

ECOFAUNISTIC RESEARCHES ON SOME TAXONOMIC INVERTEBRATE GROUPS OF THE EDAPHIC FAUNA (SHALE LITHOSOL) FROM LEAOTA MOUNTAINS, 2014 -2015

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Abstract. The areal represented by Leaota Mountains has not been researched nearly at all until 2014-2015 from the perspective of the invertebrate fauna; thus, it still represents a white spot from this point of view. For this reason, our research has focused on the north-western sector of the massif, on the contact area with Bran-Rucăr Corridor and Piatra Craiului Massif, where the geological diversity of the substratum, limestone and crystalline schists, can represent a premise for the installation of some favourable conditions for the fauna biodiversity in the edaphic soil. This study presents the results of the distribution of taxa of invertebrates (Araneae, Isopoda, Collembola, Coleoptera, Diplopoda, and Chilopoda) in the edaphic soil with a substratum of meso-metamorphic crystalline schists. The variation of this distribution was analyzed both depending on the ecological stationary and on the month of the year. The monitoring process was carried out on a monthly basis, in 2014 and 2015.

Keywords: invertebrate fauna, Leaota, edaphic soil, shale lithosol.

Rezumat. Cercetări ecofaunistice asupra unor grupe taxonomice de nevertebrate din fauna edafică (litosol șistos) din Munții Leaota. Arealul reprezentat de Munții Leaota nu a fost aproape deloc cercetat până în anii 2014-2015, din punct de vedere al faunei de nevertebrate, reprezentând încă o pată albă din acest punct de vedere. Din acest motiv, cercetările noastre s-au concentrat pe sectorul de nord-vest al masivului, la zona de contact cu Culoarul Bran-Rucăr și cu Masivul Piatra Craiului, unde diversitatea geologică a substratului, calcare și sisturi cristaline pot constitui o premisă pentru instalarea unor condiții favorabile unei biodiversități faunistice în mediul edafic. Studiul nostru prezintă rezultatele în ceea ce privește distribuția taxonilor de nevertebrate (Araneae, Isopoda, Collembola, Coleoptera, Diplopoda și Chilopoda) în mediul edafic cu substrat format din șisturi cristaline mezometamorfice. Variația acestei distribuții a fost analizată atât în funcție de staționarul ecologic, cât și în funcție de luna din an. Monitorizările au fost efectuate lunar, în anii 2014 și 2015.

Cuvinte cheie: fauna de nevertebrate, Leaota, mediu edafic, litosol șistos.

INTRODUCTION

This paper displays the results of the research regarding the distribution of some important fauna taxonomic groups in schistic lithosol (meso-metamorphic) in the north-western area of Leaota Massif. Lithosol is an undeveloped soil, with skeletal soil with fine material < 20% of the quantity, reaching a 75cm depth (FLOREA & MUNTEANU, 2012), featured by the presence, at its surface, of the parental rock, consisting of pieces of centimeters or decimeters. Parental rocks display, in case of the lithosol, a general feature: they are hard, consolidated rocks (DUMITRIU, 2003). The fertility of this soil type is reduced due to the low quantity of humus it contains. Lithosol frequently appears in many areas in Leaota, being specific both to the areas with limestone substratum and to the ones with schist substratum. Lithosol represents a type of soil with litho-clast particles of different sizes, which allow the existence of some free spaces that are populated with different invertebrate species. The lithosol is also included in this category of special habitats as a type of endogenous environment (RACOVITĂ, 1989; DECU et. al., 1991), featured by particularities of some ecological factors, which determine the temporary or permanent population with certain species.

The ecological significance of this type of habitat comes from the fact that it represents a shelter for a series of invertebrates and small mammals, when the weather conditions become unfavorable for the biocoenosis components at the surface of the soil, such as a draught period or lower temperatures. Considering all of these, the distribution of these invertebrate species in the lithosol is directly influenced by the ecological factors, such as temperature, relative humidity and also, at least in an indirect manner, by the lithological nature of the substratum; the lithological types of clasts determine the chemistry of the soil, the disintegration and alteration speed of the parenting rock and its transformation in clay (solification process) (RĂDOANE & RĂDOANE, 2007). This is the reason why we made research on the distribution of some significant taxonomic groups in schistic lithosol (Araneae, Isopoda, Collembola, Coleoptera, Diplopoda, Chilopoda).

The studies in this paper are a component of some wider research, which analyze the way in which different types of geological substratum of the SSHs influence the distribution of some invertebrate taxonomic groups in Leaota Massif. Such research is a premiere for Leaota.

MATERIALS AND METHODS

We chose three ecological stationaries, where we placed Barber traps in order to collect the fauna in the edaphic soil with a substratum formed of crystalline schists. The stationaries were placed in areas in which the anthropogenic influence would be minimum or non-existent.

Thus, the ecological stationary no. 1 was placed at the foot of the southern slope of Zăbava Mountain, at its limit with Berbece's Brook (Pârâul lui Berbece) (a right side tributary of the Ghimbav River) (Fig. 1), on the left bank of the brook.

