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**GEOECOLOGICAL STUDIES ON THE KARSTIC
SURFACES OF THE PLANNED PROTECTED AREA
IN WESTERN MECSEK, SOUTH HUNGARY**

GEOEKOLOŠKE RAZISKAVE KRAŠKEGA POVRŠJA NA
NAČRTOVANEM ZAŠČITENEM OZEMLJU V ZAHODNEM
DELU POGORJA MECSEK NA JUŽNEM MADŽARSKEM

EDIT HOYK¹

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Izvleček

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Edit Hoyk: Geokološke raziskave kraškega površja na načrtovanem zaščitenem ozemlju v zahodnem delu pogorja Mecsek na južnem Madžarskem

Na podlagi izsledkov starejših raziskav je bil zahodni del pogorja Mecsek vključen v naravni park Donava - Drava. Zato je bilo treba raziskati tudi prsti in rastlinstvo. Raziskave prsti so bile usmerjene predvsem v določanje pH in merjenje vsebnosti kalcija. To je pomembno za nadaljnje raziskave o vsebnosti težkih kovin v prsti. Vegetacijske raziskave so obsegale vodno bilanco, reakcijo prsti in njihovo kategorizacijo z vidika varstva narave. Posredni človekov vpliv na to kraško ozemlje se kaže v splošnem zniževanju pH. To pa je manjše v vrtačah, ker imajo te prsti razmeroma visoko vsebnost kalcija. Pravilnost zaščite tega kraškega območja opravičujejo rastlinske združbe z visokim deležem zaščitenih vrst med spremljajočimi vrstami. Raziskave potrjujejo, da je nujno ohraniti sedanje stanje, za kar pa je potrebna ustrezna zaščita.

Ključne besede: kras, geokologija, vrtača, prst, rastje, zaščita narave, Mecsek, Madžarska.

Abstarct

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Edit Hoyk: Geocological studies on the karstic surfaces of the planned Protected Area in Western Mecsek, South Hungary

Earlier studies on the karst in Western Mecsek have already shown that this area is worth protection due to its quite well preserved natural state. In consequence, declaring the karstic territory with its wider environment as a protected area is being considered in the Danube-Drava Natural Park. In order to prove the almost untouched natural state of an area good starting point is to examine its soil and flora. Soil studies focus on determining the pH, detecting any tendency of a shift towards lower pH values and on examining the carbonate content. In the future measurements to check the heavy metal content that are especially suitable for showing the levels of anthropogenic contamination will be added to these studies. Investigations on the flora based on the examination of water balance, soil reaction and determination of the rank according to the categories of nature conservation value offer a support to the claim of being protected. The results show that indirect anthropogenic effects can be detected by the pH shift towards lower values, but the same tendency of turning acidic is less characteristic in dolines which are the most sensitive points of karstic fields. However, the relatively high carbonate content favours the resistance against falling pH values. 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 the maintenance of the present state of the territory is a desirable objective and in order to realize it the protection of the area is absolutely justified.

Key words: Mecsek Mountains, karst, dolina, geocology, soil, vegetation, protected area, protection.

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 Area proposed by the Danube-Dráva National Park. The southern part of this area is covered by sandstone, so that is not part of our project (Fig. 1).

The intensive karstic processes began in the pleistocene and have been continuous till today (LOVÁSZ 1977), which can be proved by the high number of dolinas which are still forming.

There have been geocological examinations of the area near Orfű, which are now extended to the Abaliget and Melegmány areas.

The goal of the examinations, 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 (KEVEINÉ 1983).

