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Soil mite communities (Acari: Gamasina) from different ecosystem types from Romania

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ABSTRACT. The study aimed to characterize the distribution of soil mite populations (Acari: Gamasina) from several terrestrial ecosystems, some of them little studied in Romania as well as in Europe. We studied the Gamasina communities in seven ecosystem types from the Doftana Valley, Prahova County: *Luzulo-Fagetum* beech forest; Medio-European limestone beech forest of the *Cephalanthero-Fagion*; Pannonic woods with *Quercus petraea* and *Carpinus betulus*; Galio-carpinetum oak – hornbeam forests; Alpine rivers and their ligneous vegetation with *Myricaria germanica*; alluvial shrub, characteristic for a hilly-mountain area, with *Salix purpurea*; adjacent area to an inland cliff ecosystem. A total of 240 soil samples, 63 species and 475 individuals were analysed. The samples were taken from May 2006 till September 2010. The highest numerical abundance and species diversity was found in the area located nearby to an inland cliff, which is an early succession stage ecosystem. Considering the dominance and constancy indices quantified for mites from all investigated areas, the highest percent was recorded by the recedent-subrecedent and accessory-accidental species. Based on similarity index two different characteristic groups of gamasid populations were delimited: one for deciduous forests and one for shrubs. DCA ordination successfully handled the variation in soil mite species communities taking account of the soil type.

KEY WORDS: similarity, population, mite, dominance, constancy.

INTRODUCTION

Gamasina mites are very dynamic, free living organisms. Being mostly predators, they are permanently in search of food and favourable habitats for their development. As predators, they do not change the soil structure or plant productivity directly, but have an indirect effect on ecosystem functions by influencing the populations of other organisms (Koehler, 1997, 1999; Gulvik, 2007; Salmane & Brumelis, 2008).

Although the response of the soil mite communities to specific environmental conditions characterizing various ecosystem types (e.g., forest, grassland, arable field, sand dunes, etc.), quantified in terms of changes in population parameters (abundance, species diversity, distribution, dominance, frequency), has been examined, little information is available for Gamasina populations from shrub and cliff ecosystems (Koehler, 1997, 1999; Minor & Cianciolo, 2007; Gwiazdowicz, 2007; Bedano & Ruf, 2007, 2010; Salmane & Brumelis, 2010).

In Romania, some preliminary data from the studied area have been reported previously (Vasiliu Oromulu et al., 2008; Paucă-Comănescu et al., 2009; Manu, 2008, 2009, 2010, 2011). Other research regarding the

Gamasina fauna from hilly forests has been carried out in Moldavia (Călugăr, 2001-2003, 2004-2006). All these studies provided fragmented information concerning soil mite communities from different types of ecosystems. The main aim of this paper is to present the distribution of soil mite populations (Acari: Gamasina) from several terrestrial ecosystems, some of them little studied in Romania, as well as in Europe (as in the case of shrubs and cliffs) and to highlight the similarities or dissimilarities between them.

MATERIALS AND METHODS

The research was done in seven ecosystems types from the Doftana Valley, Prahova County, Romania, during 2006-2010. According to the Natura 2000 classification, the following ecosystems types were investigated: 9110 *Luzulo-Fagetum* beech forest (BF); 9150 Medio-European limestone beech forest of the *Cephalanthero-Fagion* (BC); 91G0 Pannonic woods with *Quercus petraea* and *Carpinus betulus* (QC); 9170 galio-carpinetum oak – hornbeam forests (GCO); 3230 Alpine rivers and their ligneous vegetation with *Myricaria germanica* (AR); alluvial shrub, characteristic for a hilly-mountain area, with *Salix purpurea* (R 4418) (AS); adjacent area to an inland cliff ecosystem in early succession stage (more than 20% are pioneer species, as: *Cytisus nigricans*, *Rosa canina* and *Hippophaë rhamnoides*) (IC) (Doniță et al., 2005). All areas belong to the Romanian Subcarpathians (Fig. 1). A brief description of the studied ecosystems, based on Paucă- Comănescu et al., 2008 and Onete et al., 2011, is presented in Table 1.

