



BOOK OF PROCEEDINGS



**10th International Congress on
"The Soil Resources and
Environment Conservation"**

Soil Science Society of Kazakhstan Cooperation with
the Federation of Eurasian Soil Science Societies and
U.U. Usmanov Institute of Soil Science and agrochemistry

17 - 19 October 2018, Almaty, Kazakhstan

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Ecological assessment of influence of technogenic factors on mesofauna of soils of the Irtysh River in Pavlodar and development bioindicative and indicative indicators

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The specific properties of the soil allow considering it as a special natural-historical body, requiring a deep analyzing on presence of organisms and their influence on the environment. The contamination of the soil, it's specific and group list, number of certain representatives, character and the periods of their activity, etc. for the majority of areas has not studied yet. The reason for the relatively poor study of soil organisms lies not only in the complexity of the conditions for the existence of organisms in the soil (in a polydispense three-phase system), but also in the difficulty of observing and studying soil animals due to the opacity and density of the habitat, and, finally, the laboriousness of even elementary work on collecting and quantitative account of soil fauna.

The research was provided in Pavlodar region, revealing that most belong to the subzone of dark chestnut soils. Dark chestnut soils of the region, in the overwhelming majority of light mechanical composition, are predominantly light loamy and sandy loamy, and in the southern region are sandy. This is a consequence of their formation on the ancient alluvial deposits of the Irtysh, which, as mentioned above, have a light mechanical composition, contain 3-4% humus in the upper horizon.

The object of the study was the mesofauna of chestnut soils of Pavlodar Priirtyshye.

During biological (mesophane) studies, comparative-geographic, comparative-analytical and experimental methods were used.

The study of soil mesofauna is important for diagnostic purposes and represents a unique opportunity to assess the evolution or degradation of soils under the influence of human economic activity.

Due to their activities, aeration of the soil is improved, its moisture permeability is increased, and other important processes for soil formation are stimulated. Especially mesofauna on virgin lands are important that are not cultivated by human, and the maintenance of their fertility is carried out at the expense of the vital activity of all the constituent parts of this biocenosis and, to a large extent, at the expense of the mesofauna. This fact was decisive in the choice of the object of research.

The selection of soil samples for the determination of physicochemical, physical properties and biological studies was carried out by layer-by-layer method of a continuous column of 10 cm to a depth of 40 cm. Below 40 cm, there is no soil-invertebrate infertility, which determined this lower limit for sampling.

Under the conditions of the experiments, soil samples are selected layer by layer in depths of 0-10; 10-20; 20-30; 30-40 cm in three terms (spring-May, summer-July, autumn-September).

In soil samples, the definition by conventional methods - moisture - by weight method, general humus - according to I.V. Turin; Specific gravity - pycnometric method; bulk weight using Kachinsky borer; general porosity - the calculation method, for determining biological indicators: mesofauna of soils - a method of manual disassembly according to Gilyarov were used. Ther was provided the research on the accumulation and migration of pollutants in the body of representatives of the mesofauna of the soils of Irtysh.

The main source of environmental threats (OC) is thermal power plants. In the process of industrial production, old technologies and standards, poor-quality raw materials and fuel are used.

Soil Ecology

The main polluters of the air basin of the Pavlodar region are the following enterprises: JSC Pavlodarenergo (CTE-2,3), Aluminum of Kazakhstan JSC, Pavlodar Petrochemical Plant CJSC, AES Ekibastuz LLP, Ekibastuz GRES-2 Station OJSC, Aksu Station Ferroalloy Plant, Eurasian Corporation JSC, Severny, Vostochny and Bogatyr sections.

Anthropogenic complex factors that affect the condition of ecosystems, are quite diverse - it's pollution emissions of industrial production, transport, excretion of waste of natural resources of fertile land the mining industry and many others. Anthropogenic stressors arise at such a rate that biological systems do not have time to adapt to them [1], at the same time their biological characteristics change under the influence of all factors [2, 3]. To one of the most toxic substances that fall into the biosphere in the results of human production can be attributed to heavy metals. In small amounts, they are found in every organism, but a significant increase in their concentration can lead to the death of animals.

Heavy metals, accumulating in the soil and litter, plants and animals, fall into the human body, causing poisoning and disease [8]. The role of animals in biogenic migration of substances in terrestrial ecosystems has not been adequately studied. The activity of animals in biogeocenoses can be regarded as a factor regulating this nutrient cycle [4].

