STATE AND SUSTAINABILITY OF GRASSLANDS AND THEIR SOILS ESTABLISHED IN THE ATLANTIC-MONTANE ZONE OF HUNGARY

Csaba CENTERI[1] – Ákos MALATINSZKY[1] – Márton VONA[2] – Ákos BODNÁR[3] – Károly PENKSZA[2]

[1]SzIU, Dept. of Nature Conservation
[2]SzIU, Dept. of Landscape Ecology
[3]SzIU, Dept. of Tropical and Subtropical Agriculture

Introduction

The Carpathian Mountains have impacts on the lower mountains of the Carpathian Basin. These impacts are reflected by the vegetation, climate and soils. Authors examined pastures established on former woodlands or arable lands of the following areas: Bükk Mts., Mátra Mts., Putnok Hills and Cserehát Hills. Results of examinations on pastures of the Bükk Mountains and on mowed meadows of the Putnok Hills are presented in the current contribution.
The examined areas of the Bükk Mts. (Nagymező) were used in the past as hay meadows (grass was mowed), but they are currently used as pastures. Results of both land use forms were examined and evaluated based on vegetation and soil parameters.
The examined site of the Putnok Hills is situated near Alsószuha village. It had been used as arable land for cereal production by the local reverend and the village teacher until 1963. In 1963 it was given for village people in small parcels for household crop cultivation. The small parcels are currently managed by different cultivation methods such as maize, wheat, oat or alfalfa production and mowing. Meadows (in a close-to-natural state) and many parcels have been abandoned during the past ten years.
The examination of erosion and regeneration of abandoned agricultural and forested lands is important, because they play an increasing role in saving the valuable natural values (Gournellos et al. 2004, Mariott et al. 2002, Rupp et al. 2004, Rehackova and Pauditsova 2003, Centeri 2002).

Material and methods

Botanical examinations followed the method of Braun-Blanquet (1964), using 5×5m quadrates. Covering rates of species are given in percentage. In the Bükk Mts., examinations in connection with grazing were done beginning from the summer stable, in groups (Penksza et al. 2005). Groups of quadrates (1–5, 6–8, 9–10, 11) were created according to the decreasing effects of exposition to grazing and trampling. Sample quadrates were designated in the following places:

- area close to the summer stable (0–25m), heavily trampled and grazed due to daily driving out and in of colts (sample quadrates no. 1–5),
- areas 50–100m from the stable, with average grazing (sample quadrates no. 6–8),
- areas 250–500m from the stable, not heavily used (sample quadrates no. 9–10),
- fenced nature conservation area, where neither grazing, nor trampling effects natural vegetation (sample quadrate no. 11, 500–600m from the stable).

 DOI: 10.1556/CRC.35.2007.2.36

On the examination site situated in the Putnok Hills quadrates were randomly distributed. In the Bükk examination site soil samples were taken from the area in parallel with botanical investigations. A one meter deep sample was taken from every area with a Pürckhauer sampler (Finnern 1994).
In the Putnok Hills, not only average soil samples were taken on the meadows, but on the upper, middle and lower part of the slope as well. This way, soil and nutrient movements and uploading at the bottom of the slope could be described (Malatinszky 2004). Control area was the continuous arable land alongside the meadow.
Soil samples were analysed (pH(H_2O), pH(KCl), $CaCO_3$, Al-P_2O_5 mg kg^{-1}, Al-K_2O mg kg^{-1}, humus % (Turin-method), nitrogen supply (estimated based on humus content) and soil texture) in laboratory according to the Hungarian standards (Buzás 1993).

Results and discussions

Pedological and botanical analyses of the examined pastures in the Bükk Mountains

On the pastures close to the stable soils have high nutrient content (Table 1): average of no. 1-5.: P_2O_5 275.5 mg kg^{-1}, K_2O 427.5 mg kg^{-1}. This is a good indicator of the area being overgrazed. Besides the high nutrient content, intensive use can be detected by heavy trampling, causing compacted and – because of increased erosion – shallow soils. The explanation for this phenomenon can be found in the defecation habits of animals, since the animals frequently move on the area, enriching the nutrient content of soils.

