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**INVERTEBRATE FAUNA IN NESTS OF THE HOUSE
SPARROW *PASSER DOMESTICUS*
AND THE TREE SPARROW *PASSER MONTANUS*
IN CENTRAL POLAND**

ABSTRACT

Nests of House (*Passer domesticus*) and Tree Sparrows (*Passer montanus*) were examined in the commune of Łomianki, near Warsaw, Poland (52°20'N, 20°50'E). 29 nests of the House Sparrow and 87 nest of the Tree Sparrow were collected. 10759 invertebrate specimens belonging to 20 taxonomic groups were isolated.

The mean abundance of invertebrate fauna in nests of the House Sparrow was 96.0 specimens. In nests of House Sparrows, most abundant were larvae of insects, *Siphonaptera* and *Psocoptera*.

The mean abundance of invertebrates in Tree Sparrow nests was 91.6 specimens. The *Psocoptera* were most abundant. Larvae of Insects, *Siphonaptera*, *Coleoptera* and *Araneae* were also abundant.

We categorized nest fauna into three groups:

1. taxonomic groups abundant and frequent in nests of at least one of the two sparrow species, and closely associated with nests of a given host species.
2. taxonomic groups abundant in nests of at least one of the two sparrow species and in at least one of the study areas, and narrowly specialized for nests of a given host species in a given area.

3. taxonomic groups not abundant and infrequent in nests of both sparrow species, that were not specialized for sparrow nests.

Representatives of these groups occurred regularly. They completed their life cycle in nests, as it is the case of *Psocoptera* and *Siphonaptera* or at least a part of it (larvae of different insects, but as they were not identified, it cannot be excluded that they completed their cycle in nests). Different trophic, topic, and microclimatic conditions play part in this process.

In terms of trophic interactions, we found ectoparasites, including ectoparasites of birds and other animals, also parasitoids, zoophages, a group comprising phytophages, saprophages, necrophages, coprophages, and then pantophages and mycophages. Among them, most abundant were phyto-, sapro-, necro- and coprophages (63%). The check-list of invertebrates recorded from House and Tree Sparrow nests is in Appendix 1.

INTRODUCTION

The House Sparrow (*Passer domesticus*) and Tree Sparrow (*Passer montanus*) are among the most abundant birds breeding in anthropogenic habitats of central Europe (Dyer et al. 1977). Both species have received increasing attention since the time of the International Biological Programme (Kendeigh and Pinowski 1973, Pinowski and Kendeigh 1977). Most papers on the fauna living in nests of sparrows concern parasites (Rosický 1950, 1957, Ter-Vartamov et al. 1956, Jurík 1974, Macháček 1977, Ryba and Balát 1977, Kaczmarek 1977a, 1977b, 1982, 1991a, Chmielewski 1980, 1982, Pomykal 1981, Zeman and Jurík 1981, Cyprich and Gusková 1984, Ambros et al. 1992, Krumpál and Cyprich 1992, Cyprich and Krumpál 1996, Cyprich et al. 1997). Papers on non-parasitic nest fauna are also frequent (Hicks 1959, 1962, 1971, Nosek and Lichard 1962, Krumpál et al. 1988, Krumpál et al. in press, Ondřejková et al. 1991 [*Invertebrata*], Kaczmarek 1981a, 1981b [*Arthropoda*], Kaczmarek 1983, Bhattacharyya 1988 [*Insecta*], Krumpál and Cyprich 1988, Bhattacharyya 1990a [*Pseudoscorpiones*], Bhattacharyya 1990b, Gajdoš et al. 1991 [*Araneae*], Wasylik 1971, 1973, Sandner and Wasylik 1973 [*Acarina*], Krumpál and Cyprich 1986 [*Diplopoda*], Dobšík and Jurík 1967, Jurík and Dobšík 1968, Országh et al. 1990 [*Hemiptera*], Jurík and Šustek 1978, Majzlan and Rychlik 1992, Šustek and Křištofík 1989, 1990 [*Coleoptera*], Włodarczyk 1963

[*Psocoptera*]). Notes on other taxonomic groups of animals in nests of sparrows are scattered and published in papers on other subjects. The purpose of this paper is to examine the invertebrate fauna of nests of the House and Tree Sparrows from central Poland.

