Mites (Acarina, Gamasida) in littoral zone of Jakubov fishponds (Slovakia)

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The research on the gamasid mites in the littoral zone of Jakubov ponds was conduced from May 1997 to March 1999. The majority of the material was collected from old duck nests. A small amount of mites came from almost permanently flooded reed stands near the pond shore, directly from the reeds or from falling plant material, on the water. Changes in the structure and composition of the assemblages of Gamasida were examined. The most abundant families were Macrochelidae, Trematuridae, Parasitidae and Zerconidae. Gamasid mites were active throughout the year. Coprophilous mite species achieved maximum numbers in autumn and free-living predators and uropodid mites achieved maximum numbers in early spring.

Keywords: Oribatida Gamasida, soil, community structure, habitat and trophic preferences.

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Introduction

The occurrence of mites in the littoral zone of fishponds has been studied only marginally in the general surveys of mites living in nests of birds. Jakubov fishponds are probably the most frequently investigated area in Slovakia, but here is are only 31 known species of mesostigmatid mites. They have been monitored in several papers dealing with nest fauna of different birds (Ambros et al., 1992; Krištofík et al., 1993; Mašán and Krištofík, 1995; Fenďa, 1999; Fenďa and Schniererová, 2000; Krištofík et al., 2001) or phoretic mites on beetles (Mašán, 1993). The aim of this paper is to determine the structure of fauna of mesostigmatid mites in several habitats of the littoral zone of fishponds.

Material and methods

The site, Jakubovské rybníky fishponds, is situated in the SW Slovakia (Borská nížina lowland, 150 m a.s.l., 48°24' N, 16°57' E) on a blown sand area. Vegetation of the littoral zone is constituted mostly by almost permanently flooded reed stands of *Phragmites australis* (Cav.) Trin. et Steud. and *Carex* spp., and fishponds are enclosed by agrocoenoses and pine forests.

The total number of samples were 204: 131 samples of litter come from the nests of *Anas platyrhynchos* Linnaeus, 1758; *Aythya ferina* (Linnaeus, 1758); *A. fuligula* (Linnaeus, 1758) and their old abandoned nests. 58 samples represented leaves and stems of *Phragmites australis* and nests of *Acrocephalus arundinaceus* (Linnaeus, 1758) and *A. scirpaceus* (Hermann, 1804), and 15 samples consisted of reed material which has fallen on the water and nests of *Fulica atra* Linnaeus, 1758; *Ixobrychus minutus* (Linnaeus, 1766) and *Podiceps cristatus* (Linnaeus, 1758).

Samples of standard volume 300 cm^3 and small nests were taken during three years (since May 1997 till March 1999). Mites from samples and nests were extracted using Tullgren funnels, preserved in 70 % ethylalcohol and they were mounted on slides using Liquido de Swann.

The species abundance relationship after Ludwig and Reynolds (1988) was used to compare the structure of the mite communities [N0 – number of species, N1 – $e^{H'}$ (H' is Shannon index), N2 – 1/λ (λ is Simpson index), E1 – Pielou evenness index]. The significance was tested by t-Student test (Poole, 1974). The estimation of species richness was performed on the basis of nonparametric estimators (Colwell, 1997) Chao 1 (an abundance-based estimator of species richness) and Chao 2 (an incidence-based estimator of species richness).

Results

A total of 55 909 gamasid mites were extracted. Analysis of the material revealed 123 species. The collector‘s curve shows, that 131 soil samples are not adequate number to recover maximum fauna (Fig. 1).

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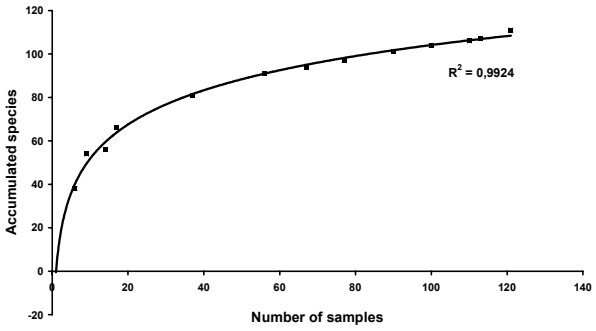

Fig. 1. Collector's curve for soil habitat (Gleason model).

