Mites (Mesostigmata) inhabiting bird nests in Slovakia (Western Carpathians)

Peter Fend'a
Department of Zoology, Faculty of Natural Sciences, Comenius University, Mlynská dolina B-1, 842 15 Bratislava, Slovakia.
E-mail: fenda@fns.uniba.sk

In Slovakia, 229 species of mesostigmatic mites (more than 230,000 specimens) have been collected from more than 2,500 nests of birds from 110 bird taxa. Most (97%) of the mite specimens were parasitic, representing 26 species, of which only six were typical avian parasites. All blood parasites had a wide host range, yet were specific for nest type (except for *Dermanyssus chelidonis* and *Eulaelaps novus*). Their abundance peaked in the nesting period. The 3% of the mite specimens that were non-parasitic were the most speciose (203 species). The composition of the non-parasitic mite fauna in the nests was dependent on nest location (habitat) and nest environment (biotope).

Key words: Mesostigmata, Aves, nest fauna, ectoparasites, Slovakia

Many arthropods seek refuge, food, and suitable microclimate for reproduction or hibernation in bird nests or they occur there by chance. Hence, the species composition in nests reflects the many taxa present in their direct environment. Heselhaus (1915) designated animals living in the nests as Nidicola. Nests harbour a miniature ecosystem, subject to density-regulating processes (Mulyarskaya, 1953).

The first record of mesostigmatic mites from birds and their nests in Slovakia was published by Mrciak & Rosický (1956), but a more comprehensive, pioneering inventory of Mesostigmata in Slovakian bird nests was published by Ambros et al. (1992). Since then, 34 studies have been published, complementing our knowledge of mesostigmatic mites inhabiting bird nests in this geographic area.

The purpose of this article is to synthesize published and unpublished information on mesostigmatic mites in bird nests, and propose a division of mesostigmatic nidofauna based on nest location, nest environment, and bird species.

MATERIALS AND METHODS

Mite material was collected from 2,572 bird nests in Slovakia in the period 1981-2005. The nests were kept in plastic polyethylene bags. Mites were extracted from the nests using a Tullgren's funnel with a 40-W light bulb as a heat source and they were collected in 70% ethylalcohol solution. The material was processed to yield microscopic preparations using a medium of chloralhydrate, called Liquid de Swan.

Apart from own data, also published data were used in a cluster analysis (Podani, 1988) performed to assess associations with bird hosts and their nests. The results of this analysis are not shown here, only preliminary conclusions are provided.

RESULTS

Including literature data, 229 species of mesostigmatic mites were identified from a sample of more than 230,000 specimens, collected from nests of birds from 110 taxa in Slovakia (Table 1).

Avian ectoparasites

Parasitic mites constituted 97% of all mesostigmatic mites found in the nests. Among the 26 species of obligatory or facultative blood-sucking mites, six species are typical avian parasites: *Dermanyssus hirundinis* was the eudominant species in nests of European penduline tit (*Remiz pendulinus*; 92.3%) and House martin (*Delichon urbica*; 84.6%). High numbers were also found in nests of Barn swallow (*Hirundo rustica*; 17.5%) and Sand martin (*Riparia riparia*; 7.9%). This species also occurred in nests in nest boxes (2.0%), in free nests of Passeriformes (0.9%), in the nests of birds of prey (4.1%), and also in nests on the ground (0.9%), or in nests on the water surface (1.0%). A total of 26 bird host species was recorded.

Dermanyssus gallinae was a typical parasite in the nests of Chicken hens (*Gallus domesticus*; 100%) and feral Rock pigeons (*Columba livia*; 99.9%). This species occurred in higher numbers in the nests of *H. rustica* (0.2%), *D. urbica* (1.0%), *R. riparia* (7.6%), and in nest boxes (0.7%), especially in the countryside in the vicinity of human settlement. In total 20 bird host species were recorded.

Dermanyssus chelidonis was a typical parasite in nests of *D. urbica* (14.1%). Sporadically, it was recorded in nests of Linnet (*Carduelis cannabina*), Blue tit (*Parus caeruleus*), and *R. riparia*.

