TO THE PROBLEM OF BIOINDICATION OF ANTHROPOGENIC CONTAMINATION OF ENVIRONMENT

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Mites, as the constant elements of soil fauna, react actively on negative changes of the environment. The researches provided in polluted and natural ecosystems of central districts of Georgia, showed that together with the level of pollution, species composition, their quantity, distribution of separate species in soil layers and demographic indexes of acaroid (Acaroidea) and oribatid (Oribatida) mites change gradually. In natural ecosystems there is high diversity of soil inhabiting mites with predomination of forest species, but in polluted districts predominate ubiquistous species, that are less sensitive to environment disturbances and can survive the extreme conditions. For some species the meaning of rodent lairs was established. It is considered that rodent lairs serve as "shelter" for acaroid mites to escape from unfavourable soil conditions.

***Keywords*:** Indicatory Zoology, untouched ecosystems, polluted territories, biotopes.

Introduction

The living organisms, including soil inhabiting ones, play an essential role in assessment of environment conditions. This fact induced creation of a new direction – Indicatory Zoology [sensu Kajaia (2008)]. The value of an indicative organism depends on its life expectancy, life style and specific importance [Cortet J., et al. (1999)]. For indicatory purposes diversity of taxonomical groups, their quantitative and qualitative indexes and distribution peculiarities are used. In this viewpoint soil inhabiting microarthropods – the mites (Acari) are considered as the most important group [Murvanidze at al. (2008); Parisi V., et al. (2005); Weigmann G., Kratz W., (1987); Kehl Ch., Weigmann G., (1992); Weigman G, Jung E., (1992)]. Their diversity is high, they occur in high numbers, they are easily sampled, they can be sampled in all seasons, adult identification is relatively easy and they represent trophically heterogeneous group. [Behan-Pelletier, V.M. (1999)].

Material and Methods

The researches were carried in summer of 1998 and 2001 years on soil inhabiting acaroid and oribatid mites. Material was sampled in untouched and polluted ecosystems.

The sampling sites were located in three districts of central part of Georgia (Kartli). Oribatid mites were studied in Tbilisi, on transect from city outskirts to the centre. Distance between the sites was about 2 km. The site description is as follows:

1. Mtatsminda Range – watershed, meadow.
2. Mtatsminda Range – *Quercus* forest
3. Turtle Lake surroundings – *Carpinus-Quercus* forest
4. Turtle Lake coast – *Pinus-Fraxinus* forest
5. 500 m lower from Turtle Lake – soil under *Spiraea* vegetation
6. 1km lower from Turtle Lake – soil under *Pinus-Spiraea* vegetation
7. The "Round" Square – soil under *Laurocerrassus officinalis* vegetation
8. Mtskheta str.
9. Chavchavadze ave.

Acaroid mites were studied on following sites:

1. Rustavi cement work territory – steppe
2. 15 km away from Rustavi, Ialguji valley – steppe
3. Gori – along the highway.

At each site three soil samples were taken, each 500 cm^3 size. In rodent lairs the upper soil layer and vegetation remnants were studied. Extraction and treatment was provided by means of methods used in soil zoology (Krivolutskyi, 1973). For mite extraction Tullgren apparatus was used. The specimens were preserved in 70% ethanol and after clearing were studied in lactic acid in an open hollow-ground microscope slide.

The acaroid mites were determined by means of special papers of Zakhwatkin (1941), Ghilarov, Krivolutsky (eds.,) (1975) and Kajaia (1975). For determination of oribatid mites, identification keys of Ghilarov, Krivolutsky (eds.,) (1975) and Weigmann (2006) were used.

Results and Discussion

On the studied territory in Gori surroundings – along the highway and 200 m away from it, 8 species of acaroid mites were registered, with predomination of *Acarus farris* (Ouds.,) and *Tyrophagus putrescentiae* (Schrk.).

Table 1 shows that number of individuals per sample are very less at the highway. Together with increasing the distance from it, the number increases and reaches the maximum at the 200m distance. Maximal quantity prevails over the minimal on 11.5 times (for *A. farris*) and on 17.5 times (for T. *putrescentiae*).

On the comparably untouched,"clean" territories, number of individuals of acaroid mites are increased. At the short distance from highway (5m), together with two dominant species (*A. farris*, T. *putrescentiae*) only one more species – *Schwiebea* sp. is found, but at 200 m distance – three additional species are registered in low quantities (*Tyrophagus silvester* A.Z., *Mycetoglyphus fungivorus* Ouds., *Schwiebia* sp.).

The literature data show, that number of acaroid mites in rodent lairs is always high compared to other habitats (Kajaia, 1975). We were interested on presence of these habitats on polluted territories.

