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Seasonal dynamics of the density of Oribatida (Acari) in a lowland meadow and pastures

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Abstract: Seasonal dynamics of abundance of Oribatida in a lowland meadow and in sheep and cattle pastures was investigated in Zielonczyn village near Bydgoszcz (northern Poland). The grazing animals changed the seasonal dynamic of the density of Oribatida in pastures, as compared to the hay meadow, mainly due to some abundant mite species. Most oribatid species were sensitive to grazing.

Key words: meadows, pastures, sheep, cattle, animal community dynamics, density, Acari, Oribatida

INTRODUCTION

The effect of grazing animals on pastures depends mainly on the way of grazing and the number of animals per ha. Sheep cut the grass low above the soil and more selectively. Moreover, they walk on narrow hoofs and therefore damage the turf more than cattle. While walking, the grazing animals change in various ways the physical properties of soil, like porosity, bulk density and infiltration (GITFORD & DADKHAH 1980, DI et al. 2001), and affect the soil fauna by their excrements.

Earlier research shows that grazing sheep and cattle reduce the density and diversity of oribatid mites on pastures, as compared to meadow, and the impact of sheep on mite density is stronger than that of cattle (CHACHAJ et al. 2005). The aim of this study was to assess the effect of sheep and cattle grazing on seasonal dynamics of the density of Oribatida.

MATERIAL AND METHODS

Three plots were chosen in this study: a meadow (control, plot 0) and pastures grazed by sheep (Polish Merino, plot 1) and cattle (Polish Black-and-White, plot 2) near Zielonczyn in the Noteć valley near Bydgoszcz. The meadow, according to the classification by BARKMAN et al. (1964), belonged to the phytosociological class *Molinio-Arrhenatheretea*, with predominating *Dactylis glomerata* L. and less frequent *Deschampsia caespitosa* (L.), *Phleum pratense* L. and *Poa pratensis* L. In the sheep pasture, the plant association was similar to *Lolio-Cynosuretum*, *Matricario matricarioidis-Polygonetum arenastri* and flooded *Potentilletum anserinae*, while the cattle pasture was classified as *Lolio-Cynosuretum*. In both pastures, typical meadow species and species tolerating grazing were present. The degree of cover by plants in the cattle pasture was 90%, and in the other plots it reached 100%. The pastures were used for grazing for about 20 years and in the last 5 years the average number of livestock (and weight in tonnes) per ha was 25 (1.3) in the sheep pasture and 2.5 (1.0) in the cattle pasture. The soils belonged to the muck soil group.

Sod samples of 16.7 cm^2 × 9 cm deep were taken in spring, summer and autumn in 2001 and 2002, in all plots and in 20 replicates, and further they were divided into the lower parts of plants (P0, 0–3 cm) and 2 soil layers, S1 (0–3 cm) and S2 (3–6 cm). The mites (total: 4395 mites) were extracted in modified Tullgren funnels, preserved and determined to species or genus, including the juveniles. The results were verified with HSD Tukey test (1-way ANOVA, Statistica 6). A logarithmic transformation (x+1) was used to normalize abundance data prior to statistical analyses (Berthet & Gerard 1965). More information on the study area, plant associations and soils was given in an earlier report (Chachaj et al. 2005). Names of oribatid species follow Subías (2004).

Table 1. Seasonal dynamics of mite density (in 10^3 individuals per m^2) in the investigated plots