In total, 240 soil core samples were collected with a MacFadyen corer (5 cm diameter), to 10 cm depth. The distance between ecosystems

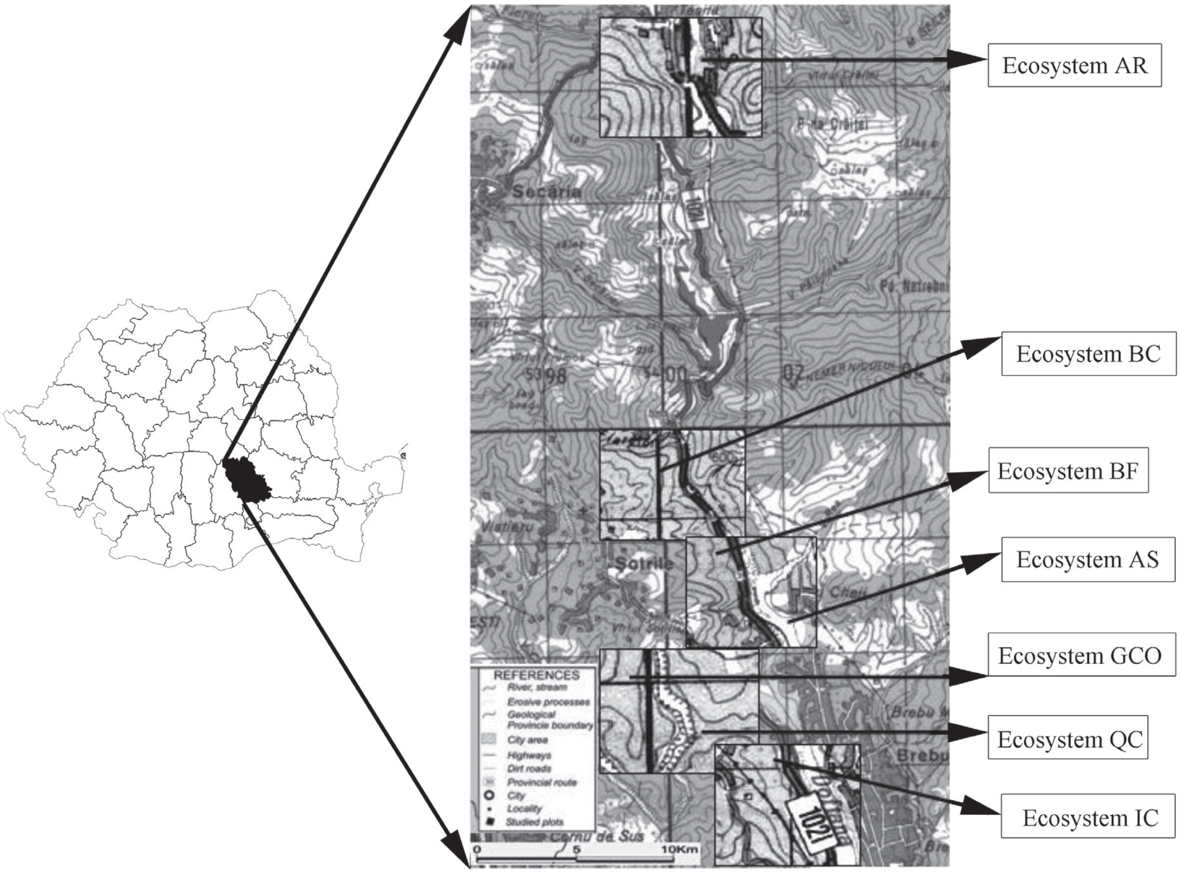


Fig. 1. – Location of the studied ecosystems in the Doftana Valley, Prahova County, Romania.

Table 1

Description of the investigated ecosystems from the Doftana Valley.

Ecosystem	**BF**	**BC**
Geographical coordinates	N: 45^{0}13’39.67”; E: 25^{0}43’48.61”	N: 45^{0}11’27.09”; E: 25^{0}44’50.24”
Altitude	600 m	490 m
Slope	30°	40°
Type of soil	Acid brown, brown iron-alluvial podzols, oligo and oligomesobasic, with moderate and low humidity, middle to deep clayey-sandy, with small-middle edaphic volume.	The humid – calcareous soil is not uniform in structure, varying from calcicolous, clayey till argillaceous or with mull humus. It has a good airflow and drainage.
Conservative value	Moderate	Moderate
Ecosystem	**QC**	**GCO**
Geographical coordinates	N: 45^0 09’49.46; E: 25^{0}45’06.62”	N: 45^0 09’45.62; E: 25^{0}44’52.60”
Altitude	500 m	490 m
Slope	25°	flat
Type of soil	Alluvial, with the upper 25 cm moderate in humus, middle trophicity; water is permanently available.	Brown eumesobasic, rich in humus, sandy-clay texture, well structured on humus layer, good drainage, low acidity on superior level.
Conservative value	Moderate	Moderate
Ecosystem	**AR**	**AS**
Geographical coordinates	N: 45^{0}16’56.38”; E: 25^{0}45’35.08”	N 45^o 20’40,1” E 25^{o}74’51,3
Altitude	663 m	485 m
Slope	flat	flat
Type of soil	Sandy-clay, with an increased humidity.	Sandy-clay, with an increased humidity.
Conservative value	High: Emerald protection	High: Emerald protection
Ecosystem	**IC**	
Geographical coordinates	N: 45° 12’ 31,1”; E: 25° 44’ 23,5”	
Altitude	537 m	
Slope	50° – 70°	
Type of soil	Three classes: clayey till argillaceous on the moderate and strongly inclined peaks, which are seriously affected by erosion; brown eumesobasic till pseudogleic, which have a mineral component formed at the soil surface, connected to a thin humified organic matter layer; typically alluvial soil.	
Conservative value	Moderate	

varied from 1 km to 25 km. Samples were taken randomly. The extraction was performed with a modified Berlese-Tullgren extractor, in ethanol and the mite samples were clarified in lactic acid. All mites were identified to species level.

