

# Research of Mesofauna in the Kurdakhany Lake Surrounding Zone from the Azerbaijan Republic

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## Abstract

The study of the soil biological environment is of great importance, because of the large variety of soil types in the dry subtropical and humid subtropical zones of Azerbaijan. The soil fauna participation in the soil formation process is always an urgent and priority subject. It plays an important role especially in bio diagnostic assessment of soils, organic substances conversion biological matters circulation and an energy circulations of the various parts in an ecological pyramid. The object of the study is natural cenoses, spread over the gray-brown soils of the Absheron Peninsula in the Kurdakhany lake surrounding areas and invertebrates living in these cenoses. On the gray-brown soils of the investigated territory, ephemeral-halophytic plants have largely spread. Studies were conducted in 2017-2018. In conducting field and laboratory studies to determine soil invertebrates, the Gilyarov's method was used. The determination of plant species collected from the object of study was carried out according to the "Azerbaijan flora". The taxonomy of the invertebrate animals in the soils under the ephemeral and halophytic vegetation formation in this zones has been fixed and the distribution analysis has been performed in the article. It was determined that the soil invertebrates concerning the Arthropoda type and insects class widely expand in the research zone.

## Keywords

Kurdakhany Lake, Biodiversity of Soil Organisms, Gray-brown Soils, Halophytes, Mesofauna

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## 1. Introduction

The complex soil forming process occurs under the natural factors impact, and its foundation is global biological circulation of substances and the sun energy transformation. It is known that till 20 million tons of organic substances are formed by the earth's plant cover every year, and this expose to much zoomicrobe and biochemical circulations under an influence of soil biota.

The nutrient important for the life action of the plants and beings in the soil is separated as a result of the organic residues crushing and mineralization. The alterations happen in the mineral part of the soil forming maternal rock under an

influence of the different soil organisms (protozoas, invertebrates), consequently the soil horizons distinguishing for wholly new morphogenetic indications are created. So, the new natural –historical thing soil is formed by the alterations in the soft mountain rocks as a result of the global life activity of the alive organisms in the great geological period phone of substances.

The invertebrate animals participation in the soil forming process is determined by a quantity and a quality of the various eco-groups which spread in the concrete natural climatic zones. The zoomass amount (from phytomass %) in the different biomass is as the following thanks to I. Y. Yanushevsky and V. A. Kovda: in tundra-0,004%, taiga

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0,1%, broad-leaved forest 0,28%, chernozem steppes—5,8%, in the deserts of Middle Asia [1]. The invertebrate enoughly form a basic part of zomass amount, for. ex. vertebrates are 4,3%, the invertebrates are 95,7% of the total mass of zoomass in tundra.

Analogically, the invertebrates mass is -99,6-99,8% but the vertebrates mass is 0,2-0,4% in animals biomass of the southern taiga, broad leaved forests, meadow chernozem fields and Middle Asia deserts, a result of phytodestructive activity analysis of the invertebrates it was determined that the rain worms play an important role among the saphrophagous in the forest ecosystem soils, they are able to treat 70-80% of the forest litter.

The ants, isopods, beetles and ticks acted in the arid soils of the desert and dry steppes. For ex. the ants are able to turn all the soil layer under the arid condition along the low Volga for 8-10 years [2]. The termites activity in the tropics is of great importance. The termite colony is capable to lift a soil mass till 10 c/h from the lower layers to the surface.

In Azerbaijan, soil-zoological researches covering various natural-climatic zones were initiated by L. A. Bababekova, and then continued by N. G. Samedov. Subsequently studied such important aspects of the mesofauna as biomass, bioenergetic indicators, the formation of trophic structure. Soil microfauna was also intensively studied. It turned out that the dynamics of their vital activity is similar to the mesofauna closely related to certain types of soils [3].

## 2. Research Object and Methods

Natural cenoses (ephemerals, halophytes) and the invertebrate animals in grey-brown soils of the Kurdakhany lake of the Absheron peninsula have been taken as a research object. The sections coordinates put during the field research are so: Section 1 (N 403022,2; E 0495621,3) (0 m.a.s.l.); Section 2 (N 403019,7; E 0495621,2) (-3 m.a.s.l.) the second cut was taken from 30 m. distance.

