SOIL AND VEGETATION ON KARST TERRAINS IN THE PROJECTED PROTECTED LANDSCAPES OF WESTERN MECSEK, HUNGARY

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Summary
Previous studies of the karst in the Western Mecsek area have shown that it is largely in a natural condition, has a high conservation value and is in need of protection. Consideration is being given to declaring the karstic territory and its wider environment a protected area in the Danube-Dráva Natural Park. This paper describes a study of the areas soil and flora designed to demonstrate the almost untouched, natural, state of an area. The soil studies focused on determining the pH, showing the tendency of a shift towards lower pH values, and examining the calcium content. The results show that indirect anthropogenic effects can be detected by a pH shift towards lower values, but the same tendency of acidification is less characteristic in dolines which are the most sensitive points of karstic fields. Examining the vegetation, and paying special attention to the ranking into nature conservation categories, a significantly high ratio of association forming and accompanying species and the presence of protected species in relatively high numbers can be seen that proves the nature conserving feature of the territory. On the basis of the investigations carried out, maintenance of the present state of the territory can be seen to be a desirable objective and in order to realize it protection of the area is absolutely justified.

Introduction

The Mecsek Mountains are the southernmost mountain-range of Hungary. There are three adjoining karstic areas in its western part: near the villages of Abaliget and Orfű, and in the Melegmány Valley. These three areas are part of the Western Mecsek Mountains Protected Landscapes proposed by the Danube-Dráva National Park. The southern part of this area is covered by sandstone, so this is not part of our project. The intensive karstic processes began in the Pleistocene and has been continuous till today (*Lovász 1977.*), which can be proved by the high number of dolines which are still forming. There had been geoecological examinations of the area near Orfű, which were now extended to the Abaliget and Melegmány areas. The goal of the examination, which concentrate on the soils and the flora, is to prove that these areas are worth protecting. There had been similar research in the Aggtelek karstic region and in the Bükk Mountains, too (*Bárány-Kevei 1983.*).

The pedological examinations were carried out in laboratories. The vegetation, however, was inspected on site.

