

# MARISIA

**Studii și materiale**

**XXXII**

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MUZEUL JUDEȚEAN MUREȘ

# MARISIA

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STUDII ȘI MATERIALE

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XXXII

ȘTIINȚELE NATURII

Târgu-Mureș  
2012

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# SOME SOIL INVERTEBRATES (COLLEMBOLA, INSECTA) OF THE REPUBLIC OF MOLDOVA AS ELEMENTS OF ECOSYSTEMS BIODIVERSITY

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**Abstract.** This paper includes the analysis of species diversity of some soil invertebrates: Collembola, Coleoptera and Aphidoidea from Moldova. At the present time in the country a total of invertebrate species: 223 Collembola, 2400 beetles and 39 soil inhabiting aphids are revealed. All Collembola and some beetles species are pedobionts and very important for the processes of organic matter decomposition and maintenance of soil fertility. Between studied insects 8 species of aphids and several genera of beetles are harmful – phytophagous. The role of invertebrates in ecosystems is varied, but all of them are important for the biodiversity and are the links of food chains.

**Keywords:** biodiversity, Collembola, Coleoptera, Homoptera, invertebrates, importance, Republic of Moldova.

## Introduction

The future of humanity depends on our ability to skillfully combine scientific knowledge and modern technology with the “wisdom of the wild nature”. We must cooperate with it and learn from it, and not to conquer, the nature, to preserve its resources.

This is particularly important for the forest, where the biodiversity is high, and biocenotic regulation is significant. However, in textbooks and monographs on forest entomology and forest protection the mass tree pests and their entomophagous are generally considered. Fauna of insects and other invertebrates, including those living on shrubs and herbaceous plants (terrestrial and soil), is not taken into account. But it is an important component of biocenotic regulation and therefore – stabilization. The ecologization of agriculture and forestry is needed [25]. The soil is the habitat of a wide variety of invertebrates, which have an important role – not only as pests but also in soil formation. They take part in the transformation of organic matter, in its humification and mineralization, in biological cycle of substances, in formation of the soil profile, in the creation of structure and porosity of the soil [11]. In nature, there are no “necessary” and “unnecessary” organisms, each of the group occupy its ecological niche and are important component of the food chains.

After all, any natural habitat, including forests, will function properly only if all trophic levels, from primary producers to decomposers, perform their separate but related roles. Forest

should be the territory where natural biodiversity, therefore the stability, are preserving and developing. Currently in Moldova the forests consist of 800 plots, ranging in size from 5 to 1500 ha [8] and together with the network of shelter belts [10], they contribute to the biological enrichment of the cultural landscape and its multi-functionality.

At the present time, unfortunately, the agrobiocenoses, and, to a lesser extent, the forests are increasingly losing the capacity for self-regulation. We have to mention that during a year in the forest huge quantities of leaf litter is forming, which annually is processed by various soil invertebrates. Between them Collembola are the second important group after mites.

Before this research in Moldova, the study were carried out only on such invertebrate groups as pest – beetles (Karpov and Neculiseanu) and nematodes (Nesterov), as well as earthworms (Cherevatov) in biocenotic oases and crops [10].

## Material and methods

The studies of invertebrates (Collembola, Coleoptera, Homoptera) inhabiting the soil of Moldova permanently or temporarily, were carried out over many years, in all the natural areas. The collection of faunistic material was performed by classical methods: Collembola with metal frames 5 × 5 and 10 × 10 cm<sup>2</sup>, the beetles using Barber traps and aphids by hand. The species of small invertebrates were identified by microscopic preparations, using the modified method of their preparation. The coleopterans were determined by morphological characteristics with binoculars.

The main identifying keys specific to each of the studied groups were used, as well as some recent work on the taxonomy, for the diagnosis of aphids the keys and also original polytomik tables were used.

## Results and discussions

Springtails (Collembola) – are primarily wingless arthropods that live in all types of soil. Despite their small size (0.5–9 mm, depending on the species), they are important components of natural ecosystems, take an active part in the cycle of matter and the decomposition of plant remains. All species of springtails are saprophagous, living in soil and feed on algae, bacteria, protozoa, nematodes, decomposing plant residues etc. In Moldova are known 223 species [6].

