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THE VARIATION OF SOME MAIN ECOLOGICAL FACTORS (TEMPERATURE AND RELATIVE HUMIDITY) ON LIMESTONE SCREE SURFACES, GHIMBAV MOUNTAIN, SOUTHERN CARPATHIANS (ROMANIA)

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Key words: *scree, MSS, mesovoid shallow substratum, ecological factors, temperature, relative humidity*

I NTRODUCTION

This paper present all the results reached subsequently to the continuous monitoring of the main ecological factors of temperature (T) and relative humidity (RH) on a period of five months (April – August 2015) in an area with limestone scree, in Ghimbav Mountain, Leaota, Southern Carpathians, Romania. These studies represents only a small part of some wide researches made in more areas and which haven't limited themselves only to the analysis of these ecological factors, but also to the study of the connection between them and the type of geologic substratum, as well as the way all of them influence the distribution and spreading of various microfauna components in or on scree (MSS). This These results are a novelty for Romania, due to the fact that the monitoring of the mentioned environmental factors were continuous, permanent, the sampling of their values was made every two hours during five months. For this reason the values are relevant, random measurements, only from time to time, fail to accurately show the real situation of the variation T and RH values.

MATERIALS AND METHODS

The scree is a very interesting living environment. It has larger or smaller interclastic spaces (Dorobăț, 2016; Dorobat *et al.,* 2017a, b; 2018; Dorobăț & Dobrescu, 2019). The size of these spaces depends on their lithological composition. These spaces facilitate the permanent or temporary installation in the grooves of zoocenotic components (invertebrates and, more rarely, micro mammals). The screes are characterized by particularities of the main ecological factors, temperature and relative humidity. All these particularities have led to the individualization of many screes as a special, very interesting habitat; Nitzu *et al*. (2014) explain which the speleologists called mesovoid shallow substratum (MSS). Moreover, this type of screes communicates, they are connected with the external environment (edaphic environment) but also, through deep cracks with the deep underground environment (the caves). For this reason, the ecological function of the MSS is very important; these screes are used by some species only temporarily, either for shelter, when outside climatic conditions are difficult (for example, drought or high temperature) or only in some stages of life, or are used to migrate. Other species live permanently in the MSS. that is why we chose to focus our attention on the variation of the values of the main environmental factors, T and RH, in order to understand the way they influence, condition the distribution of the invertebrates or even micro mammals.

We have chosen a scree surface for research purposes, areas which are not perturbed, influenced by human activity.

And we maintained this principle in this case too. We found a natural limestone scree, locate at the basis of a Ghimbav Mountain slope, southern exposure (Fig. 1) on the right bank of the river with the same name, in Leaota Mountains. This limestone area represents a continuation of the limestone from the neighboring area, from the Dâmbovicioara Valley, the area of the Piatra Craiului Mts. (Mutihac, 1990; Mutihac & Mutihac, 2010).

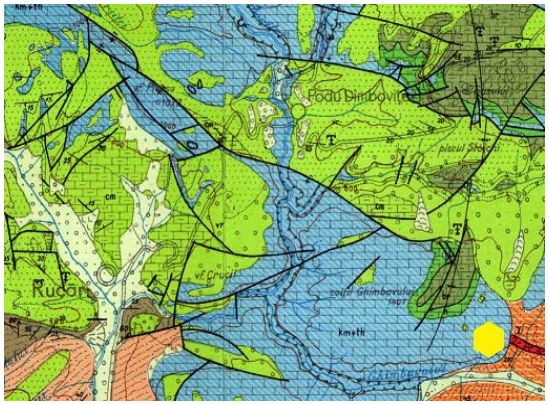

Fig. 1. Geological map of the Leaota Mts. (fragment) (after IGR, 1971).
In blue are shown the limestone areas

The central point of this surface is provided by the GPS coordinates N 45^0 22´ 42.9" E; 25° 13´ 55.2", 820 meters altitude. The scree was approximately lacking vegetation, being almost nude, mobile. The predominant size of the clasts is 10 - 20 cm, but there are some hillocks too, as well as minimal size clasts (Fig. 2). Due to the fact that we noticed fauna elements on the surface of the soil during the draughty days with high temperatures at the level of the soil, we placed a data logger on the soil, in order to make an accurate analysis of the temperature and the relative humidity at the level of the soil. The device has been set to collect the data from two to two hours, continuously, day and night, for 5 months. It has been placed next to larger rocks, making it less visible. The data logger type was DT 171.

