BIOLOGICAL LETT. 2006, 43(2): 187–192
Available online at http://www.biollett.amu.edu.pl

Gamasida (Acari) of the 'Niebieskie Źródła' Nature Reserve

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(*Received on*: *28 December 2005*; *Accepted on 22 November 2006*)

Abstract: Acarological research was conducted within a Scots pine forest (*Leucobryo-Pinetum*) and an ash-and-elm riparian forest (*Ficario-Ulmetum*) in the 'Niebieskie Źródła' Nature Reserve in Tomaszów Mazowiecki. Several aspects of gamasid mites were analysed, such as species composition, abundance, dominance and constancy. Overall, 34 species of the order Gamasida were recorded within the studied area. Both of the examined habitats were dominated by *Zercon fageticola* Halaškova, 1969. The soil of the Scots pine forest was also characterised by relatively high dominance levels of *Rhodacarus coronatus* Berlese, 1921, *Paragamasus misellus* (Berlese, 1903) and *Parazercon radiatus* (Berlese, 1914), and the riparian forest was additionally dominated by *Gamasellodes bicolor* (Berlese, 1918), *Paragamasus misellus* (Berlese, 1903) and *P. runciger* (Berlese, 1903). Statistically significant differences were recorded in species diversity within both of the researched habitats, whereas the differences in abundance of the Gamasida in the soil of the Scots pine forest and the riparian forest were statistically insignificant.

Key words: Gamasida, Acari, *Leucobryo-Pinetum*, *Ficario-Ulmetum*

INTRODUCTION

Differences in biotic and abiotic conditions between habitats usually result in the development of disparate species groups. The soil environment is shaped by a unique microclimate, which is dependent on the vegetation. Forest litter composed of fallen leaves, conifer needles, pieces of tree bark, and other organic particles, is a vital regulator of the physical and chemical characteristics of the habitat.

The research on the species diversity of soil mites in various types of habitats enables us to describe the range of their ecological tolerance at the level of species, genera and higher taxonomic units. Previous acarological research within the 'Niebieskie Źródła' Nature Reserve covered only the recognition of Hydracarina (BAZAN 1962). The aim of our study was to assess the abundance, species diversity and habitat preferences of the Gamasida in a Scots pine forest as well as an ash-and-elm riparian forest in the 'Niebieskie Źródła' Nature Reserve in Tomaszów Mazowiecki.

MATERIAL AND METHODS

The examined area is a geological nature reserve, with exquisite landscape value. It is located in the valley of the Pilica River, on its right bank, in the south-eastern part of Tomaszów Mazowiecki town (central Poland). The reserve covers the area of ca. 29 ha and it was founded in 1961 in order to protect the karst valley as well as the accompanying natural forest, scrub, wetland, and aquatic biocoenoses.

The research was conducted in June and October 2004. Altogether, 480 soil samples were collected, 50 cm^3 each, from the horizons of the soil profile in 6 permanent plots. Plots 1–3 were located in a Scots pine forest (*Leucobryo-Pinetum*) and plots 4–6 were located in an ash-and-elm forest (*Ficario-Ulmetum*). The studied habitats differ in microhabitat conditions: the ash-and-elm riparian forest grows on a soil that is rather wet, with a strongly acid reaction and an average depth of the humus horizon, whereas the Scots pine forest occupies a poor site, with a sandy podzolic soil (CHUDZIK & TRZEBSKI 1986). Within the Scots pine forest, the average pH reached 2.31, compared to 3.41 in the riparian forest. The mites were extracted by using modified Tullgren funnels for 6 days, next preserved in 70% ethyl alcohol, and finally prepared in Hoyer's liquid. All the Gamasida were identified to the species level. The zoocoenological analysis was performed by using the indices of abundance, dominance, constancy, and the number of species as well as the Shannon species diversity index. Additionally, a similarity analysis of the gamasid communities in the studied habitats was performed on the basis of the Morisita, Marczewski-Steinhaus, and Cody indices as well as the UPGMA method with percentage similarity test performed by the MVSP 3.01 statistical package (KOVACH COMPUTING SERVICES 1998). The significance of differences in species abundance within the studied plots was established with the aid of the Kruskal-Wallis test. The significance of differences between the species diversity indices was performed by using the Hutcheson test (HUTCHESON 1970).

RESULTS

In the collected samples, 28 554 mites were recorded, including 2 268 of the order Gamasida (7.94%). They represented 34 Gamasida species belonging to 14 families. The contributions of individual families to the total number of species were as follows: Parasitidae 23.5%, Ascidae 14.7%, Laelapidae 11.8%, Veigaiaiidae and Zerconidae 8.8% each, Phytoseiidae and Rhodacaridae 5.9% each, others 2.9%. The number of species in the Scots pine forest fluctuated between 14 and 20, and in the riparian forest between 21 and 23. The overall number of species belonging to the Gamasida amounted to 25 in the Scots pine forest soil and 27 in the riparian forest soil (Table 1). The abundance of the Gamasida in the Scots pine forest ranged from ca. 7 570 to 17 640 ind./m^2. The value of the same index in the riparian forest ranged from 12 450 ind./m^2 to 15 180 ind./m^2. The average abundance of the Gamasida reached 11 690 ind./m^2 in the Scots pine forest and 13 860 ind./m^2 in the riparian forest. The Shannon species diversity index fluctuated between 1.478 and 1.782 in the Scots pine forest and the average was 1.871. Values of this index in the riparian forest were markedly higher and ranged from 1.926 to 2.368, while the average was 2.306.

