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THE INFLUENCE OF SOME ABIOTICAL FACTORS ON THE STRUCTURAL DYNAMICS OF THE PREDATORY MITE POPULATIONS (ACARI: MESOSTIGMATA) FROM AN ECOSYSTEM WITH *MYRICARIA GERMANICA* FROM DOFTANA VALLEY (ROMANIA)

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Abstract. The paper presents the influence of some abiotical factors (relative humidity, temperature and pH of soil) on the structure of the adult mite populations (Acari: Mesostigmata) from an ecosystem with *Myricaria germanica*. Species composition of the gamasid mites from soil showed the presence of seven families (Parasitidae, Rhodacaridae, Pachylaelaptidae, Pseudolaelapidae, Laelaptidae, Zerconidae, Trachytidae), with 10 genera and 13 species, characteristic to the terrestrial ecosystems. The trophical structure revealed the presence of 11 predators and of 2 omnivorous species. The environmental conditions influenced the temporal and spatial dynamics of the structure of mesostigmatid populations. In temporal dynamics, in May, the most increased value of the numerical density was recorded. From the spatial point of view, litter-fermentation and soil layers were favourable habitats for development of these mesostigmatids.

Résumé. Le document présente l'influence de certains facteurs abiotiques (humidité relative, la température et le pH du sol) sur la structure de la population adulte d'acariens (Acari: Mesostigmata) de l'écosystème avec *Myricaria germanica*. De la composition des espèces d'acariens gamasides du sol on a révélé la présence de sept familles (Parasitidae, Rhodacaridae, Pachylaelaptidae, Pseudolaelapidae, Laelaptidae, Zerconidae, Trachytidae), avec 10 genres et 13 espèces, typiques pour les écosystèmes terrestres. La structure trophique a révélé la présence de 11 prédateurs et de 2 espèces omnivores. Les conditions environnementales ont influencé la dynamique temporelle et spatiale de la structure des populations de mesostigmatides. Dans la dynamique temporelle, en mai a été enregistré la plus haute valeur numérique de la densité. Du point de vue spatial, la litière, la fermentation et les couches de sol ont été favorables pour le développement des habitats de ces mesostigmatides.

Key words: Acari, Mesostigmata, population, dynamics, *Myricaria germanica*, factors, Doftana Valley, Romania.

INTRODUCTION

Mesostigmatid mites are small invertebrates which live in different habitats: bird's nest, plants, on animals, in soil and litter. In trophical structure of the soil fauna, gamasids are third consumers. The soil offers the best conditions for their development. The role of the predator mites is very important for understanding their influence in soil system, especially in interface soil-litter. The majority of the Mesostigmata are mobile predators. They are very important in regulating the densities of others soil invertebrates as: enchytreids, nematodes, spring tails, immature oribatids (Walter & Proctor, 1999).

Their presence in a favourite ecosystem, where there is a rich food source, depends on the bioedaphical factors, like: relative humidity, temperature of the air and substrate, the soil pH, i.e. Any disturbance of these abiotical factors generate modifications of the numerical densities, of the specific diversity and of the trophical structure of these invertebrates. The mesostigmatid species have preferences for hygro-mesophytic habitats and for some types of soils, depending on an acid pH (Georgescu, 1982; Salmane, 2000). The ecological researches on the gamasid populations are made especially in soil from forestry ecosystems, preferred habitats for these invertebrates. The numerical density is one of the most significant quantitative parameter, which characterized the edaphic animals from the structural relations point of view, in comparison with the entire soil invertebrate community and gives a measure of their indirect participation in the decomposing processes. In arable soils, in one square meter, between 5,000 and 100,000 individuals were identified and in the soil of forestry ecosystems and in meadows, between 10,000 and 150,000 individuals (Honciuc, 2000; Stănescu, 2007). The maximum number of individuals occurs at 5 cm deep in soil, decreasing progressively till 25-30 cm (Axel, 2002). Similar to the other soil mesofauna, population development of mesostigmatids is very much influenced by the microclimate, which depends on the structure of the herbaceous plants, shrubs or trees and on the litter layer (Koehler, 1999).

The structure and dynamics of the gamasid fauna in shrubs ecosystems has not been very studied in Romania (Paucă Comănescu et al., 2004, 2005, 2008; Honciuc & Manu, 2008). This paper proposed to analyse the influence of some abiotical factors (relative humidity, temperature, pH of soil) on the spatial and temporal dynamics of the gamasid population diversity from an ecosystem with *Myricaria germanica*.