Fig. 2 Limestone clasts in the scree

RESULTS AND DISCUSSIONS

Subsequently to the constant and continuous monitoring process (excepting June 07-16th, when, due to the defection of the initial data-logger, a new data logger was set), we reached the following sets of raw data (Fig. 3).

Right from the beginning, one can notice a quite different aspect of the daily variation of the ecological factors; this is due to the fact that we firstly set the data logger in the middle of the scree, amongst rocks that were exposed to the sunbeams (Fig. 3.). For the second and the third set of recordings, May 18th – June 6th, respectively June 17th – July 5th 2015, we placed the data logger at the basis of a larger stone, in order to hide it better. We noticed that the graphic display of recordings (Fig. 4 and 5) was changed reported to the first set of recordings, to the extent in which the daily variation of the ecological factors do not present such significant amplitude. This is also explained by the fact that the basis of the rock where we placed the data-logger was shadowed, thus the daily variation of the temperature and the relative humidity was less significant. In order to verify if this is the real reason, we replaced the device for the last recording period, July 5th – August 20th 2015 (Fig. 6) again in the middle of the scree, under clasts that were totally exposed to sun. Once again, we had a high daily variation of the above mentioned ecological factors. The daily amplitude of these ecological factors is even higher in the case of the last period, July – August, compared to the April 8th – May 18th 2015 period, as we are straight in the middle of the summer and the daily temperature at the surface of the scree is higher, causing the decrease of the relative humidity.

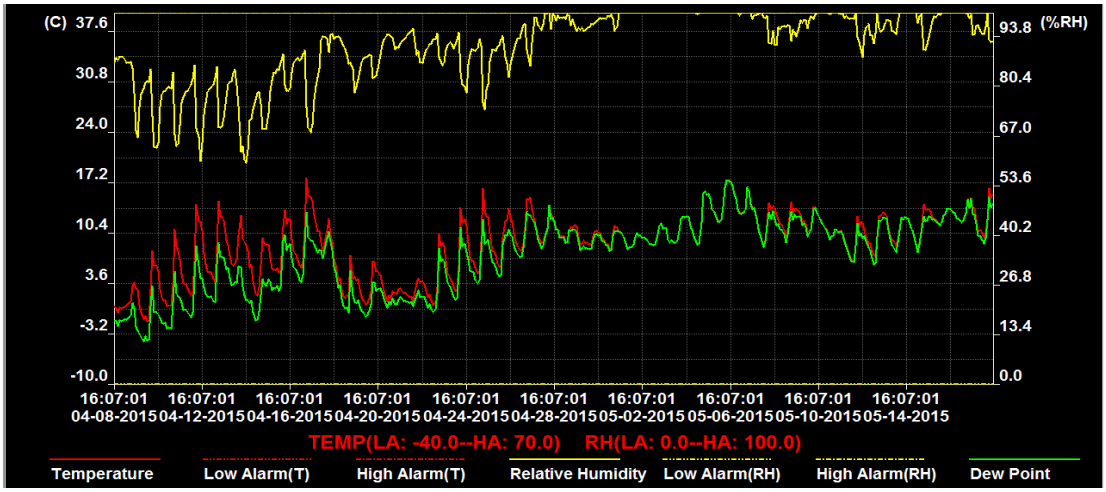

Fig. 3. The variation of temperature (T), of the relative humidity (RH) and of the dew point temperature (DP) between April 8th – May 18th 2015