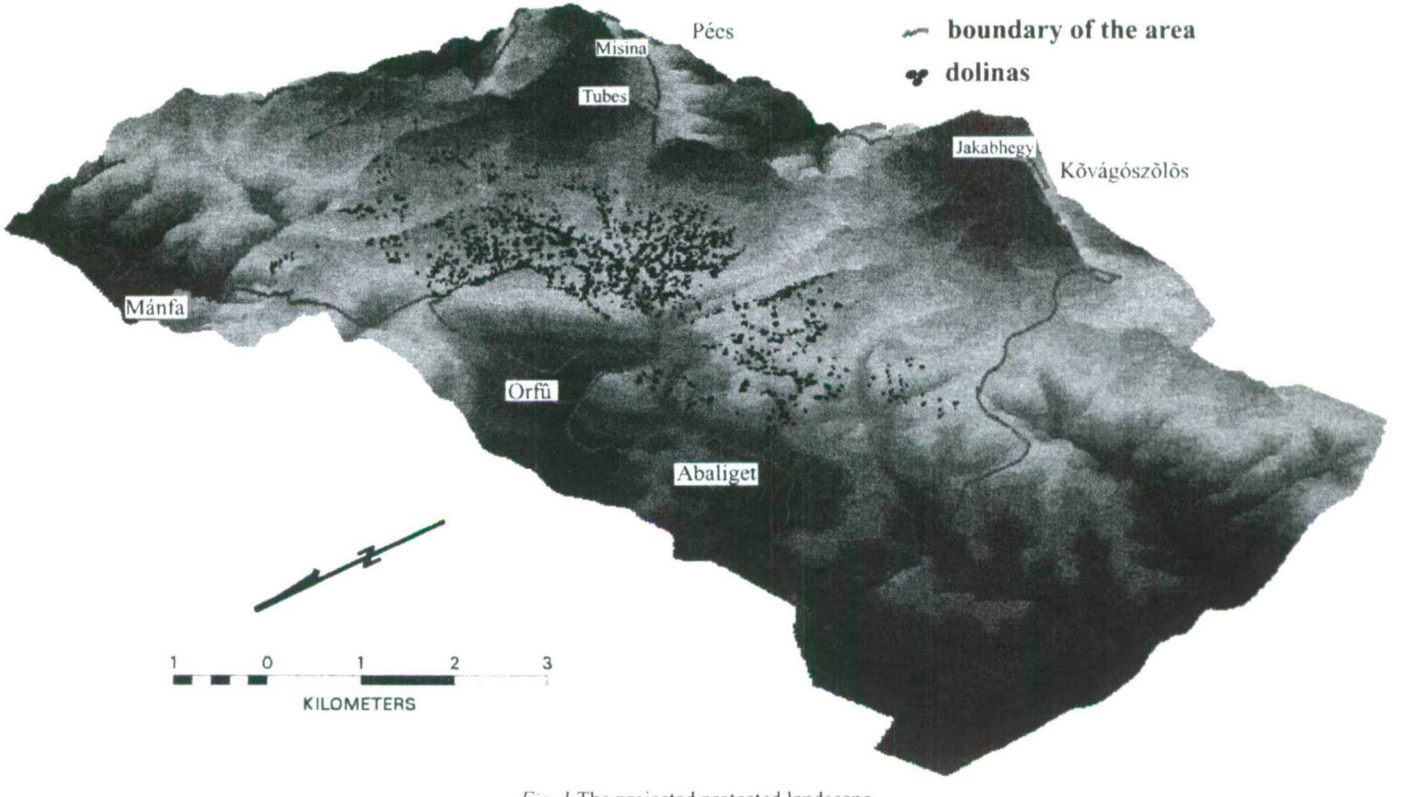

Fig. 1 The projected protected landscape

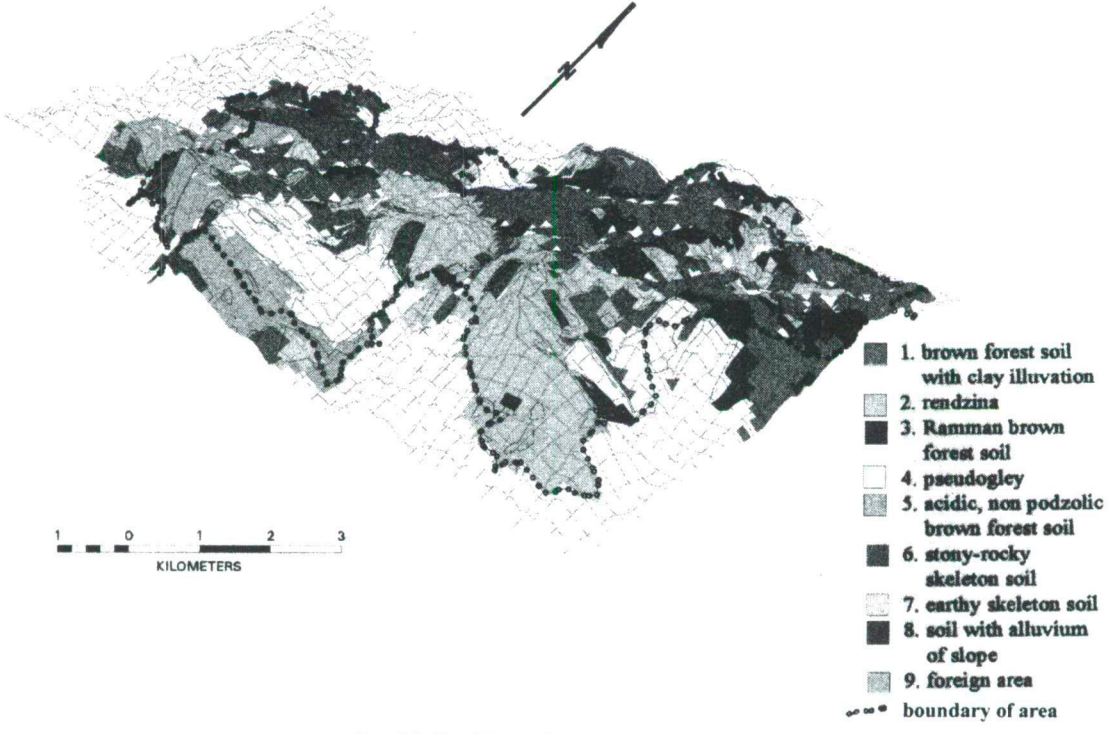

Fig. 2 Soils of the projected protected landscape

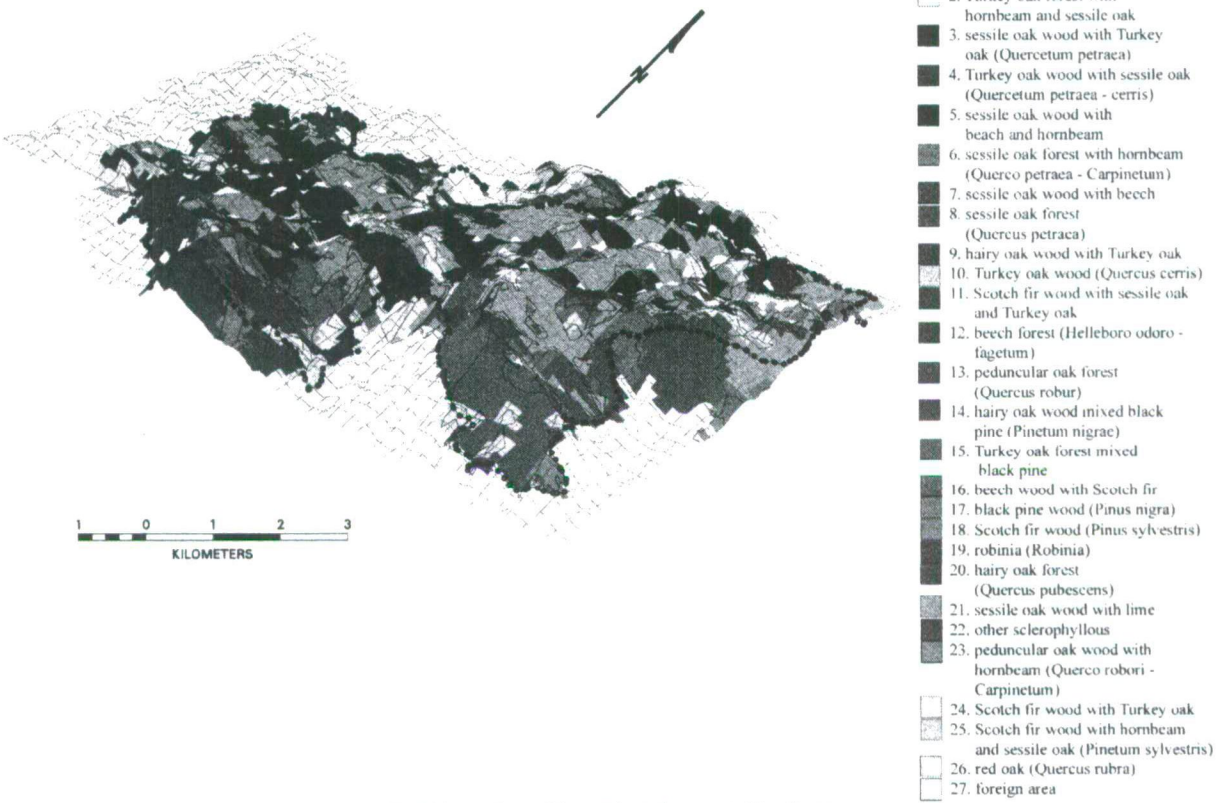

Fig 3 Vegetation of the projected protected landscape

Table 1 The carbonate-content of karstic soils in Western Mecsek (%) (1: 10 cm depth; 2: 50 cm depth)

number of sample	carbonate-content
1/1	0
1/2	0
2/1	0,106725
2/2	0,04269
3/1	0
3/2	0
4/1	0
4/2	0
5/1	0,17076
5/2	0,064035
6/1	0
6/2	0,04269
7/1	0
7/2	0
8/1	**4,6959**
8/2	**15,7953**
9/1	0,08538
9/2	0,12807
10/1	**49,5204**
10/2	**34,152**
11/1	0
11/2	0,064035
12/1	0
12/2	0
13/1	0,106725
13/2	0,04269
14/1	0,12807
14/2	0,04269
15/1	0
15/2	0
16/1	0
16/2	0,021345
17/1	0,08538
17/2	0,04269
18/1	0,08538
18/2	0,04269
19/1	0,08538
19/2	0,04269
20/1	0,064035
20/2	0,08538
21/1	0,08538
21/2	0,08538
22/1	0,021345
22/2	0
23/1	0,021345
23/2	0,04269
24/1	0,04269
24/2	0