The statistical analysis was conducted with the aid of the BioDiversity Pro 2.0 software, designed and developed by Neil McAleece and provided by The Natural History Museum, London. The Jaccard similarity index (q) was calculated using the formula: $q = c/(a + b - c)$, where a = number of species from ecosystem A; b = number of species from ecosystem B; c = number of species shared between ecosystems A and B.

Using statistical information, dominance was calculated, according to Engelmann's dominance classification (ENGELMANN, 1978).

The dominance was calculated using the formula:

D=100*n/N, where:
n - number of individuals of one species from one sample;
N - total number of individuals of all species from one sample.

The dominance classes for the identified mites were:

eudominants = over 10% (D5); dominants = 5.1-10% (D4); subdominants = 2.1 – 5% (D3); recedents = 1.1- 2% (D2) and subrecedents ≤ 1.1% (D1).

The constancy was determined following the methodology of Skorupski et al. (2009) and obtained as:

C=100*pA/P, where:
pA = number of samples with species A;
P = total number of samples.

The mite species were classified in four constancy classes: euconstants = 75.1-100% (C4), constants = 50.1-75% (C3), accessory = 25.1-50% (C2) and accidental = 1-25% (C1).

We used detrended correspondence analysis (DCA) to investigate spatial variation of soil mite community structure. DCA is an indirect eigenvector ordination technique based upon reciprocal averaging, which corrects for the 'arch effect' observed in correspondence analysis, and displays effectively primary gradients within communities. Pearson product-moment correlations were used to determine if DCA axes scores were correlated with any of the environmental variables (GAUSCH, 1982; LEGENDRE & LEGENDRE, 2000). The following types of soils, as variables, were investigated (M (mixt) - SC (sandy clay) - BE (brown eumezobasic) – HC (humid calcaros) – A (alluvial) – AB (acid brown). The scales used are different to facilitate interpretation, and a selection of species and sites is shown to facilitate visualization. Species codes are given in Table 4.

We also used canonical correspondence analysis (CCA) to investigate associations between soil mite communities and environmental variables: habitat type (Ht), altitude (Alt), slope (Spl) and soil type (St) (TER BRAAK & VERDONSCHOT; 1995; LEGENDRE & LEGENDRE, 2000). CCA is a multivariate direct ordination technique, which extracts synthetic environmental gradients that maximize niche separation within communities, thereby facilitating the interpretation of how species abundances relate to environmental variables. Non-transformed species abundance data and all four environmental variables for each sample were included in the analysis.

CCA and DCA were carried out using the vegan package in R version 1.8.1 (R DEVELOPMENT CORE TEAM, 2003; OKSANEN et al., 2011).

RESULTS

A total of 475 Gamasina mites were counted, belonging to 63 species. 45.03% of the species were only found in a single ecosystem 4 (Table 2).

The graph analysing cumulative abundance (%) plotted against species rank revealed differences

Table 2

Gamasina species identified in the forest ecosystems from the Doftana Valley (ecosystems BF, BC, QC, GCO).

