-2}	1.32	Z
Veigaiaidae					
Veigaia nemorensis (C.L. Koch, 1839)	EP	1	0.10×10^{-2}	1.32	M
Trematuridae					
Trichouropoda karawaiewi (Berlese, 1904)	ES	3	0.29×10^{-2}	2.63	M
Urodinychidae					
Dinychus perforatus Kramer, 1882	ES	1	0.10×10^{-2}	1.32	M
Uroobovella fimicola (Berlese, 1903)	CS	1	0.10×10^{-2}	1.32	M
Total	–	103 846	100.00	85.53	–

Key: EG – ecological group: OPB – obligatory parasite of birds, NP – necrophilous predator, CP – coprophilous predator, EP – edaphic predator, PP – planticolous predator, ES – edaphic saprophag, CS – coprophilous saprophag; SL – sampling sites: M – Malacky-Vinohrádok, Z – Zohor, D – Devinske Jazero, L – Láb.

doscorpions, mites and fleas were mounted into permanent slides. The beetles are preserved in alcohol. The complete material is deposited in the collection of the Institute of Zoology of Slovak Academy of Sciences in Bratislava (Slovakia). Most quantitative characteristics of the occurrence of parasites are used in the sense of Margolis et al. (1982). The occurrence extensity means the number of individuals per all nests examined, while occurrence intensity means the number of individuals per positive nests (Jurík & Šustek, 1978). Most beetles were identified according to Freude et al. (1967) and Rücker (1983). The bionomical data on beetles were taken from the former two works and Boháč & Matějíček (2003), Bucciarelli (1980), Freude et al. (1967), Roubal (1930, 1936, 1939), Rücker (1983) and Zhantiev (1976). Because of a low number of beetles, the material from all nests was pooled and evaluated together.

Results and discussion

Pseudoscorpions

One species of pseudoscorpion, *Neobium inaequale* Chamberlin, 1930, was found in two nests of the marsh warbler (1 ♀, Malacky-Vinohrádok, 12.VI.2001; 1 ♀, Malacky-Vinohrádok, 17.VI.2001). *Neobium inaequale* lives in soil, litter and prefers colder, shadowy and humid habitats (Beier, 1963). It was found in nests of more bird species by Krumpál & Cyprich (1988), according to whom it occurs accidentally in nests constructed on the ground or immediately above the ground surface. This is also the case for *A. palustris*.

Mites

In 76 nests of *A. palustris* we found 103,846 mites belonging to 25 species of mesostigmatic mites (Tab. 1). Among the examined nests mites occurred in 65 nests (85.53%). The average number of individuals in each positive nest was 1,598). Almost all individuals (99.82%) belonged to the haematophagous ectoparasitic species *Ornithonyssus sylviarum*. Other species were subrecedent with the cumulative dominance of 0.18%. *O. sylviarum* occurred in 56 nests (73.68%),

Table 2. Abundance and infestation indices of *Ornithonyssus sylviarum* in *Acrocephalus palustris* nests at individual sites and years.

Site/Year	No. of examined/positive nests	No. of mites (ind.)	Prevalence (%)	Mean intensity (ind.)
Malacky-Vinohrádok				
2001	15/14	33 819	93.33	2 416
2002	25/12	21 035	48.00	1 753
Zohor				
2001	15/14	26 611	93.33	1 901
2002	11/8	6 911	72.73	864
Devinske Jazero				
2001	5/5	15 203	100.00	3 041
2002	2/1	62	50.00	62
Láb				
2001	3/2	19	66.67	10

Table 3. Abundance and infestation indices of *Ornithonyssus sylviarum* in some *Acrocephalus* spp. (partially based on data of KRIŠTOFÍK et al., 2001).