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

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. 2) shows that the average pH in the Melegmány area is a little bit higher, and there are more values around neutral. This can be explained by the higher carbonate content of the soil here. The acidic pH is natural, because these soil types (the main type of soil is brown forest soil with clay washed in) usually have such a pH value (STEFANOVITS 1975). There is, however, a considerable difference between the

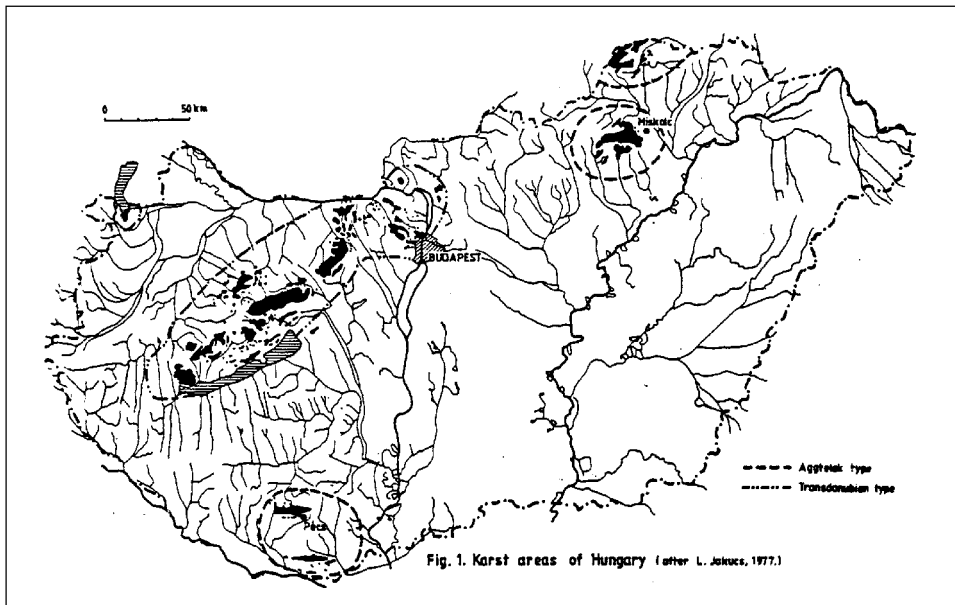


Fig. 1. Karst areas of Hungary (after L. Jakucs, 1977.)

Fig. 1: Karst areas of Hungary.

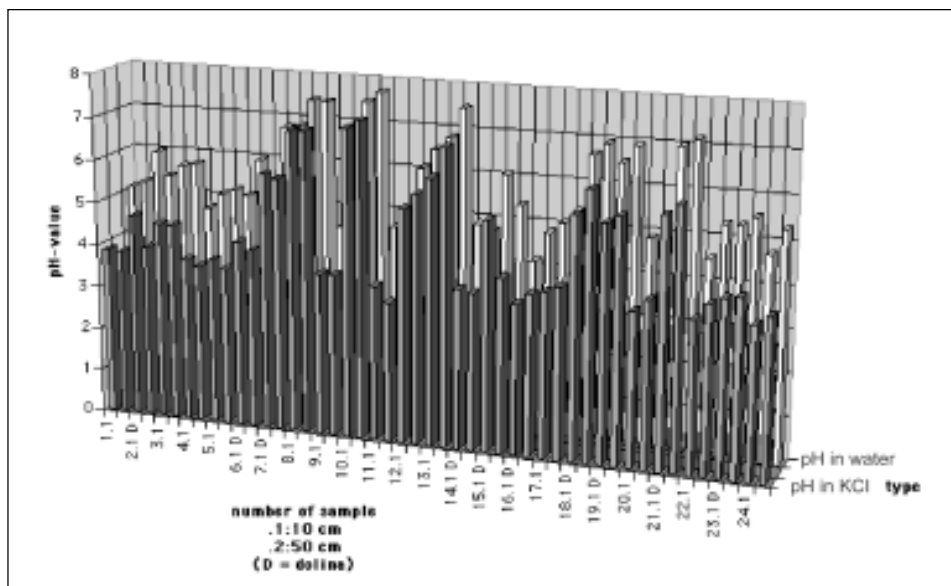


Fig. 2: The pH of soils.

pH in water and in potassium chloride. When this difference is more than 0.5, the soil is acidifying. There were only two samples that did not show a difference higher than 0.5, both near the surface and at 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 some human activity, mainly in 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 just under the surface and ones 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.

10 of the 24 soil and vegetation samples were collected from dolinas and the rest from plateaus between dolinas and from valleys.

