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ANNUAL VARIATION OF THE TERRESTRIAL MACROFAUNA DURING AUTUMN PERIOD IN A FOREST ECOSYSTEM OF GALIČICA NATIONAL PARK

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ABSTRACT

Šapkarev, J. A. (1993). Annual variation of the terrestrial macrofauna during autumn period in a forest ecosystem of Galičica National Park. Ekol. zašt. život. sred. The article dipicts the ecological conditions existing in the soil of examined forest ecosystem, gives the structure of the terrestrial macrofauna and its density of community of certain animal groups, as well as annual variation and vertical distribution of their population's densities in autumn period during 1979, 1980 and 1981.

Key words: terestrial macrofauna, ecological conditions, variation, distribution, population, community, density, composition, forest ecosystem.

ИЗВОД

Шапкарев, Ј. (1993). Годишно варирање на терестричната макрофауна во есенски период од шумски екосистем на Националниот парк „Галичица" „Екологија и заштита на животната средина". Екол. Зашт. Живот. Сред. Том 1, Бр. 1. Скопје.

Во трудот се прикажани еколошките услови во почвата од испитуваниот шумски екосистем во моментот на истражувањата, се дава структурата на терестричната макрофауна и густината на животинските групи во заедницата, како и годишното варирање и вертикалната дистрибуција на густината на популациите од есенски период во 1979, 1980 и 1981 година.

Клучни зборови: терестрична макрофауна, еколошки услови, варирање, распространување, популација, заедница, густина, состав, шумски екосистем

INTRODUCTION

The massif of this national park in Macedonia is located between two great macedonian lakes, Ohrid and Prespa. In connection with biocenological investigations to the ecosystem of oak forest (Quercetum frainetto-Cerris macedonicum Oberdorfer, 1948 em. Horvat, 1959) the heterotrophic component was investigated, from which the results of terrestrial macrofauna investigations also will be explained.

METHODS OF INVESTIGATIONS

During three years (1979, 1980 and 1981) in the months October, November and December onemonth from five different sites quantitative samples were taken. The samples were taken from a protected area of one hectar located in direct closeness to Lake Prespa. Square method with a surface of 50 X 50 cm was used. Vertically samples were taken from every 5 cm stratum to a depth of 30 cm.

Searching through the material was carried out by hand and with the aid of fine and crude sieve. Separated material was preserved using a solution of 5 parts concentrated formol, 1 part of glycerin and 94 parts of aqua destillata.

Simultaneously with taking quantitative samples of the terrestrial macrofauna under exploration, the temperature was measured of every stratum of the soil and samples taken of every stratum soil for a determination of soil structure, humus content, pH in KCL and in H_2O, and moisture content.

RESULTS OF INVESTIGATIONS

1. Some physical and pedological features of the explored soil

Temperature of the different soil strata is given on the table 1. In average for all autumn period the soil was equaly warmed up in 1979 (61°C) and in 1981 (6.2°C) and relatively less in 1980 (5.7°C). In other side, in 1979 (2.1) and 1980 (2.2) a cold spell has set in December whereas in 1981 (2.2°C) - in November.

Table 1. Temperature of different soil strata in the forest oak ecosystem in Galičica mointain.
Табела 1. Температурата во различните почвени слоеви на шумскиот дабов екосистем на планината Галичица.

Year and months Година и месеци	1979.			1980.			1981.		
Depth in cm Длабочина во см	X	XI	XII	X	XI	XII	X	XI	XII
0 - 5	8.7	7.8	1.0	9.1	3.8	1.7	10.9	1.3	5.6
5 - 10	8.4	7.8	2.0	9.5	4.9	2.2	11.1	2.1	5.1
10 - 15	8.4	7.9	2.5	9.8	6.0	2.4	11.4	2.7	5.0
15 - 20	8.4	7.9	2.9	10.0	6.4	2.7	11.7	2.9	5.0

As a rule, the percentage of the soil moisture (table 2) decreases with the depth and it increase from October to December. An exception was registered in 1980 when the smallest percentage was in November (23.10% in average for all strata). On the whole taken the most moisture for all autumn period was stated in 1980 (in average 29.38%), something less in 1979 (26.52%) and the least in 1981 (25.33%). Very low percent of moisture was stated in October 1981 (10.49% in the stratum 15-20 cm depth), in October 1979 (12.55% in the stratum 15-20 cm) and in November 1980 (16.09% in the stratum 10-15 cm). The highest moisture was found at the surface stratum (48.72%) in December 1980.

