Signs of Environmental Change as Reflected by Soil and Vegetation on Semi-arid Sandy Areas in the Carpathian Basin

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Abstract

Soil and vegetation are good indicators of changes in the environment. On the examined area is semi-arid, extreme dry where open grassland is the typical vegetation in the Carpathian Basin. Soils are dry, sandy with vegetation types of xerotherm characteristics with dominant endemic species of *Fumana procumbens* and *Festuca vaginata*. We examined natural and anthropogenic environments. The urbanization caused growth of nitrate content in the degraded, shallow, sandy soils, while the physiognomy of the vegetation remained the same with some changes in the species composition: the amount of weeds and species resistant to disturbing grew; the *Cynodon dactylon* became dominant on grasslands. A new species, *Festuca pseudovaginata* was identified. This species adapted to the new environment changed by humans. Its economical importance is that animal stock eat it more readily.

Introduction

While studying the flora it is important to learn about the bedrock, the types of soil developed and the microclimatological and hydrological status. In this case soil samples were examined during botanical and soil scientific surveys, both in disturbed and natural associations.
The nutrient poor sandy soils in the extremely dry semi-arid areas of the Carpathian Basin are characterised by open, native vegetation consisting of xerophytes. One native species of open grasslands is the *Festuca vaginata*. The examined areas can be found in Hungary (Middle-Eastern Europe) in Danube–Tisza lowland in the pasture around Örkény settlement. The survey was carried out on areas grazed by sheep and on undisturbed meadows.

Material and method

On the sandy areas of the Danube–Tisza lowland the coenological parameters of the occurrences of the *Festuca vaginata* and the *Cleitogenes serotina* were revealed by Bagi (1997). The invasive behaviour of the *Cleitogenes serotina* was reported by Molnár et al. (1997). In the newest work displaying the vegetation of Hungary (Borhidi 2003) according to the author there is vicarism among the *Festuca* species constituting the *Festucetum vaginatae* assosiation, many similar yet geographically separated taxons are present. In Hungarian literature Borhidi (1995) mentions earlier the *Festuca dominii* besides the *Festuca vaginata*. The occurrence of the species in Hungary is uncertain (Penksza 2003, Smarda ex verbis), a taxon blooming in early spring can be found instead, the *Festuca pseudovaginata,* which is described as a new species (Penksza 2003).

Coenological surveys were carried out in May 2005, employing the Braun-Blanquet (1951) method in quadrates of 2x2 m. The coverage values of the species were determined based on the scale of Braun-Blanquet (1951). The names of species follow the nomenclature of Simon (2000), the naming of associations were based on the system of Borhidi (2003). During the evaluation of data the relative ecological indicators were applied according to Borhidi (1995). Considering mean coverage values we calculated the group proportion. The nature protection value categories were used based on Simon (1988, 2000).
We considered botanical point of view when we took soil samples. Altogether 40 spot were examined. Soil samples were taken from the depth of 0-15 and 15-30cm. We examined soil parameters that might be connected to vegetation.
Laboratory experiments were the follows: pH (H_2O, KCl); $CaCO_3$; Al-P_2O_5; Al-K_2O; humus (Turin method). Nitrogen availability, nitrogen forms (KCl replaceable ammonium-nitrogen and nitrate) and total nitrogen content was measured.

Results

Botanical results

The flora of Örkény consists mainly of species from forest steppe and thermophile species with coverage of 40%, submediterranean species follow with 35%, and at last the flora of mountain and submountain broad-leaved forests with less than 20%.
47% of the vegetation of the sands of Örkény belongs to those xerophytes that can be found occasionally in humid areas as well. Aridity-indicating species living in areas with long dry periods follow, and finally the intensely xerophytes that often appear in areas totally dried up or in areas that are extremely dry for prolonged periods of time.
From the distribution of the relative nitrogen demand it is obvious that the flora of the area examined mostly belongs to the nutrient poor category 1. Altogether the relative nitrogen demand can be illustrated with a decreasing curve, its most important parameters being the coverage values of the species most tolerant to nutrient poor soil.
Based on the classification and ordination of the results it can be stated that the *Festuca* species have the most impact on both the differences and similarities of coenological surveys. Pastures consisting of the *Festuca vaginata* strongly differentiate in every surveyed area. Surveyed areas where the *Festuca pseudovaginata* is dominating differentiate as well. There are also very high variations in the species composition of the areas examined. The vegetational unit in which the *Festuca pseudovaginata* is present can hardly be called even a association, because it is exposed to the local environment and to disturbances, and contains different species. The species composition is more in line with the local, particularly anthropogenic, altered environmental factors. The lawn grasses, plants common in open sandy grasslands are dominating everywhere here as well. The differences between the two most characteristic species, the *Festuca vaginata* and the *Festuca pseudovaginata*, show that on the continuously disturbed (grazing) pastures the *Festuca pseudovaginata*, and on the less disturbed, mainly only mowed parts the *Festuca vaginata* is dominating.

