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DIVERSITY OF THE SOIL MITE POPULATIONS FROM AN ANTHROPIC ECOSYSTEM FROM HUNEDOARA COUNTY-ROMANIA

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Abstract

In 2015, the diversity of the soil mite populations from an anthropic ecosystem, as a tailing pond, was investigated. The study area was located on Mealului Valley, Certeju de Sus locality from Hunedoara County. In total, 210 soil samples were analyzed, from five transects. The vegetation was classified in two groups: tall plant species and herbaceous ones. The altitude from the studied transects variated between 325 and 363 meters. In total 1138 mites were extracted, belonging to three orders: Trombidiformes (87 ± 15.22 individuals), Sarcoptiformes (992 ± 147.6) and Mesostigmata (59 ± 7.01 individuals). Dominant were decomposer mites, followed by the predators' ones. Analysing the Shannon diversity and dominance index, we observed that the highest values was obtained in transects characterized by an herbaceous layer, in comparison with those with tall vegetation. Using correspondence analysis, we revealed that the mite fauna grouped in two classes: one the preferred the small herbaceous layer (especially invertebrates from Mesostigmata order and mites from six families belonging to Trombidiformes order) and one that is correlated with tall vegetation (as Oribatida).

Key words: *anthropic, coverage, mite, soil, vegetation.*

INTRODUCTION

Mites represent one of the most abundant fauna group from soil. Due to their small dimensions (microscopic ones) they are many times neglected, although they are very important in direct or indirect decomposing of organic matter. Edaphic communities are important for soil formation, they contribute to the improvement of some characteristics of soils and they play key roles in many processes that enhance the success of ecological restoration (Cole et al., 2005; Lützow et al., 2006; Saitoh et al., 2011; Menta et al., 2014).

Ecological studied revealed that diversity and structure of the mite population vary depending on the type of investigated ecosystems and on the environmental factors (Nielsen et al., 2012; Birkhofer et al., 2012; Hasegawa et al., 2013; Manu et al., 2013; Dirilgen et al., 2016). Due to these characteristics, mostly often soil mite populations are considered bioindicators, they being used in assessment of successional stage of different anthropic ecosystems (as coal dump areas, deforested surfaces or other industrial areas). Mining causes significant damage to the environment: the removal of top layers of soil causes loss of structure and functionality, with a subsequent reduction in biodiversity. Unfortunately, soil mite fauna are poorly monitored even though they represent a good tool for assessing soil quality (Menta et al., 2014). The most studied mite orders were Sarcoptifomes (Oribatida) and Mesostigmata (Beaulieu and Weeks, 2007; Havlicek E., 2012).

In Europe, the majority of studies on the soil mite populations from anthropic ecosystems were made in mine area or other industrial disturbed soils from Italy, Austria, Germany, Svalbard and Poland (Wanner and Dunger, 2002; Caruso and Migliorini, 2007; Menta et al., 2014; Madej and Kozub, 2014; Coulson et al., 2015).

In Romania, studies on soil mite communities from anthropic ecosystems are few and fragmented. If we take into consideration the industrial areas from Romania, the most recent acarological investigations were made in spoilt dumps from Retezat Mountains – Hunedoara county, heavy metal polluted grasslands from Zlatna –Alba county or polluted forest with cement dust from Câmpulung Muşcel - Argeş county (Manu, 2010; Călugăr, 2013; Manu et

al., 2016). A detailed research presents the taxonomical and numerical structure of the gamasid populations from four spoilt areas from Retezat and Tarcu-Petreanu mountains. Eighteen species were identified, belonging to 14 genera and 9 families. Species *Cheroseius borealis* and *Hypospis aculeifer* were dominant and present in all studied surfaces. The mite populations had structural and dynamical differences, caused by the various environmental conditions (like vegetation, soil humidity and pH). To evidence these modifications were analyzed the following statistical parameters: number of species, numerical density, relative abundance, dominance, constancy. Comparative with predator mite populations from the natural ecosystems, the values of these parameters obtained for gamasids from the spoilt areas were very low. It shows that in anthropized ecosystems the influence of the specifically biotic and abiotic factors on the mite populations was significant.
In this context, the objective of the present study was to assess the diversity aspects of all identified edaphically mites in correlation with vegetation type, specific for an anthropic area as a tailing pond (Manu, 2010).