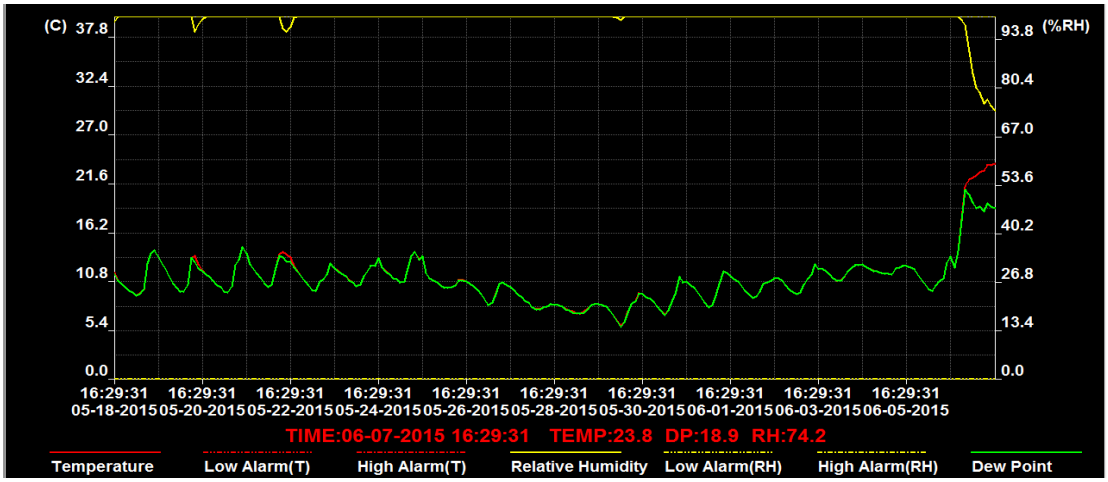

Fig. 4. The variation of temperature (T), of the relative humidity (RH) and of the dew point temperature (DP) between May 18th – June 6th 2015

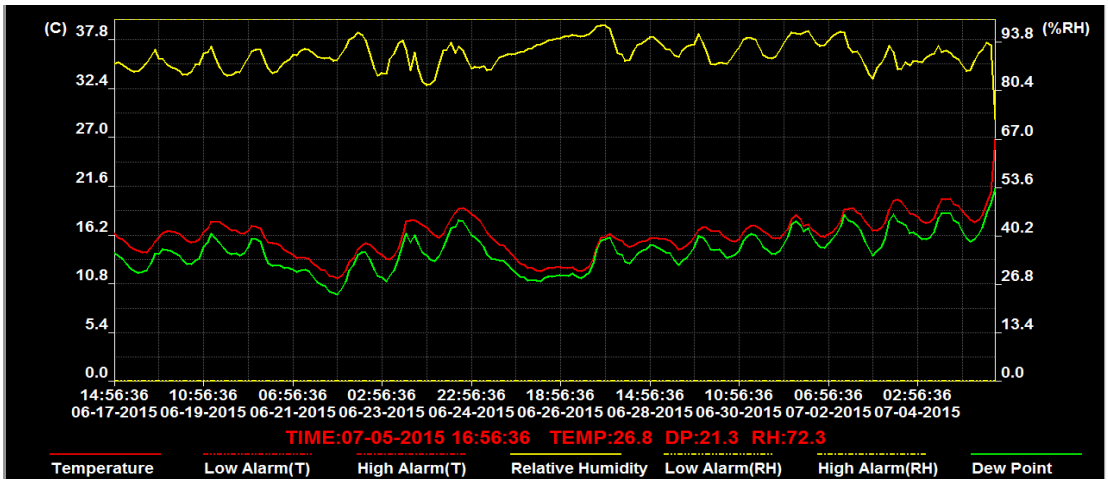

Fig. 5. The variation of temperature (T), of the relative humidity (RH) and of the dew point temperature (DP) between June 17th – July 5th 2015

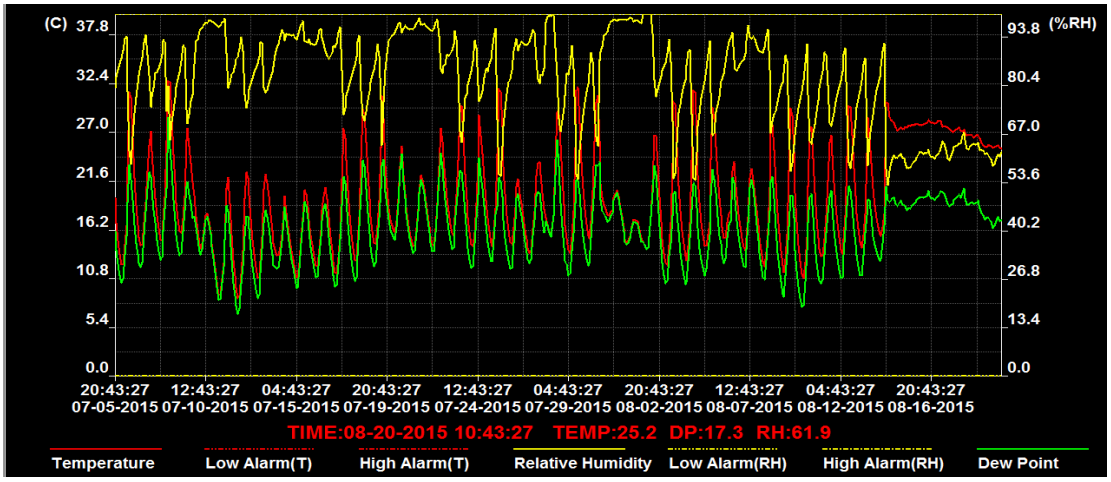

Fig. 6. The variation of temperature (T), of the relative humidity (RH) and of the dew point temperature (DP) between July 5th – August 20th 2015