Ornithonyssus sylviarum was eudominant in free nests of Passeriformes: 51.5% and even 92.1% in nests of Warblers (*Acrocephalus* spp.), *H. rustica* (82.1%), *R. pendulinus* (7.2%), and *R. riparia* (1.4%). However, in nests of *D. urbica* this

Table 1 List of species from bird nests in Slovakia (+, present; #, dominant species).

mite species / host	Acc*	Ans	Cha	Cic	Col	Cor	Fal	Gal	Gru	Pas	Pic	Pod	Psi	Str
GAMASINA														
Ameroseiidae														
Ameroseius apodius Karg, 1971	+						+			+				
Ameroseius corbiculus (Sowerby, 1806)	+	+								+				
Ameroseius lidiae Bregetova, 1977		+							+	+				
Ameroseius longitrichus Hirschmann, 1963	+													
Ameroseius plumea Oudemans, 1902	+									+				
Ameroseius plumosus (Oudemans, 1902)						+								
Epicriopsis horridus (Kramer, 1876)	+	+												
Epicrius tauricus Bregetova, 1977										+				
Ascidae														
Arctoseius cetratus (Sellnick, 1940)	+	+							+					
Arctoseius semiscissus (Berlese, 1892)	+	+		+					+	+				
Asca bicornis (Canestrini et Fanzago, 1887)	+	+								+				
Blattisocius keegani Fox, 1947	+	+				+				+				
Blattisocius tarsalis (Berlese, 1918)					+					+			+	
Cheiroseius borealis (Berlese, 1903)		+								+				
Cheiroseius cassiteridium (Evans et Hyatt, 1960)	+	+							+	+		+		
Cheiroseius curtipes (Halbert, 1923)	+	+										+		
Cheiroseius mutilus (Berlese, 1916)		+		+						+		+		
Cheiroseius necorniger (Oudemans, 1903)										+				
Cheiroseius serratus (Halbert, 1915)		+												
Cheiroseius viduus (CL Koch, 1839)		+												
Iphidozercon gibbus (Berlese, 1903)		+												
Lasioseius berlesei (Oudemans, 1938)		+												
Lasioseius confusus Evans, 1958	+	+		+					+	+		+		
Lasioseius mirabilis Christian et Karg, 1993										+				
Lasioseius ometes (Oudemans, 1903)			+		+					+				
Lasioseius penicilliger Berlese, 1916 sensu Hughes, 1961										+		+		
Leioseius bicolor (Berlese, 1918)	+	+								+				
Leioseius minusculus (Berlese, 1905)	+	+		+					+	+				
Neojordensia levis (Oudemans et Voigts, 1904)		+								+				
Neojordensia sinuata Athias-Henriot, 1973				+						+		+		
Paragarmania dentritica (Berlese, 1918)		+				+	+			+			+	
Plesiosejus italicus (Berlese, 1905)		+												
Plesiosejus major (Halbert, 1923)		+		+								+		
Proctolaelaps fiseri Samšinák, 1960		+												
Proctolaelaps pini Hirschmann, 1963	+									+				
Proctolaelaps pomorum (Oudemans, 1929)										+				
Proctolaelaps pygmaeus (J Müller, 1860)	+	+		+		+				+			+	+
Proctolaelaps scolyti Evans, 1958						+				+				+
Proctolaelaps ventrianalis Karg, 1971						+								
Zerconopsis remiger (Kramer, 1876)										+				
Dermanyssidae														
Dermanyssus carpathicus Zeman, 1979										+				
Dermanyssus chelidonis Oudemans, 1939										+				
Dermanyssus gallinae (De Geer, 1778)		+			#	+		#		+	+			#
Dermanyssus hirundinis (Hermann, 1804)	+	+				#				#			#	+
Dermanyssus passerinum Berlese et Trouessart, 1889										+	+			
Digamasellidae														
Cornodendrolaelaps presepum (Berlese, 1918)	+					+								
Dendrolaelaps cornutus Kramer, 1886	+	+								+				
Dendrolaelaps punctum (Berlese)										+				
Dendrolaelaps zwoelferi Hirschmann, 1960	+	+												+
Digamasellus punctum (Berlese, 1904)			+			+				+				
Multidendrolaelaps bispinosus (Karg, 1971)	+													
Punctodendrolaelaps arvicolus (Leitner, 1949)		+								+				
Punctodendrolaelaps fallax (Leitner, 1949)		+				+				+				
Punctodendrolaelaps latior (Leitner, 1949)		+							+					
Eviphididae														
Alliphis halleri (G et R Canestrini, 1881)	+	+	+							+				
Crassicheles holsaticus Willmann, 1937										+				
Eviphis ostrinus (CL Koch, 1836)	+	+								+				
Scarabaspis inexpectatus (Oudemans, 1903)										+				
Halolaelapidae														
Halolaelaps porulus Hirschmann et Götz, 1968														+
Halolaelaps sexclavatus (Oudemans, 1902)										+				

