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Arthropods in the penduline tit (*Remiz pendulinus*) nests: occurrence and abundance in different breeding phases

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The occurrence of spiders, pseudoscorpions, ticks, beetles, flies and fleas in penduline tit nests of four different breeding phases has been studied in several selected localities in SW Slovakia and eastern Austria. Except for the fleas, all studied groups preferred the nests in the feeding phase. Fleas and ticks were brought into the nests secondarily by other birds visiting the nests after the nestlings had finally left them. A large proportion of arthropod species found in the nests occurs there occasionally. Only fly larvae and mycetophagous beetles find suitable conditions to survive in the nests.

Key words: arthropods, pseudoscorpions, spiders, beetles, flies, fleas, penduline tit nests, *Remiz pendulinus*.

Introduction

The data concerning ectoparasites of *Remiz pendulinus* (LINNAEUS, 1758) as well as the arthropod faunula are rather scarce (HICKS, 1959, 1962, 1971 PEUS, 1960; GAJDOŠ et al., 1991). The reason for it is a specific mode of construction and location of the penduline tit nests and a relative scarcity of penduline tits in the past. Therefore, the only more extensive paper dealing with some selected arthropod groups living in the abandoned penduline tit nests is that of KRIŠTOFÍK et al. (1993), which was based on a study of deserted nests collected after the breeding season end. The aim of this paper is to complete the existing knowledge on the arthropod fauna in penduline tit nests by characteristics of differences in faunula of some arthropod groups in the nests of different breeding phases of penduline tit. Arthropods living in the penduline tit nests have not been studied from this aspect before. The mites, as the only arthropod group occurring in the penduline tit nests in large numbers and having a close trophic relation to penduline tits, will be dealt with in a separate paper.

Material and methods

During the breeding seasons 1993–1994, 357 penduline tit nests (Tab. 1) and 216 adults as well as 424 nestlings were examined for arthropods. The nests were collected around the fishponds in SW Slovakia (Jakubov, Dolný Štál), in the Morava river floodplain (Vysoká pri Morave, Devínske Jazero, Devínska Nová Ves, Markthof, Marchegg) and around the Neusiedler See lake (Illmitz, Breitenbrunn, Neusiedl, Winden, Jois) in Austria.

Table 1. Length of individual developmental phases of the penduline tit in days (total length of the nest existence taken into account) and total number of nests (N) in each group.

Nest groups	N	Phase length (days)	
		Average	Range
Without eggs	86	33	21–48
With eggs	99	27	21–33
With chicks	133	55	48–64
Replaced	39	13	5–18

In order to study the ways some parasites of penduline tit migrate, we replaced the original nests by the nests cleared of the parasites and other arthropods at the end of the breeding. These nests were collected one year prior to the investigation. The arthropods had been extracted by means of the Tulgren-type apparatus, in the same way as the arthropods from other studied nests, and the "clean" nests were stored in closed boxes. We exposed the clean nests for a period of approximately 13 days, during the time when the nestlings still came to sleep there. Immediately after the birds had finally deserted the nests, we recollected them to avoid contamination by parasites brought into the nests by other birds, especially tits (*Parus* spp.) and reed-warblers (*Acrocephalus* spp.), which frequently visited these nests (own observation).

In order to characterize the differences between microclimatic conditions in the nests with chicks, and the nests from which the chicks were picked up from to take blood samples for genetical analyses, as well as the deserted nests, we measured relative humidity and temperature in the nests by means of the digital hygro-thermometer Testoterm 6000.

For ecological analysis, we classified the collected nests into four following groups (Tab. 1):

a) deserted nests without eggs

b) deserted nests with eggs

c) nests with the nestlings up to final desertion of nests

d) replaced nests

The nests of the group a) and b) were mostly deserted during the phases of "Henkelkorb" or "Tasche" (c. f. FRANZ, 1989).

