Arthropods in nests of the red-backed shrike (*Lanius collurio*) in Poland

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ABSTRACT. Beetles, moths, spiders and mites collected from the nests of the red-backed shrike (*Lanius collurio*) in the years 1997-98 in a study area near Leszno in W Poland were analysed. The total number of nests checked was 28, and arthropods were found in 75 % of them. Only one nest was inhabited by a parasitic arthropod species (the blowfly *Protocalliphora azurea*). Altogether two species of moths, five of beetles, two of spiders, and 44 species of mites (21 spp. Oribatida and 23 spp. Gamasida) were identified. One species (*Typhlodromus wichmanni*, Acari, Gamasida) was found for the first time, and one (*Paragarmania dentriticus*, Acari, Gamasida) for the second time in Poland.

KEY WORDS: nesting biology, nests, spiders, beetles, fleas, mites, moths, Lanius collurio.

INTRODUCTION

With the recent upsurge of interest in host-parasite interactions, the influence of mites, ticks, lice, fleas and bugs living on birds has been studied with regard to antagonistic relationships with harmful effect on the fitness of an avian host, as implied in the definition of parasitism (review in MØLLER et al., 1990; LOYE & ZUK, 1991). Birds and their nests have been rarely studied as the resident sites of non-parasitic arthropods. However, the fauna of bird nests have been described only for a few species of birds, as e.g. penduline tit *Remiz pendulinus* (Linnaeus, 1758) – KRISTOFÍK et al. (1993, 1995), MASÁN & KRISTOFÍK (1995), KRISTOFÍK & MASÁN (1996), the sand martin *Riparia riparia* Linnaeus, 1758 – MASÁN & KRISTOFÍK (1993), KRISTOFÍK et al. (1994), the bee-eater *Merops apiaster* Linnaeus, 1758 – KRISTOFÍK et al. (1996), sparrows *Passer domesticus* Linnaeus, 1758 and *Passer montanus* Linnaeus, 1758 – WASYLIK (1971), CYPRICH et al. (1997), DRABER-MONKO (1997), FENA & PINOWSKI (1997). These species however, either build very characteristic closed nests as does the penduline tit, or stay in burrows as do the sand martin and the bee-eater or in holes as do the two species of sparrow. Most European bird species build open nests (NEWTON, 1998), which have been rarely studied by entomologists and acarologists. One of the exceptions is an old study by NORDBERG (1936), and earlier papers referring to spiders and gamasid mites found in bird nests in Slovakia (GAJDOS et al., 1991; AMBROS et al., 1992). In these studies, based on the same material, the nests of the red-backed shrike *Lanius collurio* (Linnaeus, 1758) were analysed. However, no ecological relationship between the nest size and the number of inhabiting spiders and mites was sought. Nest size can be a key feature affecting clutch size or, more generally, parental investment of birds (SLAGSVOLD, 1989; SOLER et al., 1998; TRYJANOWSKI, 1999), and also, indirectly, the presence of parasites (POIANI, 1993). Nest size is also a measure of the quantity of material used for its construction, which influences the probability of the presence of arthropods (HICKS, 1959; WASYLIK, 1971).

The study reported here aimed to: (1) recognise the arthropod fauna living in the red-backed shrike nests; (2) check if the number of arthropods living in a nest

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depends on its size; (3) find a possible correlation between the number of different insect species and mites, (4) establish a population structure of chosen species (gamasid mites).

MATERIAL AND METHODS

The study was conducted over a study area near Leszno in south-western Poland (51°51'N, 16°35'E). A detailed description of this study area has been presented elsewhere (KU{NIAK, 1991). The area was surveyed for shrike nests. The nests were visited at several-day intervals throughout the period from mid-May to July in 1997-1998. Each nest was visited two to seven times. The minimum number of two visits occurred when a nest was found in the stage of laying eggs and visited for the second time near the end of the nestling stage to ascertain the number of fledglings and to determine the breeding success. A higher number of visits was made to nests found during incubation and to the nests in which selected elements of breeding biology were more thoroughly examined (*cf.* KU{NIAK, 1991; TRYJANOWSKI & KU{NIAK, 1999). Nests were picked up a few days after the end of breeding, and transported to a laboratory, where arthropods were startled in Berlese – type funnels. Altogether 28 nests were collected but seven of them were kept in foil bags for more than 10 days before extracting the arthropods. The difference between the nests put directly (2-3 days) into the Berlese - type funnels and those kept longer in foil bags was statistically significant (c^2 with Yates correction = 4.25; df = 1; $P = 0.04$). In view of these results, only the data from the 21 nests were used in further analysis. After the arthropods were startled, some nests (n = 15) were weighted to an accuracy of 1 g and the relationships examined between the weight of the nest and the number of inhabiting arthropods. As a large number of nests were inhabited by only one arthropod species, resulting in a large number of "null" samples, we abandoned the search for any correlation between individual species and nest size. Only correlations between nest weight and total number of individuals and number of species of all arthropods, gamasid mites and oribatid mites were examined. There was a significant difference between the distribution observed in our study and a normal distribution (Kolomogorov-Smirnov test), so the Spearman rank correlation was applied. The material of gamasid and oribatid mites was analysed considering the following indices: constancy of occurrence (percentage of nests in which the species occurred) and dominance (ratio of the number of individuals of a given species to the number of all the individuals of the taxon under study, in percent).