Species	BF		BC		QC		GCO	
	D%	C%	D%	C%	D%	C%	D%	C%
Alloparasitus oblongus Halbert, 1915	-	-	-	-	1.22	10	-	-
Amblyseius sp.	-	-	1.61	10	-	-	-	-
Arctoseius cetratus Sellnicki, 1940	9.09	20	-	-	-	-	-	-
Asca bicornis Canestrini & Fanzago, 1887	-	-	-	-	1.22	10	-	-
Cheroseius sp.	3.03	10	-	-	-	-	-	-
Cheroseius viduus C.L.Koch, 1839	-	-	-	-	-	-	7.94	30
Dendrolaelaps willmanni Hirschmann, 1963	-	-	-	-	2.44	10	-	-
Epicrius mollis Kramer, 1876	1.52	10	-	-	-	-	-	-
Eviphis ostrinus C.L.Koch, 1836	-	-	-	-	-	-	1.59	10
Geholaspis mandibularis Berlese, 1904	-	-	-	-	1.22	10	-	-
Holoparasitus calcaratus C.L.Koch, 1839	-	-	-	-	1.22	10	-	-
Hypoaspis aculeifer Canestrini, 1883	15.15	40	8.06	30	-	-	1.59	10
Hypoaspis brevipilis Hirschmann, 1969	-	-	-	-	2.44	20	-	-
Leptogamasus parvulus Berlese, 1903	-	-	3.22	20	6.10	30	6.35	30
Leptogamasus variabilis Juvara-Balş, 1981	-	-	1.61	10	-	-	-	-
Lysigamasus conus Karg, 1971	3.03	10	-	-	-	-	-	-
Lysigamasus lapponicus Tragardh, 1910	3.03	10	9.67	40	2.44	20	15.87	50
Lysigamasus misellus Berlese, 1903	-	-	-	-	-	-	1.59	10
Lysigamasus neoruncatellus Schweizer, 1961	-	-	-	-	3.66	30	-	-
Lysisgamasus truncus Schweizer, 1961	-	-	1.61	10	1.22	10	-	-
Macrocheles carinatus C.L.Koch, 1839	-	-	-	-	3.66	10	-	-
Macrocheles decolotaus C.L. Koch, 1893	-	-	-	-	1.22	10	-	-
Macrocheles montanus Willmann, 1951	3.03	10	-	-	3.66	20	1.59	10
Olopachys suecicus Sellnick, 1950	-	-	1.61	10	6.10	50	1.59	10
Olopachys vysotkajae Koroleva, 1976	-	-	-	-	1.22	10	-	-
Pachylaelaps furcifer Oudemans, 1903	-	-	-	-	-	-	6.35	30
Pachyseius humeralis Berlese, 1910	3.03	10	-	-	-	-	-	-
Pergamasus crassipes Linne, 1758	-	-	1.61	10	-	-	-	-
Pergamasus longicornis Berlese, 1906	-	-	-	-	-	-	1.59	10
Pergamasus quisquiliarum R & C. Canestrini, 1882	-	-	-	-	1.22	10	9.52	40
Prozercon fimbriatus C.L.Koch, 1839	33.33	50	14.52	50	7.32	20	11.11	40
Prozercon rafalski Blaszak, 1971	-	-	-	-	3.66	30	-	-
Prozercon sp.	-	-	3.22	20	-	-	-	-
Prozercon traegardhi Halbert, 1923	15.15	10	11.29	30	14.63	60	3.17	20
Pseudolaelaps doderoi Berlese, 1910	-	-	11.29	30	-	-	-	-
Rhodacarellus perspicuus Halaskova, 1958	-	-	-	-	-	-	1.59	10
Veigaia exigua Berlese, 1917	6.06	10	4.84	20	-	-	-	-
Veigaia nemorensis C.L. Koch, 1839	3.03	10	22.58	60	23.17	80	23.81	70
Vulgarogamasus zschokkei Schweizer, 1922	-	-	-	-	-	-	3.17	10
Zercon fageticola Halaskova, 1969	3.03	10	-	-	3.66	30	-	-
Zercon peltatus C.L Koch, 1836	-	-	-	-	7.32	40	1.59	10

between mite communities from the investigated ecosystems. The highest values were recorded for mite communities from ecosystem IC, while the lowest were from ecosystem BF. In the other ecosystems species had smaller abundance decreasing from QC to AR to GCO to BC to AS (Fig. 2).

Taking account of the dominance index quantified for these invertebrates in forests, the highest numbers of eudominant and dominant species were recorded in ecosystem BC (28.57% and 14.28%, respectively of the total number of identified soil mites) and the lowest in ecosystem QC (9.09% and 18.18%, respectively). These species were: *Lysigamasus lapponicus* (Tragardh, 1910)*, Pseudolaelaps doderoi* (Berlese, 1910)*, Veigaia nemorensis* (C.L.Koch, 1839), *Cheroseius viduus* (C.L.Koch, 1839)*, Hypoaspis aculeifer* (Canestrini, 1883)*, Prozercon fimbriatus* (C.L.Koch, 1839)*, Prozercon traegardhi* (Halbert, 1923)*, Zercon peltatus* (C.L.Koch, 1836). The most numerous subrecedent species were found in ecosystem GCO (45.08%). In ecosystem BF no recedent or subrecedent species were recorded. Analysis of the constancy index revealed *Veigaia nemorensis* as a constant species in ecosystems BC and GCO, and as a euconstant species in ecosystem QC. The majority of the identified mites were classified as accessory and accidental species (75% - 16.67%) (Table 2).

