

STUDY ON THE DEW POINT TEMPERATURE IN AREAS WITH SUPERFICIAL LIMESTONE UNDERGROUND ENVIRONMENT (SCREE) IN THE GHIMBAV AREA, LEAOTA MOUNTAINS, 2014

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Abstract

The dew point of a mixture of a gas (air) and the water vapors represents the temperature at which the cold air becomes saturated in water vapors and they condensate. Sometimes, especially in colder periods, it is more revealing regarding the water quantity in the air as vapors, than the relative humidity indicator. The field observations have shown that, always, in the surveys in the ecologic stationaries I have installed in limestone scree in Leaota Massive, condense is formed on the walls of the PVC tubes, irrespective of the season. The continuous measuring, for a period of several months, of more abiotic parameters, amongst which the temperature of the dew point was carried out with dataloggers, which were installed at different depths in limestone scree. This type of continuous monitoring of abiotic parameters at different scree depths is a premiere for Leaota and even is a first for Romania.

Keywords: dew point, limestone scree, datalogger, Leaota

1. INTRODUCTION

Leaota Mountains are a part of the Bucegi Mountains group, in the Southern Carpathians, next to Piatra Craiului Mountains (Figure 1). From the administrative perspective, Leaota Mountains are spread on Argeș, Brașov and Dâmbovița counties. The surface of Leaota Massive is 336 km² (Murătoreanu, 2009). Though its surface is little, the geology of the massive is diverse, being represented by limestone, crystalline sericite chlorite schist, phyllites, chemical degradation clays, quartiles, detrital sedimentary rocks (Mutihac și Mutihac, 2010). In areas in the central, northern or north-eastern parts metablastic migmatites prevail, and granitic rocks are rarely met (Harta geologică a României, 1968). In the abruptions, limestones and also epimetamorphic crystalline schist are the mostly met (Murătoreanu, 2007). From the geomorphologic perspective, the interaction between the rocks and the disintegration or erosional external agents or the ones the acts in a chemical or biochemical manner have led, where the abruptions exist, to the development of scree. We frequently meet in the Leaota Massive schist or limestone scree, which generate living environments with own features for a wide range of biogenetic components. This is due to the particularities regarding the ecologic factors that are different depending on the nature of the petrology substrate.

The paper is a part of a wider plan which is to analyze the way through which the abiotic ecological parameters influence the distribution of some biogenetic components in the area of Leaota Mountains.

2. MATERIALS AND METHODS

To reach the proposed objectives, I've placed ecologic stationaries, both in areas with limestone scree and in areas with crystalline schist scree.

Regarding the limestone scree, one of the chosen areas for monitoring is located in the Ghimbav Mountain in Leaota Massive (Figure 2), on its southern slope, next to the entrance to the Ghimbav Keys. In this ecologic stationary, I have placed three surveys in limestone scree, at depths of 1 m (survey 1), 0.75 m, (survey 2) and 0.5 m (survey 3). Survey 1 was placed in semi-grassed scree, at an altitude of 883 meters, survey 2 in bare scree, at a height of 879 meters, and sample 3 was placed in the forest that covered the basis of the scree, at an altitude of 860 meters.



Figure 1. Leaota mountains location (www.hartaturistului.com)



Figure 2. Mt Ghimbav (Popescu, Călin, 1991); the site of surveys (marked as red rectangle)

The samples were made of PVC tubes, with an internal diameter of 8 cm, perforated at the lower part on the whole area of the tube, on a width of 15 cm, starting from 10 cm from the lower basis of the tube. In each survey, I introduced a Barber trap to collect the invertebrate fauna. The trap consists of a 10 cm height plastic recipient (glass), with an 8 cm upper diameter, in which I put conservative featured liquid (ethylene glycol or ethyl alcohol) and a weak alimentary attractant. On the top of each trap I hung using a clothing or nylon wire a datalogger, to measure the temperature, the relative humidity and the dew point. Data processing was continuously made during August 16th 2014 and November 26th 2014 (and until November 28th for survey 1), from hour to hour, or from 2 to 2 hours, during the whole period. The captured fauna elements in the Barber traps were collected monthly. Thus, I tried to make a correlation between the distribution of some species and the variation of these ecologic parameters, which, in turn, vary depending on the lithological features of the superficial underground environment. In this paper, I analyzed the variation of the dew point temperature in the surveys.

