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Soil mites (Acari, Mesostigmata) from Szczeliniec Wielki in the Stołowe Mountains National Park (SW Poland)

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Abstract: The species composition of mesostigmatid mites in the soil and leaf litter was studied on the Szczeliniec Wielki plateau, which is spatially isolated from similar rocky habitats. A total of 1080 soil samples were taken from June 2004 to September 2005. The samples, including the organic horizon from the herb layer and litter from rock cracks, were collected using steel cylinders (area 40 cm^2, depth 0–10 cm). They were generally dominated by *Gamasellus montanus*, *Veigaia nemorensis*, and *Leptogamasus cristulifer*. Rhodacaridae, Parasitidae and Veigaiidae were the most numerously represented families as regards to individuals. Among the 55 recorded mesostigmatid species, 13 species were new to the fauna of the Stołowe National Park. Thus the soil mesostigmatid fauna of the Szczeliniec Wielki plateau is generally poor and at an early stage of succession.

Keywords: mites, Acari, Mesostigmata, Stołowe Mountains National Park

INTRODUCTION

Biodiversity is usually described as species richness of a geographic area, with some reference to time. The diversity of plants and animals can be reduced by habitat fragmentation and spatial isolation. Moreover, spatial isolation and habitat fragmentation can affect ecosystem functioning (Schneider et al. 2007). Ecosystems with high species diversity are more resistant to disturbances and perturbations. Furthermore, ecosystem function may change unpredictably when diversity and/or species composition changes (Koehler 1997).

Soil biodiversity can be characterized by the composition of soil animal communities, e.g. nematodes, enchytraeids, and mites. Mesostigmatid mites can be used as good bioindicators, because their distribution is worldwide and they are at the end of the mesofaunal energy chain (Čoja & Bruckner 2006).

Moreover, biodiversity in spatially isolated areas should be better known in view of the anticipated impact of climate change upon soil biota and the potential consequences of ecosystem processes (Taylor & Wolters 2005). A very interesting habitat island is the Szczeliniec Wielki plateau in the Stołowe Mountains National Park. It is a high, isolated sandstone plateau with specific abiotic conditions and fauna. Low and stable temperature as well as high relative humidity create suitable conditions for arctic spiders (*Bathypanthes eumenis)* and rare collembolans (*Schaeferia emucronata*) (Smolis 2003).

Previously, several acarological projects in the Stołowe Mountains were conducted, leading to the discovery of over 81 species of mesostigmatid mites, including the rare relict species *Iphidinychus gaieri* (Micherdziński 1969, Błoszyk 1980, 1991, Błoszyk & Olszanowski 1984, Skorupski & Gołojuch 1996a, b, Skorupski et al. 1998, Kaczmarek & Marquardt 2006, Kamczyc 2006a, b, Gwiazdowicz, Kamczyc 2009). However, those studies have been done on a small scale (single samples from diverse microhabitats) in various areas of the Stołowe Mountains. However, the fauna and communities of mesostigmatid mites inhabiting the soil on Szczeliniec Wielki have never been well recognized. Due to this, the goal of the present study was to analyse the species composition of soil mesostigmatid mites on the Szczeliniec Wielki plateau.

STUDY AREA

The Szczeliniec Wielki plateau is located in the Stołowe Mountains National Park. The Stołowe Mountains are the only table hills in Poland. They are located in southwest Poland (50°29'N, 16°20'E), rising up to 919 m above sea level. The Szczeliniec Wielki plateau is bordered around by steep rock walls ending in wide boulder fields, and it is broken apart by deep cracks into a rock labyrinth. The base of the plateau and its summit are formed from sandstone, and its central part from marl. The herb layer is dominated by e.g. *Vaccinium vitis-idaea*, *Vaccinium myrtillus*, *Dicranum scoparium*, and *Calluna vulgaris.* The forest represents an early successional stage of the association *Leucobryo–Pinetum*. Scots pine *Pinus sylvestris*, common birch *Betula pendula* and Norway spruce *Picea abies* dominate in the tree layer on the plateau.

MATERIAL AND METHODS

A total of 1080 soil samples were taken from June 2004 to September 2005. The samples, including the organic horizon from the herb layer and litter from rock cracks, were collected using steel cylinders (area 40 cm^2, depth 0–10 cm). Mites were extracted using Berlese funnels with a mesh size of about 2 mm. The soil cores were heated from above, with 40 W bulbs, and the extraction lasted 7 days. The organisms were collected in 70% ethanol, mounted in permanent slides (using Hoyer's medium) and semi-permanent slides (using lactic acid), next counted, and identified. Juvenile specimens were marked as "juv." if not described in literature.