Table 1. Abundance (A, in 10^3 ind./m^2), dominance (D, in %) and constancy (C, in %) of species of Gamasida, with total abundance (A_{total}, in 10^3 ind./m^2), number of species (S) and Shannon species diversity (H’) in the studied habitats

Species of Gamasida	*Leucobryo-Pinetum*			*Ficario-Ulmetum*		
	A	D	C	A	D	C
Amblyseius obtusus (C. L. Koch, 1839)	0.01	0.11	3	0.06	0.42	12
Amblyseius sp. Berlese, 1904	0.07	0.57	7	0.005	0.04	2
Arctoseius cetratus (Sellnick, 1940)	-	-	-	0.02	0.12	2
Asca aphidioides (Linne, 1758)	0.52	4.43	38	0.09	0.68	5
Cheiroseius borealis (Berlese, 1904)	0.01	0.10	2	-	-	-
Dendrolaelaps sp. Halbert, 1915	0.03	0.26	5	0.18	1.29	13
Gamasellodes bicolor (Berlese, 1918)	-	-	-	3.16	22.82	73
Holoparasitus excipuliger (Berlese, 1905)	0.20	1.69	30	0.05	0.39	7
Hypoaspis aculeifer (Canestrini, 1883)	0.02	0.16	3	0.31	2.25	17
Hypoaspis austriaca Sellnick, 1935	0.09	0.78	13	-	-	-
Hypoaspis praesternalis Willmann, 1949	0.06	0.50	12	-	-	-
Hypoaspis vacua (Michael, 1891)	0.01	0.11	3	0.02	0.12	2
Leitneria pugio (Karg, 1961)	0.03	0.28	2	-	-	-
Macrocheles sp. Latreille, 1829	-	-	-	0.10	0.69	10
Neojordensia levis (Oudemans et. Voigts, 1904)	0.02	0.17	3	-	-	-
Paragamasus misellus (Berlese, 1903)	1.22	10.41	58	1.47	10.61	38
Paragamasus runciger (Berlese, 1903)	0.58	4.92	55	0.85	6.16	53
Paragamasus tectegynellus Athias-Henriot, 1967	0.14	1.23	8	0.33	2.39	22
Parazercon radiatus (Berlese, 1914)	0.81	6.94	55	-	-	-
Pergamasus brevicornis Berlese, 1903	0.03	0.23	5	0.38	2.76	43
Pergamasus crassipes (Linne, 1758)	-	-	-	0.05	0.34	8
Pergamasus septentrionalis (Oudemans, 1902)	-	-	-	0.15	1.05	12
Pergamasus mediocris Berlese, 1904	-	-	-	0.07	0.53	7
Prozercon kochi Sellnick, 1943	0.04	0.31	7	0.48	3.43	23
Rhodacarellus silesiacus Willmann, 1936	0.07	0.57	3	0.12	0.86	7
Rhodacarus coronatus Berlese, 1921	3.67	31.42	42	-	-	-
Trachytes aegrota (C. L. Koch, 1841)	0.01	0.06	2	0.05	0.35	8
Trichouropoda ovalis (C. L. Koch, 1839)	0.04	0.31	5	0.57	4.10	42
Urodiaspis tecta (Kramer, 1876)	-	-	-	0.40	2.86	23
Uropoda minima Kramer, 1882	-	-	-	0.07	0.51	7
Veigaia cervus (Kramer, 1876)	0.02	0.17	5	0.09	0.63	8
Veigaia exiqua (Berlese, 1916)	-	-	-	0.08	0.60	5
Veigaia nemorensis (C. L. Koch, 1839)	0.11	0.95	15	0.63	4.53	37
Zercon fageticola Halaškova, 1969	3.90	33.33	95	4.08	29.44	93
Total abundance (A_{total})		11.69			13.86	
Number of species (S)		25			27	
Shannon diversity index (H')		1.871			2.306	

Zercon fageticola Halaškova, 1969 achieved a high position in the dominance structure in both of the studied habitats. It constituted 33.3% of the Gamasida community in the soil of the Scots pine forest and 29.4% in the soil of the riparian forest, with a high constancy (over 90%). In the Scots pine forest, the species mainly penetrated the organic horizon, although in plot 3 its higher abundance was recorded in the humus, and single specimens were encountered in mineral horizons. As for the riparian forest, a higher abundance of *Z. fageticola* was recorded in the humus horizon.

