CONTRIBUTIONS TO THE EVALUATION OF THE PRODUCTIVITY OF PERMANENT GRASSLANDS FROM THE MEZIAD HILLS (BIHOR COUNTY)

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Abstract

This paper presents a case study on the evaluation of the productivity of permanent grasslands based on the floristic survey. The permanent grasslands on the Meziad Hills consist mainly of 2 associations, Festuco rubrae-Agrostetum capillaris Horvat 1951 and Trifolio repenti-Lolietum Krippelová 1967, Resmeriță et Pop 1967. In these 2 associations, a number of 10 phytocoenological relevées were carried out, 5 relevées for each association, in which the assessment of abundance-dominance was made according to the Braun-Blanquet scale.

Following the calculations performed, it was determined for the phytocoenoses of the Festuco rubrae-Agrostetum capillaris association a pastoral value (VP) of 60.53, with a green mass production (MV) of 11.18 (t/ha) and an animal load of 0.93 livestock units UVM / ha. For the Trifolio repenti-Lolietum association, a pastoral value (VP) of 55.31 was determined, with a production of green mass production (MV) of 10.66 (t/ha) and an animal load of 0.88 livestock units UVM/ha.

Key words: pastoral value, permanent grasslands, carrying capacity, green mass production

INTRODUCTION

Vegetation studies on permanent grasslands in the country do not refer to their productivity or carrying capacity. Data on grassland productivity are useful in establishing measures to improve their quality and assessing the optimal carrying capacity, which are necessary in the rational management of the pastoral fund.

The elaboration of a method for evaluating the productivity of the grasslands based on the floristic relevées is useful in establishing some economic data of production useful in the realization of the pastoral arrangements. This method is more accurate compared to the old method based on direct determination by mowing on sample surfaces.

Some studies on the assessment of grassland productivity based on floristic relevées have been carried out by Maruşca et al. 2019, Maruşca et al. 2020, Maruşca, 2016, Păşcuţ and Maruşca, 2020.

MATERIAL AND METHOD

The Braun-Blanquet scale was used to assess the abundance-dominance of plant species in the studied grasslands. The notes of appreciation of the abundance-dominance in percentages according to

constancy (K) were made according to the model implemented by Maruşca (2019). The botanical nomenclature used for the identified species is in accordance with the works elaborated by Ciocârlan (2009) and Sârbu et al. (2013).

The species in the floristic relevée, after being transformed into participation percentages, are divided into three fodder groups: *Poaceae*, *Fabaceae* and other families. The feed quality indicators are also mentioned in the table (F4-F9), as well as the harmful indicators (F1-F3), together with the indicators of useful (M1-M9) and harmful (M0 for F1-F3) forage phytomass.

The fodder value indices (F) after Păcurar and Rotar (2014), Kovacs (1979) and Maruşca (2019) are the following: F1 = toxic to animals and humans; F2 = harmful to animal products; F3 = harmful to the vegetal layer; F4 = weak fodder (ballast species); F5 = mediocre fodder; F6 = medium forage; F7 = good fodder; F8 = very good fodder; F9 = excellent fodder; X = species of unknown feed value.

The percentage share of grassland species with the indication of fodder quality indices (F) and useful phytomass index (M) gives the possibility to calculate the pastoral value (VP) according to the following formula:

$$VP = \Sigma P(\%) \times F/9$$

where: VP - pastoral value indicator (with values of 0-100), for F-with values between 4-9;

P(%) - percentage share of each species, depending on the values of F.

Depending on the values of the indicator on the pastoral value, the grasslands can be classified as follows: 0-5 degraded grassland; 5-15 very weak; 15-25 weak; 25-40 mediocre; 40-60 medium; 60-80 good; 80-100 very good.

The evaluation of the useful fodder production is performed by an indirect method based on the floristic relevées and production indices (M) of the fodder species from the grassy carpet of the grasslands (Maruşca, 2019). The determination of the average green mass production index (IM) for permanent grassland phytocoenoses shall be calculated using the following formula:

$$IM = \Sigma P(\%) \times M/100$$

where: IM - the average green mass production index; for F-with values between 4-9;

P(%) - the share of participation in percentage of each species, depending on the values of M (values between 1-9).

