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SURVEY OF THE INTERACTION BETWEEN SOIL AND VEGETATION IN A KARSTECOLOGICAL SYSTEM /AT AGGTELEK, HUNGARY/

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Introduction

The Aggtelek Karst Region was declared as part of the World Heritage on 2 December 1995. Its surface and subsurface karst formations and its ecology are both worth protecting. Since the formation of the Aggtelek National Park /1985/ the measures taken to limit human activity have brought some predictable improvement in maintaining a state close to the natural conditions. The continuous research of environmental changes undergoing in this region is very important therefore. Dolines are environmentally very sensitive sites of the karst regions /Pfeffer, K.H. 1990/, since a considerable amount of water is seeping through their deepest points into the soil and the rock. The possible harmful materials, running off the slopes laterally with the water, can concentrate there.

The soil and the vegetation of the dolines are the indicators of the changes occurring in the karstecological system, induced by outer effects. These changes are manifested on and in the upper layer of the soil, that is why the survey is focusing on them.

Methods

During the last week of August 1995, soil samples were collected and a plantecological survey was carried out in the Great Doline of Aggtelek /see it in the map of Figure 1/ and in its bushy and wooded surroundings. Soil profiles were cut and samples were collected in the bottom of the doline, in the E-W doline-section and on the N and S slopes. Vegetation survey was carried out at the same sites in units of 2x2 m. Species composition and coverage % were detected /Table 1/.

Soil samples were analyzed in laboratory for chemical reaction, mechanical composition and dimension of soil-life /number of bacteria/. Plant associations were surveyed with their soils.

Description

In the bottom of the doline there is a deep soil profile formed of 3 horizons and a thin humus cover. Underneath there is a dark brown layer rich in iron, transiting into a clayey middle, then into a red lower layer. The sediments with some red clay layers are several metres thick here, due to lateral soil run off. The mesophyllic soil here is rich in nutrients and provides