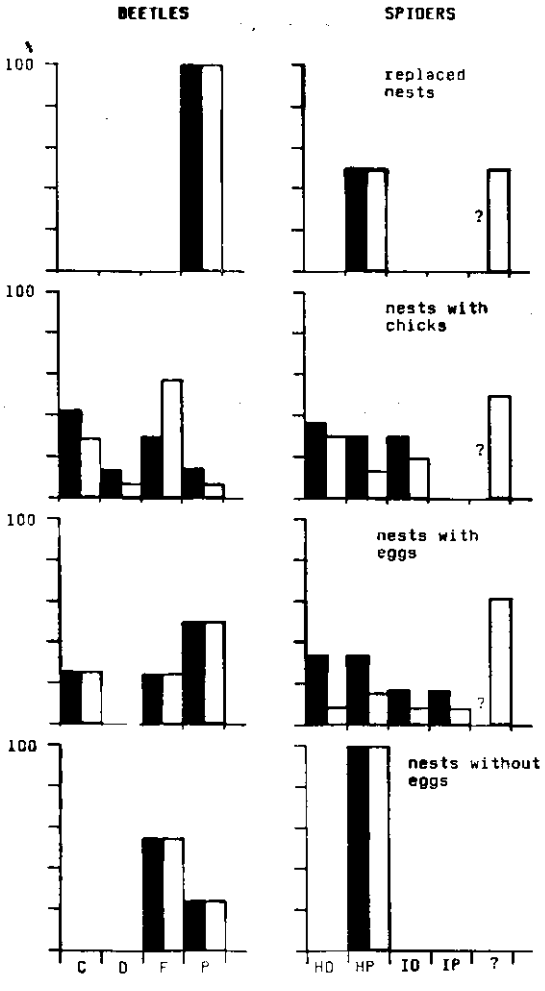

Fig. 1. Percentage of species (black columns) and relative abundance (%, white columns) of individual trophical groups of beetles and ecological groups of spiders in penduline tit nests of four different breeding stages (C – carnivorous, D – detritivorous, F – fungivorous, P – phytophagous, HO – hemihygrophilous and hemiombrophilous to ombrophilous, HP – hemihygrophilous and hemiombrophilous to photophilous, IO – indifferent to humidity and hemiombrophilous to ombrophilous, IP – indifferent to humidity and to light exposure, ? – non-identified juvenile stages).

Results

I. Spiders

Altogether 32 spiders of 15 species were obtained from the nests (Tab. 2). According to their preference for humidity and light exposure (MAUER, HANGI, 1990; MARTIN, 1991) these species can be divided into four ecological groups:

– hemihygrophilous and hemiombrophilous to ombrophilous: *Pholcus opilionides, Neriene montana, Araneus marmoreus, Larinioides sclopetarius,*

– hemihygrophilous and hemiombrophilous to photophilous: *Cercidia prominens, Dictyna uncinata, Misumenops tricuspidatus, Heliophanus auratus,*

– indifferent to humidity and hemiombrophilous to ombrophilous: *Larinoides patagiatus, Ozyptila*

Table 2. Abundance of spiders in the penduline tit nests.

Family species	Group of nests without eggs	with eggs	with chicks	replaced nests	Sum	Locality
PHOLCIDAE						
Pholcus opilionides (SCHRANK, 1781)			2		2	DŠ
LINIPHYDAE						
Neriene montana (CLERCK, 1758)			1		1	DŠ
ARANAEIDAE						
Araneus marmoreus (CLERCK, 1758)		1			1	DŠ
Araneus sp.		8			8	DŠ
Cercidia prominens (WESTRING, 1851)			1		1	M
Larinioides patagiatus (CLERCK, 1758)			1		1	DŠ
Larinioides sclopetarius (CLERCK, 1758)			1		1	DŠ
DYCTINIDAE						
Dyctina uncinata THORELL, 1856	1			1	2	N, DŠ
CLUBIONODAE						
Clubiona sp.			4	1	5	DŠ
PHILODROMIDAE						
Philodromus aureolus (CLERCK, 1757)		1			1	DŠ
THOMISIDAE						
Misumenops tricuspidatus (FABRICIUS, 1775)		1			1	DJ
Ozyptila praticola (C. L. KOCH, 1837)			2		2	V, DŠ
Xysticus sp.			4		4	Jo,DŠ,B
SALTICIDAE						
Heliophanus auratus C. L. KOCH, 1835		1			1	DŠ
Pseudeius eucarpatus (WALCKENAER, 1803)		1			1	DJ
Number of individuals	1	13	16	2	32	
Number of species	1	6	8	2	15	
Number of nests with spiders	1	6	16	2	25	