The position was determined through the GPS coordinates: N 45°22'18.1"; E 25°15'57.2", at an altitude of 1060 meters. The geological substratum consists of schist scree, covered in soil (lithosol), on which one can find a layer of litter, the thickness of the soil stratum and of the litter reaching a total of approximately 10-11 cm. In this ecologic stationary, we have placed five Barber traps in order to collect the edaphic fauna, disposed according to the collecting method that is described below (Fig. 2). The gathering of edaphic fauna was carried out on a periodical basis, the Barber traps functioning for ten days each month.

The second stationary on schist substratum was placed in Popii Valley (Valea Popii), on the left bank of the brook. The ecological stationary no. 2 – Popii Valley (Fig. 1) was placed on a plane surface, on the right bank of Popii Brook, where we placed five Barber traps, in order to collect the edaphic fauna. The GPS coordinates of the stationary are: N 45° 21'41.2"; E 25°16'37.9", at an altitude of 1079 meters. The geological substratum is also formed of crystalline schists like in the previous case, covered in soil and litter (lithosol), with a thickness of approximately 10-12 cm. The placement method of the Barber traps is the same one as in case of stationary 1. The stationary functioned from May to November (we have not installed Barber traps in April, as there was snow in the area).

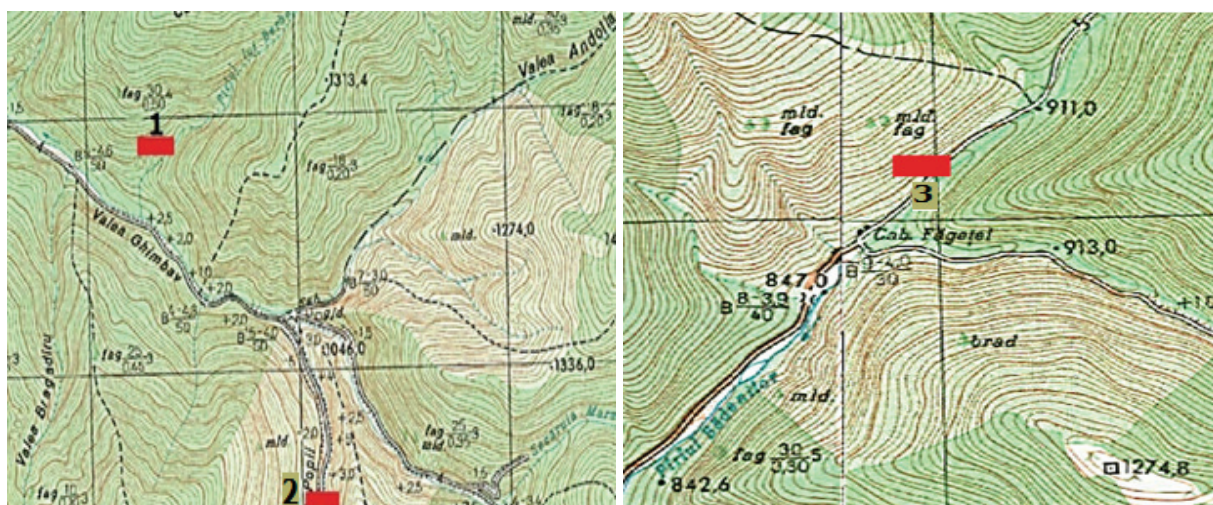


Figure 1. Location of the ecological stationary: 1 – Pârâul lui Berbece, 2 – Valea Popii, 3 – Valea Bădenilor (Bădeanca) (<http://limite.opengov.ro/leaota>)

The ecological stationary no. 3 on Bădeni Valley (Valea Bădenilor) had a temporary functioning, between July 17th and 26th 2015. We installed it in order to see if there is a potential of finding new species of invertebrates, different from the already-identified species in the two stationaries we mentioned before, 1 and 2. Samples were collected only once from Barber traps. GPS location: N 45° 17' 52.4", E 25° 14' 47.9", 863 meters altitude, on the right side of the forest road (from Leaota Peak to the village) parallel to Bădeni Valley (Fig. 1). The substratum is formed of metamorphic rocks (covered in lithosol).

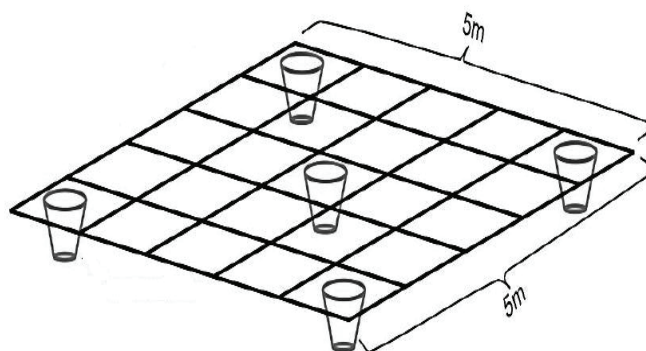


Figure 2. Barber traps layout (from NAE, 2010)

RESULTS AND DISCUSSIONS

Subsequently to the processing and the centralization of the data registered on a continuous basis, from 2 to 2 hours, regarding the main ecological factors T and RH, we drew tables 1 and 2, for a more accurate presentation, which displays the centralized values of temperature and relative humidity parameters registered at the level of the soil in the stationaries placed in the edaphic environment (lithosol).