If we compare the pH of soil samples from dolinas and the ones from plateaus, it can be seen that the pH of the samples from dolinas is higher. This led to the conclusion that dolinas are more protected against acidification, which makes them especially important.

The *carbonate content* of the soils is low (Table 1), which is not surprising with karstic types. There are some samples which have no signs of carbonate in them at all. 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 was collected from a watercourse and the other next to the tufa steps of the Melegmány Valley (samples 8 and 10).

Table 1: The carbonate - content of karstic soils in Western Mecsek (%).

f1: 10 cm depth

f2: 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

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
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

Nr. of sample	Pb	Ni	Co	Cu	Fe	Mn	Cd	Cr
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 values of pollution (plan in Hungary)	70	50	50	100	(no data)	1100	1	100

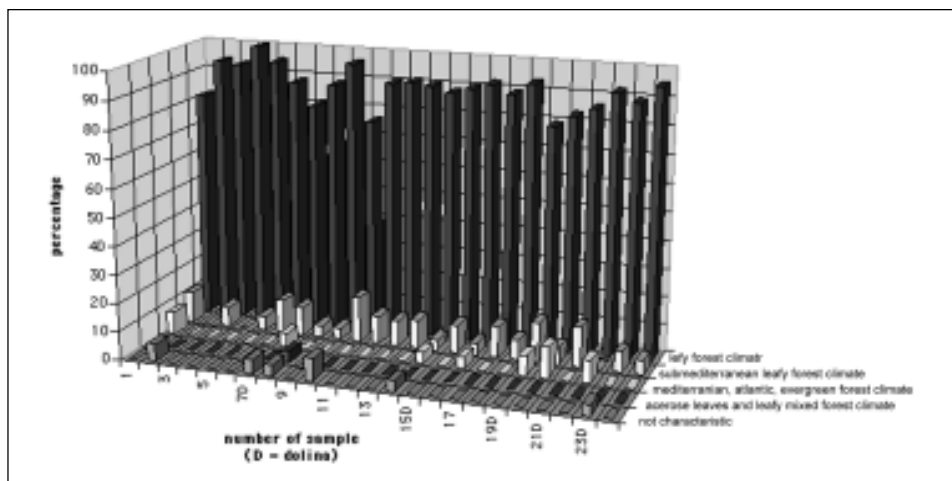


Fig. 3: Categories of T-value (temperature).

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.

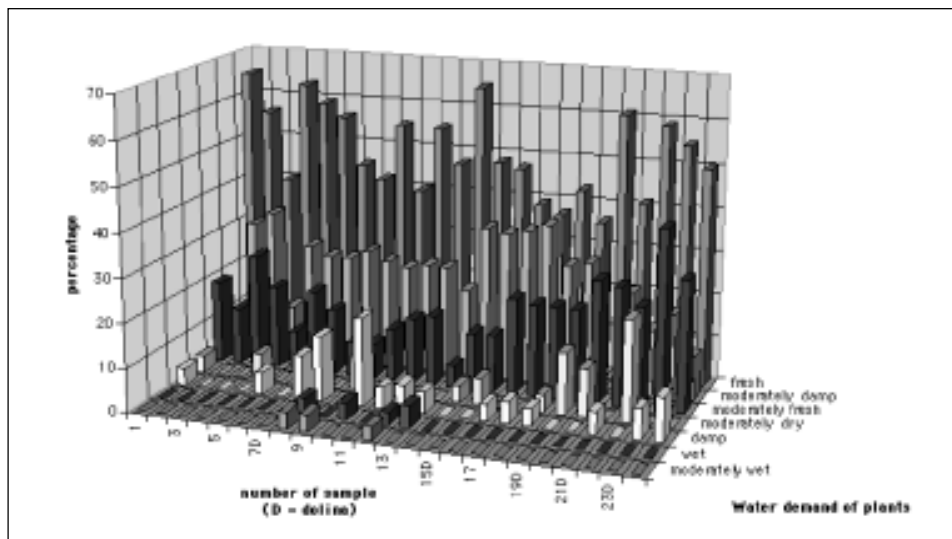


Fig. 4: Categories of W-values (water balance).