Table 1 Continued

mite species / host	Acc*	Ans	Cha	Cic	Col	Cor	Fal	Gal	Gru	Pas	Pic	Pod	Psi	Str
Hirstionyssidae														
Echinonyssus butantanensis (Fonseca, 1932)						+				+				
Echinonyssus isabellinus (Oudemans, 1913)										+				
Echinonyssus musculi (Johnston, 1849)										+			+	
Echinonyssus pauli (Willmann, 1952)										+				
Laelapidae														
Androlaelaps casalis (Berlese, 1887)	#	+				#	+			#			+	#
Androlaelaps fahrenholzi (Berlese, 1911)	+	+				+				+				+
Eulaelaps novus Vitzthum, 1925										+				
Eulaelaps stabularis (CL Koch, 1836)	+	+				+				+				+
Haemogamasus ambulans (Thorell, 1872)										+				
Haemogamasus hirsutosimilis Willmann, 1952										+				
Haemogamasus hirsutus Berlese, 1889										+				
Haemogamasus horridus Michael, 1892		+												
Haemogamasus nidi Michael, 1892		+				+				+			+	+
Hypoaspis aculeifer G Canestrini, 1884	+	+				+				+				
Hypoaspis angustiscutata Willmann, 1951		+												
Hypoaspis astronomica (CL Koch, 1839)						+								
Hypoaspis austriaca Sellnick, 1935										+				
Hypoaspis cuneifer (Michael, 1891)										+				
Hypoaspis curtipilis Hirschmann, 1969		+												
Hypoaspis giffordi Evans et Till, 1966		+							+					
Hypoaspis heselhausi Oudemans, 1912										+				
Hypoaspis heyi Karg, 1962		+								+				
Hypoaspis hyatti Evans et Till, 1966										+				
Hypoaspis intermedia Hirschmann, 1969										+				
Hypoaspis kargi Costa, 1968		+				+				+				
Hypoaspis lubrica Voigts et Oudemans, 1904	+	+				#				+			+	+
Hypoaspis lubricoides Karg, 1971		+												
Hypoaspis marginepilosa Sellnick, 1940		+												
Hypoaspis miles (Berlese, 1892)		+				#				+				
Hypoaspis nidicorva Evans et Till, 1966										+				
Hypoaspis pini Hirschmann, 1969										+				
Hypoaspis praesternalis Willmann, 1949										+				
Hypoaspis sardoa (Berlese, 1911)		+								+				
Hypoaspis vacua (Michael, 1891)		+				+				+				
Laelaps agilis CL Koch, 1836						+				+			+	
Laelaps hilaris CL Koch, 1836						+								+
Laelaps muris (Ljungh, 1799)		+												
Pseudoparasitus myrmophilus (Michael, 1891)						+								
Pseudoparasitus placentulus (Berlese, 1887)		+	+							+				
Pseudoparasitus sellnicki (Bregetova et Koroleva, 1964)	+	+												
Pseudoparasitus venetus (Berlese, 1904)		+								+				
Macrochelidae														
Geholaspis longispinosus (Kramer, 1876)		+								+				
Geholaspis hortorum (Berlese, 1904)		+												
Holostaspella exornata Filipponi et Pegazzano, 1967		+												
Holostaspella neglecta Krauss, 1970		+							+					
Holostaspella ornata (Berlese, 1903)		+												
Holostaspella subornata Bregetova et Koroleva, 1960		+												
Macrocheles americana (Berlese, 1888)										+				
Macrocheles ancyleus Krauss, 1970	#						+							+
Macrocheles confusa (Foa, 1900)			+											
Macrocheles decoloratus (CLKoch, 1839)		+												
Macrocheles glaber (J Müller, 1859)	+	+	+	+		+			+	+				
Macrocheles matrius (Hull, 1925)						#				+				
Macrocheles merdarius (Berlese, 1889)			+	+		+				+				
Macrocheles montanus Willmann, 1951	+	+	+							+				
Macrocheles muscaedomesticae (Scopoli, 1772)			#			+			+	+				
Macrocheles nataliae Bregetova et Koroleva, 1960		+								+				
Macrocheles penicilliger (Berlese, 1903)	+	#	#	+			+			+				
Macrocheles punctoscutatus Evans et Browning, 1956		+								+				
Macrocheles recki Bregetova et Koroleva, 1960										+				
Macrocheles robustulus (Berlese, 1903)		+	+	+						+				
Macrocheles rotundiscutis Bregetova et Koroleva, 1960	+	+												
Macrocheles scutatus (Berlese, 1904)										+				
Macrocheles subbadius (Berlese, 1904)										+				
Macrocheles tardus (CL Koch, 1841)										+				