The value of the average green fodder index (IM) within the range in Table 1 is multiplied by the green mass production coefficient (CMV),

resulting in the production in tonnes per hectare (MV) and finally the appreciation of this indicator.

Table 1

Production indices for feed species and estimating the useful yield per hectar of permanent unfertilized grasslands (after) Maruşca, 2019)

Average production indices green mass forage species (IM)	**Coefficients of transformation in green mass production (CMV)**	**Green mass production estimate (MV) (t/ha)**	**Appreciation of production value**
0.1 – 0.5 0.6 – 1.0	x 1.8 x 1.9	0.18 – 0.90 1.14 – 1.90	Very weak
1.1 – 1.5 1.6 – 2.0	x 2.0 x 2.1	2.20 – 3.00 3.36 – 4.20	Weak
2.1 – 2.5 2.6 – 3.0	x 2.2 x 2.3	4.62 – 5.50 5.98 – 6.90	Weak- Medium
3.1 – 3.5 3.6 – 4.0	x 2.4 x 2.5	7.44 – 8.40 9.00 – 10.00	Medium
4.1 – 4.5 4.6 – 5.0	x 2.6 x 2.7	10.66 – 11.70 12.42 – 13.50	Middle-Good
5.1 – 5.5 5.6 – 6.0	x 2.8 x 2.9	14.28 – 15.40 16.24 – 17.40	Good
6.1 – 6.5 6.6 – 7.0	x 3.0 x 3.1	18.30 – 19.50 20.46 – 21.70	Good-Very good
7.1 – 7.5 7.6 – 8.0	x 3.2 x 3.3	22.72 – 24.00 25.08 – 26.40	Very good
8.1 – 8.5 8.6 – 9.0	x 3.4 x 3.5	27.54 – 28.90 30.10 – 31.50	Excellent

The following formula is used to determine the carrying capacity (CP) expressed in livestock units (UVM) per hectare (Table 2).

$$CP(UVM/ha) = \frac{MV(t/ha)}{Nz \text{ x } Zp}$$

where: MV - represents green mass production (t/ha)

Nz - the daily requirement of grass for 1 livestock unit (UVM), 65kg (50kg+30%(15kg) seasonal climate fluctuations and unconsumed debris)

Zp - number of grazing days (season)

Table 2

Appreciation of carrying capacity of grasslands is done this way:

Units of livestock UVM/ha value	**Grassland appreciation**
0.01 - 020	Degraded (Degr.)
0.21 - 0.40	Very weak (FS)
0.41 - 0.60	Weak (S)
0.61 - 0.80	Mediocre (Med.)
0.81 - 1.20	Middle (Mijl.)
1.21 - 1.60	Good (B)
1.61 - 2.00	Very good (FB)
Over 2.00	Excellent (Ext.)

RESULTS AND DISCUSSION

The study of permanent grasslands of the Meziad Hills highlights the existence of two plant associations *Festuco rubrae-Agrostetum capillaris* Horvat 1951 and *Trifolio repenti-Lolietum* Krippelová 1967, Resmeriță et Pop 1967. The study was conducted in August 2020 resulting in a number of 10 phytocoenes relevées, 5 relevées for each association.

From a cenotic point of view, the two associations are framed in *Molinio-Arrhenatheretea* R. Tüxen 1937 class, *Arrhenatheretalia* R. Tüxen 1931 order, *Cynosurion* R. Tüxen 1947 alliance.

The *Festuco rubrae-Agrostetum capillaris* association is found at altitudes of 235-300 m, on generally shaded exposures (N, NW) with a slope of 5-12° (Table 3). The floristic composition is rich and varied, totaling 96 species.

The grasslands belonging to this association have a pastoral value (VP) of 60.53, a fodder green mass production (MV) estimated at 11.18 (t/ha), which supports an animal load of 0.93 livestock units UVM/ha, calculated for an average grazing season of 185 days.

