

ASSESSMENT OF PERMANENT GRASSLAND PRODUCTIVITY IN POIANA RUSCĂ MOUNTAINS (SOUTH- WEST ROMANIAN CARPATHIANS)

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Abstract. *The paper presents an application of a new method of evaluating the productivity of permanent grasslands based on the abundance-dominance and frequency data of the species from the floristically studies. Nine vegetation associations of representative grasslands from the Poiana Ruscă Mountains were studied, for which the pastoral value was evaluated for the forage quality. This indicator ranges from 5.0 for As. Viola declinatae - Nardetum up to 88.3 for As. Trifolio repenti-Lolietum perennis, being on average 36.7, mediocre in appreciation. The production of useful fresh phytomass is generally low, being on average 6.62 t/ha green matter, from 0.61 t/ha to 18.63 t/ha in the same phytocenoses mentioned for the pastoral value. Based on these results, the optimal grazing capacity of the permanent grasslands in the study area can be determined.*

Keywords: permanent grasslands, pastoral value, fresh matter yield, Poiana Ruscă

1. Introduction

In the mountainous area, which occupies about a third of Romania's national area, there are permanent meadows with an important role in animal husbandry, especially sheep and cattle. (Bărbulescu & Motcă, 1983) [2]. For a better management of this pastoral patrimony, in addition to the vegetation inventory studies, it is necessary to evaluate the productivity of the meadows, respectively the quality and the fodder production.

The assessment of the meadow yield is usually done on fenced areas where the grass is sown and weighed and quality analyses are performed in the laboratory. This method requires high costs of fencing and guarding them in isolated areas, being impossible to apply in the Romanian Carpathians, in most cases. For these reasons, we have developed a new method for evaluating the productivity of meadows based on floristic survey (phytosociological relevés) Marușca (2019) [7].

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Through this method, the former results of the vegetation studies on permanent meadows can be capitalized on a higher level for practice, and can then be used for the elaboration of the pastoral management plans and further, to orient the meadows improvement strategies.

2. Material and Method

To exemplify the new method, we conducted a case study on data from the doctoral thesis "Ecological and phytocenological study of grassy grassland vegetation in the Poiana Ruscă Mountains" (Arsene, 1998) [1].

In this paper we described 9 more frequent phytocenoses of grasslands as follows (according to the current 1998 Romanian synsystematics):

Cl. FESTUCO – BROMETEA, Br-BI 1943 et Tx. 1943

Ord. *FESTUCETALIA VALESIAEAE*, Br-BI et Tx., 1943

Al. *Festucion rupicolae* Soó 1940

As. *Agrostidetum capillaris* - *Festucetum rupicolae* M.Cs.-
Kaptalan(1962) 1964

As. *Botriochloetum (Andropogonetum) ischaemi* (Krist 1937),
I.Pop 1977

As. *Brometum (Zernetum) fibrosi* Roman 1974

Cl. MOLINIO – ARRHENATHERETEA Tx 1937

Ord. *ARRHENATHERETALIA* Pawl, 1928

Al. *Cynosurion* Tx., 1947

As. *Festuco rubrae-Agrostitetum capillaris* Horv. 1951

Ord. *MOLINIETALIA COERULAE* Boşcaiu 1965

Al. *Molinion coerulae* W.Koch 1926

As. *Peucedano rocheliani* - *Molinietalia coerulae* Boşcaiu 1965

Cl. NARDO - CALLUNETEA Prsg 1949

Ord. *NARDETALIA* Oberd 1949

Al. *Potentillo* - *Nardion* Simon 1957

As. *Viola declinatae* - *Nardetum* Simon 1966

Cl. TRIFOLIO - GERANIETEA SANGUINEI Müll. 1961

Ord. *Origanetalia* Müll. 1961

Al. *Trifolion medii* Müll. 1961

As. *Clinopodio* - *Pteridietum aquilini* Dihoru 1975

Cl. PLANTAGINETEA MAJORIS Tx.et Prsg. 1950

Ord. *PLANTAGINETALIA MAJORIS* Tx (1947) 1950

Al. *Agropyro* - *Rumicion crispae* Nordh.1940

As.*Trifolio repenti-Lolietum perennis* Krippelova 1957

To estimate the productivity of permanent grasslands, we proceeded to transform the Braun-Blanquet abundance-dominance (AD) notes in percentage of coverage -

participation (P %) in order to further perform statistical calculations. In this sense, we used a transformation matrix from the AD scale notes to P% values, developed by Marușca (2019) [7], Table 1.