Explanation of locality abbreviations: DJ – Devínske Jazero, DŠ – Dolný Štál, V – Vysoká pri Morave, M – Markthof, Jo – Jois, B – Breitenbrunn, N – Neusiedl, I – Illmitz, J – Jakubov

praticola, *Pseudodicius encarpatus*,
– indifferent to humidity and to light exposure: *Philodromus aureolus*.

The results (Tab. 2 and Fig. 1) show that the hemihygrophilous species predominate in the penduline tit nests. The hemiobrophilous and ombrophilous species reached approximately the same abundance as the heliophilous species or the species indifferent to light exposure. The mutual ratio of different ecological groups of spiders reflected the composition of the spider fauna of wetland habitats surrounding the penduline tit nests. The spiders occasionally penetrated into the nests already at the time of their building. The number of spider individuals and species in the nests increased progressively with life span of the nest. Only a limited number of individuals occurred in the unfinished eggless nests and in the replaced ones. On the contrary, a relatively high number of individuals and species was found in the nests with nestlings (Fig. 1).

II. Pseudoscorpions

One female of *Laprochermes nodosus* and one female of *Cheridium museorum* were found in the studied nests (Tab. 3). *L. nodosus* frequently occurs in hotbeds and compost heaps and its females live phoretically on various insects (BEIER 1963). The phoresy on arthropods might have been the reason for their presence in the penduline tit nests. *Ch. museorum* was found in the nests of starlings (*Sturnus vulgaris* LINNAEUS, 1758), sparrows (*Passer* spp.), martins (*Hirundo rustica* LINNAEUS, 1758), pigeons (*Columba* spp.), (BEIER, 1963), blackbirds (*Turdus* spp.) and redstarts (*Phaenicurus* spp.) (NORDBERG, 1936). The low number and sporadic occurrence of pseudoscorpions in the penduline tit nests might be

Table 3. Abundance of pseudoscorpions and thicks in the penduline tit nests.

Order Family Species	Group of nests				Sum	Locality
	without eggs	with eggs	with chicks	replaced nests		
Pseudoscorpionidea:						
CHERNETIDAE						
Cheridium museorum (LEACH, 1817)		1			1	DŠ
Laprochernes nodosus (SCHRANK, 1761)			1		1	J
Ixodidea:						
IXODIDAE						
Ixodes ricinus (LINNAEUS, 1758)				1	1	V

For locality abreviations see Table 2.

an indication that they do not find suitable conditions for their development in this type of nest. This conclusion is supported by the fact that the premature stages of pseudoscorpions do not occur in the nests at all.

III. Ticks

We found only one larva of *Ixodes ricinus* in a replaced nest at Vysoká pri Morave (Tab. 3). As to the larvae of *Ixodes arboricola* SCHULZE et SCHLOTKE, 1929, which was found in the penduline tit nests during our earlier investigations (KRIŠTOFÍK et al., 1993), we assume that they had been brought into the nests by tits (*Parus* spp.). The tits are one of the hosts of *I. arboricola* and, according to our observations, they frequently visited (as well as the reed-warblers (*Acrocephalus* spp.)) the penduline tit nests after these nests had been deserted by the penduline tit fledglings. We have not found *I. arboricola* even in a large number of the examined adult and young penduline tits. Therefore we conclude it to be highly improbable that *I. arboricola* could be a parasite of penduline tits or that it would develop in their nests.

IV. Beetles

Out of a total of 357 nests, we found as few as 24 beetles (Tab. 4) in only 20 nests (5.6%). Hence the average number of beetles in the positive nests was only 1.20 and mere 0.067 in all examined nests.