Table 1. The monthly average temperature (°C) in stationaries.

STATIONARIES	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1. Pârâul lui Berbece	6.85	11.1	17.03	18.62	21.46	18.25	10.25	8.3	-
2. Valea Popii	-	16.07	12.12	12.23	12.64	12.15	8.57	5.05	-0.5*

* - only for the first 5 days of December 2015 (the average of the registrations for the respective month of 2014 and 2015).

Table 2. The average monthly relative humidity (%) in stationaries.

STATIONARIES	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1. Pârâul lui Berbece	85.80	79.02	92.29	87.38	75.35	80	80.50	81	-
2. Valea Popii	-	84.24	92.57	96.65	93.14	97.93	98.40	94.20	80*

* - only for the first 5 days of December 2015 (the average of the registrations for the respective month of 2014 and 2015).

Regarding the fauna results, in the above mentioned stationaries, we have identified the following numerical distribution of the invertebrate species on stationaries and superior taxonomic categories (Table 3).

Table 3. Distribution of the invertebrate species on stationaries, within taxa.

No. of order*	Taxonomic group	Stationary 1 (Pârâul lui Berbece)	Stationary 2 (Valea Popii)	Stationary 3 (Valea Bădenilor)
1.	Ord. Araneae	10	4	2
2.	Ord. Isopoda	4	4	2
I.	Cls. Colembolla	43	21	12
3.	Ord. Coleoptera	43	37	5
II.	Cls. Diplopoda	12	10	4
III.	Cls. Chilopoda	3	2	2
	Total/stationary	115	78	27

*The orders have been numbered with Arabian and the classes with Roman numerals.

The centralized results on environmental factors T and RH (Tables 1, 2) lead to more discussions. Regarding temperature (T), its average value for the whole monitoring period was 13.61 °C for the Berbece's Brook stationary and 11.26 °C for the Popii Valley stationary. It is an evident result that the average annual temperature is higher at Berbece's Brook stationary, with $\Delta t = 2.35$ °C than at Popii Valley stationary. In May only, T had higher values in the last stationary compared to the first one.

We notice that the relative humidity ecologic factor (RH) had a notable higher value in Popii Valley compared to Berbece's Brook, during the entire monitoring period (Table 2). The annual average RH is 93.87% at the Popii Valley stationary and 82.69% in Berbece's Brook stationary (in order not to distort the results, we did not included the average value for the 5 days in December 2015).

Taking into account the faunistic results, if we analyze the total number of species on taxonomic categories in all the three ecologic stationaries with a substratum of crystalline schists, together with the number of captured individuals, than we have: 13 species of Araneae (64 individuals); 5 species of Isopoda (184 individuals); 47 species of Collembola (1,911 individuals); 61 species of Coleoptera (513 individuals); 17 species of Diplopoda (321 individuals); 5 species of Chilopoda (13 individuals).

The total number of species in the edaphic soil with schist substratum was 148 and the total number of individuals was 3,006.

The most numerous species in the edaphic soil in the two stationaries that functioned for a long time (stationaries 1 and 2) were Coleoptera: 43 species in stationary 1 (the same number as Collembola) and 37 species in stationary 2. Only in stationary 3 – Bădeni Valley, where we collected just once, the situation is opposite, as the collected fauna material is dominated by Collembola (12 species, representing almost 45%).

As number of collected individuals, Collembola leads by far, with 1,911 individuals of the total; next comes Coleoptera, with 513, Diplopoda with 321 and Isopoda with 184, and far away, Araneae, 64 and Chilopoda, with only 13 individuals (Table 3).