Table 1 Continued

mite species / host	Acc*	Ans	Cha	Cic	Col	Cor	Fal	Gal	Gru	Pas	Pic	Pod	Psi	Str
Macrocheles tridentinus (G et R Canestrini, 1882)		#												
Neopodocinum mrciaki Sellnick, 1968					+									
Macronyssidae														
Ornithonyssus bacoti (Hirst, 1913)													#	
Ornithonyssus pipistrelli (Oudemans, 1904)					+					+				
Ornithonyssus sylviarum (Canestrini et Fanzago, 1877)		+		+		+				#				+
Steatonyssus periblepharus Kolenati, 1858										+				
Myonyssidae														
Myonyssus rossicus Bregetova, 1956										+				
Pachylaelapidae														
Olopachys suecicus Sellnick, 1950		+												
Pachylaelaps ineptus Hirschmann et Krauss, 1965		+												
Pachylaelaps pectinifer (G et R Canestrini, 1882)		+												
Pachyseius humeralis Berlese, 1910		+								+				
Parasitidae														
Cornigamasus lunaris (Berlese, 1882)		+							+	+				
Eugamasus berlesei Willmann, 1935										+				
Gamasodes bispinosus (Halbert, 1915)									+			+		
Gamasodes spiniger (Trägårdh, 1910)		+				+			+	+				
Holoparasitus calcaratus (CL Koch, 1839)		+								+				
Holoparasitus excipuliger (Berlese, 1905)		+								+				
Holoparasitus tuberculatus Juvara-Bals, 1975										+				
Leptogamasus parvulus (Berlese, 1903)										+				
Leptogamasus succineus Witalinski, 1973		+												
Leptogamasus tectegynellus (Athias-Henriot, 1967)										+				
Lysigamasus cornutus (Schweizer, 1961)		+												
Lysigamasus lapponicus (Trägårdh, 1910)										+				
Lysigamasus orthogynellus (Athias-Henriot, 1967)		+												
Lysigamasus runcatellus (Berlese, 1903)		+												
Paragamasus similis (Willmann, 1953)										+				
Parasitus beta (Oudemans et Voigts, 1904)	+	+								+				
Parasitus coleoptratorum (Linnaeus, 1758) sensu Oud., 1908		+	+			+				+				
Parasitus fimetorum (Berlese, 1903)	+	#	#							+				
Parasitus hyalinus (Willmann, 1949)	+	+	+							+				
Parasitus loricatus (Wankel, 1861)		+								+				
Parasitus mammillatus (Berlese, 1904)	+	+								+				
Parasitus mustelarum (Oudemans, 1902)										+				
Pergamasus barbarus Berlese, 1904										+				
Pergamasus brevicornis (Berlese, 1903)		+	+							+				
Pergamasus crassipes (Linnaeus, 1758)	+	+								+				
Pergamasus mediocris (Berlese, 1904)										+				
Pergamasus norvegicus (Berlese, 1905)		+								+				
Pergamasus noster (Berlese, 1903)										+				
Pergamasus ruhmi Willmann, 1938										+				
Pergamasus septentrionalis Oudemans, 1902										+				
Poecilochirus austroasiaticus Vitzthum, 1930										+				
Poecilochirus carabi G et R Canestrini, 1882		+								+				
Poecilochirus davydovae Hyatt, 1980										+				
Poecilochirus necrophori Vitzthum, 1930		+								+				
Porrhostaspis lunulata J Müller, 1869			+							+				
Trachygamasus ambulacralis Willmann, 1949			+											
Trachygamasus gracilis Karg, 1965		+												
Vulgarogamasus kraepelini (Berlese, 1904)	+	+												
Vulgarogamasus oudemansi (Berlese, 1903)		+								+				
Vulgarogamasus remberti (Oudemans, 1912)		+				+				+				
Phytoseiidae														
Amblyseius andersoni (Chant, 1957)										+				
Amblyseius bidens Karg, 1970										+				
Amblyseius bicaudus Wainstein, 1962										+				
Amblyseius filixis Karg, 1970										+				
Amblyseius nemorivagus Athias-Henriot, 1961										+			+	
Amblyseius neobernhardi Athias-Henriot, 1966		+							+	+				
Amblyseius patrius Karg, 1970										+				
Amblyseius tubae Karg, 1970										+				
Dictydionotus pepperi (Specht, 1968)										+				
Euseius finlandicus (Oudemans, 1915)										+				
Neoseiulus alpinus (Schweizer, 1922)									+					
Neoseiulus cucumeris (Oudemans, 1930)		+							+	+				