Definition of land invertebrates collection and systematics in research zone was performed thanks to M. S. Gilyarov's method [4]. The soil cuts were put in selected biotopes of 0,25 m<sup>2</sup> (50 cm x50 cm). The mesofauna samples by crumbling the soil mass with the hand separately at depth of 0-10, 10-20, 20-30 cm [5].

The invertebrate representatives revealed over the layers have been put into the weighing bottle and fixed with spirit. The representatives selected under the laboratorial condition have been separately grouped and performed their systematization. Study and comparative analysis of the initial

quantity indices of the collected materials were performed.

Definition of the plant sorts gathered from the research object was performed for "Absheron flora", the azerbaijan names to the Azerbaijan flora [6], but the names in latin [www.theplantlist.org](http://www.theplantlist.org) [7].

## 3. Analysis and Discussion

The plant remnants splintering and the next humidification were widely investigated by S. A. Aliyev for the first time [8] so, phytomass in the soils with the various type, change of their mass concerning the vertical zonality law and splintering intensity were studied by him. At the same time he investigated a role of the soil biota, mainly soil microorganisms in circulation of organic residues and found a humidification coefficient separately. On the other hand S. A. Aliyev [8] improved theoretical knowledge about the invertebrates which are an inseparable part of soil biota, explained their role in soil forming process.

As a result of the scientists investigation it was known that the beings or soil biota give different biological active substances (ferments, organic acids, vitamins, hormones and other components) to the soil. For the following years study of the land invertebrates role in plant remnant splintering was continued. So, the invertebrate energetic assessment was performed in plat residues splintering in a cite of the meadow grey soils spreading in the Shirvan plain by P. A. Samadov [9]. Comparatively the natural virgin areas have been taken and the researches have been performed in the cultivated plots. It was known that plant remnants splintering occurs at the expense of Lumbrists. At the same time such splintering was observed in Lucerne and Liquorice agrocenosis. Because the mesophyll isopods and some insect larvae participate in here besides rain worms. But xerophyls mainly act in circulations under ephemeral plants in natural cenosis of the virgin area. It is necessary to note wood-lice, soil ticks, Springtails (Collembolas). It is clear that the plant residues splintering is closely connected with the abiotic factors. P. A. Samadov coordinated an activity of the biological factors abiotic factors and gave a comparative analysis of the same researches with the investigations performed before, besides it he determined a splintering rate and humidification coefficient by the biological factors participation in the soils with the different type in Azerbaijan [10].

The next researches have been continued in the technogenic-polluted soils. It was known that the insects, isopods concerned the same pollution are found in the lands polluted with the cement wastes. The perennial bushes residues of which coarsened wood is shard exposed to circulation. The situation in the soil polluted with the gypsum vegetation (salsola, cereals) are observed too. Besides the isopods the

mixed feeding insects, sometimes gastropods become active in here. But in other areas for ex: the insects and some carabids take part in splintering of halophyte grass vegetation, the plant residues in the oil-polluted areas. A short structure of the invertebrates is limited in the polluted areas of the grey-brown (chestnut) soils. Some species concerning the pentodan and *Amphicomma vulpes* participate. The saline plants saltwort, remnants, camelthorn, wormwood residues shattering is performed by the little halophilic insects in the Siyazan-Sumgayit massive. But the plant remnants conversion occurs by the *Hemilepistus* wood-louse belonging to isopods – a dominant group of the saline soils in the Salyan plain. The undervegetable, undergrain plants in the cultivated soils, but the plant remnants decomposition in agrocenosis are performed by the rain worms and some wood-lice concerning the mesophyll group. Cultivation causes increase of the biological factors activity in both types of the soils.

The sorts (Lumbricit, isopod, some insect larvae) concerning the mesophyll groups actively participate in plant residues decomposition in the forest ecosystems. The definite alterations happen in their sort structure depending on plant cover of the forests. Thereby pelvis snails due to the *Helix* species, *Dendrobayna*, rain worms, some *Diplopods*

concerned the same environment take part in the mountain-forest brown soils, isopods, diplopods and few rain worms act in the mountain-forest brown soils, because they are formed in the arid climate. Phytophagous form 60-70% in arid ecosystems, but the rest percentage falls to saprophagous and beasts' share. The saprophagous are 70%, but phytophagous and beasts are 30% [11].