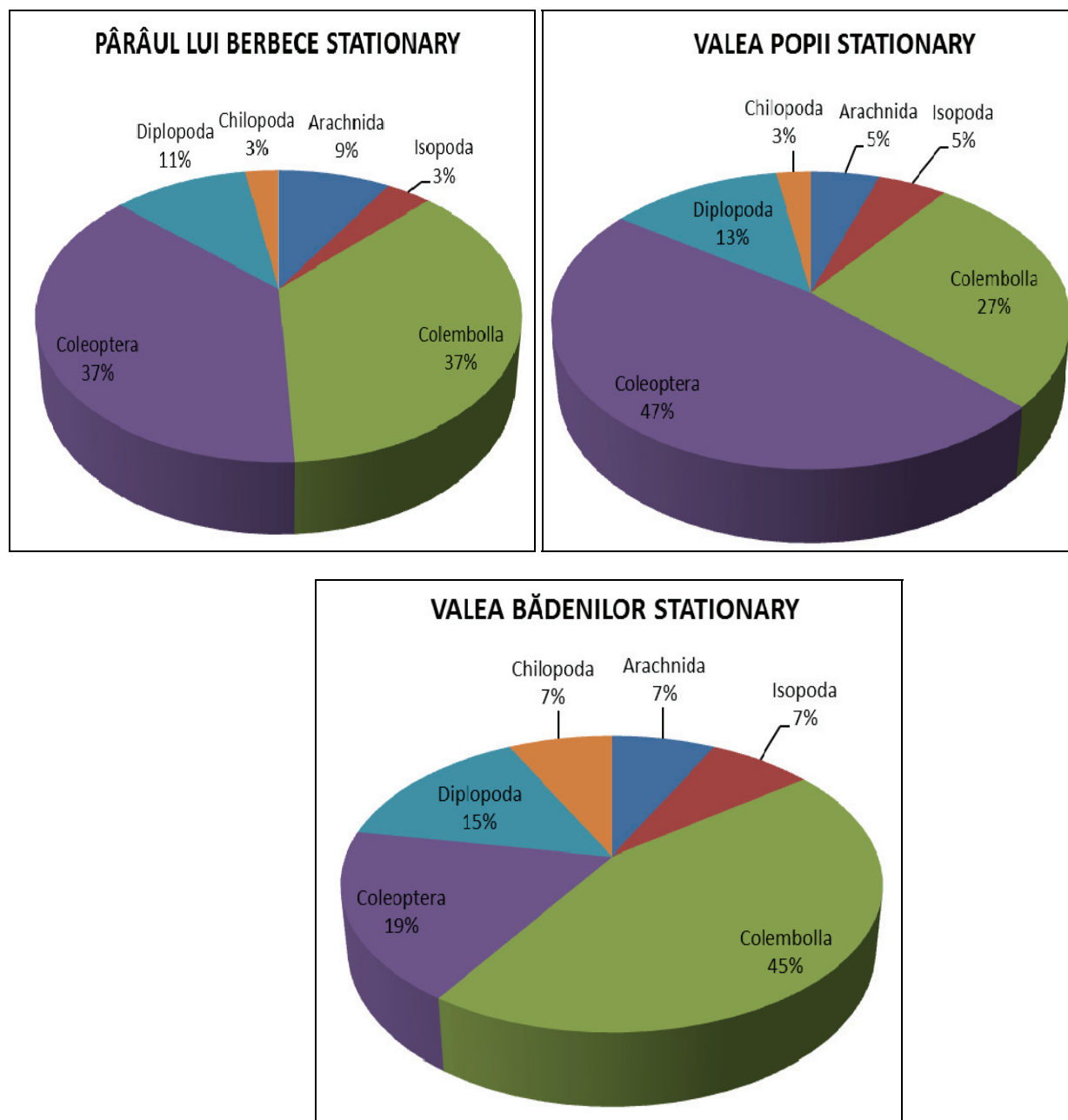


Figure 3. The percentage distribution of the six invertebrate taxa in the edaphic soil on the stationaries they were collected from.

We noted the small percentage values for Isopoda, Chilopoda and Arachnida determined in all three stationaries. Also, in the same stationaries, the relatively high values for Collembola and Coleoptera are observed (Fig. 3).

On the stationary 1 – Pârâul lui Berbece, the diversity of the species had the highest values for all six invertebrate taxa (Fig. 4).