MATERIAL AND METHODS

Nests of the House and Tree Sparrows were examined in the commune of Łomianki, near Warsaw, Poland (52°20'N, 20°50'E). The nests of both species were collected only from nest boxes. These boxes were situated within farm buildings in villages and also at a street with much traffic (Warszawska Street), and in the area of the Institute of Ecology PAS, which is situated at a distance of about 500 m from the nearest farm buildings. We collected 29 nests of the House Sparrow and 87 nests of the Tree Sparrow.

The nests were put into polyethylene bags immediately after collection, and then extracted using a Tullgren apparatus (40-W bulbs were used as a source of heat). The material was preserved in a 70% alcohol. After extraction, the material was analysed quantitatively, except for *Acarina*. The following variables were assessed: abundance (**A** — number of specimens per nest), dominance (**D** — percentage of an animal group in the total number of animals per nest), frequency (**F** — percentage of nests containing a given animal group in the total number of nests of a given *Passer* sp.), and **DF** index, characterizing the association of a given animal group with nests of a given bird species:

$$DF = \frac{D \times F}{10000}$$

(after Krumpál in Kiefer et al. 1983).

RESULTS

A total of 2785 invertebrate specimens were obtained from 29 House Sparrow nests and 7974 from 87 Tree Sparrow nests. In this material we identified representatives of 20 taxonomic groups, and two more groups consisting of larvae of insects and fleas. A third

group consisted of more than ten invertebrate specimens that we could not identify. In nests of the House Sparrow we did not find *Mollusca*, *Oniscidea* and *Chilopoda*, and in nests of the Tree Sparrow we did not find *Thysanura*.

The mean abundance of invertebrate fauna in nests of the House Sparrow was 96.0 specimens per nest. Larval insects reached the highest abundance and dominance in House Sparrow nests. The eudominants also included *Siphonaptera*, *Psocoptera* and *Coleoptera*. Other groups had a lower abundance, thus a smaller dominance.

The most frequent in the nests of the House Sparrow were larval insects (90 % of nests) and *Psocoptera* (72 %). *Araneae*, *Coleoptera* and *Siphonaptera* had higher than 50% frequencies. *Heteroptera*, *Collembola* and *Diptera* occurred less frequently. Other groups occurred infrequently in House Sparrow nests. The abundance and frequency are combined in the index **DF** (Krumpál after Kiefer et al. 1983), and from this, it is possible to characterize the relationship between a taxonomic group (taxon) and various factors, or hosts in more detail. The closest association with nests was observed in larval insects, *Siphonaptera*, and *Psocoptera*. In all these groups, the association can be considered as close. On the other side, there were groups weakly associated with nests, such as *Pseudoscorpiones* and *Thysanoptera*. Other groups were not abundant.

The mean abundance of invertebrates in Tree Sparrow nests was 91.6 specimens. The *Psocoptera* were most abundant dominants in Tree Sparrow nests (36.9 specimens per nest). The group of eudominants also included larval insects and *Siphonaptera*. Also the dominance of *Coleoptera* and *Araneae* was high. Other groups were less numerous, so their dominance was much lower.

The most frequent groups in Tree Sparrow nests were larval insects, occurring in 80 % of the nests. Very frequent were *Araneae*, *Siphonaptera* and *Coleoptera*. Three groups of invertebrates were closely associated with nests of this species: *Psocoptera*, larval insects, and *Siphonaptera*. All these groups can be considered as closely specialized. Not so closely associated with nests were *Coleoptera* and *Araneae*. The remaining groups were not abundant in nests.

Thus, Tree Sparrow nests are most abundantly inhabited by larval insects and *Coleoptera*. In terms of **DF**, the other groups occurred in the following order: *Psocoptera*, *Siphonaptera* and their larvae, followed by *Araneae*.

Generally, the fauna of House and Tree Sparrows can be categorized into several groups:

- 1) taxonomic groups abundantly and frequently occurring in nests of at least one of the sparrow species, and highly specialized for nests of a given host. This group comprises larval insects characterized by a high abundance, high frequency, and a narrow association with both *Passer* species. *Psocoptera* (species of the genus *Liposcelis*, for example *L. silvarum* and *Lachesilla pedicularia*) show similar characteristics, with high values of all the indices analysed. The third taxonomic group, characterized by relatively high values of the indices, comprises *Siphonaptera* (*Ceratophyllus gallinae*, *C. fringillae*). These are abundant in both species nests, and often specialized dwellers of sparrow nests. Other species of the genus *Ceratophyllus* (e.g. *C. sciurorum*) were less abundant and their specialization was not clear (Tables I, II; Appendix 1).
- 2) taxonomic groups occurring abundantly or frequently in nests of at least one sparrow species at least on one of the study sites, and characterized by a relatively high specialization for living in nests of a given host in a given area. This group comprises *Pseudoscorpiones*, *Araneae*, *Collembola*, *Coleoptera*, *Formicoidea*, *Diptera* and larval *Siphonaptera*. Larval fleas however, are difficult to categorize because they are little mobile, so cannot be extracted with a Tullgren apparatus. Their numbers and indices are likely to be higher when using another method of extraction. In view of this, it may be suggested that they should be included to the third ecological group. Among predators (*Pseudoscorpiones*, *Araneae* and part of *Coleoptera*) there are either permanent and characteristic inhabitants of nests of both sparrow species, or species using nests or nest surrounding (e.g. under tree bark

or in synanthropic habitats) as suitable microhabitat (*Cheiridium museorum*, *Chelifer cancroides*, *Dendrochernes cyrneus*, *Achaearanea tepidariorum*, *Theridion tinctum*, *Clubiona brevipes*, *Scotophaeus scutulatus*, *Gnathoncus spp.*, *Staphylinidae* etc.). Of course, some of these groups are represented by occasional or even accidental species. Regular nest dwellers also include some other *Coleoptera* species with different food requirements (detritophages, coprophages, phytophages, mycetophages, and the like). The occurrence of *Collembola* and *Diptera* in sparrow nests is related with their food and microhabitat requirements (Tables I, II; Appendix 1).

Table I

Fauna of House Sparrow (*Passer domesticus*) nests in terms of abundance (A), dominance (D), frequency (F), and DF index

Taxonomic group	A	D	F	DF
<i>Acarina</i>	52.83		41.4%	
Larvae <i>Insecta</i>	43.41	46.4%	89.7%	0.41597
<i>Siphonaptera</i>	18.86	27.1%	51.7%	0.14016
<i>Psocoptera</i>	13.10	14.0%	72.4%	0.10137
<i>Coleoptera</i>	13.06	13.9%	55.2%	0.07668
<i>Araneae</i>	3.79	4.1%	69.0%	0.02789
<i>Heteroptera</i>	0.62	0.7%	24.1%	0.00169
<i>Collembola</i>	0.13	0.1%	10.3%	0.00014
<i>Hymenoptera</i>	0.13	0.1%	13.8%	0.00019
<i>Diptera</i>	0.10	0.1%	6.7%	0.00007
<i>Thysanoptera</i>	0.06	0.1%	6.9%	0.00005
<i>Diplopoda</i>	0.03	0.0%	3.3%	0.00001
<i>Pseudoscor.</i>	0.03	0.0%	3.4%	0.00001
<i>Lepidoptera</i>	0.03	0.0%	3.3%	0.00001
<i>Dermaptera</i>	0.03	0.0%	3.3%	0.00001
<i>Annelida</i>	0.03	0.0%	3.4%	0.00001

Table II
Fauna of Tree Sparrow (*Passer montanus*) nests in terms of abundance (A), dominance (D), frequency (F), and DF index

Taxonomic group	A	D	F	DF
<i>Acarina</i>	105.68		58.6%	
<i>Psocoptera</i>	36.93	40.3%	40.3%	0.30108
<i>Larvae Insecta</i>	25.77	28.1%	80.5%	0.22606
<i>Siphonaptera</i>	14.82	16.2%	67.8%	0.10985
<i>Coleoptera</i>	7.54	8.2%	55.2%	0.04524
<i>Araneae</i>	5.05	5.5%	70.1%	0.03856
<i>Heteroptera</i>	0.77	0.8%	26.4%	0.00211
<i>Collembola</i>	0.2	0.2%	8.0%	0.00016
<i>Diptera</i>	0.15	0.2%	11.5%	0.00023
<i>Hymenoptera</i>	0.13	0.2%	4.6%	0.00007
<i>Thysanoptera</i>	0.1	0.1%	2.3%	0.00002
<i>Pseudoscor.</i>	0.08	0.1%	3.4%	0.00003
<i>Lepidoptera</i>	0.08	0.1%	8.0%	0.00006
<i>Formicoidea</i>	0.02	0.0%	1.2%	0.00000
<i>Larvae Siph.</i>	0.02	0.0%	2.3%	0.00000
<i>Mollusca</i>	0.02	0.0%	2.3%	0.00000
<i>Homoptera</i>	0.01	0.0%	1.1%	0.00000