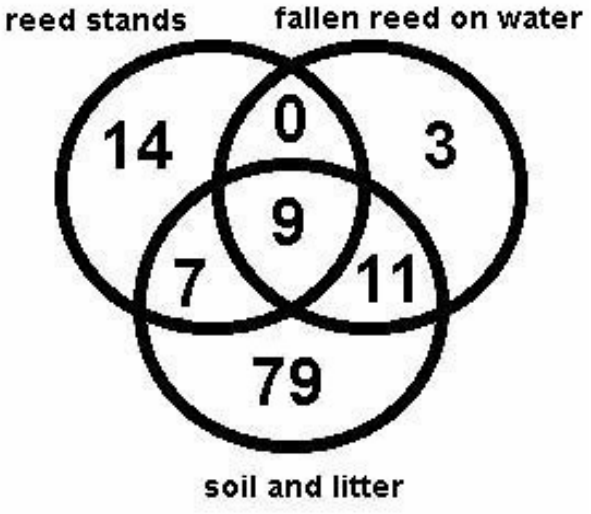

Fig. 2. Number of common species in habitats

Similar situations occur in other examined habitats. An estimation of species richness on the basis of nonparametric estimators (Colwell, 1997) renders a total of 146.5 species (Chao 1) vs. 198.6 species (Chao 2); in soil 122.9 species (Chao 1) vs. 147.3 (Chao 2), on reed stands 72.4 species (Chao1) vs. 69.2 (Chao 2), and on the water level 33.1 species (Chao1) vs. 25.6 (Chao 2).

Only 9 species were common to the litter on the fishpond shore, the almost permanently flooded reed stands and the fallen plant material on the water level (Fig. 2). The highest species richness was found in soil samples. Representatives of the cohors Uropodina, Sejina and families Veigaiaidae and Parasitidae (subfamily Pergamasinae) occurred only in soil (Table 1). Plant inhabiting mite predators from the family Phytoseiidae were recorded exclusively on reed stands. Hygrophilous species from the family Ascidae predominated in plant material sampled on the water surface. The strong soggy nests of the great crested grebe (*Podiceps cristatus*) were without mites. The mite species found in the examined habitats belonged to different trophic groups. The soil predators (40 %) and coprophilous predators (32 %) predominated in litter, parasitic mites (95 %) dominated in the nests of reed warblers, predators on plants (39 %) and parasitic mites (36 %) prevailed directly on reed, and on the water surface soil predators (80 %). T-Student test showed the significant differences in H' between communities in habitats (soil and reed stands t = 153,038***, soil and fallen reed on water level t = 15,374***, reed stands and fallen reed on water level t = 22,270***).

When we compared samples of litter and old nests situated on the ground, there were no differences in species composition. Marked differences were observed in the abundance of certain species (e.g. in September *Macrocheles penicilliger* with 301.7 ind. per nest vs. 0.3 ind. per sample of litter, *Uropoda minima* 14.8 ind. vs. 2.3 ind.).

There was no decrease of species richness in soil and reed stands during the winter months. In litter species richness achieved maximum in May (57 species) and minimum in March (23 species). On the other hand soil mites achieved the maximum of abundance in April, September and December, and minimum in March and May. There were observed changes in the abundance of dominant species throughout the year. Soil saprophages (above all *Trichouropoda karawaiewi* and *Trichouropoda ovalis*) gradually colonized mainly in heaps of plant material on the ground (former nests of ducks) with maximum abundance in April. As similar situation was observed in some free-living soil predators (e.g. *Zercon peltatus* in February). Coprophilous predators (mainly mites of the family Macrochelidae) achieved maximum in September (except for *Macrocheles rotundiscutis* in June). The abundance of the plant inhabiting predators from the family Phytoseiidae achieved the maximum in the nests of reed warblers in September and again on the reeds in November. It seems that a part of their population hibernated in the nests. Hygrophilous mites of the family Ascidae (mainly *Lasioseius confusus*) at first achieved maximum in soil in May, later on achieved maximum in the nests of reed warblers and in the fallen plant material on the water surface in June, where their abundance was the highest in comparison with other studied habitats. The ectoparasitic mite *Ornithonyssus sylviarum* reached maximum directly on reeds in July and in August, and in nests of reed warblers in August. This maximum in July can be explained by overpopulation in nests during nesting period and following migration, although this maximum in August in deserted nests, a long time after abandonment, is interesting.