Species	No. of examined/positive nests	No. of mites (ind.)	Prevalence (%)	Mean intensity (ind.)	Ratio NI : SI
A. scirpaceus	155/24	18 130	15.48	755	52 : 1
A. arundinaceus	118/44	74 047	37.30	1 683	12 : 1
A. palustris	76/56	103 660	73.68	1 851	6 : 1

Key: Ratio NI : SI – ratio of non-infested or weakly infested (<700 individuals) nests to number of strongly infested nests.

other frequently occurring species were *Amblyseius bicaudus* in 13 nests (17.11%), *Pergamasus* cf. *norvegicus* in 11 nests (14.47%), *Holoparasitus calcaratus* in 10 nests (13.16%) and *P. crassipes* in seven nests (9.21%).

The mites, according their topical and trophic requirements, represent different ecological groups (Tab. 1). Apart from the obligatory haematophages *O. sylviarum* and *D. hirundinis*, representatives of all other ecological groups are free-living predaceous or saprophagous species occurring in nests only occasionally. They represented 92% of all species, but only 0.18% of individuals (186 ind. only). Most of these species (11 spp.) are adaphic detriticoles, penetrating the nest from the soil. They were represented by the large and mobile species *Pergamasus crassipes*, *P.* cf. *norvegicus*, *Hoploparasitus calcaratus* (Parasitidae), *Macrocheles tardus* (Macrochelidae) and *Veigaia nemorensis* (Veigaiaidae). Smaller and predaceous species of Phytoseiidae, living in the shrub and herbage stratum, were represented by six species. The necrophilous (3 spp.) and coprophilous (3 spp.) mites of Macrochelidae, Urodinychidae and Parasitidae were also present. The nidicolous species *Hypoaspis lubrica* Voigts et Oudemans, 1904 and *Androlaelaps casalis* (Berlese, 1887), occurring abundantly in nests of other bird species were not recorded in marsh warbler nests. In one nest with dead chicks, a higher number of necrophilous predators *Macrocheles nataliae*, *Poecilochirus carabi* and *P. davydovae* was found. Their occurrence was accompanied by several species of carrion beetles (Tab. 4), which serve as phoretic hosts of these mites. Similarly, the coprohilous species (*Parasitus fimetorum*, *P. mustelarum* and *Uroobovella fimicola*) also spread by means of phoresy.

The structure of mite communities in the nests of marsh warblers was very similar in both years (38 nests in each year), particularly due to the enormous predominance of the ectoparasite *O. sylviarum* (99.67% in 2001 and 99.88% in 2002) and the occurrence of larger and mobile edaphic predators of the Parasitidae family (*Hoploparasitus calcaratus* and *Pergamasus* spp.) and aerophilous planticoles of the Phytoseiidae family (*Amblyseius* spp., *Anthoseius* sp., *Dubininellus* sp.). The more frequent species among them showed the following values of prevalence in 2001 and 2002: *Amblyseius bicaudus* 26.32% and 7.89%, *Hoploparasitus calcaratus* 18.42% and 7.89%, *Pergamasus* cf. *norvegicus* 13.16% and 15.79%, *P. crassipes* 7.89% and 10.53%, respectively. The species number was also very similar in both years (15 in 2001 and 16 in 2002).

A more significant difference was observed when comparing the infestation of nests by *O. sylviarum* in both years. In 2001 we recorded 35 nests (92.11%) infested by 75,650 individuals (mean intensity 2,161), while in 2002 only 21 nests (55.26%) were infested by 28,008 individuals (mean intensity 1,334). This trend was observed at all three sites (Tab. 2). The ratio of the number of strongly infested nests (> 700 ind.) and non-infested or little infested nests was also higher in 2001 (about 1:5) than in 2002 (about 1:10). It was probably an impact of colder and more humid weather in 2002 that influenced the length of reproductive cycle of *O. sylviarum* and, as a consequence, infestation of marsh warbler nests. An influence of the excessive number of *O. sylviarum* on the development of chicks was also not recorded as well as any relationship between number of chicks and number of *O. sylviarum* in the nests.