Right from the beginning, one can notice a quite different aspect of the daily variation of the ecological factors; this is due to the fact that we firstly set the data logger in the middle of the scree, amongst rocks that were exposed to the sunbeams (Fig. 3.). For the second and the third set of recordings, May 18th – June 6th, respectively June 17th – July 5th 2015, we placed the data logger at the basis of a larger stone, in order to hide it better. We noticed that the graphic display of recordings (Fig. 4 and 5) was changed reported to the first set of recordings, to the extent in which the daily variation of the ecological factors do not present such significant amplitude. This is also explained by the fact that the basis of the rock where we placed the data-logger was shadowed, thus the daily variation of the temperature and the relative humidity was less significant. In order to verify if this is the real reason, we replaced the device for the last recording period, July 5th – August 20th 2015 (Fig. 6) again in the middle of the scree, under clasts that were totally exposed to sun; once again, we had a high daily variation of the above mentioned ecological factors. The daily amplitude of these ecological factors is even higher in the case of the last period, July – August, compared to the April 8th – May 18th 2015 period, as we are straight in the middle of the summer and the daily temperature at the surface of the scree is higher, causing the decrease of the relative humidity.

As for the recordings taken in scree that was completely exposed to the sun, the period in which daytime temperatures reached the highest values is, nearly with no exception, July 5th – August 20th 2015, at 14:43 or 16:43 (data logger was set to record from two to two hours). Minimal temperatures are recorded at 4:43 and, rarely at 6:43 in the morning. We might expect that, as soon as the sun sets, to have lower temperatures, but the scree has a thermic inertia, which is why its complete cooling happens late in the night, towards next morning. As for the ecological parameter of RH, it reaches maximum values at 10:43 generally, rarely at 12:43 and even more rare, at 8:43. Very fast, as the sun exposed rocks are heated (the southern exposure of the scree), the relative humidity lowers drastically, with minimum values at 14:43 almost most of the time.

Also, the graphics in Fig. 3, associated to the recordings from April 8th – May 18th 2015, made in the same point, the maximum values of the temperature are usually between 10:07 – 14:07, rarely 16:07, the minimum temperatures are recorded most frequently at 4:07, rarely at 2:07 or later, at 6:07. If we take a look at the graphics in the two recordings (Fig. 4 and 5) taken in a more protected place, at the basis of the stone in the scree, between May 18th – June 6th; June 17th – July 5th, we see that the daytime amplitudes of the T and RH factors are lower, but, during the same periods, like during previous cases, we have recorded maximum, respectively minimum temperatures; namely, for the temperature, maximum values are reached between 10:56 - 14:56, sometimes 16:56. Minimum values of the T between 2:56 - 6:56, especially at 4:56 (Fig. 5). Looking on Fig. 4, as well, the minimum temperature values are reached at the first hours of the morning, at 4:29 (rarely 2:29 or 6:29, and the maximum values are reported in the afternoon, at 14:29 or at noon, at 12:29. For the period between May 18th and June 6th, it is interesting to notice that the value of the RH factor is mostly the one of the absolute maxim, 100%. This is somehow normal, if we analyze what happened in that period in the field. At the basis of the rock, humidity reached high values, meanwhile we had plants growing in there, as it was shadowed for long periods and the wet soil generated condensation, moistening the humidity sensor of the data-logger. (Fig. 7)

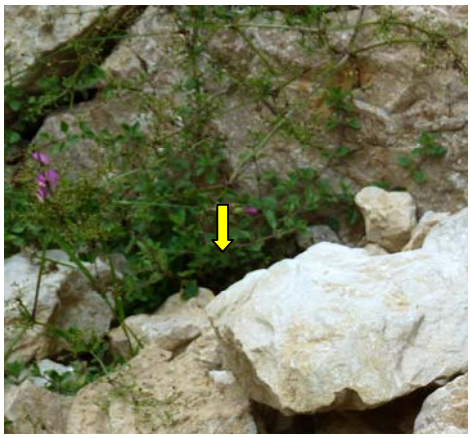

Fig. 7. The place where the device was installed

We have also verified the value of the dew point temperature parameter in order to confirm the accuracy of the recordings of some RH values of 100% for long periods of time.