Discussion

The occurrence of mites in the littoral zone of fishponds has been studied only marginally in general surveys of mites living in nests of birds. The complex view of the structure of gamasid mite communities in various habitats of the littoral zone was absent. The majority of the soil mites from the cohors Gamasina are highly mobile predators (Karg, 1993). Therefore

migration of certain species, probably through leaves and stems of reed, must be taken under consideration (Fig. 2). The gamasid mites living in soil are affected by external factors such as vegetation, climate, type of soil and human activity (Szymkowiak, 1999). From this point of view the littoral zone suggests relatively stable microclimatic conditions. Development of soil mites is determined by specific microclimate depending on the structure of the herbal layer vegetation, shrubs, tree stands and soil (Koehler, 1997).

Differences in abundance of certain species in litter and in old nests situated on the ground indicate that old nests are evidently suitable microhabitats for the majority of soil mites, because of the accumulation of decaying plant material and sufficient organic matter. Gamasid mites feeding on nematodes and insect larvae show a great preference in colonization of places like compost and manure (Karg, 1993). Likewise in compost heaps, gamasid mites were active throughout the year, with two main periods of high abundance, in June and September (Skoracka et al., 2002a). We also observed a marked maximum in September and species composition in the litter of littoral zone was similar to the species composition in compost heaps. Skoracka et al. (2002b) collected 35 species from compost heaps, and 24 of them were observed also in Jakubov fishponds. Another species without marked preferences to compost and manure materials (dominant species from cohors Uropodina) belong to typical eurytopic species found in humid and dry litter both in the open space and in the forests. *Trichouropoda karawaiewi*, *T. ovalis* and *Uropoda minima* were dominant species with the highest rate of constancy in the soil of urban green in Poznań, Poland (Krysiak et al., 2002).

In total 123 species of gamasid mites was found and another 11 species [*Amblyseius bicaudus* Wainstein, 1962 (Mašán and Krištofík, 1995); *Cheiroseius borealis* (Berlese, 1903) (Ambros et al., 1992); *Dictydionotus pepperi* (Specht, 1968) (Krištofík et al., 1993); *Holoparasitus excipuliger* (Berlese, 1905); *Holostaspella exornata* Filipponi et Pegazzano, 1967; *Macrocheles montanus* Willmann, 1951; *Parasitus hyalinus* (Willmann, 1949); *Pergamasus brevicornis* (Berlese, 1903); *Porrhostaspis lunulata* J.Müller, 1869; *Trachygamasus ambulacralis* Willmann, 1949 (Ambros et al., 1992); and *Typhlodromus rhenanus* (Oudemans, 1905) (Krištofík et al., 1993)] are known from published papers. At the present time, the Jakubov fishponds are the localities with the greatest known richness of gamasid mites in Slovakia.

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Table 1. Mites in three types of habitats. N – number of specimens, D% – dominance, C% – constancy, N0 – number of species, N1 – $e^{H'}$ (H' is Shannon index), N2 – 1/λ (λ is Simpson index), E1 – Pielou evenness index.