### 3.1. Natural-Ecological Condition of the Kurdakhany Lake

The natural-ecological condition, morphometric indices, physico-chemical characters and biochemical composition of the lake water were thoroughly investigated by V. A. Mammadov [12]. The Kurdakhany lake is situated at 3 m below

ocean-level in the northern part of the Absheron peninsula. The coast line of this lake is uneven, underwater part is inclined. There are small island and peninsulas, the lake is not running and salt watery. The water nourishment of the lake is atmospheric precipitations, communal, life and industrial slops (oily slops). A total area is 2,8 km<sup>2</sup> [13, 14]. Maximum depth isn't more than 1-2 m, but it is less than 0,5 m in summer (Table 1).

Table 1. Main morphometric parameters in the Kurdakhany lake.

Lake	Absolute height, m	Area, m <sup>2</sup>	Length, m	Average width, m	Depth, m
Kurdakhany	-3,2	279	2800	996	1-2

The surface of the bottom deposits is black, but the lower part consists of the grey colored silts. The water temperature reaches 28-32°C in summer. The most part of the coasts are polluted by the life and industrial wastes. Before this lake was widely used in salt production, but since 1984 part of the lake area has been given to the State Oil Company use and the lake strongly exposed to pollution, it showed itself in

deficiency of flora and fauna in the zone of the lake and lake surrounding.

V. A. Mammadov [12] determined that the Kurdakhany lake water possess the highest hardness for its biochemical composition (197,9 mmol/L) and it is subjected to a high contamination with the oil products (Table 2).

Table 2. Chemical composition of the Kurdakhany lake water [9].

Lake	pH	Anions		Cations			Sum of ions, gr/L	Total hardness, mmol/L	Oil products, mg/L	
		HCO <sub>3</sub>	SO <sub>4</sub>	Cl	Ca	Mg				Na+K
Kurdakhany	8,0	0,30	13,0	95,3	1,4	1,6	69,2	180,8	197,9	0,37

### 3.2. Research Object Flora

The active vegetation of ephemeral in plant cover of the zone was observed during an expedition organized for the Kurdakhany lake in 03.10.2018 (section 1). A project cover of phytocenosis is 90%, different annual and perennial grass was noted in floristic structure. From ephemerals (*Aegilops biuncialis* Vis.), *Aegilops kotschyi* (*A. kotschyi* Boiss.), redstem filaree- (*Erodium cicutarium* (L.) L'Hér.), little bur medick- (*Medicago minima* (L.) L.), common liverwort - (*M.*

*polymorpha* L.), annual meadow grass - (*Poa annua* L.), common lilac- (*S. vulgaris* L.), field marigold – (*Calendula arvensis* L.), *Caryophyllaceae* sp. exceed. camelthorns- (*Alhagi pseudalhagi* (M. Bieb.) Desv. ex B. Keller & Shap.), *Eryngium biehersteinianum* (M. Bieb.) Nevski can be cited as an example for the perennial kinds.

### 3.3. Research Object Mesofauna

We can note that the soil invertebrates amount and biomass in the grey-brown soils developed, salinized, according to P. A.

Samadov under saltwort plant formation in Absheron peninsula is little and it forms 11,2 sample/m<sup>2</sup> and 0,29 g/m<sup>2</sup> [1].

The insects exceed (96,4%) among the revealed groups, *Brachydema*, *Bulae*, *Phacephorus* species spread under phytocenosis from mostly saltworts, mustards and salt-tolerant graingrass [9]. The soil invertebrate amount and biomass rose and formed 16,87 sample/m<sup>2</sup> and 1,7 g/m<sup>2</sup>. *Acinopus*, *Alleculidae*, *Scarabaeida* species prevail from other groups the xerophil wood-louse and rain-worms can be shown [15]. The author commented that the soil invertebrate amount doesn't increase and it is 12,0 sample/m<sup>2</sup> under the same worm-wood-ephemer plant in the zone where the grey-brown soils are transferred to the meadow-grey soils [16].

The grey-brown soils of the Absheron peninsula spread under natural worm-wood ephemer vegetation, the halophyte phytostructure (*Sueda altissima*, *Salsola dendroides*, *Salsola crassa*, etc.) are found in the salinized zones.

An investigation of the invertebrate animal complexes in the shown biotopes gives an opportunity to reveal the invertebrate groups adapted and characteristic for this condition.