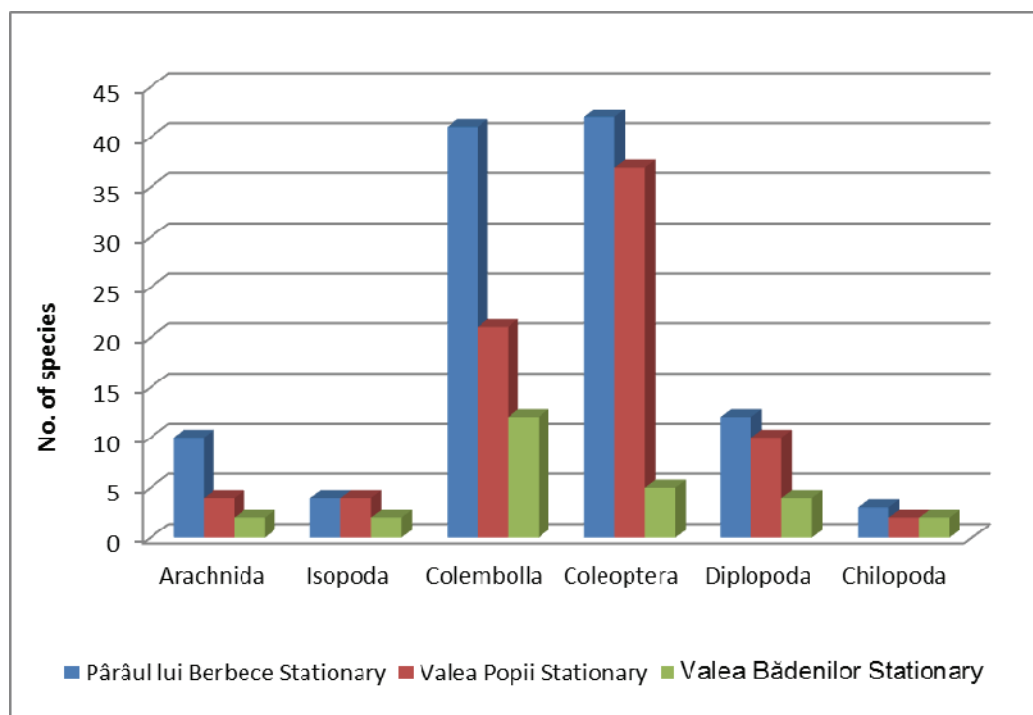


Figure 4. The comparative distribution of the six invertebrate taxa in the edaphic soil on the stationary they were collected from.

To analyze the way in which the fauna distribution fluctuates depending on the period of the year and stationary, we created, for the two ecologic stationaries 1 - Berbece's Brook and 2 - Popii Valley (Stationary 3 being used for a single data collecting), radar diagrams, which we used for the analysis of the monthly variation of the cumulated abundance and the specific diversity (Figs. 5 - 16).

In case of Araneae, at station 1 Berbece's Brook, we registered the peak of the specific diversity in July (10 species) (Fig. 5), contrary to the rest of the months. Though, the cumulated abundance had higher values for July and September, when the maximum number of individuals was reported (Fig. 6).

At station 2 - Popii Valley, both the specific diversity and the cumulated abundance of the Araneae registered very low values. In August, we noticed both the highest number of individuals and species.

As for Collembola, as well as for the Araneae, the highest specific diversity in case of the stations in the edaphic soil was also reported for stationary 1 - Berbece's Brook (Fig. 7), in July. At stationary 2 - Popii Valley, the peak of the specific diversity was reached in August, but at a much lower value. The cumulated abundance in case of Collembola species reached its peak in July for stationary 1 - Berbece's Brook and barely in September for stationary 2 - Popii Valley, with a much lower number (Fig. 8). We ascribe this delay of the maximum of the cumulated abundance for stationary 2 to the colder micro-climate, as Popii Valley is a narrower and more shadowed valley compared to the one where stationary 1 was placed, which clearly resides from table 1. Thus, in July, T reached an average value of 18.62 °C in Berbece's Brook stationary and only 12.23 °C in Popii Valley stationary. By analyzing the radar diagram of Coleoptera species on stationaries (Fig. 9), we notice that the specific diversity is the highest, with the peak in August (when factor T reached the highest monthly average value 12.64 °C) for stationary 2 - Popii Valley and with a lower, yet relatively constant number of species for July-September, in stationary 1 - Berbece's Brook. We underline that, in stationary 2 - Popii Valley, the increase and decrease of the diversity of species is sudden, compared to the peak registered in August. Though, watching the diagram in figure 10, we can notice that for the two stationaries, the cumulated abundance reached low values, compared to the specific diversity. Only in July, at stationary 1 - Berbece's Brook, we registered a significant maximum. The maximum number was lower for the other schist stationary, 2- Popii Valley, which can be explained through the colder micro-climate.

The specific diversity of the Isopoda is emphasized in case of the two stationaries located on schists in Fig. 11. For the stationary Berbece's Brook, we notice a maximum in July.

The cumulated abundance in case of Isopoda had low values for stationary 2, compared to stationary 1, with a maximum in August, which is clearly emphasized (Fig. 12).

We also reached a maximum of the cumulated abundance in August for the stationary 2, but at a much lower level compared to stationary 1, with the micro-climate and the habitat type as possible causes that generated these differences.

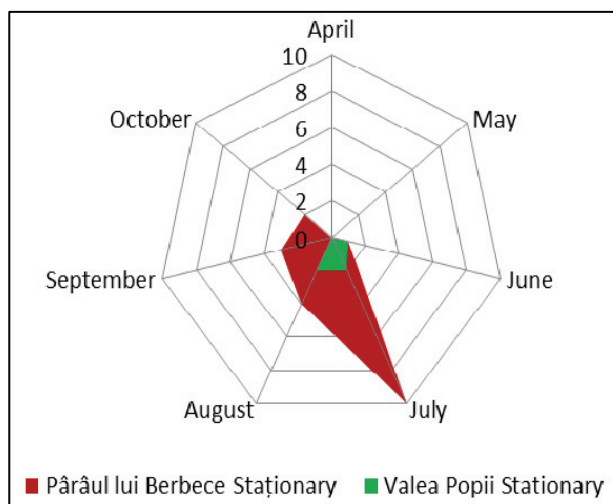


Figure 5. The radar diagram of the diversity of Araneae species from the edaphic soil on stationaries and months.

