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STUDY ON THE DEW POINT TEMPERATURE IN AREAS COVERED BY COLLUVIAL MESOVOID SHALLOW SUBSTRATUM (CRYSTALLINE SCHISTS SCREE) IN THE LEAOTA MOUNTAINS, 2014

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Abstract
This paper present and discussed the results of the monitoring of the dew point values, recorded in October and November 2014, in an ecological station in the Leaota Mountains. In this station, two polls were located in areas covered by colluvial mesovoid shallow substratum (MSS) formed by epi- and mesometamorphic crystalline schists. In the ecological stations we located in the Leaota Mountains, almost always we found condensation on the walls of the polls tubes placed at different depths. Most often in spring or autumn or in other cold days, the dew point is more revealing regarding the recording actual amount of moisture in the air, than the relative humidity indicator. This work is part of a larger project that seeks correlations between ecological factors (humidity, temperature and dew point) registered in various types of screes (limestone and crystalline schists) and some zoocenotic components (invertebrates). This research aim to know the importance of mesovoid shallow substratum for invertebrates or small vertebrates fauna and represents a premiere for Leaota Mountains, not only regarding the continuous monitoring of some ecologic factors of these types of ecosystems (MSS), rarely researched even at global level, and also regarding the inventory of the invertebrate fauna in scree for these mountains.

Keywords: mesovoid shallow substratum, MSS, shallow subterranean habitat, scree, dew point, Leaota

1. INTRODUCTION

Leaota Mountains are a part of the Bucegi Mountains group, in the Southern Carpathians. Although the surface of the Leaota Mountains, 336 sq km (Murătoreanu, 2009) is lower than the one of other mountains in Romania, their geology and geomorphology is very diverse (Harta geologică a României, 1968). In the north-western part of Leaota Massif, there is frequent slate and limestone scree (Geografia României, 1987), which generates habitats with their own features for a variety of biocenotic components, due to the particularities regarding the ecologic factors which are different depending on the nature of the rock substrate. In speleology, this kind of environment is called mesovoid shallow substratum (MSS) (Juberthie et al., 1980) or shallow subterranean habitat (SSH) (Culver & Pipan, 2014) and its importance comes from the fact that it represent a hideaway for a series of invertebrates and small mammals, and also a stage, an ecological passing way, through which they colonize the deep underground environments (the caves) (Juberthie & Decu, 1994; Ortuño et al., 2013). The paper is part of a wider plan which proposes to analyze the way some ecologic factors in the colluvial mesovoid shallow substratum with different geological substrate

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(limestone or epi- and mezometamorphic crystalline schists) influence the distribution of some biocenotic components in the area of Leaota Mountains.

The value of the dew point (DP) of a mixture of gases, in our case air, is more relevant regarding the quantity of humidity existing in the air, compared to the relative humidity, as, while relative humidity expresses the quantity of stored vapors in the air at a certain time compared to the maximum quantity the air could absorb, the temperature of the dew point represents the temperature at which the air must get cold, to reach saturation and condensation (Ciulache, 2007; http//www.erh.noaa.gov, 2015, http://www.oxfordreference.com, 2015). This paper presents the results of the value of the continuous monitoring of the dew point reported between October and November 2014, in an ecologic stable in the Leaota Mountains. On the walls of the probes installed in the field, we have always nearly found condensed water vapors, as for the paper studies this ecologic parameter.

2. MATERIALS AND METHODS

The monitoring in the field was made in an ecologic stable with four surveys, placed in a scree area consisting of epi- and mezometamorphic crystalline schists (colluvial debris) on the Popii Valley, upstream of the confluence of Popii Brook and Ghimbav River (Fig. 1.a, b), in the north-west part of the Leaota Massif, between Cumpărata Mare Mountain (east) and Albescu Mountain (west). This colluvial debris was generated by mechanical disintegration of the rock walls and it has accumulated gravitational to the slopes. To make a comparison between the collected micro-fauna in the samples and the one in the edaphic environment, and to notice how the micro-fauna migrates between the two ones, the mesovoid shallow substratum and the edaphic one, close to this first stationary of probes, we installed a second ecologic stationary, where we placed 5 Barber traps on the ground, to collect the fauna on the soil level, in the leafs litter. The Barber traps were placed 4 on the top of an imaginary square with 5m sizes and the fifth one in its middle. The distance between the two data-logger probes and the middle of the second stationary was 15 m (Fig.2). We pursued that the placement of the two ecologic stationaries to be close, as the ecologic factors to be identic, the distance between them would not lead to differences regarding the biotic parameters, the geological substrate being thus identic.