Indices of dominance (*D*) (Niedbała et al. 1981) and constancy (*C*) (Kasprzak & Niedbała 1981) were used to characterise the mite community. Dominance classes were as follows: eudominants (>10% of total catch); dominants (5.01–10%); subdominants (2.01–5.0%); residents (1.01–2%), and subresidents (<1%). For constancy, the following criteria were used: euconstants (>75% of samples); constants (50.01–75%); subconstants (30.01–50%); accessory species (15.01–30%), and accidentals (<5%).

RESULTS

Totally, 14 813 individuals from the order Mesostigmata were found in the soil samples collected on the Szczeliniec Wielki plateau (Table 1). Analysis of the sample-based species accumulation curve showed that the number of collected samples is adequate, and further collection would not cause any significant increase in species number (Fig. 1). The collected individuals belonged to 49 mite species of 2 suborders: Gamasina (45 species; 13 736 individuals) and Uropodina (4; 1077). No species from the orders Antennophorina, Microgynina as well as Sejina were found. The Parasitidae were a family represented by the largest number of species (12). Also the Laelapidae, Ascidae, and Veigaiidae were represented by several species (7, 6, and 5 species, respectively). However, Rhodacaridae (4187 individuals), Parasitidae (4093), and Veigaiidae (3496) were the families with the most numerous individuals. *Gamasellus montanus* (D = 28.25%) and *Veigaia nemorensis* (D = 13.69%) were eudominants. *Leptogamasus cristulifer* (D = 6.89%) was classified as a dominant. Only 6 of the recorded 49 species occurred in >30% samples (Table 1). Among them, *Gamasellus montanus* (C=72%) was classified as the only constant species. Most of mite species occurred in less than 10% of samples.

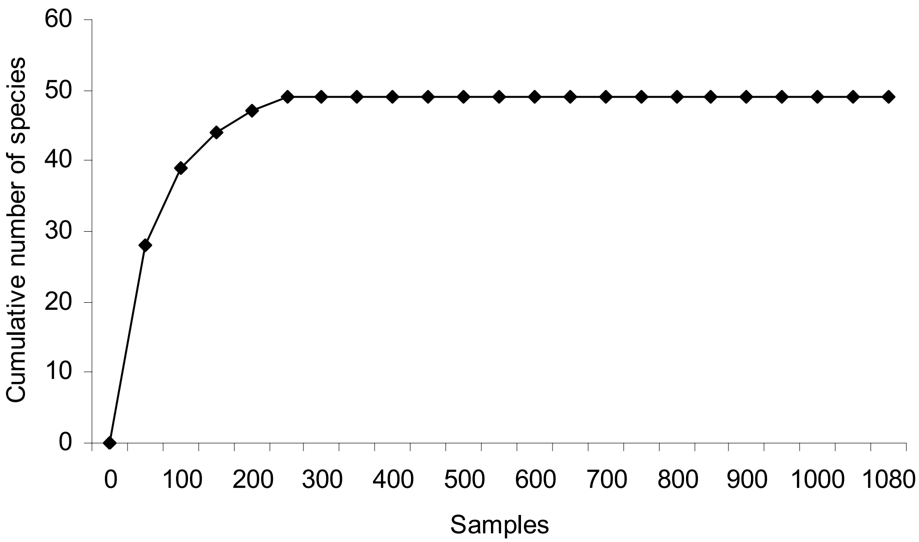

Fig. 1. Sample-based species accumulation curve for mesostigmatid mites occurring in the soil and leaf litter on the Szczeliniec Wielki plateau