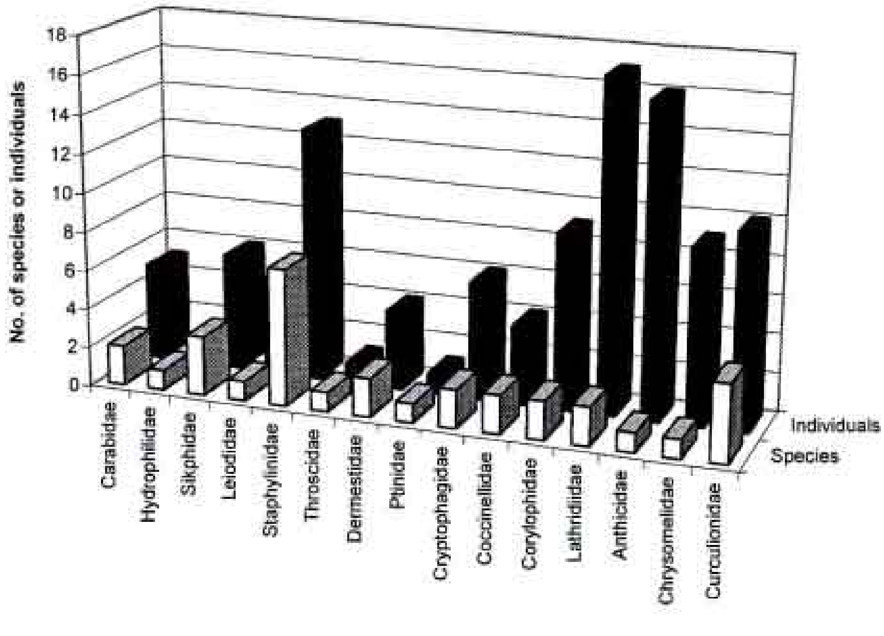

Fig. 1. Qualitative and quantitative representation of individual families of beetles found in the nests of *Acrocephalus palustris*.

Comparison of the mites in the marsh warbler nests with those in the nests of reed warblers and great reed warblers (KRIŠTOFÍK et al., 2001) shows a considerable similarity in qualitative and quantitative characteristics of mite communities in nests of these three warbler species. Generally it can be stated that these communities are poor in number of species and characterized by excessive numbers of *O. sylviarum* infesting en masse not only the nests themselves, but also their close surrounding. For example, the maximum number of mites found in one nest of the great reed warbler was 24,277 individuals, in the reed warbler 9,982 individuals (KRIŠTOFÍK et al., 2001) and in the marsh warbler 21,923 individuals. Also the representation of individual ecological groups of mites is similar. Another common feature of these mite communities is a low number of the ectoparasite *D. hirundnis*, of the "true" nidicoles and of the occasionally occurring species.

Some differences between individual species of warblers were found in the infestation of their nests by mites (Tab. 3). Species nesting above the water table are less infested by mites and there is also a higher percentage of uninfested nests among them (44.1% in great reed warbler and 77.4% in reed warbler, but only 14.5% in marsh warbler). A similar situation is also found in *O. sylviarum*: uninfested nests represent 62.7% for the great reed warbler, 84.5% in the reed warbler, but only 26.3% in the marsh warbler. This difference obviously results from isolation of nests built above the water tables inhibiting penetration of mites into the nests. However it is to be noted, that mass outbreaks of *O. sylviarum* occur in nests of all three warbler species more frequently than in other bird species.

Characteristic nesting habitats of all warbler species also influence the composition of mite communities in nests. Several hygrophilous mite species [*Ameroseius lidiae* Bregetova, 1977, *Lasioseius confusus* Evans, 1958, *L. mirabilis* Christian et Karg, 1993, *Cheiroseius necorniger* (Oudemans, 1903) and *Neojordensia levis* (Oudemans et Voigts, 1904)] occurred in the nests of great reed warblers and reed warblers, but they were not recorded in the marsh warbler nests.