- 3) taxonomic groups that were rare in nests of both sparrows, and were not narrowly specialized for living in nests. This group involves *Mollusca*, *Annelida*, *Oniscidea*, *Ixodidea*, *Chilopoda*, *Diplopoda*, *Thysanura*, *Dermaptera*, *Thysanoptera*, *Homoptera*, *Hymenoptera*, *Heteroptera* a *Lepidoptera*. These are mostly occasional inhabitants of avian nests, that cannot be classified to characteristic representatives of the fauna inhabiting House and Tree Sparrow nests. They can be brought to nests of sparrows for example with nest material or with food for nestlings, or they can be accidental immigrants from the surroundings, or the individuals searching for shelter from adverse weather. *Heteroptera* and *Lepidoptera* were an exception as their representatives found in nests of at least one

sparrow species (*Oeciacus hirundinis* and *Tinea pellionella*) belong to typical nest dwellers (Tables I, II; Appendix 1).

The representatives of these taxonomic groups can complete the whole life cycle in nests (e.g., *Psocoptera* and *Siphonaptera*), or only a part of it (larvae of different insects; however, larvae were not identified to species, thus it cannot be excluded that some of them complete their cycle in nests).

Characteristics of trophic groups of the fauna in House and Tree Sparrow nests

Ectoparasites

Subgroup of parasites of birds

Avian parasites are the most abundant trophic group in nests of both sparrow species (10 % of the total invertebrate fauna, although for individual species their dominance varied between 4 to 20 %). Among ectoparasites of birds, the most abundant were *Siphonaptera* (we did not determine numbers of *Acarina*). *Ceratophyllus gallinae* was the most abundant species in nests of Tree Sparrows. *Ceratophyllus fringillae* was most abundant in nests of House Sparrows and was an eudominant in nests of Tree Sparrows (Cyprich et al. 1997). *Ceratophyllus tribulis* was sporadic. Other species of fleas were little abundant (Appendix 1).

Ectoparasites of the group *Acarina* were abundantly represented (we did not estimate their numbers) in nests of both sparrow species. These were mainly obligatory parasites *Dermanyssus hirundinis*, *Dermanyssus gallinae* and facultative hematophages *Androlaelaps casalis* and *A. fahrenheiti* (Kaczmarek 1977b, 1991b, Chmielewski 1982, Fend'a and Pinowski 1997). Of the family *Ixodidae*, only *I. arboricola* was noted on rare occasions in Tree Sparrow nests in Slovakia (Appendix 1).

Subgroup: parasites of other animals

Representatives of this group were found on rare occasions (in only 0.01% of all the *Invertebrata* recorded from nests).

Parasitoids

Parasitoids were little more abundant than the preceding group (1%).

Zoophages

This trophic group was very abundant in sparrow nests (8 %). It included representatives of the family *Histeridae* and *Staphylinidae* (especially *Gnathoncus schmidti*, *G. buyssoni*, *Philonthus politus*, *Haploglossa pulla*, *H. nidicola*), known from nests of many birds (Kaczmarek 1977a, Kaczmarek 1991b, Majzlan and Rychlík 1992, Šustek and Krištofik 1990). Other species are shown in Appendix 1. Zoophages include *Pseudoscorpiones* (14 species) and *Araneae* (30 species). The following species characteristic of bird nests: *Cheiridium museorum*, *Chelifer cancroides*, *Dendrochernes cyrneus*, *Achaeearanea tepidariorum*, *Theridion tinctum*, *Clubiona brevipes*, *Scotophaeus scutulatus*, and some others (Krumpál and Cyprich 1988, Gajdoš et al. 1991). Among *Acarina* occurring in nests, the following zoophages were noted: *Hypoaspis lubrica*, *Macrocheles tridentinus*, *Parasitus hyalinus*, but they were not abundant (Fend'a and Pinowski 1997, Chmielewski 1982).