MATERIAL AND METHODS

The researches were made in 2007, in an ecosystem with *Myricaria germanica* from Doftana Valley (Romania). The studied area belongs to a habitat 3230 of alpine rivers and their ligneous vegetation with *Myricaria germanica* (according to „Natura 2000" habitat type). The shrub layer is dominated by this species in different proportion, being associated with *Salix purpurea*. Very rarely appear the juvenile species of *Alnus glutinosa, A. incana* and *Fagus sylvatica*. The herbaceous layer has a very active dynamics, being frequently destroyed by the floods and having the roots on the surface of soil. The most abundant gramineous species are *Agrostis stolonifera, Festuca pratensis* and *Dactylis glomerata*, as well as *Trifolium pratense, Lysimachia nummularia, Lycopus europaeus, Tussilago farfara, Aegopodium podagraria, Glechoma hederacea* and *Ranunculus repens* (Doniță et al., 2005).

The soil samplings were collected randomly, with MacFadyen soil core. Fauna of mites from these areas was sampled (10 samples), on three layers: L - litter and fermentation, S1 - humus, S2 – soil. The extraction was performed with a modified Berlese-Tullgren extractor, in ethylic alcohol and the mites samples were clarified in lactic acid. The identification of the mites from the Mesostigmata order was made till species level (after Gilarov & Bregetova, 1977; Hyatt, 1980; Karg, 1993).

The researches showed the statistical parameters of the gamasid populations (numerical density – ind./sq.m.; relative abundance – A%; constance – C) and their evolution under the influence of some identified abiotical factors, as: air and soil temperature, relative humidity and pH of soil (Tabs 1, 2, 3).

Table 1

Relative humidity of soil (%) recorded in ecosystem with *Myricaria germanica* from Doftana Valley.

Layer	April	May	July	September
0-10 cm	18.4	7.7	2.84	7.85
10-20 cm	20.27	16.94	6.34	8.09
20-30 cm	10.61	12.27	6.7	9.35
30-40 cm	10.48	10.53	10.01	8.43
Average	14.94	11.86	6.47	8.43

Table 2

The air and soil temperatures (°C) recorded in ecosystem with *Myricaria germanica* from Doftana Valley.

Level	April	May	July	September	Average
Air	9.7	17.6	22.9	13.9	16.02
Soil	17.9	26.8	34.4	14.4	23.6

Table 3

Soil pH recorded in ecosystem with *Myricaria germanica* from Doftana Valley.

Level	April	May	July	September	Average
L	7.32	7.47	7.83	7.48	7.52
S1	7.55	7.56	7.72	8.02	7.71
S2	7.62	7.65	7.63	8.05	7.74
Average	7.49	7.56	7.73	7.85	7.65

Table 4

Mesostigmatid species identified in the ecosystem with *Myricaria germanica* from Doftana Valley.

Species	Habitats	Biogeographical distribution
Parasitidae Oudemans, 1901		
Lysigamasus neoruncatellus Schweizer, 1961	Litter.	Central Europe
Lysigamasus conus Karg, 1971	Compost, litter, humus, moss, orchards, agroecosystems	Central Europe
Pergamasus quisquiliarum R. and G. Canestrini, 1882	Agroecosystems, orchards, compost, humus	Europe, South America
Rhodacaridae Oudemans, 1902		
Asca bicornis Canestrini and Fanzago, 1887	Decaying vegetation, grassland, under stones in sand	Europe
Rhodacarus denticulatus Berlese, 1921	in litter	South and Central Europe
Rhodacarellus perspicuus Halaskova, 1958	in litter	Central Europe
Pachylaelaptidae Vitzthum, 1931		
Pachylaelaps furcifer Oudemans, 1903	Mixed and decidous forests, beech forest, inland and coastal meadows	Europe
Pachyseius humeralis Berlese, 1910	Decaying vegetation, grasslands, arable fields, in mine	Europe
Pseudolaelapidae Evans and Till, 1966		

Table 4 (continued)