Table 2. Percent of moisture from different soil strata of the forest oak ecosystem in the mointain of Galičica.
Табела 2. Процент на влажност кај различните почвени слоеви од дабовиот шумски екосистем на планината Галичица.

Year and months Година и месеци	1979.			1980.			1981.		
Depth in cm Длабочина во цм	X	XI	XII	X	XI	XII	X	XI	XII
0 - 5	31.57	29.44	32.84	34.31	32.85	48.72	18.22	39.73	34.64
5 - 10	20.45	23.98	31.05	29.31	23.99	27.49	12.04	28.54	30.39
10 - 15	18.82	23.90	30.69	30.90	16.09	27.18	11.16	30.26	28.22
15 - 20	12.55	34.77	28.17	31.23	19.47	31.12	10.49	32.84	27.38

On the table 3 the data for pedological peculiarities are given. The particles from 0.05 to 2.00 mm (49.99-54.27%) were dominated in the soil structure, then the particles smaller from 0.01 mm (with 28.80-34.66), while the particles from 0.01 to 0.05 mm were with least percent (15.23-16.93%). Quantity of the finest particles increaces with the depth, whereas the most rough - decreaces. The particules from 0.01 to 0.05 mm were present something more only in the surface stratum 0-5 cm, while in other strata their percent was less and mainly constant.

Table 3. Some pedological peculiarities of different soil strata in the oak forest ecosystem from the mountain of Galičica.
Табела 3. Некои педолошки карактеристики од различните почвени слоеви на дабовиот шумски екосистем на Галичица.

Depth in cm - Длабочина во cm		0 - 5	5 - 10	10 - 15	15 - 20
Soil texture in % Механичен состав во %	0.01 mm	28.80	31.28	32.76	34.66
	0.01 - 0.05	16.93	15.48	15.23	15.35
	0.05 - 2.00	54.27	53.24	52.01	49.99

Humus content decreases with the soil depth. From 5.06% in the surface stratum (0-5 cm) to 2.32% in the deepest explored stratum (15-20 cm).

pH-value was almost the same in all strata - from 5.14 to 5.28 in water and from 3.80 to 4.21 in KCL, that means the soil presents an acid environment.

2. The composition of the terrestrial macrofauna

During the investigation period in the structure of the terrestrial macrofauna the following animal groups were present:

ANNELIDA
Glass Oligochaeta
Fam. Enchytraeidae
Fam. Lumbricidae

ARTHROPODA
Class Arachnida
Order Araneina
Class Myriapoda
Order Diplopoda
Order Chilopoda
Class Insecta
Order Coleoptera (larvae and imagines)
Order Hymenoptera (mainly fam. Formicidae)
Order Diptera (larvae and imagines)

Except these animal groups, several groups more were registered, such as for example Mollusca (small in numbers of pulmonate gastropods) or from Insecta (small in numbers of Lepidoptera). Meanwhile, their individual numbers in the terrestrial fauna were so small that they were not taken into consideration.

3. Density of communities of certain animal groups

The community of terrestrial macrofauna from the oak forest ecosystem of Galičica was not so numerous as in many other forest ecosystems, particularly to those of Middle Europe. It seems that one of the important factors which limited numbers of the community was the soil moisture. The examined area belongs to the semiarid region. From the table II it could be seen that in October the percent of moisture was about 20% and to certain soil strata it even decreases to 10 percent. Such low per cent of moisture almost is a normal occurence during the summer period. This situation influences negatively to the life of the great number of terrestrial animals, particularly to the life of earthworms, to which we had made a special consideration (Šapkarev, 1983a, 1983b, 1984).

In this relatively poor macrofauna two annelid groups of oligochaetes, Enchytraeidae and Lumbricidae, were most abundant. Afterwords were Diplopoda of Myriapoda and from Insecta larvae of Diptera and Coleoptera. The remaining animal groups were populated with less numbers, which refers particularly to Areneina and Formicidae (table 4).