This dew point of a mixture of a gas (air) and water vapors represents the temperature at which the cold air becomes saturated in the water vapors and they condense (www.oxfordreference.com). The temperature of the dew point can always be lower to the temperature of the air (Ciulache, 2004). When the relative humidity of the air (another abiotic parameter) is 100%, the temperature of the dew point is equal to the air temperature (www.erh.noaa.gov). While relative humidity is (as its name suggests) a relative measure of the water volume as vapors, the dew point temperature is an absolute measure and shows the water volume in the air (Ciulache, 2007). In the placed surveys, I have very frequently noticed condensation on the PVC tubes; from this perspective, the dew point

parameter is more relevant regarding the study of the water vapors volume in the air in the superficial underground environment.

3. RESULTS AND DISCUSSIONS

In the first monitoring period, August 16th – September 6th 2014, the registered results were (Figures 3 -5, Table 1):

For survey 1, at 1m depth, I registered the maximum value of the dew point of 12.7°C, on August 25th, at 2.15 am; values over 12°C were also registered at 16.08 p.m., 11.45 p.m. - 17.08 p.m. 10.15 p.m., 23.08, 9.15 p.m. - 08.25, 9.15 a.m. The minimal registered value was 10°C, on August 29th, 2.15 p.m.

In the case of survey 2, at 0.75m depth, the maximum value was 16.5°C, on August 17th, at 15 a.m. Similar values, between 16°C and 16.2°C were also registered between August 23th 4.34 a.m. – August 24th 6.34 a.m. The minimum value was 12,6°C on August 08th, between 10.34 a.m. and 12.34 a.m.

In the case of survey 3, at 0.5 m depth this parameter reached the maximum value on August 24th, of 13.9°C, at 6.52 a.m. and the minimum value of 12°C on August 18th between 9.52 a.m. and 12.52 a.m.

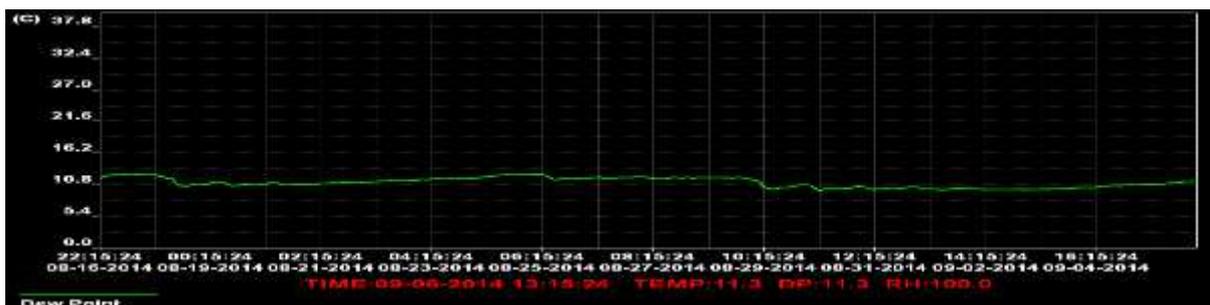


Figure 3. The variation of the dew point temperature, survey 1 (1m), August 16th – September 6th 2014

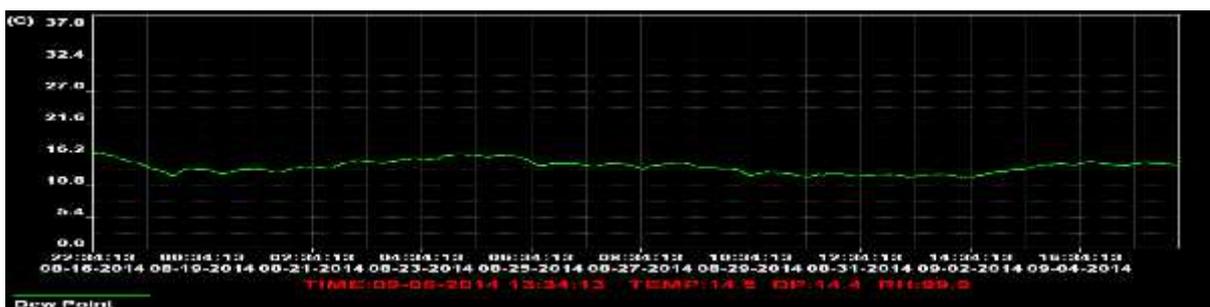


Figure 4. Variation of dew point temperature, survey 2 (0.75 m, August 16th – September 6th 2014

In the second period, for the September 6th – October 5th period, the dew point temperature varied as follows (Figures 6 - 8, Table 1):

In survey 1, the maximum value was 11,4°C on September 7th, 2.49 a.m. and the minimum value was 4°C, registered twice, on September 25th, 2.49 p.m. and on October 5th, 12.49 p.m.;

In survey 2, dew point reached the maximum at 14,6°C, on September 20th, 1.13 p.m., and the minimum of 7,1°C was registered on September 25th, 11.14 a.m. We also observe a general

decreasing trend during the period, with a single exception, between 09.20 and 09.23, when the trend is reversed and a visible growth materializes;

In survey 3, the maximum was on 09.07th, 2.37 a.m. and on 09.09th at 3.27 a.m., reaching 13.2°C and the minimum value was 8°C on 09.25th, at 9.27 a.m. and 11.27 a.m.