Table 1 Continued

mite species / host	Acc*	Ans	Cha	Cic	Col	Cor	Fal	Gal	Gru	Pas	Pic	Pod	Psi	Str
Neoseiulus reductus (Wainstein, 1962)		+							+	+				
Neoseiulus umbraticus (Chant, 1956)									+	+				
Neoseiulus versutus (Begljarov, 1981)		+												
Neoseiulus zwoelferi (Dosse, 1957)						+				+				
Paraseiulus talbii (Athias-Henriot, 1960)										+				
Phytoseius juvenis Wainstein et Arutyunyan, 1970										+				
Proprioseiopsis levis (Wainstein, 1960)	+			+					+	+				
Proprioseiopsis messor (Wainstein, 1960)										+				
Proprioseiopsis okanagensis (Chant, 1957)										+				
Typhlodromus bakeri (Garman, 1948)										+				
Typhlodromus rhenanus (Oudemans, 1905)										+				
Typhlodromus richteri Karg, 1970										+				
Typhlodromus rivulus (Karg, 1991)										+				
Typhlodromus setubali Dosse, 1961										+				
Pseudolaelapidae														
Pseudolaelaps doderoi (Berlese, 1910)		+												
Rhodacaridae														
Cyrtolaelaps chiropterae Karg, 1971										+				
Cyrtolaelaps mucronatus (G et R Canestrini, 1881)		+								+				
Euryparasitus emarginatus (CLKoch, 1839)										+				
Gamasellus montanus (Willmann, 1936)										+				
Stylochirus fimetarius (J Müller, 1859)	+	+								+				
Veigaiidae														
Veigaia cerva (Kramer, 1876)		+								+				
Veigaia exigua (Berlese, 1917)		+												
Veigaia kochi (Trägårdh, 1901)		+												
Veigaia nemorensis (CL Koch, 1839)	+	+							+	+				
Veigaia planicola (Berlese, 1892)		+												
Zerconidae														
Prozercon carpathofimbriatus Masán et Fend'a, 2004										+				
Prozercon kochi Sellnick, 1943	+													
Prozercon tragardhi (Halbert, 1923)										+				
Zercon arcuatus Trägårdh, 1931										+				
Zercon berlesei Sellnick, 1958										+				
Zercon carpathicus Sellnick, 1958										+				
Zercon curiosus Trägårdh, 1910	+									+				
Zercon hungaricus Sellnick, 1958		+								+				
Zercon peltatus var. *peltatus* CL Koch, 1836	+	+							+	+				
Zercon romagniolus Sellnick, 1944										+				
Zercon triangularis CL Koch, 1836			+											
SEJINA														
Sejidae														
Sejus togatus CL Koch, 1836		+												
Uropodellidae														
Asternolaelaps querci Wisniewski et Hirschmann, 1984										+				
UROPODINA														
Polyaspidae														
Polyaspinus kovaci Mašán et Kalúz, 1999										+				
Polyaspinus schweizeri (Hutu, 1976)	+													
Uroseius hunzikeri Schweizer, 1922										+				
Uroseius infirmus (Berlese, 1887)	+					+	#			+				+
Uroseius trogicolis Mašán, 1999	+									+				
Trachytidae														
Trachytes aegrota (CL Koch, 1841)		+								+				
Trachytes baloghi Hirschmann et Zirngiebl-Nicol, 1969										+				
Trematuridae														
Nenteria breviunguiculata (Willmann, 1949)	+	+	+							+				
Nenteria dobrogensis Feider et Hutu, 1971						+								
Nenteria pandioni Wisniewski et Hirschmann, 1985	#	+					+			+				+
Nenteria stylifera (Berlese, 1904)		+								+				
Trichouropoda karawaiewi (Berlese, 1904)	+	#								+				
Trichouropoda longiovalis Hirschmann et Zirngiebl-Nicol, 1961						+				+				
Trichouropoda obscurasimilis Hirschmann et Zirngiebl-Nicol, 1961	+					+				+				
Trichouropoda orbicularis (CL Koch, 1839)										+				+
Trichouropoda ovalis (CL Koch, 1839)	+	#								+				
Trichouropoda patavina (G Canestrini, 1885)						+								
Trichouropoda rafalskii Wisniewski et Hirschmann, 1984		+												
Trichouropoda tuberosasimilis Hirschmann et Wisniewski, 1987										+				