Occurrence of individual species in the nests was mostly occasional. Among 14 species registered in the nests, nine species (64.3%) represented by 12 individuals (50%) are characteristic inhabitants of other ecological niches (ROUBAL, 1930, 1936, 1939). The hydrophilid *Chaetarthia seminulum* lives in swamps. The staphylinids *Quedius fuliginosus, Tachinus signatus* and *Tachyporus nitidulus* live in litter. The first two species are hygrophilous, the later species is eurytopic. The helodid *Cyphon nigripes* lives on plants in the shore vegetation. The weevils *Dorytomus longimanus* and *D. hirtipes* are oligophags on poplars and willows. The salphingid *Salphingus planirostris* lives in the twigs of various trees in galleries of bark beetles. *Meligethes ovatus* lives on flowers of various plants. It is obvious that the composition of species in the nests strongly depends on the species living in the surrounding at the time of nest collection.

Only five species (*Corticarina gibbosa, Atomaria prolixa. Atomaria fuscicollis, Mycetea subterranea* and *Sericoderus lateralis*) have a closer relation to the penduline tit nests. They are not primarily nidicolous, but they occur anywhere on various moulding plant substances. Due to this fact they also belong to the regular inhabitants of the majority of bird nests in spite of the fact that they are not primarily nidicolous. Because of their minute body size (1–1.5 mm) they are the only beetles able to move and hid in the dense felt-like walls of the penduline tit nests.

As to the differences in occurrence of beetles in each of four different groups of the nests (Fig. 1), the fungivorous species preferred the nests with chicks. The slightly higher number of other beetles in these nests was evidently caused by the higher number of these nests (Tab. 4). On the contrary, except for two individuals of *Cyphon nigripes*, no beetles were found in the replaced nests. This difference was caused on the one hand, by low humidity in the replaced nests collected mostly in the preceding season and stored in a dry place and exposed during a shorter time. On the other hand, the longer exposure of the original nests and the presence of the young with their excrements in the nests might have increased the humidity stimulating development of the mildews in the nests attracting the fungivores. Besides, the relatively (!)

Table 4. Abundance of beetles in the penduline tit nests.

Family species	Trophic relations	Relation to nest	Group of nests without eggs	 with eggs	 with chicks	 replaced nests	Sum	Locality
HYDROPHILIDAE								
Chaetarthia seminulum (HERBST, 1797)	D	I			1		1	DŠ
STAPHYLINIDAE								
Quedius fuliginosus (GRAVENHORST, 1802)	C	I			1		1	DŠ
Tachinus signatus (GRAVENHORST, 1802)	C	I			2		2	DŠ
Tachyporus nitidulus (FABRICIUS, 1781)	C	I			1		1	J
HELODIDAE								
Cyphon nigripes KIESENWETTER, 1860	P	I	1			2	3	DŠ,Jo,Ma
NITIDULIDAE								
Meligethes ovatus STURM, 1845	P	I		1			1	DŠ
CRYPTOPHAGIDAE								
Atomaria prolixa ERICHSON, 1846	F	T	1				1	DJ
Atomaria fuscicollis MANNERHEIM, 1852	F	T		1			1	DJ
ENDOMYCHIDAE								
Mycetea subterranea (FABRICIUS, 1801)	F	T	1				1	V
CORYLOPHIDAE								
Sericoderus lateralis (GYLLENHAL, 1827)	F	T			1		1	J
LATHRIDIIDAE								
Corticarina gibbosa (HERBST, 1793)	F	T	1		7		8	V,M,DŠ,DJ
SALPINGIDAE								
Salpingus planirostris (FABRICIUS, 1787)	C	I		1			1	DŠ
CURCULIONIDAE								
Dorytomus hirtipenis (BEDEL, 1884)	P	I		1			1	DŠ
Dorytomus longimanus (FORSTER, 1771)	P	I			1		1	M
Number of individuals			4	4	14	2	24	
Number of species			4	4	7	1	14	
Number of nests with beetles	-	-	5	10	3	2	20	

Explanations: Trophic relations: C – carnivorous, D – detritivorous, F – fungivorous, Py – phytophagous,
Relations to nests: T – trophic, I – indifferent or predominantly indifferent
For locality abbreviations see Table 2.

high share of the fungivores in the egg-free nests suggests that some fungivores might be introduced into the nests already with the construction material collected from the ground. Due to the extremely low number of individuals no beetles (nor the fungivorous ones) are able to form a guild in the penduline tit nests.