Phytophages, saprophages, necrophages and coprophages

This group accounts for the major part of the nest fauna (63%). We include here a broader spectrum of consumers of the first and second orders, as we did not identify larvae of insects and fleas, or taxonomic groups such as *Diptera* and *Collembola*. Despite this, it can be stated that the most abundant saprophages were represented mainly by larval fleas, partly by larvae of other insects, *Collembola*, *Diptera*, *Coleoptera* and less often *Oniscidea* and *Diplopoda*. Other groups were less abundant, although phytophages were relatively numerous (e.g., representatives of the families *Chrysomelidae*, *Curculionidae*, *Forficula auricularia* etc.). Necrophages were represented mostly by species of *Silphidae*, *Dermestidae* and *Cholevidae* (e.g., *Anthrenus pimpinellae*). Coprophages showing preference for nests with much faeces, such as *Sturnus vulgaris* and *Upupa epops*, were rare (*Uropoda* sp., *Cercyon convexiusculus*). Kaczmarek (1977a, 1977b, 1991a) found the same.

Mycetophages (Mycophages)

Representatives of this group accounted for 2 % of all *Invertebrata*. It includes some species of the *Coleoptera* (*Cryptophagus acutangulus*, *Atomaria* sp., *Corticaria* spp., *Enicmus minutus* etc.). Presumably, mycophages are present also among *Collembola* and *Diptera*.

Pantophages

In particular, this group is represented by ants of the genera *Formica* and *Myrmica*.

DISCUSSION

The mean numbers of the fauna recorded from nests of House and Tree Sparrows in central Poland were 2.5 times higher than those in Pomerania, northern Poland (Kaczmarek 1991b). This author analysed only insects, whereas we included also other *Invertebrata* groups, but these were not abundant and did not greatly influence the totals. Similarly, the results of a study of Tree Sparrow nests from Słowiński National Park (Pomerania, northern Poland) are even lower (16.5 specimens per nest) (Kaczmarek and Pajkert 1987). Our results are similar to those also obtained from nest boxes by Ondřejková et al. (1991) - 178.9 specimens per nest, and also from nests in burrows of *Riparia riparia* - 84.9 specimens per nest (Krumpál et al. 1993). The group of eudominants comprised larval fleas in northern Poland (Pomerania) (Kaczmarek 1991b), and a *Psocoptera* in central Poland. In our material, different larval insects are numerous, and flea larvae are less abundant. In northern Poland (Pomerania), the dominants were *Dermaptera* in addition to *Siphonaptera* and *Collembola* (Kaczmarek 1991b).

Among trophic groups, the most abundant were saprophages and phytophages. Their proportions varied from 60 % to 71 %. Differences were noted in the occurrence of avian ectoparasites, which in Pomerania accounted for 37 % of the House Sparrow nest fauna, and 19.4% of the Tree Sparrow, but in our material only for 10 %. High numbers of avian parasites were found in nests of *Riparia riparia* (57.2%) and in nests from nest boxes (20 %) (Krumpál et al.

1991, 1993). In material from Slovakia also pantophages were abundant (16 %) due to their mass occurrence (Krumpál et al. in print). Similar differences were found in zoophages. In northern Poland (Pomerania), zoophages reached 0.2-0.8%, and in Slovakia 8 %, although to some extent this is because Kaczmarek (1991b) did not include *Pseudoscorpiones* and *Araneae*. The abundance of parasitoids was low in all regions. We distinguished a trophic group of mycetophages (mycophages), (like Majzlan and Rychlik 1992, and Jurík and Šustek 1982), but Kaczmarek (1991b) included mycophages to phytophages. It seems that because of the specific microclimate in nests, especially in holes, mycophages are an important group of nest fauna. In Slovakia and central Poland, they accounted for 3 %. Even higher values were found for beetles from nests of House Sparrows (5 %) (Jurík and Šustek 1982), and also from nests of different bird species, including both sparrow species (20 %) (Majzlan and Rychlik 1992).

SUMMARY

Of 116 House Sparrow and Tree Sparrow nests, 10759 invertebrate specimens were isolated belonging to 20 taxonomic groups. In addition, larvae of insects and fleas were recorded.

In nests of House Sparrows the most abundant group were larval insects, *Siphonaptera*, and *Psocoptera*, however their specialization was not so clear.

In Tree Sparrow nests most specialized were *Psocoptera*, larval insects, and *Siphonaptera*. A relatively narrow specialization showed *Coleoptera* and *Araneae*. Other groups were rare in Tree Sparrow nests.

We categorized nest fauna into three groups:

1. taxonomic groups abundant and frequent in nests of at least one of the two sparrow species, and closely associated with nests of a given host species.
2. taxonomic groups abundant in nests of at least one of the two sparrow species and narrowly specialized for nests of a given host species.
3. taxonomic groups not abundant and infrequent in nests of both sparrow species, that were not specialized for sparrow nests.