Maps

The maps showing the area (*Fig. 1-3*) were made by digital techniques. The soil and the vegetation maps (*Fig. 2, 3*) were drawn on the basis of sylvicultural data. These maps show not only the karstic areas but the full area of the projected conservation area. By comparing these maps, one can notice several relationships between the soil and the vegetation. These relationships can be examined especially in the southern part of the area. On the southern slope of the Tubes Mountain, for example, the dominant soil-type is rendzina, which is accompanied by hairy oak and black pine - sessile oak. On the southern slope of Jakab-hegy, the dominant soil type is acidic, non podzolic brown forest-soil and the dominant vegetation type is sessile oak. There are mostly black pine plantations on stony-rocky skeleton soil. The soil of the Abaliget karst is mainly brown forest soil with clay illuviation. This type is accompanied by rendzina near Orfű, and by Rammann brown forest soil in the Melegmány Valley. It is usually the exposure that defines the type of vegetation there. On the northern slopes beech stands with sessile oak and hornbeam are dominant, on the southern ones, however, oak forests with hornbeam are typical.

Soils

The pedological examinations consisted of the analysis of pH-value, carbonate-, and heavy metal-content. The *pH-value* of the soil is acidic, the average value is 5-6. The graph (*Fig. 4*) shows that the average pH in the Melegmány area is a little bit higher, and there are more values around neutrality. This can be explained by the higher carbonate-content of the soil. The acidic pH is natural, because these soil types (the main type of soil is brown forest soil with clay illuviation) usually have such a pH-value (*Stefanovits 1975.*). There is, however, a considerable difference between the pH in water and in potassium chloride solution. When this difference is higher than 0.5, the soil is acidifying. There were only two samples that didn't show a difference higher than 0.5 near the surface and in a depth of 50 cm. The differences in the other samples were around 1.2. It can clearly be seen that there is a

tendency towards acidification, especially in the Orfű area. The acidification may be caused by human activity, it originates mainly from the industrial areas of the city of Pécs. The acidification is caused by indirect effects which can be traced by comparing the acidity of the samples collected from slightly under the surface and another one from a depth of 50 cm. The pH of samples taken from deeper sections is usually higher because acidification is more intensive closer to the surface. Ten out of the 24 soil and vegetation samples were collected from dolines and the rest from plateaus between dolines and from valleys. If we compare the pH of soil samples from dolines and the ones from plateaus, it can be seen that the pH of the samples from dolines is higher. This led to the conclusion that dolines are more protected against acidification, which makes them especially important.

The *carbonate-content* of the soils is low (*Table 1*), which is not surprising on karstic bedrock. Some samples even had no measurable carbonate-content In the samples, however, in which the difference between the pH in water and in potassium chloride is below 0.5, we have detected high carbonate-content. It proves the considerable buffer-effect of carbonate-content, so in these cases carbonate-content decreases the intensity of acidification. One of the two samples were collected from a watercourse and the other next to the travertine cascades of the Melegmány Valley (samples 8 and 10). The *heavy metal tests* were carried out with aqua regia and atomic absorption spectrophotometer. Ni, Co, Fe, Mn, Cr, Cu, Pb, Cd were tested. The low quantity of these elements (*Table 2*) implies that the pollution from human sources is low, which proves the existence of natural conditions in the area.

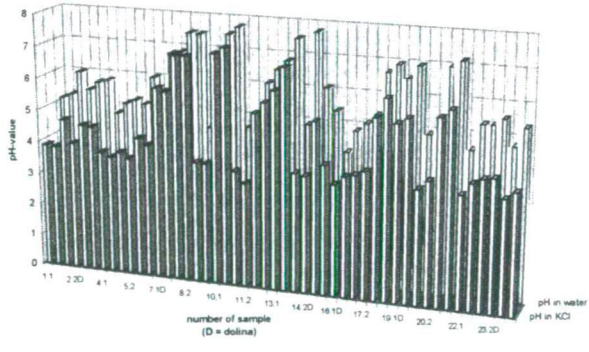

Fig. 4 The pH of soils in Orfű

Table 2 The heavy metal-content of karstic soils in Western Mecsek (ppm)(1: 10 cm depth; 2: 50 cm depth)