Similarly as the nests studied by KRIŠTOFÍK et al. (1993), the nests analysed in this paper were extremely poor in beetles.

V. Flies

Altogether 123 flies belonging to 11 species (Tab. 5) were found in the nests. Based on the food preference of their larvae, the flies can be divided into five partly overlapping trophic groups: coprophags, microphags, mycetophags, necrophags and saprophags (ČEPELÁK et al., 1986). Due to such food specialization the fly larvae had suitable conditions in the nests and hence the presence of these species (adults and larvae) was not surprising. Flies occurred mainly in nests with nestlings. The nests with eggs were preferred less. Only a very limited number of flies occurred in the unfinished egg-free nests as well as in the replaced nests (Tab. 5).

We did not find the typical ectoparasites of birds from the families Hippoboscidae and Calliphoridae (from the genus *Protocalliphora*) registered by other authors (PEUS, 1960; HICK, 1971; BOROWIEC, 1979) neither in an extensive number of adults and chicks.

Table 5. Abundance of flies in the penduline tit nests (m – males, f – females).

Family Species	Group of nests								Sum	Locality
	without eggs		with eggs		with chicks		replaced nests			
	m	f	m	f	m	f	m	f		
SCATOPSIDAE										
Coboldia fuscipes (MEIGEN, 1830)					31	72			103	DŠ
PHORIDAE										
Megaselia sp.				1					1	M
DROSOPHILIDAE										
Drosophila funebris (FABRICIUS, 1787)	1			1					2	DŠ, J
Drosophila phalerata MEIGEN, 1830				1					1	DŠ
Drosophila melanogaster MEIGEN, 1830			1		1	5		1	8	M,J,DŠ,V
PIOPHILIDAE										
Parapiophila vulgaris (FALLÉN, 1820)				1					1	Jo
ANTHOMYIDAE										
Hylemia partita (MEIGEN, 1826)						1			1	DŠ
FANNIIDAE										
Fannia armata (MEIGEN, 1826)						1			1	Jo
Fannia canicularis (LINNAEUS, 1761)					2		1		3	Jo,DŠ
Fannia lustrator (HARRIS, 1780)						1			1	DŠ
MUSCIDAE										
Musca autumnalis DE GEER, 1776						1			1	M
Number of individuals	1	0	1	4	34	82	1	1	123	
Number of species	1		5		7		2		11	
Number of nests with flies	1		5		9		2		17	

For locality abbreviations see Table 2.

Table 6. Abundance of fleas in the penduline tit nests (m – males, f – females).

Family Species	Group of nests								Sum	Locality
	without eggs		with eggs		with chicks		replaced nests			
	m	f	m	f	m	f	m	f		
CERATOPHYLIDAE										
Ceratophylus galinae (SCHRANK, 1803)				1			1	1	3	DJ, V
Ceratophylus garei (ROTSCHILD, 1902)						1		3	4	DŠ, V
Number of individuals				1		1	1	4	7	
Number of species			1		1		2		2	
Number of nests with fleas			1		1		4		6	

For locality abbreviations see Table 2.

VI. Fleas

Only seven fleas of two species – *Ceratophyllus gallinae* and *C. garei* (Tab. 6) were found in the studied nests. In contrast to other arthropods, the fleas usually occurred in the replaced nests, which indicated that they were introduced by other birds visiting the nests after the fledglings had deserted the nests.

Temperature in the nests was found to be relatively stable during the breeding cycle. However, depending on the actual weather, the relative humidity oscillated considerably within the same day

(34–76%). This fact and the low degree of parasitation of adults indicate that the fleas do not develop in the penduline tit nests.