Rhodacarus coronatus Berlese, 1921 showed a high dominance in the Scots pine forest (31.42%), although its contribution to the gamasid community was clearly falling from plot 1 to plot 3 (from 51.58% to 0.44%). In the soil of the Scots pine forest, the species preferred the mineral horizons of the soil, although in plot 3 it only occurred in humus. This species was not recorded in the soil of the riparian forest.

Gamasellodes bicolor (Berlese, 1918) was a species whose contribution was high only in the riparian forest (22.82%). However, its contribution to the gamasid community dropped from plot 4 in the direction of plot 6 (from 34.30% to 10.69%). It primarily occurred in the humus horizon.

A species that had a similar contribution to the gamasid community in both the studied habitats was *Paragamasus misellus* (Berlese, 1903), whose dominance reached ca. 10.5%. In both habitats it preferred the humus microhabitat. *Paragamasus runciger* (Berlese, 1903) accounted for 4.92% of the community in the Scots pine

Table 2. Similarity of gamasid mite communities on the studied plots, based on Morisita (top), Marczewski-Steinhaus (middle) and Cody (bottom) indices. Plots 1-3: *Leucobryo-Pinetum*, 4-6: *Ficario-Ulmetum*

	Plot				
Plot	2	3	4	5	6
	0.680	0.361	0.244	0.255	0.313
1	0.545	0.435	0.385	0.296	0.321
	0.065	0.211	0.412	0.335	0.350
		0.801	0.600	0.607	0.766
2		0.625	0.400	0.414	0.483
		0.175	0.326	0.326	0.320
			0.640	0.694	0.861
3			0.414	0.429	0.448
			0.238	0.238	0.213
				0.899	0.829
4				0.654	0.731
				0.082	0.087
					0.892
5					0.692
					0.074

forest and 6.16% in the riparian forest, with a relatively low constancy, ranging from 53% to 55%.

As for *Parazercon radiatus* (Berlese, 1914), it was only recorded in the Scots pine forest. There, the species reached the average contribution of 6.94%, with a visible drop from plot 1 (D=10.84%) in the direction of plot 3 (D=1.83%).

Values of the Morisita, Marczewski-Steinhaus, and Cody indices as well as the UPGMA results show qualitative, quantitative and qualitative-quantitative differences between gamasid communities of plots 1-3 within the Scots pine forest, while plots 4–6 in the riparian forest showed a clearly higher similarity between the communities of mites living within the same habitat (Tables 1, 2). There were statistically significant differences in the level of species diversity described by means of the Shannon index ($P<0.001$) between the forest types. On the other hand, the differences in species abundance between the habitats proved statistically insignificant (Kruskal-Wallis: H=2.459, $P=0.117$).

DISCUSSION

Both plants and animals have certain needs as far as their habitat conditions are concerned. Those conditions directly influence the flora, which in turn shapes the higher levels of the trophic structure of the ecosystem. The occurrence of certain species groups in the soil environment is limited by the biotic factors (such as food, competing species, etc.) and the abiotic factors (such as pH, oxygen conditions, humidity, soil structure) of the microhabitats. In the soil environment with variously developed humus horizon, ecological niches are occupied by disparate species communities (GÓRNY 1975, ODUM 1982). An increase in soil acidity stimulates the growth of soil fungi, lowers bacterial density and supports the development of overlying humus. Indirectly, through the food base, it also limits the possibilities of existence of certain predatory gamasid species. Directly, however, such effects influence the bacteriophagous, mycophagous, and saprophagous mites belonging to the Oribatida and Uropodina (GÓRNY 1975, SENICZAK 1978, BURYN & BRANDL 1992, BŁOSZYK 1999).

The low contribution of soil Gamasida recorded within the study area (7.94% of all mites) results from their generally predatory feeding and a high level of metabolism (KACZMAREK 1985, 2000). The high abundance of *Zercon fageticola* in both of the examined forest stands points to a wide spectrum of ecological tolerance of the species towards its habitat. This species has so far been recorded within environments of both high and low humidity, in various types of forest stands (BŁASZAK 1974). *Paragamasus misellus* reacted in a similar way, although it occurred with a lower dominance and constancy levels than *Zercon fageticola*. The soil being more humid in the riparian forest resulted in the absence of *Rhodacarus coronatus*, which prefers lower horizons of the soil. On the other hand, *Gamasellodes bicolor* was a species favouring the wetter microhabitat of the riparian forest. Statistically significant differences ($P<0.05$) in the level of species diversity indicate the development of clearly disparate gamasid community structures in diverse habitat conditions, although on the grounds of the distribution of the abundance of Gamasida, the researched habitats do not differ significantly ($P>0.05$). That indicates the reaction of the examined mite communities to the disparate habitat conditions as well as the lack of reaction in respect of community size.

CONCLUSIONS

1. The differences in the abundance of the Gamasida between the studied forest types were not statistically significant.
2. The differences in the structure of the gamasid communities between the Scots pine forest and the ash-and-elm riparian forest were statistically significant.
3. *Zercon fageticola* Halaškova, 1969 was the most dominant species in both of the studied habitats.

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Associate editor: MACIEJ SKORUPSKI