The highest numbers of eudominant and dominant species were recorded in ecosystem AR, shrub with *Myricaria germanica* (16.67% and 25%, respectively) and the lowest in ecosystem IC, adjacent area of the cliff (2.94% and 1.47%, respectively). In the shrub ecosystem, these species were: *Asca bicornis* (Canestrini and Fanzago, 1887), *Hypoaspis aculeifer, Pachyseius humeralis* (Berlese, 1910), *Lysigamasus conus* (Karg, 1971), *Lysigamaus lapponicus, Macrocheles carinatus* (C.L. Koch, 1839) and in adjacent area to the cliff: *Geholaspis mandibularis* (Berlese, 1904), *Prozercon traegardhi* (Halbert, 1923), *Veigaia nemorensis, Veigaia planicola* (Berlese, 1905). 78.18% of the total number of species from shrub with *Salix purpurea* (ecosystem AS) were recedents and subrecedents. *Veigaia nemorensis*, *Veigaia planicola* and *Prozercon traegardhi* were identified as euconstant species, *Leptogamasus obesus* (Holtzmann, 1969) as constant, all of them found in ecosystem IC. The shrub ecosystems (AR and AS) were characterized only by accessory (8.33% in ecosystem AR; 33.33% in ecosystem AS) and accidental species

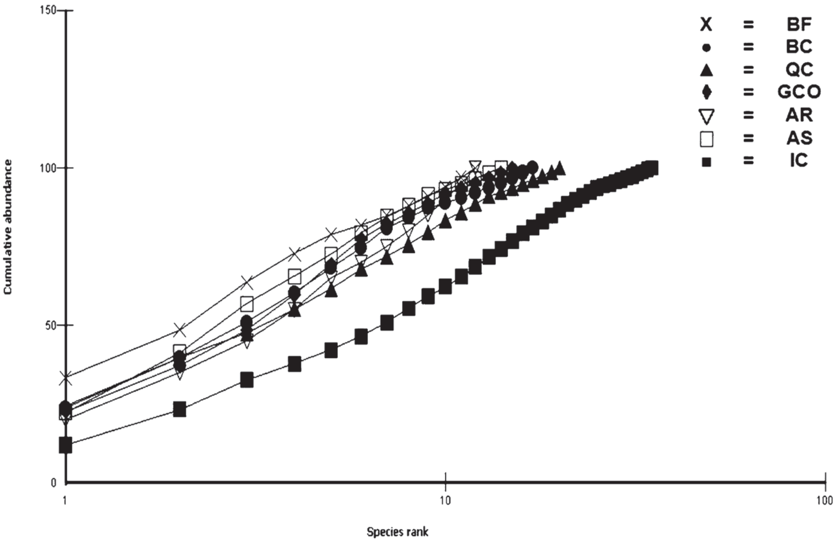


Fig. 2. – Cumulative abundance (%) of the identified Gamasina species from the investigated ecosystems.

Table 3

Gamasina species identified in the shrub and adjacent area to the cliff ecosystems from the Doftana Valley (ecosystems AR, AS, IC).