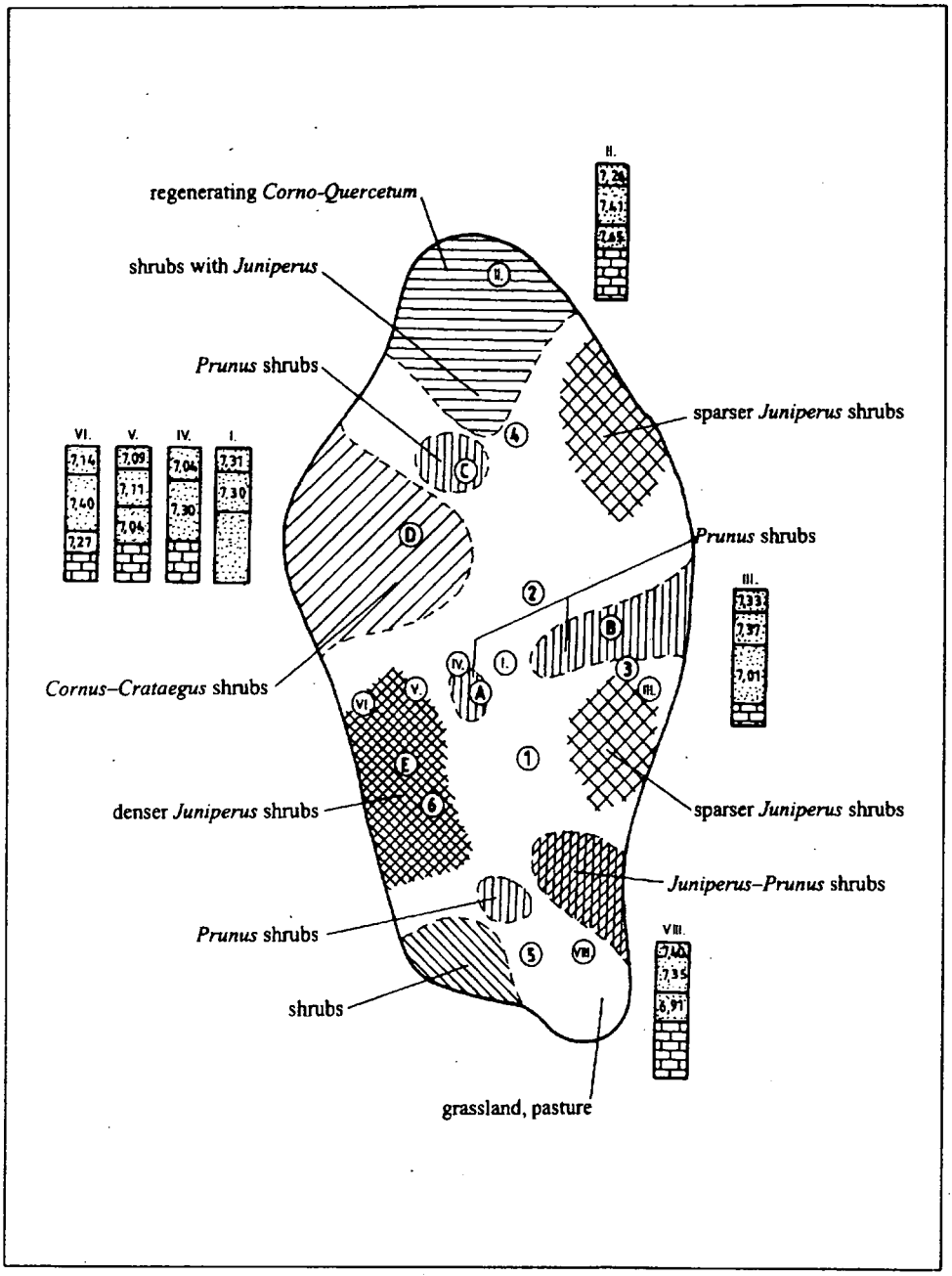

Figure 1 *Plantecological wits in the Great Doline of Aggtelek*

	1	2	3	4	5	6	7	8
Festucetalia valesiaceae								
Agropyron intermedium					25			
Doryenium herbaceum			8		4	4	+	
Festuca rupicola	6	6	6	3	6	35	6	5
Fragaria viridis	1.5	1.5	+		2.5	+	1.5	6
Seseli varium							1	+
Festuco-Brometea								
Agrimonia eupatoria	15	17	1.5	3	15	1	4	12
Agropyron repens	2	2						
Asperula cynanchica		+		+				
Aster linosyris	+							
Carlina vulgaris						+		
Eryngium campestre			1			5		
Filipendula vulgaris	+			+			2.5	1
Galium verum	2	12	1		3		0.5	
Hieracium pilosella				2		1.5	2	2
Hypericum perforatum					+			
Koeleria cristata			+	1.5				
Poa angustifolia								+
Potentilla arenaria					1.5			0.5
Potentilla argentea					+			
Scabiosa ochroleuca			2.5	+	+	0.5	0.5	+
Sedum sexangulare				2	0.5			
Teucrium chamaedrys			+	7	9			2
Veronica spicata		+		1	4	1.5	+	
Nardetalia & Nardo-Callunetea								
Alchemilla sp.		+						
Agrostis tenuis	1	+		1		4	1	5
Juniperus communis					0.5			
Viola canina	+			+		2	0.5	
egyéb fajok								
Bromus sp.	+							
Cuscuta sp.		1						
Inula britannica			1	+		4		
Ranunculus sp.						+	+	+
Thymus sp.	1	2	1	15	2	2.5	4	4
Trifolium arvense			+		+			
Trifolium sp.						1	+	1.5
Veronica sp.	+		+					

Table 1A. *Phytocoenological types in the Great Doline.*

	1	2	3	4	5	6	7	8
Arrhenatheretalia & Arrhenatheretea & Molinietalia & Molinio-Juncetea								
Achillea millefolium	3	3	5	5	1	7	2.5	1.5
Anthoxanthum odoratum								+
Arrhenatherum elatius	15	1		4		1	15	1
Briza media				1		+	+	+
Centaure pannonica		1	+				1	
Coronilla varia		3		1.5		3		+
Daucus carota	+	1	+			+		+
Euphrasia stricta						+		
Genista tinctoria			2		+			
Leontodon autumnalis	0.5	3	+		+	5	7	4
Lotus corniculatus	1	1.5	+				0.5	
Pimpinella saxifraga	1	1	0.5	+	+	+	0.5	1.5
Plantago lanceolata		1	1		1.5	+	+	1
Plantago media	1	4		8	+	6	7	1
Potentilla reptans	7	1.5		8		1.5	1.5	+
Prunella vulgaris			1	2		1.5	0.5	1.5
Trifolium repens						+	+	+
Chenopodietea & Secalietea & Plantaginetea								
Cirsium arvense	1	3						
Cirsium vulgare				+	+			
Convolvulus arvensis		1.5	+	+		0.5		
Dipsacus laciniatus		0.5						
Euphorbia cyparissias							+	
Prunetalia								
Crataegus monogyna						+		
Prunus spinosa	+					1	1.5	
Querco-Fagetea & Quercetea pubescenti-petraeae								
Astragalus glycyphyllus	3							
Brachypodium pinnatum				25				
Clinopodium vulgare					+	0.5		
Galium mollugo		+				+		
Glechoma hederacea		+						
Ligustrum vulgare					1			
Quercus cerris								+
Quercus petraea						+		
Viola hirta		+	1	1.5	1	3	+	2

Table 1B. *Phytocoenological types in the Great Doline*

an excellent living site. Its vegetation is a moderately degraded lawn association, though when compared to the whole of the doline's vegetation it is relatively the most degraded due to nitrophyllic weeds striving on the nutrients accumulated in the bottom. The stand is composed of Festuca rupicola, Agrostis tenuis and Arrhenetherum elatius. There are thorny and pricky species here like Dipsacus laciniatus, Cirsium arvense, C. vulgare, Eryngium campestre.