Beetles

Beetle fauna in the nests of *A. palustris* was relatively rich in number of species (32), but poor in number of individuals (102). Its structure was very heterogeneous. The species found in the nests belonged to 15 families (Tab. 4, Fig. 1) among which the richest in number of species were Staphylinidae (7 spp.), whereas most abundant were representatives of Lathridiidae (17 ind.) and Anthicidae (16 ind.). The former two families represented almost one third of individuals. One half of species (16) was represented by one individual only. The majority (40.6%) of the remaining species was represented only by 2–5 individuals.

Composition of beetle fauna in the nests was strongly influenced by external biotic factors. The most abundant species, the anthicide *Notoxus monoceros* is a typical inhabitant of herbage stratum in moderately humid places. Its adults ascending on the vegetation also penetrate the nests of *A. palustris*. This also explains the presence of *Lythraria ferruginea*, all curculionids, some staphylinids (particularly *Tachyporus hypnorum* and *Paederus schoenheri* (Tab. 4) and carabids *Amara aulica* and *Demetrias monostigma*. All these species showed an increased value (> 1.0) in occurrence intensity index (Tab. 4).

The presence of the Silphidae, Leiodidae, Dermestidae and *Aleochara curtula* (Tab. 4) was obviously caused by the death of chicks in one of the nests examined. These species were also accompanied by the necrophilous or phoretic mites (see above).

Table 4. Systematic survey of beetles in the nests of *Acrocephalus palustris*.

Family Species	TR	*N*	*D* (%)	*P* (%)	IO	IOI
Carabidae						
Amara aulica (Panzer, 1797)	P	3	2.94	3.95	1.00	0.039
Trechus quadristriatus (Schrank, 1781)	C	1	0.98	1.32	1.00	0.013
Demetrias monostigma Samouelle, 1829	C	1	0.98	1.32	1.00	0.013
Hydrophilidae						
Megasternus obscurum (Marsham, 1802)	D	1	0.98	1.32	1.00	0.013
Silphidae						
Nicrophorus vespillo (L., 1758)	N	4	3.92	1.32	4.00	0.053
Nicrophorus vespilloides Herbst, 1784	N	1	0.98	1.32	1.00	0.013
Thanatophilus rugosus (L., 1758)	N	1	0.98	1.32	1.00	0.013
Leiodidae						
Sciodrepoides watsoni Spence, 1815	N	5	4.90	1.32	1.00	0.066
Staphylinidae						
Sepedophilus pedicularius (Gravenhorst, 1802)	C	4	3.92	5.26	1.00	0.005
Tachyporus hypnorum (F., 1775)	C	3	2.94	3.95	1.00	0.039
Paederus schoenheri Czwalina, 1899	C	2	1.96	2.63	1.00	0.026
Aleochara curtula (Goeze, 1777)	C	1	0.98	1.32	1.00	0.013
Philonthus succicola C.G. Thomson, 1860	C	1	0.98	1.32	1.00	0.013
Stenus cicindeloides (Schaller, 1783)	C	1	0.98	1.32	1.00	0.013
Drusila canaliculata (F., 1787)	C	1	0.98	1.32	1.00	0.013
Throscidae						
Trixagus obtusus (Curtis, 1827)	D	1	0.98	1.32	1.00	0.013
Dermestidae						
Anthrenus verbasci (L., 1767)	N	1	0.98	1.32	1.00	0.013
Dermestes undulatus Brahm, 1790	N	3	2.94	1.32	3.00	0.039
Ptinidae						
Ptinus rufipes Olivier, 1790	D	1	0.98	1.32	1.00	0.013
Cryptophagidae						
Atomaria atricapila Stephens, 1830	M	4	3.92	5.26	1.00	0.053
Atomaria linearis Stephens, 1830	M	2	1.96	2.63	1.00	0.026
Coccinellidae						
Rhizobius litura (F., 1787)	C	1	0.98	1.32	1.00	0.013
Coccidula scutellata (Herbst, 1783)	C	3	2.94	3.95	3.67	0.145
Corylophidae						
Corylophus cassidoides (Marsham, 1802)	M	4	3.92	5.26	1.00	0.053
Sericoderus lateralis (Gyllenhall, 1827)	M	5	4.90	6.58	1.00	0.066
Lathridiidae						
Corticaria impressa (Olivier, 1790)	M	15	14.71	13.16	1.50	0.197
Cortinicara gibbosa Herbst, 1793	M	2	1.96	2.63	1.00	0.026
Anthicidae						
Notoxus monoceros (L., 1761)	D	16	15.69	11.84	1.78	0.211
Chrysomelidae						
Lythraria ferruginea (Scopoli, 1763)	P	9	8.82	9.21	1.29	0.118
Curculionidae						
Datonychus arquatus (Herbst, 1795)	P	7	6.86	9.21	1.00	0.092
Apion confluens Kirby, 1868	P	1	0.98	1.32	1.00	0.013
Sitona lineatus (L., 1758)	P	1	0.98	1.32	1.00	0.013
Otiorrhynchus sulcatus (F., 1775)	P	1	0.98	1.32	1.00	0.013
Total		102	100.00			