Species	**AR**		**AS**		**IC**	
	D%	C%	D%	C%	D%	C%
Arctoseius resinae Karg, 1969	-	-	-	-	0.63	10
Asca bicornis Canestrini & Fanzago, 1887	20	30	-	-	0.63	10
Eviphis ostrinus C.L.Koch, 1836	-	-	3.45	20	1.89	30
Geholaspis longisetosus Balogh, 1958	-	-	-	-	1.89	20
Geholaspis mandibularis Berlese, 1904	-	-	18.97	50	5.03	50
Hypoaspis aculeifer Canestrini, 1883	10	10	15.52	50	1.26	20
Hypoaspis milles Berlese, 1892	-	-	3.45	10	-	-
Hypoaspis sp.	10	20	-	-	-	-
Leptogamasus obesus Holtzmann, 1969	-	-	-	-	4.40	70
Leptogamasus sp.	-	-	5.17	20	-	-
Lysigamasus conus Karg, 1971	15	20	-	-	-	-
Lysigamasus neoruncatellus Schweizer, 1961	5	10	-	-	0.63	10
Lysigamasus sp.	-	-	1.72	10	0.63	10
Lysigamaus lapponicus Tragardh, 1910	-	-	6.90	20	0.63	10
Macrocheles carinatus C.L.Koch, 1839	-	-	8.62	30	-	-
Macrocheles matrius Hull, 1925	-	-	-	-	2.52	30
Macrocheles montanus Willmann, 1951	-	-	1.72	10	1.26	20
Macrocheles sp.	-	-	-	-	3.14	30
Olopachys suecicus Sellnick, 1950	-	-	-	-	1.26	20
Olopachys vysotskajae Koroleva, 1976	-	-	-	-	1.26	20
Pachylaelaps dubius Hirschmann & Krauss, 1965	-	-	-	-	0.63	10
Pachylaelaps furcifer Oudemans, 1903	5	10	1.72	10	4.40	50
Pachylaelaps pectinifer R & C. Canestrini, 1882	-	-	-	-	0.63	10
Pachyseius humeralis Berlese, 1910	10	20	-	-	3.14	20
Parasitellus sp.	-	-	-	-	0.63	10
Pergamasus barbarus Berlese, 1904	-	-	1.72	10	1.89	30
Pergamasus longicornis Berlese, 1906	-	-	-	-	2.52	30
Pergamasus quisquiliarum R & C. Canestrini, 1882	5	10	-	-	-	-
Poecilochirus carabi G. &. R. Canestrini, 1882	-	-	-	-	0.63	10
Prozercon carsticus Halaskova, 1963	-	-	-	-	4.40	50
Prozercon sp.	5	10	-	-	-	-
Prozercon traegardhi Halbert, 1923	-	-	-	-	9.43	80
Pseudolaelaps doderoi Berlese, 1910	5	10	-	-	2.52	40
Rhodacarellus perspicuus Halaskova, 1958	5	10	-	-	-	-
Rhodacarus denticulatus Berlese, 1921	5	10	-	-	-	-
Veigaia exigua Berlese, 1917	-	-	6.90	30	3.14	40
Veigaia nemorensis C.L. Koch, 1839	-	-	22.41	50	11.95	100
Veigaia planicola Berlese, 1892	-	-	-	-	11.32	80
Veigaia propinqua Willmann, 1936	-	-	-	-	1.89	10
Vulgarogamasus kraepelini Berlese, 1905	-	-	-	-	1.89	20
Zercon foveolatus Halaskova, 1969	-	-	-	-	4.40	50
Zercon hungaricus Sellnick, 1958	-	-	-	-	3.14	10
Zercon peltadoides Halaskova, 1970	-	-	-	-	3.77	40
Zercon triangularis C.L.Koch, 1836	-	-	1.72	10	-	-

Table 4

Pearson product-moment correlations between DCA axes site scores and environmental variable.

	Habitat type	Altitude	Slope	Soil type
DCA1	-0.422**	0.188	0.05	-0.450**
DCA2	-0.394**	-0.255*	0.081	-0.382**

* p < 0.5, ** p < 0.01

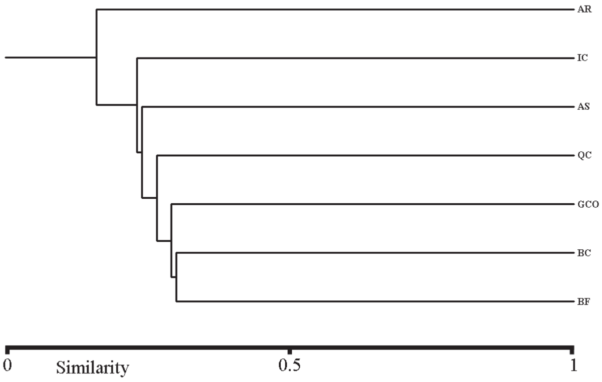


Fig. 3. – Dendrogram depicting similarities between the Gamasina communities between the seven investigated ecosystem types.

(91.67% in ecosystem AR; 66.66% in ecosystem AS) (Table 3).

The highest values of the Jaccard similarity index (q), which considers the species abundance from each investigated ecosystem, were recorded between mite populations from ecosystems BC and BF (q= 0.30), GCO-BC (q= 0,29) and GCO-QC (q= 0.26). In addition, the pairs of ecosystems AS-IC (q=0.23), AS-BF (q= 0.238) and AS-GCO (q= 0.24) had close values of the similarity index (Fig. 3).

The first axis of the DCA ordination accounted for 26.6% of the variance in soil mite community