The grey-brown soils in the Kurdakhany lake surrounding of the Absheron peninsula spread under ephemeral-halophytic vegetation type. The grey-brown soils developed under halophyte vegetation possess heavy mechanical structure, calcareous. Density-1,43 g/m<sup>3</sup>, salt quantity- 1,5, humus amount-0,85% at 0-30 cm layer. An amount of dry residue is 0,47%, humus-1,32% in the soils developed under worm-wood-ephemer vegetation [17].

The conclusions of the soil invertebrate laboratorial analyses collected during the field researches around the Kurdakhany lake are presented on the following table.

**Table 3.** Soil invertebrates group structure spread in the grey-brown soils around the Kurdakhany lake.

Type	Class	Cluster	Family	Species	Sort	
Artropoda	Insecta	Coleoptera	Carabidae	<i>Pterastichus</i>	<i>Pterastichus cupreus Dej</i>	
			Scarabaeidae	<i>Aphodius larva</i>		
			Hemiptera	<i>Pentatomidae-imago</i>		
		Diptera	Tipulidae	<i>Tipula sp.</i>		
			Dermaptera		<i>Forficula</i>	<i>Forficula auricularia</i>
		Crustacea	Isopoda	Porcellionidae	<i>Porcellio sp.</i>	
		Arachnidae	Araneidae	Aranei sp.		
		Phalangidae sp.				
Mollusca	Gastropodae	Helicidae	<i>Xeropicta sp.</i>			

We defined 2 types (Artropoda, Mollusca), 4 classes (Insecta, Crustacea, Arachnidae, Gastropodae), 6 clusters (Coleoptera, Hemiptera, Diptera, Dermaptera, Isopoda, Aranei), 8 families (Carabidae, Scarabaeidae, Pentatomidae, Tipulidae, Porcellionidae, Araneidae, Phalangidae, Helicidae), 5 species (Aphodins, Tipula, Forficula, Porcellio, Xeropicta) in the zone around the Kurdakhany lake according to the field and laboratorial researches carried out for the soil invertebrates definition in these soils.

As is seen from the table mostly insects (Artropoda) expand in the investigated zone- 8 sorts. They form 85,7% of the main mass of the soil invertebrates in the same region. Beetles (Coleoptera), true bugs (Hemiptera), flies (Diptera), ground beetles (Carabidae), earwigs (Dermaptera), crustaceans (Isopoda), spiders (Aranei sp.) dominates among the insects. Molluscs (Mollusca) represents the other type spreaded in the region their amount is the little and form 14,3% of the invertebrates. The pictures of some sorts of soil invertebrates of the surrounding zone of Kurdakhany lake are presented (Figure 1-4):



**Figure 1.** Gastropodae.



**Figure 2.** Dermaptera.





Figure 3. Scarabaeidae.



Figure 4. Isopoda.

These groups mainly act at 0-10, 10-20, 20-30 cm of layers. The pedobionts on the soil surface decompose the plant residues, they participate in humus layer formation. The pedobionts revealed in the soil are mainly divided into 3 groups: 1. Saprophagous; 2. Phytophagous; 3. Beasts. The substance-energy exchange occurs in this trophic structure.

The place in the trophic structure of soil invertebrates determined in our object of study and to which the environmental group they belong (saprophagous, phytophagous, beasts). The insects concerning the *Arachnidae* class and *Phalangidae sp.* family belong to the beasts group. But the invertebrates represented the Molluscs (*Mollusca*) type prefer mixed type of feeding (saprophytophagous and optional predators).

## 4. Conclusion

It was determined that the soil invertebrates group structure in natural cenosis around the Kurdakhany lake consist of the insects (*Artropoda*) (85,7%) and molluscs (*Mollusca*) (14,3%). The observed invertebrates group is concerned the arid ecoenvironment of Absheron. It was defined that these soil invertebrates concern the different ecological groups of the trophic structure, thereby *Pterastichus cupreus Dej* are predators, *Scarabaeidae*- phytosaprophagous, *Aphodius larvae*-saprophagous. It was defined that True bugs (*Hemiptera*) cluster and beasts *Pentatomidae-imago* family concern the group predators, flies (*Diptera*) cluster belongs to saprophagous group, the invertebrates *Porcellionidae* belonging to crustaceans (*Isopoda*) cluster concern the saprophagous ecological group. The reason is a relation of

their life activity with the lake surrounding plant cover and this formed complex food structure.

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