Species	Habitats	Biogeographical distribution
Pseudolaelaps doderoi Berlese, 1910	Decaying vegetation, grassland, under stones, arable fields	Europe
Laelaptidae Berlese, 1892		
Hypoaspis sp.		
Hypoaspis aculeifer Canestrini, 1883	Decaying vegetation, grassland, heathland, sand dunes, seashore, moss, small mammal and bird nests, coal shale, arable fields, stored cereal products, farm animal waste	Europe, Asia; North America
Zerconidae Caneastrini, 1891		
Prozercon sp.		
Trachytidae Tragardh, 1938		
Trachytes aegrota C.L. Koch, 1841	Decaying vegetation from forests	Europe

RESULTS AND DISCUSSIONS

In studied ecosystem with *Myricaria germanica*,13 mesostigmatids species (Acari - Mesostigmata) were identified, belonging to 10 genera and 7 families: Parasitidae, Rhodacaridae, Pachylaelaptidae, Pseudolaelapidae, Laelaptidae, Zerconidae, Trachytidae. The identified species are predators, with exception of zerconids and trachytids, which are omnivorous. Most of the described species have an European and Central European distribution, exceptiing of *Pergamasus quisquiliarum* and *Hypoaspis aculeifer*, which are more widely spread (Karg, op. cit.; Skorupski & Luxton, 1998; Salmane, 2001) (Tab. 4).

These species recorded an annual numerical density of 2,100 ind./sq.m. Analysing the temporal dynamics of the mite populations, in May, the most increased value of the numerical density (1,500 ind./sq.m.) was obtained, as well as of the specific diversity (7 species). In September low values of these parameters were recorded, only one species being identified, with 100 ind./sq.m. (Fig. 1).

In spatial dynamics, at the soil level, litter-fermentation and soil layers (each recorded 800 ind./sq.m.) were best represented from the numerical point of view were, in comparison with the humus layer (500 ind./sq.m.) (Fig. 2).

Analysing the numerical density, the following species recorded maximum values: *Lysigamasus conus* (300 ind./sq.m.), *Asca bicornis* (400 ind./sq.m.), *Hypoaspis aculeifer* (200 ind./sq.m.) and *Pachyseius humeralis* (200 ind./sq.m.). They are eudominant and dominant species, cosmopolite, characteristic to different types of ecosystems: forests, arable fields, meadows, etc. The most decreased values were recorded in following species: *Lysigamasus neoruncatellus, Pergamasus quisquiliarum, Rhodacarus denticulatus, Rhodacarellus perspicuus, Pachylaelaps furcifer, Pseudolaelaps doderoi, Prozercon* sp. and *Trachytes aegrota*, each of them reaching 100 ind./sq.m.. These are accidentally species, mostly predators, very sensitive to the modification of the abiotic factors, which in dry conditions are not able to develop their populations (Figs 3, 4).

In spatial dynamics, in soil, the abiotic factors (decreased relative humidity and an increased temperature) recorded at litter-fermentation layer were less favourable to the development of the mesostigmatid species. These abiotic conditions determined the identification of the species *Asca bicornis* (with 400

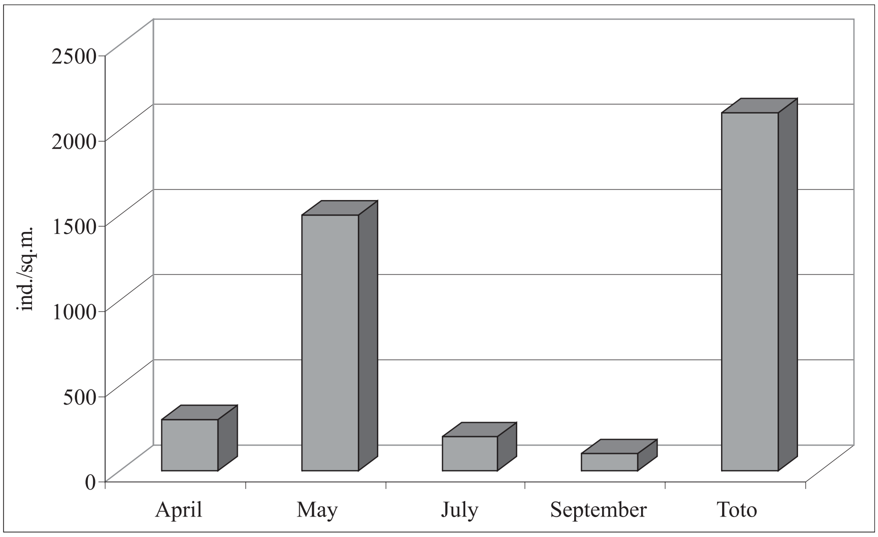

Fig. 1 – Numerical density (ind./sq.m.) of the mesostigmatids in ecosystem with *Myricaria germanica*, from Doftana Valley.