Table 1. List of mesostigmatid mites from the Szczeliniec Wielki plateau

Species	Family	N	Dominance (%)	Constancy (%)
Gamasina				
Gamasellus montanus (Willmann, 1936)	R	4184	28.25	72.22
Veigaia nemorensis (C.L. Koch, 1839)	V	2029	13.70	46.11
Leptogamasus cristulifer (Athias-Henriot, 1967)	P	1022	6.90	36.57
Leptogamasus sp. (juv.)	P	995	6.72	37.13
Veigaia mollis Karg, 1971	V	884	5.97	31.67
Leptogamasus obessus (Holzmann, 1955)	P	764	5.16	30.28
Parazercon radiatus (Berlese, 1914)		679	4.58	16.85
Paragamasus neoruncatellus (Schweizer, 1961)	P	427	2.88	22.96
Geholaspis pauperior Berlese, 1918		425	2.87	5.93
Veigaia cervus (Kramer, 1876)	V	392	2.65	24.07
Pachylaelaps furcifer Oudemans, 1903		314	2.12	17.59
Paragamasus sp. (juv.)	P	269	1.82	14.17
Amblyseius sp.		233	1.57	10.00
Paragamasus holzmannae (Micherdziński, 1969)	P	226	1.53	13.61
Veigaia kochi (TrägÍrdh, 1901)	V	178	1.20	10.46
Pergamasus barbarus (Berlese, 1904)	P	134	0.90	8.43
Pergamasus (*Thenargamasus*) sp. (juv.)	P	77	0.52	5.09
Hypoaspis procera Karg, 1965	L	67	0.45	3.89
Porrhostaspis lunulata Müller, 1859	P	63	0.43	1.85
Hypoaspis vacua (Michael, 1891)	L	62	0.42	1.67
Eviphis ostrinus (C.L. Koch, 1836)		60	0.41	3.89
Pergamasus mediocris Berlese, 1904	P	58	0.39	4.72
Hypoaspis isotricha (Kolenati, 1858)	L	20	0.14	1.57
Ololaelaps veneta (Berlese, 1903)	L	15	0.10	0.83
Lasioseius lawrencei Evans, 1958	A	14	0.09	1.30
Paragamasus insertus (Micherdziński, 1969)	P	13	0.09	0.65
Veigaia transisalae (Oudemans, 1902)	V	13	0.09	0.65
Vulgarogamasus kraepelini (Berlese, 1904)	P	13	0.09	0.74
Arctoseius semiscissus (Berlese, 1892)	A	12	0.08	1.02

Pergamasus (*Pergamasus*) sp. (juv.)		12	0.08	1.02
Prozercon kochi Sellnick, 1943		12	0.08	0.74
Pergamasus brevicornis Berlese, 1903	P	11	0.07	0.83
Pachylaelaps sp. (juv.)		10	0.07	0.74
Paragamasus sp.	P	8	0.05	0.46
Epicrius resinae Karg, 1971		7	0.05	0.56
Hypoaspis aculeifer (Canestrini, 1883)	L	6	0.04	0.46
Arctoseius wisniewskii Gwiazdowicz et Kamczyc, 2009	A	5	0.03	0.46
Arctoseius brevichelis Karg, 1969	A	3	0.02	0.19
Hypoaspis oblonga (Halbert, 1915)	L	3	0.02	0.19
Asca aphidioides (Linnaeus, 1758)	A	2	0.01	0.19
Asca bicornis (Canestrini et Franzago, 1887)	A	2	0.01	0.19
Geholaspis longispinosus (Kramer, 1876)		2	0.01	0.09
Hypoaspis praesternalis Willmann, 1949	L	2	0.01	0.09
Zercon fageticola Halašková, 1969		2	0.01	0.19
Dendrolaelaps arvicolus (Leitner, 1949)		1	0.01	0.09
Epicrius sp.		1	0.01	0.09
Paragamasus runcatellus (Berlese, 1903)	P	1	0.01	0.09
Rhodacarus aequalis Karg, 1971	R	1	0.01	0.09
Rhodacarus mandibularis Berlese, 1921	R	1	0.01	0.09
Rhodacarus sp.	R	1	0.01	0.09
Zercon sp.		1	0.01	0.09
Uropodina				
Trachytes aegrota (C.L. Koch, 1841)		781	5.27	27.78
Trachytes pauperior (Berlese, 1914)		177	1.19	4.63
Urodiaspis tecta (Kramer, 1876)		111	0.75	8.15
Trichouropoda ovalis (C. L. Koch, 1839)		8	0.05	0.19

juv. = juvenile; N = number of individuals. Families: A = Ascidae; L = Laelapidae, P = Parasitidae, R = Rhodacaridae, V = Veigaiidae

Thanks to this study, the list of known mesostigmatid mites for the Stołowe Mountains National Park has been supplemented with 13 species: *Arctoseius brevichelis*, *Asca aphidioides*, *A. bicornis*, *Dendrolaelaps arvicolus*, *Epicrius resinae*, *Hypoaspis isotricha*, *H. praesternalis*, *Ololaelaps veneta*, *Paragamasus holzmannae*, *Rhodacarus mandibularis*, *Trichouropoda ovalis*, *Urodiaspis tecta* and *Veigaia transisalae*. No relict mite species was found in this study.

CONCLUSIONS

1. The soil environment of the Szczeliniec Wielki plateau is generally poor in Mesostigmata. Only 49 species of mites were found in this study.
2. The acarofauna of the Szczeliniec Wielki plateau is characterized by the presence of rare mites (e.g. *A. wisniewskii*, *L. cristulifer*, *V. mollis*).
3. Mite community of the study area is at an early stage of succession, reflected in the large number of predators from the families Parasitidae and Veigaiidae.

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