Table 4. Density of the different animal groups of the macrofauna populated in the soil of the oak forest ecosystem from Galičica.
Табела 4. Густина на различните животински групи во макрофауната населена во почвата од дабов шумски екосистем на Галичица.

Year and months / Animal groups		Specimens per square meter	1979 X	1979 XI	1979 XII	1980 X	1980 XI	1980 XII	1981 X	1981 XI	1981 XII
Enchytraeidae			37.2	52.8	41.2	8.8	40.0	39.2	0.8	5.6	-
Lumbricidae			53.9	89.6	66.1	39.2	65.6	49.6	18.4	32.0	40.0
Araneina			9.8	2.4	-	0.8	0.8	0.8	0.8	-	0.8
Diplopoda			6.5	57.8	-	34.4	15.2	-	0.8	11.6	4.0
Chilopoda			-	4.0	8.0	8.0	5.8	0.8	0.8	1.6	1.6
Diptera	larvae		33.6	20.8	24.8	8.8	19.2	4.8	4.8	9.6	30.4
	imagines		4.0	-	0.8	-	0.8	-	-	-	-
Coleoptera	larvae		25.2	21.8	13.2	16.0	19.2	12.8	8.0	128	23.2
	imagines		12.8	2.4	0.8	4.8	3.2	0.8	11.2	3.2	2.4

In addition different numbers in oak forest ecosystem examined to various animal groups a different relation in numbers on the different sites examined was registered although they not excessively distance each other as well as the variation of the density of one and the same group in the different autumn months in 1980. So, at the first site examined, Diplopoda was dominant in numbers; at the second and third sites it was Enchytraeidae, whereas at fourth and fifth sites the dominant place belongs to group Lumbricidae. So at first site in October diplopod's settlement reaches to 160 ind/m^2, at the second site enchytraeids in November - to 120 ind/m^2, whereas at fourth site in November lumbricids reached to 180 ind/m^2.

From another side, the most frequent were insect groups Diptera and Coleoptera and lumbricides, which in all examined sites and in all autumn months have been present. In this regard enchytraeids are characterized although they were with something less frequency than the previous ones. It was not case with diplopods, although they belong on the category of the dominant groups. Araneines, formicids and lepidopters were especially with small frequency.