Table 1 Continued

mite species / host	Acc*	Ans	Cha	Cic	Col	Cor	Fal	Gal	Gru	Pas	Pic	Pod	Psi	Str
Urodinychidae														
Dinychus bincheaecarinatus Hirsch., W.-A. et Zirn.-Nicol, 1984		+												
Dinychus carinatus Berlese, 1903										+				
Dinychus inermis (CL Koch, 1841)		+								+				
Dinychus perforatus Kramer, 1886		+	+							+				
Dinychus woelkei Hirschmann et Zirngiebl-Nicol, 1969	+									+				
Urodiaspis tecta (Kramer, 1876)										+				
Uroobovella fimicola (Berlese, 1903)	+									+				
Uroobovella minima (CL Koch, 1841) sensu Willmann, 1951	+													
Uroobovella pulchella (Berlese, 1904)		+								+				
Uroobovella pyriformis (Berlese, 1920)	#									+				
Uropodidae														
Discourella modesta (Leonardi, 1899)		+												
Uropoda minima Kramer, 1882	+									+				
Uropoda orbicularis (OF Müller, 1776)	+	+								+				
Uropoda subterrana (Schweizer, 1922)			+											

*Acc, Accipitriformes; Ans, Anseriformes; Cha, Charadriiformes; Cic, Ciconiiformes; Col, Columbiformes; Cor, Coraciiformes; Fal, Falconiformes; Gal, Galliformes; Gru, Gruiformes; Pas, Passeriformes; Pic, Piciformes; Pod, Podicipediformes; Psi, Psittaciformes; Str, Strigiformes.

species was not found and in nest boxes its occurrence was low (0.2%). In total 20 bird host species were recorded.

The taxonomic position of two other species reported to occur in Slovakia is doubtful: *Dermanyssus carpathicus* and *Dermanyssus passerinus*. Not (yet) known from Slovakia, but present in neighbouring countries, such as Poland and Austria, are the avian ectoparasites *Dermanyssus alaudae* (Schrank) and *Dermanyssus quintus* Vitzthum.

Nidofauna

Only 3% of the mite specimens were non-parasitic, but they are much more speciose (203 species). Their species composition is most influenced by nest location (habitat) and nest environment (biotope).

1. Synantropical nests (*C. livia* and *G. domesticus*). These nests typically harboured the blood-sucking mite *D. gallinae* (99.9 and 100%, respectively).

2. Nests of birds of prey (Accipitriformes, Falconiformes, and also Strigiformes; e.g., Long-eared owl [*Asio otus*] and Eurasian eagle-owl [*Bubo bubo*]). Typically, these nests had a low proportion of parasitic species, usually only *D. hirundinis* (4.1%). The mesostigmatic species typical for these nests were *Nentera pandioni*, *Macrocheles ancyleus*, *Uroobovella pyriformis*, and *Uroseius infirmus*. Fauna composition is relatively stable, even during the winter months.