Key: TR – trophic relations: P – phytophages, C – carnivores, D – detritophages, N – necrophages, M – mycetophages; *N* – number of individuals, *D* – dominance, *P* – presence, IO – index of occurrence, IOI – index of occurrence intensity.

Unlike nests of the great reed warbler and reed warbler (KRIŠTOFÍK et al., 2001), the narrowly specialised coccinelid *Coccidulla scutelata* eating the aphids living on reed and occurring in their nests in large numbers was almost absent (only 3 ind.) in the nests of *A. palustris*. This striking difference results from the placement of nests of *A. palustris* on grasses, out of the continuous reed stands.

With respect to the trophic groups of beetles, the richest group were mycetophages, followed by phytophages, carnivores and necrophages (Fig. 2B). However, if one nest with dead chicks is excluded (Fig. 2A), representation of necrophages becomes, negligible, while the proportion of other groups remains almost unchanged.

Generally it can be concluded, that the beetle fauna in nests of all three warbler species had two common features: (i) a strong dependence on planticolous beetles fauna living on the plants, on which the nests are built up; (ii) absence of any typical nidicolous species

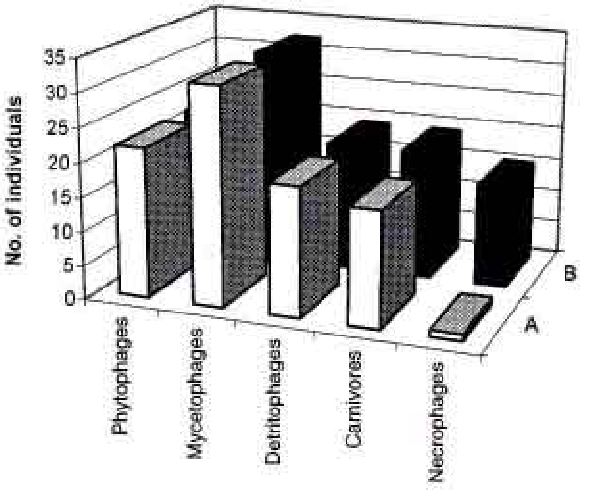

Fig. 2. Representation of individual trophic groups of beetles: A – except the nests with died chicks; B – all nests together.

occurring in nests of many other birds. A poor beetle fauna with an increased proportion of mycetophagous beetles was also characteristic of nests of the penduline tit (KRIŠTOFÍK et al., 1993, 1995). An abundant representation of a very heterogeneous complex of phytophagous and planticolous beetles was also characteristic for the nests of *Lanius collurio* and *L. minor* (KRIŠTOFÍK et al., 2002). Unlike nests of all other birds species, particularly owls (KRIŠTOFÍK et al., 2003) and passerine birds (NORDBERG, 1936; HICKS, 1959; JURÍK & ŠUSTEK, 1978; ŠUSTEK & KRIŠTOFÍK, 2002, 2003), there were no typical nidicolous carnivores represented (species of the genera *Haploglossa* and *Gnathoncus*) and necrophages (*Anthrenus* spp.).