TAXON	soil and litter			reed stands			fallen reed on water		
	N	D%	C%	N	D%	C%	N	D%	C%
GAMASINA									
Ameroseiidae									
Ameroseius corbiculus (Sowerby, 1806)	21	0.04	3.05	-	-	-	-	-	-
Ameroseius lidiae Bregetova, 1977	13	0.03	3.82	-	-	-	-	-	-
Epicriopsis horridus (Kramer, 1876)	418	0.86	33.59	-	-	-	-	-	-
Ascidae									
Arctoseius cetratus (Sellnick, 1940)	8	0.02	3.82	3	0.05	1.72	2	0.46	6.67
Arctoseius semiscissus (Berlese, 1892)	145	0.3	10.69	6	0.09	3.45	43	9.86	26.67
Asca aphidioides (Linnaeus, 1758)	-	-	-	1	0.01	1.72	-	-	-
Asca bicornis (Canestrini et Fanzago, 1887)	2	0.004	0.76	-	-	-	-	-	-
Blattisocius keegani Fox, 1947	9	0.02	1.53	1	0.01	1.72	-	-	-
Cheiroseius cassiteridium (Evans et Hyatt, 1960)	23	0.05	5.34	-	-	-	29	6.65	13.33
Cheiroseius curtipes (Halbert, 1923)	164	0.34	9.92	-	-	-	-	-	-
Cheiroseius mutilus (Berlese, 1916)	19	0.04	3.82	-	-	-	2	0.46	6.67
Cheiroseius serratus (Halbert, 1915)	1	0.002	0.76	-	-	-	-	-	-
Cheiroseius viduus (C.L.Koch, 1839)	10	0.02	5.34	-	-	-	-	-	-
Iphidozercon gibbus (Berlese, 1903)	38	0.08	6.87	-	-	-	-	-	-
Lasioseius berlesei (Oudemans, 1938)	50	0.1	5.34	-	-	-	-	-	-
Lasioseius confusus Evans, 1958	181	0.37	12.98	27	0.4	13.79	217	49.77	33.33
Leioseius bicolor (Berlese, 1918)	42	0.09	6.87	-	-	-	-	-	-
Leioseius minusculus (Berlese, 1905)	356	0.73	29.01	29	0.43	10.34	7	1.61	20
Neojordensia sinuata Athias-Henriot, 1973	1	0.002	0.76	17	0.25	6.9	2	0.46	13.33
Paragarmania dentritica (Berlese, 1918)	7	0.01	0.76	77	1.15	10.34	-	-	-
Platyseius sp.	-	-	-	-	-	-	1	0.23	6.67
Plesiosejus italicus (Berlese, 1905)	94	0.19	6.87	-	-	-	-	-	-
Plesiosejus major (Halbert, 1923)	1	0.002	0.76	-	-	-	17	3.9	20
Proctolaelaps fiseri Samšiňák, 1960	1	0.002	0.76	-	-	-	-	-	-
Proctolaelaps pygmaeus (Müller, 1860)	660	1.35	9.16	-	-	-	-	-	-
Proctolaelaps sp.	-	-	-	1	0.01	1.72	-	-	-
Dermanyssidae									
Dermanyssus gallinae (De Geer, 1778)	1	0.002	0.76	8	0.12	5.17	-	-	-
Dermanyssus hirundinis (Hermann, 1804)	156	0.32	13.74	32	0.48	13.79	-	-	-
Digamasellidae									
Dendrolaelaps arvicolus (Leitner, 1949)	9	0.02	1.53	-	-	-	-	-	-
Dendrolaelaps fallax (Leitner, 1949)	1	0.002	0.76	-	-	-	-	-	-
Dendrolaelaps latior (Leitner, 1949)	266	0.55	7.63	1	0.01	1.72	19	4.36	6.67
Dendrolaelaps zwoelferi Hirschmann, 1960	4	0.01	1.53	-	-	-	-	-	-
Dendrolaelaps sp.	5	0.01	3.05	-	-	-	2	0.46	13.33
Dendrolaelaspis sp.	19	0.04	5.34	-	-	-	-	-	-
Eviphididae									
Alliphis halleri (G. et R.Canestrini, 1881)	1	0.002	0.76	-	-	-	-	-	-
Eviphis ostrinus (C.L.Koch, 1836)	767	1.57	48.09	-	-	-	-	-	-
Laelapidae									
Androlaelaps casalis (Berlese, 1887)	163	0.33	3.82	2	0.03	1.72	-	-	-
Androlaelaps fahrenholzi (Berlese, 1911)	23	0.05	3.82	-	-	-	-	-	-
Eulaelaps stabularis (C.L.Koch, 1836)	323	0.66	11.45	-	-	-	-	-	-
Haemogamasus horridus Michael, 1892	2	0.004	1.53	-	-	-	-	-	-
Haemogamasus nidi Michael, 1892	146	0.3	5.34	-	-	-	-	-	-
Hypoaspis aculeifer G. Canestrini, 1884	9	0.02	1.53	-	-	-	-	-	-
Hypoaspis angustiscutata Willmann, 1951	1	0.002	0.76	-	-	-	-	-	-
Hypoaspis aff. *curtipilis* Hirschmann, 1969	1	0.002	0.76	-	-	-	-	-	-
Hypoaspis aff. *giffordi* Evans et Till, 1966	4	0.01	1.53	-	-	-	1	0.23	6.67
Hypoaspis heyi Karg, 1962	331	0.68	7.63	-	-	-	-	-	-
Hypoaspis lubrica Voigts et Oudemans, 1904	152	0.31	5.34	-	-	-	-	-	-
Hypoaspis aff. *lubricoides* Karg, 1971	1	0.002	0.76	-	-	-	-	-	-
Hypoaspis aff. *marginepilosa* Sellnick, 1940	1	0.002	0.76	-	-	-	-	-	-
Hypoaspis miles (Berlese, 1892)	245	0.5	8.4	-	-	-	-	-	-
Hypoaspis vacua (Michael, 1891)	251	0.51	12.21	-	-	-	-	-	-
Hypoaspis sp.	1	0.002	0.76	-	-	-	-	-	-
Ololaelaps placentulus (Berlese, 1887)	1789	3.67	73.28	-	-	-	-	-	-
Ololaelaps sellnicki Bregetova et Koroleva, 1964	11	0.02	3.05	-	-	-	-	-	-
Macrochelidae									
Geholaspis hortorum (Berlese, 1904)	215	0.44	29.77	-	-	-	-	-	-
Geholaspis longispinosus (Kramer, 1876)	368	0.76	43.51	-	-	-	-	-	-

Table 1. Continuation.