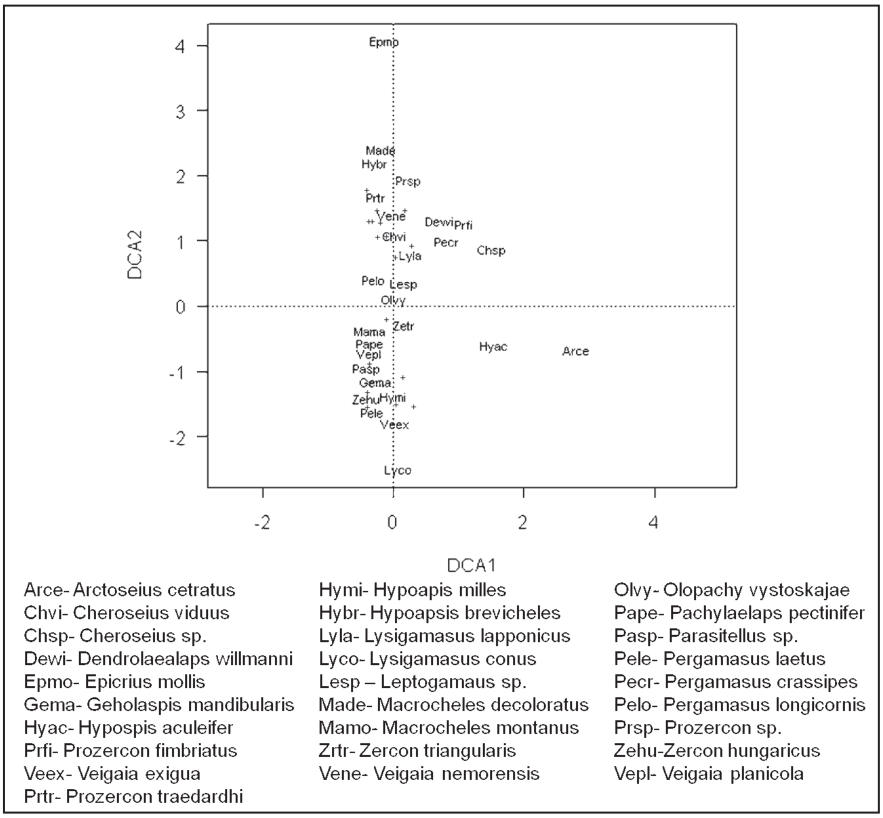


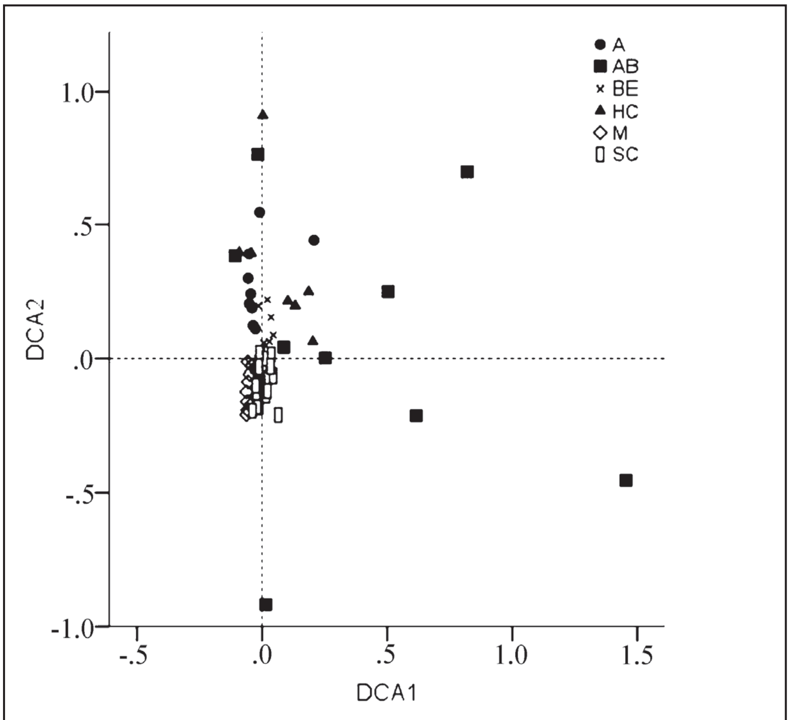
Fig. 4. – DCA ordination of soil mite species on the first two axes.

data (eigenvalue = 0.20) with a gradient length of 1.5 standard deviation units (Fig. 4). Site scores along axis one of the DCA ordination diagram clustered along the type of soil gradient. The second axis explained 14.42% of the variance (eigenvalue = 0.14) with a gradient length of 1.8 standard deviation units and represented an altitude gradient (high to low) (Fig. 5). DCA axis 1 was negatively correlated with soil type and habitat type whereas DCA axis 2 was most correlated with altitude (Table 4).

DISCUSSION

The number of Gamasina species (63) obtained in the investigated ecosystems is in concordance with the findings from other temperate ecosystems, where this parameter varies from 13 to 98 (KOEHLER, 1997, 1999; SKORUPSKI, 2001; MORAZA, 2006; GWIAZDOWICZ, 2007; GULVIK, 2007; SKORUPSKI et al., 2009; SALAMANE & BRUMELIS, 2010). In general, dominant species were common eurytopic detriticol species, with a wide ecological range. The highest values of abundance and frequency of occurrence were recorded in leaf litter and soil detritus from deciduous temperate forests. The fact that these species are dominant in all investigated ecosystems means that they do not have a certain preferred habitat, being capable of adapting to any environmental conditions (GWIAZDOWICZ, 2007).