Nr.of sample	Pb	Ni	Co	Cu	Fe	Mn	Cd	Cr
1/1	26	34	17	12	28850	761,5	0,3	19,5
1/2	21,5	39,5	12	14,5	32450	667,5	0,05	20,5
2/1	25	35	16	13	29000	778,5	0,3	21
2/2	24	36	13	13	28050	718	0,1	20
3/1	26	44,5	12	17	36400	599	0,6	27
3/2	25	58	16	23	42500	841,5	0,5	29,5
4/1	22,5	33	14	10,5	27500	572,5	0,55	18
4/2	19,5	40,5	15	17,5	34650	532,5	0,45	20

Nr.of sample	Pb	Ni	Co	Cu	Fe	Mn	Cd	Cr
5/1	22,5	35,5	9,5	13	28900	448	0,2	20,5
5/2	17,5	42	13,5	18	32600	558	0,2	20,5
6/1	24,5	41,5	13	13,5	29000	1054	0,5	20,5
6/2	21,5	40,5	15,5	14	29500	260,5	0,5	19
7/1	22,5	43	11,5	17	30400	1100	0,35	23,5
7/2	20	45,5	13	19	32650	875,5	0,65	21,5
8/1	42	49	16,5	21	27550	1525	1,45	25,5
8/2	36,5	46	13	21,5	24400	1397,5	1,5	23,5
9/1	30,5	36,5	14	17,5	32350	1152	0,2	22
9/2	24	43,5	21	23,5	37200	1042,5	0,7	21
10/1	38,5	47	11,5	12,5	18450	604,5	3,35	18,5
10/2	38,5	48	18,5	10,5	16200	224	3	17
11/1	16,5	29	9	12	23550	323,5	0,3	18,5
11/2	20	40,5	12,5	14,5	28700	772,5	0,35	18,5
12/1	35	52,5	14	17,5	24400	948,5	0,95	32
12/2	30	54,5	18,5	17	37450	770,5	1,15	30
13/1	23	36	12	14	28650	704	0,35	23
13/2	20	41	15	13,5	27450	1071	0,65	20
14/1	23,5	35,5	12,5	13	30200	696	0,15	20
14/2	20	44,5	15,5	19	35850	575	0,35	22
15/1	26,5	38,5	12	12	27150	1395	0,55	20
15/2	23,5	36,5	11	12,5	28700	1108,5	0,15	19
16/1	17,5	29	10	10	24800	579	0,1	17,5
16/2	18	34	11,5	12,5	26350	722	0,55	16
17/1	28	33	17	10	28000	810,5	1,05	19
17/2	26,5	36	20,5	12,5	29800	883,5	0,85	18
18/1	32	54	17	20	39650	1242,5	1,05	29
18/2	28,5	63	19,5	22	40650	889,5	1,2	27,5
19/1	23	52,5	15	19,5	37850	713,5	0,7	26
19/2	23,5	49,5	16	19	36600	577	0,7	22,5
20/1	21,5	32,5	13,5	9,5	25850	649,5	0,1	18,5
20/2	21,5	46,5	19	15	32900	803	0,8	20,5
21/1	23	38	11	16	28100	1122,5	0,3	24
21/2	19	31,5	10	10,5	22650	698,5	0	17
22/1	25,5	38,5	19	13,5	31000	704,5	0,35	20
22/2	20,5	59,5	14,5	25	39850	628	0,85	26
23/1	25,5	34,5	14,5	10,5	26700	950,5	0,25	18
23/2	19,5	41	18	15,5	31100	812,5	0,85	18,5
24/1	22,5	34	11,5	9,5	26700	474	0,15	19
24/2	23	52,5	18	19	35500	620	0,5	22
average	**24,6**	**41,8**	**14,4**	**15,3**	**30307**	**790,8**	**0,64**	**21,4**
limit val. of poll. (in Hung.)	**70**	**50**	**50**	**100**	**(no data)**	**1100**	**1**	**100**

Vegetation

The vegetation was examined with the help of ecological indexes considering temperature (T-values), water-balance (W-values), soil reaction (R-values) and nature conservation categories (TVK-values). Considering the *temperature* (*Fig. 5.*), most of the plants (80-100%) indicate deciduous forest climate which is combined with submediterranean deciduous forest climate - which refers to the typical vegetation in the

Mecsek Mountains - and atlantic evergreen forest climate. Plus, in the above-mentioned watercourse, which is in a ravine forest, there are some plants that indicate coniferous wood and deciduous mixed forest. Looking at the graph showing *water-balance* (*Fig. 6.*), one can see that most of the plants indicate moderately fresh, fresh, and moderately damp conditions. These values are caused by the fact that these areas are covered by forests. The samples which have a higher number of plants that refer to wet and damp conditions were collected by springs, streams and the travertine cascades of the Melegmány Valley. Species that represent moderately dry conditions can be found in the areas where several relatively open oak companies are. On the basis of *soil reaction* (*Fig. 7.*), species that indicate moderately calciphilous and neutral circumstances are in majority. Plants referring to calciphilous and basic conditions can be found mostly in samples, which showed a high value of carbonate-content.