Conclusions

1. The faunula of spiders, pseudoscorpions, ticks, beetles, flies and fleas in the penduline tit nests was confirmed to be rather poor in the number of species and individuals.
2. We found that arthropods began to penetrate into the nests already at the time of their building-phase.
3. With the exception of fleas, all arthropod groups preferred nests with nestlings offering more organical scrap and a higher degree of humidity.
4. Fleas, ticks and pseudoscorpions did not develop in the nests. Fleas were brought into the nests secondarily, by other birds visiting the nests after the fledged chicks had deserted them.
5. No typical nidicolous beetle species frequently occurring in the nests of other birds were found here. Majority of the beetles found in the nests penetrated into them only occasionally from the surroundings. The only group of beetles being able to develop in penduline tit nests and occurring there more frequently are the mycetophagous species of the families Lathridiidae, Cryptophagidae, Corylophidae and Endomychidae. These species were also most abundant in nests with nestlings.
6. The arthropod faunula in the replaced nests was even poorer than that of the unfinished nests. This was caused by the short exposure time not allowing the arthropods to penetrate into the nests in larger numbers of individuals. There were no trophical guilds of arthropods in the replaced nests.

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References

BEIER, H., 1963: Ordnung Pseudoscorpionidae.– Akademie Verlag, Berlin, 313 pp.

BOROWIEC, L., 1977: Materialy do znajmosci muchówek z rodziny wpleszowatych (Diptera, Hippoboscidae) pasożytujących na ptakach w Polsce.– Pol. pismo ent. **47:** 37–42.

ČEPELÁK, J. (ED.)., 1986: Diptera Slovenska II.– Bratislava, 435 pp.

FRANZ, D., 1989: Paarungssystem und Fortpflanzungsstrategie der Beutelmeise *Remiz pendulinus pendulinus* (L.).– PhD. thesis, Faculty of Natural Sciences. Fridrich-Alexander-Universität Erlangen-Nürnberg. 176 pp.

GAJDOŠ, P., KRIŠTOFÍK, J., ŠUSTEK, Z., 1991: Spiders (Araneae) in the bird nests in Slovakia.– Biológia, Bratislava, **46:** 887–905.

GEMYCKI, A. S., JAKEMAVA, G. A., ZHUKOVEC, JA. M., 1985: Pavuki (Aranei) z gnozdaj ptushak Belarusi.– Vesci Akad. Nauk BSSR. ser. biol., **1:** 81–87.

HICKS, E., 1959: Check-list and bibliography on the occurrence of insects in bird nests.– Ames, Iowa, 681 pp.

HICKS, E., 1962: Check-list and bibliography on the occurrence of insects in bird nests. Supplement I.– Iowa St. J. Sci. **36:** 233–348.

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

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

MARTIN, D., 1991: Zur Autökologie der Spinnen (Arachnida: Aranea). I. Charakteristik der Habitusaustattung und Präferenzverhalten epigäischer Spinnenarten.– Arachnol. Mitt. **1:** 5–26.

MAUER, D., HÄNGI, A., 1990: Katalog der schweizerischen Spinnen.– Doc. Faun. Helvetiae **12:** Zürich.

NORDBERG, S., 1936: Biologisch-ökologische Untersuchungen über die Vogelnidicolen.– Acta Zool. Fenn. **21:** 1–168.

PEUS, F., 1960: Zur Kenntnis der ornithoparasitischen Phormiinen (Diptera, Calliphoridae).– Dtsch. ent. Z. **7:** 193–235.

ROUBAL, J., 1930: Katalog Coleopter Slovenska a Podkarpatska. Vol. I.– Bratislava, 527 pp.

ROUBAL, J., 1936: Katalog Coleopter Slovenska a Podkarpatské Rusi. Vol. II.– Bratislava, 434 pp.

ROUBAL, J., 1939: Katalog Coleopter Slovenska a východních Karpat. Vol. III.– Praha, 363 pp.

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