The block of soil-litter invertebrates is characterized by an early reaction to the contamination of their habitats with heavy metals. It is known that the representatives of the mesofauna act as active storage rings [5]. Migration of microelements along the trophic chains of these animals and other consumers arouse interest to determine their resistance to toxicants, and to identify loads on the ecosystem as a whole [6]. Thus, insects - representatives of mesofauna, the concentration of heavy metals in food is one of the main factors that determines their content in the animal's body. The absorption of toxic trace elements in them in most cases occurs through the intestine. Subsequently, their redistribution across all parts of the body is observed. Studies on the accumulation of heavy metals by soil-littered vertebrates were carried out near the above pollutants.

The quantity of heavy metals in invertebrate animals was carried out using the method of atomic absorption spectrophotometry on an AAS-30 spectrophotometer according to the standard procedure [7]. The results of the analyzes were calculated using the formula: $C = CoV / P$, where Co is the quantity of the element in the test solution; V is the volume of the solution, ml; P - weight of the sample, g.

More than 40 samples were prepared for the atomic absorption analysis. The samples analyzed the presence of such elements as Cu, Pb, Cd, Zn, which are priority pollutants for the study region.

In addition, the presence of heavy metals in the upper soil horizon, litter, was investigated.

It is known that macro- and microelements occur in the body of animals and bioaccumulate in them in the process of feeding. Therefore, the specific features of the accumulation of heavy metals in invertebrates, not only on the taxonomic level, but also on the trophic level, are of undoubted interest.

The structural and functional composition of the representatives of the soil mesofauna is diverse and includes representatives of zoophages, phytophages and saprophagous. Representatives of each trophic group have a specific way of feeding.

Invertebrates living in the upper soil horizon - litter, are closely connected on the one hand with plants, which, like animals, accumulate heavy metals and are the object of food for the representatives of phytophages. On the other hand, they are associated with a litter that performs barrier functions on the way of toxicants entering the soil, being not only the habitat of the animal group under study, but also an object of destructive influence of representatives of saprophagous. During the study, representatives of Carabidae, Scarabaeidae, Elateridae, Formicidae were determined.

Soil Ecology

Representatives of each functional group accumulate heavy metals in various quantities. Naturally, the highest quantity of microelements of biogenic origin in representatives of all functional groups, such as Cu, Zn, Pb, Cd. It has been revealed that such highly toxic elements as Cd, Pb accumulate in invertebrate animals in a much smaller quantity.

Copper. Significant differences in the accumulation of copper by representatives of all trophic groups are not recorded. Each of the three trophic groups of soil invertebrates accounts for 32.9-36.1% of this element from its content in the studied groups of soil invertebrates.

Zinc. If the share in the accumulation of zinc in representatives of zoophages and saprophagous is 34.4-35.1%, then phytophages in comparison with them accumulate it in 1.14-1.16 times less.

One of the toxic elements, which has the most negative impact on the life of the representatives of the mesofauna, is lead. This element in the largest number is accumulated by representatives of zoophages - 1.14 times more compared to phytophages and, in turn, 1.19 times more than in saprophages.

Cadmium is accumulated in the greatest quantity by representatives of saprophagous - 54.5% of the total quantity in the mesofauna of the soil, and in the smallest - of zoophages, 6.9%. Comparative analysis of heavy metals in representatives of different functional groups of invertebrates shows that cadmium, in comparison with all microelements, is accumulated by animals in the smallest quantity (1.1-9.1 mg / kg dry weight) (Table 1).

Table 1. Accumulation of heavy metals by representatives of soil invertebrates of various functional groups on the highway (mg / kg dry weight)

Functional groups	Cu	Zn	Pb	Cd
Phytophagous	492.3	1816.6	147.3	6.5
Zoophages	523.6	2058	165.8	1.7
Saprophages	571.9	2104.1	89.5	9.1

As a result, the importance of these groups of invertebrates in the migration of heavy metals through food chains, including vertebrates, can not be overestimated. In the future, it is necessary to continue monitoring studies of the migration of heavy metals in biogeocoenoses, including trophic networks.

The obtained data can be used for bioindication and monitoring studies of environmental pollution. Thus, it was revealed that the accumulation of heavy metals by representatives of various trophic groups of soil invertebrates is not unambiguous. In conditions of technogenic pollution of cadmium, representatives of the soil mesofauna accumulate in the smallest amounts under these conditions.

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