Representatives of group 1 occurred regularly. They completed their life cycle in nests, as it is the case of *Psocoptera* and *Siphonaptera* or at least a part of it (larvae of different insects, but as they were not identified, it cannot be

excluded that they completed their cycle in nests). Different trophic, topic, and microclimatic conditions play part in this process.

In terms of trophic interactions, we found ectoparasites, including ectoparasites of birds and other animals, also parasitoids, zoophages, a group comprising phytophages, saprophages, necrophages, coprophages, and then pantophages and mycophages. Among them, most abundant were phyto- sapro-, necro-, and coprophages.

The check-list of invertebrates recorded from House and Tree Sparrow nests is in Appendix 1.

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Appendix 1

List of *Invertebrata* species in sparrow nests in Poland [PL] (this paper) and Slovakia [SK] (Krumpál et al. in press). Abbreviations: SAP – saprophage, S-PHY – sapro-phytophage, S-MYC – sapro-mycetophage, PHY – phytophage, ZOO – zoophage, PAR – parasite, FH – facultative haematophage

	<i>Passer domesticus</i>		<i>Passer montanus</i>		<i>Passer</i> sp.		Trophic level
	PL	SK	PL	SK	PL	SK	
<i>ONISCIDEA</i>							
<i>Armadillidium versicolor</i>				+			SAP
<i>Armadillidium quinqueseriatum</i>							
<i>Armadillidium zenckeri</i>				+			SAP
<i>Porcellium collicolum</i>				+			SAP
<i>Trachelipus rathkii</i>				+			SAP
<i>ACARINA</i>							
<i>Amblyseius</i> sp.		+					ZOO
<i>Ameroseius plumea</i>			+	+			ZOO
<i>Androlaelaps casalis</i>	+	+	+	+	+	+	FH
<i>Androlaelaps fahrenheitzi</i>				+			FH
<i>Asternolaelaps querci</i>				+			?
<i>Blattisocius tarsalis</i>	+		+				ZOO
<i>Cyrtolaelaps chiropterae</i>			+				ZOO
<i>Dermanyssus gallinae</i>	+	+	+	+	+		PAR
<i>Dermanyssus hirundinis</i>	+		+	+	+	+	PAR
<i>Echinonyssus musculi</i>			+				PAR
<i>Eulaelaps stabularis</i>			+	+			FH
<i>Haemogamasus nidi</i>			+	+			FH
<i>Hypoaspis lubrica</i>				+			ZOO

<i>Hypoaspis marginopilosa</i>			+			ZOO
<i>Laelaps agilis</i>			+	+		PAR
<i>Lasioseius penicilliger</i>				+		?
<i>Leioseius bicolor</i>				+		?
<i>Macrocheles penicilliger</i>			+			ZOO
<i>Macrocheles</i> sp.			+			ZOO
<i>Nenteria breviunguiculata</i>			+			SAP
<i>Ornithonyssus pipistrelli</i>				+		?
<i>Ornithonyssus sylviarum</i>				+		?
<i>Paragarmania dentritica</i>	+	+	+	+	+	ZOO
<i>PARllus talparum</i>			+			ZOO
<i>Parasitus hyalinus</i>		+		+		ZOO
<i>Proctolaelaps longanalis</i>			+			ZOO
<i>Proctolaelaps pini</i>				+		?
<i>Proctolaelaps pygmaeus</i>		+		+		?
<i>Trichouropoda orbicularis</i>				+		?
<i>Trichouropoda ovalis</i>				+	+	?
<i>Trichouropoda tuberosasimilis</i>		+				?
<i>Uropoda</i> sp.				+		ZOO
<i>Uroseius infirmus</i>				+		?
<i>Uroseius trogicollis</i>			+			?
<i>Vulgarogamasus oudemansi</i>			+			ZOO
<i>Vulgarogamasus remberti</i>			+			ZOO
<i>Ixodidae</i>						
<i>Ixodes arboricola</i>				+		PAR
<i>Ixodes</i> sp.	+	+		+		PAR