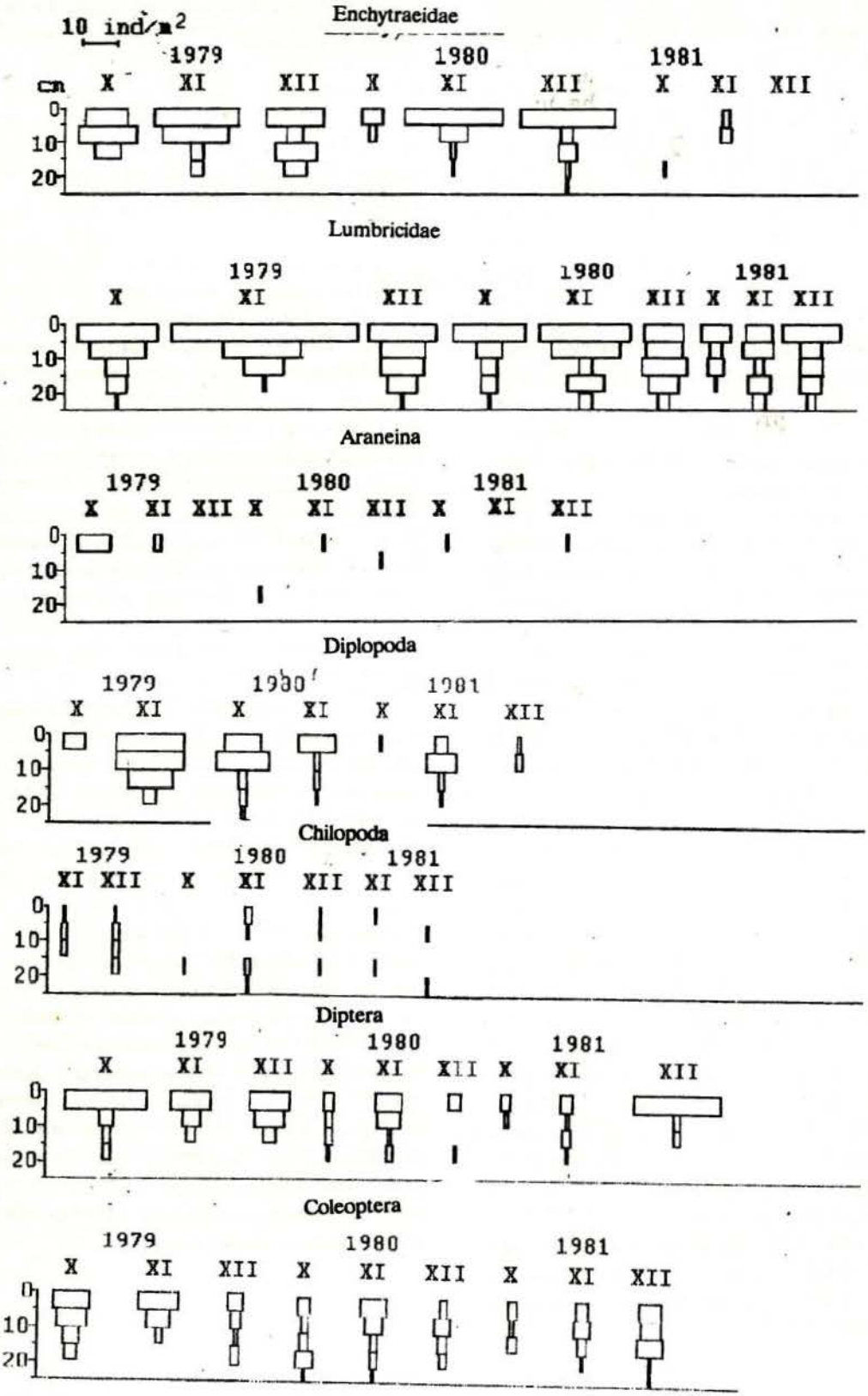
On the diagramms of figure one are showed the average quantitative values of the terrestrial macrofauna from five sites examined during October, November and December in 1979, 1980 and 1981. From these diagramms the dominance of both annelid groups, Enchytraeidae and Lumbricidae, during autumn aspect in 1979 (even 454, resp. 400 ind/m^2) and 1980, followed by Diplopoda in numbers (in November 1979 with about 320 ind/m^2) can be seen. In this year was particularly interesting that the number of araneid specimens decreases to almost 200 ind/m^2.

Identical state was found in 1980 with a difference of the previous year that the numbers of araneid specimens was exceptionaly smal (under 200 ind/m^2).

On the contrary to previous two years, in 1981 the number relations of the different animal groups have changed quite a bit. So, enchytraeids which in 1979 and 1980 were dominant, in 1981 their number value was so small that it was equal to that of araneids, chilopods and formicids. It was very interesting that in that year diplopods were populated with a very small number of specimens, too. Dominant group were lumbricids, but also two groups of insects, dipterans and coleopterans.

Fig. 1. Average densities and vertical distribution of sevan animal groups of the soil to oak forest ecosystem from Galičica during autumn months in 1979., 1980. and 1981.

Сл. 1. Просечни густини и вертикална дистрибуција од седум животински групи од почвата на дабов шумски екосистем од Галичица во есенски месеци од 1979., 1980. и 1981 година.



4. Annual variation of the density of communities

From the diagramms of the figure 1 it could be seen annual variation of the autumn period 1979 - 1981 for more abundant animal groups of the soil macrofauna. It was registered that the number of specimens of enchytraeids decreases from 1979 to 1981. Almost the same direction of the annual variation had the diplopods. This kind of annual variation was registered on the sites I, II and IV for lumbricids but not the same on the sites III and V. Finally, the annual variations to the numbers of dipterans and coleopterans was different on the different sites explored.

5. Vertical distribution of the density of communities

The vertical distribution for most of the animal components of the terrestrial fauna in the examined forest ecosystem reaches to a depth of 25 cm. Only lumbricids were found to 30 cm depth. In the autumn period of all three examined years the density of settlement for the most of animal groups had such vertical distribution was such that the density decreases from the surface towards the deeper soil strata. Only in December of that period a certain tendency appeared that some of deeper strata to be denser populated than another soil strata. This tendency was observed for all three years of investigation.