MATERIAL AND METHODS

The present study was developed in Mealului Valley, Certeju de Sus locality from Hunedoara County (Figure 1).

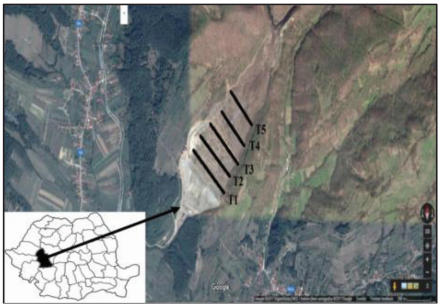

Figure 1. The geographic description of investigated ecosystem from Mealului Valley

Due to the gold and silver exploitation from the communism period (1565-1990), the landscape was modified from a natural meadows and forests to an anthropic ecosystem (a tailing pond).
This tailing pod was situated at $45^0$57’38.97” N and $22^0$58’55.39” E.
Altitude has varied between 325 and 370 meters. The soil samples were collected in September 2015.
The dominant high plant species (1-5 meters) from the tailing pond were: *Calamagrostis arundinacea* (L.) Roth, *Phragmites australis* (Cav.) Trin. Ex Steud, *Robinia pseudoacacia* L., 1753 (in T1, T2, T3 and T4) and *Betula pendula* Roth, *Salix purpurea* L., *Phragmites australis* (Cav.) Trin. Ex Steud (in T5). The coverage percentage was: 72% in T1 and T3; 42% in T2; 98.8% in T4 and 88.75% in T5 (Figure 2A).
If we take into discussion the herbaceous vegetation with a height of 0-1 meter from the soil, the dominant species were: *Conyza canadensis* (L.) Cronquist, *Medicago sp*. (in T1,T2), *Agrostris sp.* (in T2, T3), bryophytes (T1, T2, T3, T4), *Equisetum palustre* L. (in T3), *Tussilago farfara* L. (in T4) and *Epilobium palustre* L. (T5).
The coverage percentage was: 24% in T1, 37% in T2, 21% in T3, 12% in T4 and 11.5% in T5 (Figure 2B). In order to investigate the heterogeneity of the tailing pond, five transects were established in this ecosystems.
The distance between transects is about 25 meters. In each transect, 14 sampling points were established.
From each sampling point, three soil samples were collected. In total, 210 samples were analyzed (42 samples/transect X 5 transects), with a MacFadyen corer, on a depth of 10 cm, by 5 cm diameter.
The mites were extracted with a modified Berlese-Tullgren funnels, in ethyl alcohol, clarified in lactic acid and identified to family level, using actual published identification keys (Balogh, 1972; Balogh and Mahunca, 1983; Ghiliarov and Bregetova, 1977; Karg, 1993; Gwiazdowicz, 2007; Krantz and Walter, 2009).
In order to assess the diversity aspects of edaphically mites, a comparative analyze was made between the five transects from the anthropogenic ecosystem. Mite diversity (Shannon index), dominance (D index) and equitability (J index) and the correspondence analysis (CA) were calculated using the statistical soft PAST (Hammer et al., 2001).

A. Tall vegetation

B. Herbaceous layer

Figure 2. The vegetation from investigated ecosystem from Mealului Vallety (A- tall vegetation; B- herbaceous layer)

RESULTS AND DISCUSSIONS

In total, 1138 mites (including immatures) were extracted from the 210 soil cores (87±15.22 individuals from Trombidiformes order, 992 ± 147.6 from Sarcoptiformes order and 59 ± 7.01 individuals from Mesostigmata).

From Trombidiformes order, six families were identified, the dominant ones being Trombidiidae and Cunaxidae (Table 1).