TAXON	soil and litter			reed stands			fallen reed on water		
	N	D%	C%	N	D%	C%	N	D%	C%
Holostaspella neglecta Krauss, 1970	37	0.08	2.29	-	-	-	5	1.15	6.67
Holostaspella ornata (Berlese, 1903)	17	0.03	8.4	-	-	-	-	-	-
Macrocheles glaber (J. Müller, 1859)	8	0.02	0.76	-	-	-	1	0.23	6.67
Macrocheles merdarius (Berlese, 1889)	-	-	-	1	0.01	1.72	-	-	-
Macrocheles muscaedomesticae (Scopoli, 1772)	-	-	-	-	-	-	14	3.21	13.33
Macrocheles nataliae Bregetova et Koroleva, 1960	3	0.01	0.76	-	-	-	-	-	-
Macrocheles penicilliger (Berlese, 1903)	12101	24.82	61.07	-	-	-	1	0.23	6.67
Macrocheles robustulus (Berlese, 1903)	222	0.45	3.05	-	-	-	-	-	-
Macrocheles rotundiscutis Bregetova et Koroleva, 1960	314	0.64	14.5	-	-	-	-	-	-
Macrocheles subbadius (Berlese, 1904)	-	-	-	1	0.01	1.72	-	-	-
Macrocheles tardus (C.L. Koch, 1841)	1018	2.09	59.54	-	-	-	-	-	-
Macronyssidae									
Ornithonyssus sylviarum (Canestrini et Fanzago, 1877)	31	0.06	1.53	6226	92.69	36.21	25	5.73	6.67
Pachylaelapidae									
Olopachys suecicus Sellnick, 1950	16	0.03	3.82	-	-	-	-	-	-
Pachylaelaps ineptus Hirschmann et Krauss, 1965	6	0.01	4.58	-	-	-	-	-	-
Pachylaelaps pectinifer (G.et R.Canestrini, 1882)	133	0.27	6.87	-	-	-	-	-	-
Pachyseius humeralis Berlese, 1910	1	0.002	0.76	-	-	-	-	-	-
Parasitidae									
Cornigamasus lunaris (Berlese, 1882)	96	0.2	7.63	-	-	-	4	0.91	13.33
Gamasodes bispinosus (Halbert, 1915)	-	-	-	-	-	-	23	5.28	13.33
Gamasodes spiniger (Trägårdh, 1910)	57	0.12	6.11	1	0.01	1.72	1	0.23	6.67
Holoparasitus calcaratus (C.L. Koch, 1839)	2536	5.2	76.34	-	-	-	-	-	-
Leptogamasus succineus Witaliński, 1973	7	0.01	2.29	-	-	-	-	-	-
Lysigamasus aff. *orthogynellus* (Athias-Henriot, 1967)	856	1.76	45.04	-	-	-	-	-	-
Lysigamasus aff. *runcatellus* (Berlese, 1903)	1462	2.99	54.2	-	-	-	-	-	-
Parasitus fimetorum (Berlese, 1903)	683	1.4	14.5	-	-	-	-	-	-
Parasitus loricatus (Wankel, 1861)	16	0.03	4.58	1	0.01	1.72	-	-	-
Parasitus sp.	1	0.002	0.76	-	-	-	-	-	-
Pergamasus crassipes (Linnaeus, 1758)	850	1.74	68.7	-	-	-	-	-	-
Pergamasus norvegicus (Berlese, 1905)	162	0.33	15.27	-	-	-	-	-	-
Pergamasus noster (Berlese, 1903)	-	-	-	1	0.01	1.72	-	-	-
Poecilochirus carabi G.et R.Canestrini, 1882	145	0.29	2.29	-	-	-	-	-	-
Trachygamasus gracilis Karg, 1965	5	0.01	3.05	-	-	-	-	-	-
Vulgarogamasus kraepelini (Berlese, 1904)	443	0.91	27.48	-	-	-	-	-	-
Vulgarogamasus remberti (Oudemans, 1912)	137	0.28	5.34	-	-	-	-	-	-
Phytoseiidae									
Amblyseius andersoni (Chant, 1957)	-	-	-	6	0.09	6.9	-	-	-
Amblyseius nemorivagus Athias-Henriot, 1961	-	-	-	8	0.12	1.72	-	-	-
Amblyseius neobernhardi Athias-Henriot, 1966	1	0.002	0.76	-	-	-	2	0.46	13.33
Amblyseius sp.	-	-	-	2	0.03	1.72	-	-	-
Neoseiulus cucumeris (Oudemans, 1930)	10	0.02	6.11	164	2.44	43.1	17	3.9	20
Neoseiulus umbraticus (Chant, 1956)	-	-	-	5	0.07	1.72	-	-	-
Neoseiulus sp.	1	0.002	0.76	-	-	-	-	-	-
Phytoseius juvenis Wainstein et Arutyunyan, 1970	-	-	-	1	0.01	1.72	-	-	-
Proprioseiopsis levis (Wainstein, 1960)	-	-	-	1	0.01	1.72			
Proprioseiopsis sp.	-	-	-	1	0.01	1.72			
Typhlodromus bakeri (Garman, 1948)	-	-	-	1	0.01	1.72	-	-	-
Typhlodromus sp.	-	-	-	91	1.36	8.62	-	-	-
Rhodacaridae									
Cyrtolaelaps mucronatus (G.et R.Canastrini, 1881)	2	0.004	1.53	1	0.01	1.72	-	-	-
Veigaiaidae									
Veigaia cerva (Kramer, 1876)	322	0.66	29.01	-	-	-	-	-	-
Veigaia exigua (Berlese, 1917)	8	0.02	3.05	-	-	-	-	-	-
Veigaia kochi (Trägårdh, 1901)	148	0.3	24.43	-	-	-	-	-	-
Veigaia nemorensis (C.L. Koch, 1839)	3100	6.36	67.18	-	-	-	1	0.23	6.67
Zerconidae									
Prozercon carpathofimbriatus Mašán et Fenďa, 2004	439	0.9	28.24	-	-	-	-	-	-
Prozercon traegardhi (Halbert, 1923)	29	0.06	2.29	-	-	-	-	-	-
Zercon peltatus peltatus C.L. Koch, 1836	4524	9.28	74.81	-	-	-	-	-	-
SEJINA									
Sejidae									
Sejus togatus C.L. Koch, 1836	144	0.3	12.21	-	-	-	-	-	-
UROPODINA									