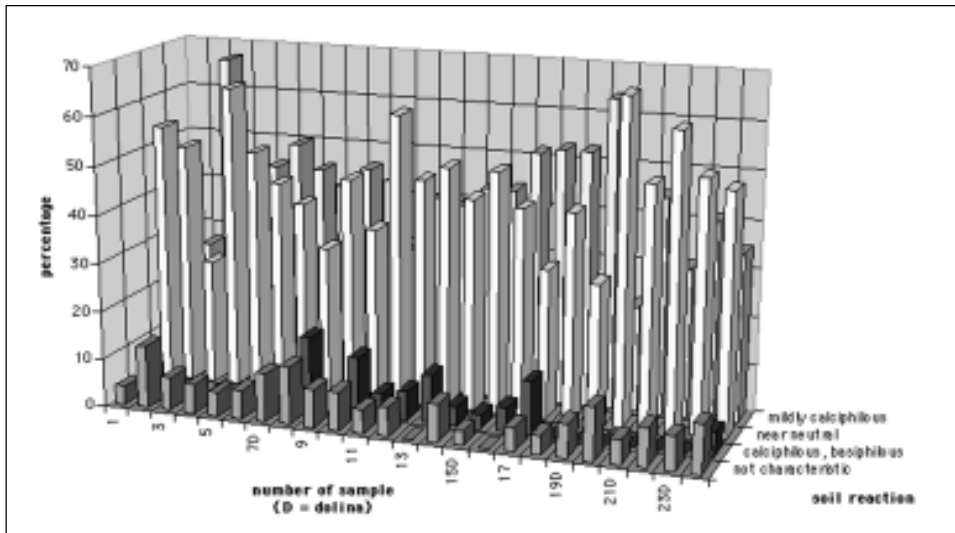


Fig. 5: Categories of R-value (soil reaction).

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. 3), most of the plants (80-100%) indicate a leafy forest climate which is combined with submediterranean leafy 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 a ravine forest, there are some plants that indicate coniferous wood and leafy mixed forest.

Looking at the graph showing *water balance* (Fig. 4), 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 relate to wet and damp conditions were collected by springs, streams and the tufa steps of the Melegmány Valley. Species that represent moderately dry conditions can be found in the areas where there are several relatively open oak associations.

On the basis of *soil reaction* (Fig. 5), species that indicate moderately calciphilous and neutral circumstances are a majority. Plants referring to calciphilous and basic conditions can be found mostly in samples which showed a high value of carbonate-content.

The graph showing the *nature conservation values* (Fig. 6) reveals that most of the species present refer to natural circumstances (accompanying, associated, protected). The proportion of plants that signal 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.