Table 1. Laboratory results of soil analyses

Quadrate	Soil horizon	pH (H_2O)	pH (KCl)	SOM %	P_2O_5 mg kg^{-1}	K_2O mg kg^{-1}	N	Texture
1-5	A	6.6	6.0	15.8	275.5	427.5	very g.	clay
(average)	B	6.7	6.2	4.7	14.8	143.4	very g.	c. loam
6-8	A	5.6	4.9	16.3	83.2	288.9	very g.	loam
(average)	B	5.8	4.1	2.1	10.9	79.4	adequate	loam
9-10	A	5.0	4.1	14.4	60.3	239	very g.	c. loam
(average)	B	5.8	3.9	9.2	14.8	89.6	very g.	loam
11	A	4.9	4.1	16.6	103.2	243	very g.	c. loam

SOM = soil organic matter, g. = good; c. = clayey

Average soil thickness in quadrates no. 6-8 is only 35cm. Its parent material is weathered limestone. Organic matter content is high (above 15%) and nutrient content is good (P_2O_5 83.2 mg kg^{-1}, K_2O 288.9 mg kg^{-1}) (Table 1), reflecting to the characteristics of the soil type. Low phosphorous means undisturbed ground.
Sample areas no. 9-11 are situated on the ground of dolinas, in the accumulation zone of the eroding soil (Table 1). Observed soils are characterised by mixed B-horizons, their parent material is limestone (below 100cm). Typical soil type of these surfaces is Luvisols formed on colluviums. Its pH is acidic (4.9). Based on their very poor phosphorous content (7.6 mg kg^{-1}) it is supposed that the re-deposited colluvium originated from the B-horizons of nearby soils.

Fenced sample area (no. 11) is exceptional, where nutrient supply can be regarded as more favourable, probably because of decreasing erosion and less disturbed soil generation processes.
Results of coenological investigations show significant difference, even new taxa have appeared and covering rate of certain plants has decreased or certain species have disappeared. Several weed species have been dominant around the summer stable. Besides great stands of *Polygonum aviculare* and *Plantago major*, several grass species (*Festuca rubra, Agrostis capillaris, Dactylis glomerata)* can not be found in the these relevés. As a consequence of over-grazing and trampling, the area around the summer stable could be described as a thoroughly anthropogenic, degraded area.

Pedological and botanical analyses of the examined meadows in the Putnok Hills

This site has varying soil thickness (65-100cm), but soils are still in good condition from the soil degradation point of view. Laboratory data (Table 2) reflect to the low-scale use of fertilizers: AL-P_2O_5-content of the examined soil is very low.

Table 2. Laboratory data of the soil profile examined in Alsószuha, arable land, upper third of slope

Soil horizon	pH (KCl)	pH (H_2O)	$CaCO_3$ (%)	P_2O_5 (mg kg^{-1})	K_2O (mg kg^{-1})	SOM* (%)
A	6.07	7.37	0	24.47	127.11	1.84
B	6.54	7.81	0.5	45.26	149.88	0.58
C_1	6.65	7.95	0.6	22.35	178.62	0.53
C_2	6.77	8.13	0.6	128.81	164.06	0.27

*SOM = soil organic matter

In the Alsószuha area, soil properties of an arable land with abandoned parcels (abandoned 10 and 40 years ago, respectively) were compared. Abandoned lands are mostly covered by grassland species and functioning as meadows for mowing. There are differences in the distribution of the examined soil parameters (Table 3).