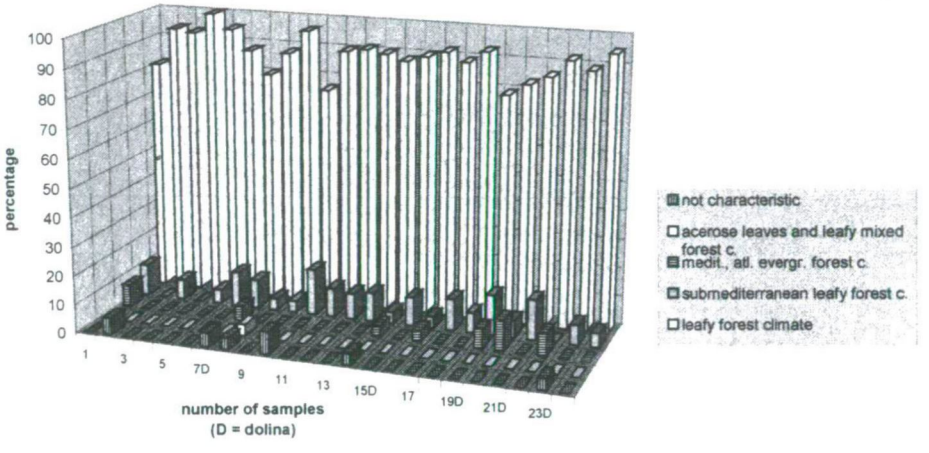

Fig. 5 Categories of T-values (temperature)

The graph showing the *nature conservation values* (*Fig. 8.*) reveals that most of the presented species refer to natural circumstances (accompanying, associated, protected). The proportion of plants signing degradation (weeds) rarely exceeds 10 %. These latter samples were either collected near tourist-paths under heavy usage or close to the Orfű-Pécs highway. The test point near the highway (sample 8) shows well enough how human activity can degrade precious natural areas. It is on the bank of the fore mentioned watercourse with a ravine forest containing several protected species. The high proportion of weeds here refers to the interfering effect of the nearby highway. The samples from the dolines reveal that they host greater variety of species. There are more plants that endure shadow because of the steep sides of these karstic forms. The graph showing the preservation categories reveals that there is a tendency that the proportion of protected species is higher in the dolines than in other areas. It shows how important they are from the point of view of nature preservation. Dolines are one of the most sensitive places of the

karstic surfaces as, beside swallets, they are the points where pollution can enter the karstic system. Therefore it is good that the dolines of all three examined areas are free of human interference, which supports the idea of declaring these areas to be protected.

Conclusions

The *goal* of our pedological and vegetation examinations carried out in the Western Mecsek karstic area is *to support the efforts to pronounce these areas protected.* The analysis of the carbonate- and heavy metal-content, and the pH have shown that *there is harmful antropogenic influence* in the area, but it is only an *indirect effect* which manifests itself in acidic subsidence. *Ecological indexes* also show that this part of the Mecsek Mountains is still in a *natural condition,* which justifies the claim to make this area a nature preserve. On the basis of the comparisons of samples from dolines and other forms, it must be noted that *dolines are the most valuable places of the three karstic areas* examined. The pH of the soils of the dolines *is* close to the values of the prevailing soil type (brown forest soil with clay illuviation), whereas the pH of samples from other places is lower. The analysis of the vegetation also showed that *dolines are in a natural condition* in a greater degree, because they host a higher number of protected species. *Karstic area is a vulnerable natural system* that reacts with great sensitivity to antropogenic influences, so it requires an increased protection. Particular stress must be laid on dolines, where we found original vegetation and undisturbed soils. Because of their importance, they are being surveyed and enumerated at present. The first step to preserve the condition of this area is to declare it protected. In the framework of general protection *dolines should be strictly protected.* The declaration of protection would not only mean the creation of a new nature preserve but could also have a favourable effect in the extended surroundings because the comprehensive karstic system is quite far-reaching.

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