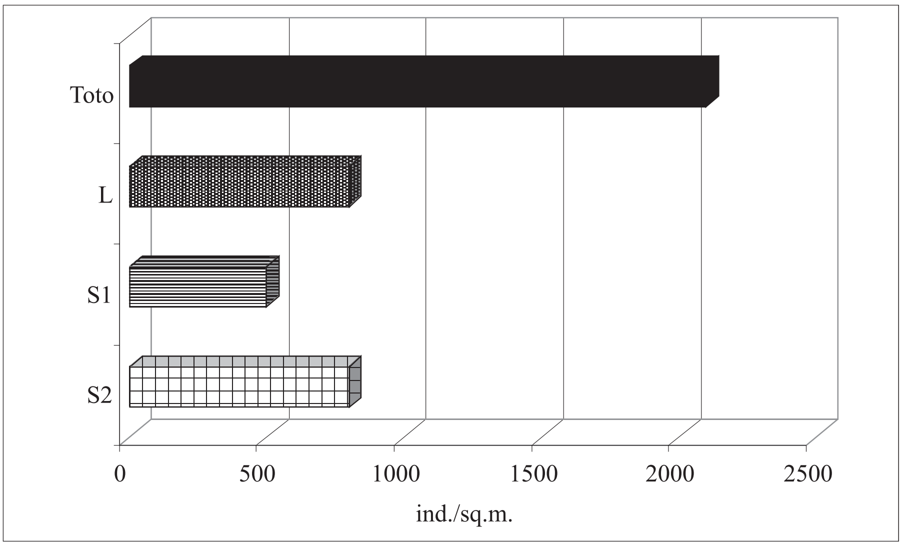

Fig. 2 – Numerical density (ind./sq.m.) of the mesostigmatids from soil layers, in ecosystem with *Myricaria germanica*, from Doftana Valley.

ind./sq.m.), which could adapt to this habitat, due to its small body dimension (0.25-0.5 mm) (Koehler, op. cit.). The humus and soil layers offered good conditions for the development of the predators species *Lysigamasus conus* (100 ind./sq.m., respectivelly 200 ind./sq.m.) and *Pachyseius humeralis* (100 ind./sq.m. in each layer). Species *Hypospis aculeifer* was identified only in soil layer (200 ind./sq.m) (Fig. 5).

The most increased value recorded on numerical density, in May, can be explained by the development of the immature stages of different invertebrate groups, which represent the food source of the mesostigmatids (Karg, op. cit.; Koehler, op.cit.; Walter & Proctor, op.cit.).

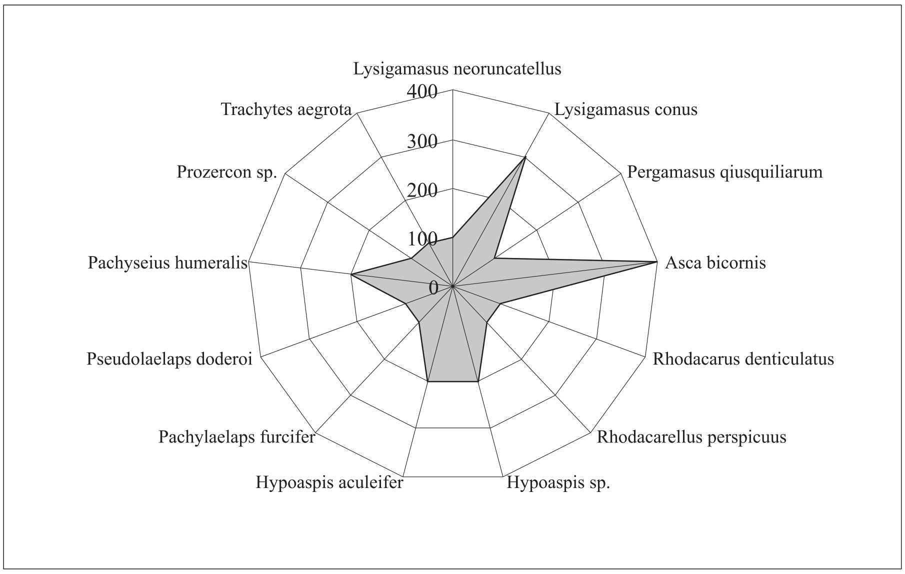

Fig. 3 – Numerical density (ind./sq.m.) of the mesostigmatids from ecosystem with *Myricaria germanica*, from Doftana Valley.