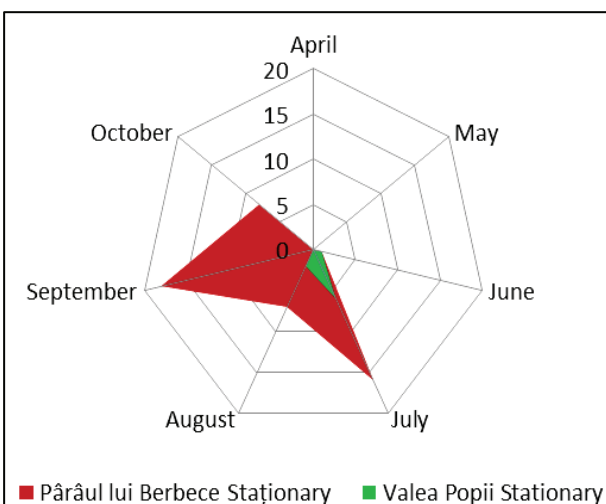


Figure 6. The radar diagram of the cumulated abundance of Araneae species from the edaphic soil on stationaries.

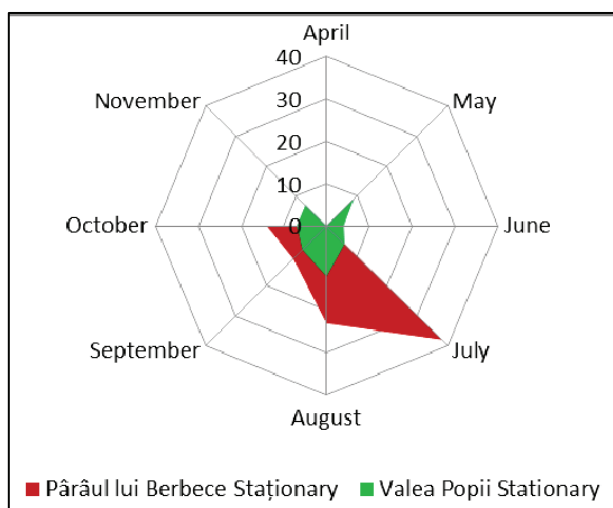


Figure 7. The radar diagram of the diversity of Collembola species from the edaphic soil on stationaries and months.

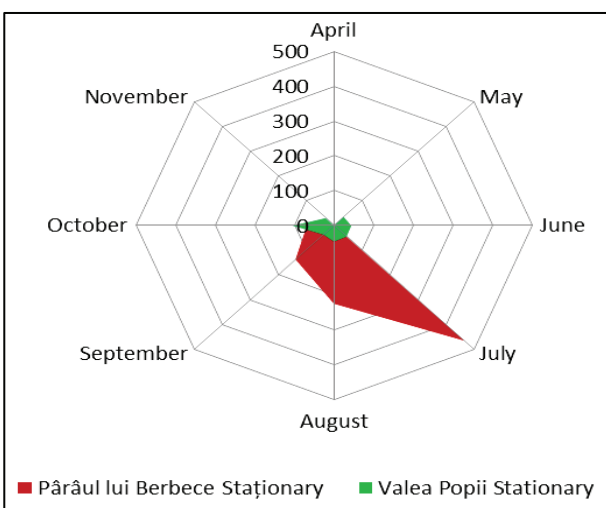


Figure 8. The radar diagram of the cumulated abundance of Collembola species from the edaphic soil on stationaries.

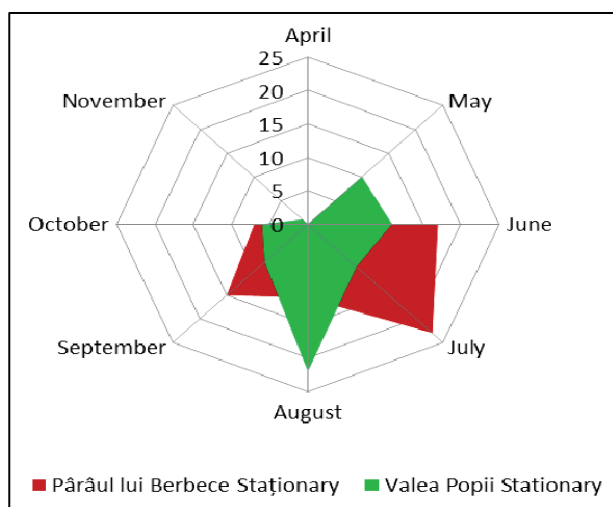


Figure 9. The radar diagram of the diversity of Coleoptera species from the edaphic soil on stationaries and months.