TABLE 1

Oribatid mites (Oribatida) found in the red-backed shrike nests

No.	Species	No. of ind.	Constancy (%)	Dominance (%)
1	*Phthiracarus crinitus* (Koch, 1841)	1	4.8	0.11
2	*Hoplophthiracarus vanderhammeni* Niedbala, 1991	1	4.8	0.11
3	*Nothrus pratensis* Sellnick, 1928	2	4.8	0.22
4	*Camisia spinifer* (Koch, 1835)	4	19.0	0.43
5	*Heminothrus peltifer* (Koch, 1839)	7	14.3	0.76
6	*Liacarus coracinus* (Koch, 1841)	2	4.8	0.22
7	*Ceratoppia quadridentata* Haller, 1882	65	38.1	7.07
8	*Carabodes areolatus* Berlese, 1916	1	4.8	0.11
9	*Carabodes labyrinthicus* (Michael, 1879)	1	4.8	0.11
10	*Tectocepheus velatus* (Michael, 1880)	22	23.8	2.39
11	*Micreremus brevipes* (Michael, 1888)	1	4.8	0.11
12	*Scheloribates laevigatus* (Koch, 1836)	1	4.8	0.11
13	*Zygoribatula exilis* (Nicolet, 1855)	241	28.6	26.20
14	*Protoribates variabilis* Rajski, 1958	56	47.6	6.09
15	*Chamobates voigtsi* (Oudemans, 1902)	263	28.6	28.59
16	*Ceratozetella minima* (Sellnick, 1929)	2	4.8	0.22
17	*Trichoribates novus* (Sellnick, 1928)	83	61.2	9.02
18	*Eupelops torulosus* (Koch, 1840)	4	9.5	0.43
19	*Oribatella berlesei* (Michael, 1898)	67	4.8	7.28
20	*Achipteria coleoptrata* (Linnaeus, 1758)	12	4.8	1.30
21	*Pergalumna nervosa* (Berlese, 1914)	7	14.3	0.76
22	*Damaeidae*	30	14.3	3.26
23	*Belbidae*	24	14.3	2.61
24	*Oppiidae*	6	9.5	0.65
25	juveniles indet.	17	23.8	1.85
	Total	**920**	**95.2**	**100**

RESULTS

Spiders

In eight nests, (38.1 %) a total of 35 individuals (mean ± SD = 4.4 ± 6.0) of the *Oxyptila trux* (Blackwall, 1846) were found. A single female of *Troxochrus scabriculus* (Westring, 1851) was identified. These two species are common in the fauna of Poland, occurring mainly in grassy habitats, both dry and wet, where they live at ground level. These species have not been noted in the nests of red-backed shrike in Slovakia (GAJDOS et al., 1991).

Oribatid mites

A total of 920 oribatid mites belonging to at least 21 species were found (Table 1). Representatives of the three species: *Trichoribates novus* (in 61.2% of nests), *Protoribates variabilis* (47.6%) and *Ceratoppia quadridentata* (38.1%) were noted in the greatest number of nests. Representatives of the other species were met in individual nests, although sometimes in a large numbers, e.g. *Chamobates voigtsi* (max. 167 individuals in one nest). The majority of them are saprophages and fungivores. All the species encountered are widespread, mainly in forest habitats in Poland (OLSZANOWSKI et al., 1996). The number of oribatid mite species found in the nest was correlated with the number of these mites in the nest (r_s = 0.77, n = 21, P < 0.001).