The value of the dew point temperature (DP) in the air is more relevant regarding the humidity volume in the air, reported to the relative humidity, as, while the relative humidity represents the vapors' volume stocked in the air at a certain moment, reported to the maximum volume that the air could absorb, the dew point temperature represents the temperature to which the air must get cold in order to reach saturation and condensation (Ciulache & Ionac, 2007; http://www.oxfordreference.com, 2015; http//www.erh.noaa.gov, 2015). Or, at 100% values of the RH, the temperature of the dew point (DP) must be the same with the value of the temperature (T), which also confirms our recording.

More significant are the monthly average values of the T and RH ecological factors, which we have calculated as a result of the recordings and which we synthetically present to you in the table below (Table 1).

Table 1. The average, maximum and minimum monthly values of the temperature and the relative humidity in the investigated location

Month / Value	April		May		June*		July		August	
	T	RH	T	RH	T	RH	T	RH	T	RH
Average	6.85	85.8	11.1	99.01	14.36	92.89	18.69	87.38	21.46	75.35
Maximum	17.7	100	17.5	100	23.8	100	32.6	99.9	31.6	100
Minimum	-1.4	59.7	6	88.2	8	74.2	8.7	54.7	10.9	53

*excepting the 7-16th of June 2015 period

The results of the calculus show:

- The maximum monthly average temperature was registered in August 2015 and reached 21.46°C.
- The maximum temperature at the level of the soil was though registered not in August, the hottest month, but on July 8th 2015, at 14:43, reaching 32.6°C.
- The minimum monthly average temperature was 6.85°C, Aprin 2015.
- Still in April, we registered the minimum temperature for the whole research period, - 1,4°C, on April 10th, at 4:07. To mention that this negative value is not singular, as it was preceded or followed by negative values (- 0,3°C, on April 8th, 20:07 and on April 9th, 22:07; - 1,1°C, on April 10th, 0:07, - 0,8°C, two hours later, at 02:07; - 1,3°C on April 10th, 06:07).
- The maximum value of the monthly average for the relative humidity (RH) was calculated as available for May 2015: 99.01%.
- The minimum value of the monthly average of the RH was 75.35%, in August 2015.
- The maximum value of the RH was 100% and it was registered during more periods in August, June, May and April 2015: August 2nd between 0:43 and 10:43; on the whole period between June 1st, 0:29 and June 6th, 20:29; in large periods of May; only on April 28th, at 8:07 and 10:07.
- The minimum value of the RH was 53% and was reached on August 14th 2015, at 14:43.
- The average monthly temperature for the whole period, April – August* 2015, was 14.49°C.
- The monthly average HR calculated for the whole period* is 88.09%

CONCLUSIONS

Daytime variations of the T and RH ecological factors are higher where the scree (MSS) is completely nude and totally exposed to the sun.

More shadowed areas, at the basis of a rock or covered by a plant, can maintain a high relative humidity for a longer while, but it also depends on the falling precipitations. Anyhow, it can generate a living microenvironment which can represent an ecological shelter for some invertebrates, maybe even micro-mammals, when, during the summer, the completely nude scree gets very hot.

Maximum daytime temperatures are recorded one to two hours after noon or even at noon, rarely before. Daytime minimum values are registered early in the morning, between 04:00 and 06:00, with little exceptions.

High temperatures at the surface of the scree, during summer, lead to the warming of the scree, which is avoided by invertebrates, as they take shelter under rocks, thus avoiding the direct action of the sunbeams.

The MSS presents, from the perspective of the T and RH variation, interesting, specific features, which makes it a special type of habitat, with ecological specifics, "valued" by numerous living species, most of them invertebrates, which either populate on a permanent basis this type of habitat, or in different stages of their lives.

ABSTRACT

This article presents the results we have obtained regarding the continuous monitoring, for five months, of the ecological factors temperature and relative humidity at the surface of a thicket of calcareous origin, located in Ghimbav Mountain (Leaota Massif, Southern Carpathians). This article presents the results we have obtained regarding the continuous monitoring, for five months, of the ecological factors temperature and relative humidity at the surface of a thicket of calcareous origin, located in Ghimbav Mountain (Leaota Massif, Southern Carpathians).

The results show that the variations of temperature, but also of the relative humidity depend on the period of the day, depend on the weather, but also on the location, on the position in the scree.

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