On the E slope /exposed to W/ there is a limestone outcrop with rootkarrens on its surface. Its dark upper layer contains some humus, its light brown middle layer is clayey, while its lower layer is quartz-bearing red clay. Its dominating species like Sedum sexangulare, S. acre and Potentilla arenaria.

On the S slope /exposed to N/ there is less milieu due to self-shadows. The soil is composed of 3 levels: the upper one is brown, there is a clayey one with iron, then red clay at the bottom. The dominating vegetation is composed of Festuca, Agrostis and Arrhenetherum. The grass association is less degraded and more open than the one in the doline's bottom.

On the W slope /exposed to E/ there is light rocky soil layer underlying the dark brown upper level with humus. Its lowest level is red clay with much outcrop. The soil is redeposited here as evidenced by the charcoal remains between the upper, middle and lower levels. Festuca, Agrostis and Arrhenetherum make up the dominant grassy association in the clearings of the juniper. Juniper is characteristic in this part of the doline.

On the N slope /exposed to S/ the soil has a dark brown upper, a brown clayey middle and a red lower layer. Parent rock is situated at a depth of 50 cm. There is some karst-alien, volcanic sediment in the soil here. Vegetation is patched and dominated by Brachypodium pinnatum finding a forest-steppe like environment here.

Besides the Great Doline there was a control vegetation survey in a neighbouring doline. The findings can be summed up below.

Most of the dolines are covered by grass associations dominated by much the same species. Long lasting animal grazing has brought about a patching in the vegetation cover, however. It does not hide the natural and original heteromorphic composition of vegetation within the dolines, e.g. there is a xerophilous and thermophilous vegetation on the steep, rocky E slopes.

Nature conservation value of the dolines' grass associations /Figure 2/ shows that disturbance-resistant weeds make up almost half of the species, while there was only one single protected weed found in the examined area, the lady's mantle /Alchemilla vulgaris/.

Association survey of the lawn types showed that some 30 % of the species belong to the xerophilous and petricolous groups. It is in accordance with the bad water management capacity of the soils on limestone. Fresh and wet meadows were also found in similar dimension. They occur where, like in the bottom of the Great Doline, clay has been accumulated to such an extent that soil has become impermeable, creating a lateral seepage of water.

Lawns exposed to N /4/, and in the bottom of the dolines /1/ are very different as far as their water budget /W/ soil reaction /R/ and nitrogen demand /N/ is concerned /Figure 3./

On the S slope /exposed to N/ dominated by strong self-shadow effect, the grass association is composed of sort of hydrophillic, medium nitrogen demanding species finding habitation on acid soils as well. In the bottom of the doline, however, where water is concentrated due to run off, soil is wetter, wash out is stronger /soil reaction has got a lower value/. Nitrogen demand is higher here at the same time, allowing the conclusion that degradation has caused the species of high nitrogen demand to spread. Ecological conditions are very similar here to that of the slopes of N exposure. The other extremity occurs on the W facing slopes, where species require very little humidity, low nitrogen demand and a relatively high soil reaction value /lime demand/.