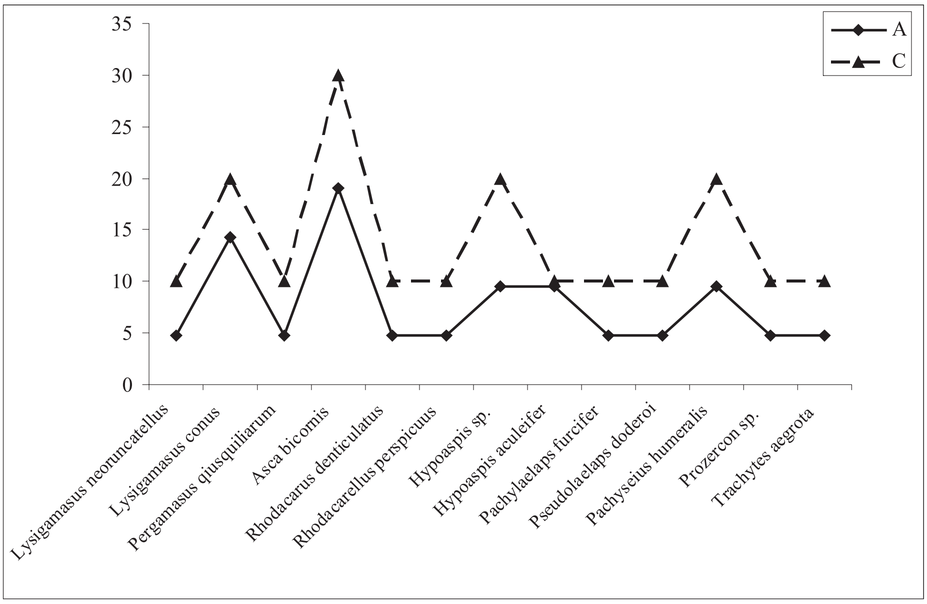

Fig. 4 – Relative numerical abundance (A%) and constance (C) of the mesostigmatids in ecosystem with *Myricaria germanica*, from Doftana Valley.

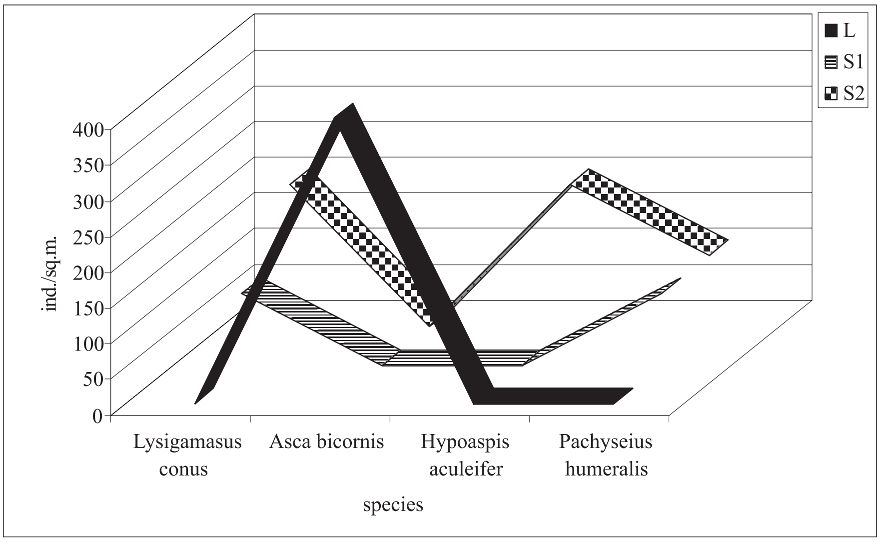

Fig. 5 – Numerical density (ind./sq.m.) of the mesostigmatids in the soil layers, in ecosystem with *Myricaria germanica* from Doftana Valley.

The unfavorable evolution of gamasid populations recorded in September is caused by the drought periods (with high temperature at the soil level, till 34.4°C, the optimal values being between 12-16°C), which determined a strong decreasing of the relative humidity of the soil (the optimal value being more then 60%) and due to a slow basic pH, knowing the fact that the mesostigmatids have preferences for hygro-mesophyllous habitats and for some certain types of soils. The presence of these mites fauna is due to an acid pH, phenomena that is not observed in a basic pH (Georgescu, op. cit.; Salmane, op. cit.).