Table 3

The floristic composition of the *Festuco rubrae-Agrostetum capillaris* Horvat 1951 association from the Meziad Hills (Bihor County)

No. relevées	1	2	3	4	5	K	Participation P (%)	Indices	
Altitude (m.s.m.)	300	240	260	240	235				
The coverage of vegetation layer (%)	100	100	100	100	100				
Exposition	N	NV	S	NV, V	NV				
Slope (°)	18	5	12	10	10				
Area	100	100	100	100	100				
GPS Lat. N	46.72686	46.71821	46.71074	46.70857	46.71959				
coordonates Long. E	22.42470	22.36428	22.38382	22.35676	22.31812			F	M
0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Poaceae									
Festuca rubra	3	2	3	4	4	V	40	7	6
Agrostis capillaris	2	3	2	1	1	V	21,3	7	5
Cynosurus cristatus	+	+	+	+	+	V	0,5	7	4
Holcus lanatus	+	+	+	+	+	V	0,5	6	6
Anthoxanthum odoratum	+	+	+	+	+	V	0,5	5	3
Danthonia decumbens	+	+	+	+	+	V	0,5	4	3
Calamagrostis epigeios	+	+	1	+	+	V	2,8	3	0
Festuca pratensis	+	+	·	+	+	IV	0,4	9	8
Lolium perenne	+	1	·	+	+	IV	2	9	8
Festuca arundinacea	+	+	·	+	+	IV	0,4	8	9
Festuca valesiaca	+	+	+	+	·	IV	0,4	5	3
Nardus stricta	+	+	+	+	·	IV	0,4	3	0
Poa pratensis	·	+	·	+	+	III	0,3	8	6
Molinia caerulea	+	+	·	+	·	III	0,3	3	0

0	1	2	3	4	5	6	7	8	9
Dactylis glomerata	+	+	·	·	·	II	0,2	9	8
Phleum pratense	·	+	·	·	+	II	0,2	9	8
Arrhenatherum elatius	·	·	·	+	+	II	0,2	8	8
Festuca rupicola	+	·	+	·	·	II	0,2	5	5
Fabaceae									
Lotus corniculatus	+	+	+	+	+	V	0,5	8	6
Trifolium hybridum	+	+	+	+	+	V	0,5	8	6
Trifolium repens	1	1	+	1	+	V	2,8	8	5
Trifolium pretense	+	+	+	·	+	IV	0,4	8	7
Trifolium medium	·	+	+	+	·	III	0,3	6	4
Dorycnium pentaphyllum	+	·	·	+	+	III	0,3	3	0
Medicago lupulina	·	·	+	·	+	II	0,2	8	3
Trifolium campestre	·	+	·	·	+	II	0,2	7	2
Coronilla varia	·	+	·	·	+	II	0,2	3	0
Ononis spinosa	+	·	·	·	+	II	0,2	3	0
Other families									
Achillea millefolium	+	+	+	+	+	V	0,5	6	4
Plantago lanceolata	+	+	+	+	+	V	0,5	6	1
Leontodon hispidus	+	+	+	+	+	V	0,5	5	3
Potentilla erecta	+	+	+	+	+	V	0,5	5	2
Hieracium pilosella	+	+	+	+	+	V	0,5	4	1
Prunella vulgaris	+	+	+	+	+	V	0,5	4	2
Prunella laciniata	+	+	+	+	+	V	0,5	4	2
Thymus glabrescens	+	+	+	+	+	V	0,5	4	2
Erigeron annuus	+	+	+	+	+	V	0,5	3	0
Juncus effusus	+	1	1	+	+	V	2,8	3	0
Polygala vulgaris	+	+	+	·	+	IV	0,4	4	1
Carduus acanthoides	+	+	+	+	·	IV	0,4	3	0
Carex hirta	+	+	+	+	·	IV	0,4	3	0
Filago germanica	+	+	·	+	+	IV	0,4	3	0
Pteridium aquilinum	2	1	2	1	·	IV	7,9	3	0
Viola tricolor	+	+	+	+	·	IV	0,4	3	0
Carlina vulgaris	+	+	+	·	+	IV	0,4	2	0
Galium verum	·	+	+	·	+	III	0,3	5	4
Centaurea phrygia	+	·	+	·	+	III	0,3	4	6
Rumex acetosa	+	+	·	·	+	III	0,3	4	5
Cerastium holosteoides	+	·	·	+	+	III	0,3	3	0
Epilobium roseum	+	+	·	·	+	III	0,3	3	0
Eryngium campestre	+	·	·	+	+	III	0,3	3	0
Euphrasia stricta	+	+	+	·	·	III	0,3	3	0
Juncus tenuis	·	+	·	+	+	III	0,3	3	0
Lysimachia nummularia	·	+	+	+	·	III	0,3	3	0
Hypericum perforatum	+	·	·	+	+	III	0,3	2	0
Ranunculus polyanthemos	+	+	·	·	+	III	0,3	1	0
Bellis perennis	·	·		+	+	II	0,2	5	1
Cichorium intybus	+	·	·	·	+	II	0,2	5	6
Fragaria vesca	·	+	·	·	+	II	0,2	5	1
Leucanthemum vulgare	+	+	·	·	·	II	0,2	5	5
Lythrum salicaria	+	·	·	·	+	II	0,2	4	7
Mentha longifolia	·	·	·	+	+	II	0,2	4	6
Veronica officinalis	·	+	+	·	·	II	0,2	4	4