Taxon		Control (meadow)			Sheep pasture			Cattle pasture		
		Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut
Oribatida (all)	total	12.0	10.3	12.8	4.0*	3.8*	2.5*	6.1	8.7 ^{A}	5.8*
	juv	6.5	6.3	4.8	1.4*	1.8*	0.7*	2.6	5.7 ^{A}	3.2*
Achipteria coleoptrata (Linnaeus, 1758)	total	2.3	1.2	3.5 ^{C}	0.3*	0.2*	0.3	<0.1*	0.0	<0.1*
	juv	1.2	0.1	0.2 ^{C}	0.1*	<0.1*	0.1*	0.0	0.0	0.0
Eupelops occultus (C. L. Koch, 1835)	total	1.7	1.3	1.0	2.0	1.1	1.0	1.9	3.1	2.4
	juv	1.0	0.5	0.3	0.7	0.6	0.3	0.9	1.7	1.1
Heminothrus peltifer (C. L. Koch, 1839)	total	0.1	0.1	0.2	0.4	0.4	0.4	0.0	0.0	<0.1
	juv	0.1	0.1	0.1	0.3	0.3	0.2	0.0	0.0	<0.1
Liebstadia similis (Michael, 1888)	total	0.1	<0.1	0.0	<0.1	<0.1	<0.1	2.7*	2.7*	1.2 ^{BC}
	juv	0.1	<0.1	0.0	<0.1	0.0	0.0	0.9*	2.0	0.6 ^{BC}
Scheloribates laeviga-tus (C. L. Koch, 1835)	total	1.6	4.9 ^{A}	4.3 ^{B}	<0.1*	<0.1*	<0.1*	1.5	2.3 ^{A}	1.7
	juv	0.7	4.2 ^{A}	2.3 ^{B}	<0.1*	<0.1*	<0.1*	0.9	2.0 ^{A}	1.2
Topobates sp.	total	0.0	0.0	0.0	1.4	1.3	0.7	0.0	0.0	0.0
	juv	0.0	0.0	0.0	0.4	0.7	0.1	0.0	0.0	0.0

Spr – spring; Sum – summer; Aut – autumn; juv – juvenile stages; significant differences at $P<0.05$ between: ^{A} – Spr and Sum; ^{B} – Spr and Aut; ^{C} – Sum and Aut.; * – control plot and pastures

RESULTS AND DISCUSSION

Seasonal dynamics of oribatid communities is shaped mainly by the most abundant species and the competition between them for habitat supplies. The density of total Oribatida in the meadow was similar in all investigated seasons, but substantial changes in density were observed in some abundant species (Table 1). For example, the density of *Achipteria coleoptrata* (Linnaeus, 1758) in the autumn was significantly higher than in the spring and summer, while the density of *Scheloribates laevigatus* (C. L. Koch, 1835) in the summer and autumn was significantly higher than in the spring.

Sheep grazing decreased the density of Oribatida in the autumn, but cattle grazing increased the density in the summer, compared to meadow. In cattle pasture, *Liebstadia similis* (Michael, 1888) was in the autumn significantly less abundant than in the spring and summer, while the density of *Scheloribates laevigatus* in the summer was significantly higher than in the spring. Generally, the animal grazing reduced the density of Oribatida, in the sheep pasture significantly in all seasons, while in the cattle pasture only in the autumn, mainly due to relatively high densities of *S. laevigatus* and *A. coleoptrata* in the control plot and sensitivity of these species to grazing.

The grazing animals affected the seasonal dynamics of abundance of oribatid mites in pastures, but their influence varied, depending mainly on the way of grazing and treading the soil. Sheep cut the grass lower and more selectively than cattle, so sheep favoured plants that tolerate grazing and caused a reduction in the density of

Table 2. Vertical distribution of mites in spring (Spr), summer (Sum) and autumn (Aut): density as individuals per 100 cm^3

Taxon		Control (meadow)			Sheep pasture			Cattle pasture		
		Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut
Oribatida (all)	P0	17.0	26.9	27.3	10.9	9.3	6.4	18.2	20.9	17.5
	S1	22.0	6.1	14.7	2.5	2.5	1.5	2.0	7.2	1.7
	S2	1.1	1.2	0.7	0.0	0.9	0.5	0.2	0.9	0.2
Eupelops occultus (C. L. Koch, 1835)	P0	4.6	3.8	1.8	5.3	3.2	2.6	5.3	5.7	7.2
	S1	0.9	0.7	1.3	1.0	0.6	0.7	0.7	4.3	0.6
Liebstadia similis (Michael, 1888)	P0	0.1	0.1	0.0	0.1	0.0	0.0	8.2	7.2	3.3
	S1	0.1	0.0	0.0	0.0	0.1	0.1	0.8	1.5	0.5
Scheloribates laeviga-tus (C. L. Koch, 1835)	P0	3.1	2.8	8.2	0.6	0.4	0.5	0.0	0.0	0.1
	S1	3.9	1.4	3.1	0.7	0.3	0.3	0.1	0.0	0.0
Malaconothrus sp.	P0	0.7	1.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0
	S1	3.5	0.6	3.9	0.0	0.0	0.0	0.0	0.1	0.0