Pedology

The pH of the examined topsoil was usually around 8, $CaCO_3$ content between 3-5% that refers to weak lime content. The humus content was very low in all case (<0.5%). The area has very low nutrition content; the overall average N content was 300 mg/kg, P_2O_5 content 25 mg/kg, K_2O content 35 mg/kg. Based on the soil laboratory and field data, soils can be classified as regosoils. In the Hungarian Classification System they belong to moving sand and featureless sandy soil type, calcareous subtype and low humus version (Stefanovits 1992).

Summary, conclusions

We found reason for the distribution and existence of the species based on the soil examinations. The *Festuca vaginata* population was found on soils with higher nitrogen and phosphorus content, while *Festuca pseudovaginta* was wide spread on soils with lower nutrients.

	Festuca pseudovaginata (0-15cm)	*Festuca vaginata* (0-15cm)
Total N	94	439,1
P_2O_5	15,31	30
K_2O	27,71	52,45
	Festuca pseudovaginata (15-30cm)	*Festuca vaginata* (15-30cm)
Total N	177,88	311,1
P_2O_5	25,34	19,83
K_2O	38,24	36,74
	Average	
	Festuca pseudovaginata (0-30)	*Festuca vaginata* (0-30cm)
Total N	166,875	434,3
P_2O_5	16,575	26,42
K_2O	31,91	47,215

Table 1. Total N, P_2O_5, K_2O content of the examined soils under two *Festuca* sp.

Based on the data in Table 1., we can conclude that the nutrient content of the upper 0-15cm layer of the soil was different under the plant associations, dominated by two *Festuca* species. The association with *Festuca vaginata* was wide spread on nutrient richer soils while the association with *Festuca pseudovaginata* is living on soils with extremely poor nutrient content.
In the 15-30cm layer differences between the two species are smaller. The difference is in total N. The reason of this can be explained by the lower biological activity (thickness of root system), and by the possible anthropogenic effects (mixing of layers, lower, nutrient poor layers might have been mixed with upper layers).
The average of the two upper layers prove the association with *Festuca vaginata* to live on nutrient rich soils. Higher nutrient content can be explained by lower anthropogenic effects. (*Festuca vaginata*). The examined field was much smoother, nutrient distribution was more equal and nutrient content was higher. There was no mixture of the soil layers.
This poor environment with *Festuca pseudovaginta* could only allowed the formation of an open meadow; there are no weeds, either. The disturbance, mixing of the soil layers can be seen from the coenological descriptions. It is a very colorful place with a lot of species.

During our examination, which was extended onto disturbed sandy areas as well, we took special interest in the inter-vegetational relations and the distribution of two *Festuca* species, the *Festuca vaginata* and the *Festuca pseudovaginata*. The recently discovered *Festuca pseudovaginata* is adapting much better to the environment developed during human activity than other members of the genus, thus on the disturbed (grazing, military areas, etc) the dominance of the *Festuca pseudovaginata*, and on the less disturbed, mainly just mowed parts the dominance of the *Festuca vaginata* can be observed.

Based on soil scientific examinations it can be stated that in soil samples from under the stands of the *Festuca vaginata* the amount of phosphorous and nitrogen was higher than in the case of the *Festuca pseudovaginata*. This poorer environment of *Festuca pseudovaginata* only allowed the forming of open grasslands, weed species did not appear in significant numbers either. Based on our survey series, coenological point of view the vegetation divers under conditions influenced by disturbance, we found also in each habitat a divergent species composition.

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