3. Nests on the ground (Anseriformes). These nests typically had a very low proportion of avian parasitic species, usally only *D. hirundinis* (0.3%) and *D. gallinae* (0.01%). As a consequence of direct contact with the soil, the nidofauna contained many soil-inhabiting mites, such as *Macrocheles tridentinus*, *Trichouropoda karawaiewi*, and *T. ovalis*. Typical nidicolous species were *Macrocheles penicilliger* and *Parasitus fimetorum*. A relatively large proportion of mites were typically facultative blood-feeders on small mammals, such as *Eulaelaps stabularis* (1.0%) and *Haemogamasus* spp. (0.3%).

4. Nests on water (Podicipediformes, Gruiformes). These nests contained few avian parasites, such as *D. hirundinis* (0.7%), *D. gallinae* (0.1%), and *O. sylviarum* (1.4%). The nidofauna typically contained hygrophilous species, such as *Gamasodes bispinosus*. According to cluster analysis, nests on water group together with nests of various species of birds in the same habitat, such as Marsh harrier (*Circus aeruginosus*; Accipitriformes), Reed bunting (*Emberiza schoeniclus*; Passeriformes), and Little bittern (*Ixobrychus minutus*; Ciconiiformes).

5. Free nests of Passeriformes. [5.1] Nests on vegetation. The avian blood-sucking species *Ornithonyssus sylviarum* was dominant in nests on vegetation (51.5%) and in nests of *Acrocephalus* spp. it even reached 92.1%. A relatively large proportion of species belonged to the family Phytoseiidae. [5.2] Nests of *Turdus* spp. These nests had few species of avian parasites, but 10 species of parasites known from small mammals. A common species was *Androlaelaps casalis* (19.4%). [5.3] Nests of *Remiz pendulinus*. Eudominant species were *D. hirundinis* (92.3%) and *O. sylviarum* (7.2%). Again, a relatively great proportion of species belonged to the family Phytoseiidae. [5.4] Nests of *Delichon urbica*. Eudominant species were *D. hirundinis* (84.6%), *D. chelidonis* (14.1%), and *D. gallinae* (1.0%). Phytoseiidae species were absent. [5.5] Nests of *Hirundo rustica*. Eudominant species were *O. sylviarum* (82.1%) and *D. hirundinis* (17.5%). Phytoseiidae species were absent.

6. Nests in cavities (Passeriformes, Coraciiformes). [6.1] Nests in tree holes and nest boxes (Passeriformes). *Androlaelaps casalis* is a typical inhabitant of this nest type (75.7%). Even in tree holes without nests, *A. casalis* is a eudominant species. Another species typical in these nests is the predator *Hypoaspis lubrica*. The mite fauna in nests from nest boxes with Falconiformes or Strigiformes is enriched with species typical for nests of birds of prey. Nest boxes were sometimes also occupied by bats, which may explain the findings of bat parasites, such as *Ornithonyssus pipistrelli* (0.8%) and *Steatonyssus periblepharus* (0.3%). When previously occupied by small rodents, findings of *Echinonyssus pauli* and *E. musculi* are not rare. In nest boxes in an aviary with Zebra finches (*Taenopygia guttata*) in a village courtyard, *Ornithonyssus bacoti* (ectoparasite of rats) was a eudominant species. [6.2] Nests in burrows in the soil (Passeriformes, Coraciiformes). *Androlaelaps casalis* is also a typical inhabitant of burrow-nesting birds such as *R. riparia* (62.2%) and European bee-eater (*Merops apiaster*; 97.7%). In these nests, *D. hirundinis* and *D. gallinae* are also regularly found, whereas in the nests of *R. riparia*, *Eulaelaps novus* (2.2%) was recorded as a typical species. Six species of rodent ectoparasites were frequently found, but always in low numbers.

DISCUSSION

The nidofauna in Slovakia is quite similar to that found in neighbouring countries in nests of White-tailed eagle (*Haliaeetus albicilla*) in northern Poland (Gwiazdowicz et al., 2005), *C. livia* in Ukraine (Piryanik & Akimov, 1964), House sparrow (*Passer domesticus*) and Tree sparrow (*Passer montanus*) in Poland (Fenda & Pinowski, 1997; Krumpál et al., 2001), and White stork (*Ciconia ciconia*) from Poland (Bloszyk et al., 2005). The absence of the avian parasite *Ornithonyssus bursa* (Berlese) in Slovakia is striking, because this species is known from Western Europe and also from Poland and the Czech Republic (Kristofík et al., 2001).