In the first ecologic stationary, we installed four surveys, three at 0.5 meters and one at 1 meter depth. We pursued the lack of anthropic influences in the area.

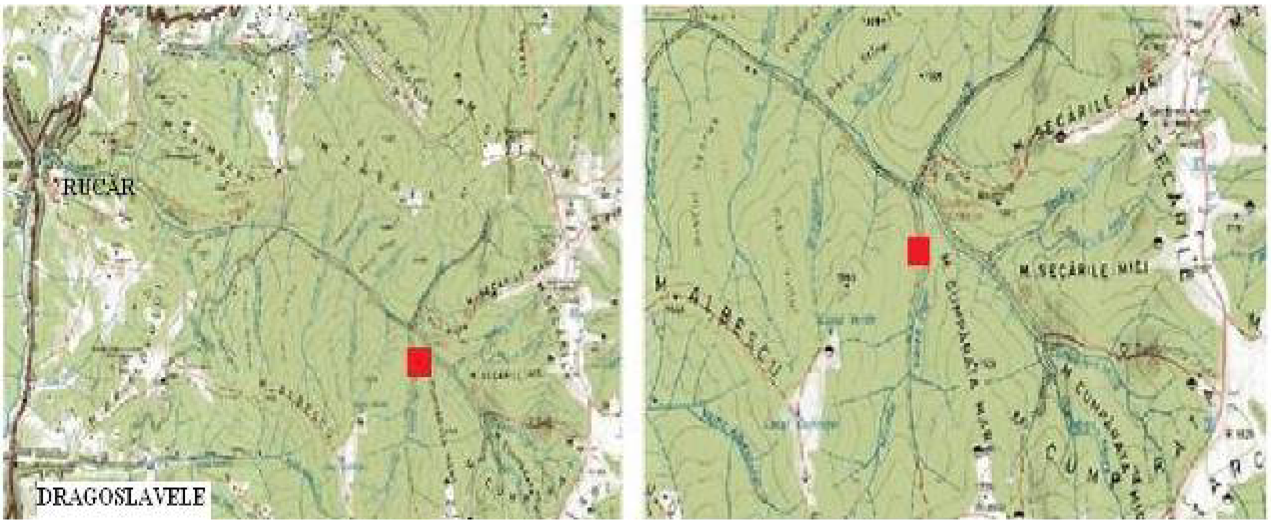

Fig.1. a. Location of ecological stationary (overview); b. Location of ecological stationary (detail)

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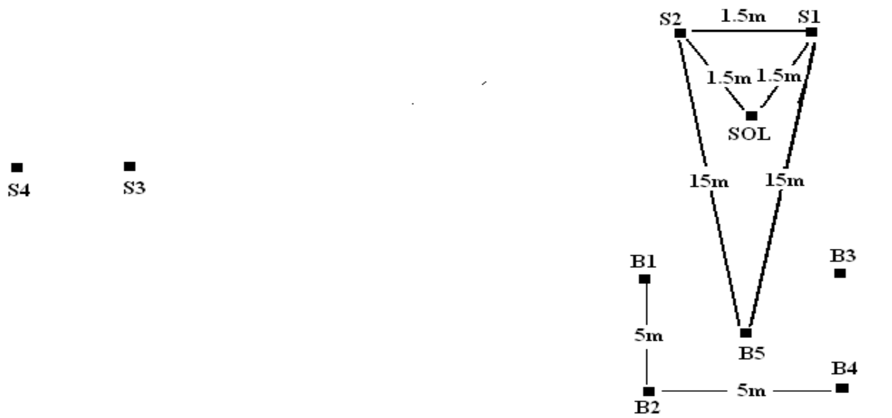