0	1	2	3	4	5	6	7	8	9
Agrimonia eupatoria	·	·	·	+	+	II	0,2	3	0
Campanula patula	·	·	·	+	+	II	0,2	3	0
Centaurium erythraea	+	·	·	+	·	II	0,2	3	0
Cruciata glabra	+	+	··	·	·	II	0,2	3	0
Dianthus carthusianorum	+	·	·	·	+	II	0,2	3	0
Filipendula hexapetala	·	·	·	+	+	II	0,2	3	0
Galium mollugo	·	+	·	·	+	II	0,2	3	0
Hypochaeris radicata	+	+	·	·	·	II	0,2	3	0
Juncus inflexus	·	·	·	+	+	II	0,2	3	0
Lycopus europaeus	+	·	·	·	+	II	0,2	3	0
Matricaria perforata	·	+	·	+	·	II	0,2	3	0
Potentilla reptans	+	·	·	·	+	II	0,2	3	0
Other species (K I; P 0.1%; F 1.2.3.): *Gnaphalium sylvaticum, Knautia arvensis, Convolvulus arvensis, Juncus conglomeratus, Potentilla argentea, Anthemis arvensis, Scrophularia umbrosa, Polygonum hydropiper, Rumex conglomeratus, Euphorbia cyparissias, Dipsacus laciniatus, Urtica dioica, Lysimachia vulgaris, Stellaria graminea, Ranunculus repens, Clinopodium vulgare, Rubus sulcatus, Rosa canina, Prunus spinosa, Crataegus monogyna, Juniperus communis.*									

where: F - fodder quality indices; M - production indices; K - constancy;

The phytocenoses belonging to the *Trifolio repenti-Lolietum* association colonize the flat lands (slope 5-8°), with V, NV exposures, at altitudes of 200-275 m. (Table 4). The floristic composition totals a number of 70 species. The pastoral value (VP) of these meadows is 55.31, with a green mass production (MV) of 10.66 (t/ha) and an animal load of 0.88 livestock units UVM/ha, calculated for a duration of the grazing season in an average of 185 days.

Table 4

The floristic composition of the *Trifolio repenti-Lolietum* Krippelová 1967, Resmeriță et Pop 1967 association from the Meziad Hills (Bihor County)

No. relevées		1	2	3	4	5	K	Participation P (%)	Indices	
Altitude (m.s.m.)		275	210	200	230	225				
The coverage of vegetation layer (%)		100	100	100	100	100				
Exposition		NV	-	V	-	-				
Slope (°)		8	-	5	-	-				
Area		100	100	100	100	100				
GPS coordonates	Lat. N	46.73142	46.73442	46.73887	46.73853	46.73211				
	Long. E	22.43307	22.37059	22.30894	22.32494	22.32460			F	M
0		1	2	3	4	5	6	7	8	9
Poaceae										
Lolium perenne		3	3	3	3	2	V	27,5	9	8
Festuca pratensis		1	1	1	+	1	V	2,8	9	8
Agrostis capillaris		1	1	1	1	1	V	5	7	5
Festuca rubra		+	1	1	+	1	V	2,8	7	6
Agropyron repens		+	+	·	1	+	IV	2	6	7