Table 2 shows that on both studied territories (Rustavi surroundings) number of mites on rodent lairs are high compared to soil, but on the territory of Rustavi cement work the difference is much more evident. The situation differs in soil: on the cement work territory number of specimens is lower than on the Ialguji valley. We consider that rodent lairs are inhabited more intensively because of more suitable conditions for development of acaroid mites.

Table 1

Quantitative changes of Acaroid mites on the along the highway (Gori surroundings)

Habitat	*Acarus farris*			Tyrophagus putrescentiae		
	Quantity					
	Min	Max	Average	Min	Max	Average
5 m from highway	6	10	8	2	5	3.5
40-50 m from highway	18	25	22	13	15	14
80-100m from highway	45	55	50	31	37	34
180-200m from highway	88	97	92	57	71	64

Table 2

Quantitaty of Acaroid mites in soil and rodent lairs

Territory, Habitat	*Acarus farris*			Tyrophagus putrescentiae		
	Quantity					
	Min	Max	Average	Min	Max	Average
Cement work territory						
Soil (upper layer)	4	8	6	3	6	4.5
Rodent lairs	21	28	24.5	18	24	21
Ialguji valley						
Soil (upper layer)	8	12	10	6	12	9
Rodent lairs	12	15	13.5	10	14	12

On Ialguji valley the value of imagos composes 30 % of total population quantity. On the territory of cement work, this index increases up to 70%. We consider that polluted environment induces high mortality of larval stages.

In rodent lairs number of acaroid mites is always high on polluted territories than on untouched sites. Here the rare, unusual for lair habitat species are also found occasionally, like the representatives of *Schwiebea* genus, that usually are found in dead wood, or tree hollows. In this case, the rodent lairs serve as the "shelter", where the mites migrate from other habitats.

The influence of environment pollution on soil inhabiting oribatid mite fauna was studied on transect from Mtatsminda Range (Tbilisi) to city centre.

Number of individuals of oribatid mites per sample in city outskirts appeared much higher compared to the city centre. 122 specimens per sample were registered in hornbeam-oak forest on Mtatsminda Range, whereas in Mtsketa str. and Chavchavadze ave. only 3 individuals per sample were found (fig. 1). Number of species per site decreases in the same gradient: 11 species are registered on watershed, 10 species – in oak forest, 14 species – in hornbeam-oak forest, 3 species in square on Chavchavadze ave and 1 species on Chavchavadze ave (fig. 1). In natural biotopes prevailed rare and forest specific species, such as *Cosmochthonius lanatus, Arthrodamaeus starki, Licnodamaeus undulates, Ctenobelba pilosella, Microzetorchestes emeyi, Gustavia microcephala, Quadreoppia michaeli,* etc., but in city centre dominated everytopic, ubiquistous species, like *Oribatula tibialis, Scheloribates latipes* and *Ramusella clavipectinata*.

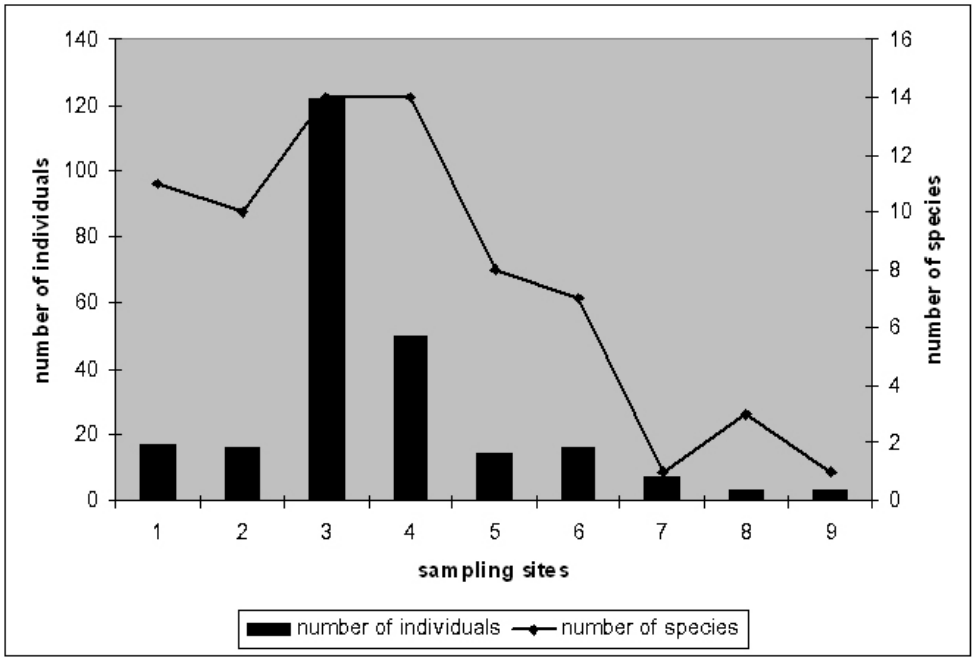

Fig. 1. Changes of number of individuals and number of species of oribatid mites on transect from Mtatsminda Range to city centre