Gamasid mites

The total number of gamasid mite individuals found in all nests was 1303, representing at least 23 species (Table 2). Two species in particular are of interest. One,

TABLE 2

Gamasid mites (Gamasida) found in the red-backed shrike nests

Explanations: P - protonymphs, D - deutonymphs, F - females, M - males

No.	Species	P	D	F	M	Total	Constancy	Dominance
1	*Alliphis siculus* (Oudemans, 1905)		13	74	35	122	47.62	9.36
2	*Amblyseius* sp.			9	2	11	4.76	0.84
3	*Typhlodromus* (*Anthoseius*) sp.			27	15	42	28.57	3.22
4	*Arctoseius semiscissus* (Berlese, 1892)			15		15	4.76	1.15
5	*Asca bicornis* (Canestrini et Fanzago, 1887)			1		1	4.76	0.08
6	*Blattisocius tarsalis* (Berlese, 1918)			1		1	4.76	0.08
7	*Celaenopsis badius* Koch, 1836				1	1	4.76	0.08
8	*Cornigamasus lunaris* (Berlese, 1882)		1			1	4.76	0.08
9	*Discourella modesta* (Leonardi, 1899)			1		1	4.76	0.08
10	*Gamasellodes bicolor* (Berlese, 1918)		7	83	8	98	47.62	7.52
11	*Gamasodes spiniger* (Trägardh, 1910)		21		1	22	19.05	1.69
12	*Holoparasitus calcaratus* (Koch, 1839)			4	2	6	9.52	0.46
13	*Hypoaspis (Cosmolaelaps) vacua* (Michael, 1891)			1		1	4.76	0.08
14	*Lasioseius ometes* (Oudemans, 1903)			6	1	7	14.29	0.54
15	*Lasioseius* sp.			10	5	15	14.29	1.15
16	*Macrocheles glaber* (Müller, 1860)	3	4	60	20	87	23.81	6.68
17	*Macrocheles rotundiscutis* Bregetova et Koroleva, 1960			35	28	63	4.76	4.83
18	*Paragamasus (Anidogamasus) vagabundus* (Karg, 1968)			6	1	7	4.76	0.54
19	*Paragarmania dentriticus* (Berlese, 1918)		9	65	14	88	38.10	6.75
20	*Parasitus fimetorum* (Berlese, 1904)	15	133	14	10	172	14.29	13.20
21	*Pergamasus (Pergamasus)* sp.		1			1	4.76	0.08
22	*Pergamasus (Thenargamasus)* sp.		4			4	14.29	0.31
23	*Proctolaelaps pygmaeus* (Müller, 1860)		6	307	3	316	28.57	24.25
24	*Proctolaelaps* sp.			5		5	9.52	0.38
25	*Trichouropoda ovalis* (Koch, 1839)	1	61	52	27	141	14.29	10.82
26	*Trichouropoda* sp.		1			1	4.76	0.08
27	*Typhlodromus* (*Anthoseius*) wichmanni Hirschmann, 1962			7		7	14.29	0.54
28	*Uroobovella* (group *flagelliger*) sp.			1		1	4.76	0.08
29	*Uropoda orbicularis* (Müller, 1776)		41	10	1	52	4.76	3.99
30	*Uroseius infirmus* (Berlese, 1887)			10	3	13	4.76	1.00
31	*Zercon peltatus* Koch, 1836			1		1	4.76	0.08
	Total	**19**	**302**	**805**	**177**	**1303**		**100**

Typhlodromus (*Anthoseius*) *wichmanni* – present in three nests – has not previously been noted in Poland and this is the first record establishing its site of occurrence. The other *Paragarmania dentriticus* – found in eight nests – has to date been reported only from the vicinity of Poznan, *ca*. 60 km N of the area of study (BLASZAK, 1976). Thus, this work reports the second site of occurrence of this species in Poland. The other species finds favourable conditions in the red-backed shrike nests. Considering the frequency of occurrence in the nests and the presence of juveniles, two other species also find suitable conditions in the nests of the red-backed shrike: *Parasitus fimetorum* and *Trichouropoda ovalis*. A correlation was found between the number of species of gamasid mites in the nest and their abundance ($r_s = 0.74$, n = 24, $P < 0.0001$). None of the gamasid mite species found in the nests studied has been noted in the nests of the same bird species in Slovakia (AMBROS et al., 1992).

Coleoptera

We found as few as six beetles in only three (14.3 %) nests. Two individuals of *Tachyporus hypnorum* (Fabricius, 1775) (Staphylinidae) were found in one nest. The other species were represented by single individuals in the nest: *Phyllodrepa nigra* (Gravenhorst, 1806) (Staphylinidae), *Meligethes aeneus* (Fabricius, 1775) (Nitidulidae), *Corticaria elongata* Gyllenhal, 1827 and *Cortinicara gibbosa* (Herbst, 1793) (Latridiidae). All the species found are eurytypic and common, and their presence in the nests was accidental, although both lathridid species, as typical mycetophages, are often inhabitants of bird nests (KRISTOFÍK et al., 1995, 1996).