P0 – lower parts of plants, S1 and S2 – soil layers mites. Many mites occupied the lower parts of plants, so sheep ate them with grass. Grazing animals affected also porosity, bulk density and infiltration of soil (GITFORD & DADKHAH 1980, DI et al. 2001), and this additionally deteriorated the living conditions of oribatid species.

Generally, the pastures are under a strong human influence, like grazing by domestic animals, draining and fertilizing, and therefore they are usually poorer in mite species than meadows are (BARDGETT & COOK 1988, BEHAN-PELLETIER 1999, CHACHAJ et al. 2005). Human activity favours the soil bacteria, which decompose the litter quickly and accelerate the circulation of elements in ecosystems, but this decreases the heterogeneity and stability of ecosystems. Such a situation was observed in the sheep and cattle pastures, where the number of plant species as well as oribatid mite density and diversity were lower than in the meadow (CHACHAJ et al. 2005).

The Oribatida occupied mainly the lower parts of grasses, and mite density decreased with soil depth, except for *Malaconothrus* sp., which was more abundant in the upper soil horizon (Table 2). Such a distribution of mites poses threat to grazing animals. Many species of Oribatida are intermediate hosts of tapeworms from the group of Anoplocephalata (SENGBUSH 1977), and in areas with abundant parasites the grazing animals may be infected by them while eating grass with oribatid mites.

CONCLUSIONS

1. The grazing animals changed the seasonal dynamics of the density of Oribatida in pastures, compared to a hay meadow, mainly due to some abundant species.
2. Most oribatid species were sensitive to grazing.

REFERENCES

BARDGETT R. D., COOK R. 1988. Functional aspects of soil animal diversity in the agricultural grasslands. Appl. Soil Ecol. 10: 263–276.

BARKMAN J. J., DOING H., SEGAL S. 1964. Kritische Bemerkungen und Vorschlage zur quantitativen Vegetationsanalyse. Act. Bot. Neerl. 13: 394–419.

BEHAN-PELLETIER V. 1999. Oribatid mite biodiversity in agroecosystems: role for bioindication. Agr. Ecosyst. Environ. 74: 411– 423.

BERTHET P., GERARD G. 1965. A statistical study of microdistribution of Oribatei (Acari). I. The distribution pattern. Oikos 16: 214–227.

CHACHAJ B., SENICZAK S., WALDON B., KOBIERSKI M. 2005. The influence of sheep, cattle and horse grazing on soil mites (Acari) of lowland pastures. Zesz. Nauk. ATR, Bydgoszcz, Zootechnika 35: 69–77 (in Polish).

DI H. J., CAMERON K. C., MILNE J., DREWRY J. J., SMITH N. P., HENDRY T., MOORE S., REINEN B. 2001. A mechanical hoof for simulating animal treading under controlled conditions. New Zeal. J. Agr. Res. 44: 111–116.

GITFORD G. R., DADKHAH M. 1980. Trampling effects on rangeland. Utah Sci. 41: 71–73.

SENGBUSH H. G. 1977. Review of oribatid mites-anoplocephalan tape worm relationship (Acari: Oribatei: Cestoda: Anoplocephalidae). Proc. Symp. East. Br. Ent. Soc. Am. 70: 87–102.

SUBÍAS L. S. 2004. Systematic, synonymic and biogeographical check- list of the world's oribatid mites (Acariformes, Oribatida) (1758–2002). Graellsia 60: 3–305 (in Spanish).

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