Fig.2. Field arrangement Barber traps. S = survay; B = Barber trap on the ground

The probes were represented by PVC tubes perforated at the bottom (Fig. 3), with ethylene glycol as conserving liquid. On top of the trap glass, in probe 1 and 2 a data-logger was installed hanging on a wire (Fig. 4a, b), which helped the monitoring of three ecologic factors, temperature, relative humidity and the dew point. The devices were set to continuously register, from 2 to 2 hours, the value of the reminded ecologic factors and to memorize it. The tubes were covered so that the micro-climate in the shallow subterranean habitat not to be influenced from the outside. The two probes of 1, respectively 0.5 m, were placed in the scree one near to another (Fig. 5), to observe the way in which the depth influences the value of the abiotic parameters and the distribution of the fauna depending on the depth. On the ground, we installed another data-logger to evaluate the temperature, the relative humidity and the temperature of the dew point on the surface of scree. This data-logger and the openings of sample 1 and 2 form an imaginary equilateral triangle with the size of 1.5m.

The monthly-registered data was downloaded and processed, and the collected fauna was taken to be sorted and identified.

Sample 1 and 2 were placed in empty, mobile scree, the first one at 1m and the second one at 0.5m depth, with the GPS N 45° 21´ 41.6" and E 25° 16´ 38.8 " coordinates, at a height of 1076m.

Samples 3 and 4 were placed in schist scree, fixed on herbal and tree forest vegetation, at a height of 1081 meters, with N 45° 21° 42.4", E 25° 16´ 36.9" coordinates, respectively 1070m and N 45° 21° 45.5", E 25° 16´ 36.1" positioning.

Fig. 3. Placing survey 2; PVC tube with perforated bottom

Fig. 4.a. Data-logger and upper opening of the poll

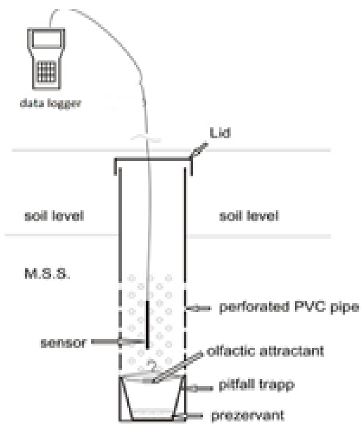

Fig. 4.b. Survey scheme with data-logger (by Nitzu et al., 2010)

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Fig. 5. Location surveys 1 (1m) and 2 (0.5m) in colluvial mesovoid shallow substratum consisting of crystalline schist scree

The discussed monitoring period regarding the probes was in October and November 2014. We considered samples 1 and 2, placed near each other, at a distance of approximately 1.5 meters. Being practically placed in the same place, on the same type of mobile, naked scree (uncovered by vegetation), consisting of epimetamorphic crystalline schist, the value differences regarding the temperature of the dew point between the two samples are the exclusive result of the different depths of the two probes. We can thus make a comparison, noticing the way in which ecologic factor, the dew point, exclusively varies depending on the depth, removing other possible causes that could influence the evaluation, such as the different scree type (covered or uncovered by vegetation, mobile or fixed, different lithology), or different placement of the probes, for example, on slopes with different exposure, closer or further to a river etc; the evaluation of the dew point temperature at the surface of the soil was made by placing a data-logger in the same area at 1.5m from the two probes. Thus, the openings of the two probes and the data-logger on the soil create an equilateral triangle, with a side of 1.5m.

3. RESULTS AND DISCUSSIONS

In sample 1, at 1m depth, for October, the maximum registered value was 8.9^0 C, on 24th, at 00.02, and the minimum value vas reported on 28th, at 09.02, being 1.9^0 C. For November, the maximum value of the dew point temperature was registered on the 8th, at 18.02, being 6.7^0 C, and the minimum was -1.3^0 C, reported on the 25th, at 06.02. The minimum value of the whole studied sample was -1.3^0 C, on the 25th of November 2014, at 06:02, and the maximum value was 8.9^0 C, on October 24th 2014. (Tab.1, Fig. 6)