Fleas

Only one species, *Ceratophyllus garei* Rothschild, 1902 (13 ♂♂, 28 ♀♀) was found in the nests of *A. palustris* studied. *Ceratophyllus garei* is distributed in the Holarctic region, particularly in its northern part and prefers humid habitats (BEAUCOURNU & LAUNAY, 1990). It was recorded in nests of many bird species (HICKS, 1959, 1962, 1971), including all of the orders Passeriformes, Lariformes and Anseriformes (BEAUCOURNU & LAUNAY, 1990). In the material studied it was found in 12 nests (prevalence 15.8%, mean intensity 6.3 ind.) in numbers ranging from 1 to 22. Based on our findings, it is possible to state that the marsh warbler, similarly to the great reed warbler and reed warbler, is a main host species of *C. garei*. When compared with the great warbler nests (KRIŠTOFÍK et al., 2001), the prevalence of *C. garei* in marsh warbler nests was lower, but it was higher than in the reed warbler. However, the mean intensity of *C. garei* was lower in marsh warbler nests than in nests of other warbler species.

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References

BEAUCOURNU, J.-C. & LAUNAY, H. 1990. Les puces (Siphonaptera) de France et du Bassin méditerranéen occidental. Fédération Française des Sociétés de Sciences Naturelles, Paris, 548 pp.

BEIER, M. 1963. Ordnung Pseudoscorpionidea. Bestimmungsbücher zur Bodenfauna Europas. Lieferung 1. Akademie-Verlag, Berlin, 313 pp.

BEIER, M. 1971. Ein neuer *Muddochthonius* (Arachnida, Pseudoscorpinidae) aus der Steiermark. Mitt. Naturwiss. Ver. Steiermark **100:** 386–387.

BOHÁČ, J. & MATĚJÍČEK, J. 2003. Katalog brouků Prahy, Svazek IV, Drabčíkovití – Staphylinidae. Praha, 256 pp.

BUCCIARELLI, I. 1980. Fauna d' Italia, Coleoptera, Antihicidae. Edizioni Calderini, Bologna, 240 pp.

FREUDE, H., HARDE, K.H. & LOHSE, G.A. 1967. Die Käfer Mitteleuropas, Band. 7, Clavicornia. Goecke, Evers, Krefeld, 310 pp.

HICKS, E.A. 1959. Check-list and bibliography on the occurrence of insects in bird's nests. The Iowa State College Press, Iowa, 681 pp.

HICKS, E.A. 1962. Check-list and bibliography on the occurrence of insects in bird's nests. Supplement I. Iowa State J. Sci. **36:** 233–347.

HICKS, E.A. 1971. Check-list and bibliography on the occurrence of insects in bird's nests. Supplement II. Iowa State J. Sci. **46:** 123–338.

HUDEC, K. (ed.) 1983. Fauna ČSSR. Ptáci III/1. Academia, Praha, 704 pp.

JURÍK, M. & ŠUSTEK, Z. 1978. The Coleoptera in the nests of *Passer domesticus* in Czechoslovakia. Věst. Česk. Spol. Zool. **42:** 255–272.

KRIŠTOFÍK, J., MAŠÁN, P. & ŠUSTEK Z. 1996. Ectoparasites of bee-eater (*Merops apiaster*) and arthropods in its nests. Biologia, Bratislava **51:** 557–570.

KRIŠTOFÍK, J., MAŠÁN, P. & ŠUSTEK, Z. 2001. Mites (Acari), beetles (Coleoptera) and fleas (Siphonaptera) in the nests of great reed warbler (*Acrocephalus arundinaceus*) and reed warbler (*A. scirpaceus*). Biologia, Bratislava **56:** 525–536.

KRIŠTOFÍK, J., MAŠÁN, P., ŠUSTEK, Z. & GAJDOŠ, P. 1993. Arthropods in the nests of penduline tit (*Remiz pendulinus*). Biologia, Bratislava **48:** 493–505

KRIŠTOFÍK, J., MAŠÁN, P., ŠUSTEK, Z. & KLOUBEC, B. 2003. Arthropods (Pseudoscorpionidea, Acari, Coleoptera, Siphonaptera) in the nests of the tengmalm's owl, *Aegolius funereus*. Biologia, Bratislava **58:** 231–240.