Figure 5. Variation of the dew point temperature, survey 3 (0.5m) August 16th – September 6th 2014

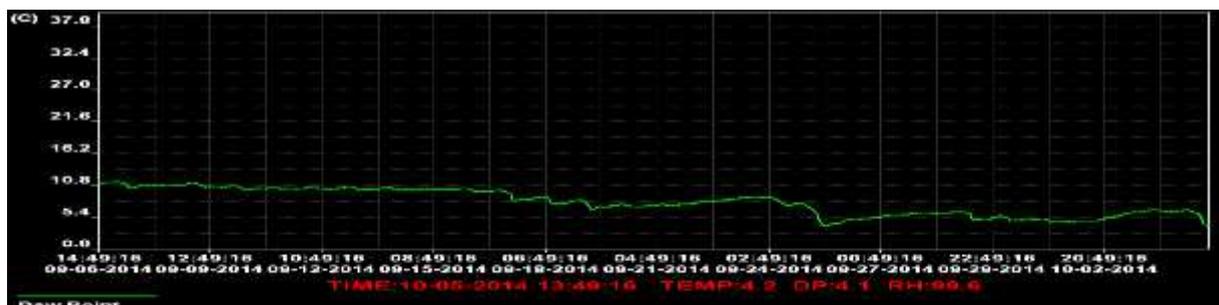


Figure 6. Variation of the dew point temperature, survey 1 (1m), September 6th – October 5th 2014

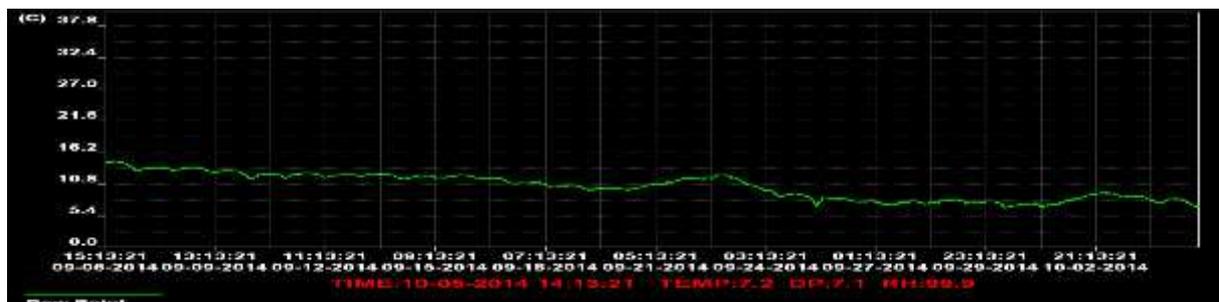


Figure 7. Variation of the dew point temperature, survey 2 (0.75m) September 6th – October 10th 2014

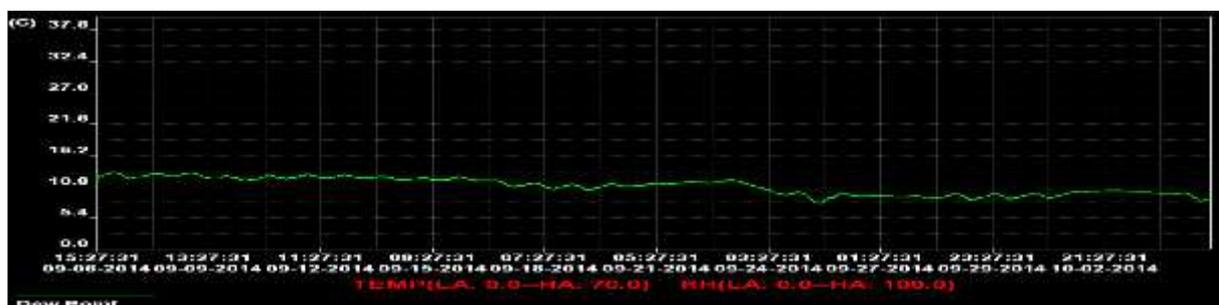


Figure 8. Variation of the dew point temperature, survey 3 (0.5m), September 6th – October 5th 2014

On the third period (Figures 9 - 11, Table 1), the maximum registered value was 7.7°C on 10.19th, at 1.44 a.m. This value was preceded and succeeded by almost similar one, of 7.6°C , registered between 10.18th, 5.44 a.m. – 10.19th, 11.44 a.m., the 10.19th, 5.44 a.m. - 9.44 a.m. The lower value was 2.7°C on 11.27th between 9 a.m. and 1.44 p.m. (Values registered on 11.7th, on 3.44 p.m. for the temperature, relative humidity and the dew point were wrong, probably the sensors were influenced by water condensation, sweat, the water got to the datalogger, the relative humidity reached 100%; at the same time, the measured temperature was -40°C , which confirms deflection device).