Table 3. Laboratory data of the topsoil of upper and lower thirds of slopes in Alsószuha

Surface cover	Slope	pH_{KCl}	pH_{H2O}	$CaCO_3$ (%)	P_2O_5 (mg kg^{-1})	K_2O (mg kg^{-1})	SOM* (%)
Arable land	UT*	5,41	6,50	0	32,41	162,68	2,55
	LT**	5,96	6,70	0	90,07	184,35	3,28
Abandoned (10 years)	UT	5,32	6,30	0	28,67	141,86	3,01
	LT	5,25	6,16	0	20,85	118,72	2,37
Abandoned (40 years)	UT	6,47	6,85	0	66,59	166,23	2,5
	LT	5,70	6,37	0	19,58	188,04	2,86

*UT = upper third, **LT = lower third, ***SOM = soil organic matter

 DOI: 10.1556/CRC.35.2007.2.36

All the parcels were previously used as arable land. The parcel that has been abandoned from cereal production in 1994 is weedier as a result of not mowing every year. The parcel that has been abandoned in 1963 and grazed until 1990, currently uncared, uncultivated is in a close-to-natural state. Valuable plant taxa found in this area are *Euphorbia salicifolia*, *Rapistrum perenne*, *Scutellaria hastifolia* and *Dianthus deltoides*.

Conclusions

The original soil type of both examined areas was Luvisol, originally covered by forests. Soils undergone extreme changes in the Bükk Mountains, following the forest cuttings, in most of the area lacking the humic layer. The area of thinner soils and sediment areas increased. In the Putnok Hills area the reason of relatively low erosion rate originates in soil texture (clay-clayey loam) and land use (household crop cultivation by hand tools, frequent monitoring of the area and dense grass vegetation). After erosive rainfall events surface is smoothed soon, therefore erosion cannot develop any further on the arable control area. The other reason for slower erosion is the shorter slope and a relatively long non-erosive plateau above the arable land, covered by alfalfa.

References

Buzás I. (szerk.): 1993. Talaj- és agrokémiai vizsgálati módszerkönyv I. (Soil and agrochemical analyses booklet I.) – INDA 4231 Kiadó, Bp. 357 pp.

Braun-Blanquet, J.: 1964. Pflanzensociologie 3. – Wien, 865. pp.

Centeri, Cs.: 2002. Importance of local soil erodibility measurements in soil loss prediction – Acta Agronomica Hungarica vol. 50 no. 1 43-51 pp.

Finnern, H. (ed.): 1994. Bodenkundliche Kartieranleitung. 4. verbesserte und erweiterte Auflage – Hannover, 392 pp.

Gournellos, Th. – Evelpidou, N. – Vassilopoulos, A.: 2004. Developing an Erosion risk map using soft computing methods (case study at Sifnos island) – Natural Hazards, vol. 31 no. 1 39-61 pp.

Malatinszky Á.: 2004. Botanikai értékek és tájgazdálkodási formák a kapcsolata a Putnoki-dombságban (Connections between botanical heritage and landscape management forms in the Putnok Hills) – Tájökológiai Lapok (Hungarian Journal of Landscape Ecology) vol. 2 no. 1 65-76 pp.

Marriott, C. A. – Bolton, G. R. – Barthram, G. T. – Fisher, J.M. – Hood, K.: 2002. Early changes in species composition of upland sown grassland under extensive grazing management. – Applied Vegetation Science vol. 5 no. 1 87–98 pp.

Penksza K. – Benyovszky B. M. – Malatinszky Á.: 2005. Legeltetés okozta fajösszetétel változások a bükki nagymező gyepében (Species composition change caused by grazing in the meadow of Nagymező, Bükk) – Növénytermelés vol. 54 no. 1-2 53-64 pp.

Rehackova, T. – Pauditsova, E.: 2003. Ecological networks in urban areas – New approaches – Ekol. Bratislava vol. 22 108–118 pp.

Rupp, H., Meissner, R. & Leinweber, P.: 2004. Effects of extensive land use and re-wetting on diffuse phosphorus pollution in fen areas - results from a case study in the Dromling catchment, Germany – J. Plant Nutr. Soil Sc. vol. 167 no. 4 408–416 pp.