Table 1. Numerical abundance of the investigated mites' taxa from Mealului Valley

	Taxa	T1	T2	T3	T4	T5	Total
Order	Trombidiformes						
Family	Tydeidae		6	4	1	1	12
	Trombidiidae		3		13	5	21
	Cunaxidae		5	7	1	5	18
	Tetranychidae			1			1
	Cheyletidae			3			3
	Scutacaridae			1		31	32
	Total		14	16	15	42	87
Order	Sarcoptiformes						
Suborder Oribatida							
Family	Ceratozetidae	2	12	4		5	33
	Astegistidae		90	68	6	16	180
	Opiidae	5	106	78	102	344	635
	Eulohmanniidae	1					1
	Galumnidae				6	15	21
	Liacaridae				1		1
	Belbidae	1					1
	Mycobatidae				1	4	5
	Phenopelopidae		1	1	2		4
	Protoribatidae					1	1
	Suctobelbidae	1	1	2			4
	Tectocepheidae	1	55	17		1	74
Suborder Astigmata							
Family	Acaridae		18	12		5	35
	Glycyphagidae			4		3	7
	Total	11	283	186	118	394	992
Order	Mesostigmata						
Family	Ascidae		6	7		16	29
	Amblyseidae		1			1	2
	Lealapidae		8	6	4	2	20
	Rhodacaridae		1				1
	Uropodidae	5		1		1	7
	Total	5	16	14	4	20	59

Analyzing the dominance and Shannon diversity index, we observed that the highest values were obtained in T3, followed by the T2 and T1.

The equitability index revealed that in transects with high values of mite diversity, the taxa were represented by a similar number of individuals (Table 2).

Table 2. Population parameters of the investigated mites from Mealului Valley

Transect	T1	T2	T3	T4	T5
No.of taxa	7	14	16	10	17
No. ind.	16 (±1.41)	313 (± 28.19)	216 (± 19.86)	137 (± 20.32)	456 (± 68.26)
Dominance_D	0.23	0.23	0.24	0.57	0.58
Shannon_H	1.68	1.75	1.84	1.03	1.11
Equitability_J	0.86	0.66	0.66	0.45	0.39

Using correspondence analysis (CA), in order to evaluate the relationship between mite taxa abundance and habitat, we determined the preferences of the all soil invertebrates for the investigated transects from tailing pond.

The eigenvalue (the dispersion of the sites/species distribution along the ordination axis) was significant for axis 1 (k = 0.37) and axis 2 (k = 0.34) (Figure 3).