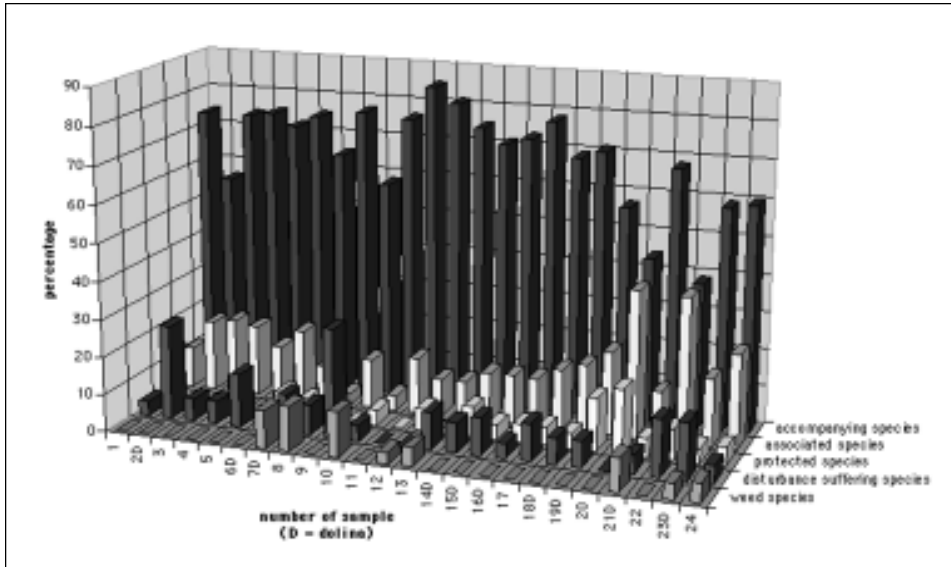


Fig. 6: Categories of TVK-values (nature conservation value).

This is the forementioned watercourse with a ravine forest containing several protected species. The high proportion of weeds here is put down to the interfering effect of the nearby highway.

The samples from the dolinas reveal that they host a larger 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 dolinas than in other areas. It shows how important they are from the point of view of nature preservation. Dolinas are one of the most sensitive places of the karstic surfaces as, like swallets, they are points where pollution can enter the karstic system. Therefore it is good that the dolinas of all three examined areas are free from human interference, which supports the idea of declaring these areas protected.

CONCLUSIONS

The *goal* of our pedological and vegetation examinations carried out in the Western Mecsek karstic area is *to support the efforts to declare these areas protected*.

The analysis of the carbonate and heavy metal-content, and the pH have shown that *there are harmful anthropogenic influence* in the area, but it is only an *indirect effect* which manifests itself in falling pH values.

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 natural preserve. On the basis of the comparisons of samples from dolinas and other features, it must be noted that *dolinas are the most valuable places*

of the three karstic areas examined. The pH of the soils of the dolinas is close to the values of the prevailing soil type (brown forest soil with clay washed in), whereas the pH of samples from other places is lower. The analysis of the vegetation also showed that *dolinas are in a natural condition* to a greater extent, because they host a larger number of protected species.

A karstic area is a vulnerable natural system, that reacts with great sensitivity to antropogenic influences, so it requires increased protection. Particular stress must be layed on dolinas, which are depositaries of the original vegetation and soil. 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, *dolinas should be more strictly protected*. The declaration of protection would not only mean the creation of a new nature reserve but could also have a favourable effect in the wider surroundings because the comprehensive karstic system is quite far-reaching.

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GEOEKOLOŠKE RAZISKAVE KRAŠKEGA POVRŠA NA NAČRTOVANEM ZAŠČITENEM OZEMLJU V ZAHODNEM DELU POGORJA MECSEK NA JUŽNEM MADŽARSKEM

Povzetek

Na podlagi izsledkov starejših raziskav zahodnega dela pogorja Mecsek na južnem Madžarskem, ki so pokazale na dobro ohranjeno naravno stanje, je bilo ozemlje vključeno v naravni park Donava - Drava. Da bi pa to res dokazali, so se za najboljšo osnovo izkazale raziskave prsti in rastlinstva.

Raziskave prsti so bile usmerjene predvsem v določanje pH in merjenje vsebnosti kalcija. Rezultati meritev pH kažejo tendenco proti nižjim vrednostim. Za bodočnost načrtujemo raziskave vsebnosti težkih kovin v prsti, kar je posebno primerno za ugotavljanje nivoja onesnaževanja, ki ga povzroča človek.

Vegetacijske raziskave so obsegale vodno bilanco, reakcijo prsti in njihovo kategorizacijo z vidika varstva narave. Posredni človekov vpliv na to kraško ozemlje se kaže v splošnem zniževanju pH. To pa je manj značilno za vrtače kot najboljčutljivejša mesta kraškega površja. Razmeroma visoka vsebnost kalcija je vzrok njihove odpornosti proti zniževanju pH. Pravilnost zaščite tega

kraškega območja opravičujejo rastlinske združbe, kategorizirane z vidika ohranjanja narave, ki imajo visok delež zaščitnih vrst med osnovnimi in spremljajočimi vrstami. Raziskave potrjujejo, da je nujno ohraniti sedanje stanje, za kar pa je potrebna ustrezna zaščita.