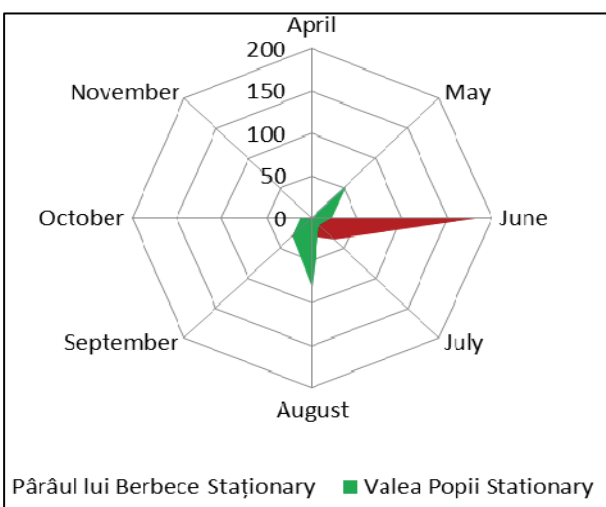


Figure 10. The radar diagram of the cumulated abundance of Coleoptera species from the edaphic soil on stationaries.

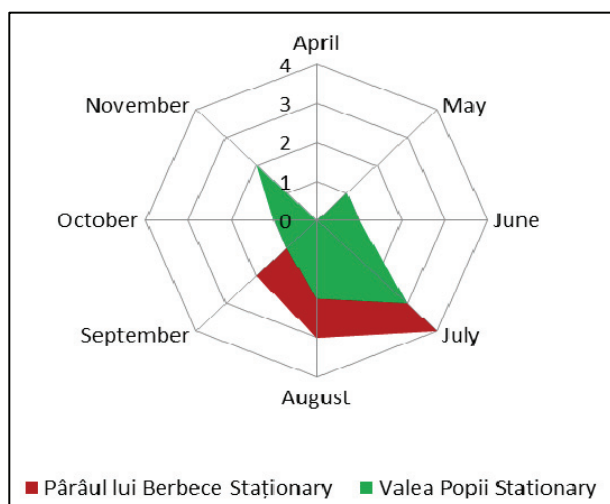


Figure 11. The radar diagram of the diversity of isopod-species from the edaphic soil on stationaries and months.

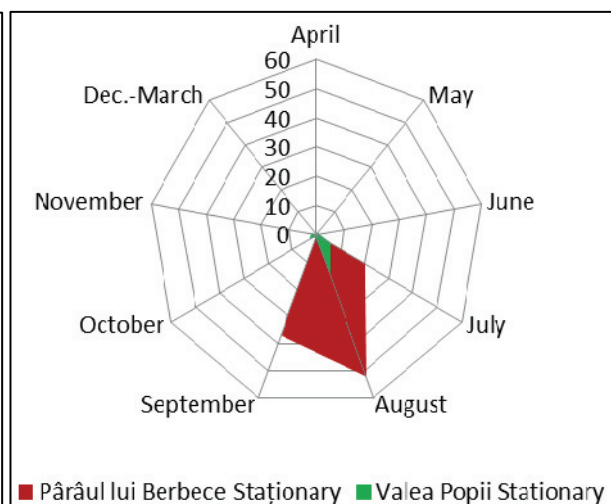


Figure 12. The radar diagram of the cumulated abundance of the isopod species from the edaphic soil on stationaries.

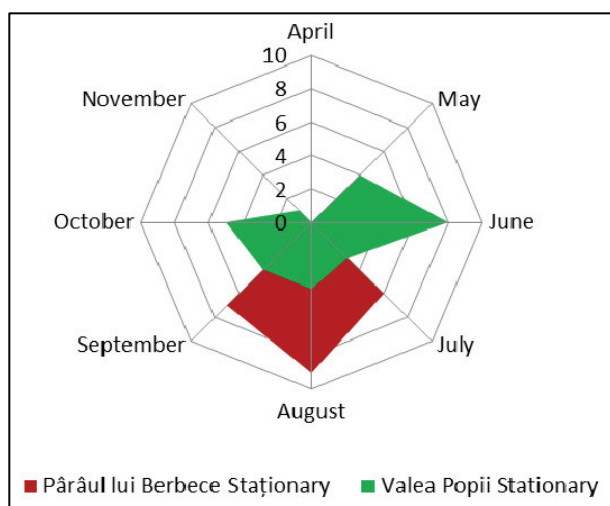


Figure 13. The radar diagram of the diversity of Diplopoda species from the edaphic soil on stationaries and months.

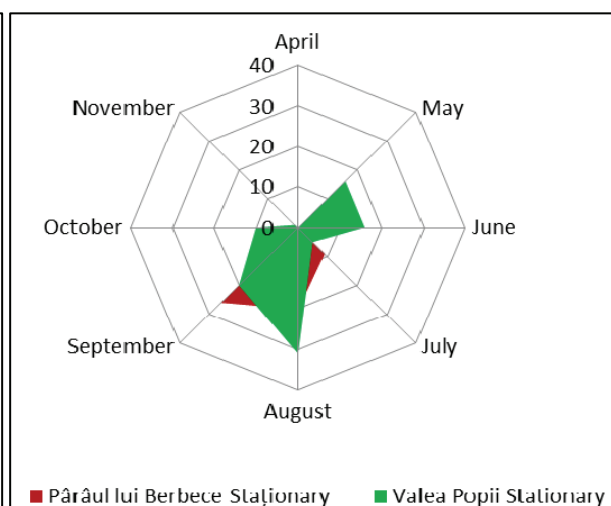


Figure 14. The radar diagram of the cumulated abundance of Diplopoda species from the edaphic soil on stationaries.