Despite the poor vegetation and soil (mineral component formed at soil surface, connected to a thin humified organic matter layer), species diversity was the highest in ecosystem IC. In the early ecological succesion, the mite's abundance and diversity can be very high and their trophical specialization is not so strict. Gamasina are able to exploit spatially and temporarily restricted habitats. High dispersal capability is characteristic of many species; dispersal occurs by wind drift, phoresy on insects or from adjacent species-rich ecotones, and the recolonization of various source and sink patches is an important part of the life strategy of many species (KOEHLER, 1999; MINOR & CIANCIOLO, 2007).



Types of soil: A = alluvial, B = acid brown, BE = brown eumezobasic, HC = humid calcareous, M = mixt, SC = sandy clay

Fig. 5. – DCA ordination of surveyed sites coded by soil type.

Differences were found in dominance and constancy indices for individual mite species in each investigated ecosystem. The high percent of recedent - subrecedent species (ecosystem GCO) and of accessory - accidental species (ecosystems BC, QC, AR and AS) showed that the unfavourable environmental conditions (type of vegetation, slope, sandy soils without organic matter and the dryness) influence the stability of the studied populations. Being predators, they are very mobile species, always migrating to favourable habitats in search for food.

Veigaia nemorensis (C.L.Koch, 1839) was identified as a euconstant-constant species in six out of the seven studied ecosystems. This is likely due to its wide niche breadth, being a well-recognised ubiquitous species (SALMANE, 2001; SALAMANE & BRUMELIS, 2010).

The dendogram showed that the deciduous forests (ecosystems BF, BC, QC, GCO) have more common species in comparison with the other ecosystems, highlighted by the high value of the similarity index. A common characteristic was the presence of humus in all forests, which represents a proper habitat for Gamasina species, providing them a proper trophic source (springtails, nematodes, enchytreides and other mites). The mite populations from shrub ecosystems (AR, AS) and adjacent area of the cliff (IC) formed a distinct group, based on characteristic species composition (especially in ecosystem IC). This phenomenon was reflected in dissimilarity between Gamasina mite populations from ecosystems BC-AR, AR-QC, AR-AS and AS-IC. These differences could be explained through both large geographic distance between ecosystem AR and the other ecosystems (about 15 km) and the characteristic environmental conditions (type of soil, vegetation).

The DCA showed that the species *Epicrius mollis, Geholapsis mandibularis, Hypospis aculeifer, Veigaia exigua, Veigaia nemorensis, Macrocheles montanus Prozercon fimbriatus* and *Prozercon traegardhi* are highly correlated with different types of soils. As these mites are predators, the soil of the investigated habitats represents the trophic reservoir for them. Acid soils allow proper development of invertebrate populations (oribatids, springtailis, nematodes, etc), which are the favoured food of gamasids (KOEHLER, 1997, 1999; GULVIK, 2007).

The soil type from deciduous forest, characterized by increased soil humidity and presence of organic matter (decayed wood), is proper habitat for predatory species, e.g. *Veigaia nemorensis* and *Hypospis aculeifer* and also for the hygromesophilous omnivorous species *Zercon fageticola* and *Zercon peltatus* (MASAN & FENDA, 2004; SABELIS & LESNA, 2010; GWIAZDOWICZ ET AL., 2011).

In ecosystems GCO and AR two small species were identified. Due to their small body dimensions (0.25-0.45 mm), *Asca bicornis* and *Rhodacarellus perspicuus* adapt easily to rough conditions from shrub ecosystems (dryness, sandy soils low in organic matter), as they are able to migrate deep in the soil, till 20 cm (KOEHLER, 1997; BERNT et al., 2003, GULVIK, 2007; MANU, 2008).

The high number of accessory and accidental species from ecosystems AS and IC indicates that these habitats are not preferred by mites. Being very mobile predatory invertebrates, they are able to migrate from adjacent ecosystems, and such migration may explain why these species were not directly correlated with the ecosystem type.

CONCLUSIONS

Each studied ecosystem was characterized by the dominant species, which are characteristically for temperate ecosystems. The ecosystem nearby the inland cliff, which is in early succession stage, was characterised by the highest numerical abundance and species diversity. *Veigaia nemorensis* was identified in six ecosystems, having the widest ecological plasticity.

Considering the dominance and constancy indices, the highest values were recorded for recedent - subrecedent and accessory - accidental species in all ecosystems. This phenomenon showed that these soil mite communities cannot be considered as stable populations, since they are continuously migrating in search for food.

Analysing the distribution of the Gamasina fauna we observed different composition structure, depending on vegetation (habitat type), soil conditions and geographical position. The similarity analysis between mite populations showed two distinct groups: species from deciduous forests and those from shrubs. The multivariate analysis showed us that the soil mite communities are strongly influenced by the environmental variables, especially by the type of soil.

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