<i>Haemaphysalis concinna</i>				+			PAR
PSEUDOSCORPIONES							
<i>Cheiridiidae</i>							
<i>Cheiridium museorum</i>		+	+				ZOO
<i>Cheliferidae</i>							
<i>Chelifer cancroides</i>		+	+				ZOO
<i>Dactylochelifer latreillei</i>				+		+	ZOO
<i>Neobisiidae</i>							
<i>Neobisium carcinoides</i>				+			ZOO
<i>Chernetidae</i>							
<i>Lamprochernes nodosus</i>				+			ZOO
<i>Chernes cimicoides</i>				+			ZOO
<i>Chernes hahni</i>				+			ZOO
<i>Chernes</i> sp.				+		+	ZOO
<i>Dendrochernes cyrneus</i>				+		+	ZOO
<i>Allochernes vicinus</i>				+			ZOO
<i>Toxochernes similis</i>				+			ZOO
<i>Toxochernes panzeri</i>				+			ZOO
<i>Pselaphochernes</i> sp.				+			ZOO
ARANEAE							
<i>Dysderidae</i>							
<i>Dysdera</i> sp.		+		+		+	ZOO
<i>Harpactea hombergi</i>				+		+	ZOO
<i>Harpactea rubicunda</i>				+			ZOO
<i>Theridiidae</i>							
<i>Achaearana tepidariorum</i>		+		+		+	ZOO
<i>Neottiura bimaculatum</i>		+		+			ZOO
<i>Theridion pinastri</i>				+			ZOO

<i>Theridion tinctum</i>		+		+		+	ZOO
<i>Linyphiidae</i>							
<i>Leptyphantes minutus</i>				+			ZOO
<i>Araneidae</i>							
<i>Larinioides ixobulus</i>				+			ZOO
<i>Agelenidae</i>							
<i>Agelena labyrinthica</i>		+		+		+	ZOO
<i>Tegenaria agrestis</i>				+			ZOO
<i>Tegenaria campestris</i>				+		+	ZOO
<i>Tegenaria ferruginea</i>				+			ZOO
<i>Dictynidae</i>							
<i>Dictyna arundinacea</i>				+			ZOO
<i>Lathys humilis</i>		+					ZOO
<i>Nigma viridissima</i>				+		+	ZOO
<i>Amaurobiidae</i>							
<i>Amaurobius fenestralis</i>				+			ZOO
<i>Liocranidae</i>							
<i>Liocranum rupicola</i>		+		+			ZOO
<i>Clubionidae</i>							
<i>Clubiona brevipes</i>		+		+		+	ZOO
<i>Clubiona marmorata</i>				+			ZOO
<i>Clubiona</i> sp.		+		+		+	ZOO
<i>Gnaphosidae</i>							
<i>Scotophaeus scutulatus</i>		+		+		+	ZOO
<i>Philodromidae</i>							
<i>Philodromus aureolus</i>		+		+		+	ZOO
<i>Philodromus emarginatus</i>		+		+		+	ZOO
<i>Philodromus</i> sp.		+		+		+	ZOO
<i>Thomisidae</i>							

<i>Ozyptila praticola</i>				+		ZOO
<i>Xysticus</i> sp.				+		ZOO
<i>Salticidae</i>						
<i>Salticus zebraenus</i>		+		+		ZOO
<i>Salticus</i> sp.				+		ZOO
DIPLOPODA						
<i>Polyxenus lagurus</i>				+	+	SAP
THYSANURA						
<i>Lepisma saccharina</i>	+					SAP
NEUROPTERA						
<i>Chrysoperla carnea</i>				+		ZOO
DERMAPTERA						
<i>Forficula auricularia</i>		+				SAP
PSOCOPTERA						
<i>Liposcelis silvarum</i>	+		+			SAP
<i>Lachesilla pedicularia</i>	+					SAP
THYSANOPTERA						
<i>Haplothrips aculeatus</i>				+		PHY
<i>Chirothrips manicatus</i>		+		+		PHY
<i>Limothrips denticornis</i>		+		+		PHY
<i>Taeniothrips atratus</i>		+				PHY
<i>Thrips major</i>		+		+		PHY
<i>Thrips viminalis</i>				+		PHY
HETEROPTERA						
<i>Oeciacus hirundinis</i>		+		+	+	PAR
HYMENOPTERA						
<i>Aleiodes crassipes</i>				+		ZOO*
<i>Apanteles carpatis</i>				+		ZOO*
<i>Apanteles immunis</i>				+		ZOO*
<i>Chremylus elaphus</i>				+		ZOO*
<i>Opius pallipes</i>				+		ZOO*
FORMICOIDEA						