Due to the geographical position of this ecosystem (in the basin of the Doftana river), short periods with great quantities of precipitations (sometime even freshets) were recorded, which destroy the thin layer of humus. The S1 layer was replaced with a thick sandy substratum, this temporal habitat being fast colonised by the accidental mite species as well as by other invertebrate groups, too, which represent the trophical preferences for the mesostigmatids. The low relative humidity of the soil determined the migration of the mesostigmatids mites in deeper layers.

Under these unfavourable conditions species (*Rhodacarus denticulatus* and *Rhodacarellus perspicuus)* with a high number of individuals in soil layer-S2 (800 ind./sq.m.) were identified, which have an adaptation capacity, straining in the narrow and crooked pores of soil, due to the small dimensions and to the flexibility of their body (Koehler, op. cit.).

Conclusions

Taxonomical structure of the mesostigmatid populations showed the presence of 7 families, with 10 genera and 13 species. The identified species are characteristic to the terrestrial temperate ecosystems. Analysing the trophical structure of these invertebrates, 11 predator species (Parasitidae, Rhodacaridae, Pachylaelaptidae, Pseudolaelapidae, Laelaptidae) and two omnivorous species (Zerconidae, Trachytidae) were identified.

The eudominant identified species (*Lysigamasus conus* and *Asca bicornis)* as well as the dominant ones (*Hypospis aculeifer* and *Pachyseius humeralis*) are characteristic to different types of temperate terrestrial ecosystems. It is obvious that in the studied ecosystem with *Myricaria germanica*, euconstant and constant species were not described, only the accessory (*Asca bicornis*) and accidental ones, due to the unfavourable environment conditions (especially the decreased humidity of soil), which did not allow the development of other invertebrate groups (as: enchytreids, nematods, springtails, immature oribatids), the trophical preferences of the mites.

In spatial dynamics, the litter - fermentation and soil layers offered favourable conditions for the development of predator mites, in comparison with humus layer, which, due to the low quantity of organic matter and of the sandy structure, was not preferred by these mesostigmatids.

In temporal dynamics, in May, maximum values of the numerical density were recorded, probably caused by the development of immature stages of the other invertebrate groups from soil, which represent the food source for these studied mites. In September, due to the severe decreasing of the relative humidity of the soil, the number of individuals per square meter decreased drastically.

The structural dynamics of the mesostigmatid mites is directly, but most frequently indirectly influenced by the temperature, humidity and pH of soil. The relative humidity of soil is an important restrictive factor in the development of these mite populations.

INFLUENȚA UNOR FACTORI ABIOTICI ASUPRA DINAMICII STRUCTURALE A POPULAȚIILOR DE ACARIENI PRĂDĂTORI (ACARI: MESOSTIGMATA) DINTR-UN ECOSISTEM CU *MYRICARIA GERMANICA* DE PE VALEA DOFTANEI (ROMÂNIA)

REZUMAT

Lucrarea prezintă influența câtorva factori abiotici (umiditatea relativă, temperatura și pH-ul solului) asupra structurii populațiilor adulte de acarieni (Acari: Mesostigmata) dintr-un ecosistem cu *Myricaria germanica*. Compoziția specifică a faunei de acarieni prădători din sol, a arătat prezența a 7 familii (Parasitidae, Rhodacaridae, Pachylaelaptidae, Pseudolaelapidae, Laelaptidae, Zerconidae, Trachytidae), cu 10 genuri și 13 specii, caracteristice pentru ecosistemele terestre temperate. Structura trofică a arătat prezența a 11 specii prădătoare și a 2 omnivore.

Condițiile de mediu au influențat dinamica temporală și spațială a structurii populațiilor de mesostigmate. În dinamica temporală in luna mai s-a inregistrat cea mai mare valoare a densității numerice. Din punct de vedere spațial, stratul de litieră - fermentație și cel de sol au constituit habitate favorabile pentru dezvoltarea populațiilor de mesostigmate.

LITERATURE CITED

AXEL, C., 2002 – Colonization of primary sterile soils by edaphic gamasina mites. Acarid Phylogeny and Evolution. Adaptations in mites and ticks, 169-173 pp.