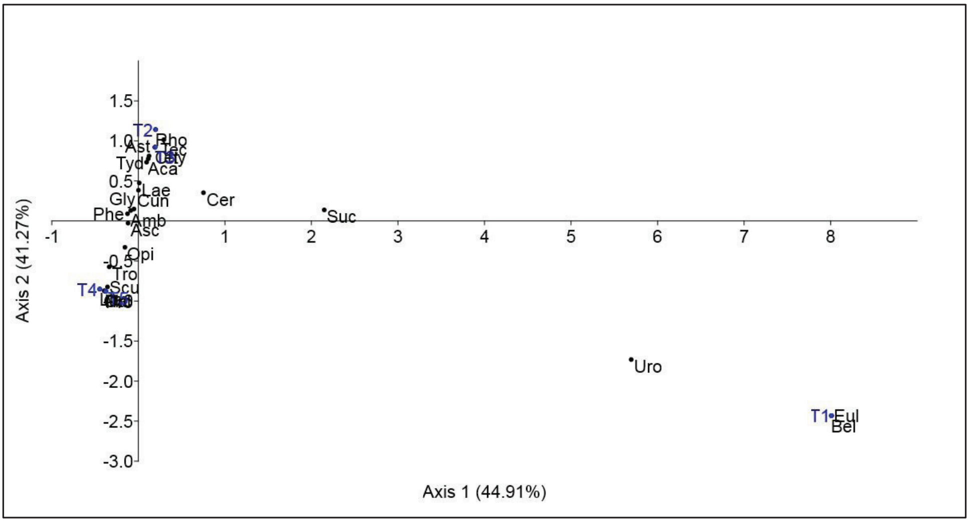

Figure 3. Correspondence analysis (CA) of the taxa abundance and investigated transects
(Eul=Eulohmanniidae; Phe=Phenopelopidae; Aca=Acaridae; Amb=Amblyseidae; Asc=Ascidae; Ast=Astegistidae; Bel=Belbidae; Cer=Ceratozetidae; Chy=Chyletidae; Cun=Cunaxidae; Gal=Galumnidae; Gly=Glycyphagidae; Lae=Laelapidae; Lia=Liacaridae; Mic=Micobatidae; Opi= Opiidae; Pro=Protoribatidae; Rho= Rhodacaridae; Scu= Scutacaridae; Suc=Suctobelbidae; Tec=Tectocepheidae; Tet=Tetranychidae; Tro=Trombidiidae; Tyd=Tydeidea; Uro=Uropodidae)

Axis 1 divided the mite fauna in two groups, differentiated by their preferences to certain transect: T2-T3-T1 (with the highest coverage percent of herbaceous layer) and T4-T5 (with a lowest coverage percent of herbaceous layer, but highest at tall plant species).

Mites associated with the first group were: species from Tydeidae, Cunaxidae and Cheyletidae families (Trombidiformes); Uropodidae and Laelapidae (Mesostigmata) and Ceratozetidae, Astegistidae, Suctobelbidae, Tectocepheidae and Acaridae (Sarcoptifomes).

The second group is formed from Trombidiidae, Scutacaridae (Trombidiformes), Mycobatidae, Opiidae and Galumnidae (Sarcoptiformes).

Mites from Cunaxidae family are present in various type of ecosystems (forest, grasslands, agricultural fields), but also in anthropogenically disturbed areas. They are opportunistic predators, feeding with nematodes, collembolans, phytophagous mites or thrips (Skvarla et al., 2014). Tydeidae are among the smallest mites, many being fungus feeders, but others plant feeders, predators and scavengers (Da Silva et al., 2016).

Invertebrates from Cheyletidae family are phytophilous predators, searching prey on the leaf and steam surface of plants (Walter and Proctor, 2003).

Their preferences for the transects with abundant herbaceous vegetation, could be possible due to the specific more compact habitat, that created favorable environmental condition for these predators mites.

On the other hand, in transect T1, T2 and T3, a developed moss layer was identified, this representing a favorable habitat, for predator mites as Laeleapidae. The moss layer is rich in organic matter and other soil invertebrates, which are the trophic source for these mites (Salmane and Brumelis, 2008; Glime, 2013).

We also observed that in T4 and T5, was recorded the highest numerical abundance of oribatids. The results are confirmed by the studies of other specialists, which revealed that the densities of Oribatida were positively correlated with tall vegetation (as trees from broad-leaved forests) and the species richness of Mesostigmata was positively correlated with species richness of forest floor plants (Hasegawa et al., 2013; Schatz, 2015).

The second axis differentiates mites into two groups: T1-T4-T5 and T3-T2, the first group being correlated with transects were *Phragmites australis* was identified, in comparison with the last one, which preferred the habitat with *Agrostris sp.*(Figure 3).

CONCLUSIONS

Each investigated transects from tailing pond were characterized by specific vegetation composition and coverage. Considering the mite fauna, the most abundant group was represented by Sarcoptiformes order, mainly represented by oribatids, followed by Trombidiformes and Mesostigmata orders. Quantification of Shannon diversity index indicated that transects with herbaceous vegetation represented the most favorable habitats for the soil mites. The equitability index revealed that in transects with high values of mite diversity, the taxa were represented by a closed number of individuals.

Using multivariate analysis, the influence of vegetation on soil mite populations was investigated.

The results revealed that the mite fauna grouped in two classes: one the preferred the small herbaceous layer (especially Mesostigmata and some Trombidiformes) and one that is correlated with tall vegetation (as Oribatida).

In order to investigate more complex ecological process between soil mite and characteristic environment of an anthropic ecosystem, as tailing pond, further investigation are requested.

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