0	1	2	3	4	5	6	7	8	9
Holcus lanatus	1	·	+	1	1	IV	2	6	6
Anthoxanthum odoratum	+	·	+	+	1	IV	2	5	3
Phleum pratense	+	+	·	+	·	III	0,3	9	8
Festuca arundinacea	+	+	·	·	+	III	0,3	8	9
Cynosurus cristatus	+	·	+	·	+	III	0,3	7	4
Danthonia decumbens	+	·	+	·	+	III	0,3	4	3
Nardus stricta	+	+	·	·	+	III	0,3	3	0
Dactylis glomerata	+	·	·	+	·	II	0,2	9	8
Poa pratensis	·	·	1	1	·	II	1,5	8	6
Calamagrostis epigeios	·	·	+	+	·	II	0,2	3	0
Molinia caerulea	·	·	+	·	+	II	0,2	3	0
Fabaceae									
Lotus corniculatus	1	+	1	1	+	V	2,8	8	6
Trifolium hybridum	+	+	+	+	+	V	0,5	8	6
Trifolium repens	1	1	1	1	1	V	5	8	5
Trifolium pratense	+	·	1	1	+	IV	2	8	7
Medicago lupulina	·	·	+	+	·	II	0,2	8	3
Trifolium medium	+	·	·	+	·	II	0,2	6	4
Other families									
Achillea millefolium	+	+	+	+	+	V	0,5	6	4
Plantago lanceolata	+	+	+	+	+	V	0,5	6	1
Leontodon hispidus	+	+	+	+	+	V	0,5	5	3
Polygala vulgaris	+	+	+	+	+	V	0,5	4	1
Prunella vulgaris	+	+	+	+	+	V	0,5	4	2
Cerastium holosteoides	+	+	+	+	+	V	0,5	3	0
Juncus effusus	1	2	+	1	2	V	9	3	0
Potentilla erecta	+	+	·	+	+	IV	0,4	5	2
Rumex acetosa	+	+	·	+	+	IV	0,4	4	5
Thymus glabrescens	+	+	+	+	·	IV	0,4	4	2
Agrimonia eupatoria	·	+	+	+	+	IV	0,4	3	0
Carduus acanthoides	+	+	+	·	+	IV	0,4	3	0
Eryngium campestre	·	1	1	+	1	IV	2	3	0
Pteridium aquilinum	2	+	·	+	1	IV	6,3	3	0
Euphorbia cyparissias	·	1	1	1	1	IV	3,5	1	0
Cichorium intybus	+	+	·	+	·	III	0,3	5	6
Centaurea phrygia	+	·	·	+	+	III	0,3	4	6
Hieracium pilosella	+	·	+	·	1	III	1,4	4	1
Leucanthemum vulgare	·	·	+	+	·	II	0,2	5	5
Prunella laciniata	+	+	·	·	·	II	0,2	4	2
Veronica officinalis	+	+	·	·	·	II	0,2	4	4
Campanula patula	+	·	·	+	·	II	0,2	3	0
Centaurium erythraea	+	·	·	+	·	II	0,2	3	0
Galium mollugo	·	·	+	+	·	II	0,2	3	0
Matricaria perforata	+	·	+	·	·	II	0,2	3	0
Potentilla reptans	+	·	+	·	·	II	0,2	3	0
Potentilla anserina	+	·	+	·	·	II	0,2	3	0

Other species 1937 (K I; P 0.1%; F 1.2.3.):
Polygonum hydropiper, Ambrosia artemisiifolia, Rumex conglomeratus, Xanthium strumarium, Verbena officinalis, Dipsacus laciniatus, Urtica dioica, Filago germanica, Erigeron annuus, Mentha pulegium, Lythrum salicaria, Hypericum perforatum, Lycopus europaeus, Juncus tenuis, Juncus inflexus, Carex hirta, Rubus sulcatus, Rosa canina, Frangula alnus, Prunus spinosa, Crataegus monogyna.

where: F - fodder quality indices; M - production indices; K - constancy;

CONCLUSIONS

The permanent mesophilic grasslands of the Meziad Hills have a great floristic diversity, colonizing the slightly to moderately sloping slopes, with generally shady exposures and acidic brown and humic brown soils, that are rich in humus with different degrees of saturation in bases, district-soil type.

The pastoral value of these grasslands is medium-good, with a production of green mass between 10.66 and 11.18, which allows an optimal load of animals of 0.88-0.93 livestock units UVM/ha in 185 days of grazing.

These studies on the productivity and grazing capacity of permanent grasslands can be compared with those of the past in order to establish their dynamically economic evolution.

Determining the productivity of grasslands through this new method of evaluation based on floristic relevées serves to prepare pastoral arrangements and the evolution over time of this indicator.

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