KRIŠTOFÍK, J., ŠUSTEK, Z. & GAJDOŠ, P. 1994. Arthropods in nests of the Sand Martin (*Riparia riparia* Linnaeus, 1758) in South Slovakia. Biologia, Bratislava **49:** 683–690.

KRIŠTOFÍK, J., ŠUSTEK, Z. & GAJDOŠ, P. 1995. Arthropods in the penduline tit (*Remiz pendulinus*) nests: occurrence and abundance in different breeding phases. Biologia, Bratislava **50:** 487–493.

KRIŠTOFÍK, J., ŠUSTEK, Z. & MAŠÁN, P. 2002. Arthropods (Pseudoscorpionidea, Acari, Coleoptera, Siphonaptera) in the nests of red-backed shrike (*Lanius collurio*) and lesser grey shrike (*Lanius minor*). Biologia, Bratislava **57:** 603–613.

KRUMPÁL, M. & CYPRICH, D. 1988. O výskyte štúrikov (Pseudoscorpiones) v hniezdach vtákov (Aves) v podmienkach Slovenska. Zbor. Slov. Nár. Múz., Prír. Vedy **34:** 41–48.

MARGOLIS, L., ESCH, G.W., HOLMES, J.C., KURTS, A.M. & SCHAD, G.A. 1982. The use of ecological terms in parasitology (Report of an ad hoc commitee of the American society of parasitologists). J. Parasitol. **66**: 131–132.

NORDBERG, S. 1936. Biologisch–ökologische Untersuchungen über die Vogelnidicolen. Acta Zool. Fenn. **21**: 1–169.

ROLNIKOVÁ, T. 2000. Výskyt blch (Siphonaptera) na vtákoch (Aves) a v ich hniezdach na Slovensku a niektoré aspekty ich ekológie. Thesis, Fac. Natur. Sci., Comenius University, Bratislava, 176 pp.

ROUBAL, J. 1930. Katalog Coleopter Slovenska a Podkarpatska. Vol. I. Učená spol. P.J. Šafárika, Bratislava, 527 pp.

ROUBAL, J. 1936. Katalog Coleopter Slovenska a Podkarpatskej Rusi. Vol. II., Učená spol. P.J. Šafárika, Bratislava, 434 pp.

ROUBAL, J. 1939. Katalog Coleopter Slovenska a východních Karpat. Vol. III. Česká Akademie věd a umění, Praha, 363 pp.

RUCKER, W.H. 1983. Különbözőcsápú bogarak VI. - Diversicornia VI. Bunkócsápú bogarak VII. - Clavicornia VII. Fauna Hungariae. Vol. 138. Akadémiai Kiadó, Budapest, 68 pp.

SCHNIERER OVÁ, E. 2000. Synúzie roztočov (Acarina, Mesostigmata) hniezd vtákov umiestnených na alebo nad vodnou hladinou. Thesis, Fac. Natur. Sci., Comenius University, Bratislava, 72 pp.

ŠUSTEK, Z. & KRIŠTOFÍK, J. 2002. Beetles (Coleoptera) in deserted nests of *Phoenicurus ochruros*, *Parus caeruleus*, *Parus major*, *Sitta europaea* and*Sturnus vulgaris*. Entomofauna Carpathica **14**: 64–69.

ŠUSTEK, Z. & KRIŠTOFÍK, J. 2003. Beetles (Coleoptera) in nests of house and tree sparrows (*Passer domesticus* and *P. montanus*). Biologia, Bratislava **58**: 953–965.

ZHANTIEV, R.D. 1976. Zhuki kozhoedy (semeistvo Dermestidae fauny SSSR. Izd. Moskovskogo Universiteta. Moskva, 182 pp.

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