<i>Formica</i> sp.	+		+		+		PAN
<i>Myrmica rubida</i>			+				PAN
LEPIDOPTERA							
<i>Tinea pelionella</i>					+		SAP
COLEOPTERA							
Carabidae							
<i>Dyschirius globosus</i>					+		ZOO
<i>Platynus assimilis</i>					+		ZOO
<i>Platynus krynickii</i>					+		ZOO
Hydraenidae							
<i>Hydrochus brevis</i>					+		S-PHY
Hydrophylidae							
<i>Cercyon covexusculus</i>					+		S-PHY
Histeridae							
<i>Gnathoncus schmidti</i>		+			+		ZOO
<i>Gnathoncus buyssoni</i>					+		ZOO
<i>Margarinotus merdarius</i>					+		ZOO
Silphidae							
<i>Necrophorus fossor</i>					+		SAP
<i>Necrophorus vespilloides</i>					+		SAP
<i>Oeceptoma thoracica</i>					+		SAP
Cholevidae							
<i>Nemadus colonoides</i>					+		SAP
<i>Scridrepoides fumatus</i>					+		SAP
Orthoperidae							
<i>Sericoderus lateralis</i>		+					?
Staphylinidae							
<i>Phloeocharis subtilissima</i>					+		?
<i>Eusphalerum longipenne</i>					+		?

<i>Cryptophagidae</i>							
<i>Atomaria atrata</i>		+					S-MYC
<i>Cryptophagus acutangulus</i>		+					S-MYC
<i>Lathridiidae</i>							
<i>Enicmus minutus</i>		+					S-MYC
<i>Corticaria serrata</i>		+		+			S-MYC
<i>Corticaria inconspicua</i>				+			S-MYC
<i>Corticaria truncatella</i>		+					S-MYC
<i>Mycetophagidae</i>							
<i>Typhaea stercorea</i>		+					S-MYC
<i>Colydiidae</i>							
<i>Cerylon histeroideis</i>				+			S-MYC
<i>Coccinellidae</i>							
<i>Coccinella septempunctata</i>				+			ZOO
<i>Anobiidae</i>							
<i>Stegobium paniceum</i>				+			S-PHY
<i>Ptinidae</i>							
<i>Ptinus fur</i>				+			SAP
<i>Ptinus raptor</i>				+			SAP
<i>Tenebrionidae</i>							
<i>Alphitobius diaperinus</i>				+			S-MYC
<i>Stenomax aeneus</i>				+			S-MYC
<i>Scarabeidae</i>							
<i>Trox scaber</i>				+			SAP
<i>Chrysomelidae</i>							
<i>Cryptocephalus populi</i>				+			PHY
<i>Chrysomela diversipes</i>				+			PHY
<i>Agelastica alni</i>				+			PHY
<i>Phylotretta vittula</i>				+			PHY
<i>Podagrica malvae</i>				+			PHY

<i>Curculionidae</i>							
<i>Otiiorhynchus bisulcatus</i>				+			PHY
<i>Otiiorhynchus raucus</i>				+			PHY
<i>Sitona lineatus</i>				+			PHY
<i>Sitona hispidulus</i>				+			PHY
<i>Tanysphyrus lemnae</i>				+			PHY
<i>Furcipes rectirostralis</i>				+			PHY
<i>Rhynchaenus populi</i>				+			PHY
SIPHONAPTERA							
<i>Ceratophyllidae</i>							
<i>Ceratophyllus gallinae</i>	+	+	+	+	+	+	PAR
<i>Ceratophyllus fringillae</i>	+	+	+	+		+	PAR
<i>Ceratophyllus garrei</i>		+	+	+	+		PAR
<i>Ceratophyllus pullatus</i>		+	+	+			PAR
<i>Ceratophyllus rusticus</i>						+	PAR
<i>Ceratophyllus tribulis</i>		+	+	+		+	PAR
<i>Ceratophyllus sciurorum</i>		+	+			+	PAR
<i>Ceratophyllus styx</i>		+					PAR
<i>Ceratophyllus</i> sp.			+				PAR
<i>Dasypsyllus gallinulae</i>		+		+			PAR
<i>Ctenophthalmus agyrtes</i>				+			PAR
<i>Ctenophthalmus assimilis</i>				+			PAR
<i>Ctenophthalmus solutus</i>				+			PAR
<i>Megabothris turbidus</i>			+	+		+	PAR
<i>Nosopsyllus fasciatus</i>				+		+	PAR