DONIȚĂ, C., A. POPESCU, M. PAUCĂ COMĂNESCU, S. MIHĂILESCU, I. BIRIȘ, 2005 – Habitatele din România. Edit. Tehnică Silvică, București, 269-271 pp. (in Romanian)

GEORGESCU, A., 1982 – Populația de acarieni (Gamasida-Mesostigmata) liberi din unele tipuri de soluri forestiere. Rezumatul tezei de doctorat, Universitatea Babeș-Bolyai, Cluj-Napoca. (in Romanian)

GILAROV, M. S., N. G. BREGETOVA, 1977 - Opredeliteli Obitaiuscih v Pocive Clescei, Mesostigmata. Isdatelistvo "Nauka", Leningratkoe, Otdelenie, Leningrad, 717 pp. (in Russian)

HONCIUC, V., 2000 – Rolul ecologic al oribatidelor (Acari: Oribatida) în ecosistemele forestiere naturale şi antropizate din România. Universitatea Bucureşti, Facultatea de Biologie. Teză de doctorat. (in Romanian)

HONCIUC, V., M. MANU, 2008 **-** Taxonomia şi ecologia populaţiilor de acarieni edafici (Arachnida, Acari) din tufărişurile de pe Valea Prahovei şi Valea Doftanei. Volumul Lucrărilor Conferinţei Naţionale de Ecologie: "Protecţia şi Restaurarea Bio şi Ecodiversităţii", Edit. Ars Doncenti, 19-23. (in Romanian)

HYATT, K. H., 1980 – Mites of the subfamily Parasitinae (Mesostigmata: Parasitidae) in the British Isles. Bulletin of the British Museum, Zoology series, 38 (5): 237-378.

KARG, W., 1993 - Acari (Acarina), Milben Parasitiformes (Anactinochaeta) Cohors Gamasina Leach, 59: 1-513.

KOEHLER, H. H., 1999 – Predatory mites (Gamasina, Mesostigmata). Agriculture, Ecosystems and Environment, 74: 395-410.

PAUCĂ COMĂNESCU, M., G. DIHORU, M. ONETE, L. VASILIU OROMULU, M. FALCĂ, V. HONCIUC, M. STĂNESCU, D. PURICE, B. MATEI, 2004 - The diversity of some alluvial shrubland flora and fauna in the Neajlov Floodplain. Proceedings of the Institute of Biology, Bucureşti, Romanian Academy, 6: 105-118.

PAUCĂ COMĂNESCU, M., S. ŞTEFĂNUŢ, D. ŞINCU, L. VASILIU OROMULU, M. FALCĂ, V. HONCIUC, M. STĂNESCU, D. PURICE, C. FIERA, 2005 – Biodiversity of alluvial shrubs characteristic to the Câlniştea River. Proceedings of the Institute of Biology, Bucureşti, Romanian Academy, 7: 87-111.

PAUCĂ COMĂNESCU, M., M. ONETE, V. HONCIUC, L. VASILIU OROMULU, M. MANU, C. FIERA, D. PURICE, M. FALCĂ, D. ŞINCU, M. ION, 2008 - Structura unor componente biotice din tufărişurile aluviale colinare. Volumul Lucrărilor Conferinţei Naţionale de Ecologie: "Protecţia şi Restaurarea Bio şi Ecodiversităţii", Edit. Ars Doncenti, 165-170. (in Romanian)

SALMANE, I., 2000 – Investigation of the seasonal dynamics of soil Gamasina mites (Acari: Mesostigmata) in *Pinaceum myrtilosum*. Latvia Ekologia, 19 (3): 245-252.

SALMANE, I., 2001- A check list of Latvian Gamasina mites (Acari, Mesostigmata) with short notes to their ecology. Latvijas Entomologs, 38: 21-26.

SKORUPSKI, M., M. LUXTON, 1998 - Mesostigmatid mites (Acari: Parasitiformes) associated with yew (*Taxus baccata*) in England and Wales. Journal of Natural History, 32: 419-439.

STĂNESCU, M., 2007 – Cercetări ecologice asupra populaţiilor de gamaside (Acari: Mesostigmata) din solurile unor ecosisteme forestiere din Masivul Bucegi. Academia Română, Institutul de Biologie, Bucureşti. Teză de doctorat. (in Romanian)

WALTER, D. E., H. C. PROCTOR, 1999 – Mites – Ecology, Evolution and Behavior. Unsw Press. Printed by Everbest Printing Hong-Kong, 95-131.

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