The occurrence of *D. hirundinis* and *O. sylviarum* is probably correlated to air humidity. Ioff (1958) noticed that *D. hirundinis* prefers moderate humidity in nest material. In nest boxes from Slovakia, prevalence of *D. hirundinis* was 2.0% and *O. sylviarum* 0.1% (similar to nests in burrows, nests of *R. pendulinus* and *Turdus* spp.), but in free nests (including *H. rustica*) prevalence of *D. hirundinis* was 0.9% and *O. sylviarum* 51.5%. *Ornithonyssus sylviarum* spends most of its lifetime on the host's body (Borisova, 1977) and therefore it can better cope with low humidity in the environment. All avian blood-sucking mesostigmatic mites had a wide host range, but occurred in specific nest types (with the exception of *D. chelidonis*). Abundance of these mites was highest in the nesting period.

The first division of bird nests was proposed by Nordberg (1936): (1) nests on wet ground and on water, (2) nests on the ground, (3) nests above the ground, and (4) nests in burrows. Later, by subjecting all material to cluster analysis to compare the results with their intuitive ecological classification of the nests, Ambros et al. (1992) extended their division as follows: (1) free nests on the water and in wet habitats, (2) free nests above the ground, either (a) in nature, (b) on buildings (*Delichon*, *Hirundo*), or (c) both (a) + (b) (*Falco*, *Columba*, *Ciconia*), (3) nests on the ground, (4) nest in cavities, such as (a) nest boxes, and (b) nests in burrows (*Merops*, *Riparia*), and (5) nests from miscellaneous sites (*Motacilla*, *Phoenicurus* on buildings and on the ground). Since then, much more data are available, and a preliminary conclusion from cluster analysis is that especially the group of free nests above the ground requires more differentiation.

Acknowledgements

The author wishes to thank all collectors of bird nests, especially M. Krumpál and D. Cyprich.

REFERENCES

Ambros M, Krištofík J & Šustek Z (1992) The mites (Acari, Mesostigmata) in the birds' nests in Slovakia. Biologia (Bratislava) 47: 369-381.

Bloszyk J, Gwiazdowicz DJ, Bajerlein D & Halliday RB (2005) Nests of the white stork *Ciconia ciconia* (L.) as a habitat for mesostigmatic mites (Acari, Mesostigmata). Acta Paras 50: 171-175.

Borisova VI (1977) Gamazovye kleshchi gnezd ptits Volzhsko-Kamskogo zapovednika. Parazitologiya (St. Petersburg) 11: 141-146.

Fend'a P & Pinowski J (1997) The mites (Acarina: Mesostigmata) in the nests of sparrows (*Passer domesticus* and *Passer montanus*) in suburban villages of Warsaw (Poland). International Studies on Sparrows 24: 37-47.

Gwiazdowicz DJ, Bloszyk J, Mizera T & Tryjanowski P (2005) Mesostigmatic mites (Acari: Mesostigmata) in White-tailed Sea Eagle nests (*Haliaeetus albicilla*). J Raptor Res 39: 60-65.

Heselhaus F (1915) Weitere Beiträge zur Kenntnis der Nidikolen. Tijdschr Ent 58: 251-274.

Ioff IG (1957) Kleshchi i blochi - obitateli ptichich gnezd v Okskom zapovednike. Tr Okskogo gos zap 184-191.

Kristofík J, Masán P & Sustek 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.

Krumpál M, Cyprich D, Fend'a P & Pinowski J (2001) Invertebrate fauna in nests of the house sparrow *Passer domesticus* and the tree sparrow *Passer montanus* in central Poland. International Studies on Sparrows 27-28: 35-58.

Mrciak M & Rosický B (1956) K faune roztocu rádu cmelíkovcu (Parasitiformes) z území CSR. Zool listy 5: 143-148.

Mulyarskaya LV (1953) Biocenoses of birds' nests. Trudy Inst Zool Parasit AN Tadj SSR 13: 1-81.

Nordberg S (1936) Biologisch-Ökologische Untersuchungen über die Vogelnidicolen. Acta Zool Fenn 21: 1-168.

Piryanik GI & Akimov IA (1964) Gamazovye kleshchi ptits i ikh gnezd v Ukrainskoi SSR. Zool Zh 43: 671-679.

Podani J (1988) Syn-tax III user's manual. Abstr botanica Suppl I: 1-183.