DISCUSSION

In the composition of terrestrial macrofauna from the explored ecosystem mainly took part two animal groups: Annelida and Arthoropoda. The present of Mollusca was registered but the specimens of their gastropod representatives was minor and because of that it was not taken into consideration. That was the case with some larvae of the insect group Lepidoptera. The annelids were represented by oligocaete's Enchytraeidae and Lumbricidae whereas arthropods from Arachnida (with Araneina), Myriapoda (Diplopoda and Chilopoda) and Insecta (Diptera, Coleoptera, Lepidoptera and Hymenoptera). Almost identical case was with the terrestrial macrofauna of the forest ecosystem Quercus pubescens on the hill of Katlanovo in North Macedonia (Naumovski, 1981).

According to Ghilarov (1965) for classification into groups, the trophic structure of the pedozoocenose of the examined forest ecosystem could be divided into four basic trophic groups: saprophages, phytophages, zoophages and omnivores. Saprophages were dominant group among which the most important are lumbricids and diplopods; after that phytophages mainly represented by the insects; considerably less are zoophages (chilopods and araneins) and omnivores (ants). In regard to connection of macrozoobionts for the soil (Ghilarov, 1965), there were typical geobionts, among which the most important were enchytraeids, lumbricids and formicids. Also an important part were geophilous (almost all insects) and only an insignificant part was represented by geoksenes (pulmonate snails and butterflies) which, more or less, incidently were present in the soil.

The population density in the macrofauna was the highest of Enchytraeidae and Lumbricidae, after that were Diplopoda from myriapods and from insects larvae of Diptera and Coleoptera. Other animal groups were populated with significantly less number of individuals Araneina and Formicidae especially. In the investigations by Naumovski (1981) in the oak forest ecosystems on hill of Katlanovo (Macedonia), insects and lumbricids were dominant. Among the soil animals from the forest ecosystem of Poland, larvae of Diptera and Coleoptera have been most abundant (Olechowich, 1986).

As far as vertical distribution concerned it could be said that autumn period population density of the most number of animal groups decreases with the depth and only in December there are a tendency some of deeper strata to be densier populated than other soil strata. One of the reasons for such autumn vertical distribution of macrofauna groups was temperature, because in that month 1979 and 1980 a cold spell hurriedly has set in soil, so that the temperature in the soil strata increased with the depths.

Finally, the annual variation of soil macrofauna in autumn period was charecterized by making a big difference among different animal groups. So, the numbers of enchytraeid - and diplopod-individuals decreases from 1979 to 1981. Something like this, but not in all examined sites, were the lumbricids, whereas dipterans and coleopterans there were a different dynamics at different examined sites.

CONCLUSIONS

The investigation of terrestrial macrofauna were carried out in the soil of a protected area of the oak forest ecosystem on the mountain of Galičica. Quantitative samples were taken in autumn period (October-December) 1979, 1980 and 1981. Simultanously, some of phisical-chemical pecularities were taken. The results of these investigations can be summarized as follows:

- in average for the all autumn period the soil was equally warmed up (6.1°C in 1979, 6.2 in 1980 and 5.7 in 1981). It has gotten cold in December (2.1°C in 1979 and 2.2°C in 1980) and in November 1981 2.2°C;
- percentage of a soil moisture as a rule decreases with the depth and it increases from October to December. On the whole taken for all autumn period the highest moisture was registered in 1980 (in average 29.38%) and the lowest in 1981 (25.33%);
- in regard to mechanical composition of the explored soil the particles from 0.05 to 2.00 mm were dominant (49.99 - 54.27%); the particles smaller of 0.01 mm - 28.80 to 34.66% whereas the particles from 0.01 to 0.05 paricipate with 15.23 - 16.93%. Amount of the finest particles increases with the depth, while the amount of rawest particles decreases;
- humus content decreases with the soil depth (from 5.06% in the stratum of 0-5 cm to 2.32% in the stratum of 15 - 20 cm);
- the explored soil was acid environment. pH-value was between 5.14 and 5.28 and almost the same in all strata;
- in the composition of the pedomacrofauna the representatives of annelids took place with the group Oligochaeta and arthropods mainly with groups Arachnida, Myriapoda and Insecta. Molluscs with pulmonate gastropods of the group Stylomatophora were very rare;
- taking in whole the animal settlement was relatively poor. Annelids were dominant in numbers as well as diplopods of Myriapoda and insects (dipteran and coleopteran larvae);
- variations in numbers of enchytraeids and diplopods in the autumn period of three examined years were characterized by a decrease from 1979 to 1981. Something like this there were lumbricids, but such direction of variations was not registered by the larvae of dipterans and coleopterans;
- for the most of animal components the vertical distribution reaches to a depth of 25 cm and only lumbricids were found to 30 cm depth. In the autumn period of explored years the density of settlement from most animal groups decreases from the surface towards the deeper soil strata. Only in December of that period a certain tendency appeared that some of deeper strata to be denser populated than another soil strata.