Table 1. Conversion matrix of the Abundance-Dominance notes (A-D) and of the values of average constancy (K %) from the phytosociological tables in values of species participation (P %), or coverage (according to Marușca 2019 [7], revised)

Braun-Blanquet A-D scale notes	AD based on K (%)				
	K class V (81% – 100%)	K class IV (61% – 80%)	K class III (41% – 60%)	K class II (21% – 40%)	K class I (<20%)
5	87.5*	61.3	43.8	26.3	8.8
4 - 5	75.0	52.5	37.5	22.5	7.5
3 - 5	62.5	43.8	31.3	18.8	6.3
2 - 5	52.5	36.8	26.3	15.8	5.3
1 - 5	46.3	32.4	23.2	13.9	4.6
+ - 5	44.0	30.8	22.0	13.2	4.4
4	62.5*	43.8	31.3	18.8	6.3
3 - 4	50.0	35.0	25.0	15.0	5.0
2 - 4	40.0	28.0	20.0	12.0	4.0
1 - 4	33.8	23.7	16.9	10.1	3.4
+ - 4	31.5	22.1	15.8	9.5	3.2
3	37.5*	26.3	18.9	11.3	3.8
2 - 3	27.5	19.3	13.8	8.3	2.8
1 - 3	21.3	14.9	10.7	6.4	2.1
+ - 3	19.0	13.3	9.5	5.7	1.9
2	17.5*	12.3	8.8	5.3	1.8
1 - 2	11.3	7.9	5.7	3.4	1.1
+ - 2	9.0	6.3	4.5	2.7	0.9
1	5.0*	3.5	2.5	1.5	0.5
+ - 1	2.8	2.0	1.4	0.8	0.3
+	0.5*	0.4	0.3	0.2	0.1

*) Correspondence of the AD Braun-Blanquet scale in coverage percentages, according to Tüxen and Ellenberg (1937, in Cristea *et al.*, 2004 [3]).

The pastoral value (PV) of each plant association was calculated using the formula:

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

where:

F is the feed quality index according to (Kovacs (1979) [4], Păcurar & Rotar (2014) [8], and Marușca (2019) [7]:

F1 = toxic plants for animals and humans;

F2 = plants harmful to animal products;

F3 = weeds harmful to the meadows vegetal carpet;

F4 = low fodder plants (ballast);
F5 = mediocre forage plants (previously considered F1 on a 5-step scale);
F6 = medium fodder plants (former category F2);
F7 = good fodder plants (formerly F3);
F8 = very good fodder plants (formerly F4);
F9 = excellent fodder plants (formerly F5).

Only species with F indices values from 4 to 9 (F4 to F9) entered the calculation for the evaluation of PV, the remaining F₁ to F₃ are considered harmful.

The PV values assessment is as follows:

0 - 5 degraded meadow (Deg.); 40 - 60 middle (Middle);
5 - 15 very low (VL); 60 - 80 good (G);
15 - 25 low (L); 80 - 100 very good (VG).
25 - 40 mediocre (Med.);

The production of useful phytomass or consumable green fodder (CGF) was estimated considering only the species with F4 to F9+, by multiplying the P% value with a plant habitus coefficient (M), having values from 1 (very small) to 9 (very high), thus establishing a weighted IM index value (Marușca 2016, 2019) [5, 6]. The final evaluation of the CGF is made by multiplying the IM habitus index value with other indices values established in meadow experiments, according to Table 2.

Table 2. Correspondence between the values of the production indices of the species (IM) and the estimated consumable green fodder (CGF) (according to Marușca, 2019 [7])

IM values	Conversion coefficients in CGF	Estimated CGF (t/ha)	Productivity class
0.1 – 0.5	x 1.8	0.2 – 0.9	very low
0.5 – 1.0	x 1.9	1.0 – 1.9	
1.0 – 1.5	x 2.0	2.0 – 3.0	low
1.5 – 2.0	x 2.1	3.2 – 4.2	
2.0 – 2.5	x 2.2	4.4 – 5.5	low - middle
2.5 – 3.0	x 2.3	5.8 – 6.9	
3.0 – 3.5	x 2.4	7.2 – 8.4	middle
3.5 – 4.0	x 2.5	8.8 – 10.0	
4.0 – 4.5	x 2.6	10.4 – 11.7	middle-good
4.5 – 5.0	x 2.7	12.2 – 13.5	
5.0 – 5.5	x 2.8	14.0 – 15.4	good
5.5 – 6.0	x 2.9	16.0 – 17.4	
6.0 – 6.5	x 3.0	18.0 – 19.5	good-very good
6.5 – 7.0	x 3.1	20.2 – 21.7	
7.0 – 7.5	x 3.2	22.4 – 24.0	very good
7.5 – 8.0	x 3.3	24.8 – 26.4	
8.0 – 8.5	x 3.4	27.2 – 28.9	excellent
8.5 – 9.0	x 3.5	29.8 – 31.5	

The value of CGF thus calculated varies greatly, from 0.2, for degraded meadows, to 31.5 t / ha, for extensively used meadows.

3. Results and Discussions

The pastoral value (PV) as a quality indicator of the phytocenoses studied is presented in Table 3.