The Collembola are classified according to morphological difference in groups depending on their vertical distribution in soil horizons and ecology [19]:

1. Atmobionts – group of species, including the largest representatives of the class, they are brightly colored, with well-developed eyes, 8 on each side of the head, that can rise on herbaceous plants, shrubs and trees – up to 2 meters high and more. They are often found in berries and inflorescence of trees and shrubs, are actively moving through jumps (species from the genus *Entomobrya*, having the size of 1 mm, has the ability to jump to a height of 16 cm) and move for a distance up to 300 meters per day [20]. This group includes species of the genera *Orchesella*, *Entomobrya*, *Willowsia*, *Sminthurus*, *Bourletiella* etc.
2. Hiperedaphic species can be found in the upper layers of the litter, they inhabit in abundance on decaying algae on the rivers banks and other water basins, on accumulations of organic matter or compost. This group includes mid-sized species, the antennae, legs and fork are well developed, and they also have eyes and pigment. Among hiperedaphics must be mentioned the species from genera *Hypogastruridae*, *Pseudachorutes*, *Brachystomella*, *Isotoma*, *Desoria*, *Sminthurinus* etc.



3. Hemiedaphic species inhabit lower-litter and litter-soil layers. The color of these species is much less bright, the number of eyes varies from 7+7 to 1+1, furcula, legs and antennae are short, adapted to the movement among litter and other plant remains. This group includes species of the genera *Neanura*, *Deutonura*, *Endonura*, *Lathriopyga*, *Anurida*, *Micranurida*, *Folsomia*, *Folsomides*, *Arrhopalites* etc.
4. Euedaphics or deep-soil species – the most small, colorless and blind species which are most often elongated (families Tullbergiidae and Onychiuridae) or spherical (family Neelidae) body shape, and are among the most important in soil formation, because they participate in humus formation.
5. Highly specialized forms including myrmecophilous species occurring with social insects ants and termites (family Cyphoderidae), and troglomorph species, or inhabitants of caves, belonging to the genera *Pseudosinella*, *Oncopodura*, *Arropalites* etc.

In addition to their primary function – processing of litter and other organic residues, Collembolans are important link in other food chains. They serve as food for a large number of invertebrates, including – beetles, centipedes, spiders, mites, pseudoscorpions, ants, birds, fish etc. For some of them Collembolans are a common source of nutrients in their daily diet, for others only a temporary source of energy or substitute in the absence of main trophic groups.

Beetles (Coleoptera) are one of the most important components of forest and agricultural ecosystems, including those living in the soil, litter and herbaceous plants in the woods, with a particular preference for certain biotic and abiotic factors.

According their trophic preference the soil-beetles (in imago stage) are divided into the following groups: saprophagous (xylophagous, detritophagous, necrophagous – feeding on carrion, coprophagous) mycetophagous, phytophagous and zoophagous [11].

Saprophagous species. This type of feeding is particular for soil-beetle larvae, but also occurs in adults.

1. Xylophagous are the beetles feeding on dead decaying wood. Among them are the species of the genera *Dorcus*, *Lucanus*, *Platycerus*, *Cerambyx*, *Carabus*, *Elater* etc.
2. Detritophagous are the species feeding on decomposing organic remains and having an important role in humus formation. Larvae of species from subfamily Cetoninae are detritophagous and the adults are antrophagous or herbivores. Some species of the family Staphylinidae are detritophagous, including: *Tachyporus hypnorum* (Fab.), *T. nitidulus* (Fab.), *T. solutus* Erich., *Tachinus corticinus* Grav., *Anthobium atrocephalum* (Gyll.), *Ontholestes haroldi* (Eppe.), *Anotylus rugifrons* (Hoch.), *A. sculpturatus* (Grav.), *Drusila canaliculata* (Fab.), *Oxyopoda opaca* (Grav.), *Omalium caesum* Grav., *Ocalea badia* Erich., *Parocyusa rubicunda* Erich., *Philonthus carbonarius* (Grav.), *Othius punctulatus* (Goeze.), *Quedius ochropterus* Erich., *Q. nitipennis* (Steph.), *Heterothops niger* Kraatz, *Carpelimus corticinus* (Grav.), *C. exiguus* (Erich.), *Stenus boops* Ljungh, *Sepedophilus testaceus* (Fab.) etc.
3. Necrophagous are beetles that feed on dead animals, and they are a necessary element in the biological cycle of substances. These are the species of genera *Nicrophorus*, *Silpha*, *Trox*, some staphylinid beetles and others.
4. Coprophagous are beetles that feed on animal excrements. Subfamily Scarabaeinae includes coprophagous species, also coprophagous are some species of family Staphylinidae – *Philonthus corruscus* (Grav.), *Anotylus rugifrons*, *A. sculpturatus*, *Aleochara bipustulata* (L.), *A. curtula* (Goeze), *A. lata* Grav., *Ontholestes tessellatus* (Geoff.), *Philonthus tenuicornis* (Mulsant & Rey), *P. succicola* Th., gen. *Sphaeridium* of fam. Hydrophilidae etc.