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ГОДИШНО ВАРИРАЊЕ НА ТЕРЕСТРИЧНАТА МАКРОФАУНА ВО ЕСЕНСКИ ПЕРИОД ОД ШУМСКИ ЕКОСИСТЕМ НА НАЦИОНАЛНИОТ ПАРК „ГАЛИЧИЦА"

Јонче А. ШАПКАРЕВ

РЕЗИМЕ

Истражувањата на терестричната макрофауна се вршени во шумска почва од дабов екосистем на Галичица во есенски период, во тек на три години (1979-1981). Напоредо со овие испитувања, истражувани се и неколку есенциелни физичко-хемиски и педолошки фактори на средината. Резултатите од овие истражувања би можеле на кратко да се сведат на следното:

- во просек за истражуваниот есенски период почвата беше подеднакво загреана (6,1°C во 1979; 6,2 во 1980 и 5,7 во 1981 година). Поголемо заладување беше забележано во декември (2,1°C во 1979 и 2,2 во 1980) и во ноември 1981 година 2,2;

- процентот на влажност на почвата по правило опаѓа со длабочината, а се зголемува од октомври кон декември. Земено во целина, за целиот есенски период најголема влажност беше констатирана во 1980 (29,38% во просек), а најмала во 1981 год. (25,33%). Многу низок процент на влажност беше регистриран во октомври 1981 год. во почвениот слој 15-20 см (10,49%), а највисок во површинскиот слој од декември 1980 (48,72%);

- во поглед на механичкиот состав на почвата доминираа честички 0,05-2,00 мм со 49,99-54,27%; честички помали од 0,01 мм учествуваа со 28,80-34,66%, додека честичките од 0,01-0,05 мм беа најмалку - 15,23 до 16,93%. Квантитетот од најфини честички расте со длабочината, додека тој од најгрубите честички опаѓа;

- количеството на хумусот опаѓа со длабочината, и тоа од 5,06% во слојот 0-5 см до 2,32% во слојот 15-20 см;

- тлото беше слабо кисело со pH-вредност помеѓу 5,14 и 5,28 и скоро исто во сите слоеви;

- во составот на педомакрофауната беа присутни претставници од Annelida со групата Oligochaeta и Arthropoda со Arachnida, Myriapoda и Insecta. Беше регистрирана и Mollusca со пулмонатни гастроподи од групата Stylomatophora, но беше застапена многу ретко;

- населбата на макрофауната беше релативно сиромашна со доминирање на анелиди, диплоподи и ларвена фауна на диптерските и колеоптерските инсекти;

- во есенскиот аспект од трите испитувани години, варирањето на густината на населбата на енхитреидите и диплоподите се одвиваше во правец на опаѓање на бројноста на единките од 1979 кон 1981 година. Нешто сличен ток на варирање беше регистриран и кај лумбрицидите. Меѓутоа, такви правилности не беа забележани во густината на диптерските и колеоптерските ларвени населби;

- за најголем број животински групи навлегувањето вертикално во почвата изнесуваше до 25 см длабочина (а за лумбрицидите и до 30 см). За есенскиот период беше востановено густината на населбата од најголем број животински групи да опаѓа од површината кон подлабоките почвени слоеви. Само во декември беше регистрирана тенденција за населување со поголем број единки во некои од подлабоките слоеви.