Moths and other insects

The presence of tineid moths *Tinea trinotella* (Thunberg, 1794) (Lepidoptera, Tineidae) was evidenced in 17 nests (81%). The total number of adult individuals was 103 (64 males and 39 females, max 14 ind. and 35 ind. in one nest, respectively) and 30 larvae. This species, like other tineid moths, is often met in bird nests as they provide favourable conditions for reproduction and – as far as larvae are concerned – a good source of nutrition (HICKS, 1959; HANNEMANN, 1977; BUSZKO, 1996). Moreover, one imago *Coleophora milvipennis* Zeller, 1839 (Lepidoptera, Coleophoridae) and one imago *Nomophila noctuella* (Denis et Schifferm˘ller, 1775) (Lepidoptera, Pyralidae) were found. Their presence was accidental since the developmental stages of neither are related to bird nests. Also a single larva of *Raphidia notata* (Fabricius, 1781) (Raphidoptera, Raphidiidae) was found, which probably searched there for larvae of other insects. In one nest we found a large number (ca. 35) of larvae of the blowfly *Protocalliphora azurea* (Fallen, 1817) (Diptera, Calliphoridae), which is a well known parasite of nestlings of different species of birds (LINDNER, 1956).

DISCUSSION

Ecological relationships

Typical parasites of birds were found only in one nest. These were the blowfly larvae in an unsuccessful nest, destroyed by a predator. The other arthropods were either brought into the nest by accident together with the construction material or sought a suitable site for reproduction as did the tineid moths. It is generally known that many elements of bird nest fauna are of accidental origin (NORDBERG, 1936; HICKS, 1959; GAJDOS et al., 1991; AMBROS et al., 1992; KRISTOFÍK et al., 1993, 1996; NEUBIG & SMALLWOOD, 1999) and their presence is not related to the host of the nest. For many of these species, in contrast to parasites, the most important factor is the size and construction of the nest (NORDBERG, 1936; HICKS, 1959; WASYLIK, 1971; BUSZKO, 1996). The mean weight of a dried nest of red-backed shrike (from our data in the area of study) was 43.2 (± 8.5; range 28-59) g. The nest mass was significantly positively correlated with the abundance and number of species of gamasid mites ($r_s = 0.51$ and $r_s = 0.54$, respectively; n = 21 and $P < 0.05$ in both cases). For the other groups of arthropods this relationship was statistically insignificant ($P > 0.3$ in all cases). Analysis of possible correlations between different groups of arthropods living in the nests revealed only one significant correlation, between the abundance of gamasid mites and larvae of tineid moths ($r_s = 0.49$; $P < 0.05$). This relationship is most probably related to the common way of feeding of these two groups of arthropods, which live on dead organic matter (HANNEMANN, 1977).

Concluding remarks

In 28 studied nests of red-backed shrike, representatives of arthropods were found in 21 (75 %). The total number of individuals was 2436 and they represented at least 54 species. The most abundant groups were gamasid mites (1303 indiv. and at least 23 spp.) and oribatid mites (920 indiv. and at least 21 spp.). The representatives of mites made up 91% of the number of arthropod individuals and their species constituted 81% of all arthropod species found. Among all arthropods evidenced in the nests only one species, the blowfly *Protocalliphora azurea,* is known as a bird parasite. The other species are sapro-, fungi-,phytophagous and predators such as moths, beetles, and some mites, which found themselves in the nests when looking for sites rich in dead organic matter either as sources of nutrition or as suitable sites for reproduction. A large number of the representatives of these arthropods could have been brought into the nests together with the nest constructing material or with food for the nestlings.

An interesting observation is the lack of species of spiders and gamasid mites in the nests of red-backed shrike which would be common in the nests studied in Poland (this study) and Slovakia (GAJDOS et al., 1991; AMBROS et al., 1992) and in fact, that generally arthropod numbers in shrike nests in Poland were surprisingly low. The differences may be due to the geographical distribution of the species or, more probably, to the differences in the time of nest collection (WASYLIK, 1971; KRISTOFÍK et al., 1995; KRISTOFÍK & MASÁN, 1996). In general, the number of evidenced representatives of gamasid mites is close to that found in the nests of birds of other species, while the number of representatives of spiders and beetles is lower than the corresponding data for other birds' species (GAJDOS et al., 1991; AMBROS et al., 1992; KRISTOFÍK et al., 1993, 1996; MASÁN & KRISTOFÍK, 1993, 1995; FENA & PINOWSKI, 1997). The results reported in this work cannot be reliably compared with those obtained by other authors because of differences in the time of nest collection and sample size.

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