Along the studied transect distribution of ecological groups of oribatid mites, based on the level of chitinization (Gordeeva, 1975) was studied as well. Strongly chitinized forms, inhabiting upper layers of soil, moss and forest litter, like *Parachipteria nicoleti, Peloptulus*

phaenotus, Eupelops acromios, Trichoribates novus etc., prevailed in forest biotopes, whereas in urban ecosystems predominated weakly chtinized species like *Oppiidae, Tectocepheus,* etc., that inhabit deeper layers of soil, where they can avoid influence of disturbed soil surface and air pollution.

Our research proofed that in natural ecosystems there is high diversity of soil inhabiting mites with predomination of forest species, but in polluted districts predominate ubiquistous species, that are less sensitive to environment disturbances and can survive the extreme conditions. We consider the above mentioned characters having an indicatory meaning for environment pollution.

R E F E R E N C E S

Behan-Pelletier V. 1999. Oribatid mite biodiversity in agroecosystems: role for bioindication. Agriculture, Ecosystems and Environment. 74, 411-423.

Cortet, J., Gomot-De Vauflery, A., Poisot-Balaguer, N., Gomot, L., Taxier, Ch., Cluzeau D., 1999. The use of invertebrate fauna in monitoring pollutant effects. European J. of Soil Biology. 35(3), 115-134.

Gilarov, M. S. and Krivolutski, D .A. (Eds) 1975. Sarcoptiformes. In: Opredelitel' obitajuschtschich w potschwe kleschtschej [The identification keys of soil inhabiting mites]. Ist. Nauka, Moskau: 1-490. (in Russian)

Gordeeva E. V., 1985. Fauna pantsirnikh kleshchei gornogo Krima [The fauna of oribatid mites of mountainous Crimea]. Ekologiya pochvennikh bespozvonochnikh. “Nauka”. 195-202 (in Russian)

Kajaia, G., 1975. The Ecological-morphological Analyses of the Caucasian Acaridae (*Acariformes*). “Metsniereba”. Tbilisi. 170pp.

Kajaia G., 2008. The Ecological Principles of Environment Protection. “Intelekti”. Tbilisi. 272pp. (in Georgian)

Kehl, Ch., Weigmann, G., 1992. Die Hornmilbenzonosen (Acari, Oribatida) an Apfelbaumen im Stadtgebiet von Berlin als Bioindikatoren fuer Luftqualitat. Zool. Beitr. 34(2), 261-171

Krivolutskyi, D. A., 1973. Metodika kompleksnogo obsledovaniya pochv ta naselennost mikroartropodami [The Methods of Complex Soil Investigations on the Inhabiting Microarthropods]. In.: Methods of Soil-Zoological Investigations. “Nauka”. 44-48. (in Russian)

Murvanidze M., Arabuli T., Bagathuria N., Eliava I., Kvavadze Er., Mumladze L. (2008): The nematodes and oribatid mites as indicators of urban environment. Proceedings of the Institute of Zoology XXIII: 180-193

Parisi, V., Menta, Ch., Gardi, C., Jacomini, C., Mozzanica E., 2005. Microarthropod communities as a tool to assess soil quality and biodiversity: a new approach in Italy. Agriculture, Ecosystems and Environment. 105, 323-333

Weigmann G. 2006. Hornmilben (Oribatida). – Die Tierwelt Deutschlands 76. 520 p.

Weigmann, G., Jung, E., 1992. Die Hornmilben (Acari, Oribatida) an Strassenbaumen in Stadtzonen unterschiedlicher Luftbelastung in Berlin. Zool. Beitr. 34(2), 273-287

Weigmann, G., Kratz, W., 1987. Oribatid mites in urban zones of West Berlin. Biol Fertil Soils, 81-84

Zachvetkin, A. A., 1941 Paukoobraznye, Tyrogliphoidnye kleshchi (*Tiroglyphoidea*) [Spiderlike, Tyrogliphoid mites (*Tiroglyphoidea*)]. Fauna SSSR 6(1). Moscow-Leningrad, 475p.

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