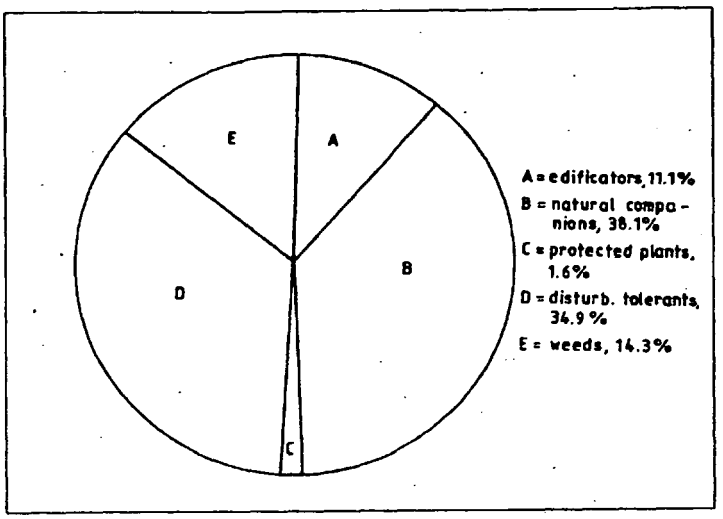

Figure 2 *Nature conservation value of the dolines grass association*

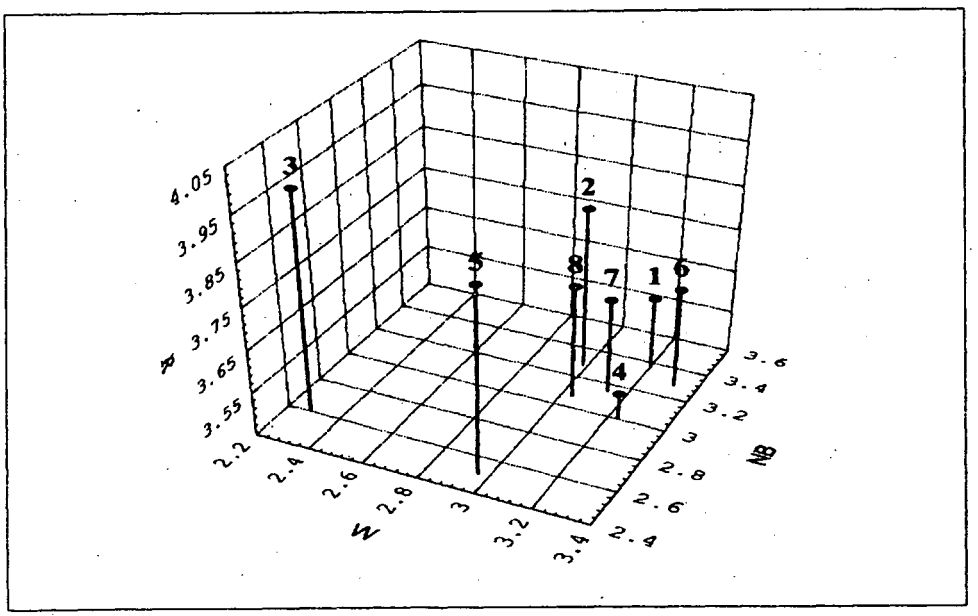

Figure 3 *Value of ecological indicators /W-water budget, R-soil reaction, N-nitrogen demand/ in the doline.*

Results

There are two important development trends in the grassy associations of dolines. Rock grass is formed where soils get dry owing to the microclimate. Where there is less sunshine and wetter soil, shrubby vegetation begins to spread.

Degraded grass-plots can be found where animal grazing used to be intensive: stamping and natural dunging led to a uniform grass association. Pasturing and animal grazing had been preceded by deforestation in the Aggtelek Karst, having led to the formation of secondary grass associations which were then degraded by animal grazing actually.

Figure 4 shows the place and the possible development of the grass associations of dolines within the natural succession. The territory declared as part of the World Heritage has got slowly improving karstecological conditions as compared to its previous state, though further surveys are needed to evaluate the temporal changes. Proposals of practical worth have to be worked out in order to maintain a sustainable landscape development serving both nature conservation policy and land use.

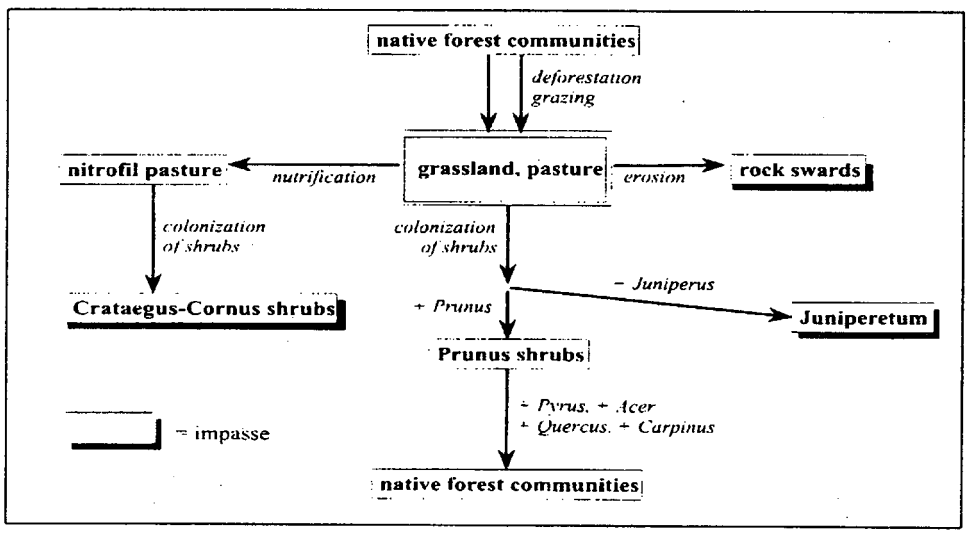

Figure 4 *Possible development of the grass associations of dolines.*

Literature

Pfeffer, K.H. /1990/: Wissenschafliche Informationen zu Karstökosystemen - einewichtige Aufgabe und Planungen. Tübinger Geographiche Studien. Heft. 105. pp. 1-34.

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