In survey 2, we notice that the maximum dew point temperature was registered on October 10th, at 4.08 p.m., with the value of 10.4°C , and the minimum value was 2.3°C , registered on November 4, at 10.08 p.m.

Finally, in survey 3, observations showed that the maximum was on October 23rd, with the value of 10.3°C , and the minimum was -1.8°C , on October 22nd, 2.50 p.m.



Figure 9. Variation of the dew point temperature, survey 1 (1m), October 5th - November 28th 2014



Figure 10. Variation of the dew point point temperature, survey 2 (0.75m), October 5th - November 25th 2014



Figure 11. Variation of the dew point temperature, survey 3 (0.5m), October 5th – November 25th 2014

The cumulative analysis of the registered value (Table 2), on the whole August 16th – November 25th 2014 period shows the following facts:

The maximum temperature of the dew point at 1m depth was 12.7°C and the minimum temperature was 2.7°C, leading to a difference in the dew point temperature of $\Delta DP_{1m} = 10^\circ\text{C}$.

The maximum temperature of the dew point at 0.75m depth was 16.5°C and the minimum temperature was 2.3°C, leading to a difference in the dew point temperature of $\Delta DP_{0.75m} = 14.2^\circ\text{C}$.

The maximum temperature of the dew point at 0,5m depth was 13.9°C and the minimum temperature was -1.8°C, leading to a difference in the dew point temperature of $\Delta DP_{0.5m} = 15.7^\circ\text{C}$.

Table 1. The minimum and maximum dew point temperature in the three periods

August 16 th -September 6 th 2014				September 6 th - October 5 th 2014			October 5 th – November 25 th 2014		
depth survey (m)	DP _{max} (°C)	DP _{min} (°C)	ΔDP (°C)	DP _{max} (°C)	DP _{min} (°C)	ΔDP (°C)	DP _{max} (°C)	DP _{min} (°C)	ΔDP (°C)
1	12.7	10	2.7	11.4	4	7.4	7.7	2.7	5
0.75	16.5	12.6	3.9	14.6	7.1	7.5	10.4	2.3	8.1
0.5	13.9	12	1.9	13.2	8	5.2	10.3	-1.8	12.1

Table 2. The minimum and maximum dew point temperature in cumulative periods

August 16 th - November 25 th 2014			
depth survey (m)	DP _{max} (°C)	DP _{min} (°C)	DPΔ (°C)
1	12.7	2.7	10
0.75	16.5	2.3	14.2
0.5	13.9	-1.8	15.7

4. CONCLUSIONS

From the monitoring and registrations made during August 16th and November 25th 2014 in the ecologic stationary installed in Ghimbav, we can conclude that the variation of the dew point temperature slightly decreases at the same time with the increase in the depth of the surveys;

$\Delta DP_{1m} < \Delta DP_{0.75m} < \Delta DP_{0.5m}$; the difference between the variation of the dew point at 1m depth and the one at 0.75m depth is $\Delta DP_{0.75m} - \Delta DP_{1m} = 4.2^\circ\text{C}$; the difference between the variation of the dew point at 0.75 m depth and the variation at 0.5m depth is $\Delta DP_{0.5m} - \Delta DP_{0.75m} = 1.5^\circ\text{C}$.

The highest values of the temperature at which condense is produced, respectively the dew point were registered in the summer, and the lowest in the winter, which is a normal thing, considering that, as low as the air temperature is, the the temperature the vapors in the air become saturated gets lower, namely the temperature at which condense is produced.

Of the values registered in table 1 we can see that, for the same periods, the maximum values of the dew point temperature were registered at 0.75m depth: 16.5°C, respectively 14.6°C and 10.4°C. As for the minimum values of the same parameter, they were measured twice at 1m depth during the

first two time periods: 10°C, respectively 4°C, but the minimum value of was –1.8°C, registered in the third monitoring period at 0.5 m depth.

All of the above show that approximately always, irrespective of the depth, in the limestone scree, we either find air which is saturated in water vapors (in most cases, the relative humidity reached nearly 100%, the value at which the temperature of the dew point is the same with the one of the air), or close to saturation: this was confirmed by the fact that, when the Barber traps were monthly collected from the surveys and the data was registered by the dataloggers, condense has been always noticed on the PVC tube, which sometimes raised issues by affecting the registration sensors.

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