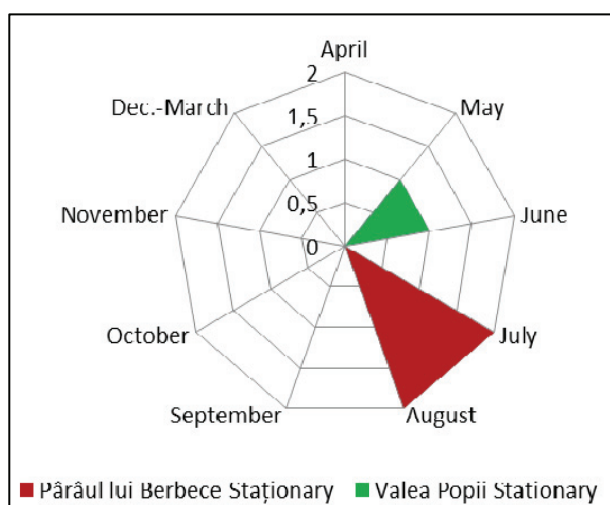


Figure 15. The radar diagram of the diversity of Chilopoda species from the edaphic soil on stationaries and months.

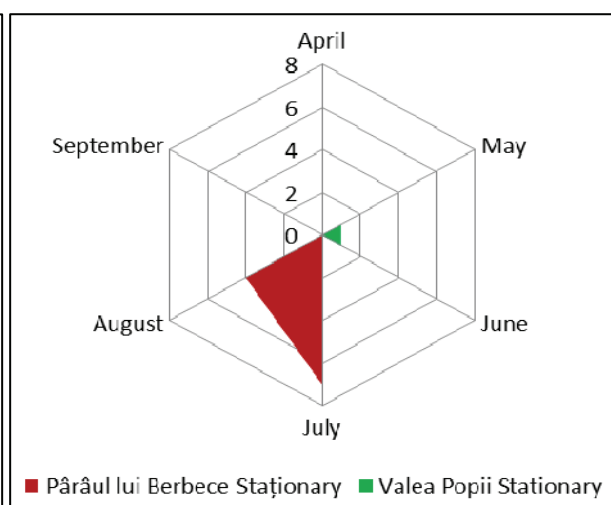


Figure 16. The radar diagram of the cumulated abundance of Chilopoda species from the edaphic soil on stationaries.

By analyzing the radar diagrams in case of Diplopoda (Figs. 13, 14), we notice that, in August, we have the highest number of species in stationary 1 – Berbece's Brook, with a slight decrease in September. What is interesting is the maximum in June in stationary 2 – Popii Valley, followed by a stiff decrease in July and a slight increase in August. As for the cumulated abundance, for stationary 2 – Popii Valley, the maximum number of individuals is in August, and, for the other stationary, Berbece's Brook, barely in September. We link this observation to the fact that, in August, in Berbece's Brook stationary, the average T reached 21.46 °C, significantly higher than 12.64 °C, the average value in Popii Valley stationary.

Chilopoda diagrams (Figs. 15, 16) show a specific diversity and a low abundance for both stationaries. At stationary 1 – Berbece's Brook, we have the highest specific diversity and also cumulated abundance. Regarding the ecologic stationary 3 in Bădeni Valley, this only functioned in July 2015, when we collected fauna elements, in order to explore the area and see if there are any chances of finding new species. Our intuition was confirmed by the fact that, after the determination of the collected fauna material, we identified 3 species we did not meet in the other two stationaries.

CONCLUSIONS

The microclimate is essential for the differentiation of the distribution of the analyzed taxonomic groups; the ecological factor temperature (T) is the most important from this perspective, but the relative humidity also plays a significant role.

Lower values of the average temperature lead to lower values of the specific diversity and also of the cumulated abundance, as well as a gap, a delay of the month when the maximum cumulated abundances is reached.

The habitat type also has a significance regarding the percentage distribution of the taxonomic groups in the stationaries.

Thus, in Popii Valley stationary, Coleoptera represents 47% of the total species, compared to 37%, which was registered in Berbece's Brook stationary, and the distribution of Collembola is the opposite, with only 27% in Popii Valley and 37% in Berbece's Brook, which can be explained by the differences between the average values of the ecologic factors T and RH.

It is a higher potential to discover new species of invertebrates in Leaota Massif, compared to the ones we have already identified.

In order to reach a higher efficiency regarding the collecting of the fauna material, we need combined capturing methods, the Barber traps being less efficient in case of Araneae or Chilopoda.

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