Table 1.The variation of the dew point temperature

	October 2014			November 2014			October-November 2014		
Depth of the probe (m)	DP_{max} (^{0}C)	DP_{min} (^{0}C)	ΔDP (^{0}C)	DP_{max} (^{0}C)	DP_{min} (^{0}C)	ΔDP (^{0}C)	DP_{max} (^{0}C)	DP_{min} (^{0}C)	ΔDP (^{0}C)
1	8.9	1.9	7	6.7	-1.3	8	8.9	-1.3	11.2
0.5	9.6	2.1	7.5	6.3	- 2.1	8.4	9.6	- 2.1	11.7
0 (on the ground)	11.1	0.7	9.4	9.4	- 1.4	10.8	11.1	- 1.4	12,5

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In sample 2, at 0.5m depth, the maximum value of the dew point temperature for October was 9.6^{0} C, on the 16th of October, at 17:02, and the minimum value was 2.1^{0} C, registered on the 28th of October, successively at 7:02, 9:02 and 11:02. (Tab.1, Fig. 7)

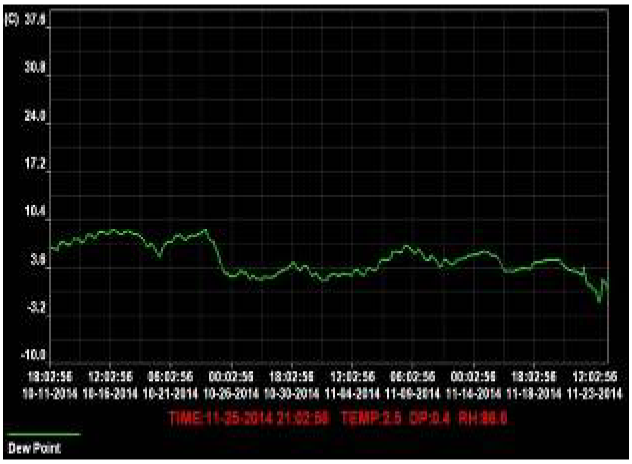

Fig.6. The variation of the dew point temperature, survey 1 (1m)

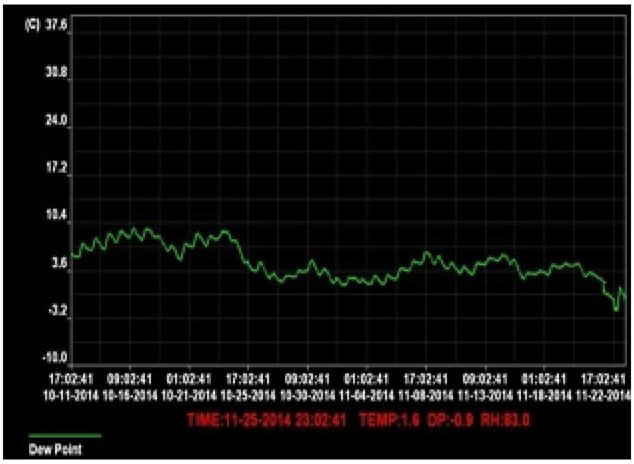

Fig.7. The variation of the dew point temperature, survey 2 (0.5m)

For November, the maximum value of the dew point ecologic factor was 6.3^{0} C, on 8th, at 17:02, and the minimum was -2.1^{0} C, registered on the 25th, at 07:02. For the whole monitoring period, the maximum value of the abiotic studied parameter concurs with the maximum value in October (9.6^{0} C), and the minimum value is the same as the one in November (-2.1^{0} C).

As for the situation at the surface of the soil, for October, the maximum temperature of the dew point was 11.1^{0} C, reported at 15:48 on the 16th, and the minimum value was 0.7^{0} C, reported on the 28th of the month, at 02:48. (Tab.1, Fig. 8)