5. Phytophagous are species adapted to feed on living tissues of higher plants, the majority of phytophagous are associated with flowering plants [11]. The species of families Curculionidae, Chrysomelidae, Tenebrionidae, Elateridae, genera *Amara*, *Ophonus* and *Harpalus* of family Carabidae etc. are also phytophagous.
6. Zoophagous are carnivorous organisms that feed on other animals or on their own species. These are representatives of fam. Carabidae, Coccinellidae, and some species of the family Staphylinidae, larvae of some species of fam. Elateridae etc.
7. Mycetophagous are species feeding on mushrooms and include some representatives of fam. Staphylinidae (*Anthobium fuscum* (Erich.), *Mycetoporus nigricollis* Steph., *Lordithon trinotatus* (Erich.), *L. lunulatus* (L.), Micetophagidae, Tenebrionidae etc.

The beetles feed in accordance with the environment, and in some species a part of the life cycle occurs in the soil. Among them the phytophagous species damaging the crops were studied more intense, including the soil fauna. Their positive role was less considered, particularly in limiting the number of pests and maintaining the relative balance in natural ecosystems.

In the Republic of Moldova the representatives of soil beetles from fam. Carabidae, Scarabaeidae, Silphidae, Staphylinidae, Meloidae, Tenebrionidae and Elateridae were studied more profound [18].

Among fam. Carabidae are known 510 species [17], Scarabidae – 122 [7], Silphidae – 21 [2]. Within fam. Staphylinidae are known about 300 species [1, 3, 4, 9, 13, 15, 16], in fam. Meloidae – 26 [5], Tenebrionidae – 34 species [1].

In some special studies there are also reported the soil-beetles species from other groups [21, 13, 14, 18 etc.]. At present, in the fauna of the Republic of Moldova there are about 2400 species of beetles, of which only a several species (some representatives of fam. Cerambycidae and Ipidae) depend only on decaying wood or agricultural products (Tenebrionidae and Curculionidae).

In general, the role of soil-beetles is huge; they are involved in different processes: loosening and aerating of the soil, the decomposition of detritus, manure and dead organisms in food chains. However, the most important thing is that they reduce the number of many pests, thus maintaining the balance of ecosystems without contamination.

Aphids (Aphidoidea) are known to quickly respond to unbalanced transformation of ecosystems and climate, particularly by changing their spreading ranges. For example, such representative is the Mediterranean region species *Pterochloroides persicae* Cholodk., recently was recorded in Moldova too. For aphids the ecological polymorphism is also particular. In total in Moldova are registered about 350 species of aphids, and in the world around 4700.

We have to mention that the disturbance occurring in agricultural landscapes, cause changes not only in the spreading range, but also in the population structure of aphids, and this process is rather quick, due to their parthenogenesis. Thus, there is a simplification of the life cycle of holocyclic aphid populations, as result of loss of sexual generation and transition anholocyclic lifestyle. This leads to acceleration of variability, to selection of aggressive clones of aphids and this fact is reflected in the dynamics of their number, process which also occurs in Moldova [27].

Aphids are one of the components of soil inhabiting invertebrates, and in general, their role in the ecosystem is multifunctional. Although they are known as pests [27, 25, 12 etc.], in the deciduous forests of Moldova, however, all species of aphids are links of food chains, which contribute to biocenotic regulation of entomofauna, especially due to the emission of “honeydew” [22]. Many aphid species inhabit only on spontaneous plants, and only few on cultural

ones. Some of the “agrarian” aphids still belong to major pests [27, 12, 23 etc.], in Moldova they constitute about 9% of aphid fauna.

As for the soil inhabiting aphids in Moldova the following species were identified:

Fam. Phylloxeridae – *Viteus vitifoliae* (Fitch); Fam. Pemphigidae – *Eriosoma lanigerum* (Hausm.), *E. lanuginosum* (Hart.), *Forda marginata* Koch, *Paracletus cimiciformis* Heyd., *Patchiella reaumuri* (Kalt.), *Pemphigus borealis* Tullgr., *P. bursarius* L., *P. fuscicornis* (Koch), *P. phenax* Börn et Blunck., *Smynthurodes betae* Westw., *Tetraneura ulmi* (L.); Fam. Lachnidae – *Maculolachnus submacula* (Walk.), *Protrama flavescens* (Koch), *P. radialis* (Kalt.), *Trama rara* Mordv., *T. troglodytes* Heyd.; Fam. Aphididae – *Anuraphis farfarae* (Koch), *A. subterranea* (Walk.), *Aphis frangulae beccabungae* Koch, *A. gossypii* Glov., *A. lambersi* (Börn.), *A. sambuci* L., *A. seseli* Bozh., *Brachycaudus ballotae* (Pass.), *B. lamii* (Koch), *B. lychnidis* (L.), *B. mordvilkoii* H. R. L., *B. persicae* (Pass.), *B. rinariatus* Andr., *B. virgatus* Shap., *Dysaphis brancoi* (Börn.), *D. crataegi* (Kalt.) s.l., *D. lappae* (Koch), *D. ranunculi* (Kalt.), *Protaphis anuraphoides* Nevs., *P. elongata* Nevs., *Toxopterina vanderhooti* (Börn.), *Zinia veronicae* Shap. In addition to the above mentioned species of aphids, in Moldova were recorded, but so far only on the main host plants, some species which weren't found here in the soil (the intermediate host).