Table 1. Continuation.

TAXON	soil and litter			reed stands			fallen reed on water		
	N	D%	C%	N	D%	C%	N	D%	C%
Trachytidae									
Trachytes aegrota (C.L. Koch, 1841)	3	0.01	0.76	-	-	-	-	-	-
Trematuridae									
Nenteria breviunguiculata (Willmann, 1949)	308	0.63	35.88	-	-	-	-	-	-
Nenteria pandioni Wiśniewski et Hirschmann, 1985	1	0.002	0.76	-	-	-	-	-	-
Nenteria stylifera (Berlese, 1904)	1	0.002	0.76	-	-	-	-	-	-
Trichouropoda karawaiewi (Berlese, 1904)	3797	7.79	65.65	-	-	-	-	-	-
Trichouropoda ovalis (C.L. Koch, 1839)	5455	11.19	65.65	-	-	-	-	-	-
Urodinychidae									
Dinychus bincheaecarinatus Hirschmann, Wagrowska-Adamczyk et Zirngiebl-Nicol 1984	123	0.25	3.05	-	-	-	-	-	-
Dinychus inermis (C.L. Koch, 1841)	44	0.09	12.98	-	-	-	-	-	-
Dinychus perforatus Kramer, 1886	502	1.03	41.22	-	-	-	-	-	-
Uroobovella pulchella (Berlese, 1904)	39	0.08	9.92	-	-	-	-	-	-
Uropodidae									
Discourella modesta (Leonardi, 1899)	3	0.01	2.29	-	-	-	-	-	-
Uropoda minima Kramer, 1882	721	1.48	31.3	-	-	-	-	-	-
Uropoda orbicularis (O.F. Müller, 1776)	136	0.28	9.16	-	-	-	-	-	-
Average number of specimens per sample	372.2			115.8			29.07		
H’	2.974			0.417			1.943		
N0	106			30			23		
N1	19.57			1.517			6.98		
N2	9.901			1.163			3.636		
E1	0.634			0.123			0.620		