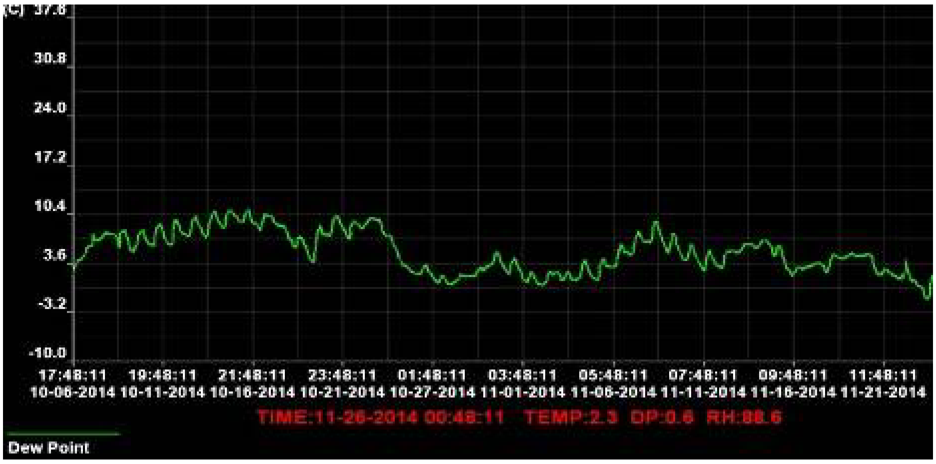

Fig.8. The variation of the dew point temperature, soil level (0m)

In November, the minimum temperature of the dew point was - 1.4^{0} C, registered on the 25th of the month, at 08:48, and the maximum value was reached on the 8th of the month, at 15:48, as being 9.4^{0} C. We conclude that, for the whole period, at the level of the soil, the maximum value of the dew point abiotic parameter has also concurred to the value in October (11.1^{0} C), and the minimum concurred to the one in November (-1.4^{0} C).

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4. CONCLUSIONS

The maximum temperature of the dew point slightly decreases from the ground level to the depth of the scree for every month (for October: $DP_{max}0m = 11.1^0$ C; $DP_{max}0.5m = 9.6^0$ C; $DP_{max}1m = 8.9^0$ C; for November: $DP_{max}0m = 9.4^0$ C; $DP_{max}0.5m = 6.3^0$ C; $DP_{max}1m = 6.7^0$ C).

At the same time with the growth of the depth, the variation of the dew point temperature (ΔDP) is lower (for October: $\Delta DP_{0m} = 9.4^o$ C; $\Delta DP_{0.5m} = 7.5^o$ C; $\Delta DP_{1m} = 7^o$ C; for November: $\Delta DP_{0m} = 10.8^o$ C; $\Delta DP_{0.5m} = 8.4^o$ C; $\Delta DP_{1m} = 8^o$ C).

The difference between the maximum and minimum of the dew point temperature (ΔDP) increases in November compared to October regardless of depth (ΔDP_{0m} for October = 9.4º C; ΔDP_{0m} for November = 10.8º C; $\Delta DP_{0.5m}$ for October = 7.5º C; $\Delta DP_{0.5m}$ for November = 8.4º C; ΔDP_{1m} for October = 7º C; ΔDP_{1m} for November = 8º C).

Almost always, irrespective of the depth, the existing air between clasts in this shallow subterranean habitat consisting of crystalline schist scree is close to saturation in water vapors (in many cases, relative humidity reached 100%, value at which the dew point temperature is the same with the one of the air), or even at saturation. This explains the formation of condensed water, which is a feature that we've frequently met on the field, condensed water being noticed not only on the walls of the PVC tubes in the probes, when the collection of the Barber traps content was made, but also on the screeclasts, starting from approximately 20 cm depth. Increased and constant humidity in this shallow subterranean habitat consisting of crystalline schist scree creates the needed condition for the setting of a diversified invertebrate fauna.

The results in this paper will be correlated to the ones reached in 2015 in the same ecologic stationary, and with the results of the monitoring also carried in the north-west of Leaota Mountains, in other ecologic stationaries with limestone substrate (three ecologic stationaries with samples placed on the Cheii, Rudăriței and Ghimbav Valleys and in three other stationaries with Barber traps placed on the ground, in the same areas).

On medium term, these researches propose to comparatively analyze the areas covered by mesovoid shallow substratum in the contact zone of Leaota Mountain and Piatra Craiului Mountains (much better researched) which are split by the Rucăr-Bran Corridor. The placement of the ecological stations in the north-western side of Leaota Massif is justified by the fact that this is the contact area between them and the neighboring mountains, Piatra Craiului. We will thus follow the distribution and migration of the microfauna between the two massifs, the way in which the strong human intervention of the Rucăr-Bran Corridor influences the spreading of biocenotic components and the way in which the MSS contributes to the keeping of a microfauna biodiversity, itself representing a permanent location of it or functioning just as an intermediary ecologic relay.

5. ACKNOWLEDGEMENTS

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