Soil inhabiting (root) aphids from Moldova mostly belong to the following groups [21]:

1. Dioecious aphids species in the period of their population inhabiting on intermediate plants – hosts. These are, for example, the species *Eriosoma lanuginosum*, *Dysaphis brancoi* and *Tetraneura ulmi*.
2. Constantly inhabiting the soil anholocyclic species, which completely lost their main host plants (aphids of gen. *Protrama* Bak., *Trama* Heyd.), or, just over a significant part of their range, including Moldova (*Forda marginata*, *Paracletus cimiciformis*).
3. Holocyclic species, which colonies are constantly living on roots and (or) the basal parts of plants (*Brachycaudus ballotae*, *B. rinariatus*, *Protaphis elongata*).
4. Anholocyclic or holocyclic species, large colonies of which develop on the upper parts of the plant only in the period of abundant vegetation of these parts (*Brachycaudus persicae*, *B. virgatus*).

In Moldova certain aphid species inhabiting the soil were registered as crop pests, namely – *Viteus vitifoliae* – pest of grapes, *Eriosoma lanigerum* – pest of Apple trees, *Pemphigus fuscicornis* – pest of beet [12], *Tetraneura ulmi* – pest of corn, *Dysaphis crataegi* – pest of carrots.

In the following ant species were found connections with root aphids in Moldova: *Formica cinerea* Mayr., *F. gagates* Latr., *F. pratensis* Retz., *Lasius affinis* Schenck., *L. alienus* Först., *L. brunneus* Latr., *L. emarginatus* Oliv., *L. flavus* F., *L. niger* L., *Myrmecina graminicola* Latr. and *Tetramorium caespitum* L. (out of 31 species of all registered in Moldova aphidophilous ants).

Ants are known to protect many plants against phytophagous insects, but they also “take care” of aphids feeding on plants, even transfer them from one root to another. The trophobiosis with ants allow to some aphid species to live in the soil on the roots of plants, where they can find favorable and stable living conditions [24]. The aphid “honeydew” is used in carbohydrate diet of many ant species. It was emphasized that “honeydew” stimulate soil microflora and accelerates the course of soil formation processes, involving various microorganisms

## Conclusion

Only a small part of the invertebrates inhabiting the soil in the Republic of Moldova has been studied. A huge number of groups, including soil inhabiting mites, spiders, pseudoscorpions, myriapods, terrestrial crabs and others remain unexplored.

The invertebrates, including springtails, beetles and aphids are components of soil fauna. Collembola are primarily wingless arthropods, they inhabit all types of soils, both natural and anthropogenic modified. A total of 223 springtails species are known in Moldova and all of them inhabit the soil. Their importance in the processes of organic matter decomposition and maintenance of soil fertility is huge. In Moldova fauna are recorded about 2400 species of beetles. The role of soil inhabiting beetles is huge and versatile, particularly in reducing the number of pests. In Moldova 39 soil inhabiting aphid species were identified. Their value in ecosystems is also varied, among them 5 species of harmful aphids in varying degrees. The rest of the species are only links of food chains, elements of biodiversity, including their trophobiosis with ants, in Moldova – with 11 of ant species.

For biodiversity optimization in general, it is important the knowledge of its individual components and their role in ecosystems, as shown on the example of soil inhabiting Collembola and Insecta (Coleoptera, Aphidoidea) from Moldova.

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**UNELE NEVERTEBRATE EDAFICE (COLLEMBOLA, INSECTA) DIN REPUBLICA MOLDOVA,  
CA PARTE COMPONENTĂ A BIODIVERSITĂŢII ECOSISTEMELOR  
(Rezumat)**

Lucrarea include analiza diversităţii speciilor de nevertebrate Collembola, Coleoptera şi Aphidoidea din Republica Moldova. În urma cercetărilor efectuate şi analizei datelor din literatură au fost evidenţiate 223 specii de colebole, 2400 specii de coleoptere şi 39 specii de afide. Colebolele şi unele specii de coleoptere sunt pedobionte şi participă activ în procesul de descompunere a materiei organice şi menţinerea fertilităţii solului. Între insectele studiate, afidele şi unele genuri de coleoptere sunt dăunători-fitofagi. Rolul nevertebratelor în ecosisteme este variat, dar toate grupele sunt importante pentru biodiversitate fiind parte componentă a lanţurilor trofice.