Table 3. The permanent meadows pastoral value of the phytocenoses in the Poiana Ruscă Mountains

Phytocenosis type	Pastoral value (PV)	Difference + -	% from the mean	PV appreciation
Al. <i>Festucion rupicolae</i> (mean)	29.4	-7.3	80	Mediocre
As. <i>Agrostideto capillaris-Festucetum rupicolae</i>	61.1	+24.4	166	Good
As. <i>Botriochloetum ischaemi</i>	15.1	-21.6	41	Low
As. <i>Brometum fibrosi</i>	12.1	-24.6	33	Very low
Al. <i>Cynosurion</i>				
As. <i>Festuco rubrae-Agrostietum capillaris</i>	28.7	+65.4	178	Good
Al. <i>Violo declinatae-Nardion</i>				
As. <i>Violo declinatae-Nardetum</i>	5.0	-31.7	14	Degraded
Al. <i>Trifolion medii</i>				
As. <i>Clinopodio-Pteridietum</i>	6.7	-30.0	18	Very low
Al. <i>Agropyro-Rumicion</i>				
As. <i>Trifolio repenti-Lolietum perennis</i>	88.3	+51.6	241	Very good
Al. <i>Molinion coerulae</i>				
As. <i>Peucedano-Molinietum</i>	30.8	-5.9	84	Mediocre
Al. <i>Potentillion anserinae</i>				
As. <i>Junco inflexi-Menthetum longifoliae</i>	46.1	+9.4	126	Middle
Mean	36.7	0	100	Mediocre

Considering that 8 phytosociological alliances are each represented by only one association and only one, *Festucion rupicolae*, has 3 subordinates, the assessment of the pastoral value was made at the alliance level which is generally assimilated with the habitat for the permanent meadows. On average, the meadows in the Poiana Ruscă Mountains have a pastoral value of 36.7, considered as mediocre, with variations from 5.0 (degraded) for *Violo declinatae - Nardion* to 88.3 (very good) for *Agropyro - Rumicion* with the most valuable forage species such as *Lolium perenne* and *Trifolium repens*. Good pastoral value is recorded for the As. *Agrostideto capillaris - Festucetum rupicolae*, with PV over 60, the rest of PV values being lower.

By comparison, the average pastoral value of the phytocenoses in the Poiana Ruscă Mountains, which is 36.7, is 5% better than that of the phytocenoses in the Măcin Mountains, where an average PV value of 35.0 was evaluated (Maruşca *et al.*, 2019) [7].

The CGF of the phytocenoses from the Poiana Ruscă Mountains follows the same trend as the pastoral value to which it is directly related proportionally (Table 4).

Table 4. Estimated CGF of permanent grassland phytocenoses in the Poiana Rusca Mountains

Phytocenosis type	Useful phytomass index (IM)	Coefficients of transformation in CGF	CGF (t /ha)	% compared to the mean	CGF appreciation
Al. Festucion rupicolae					
As. Agrostideto capillaris-Festucetum rupicolae	4.42	2.6	11.49	174	Middle
As. Botriochloetum ischaemi	0.96	1.9	1.82	27	Very low
As. Brometum fibrosi	0.89	1.9	1.69	26	Very low
Al. Cynosurion					
As. Festuco rubrae-Agrostietum capillaris	4.47	2.6	11,62	176	Middle
Al. Violo declinatae-Nardion					
As. Violo declinatae-Nardetum	0.34	1.8	0.61	9	Very low
Al. Trifolion medii					
As. Clinopodio-Pteridietum	0.41	1.8	0.74	11	Very low
Al. Agropyro-Rumicion					
As. Trifolio repenti-Lolietum perennis	6.21	3.0	18.63	281	Very low
Al. Molinion coerulae					
As. Peucedano-Molinietum	1,94	2,1	4,07	61	Low
Al. Potentillion anserinae					
As. Junco inflexi-Menthetum longifoliae	3.55	2.5	8.88	134	Middle
MEAN	2.55	2.6	6.62	100	Low

The highest CGF, of 18.63 t/ha, is estimated for the As. *Trifolio repenti-Lolietum perennis*, and the lowest (0.61 t/ha) at As. *Violo declinatae-Nardetum*.

The CGF values, around 11.5 t/ha, were estimated for the As. *Agrostideto capillaris-Festucetum rupicolae* and As. *Festuco rubrae-Agrostietum capillaris*, otherwise the yields are lower.

The average production of grassland phytocenoses in the Poiana Rusca Mountains is 6.62 t/ha, 12% higher than those in the Macinului Mountains where 5.89 t/ha was assessed (Marușca *et al.* 2019) [7], in both situations being considered as low yields.

Conclusions

- (1). Assessing the productivity of permanent meadows (quality and yield) is necessary for the preparation of pastoral management plans and further for the scientific management of this land category of agricultural use.
- (2). The pastoral value and CGF assessment on the basis of floristic surveys proved to be a rather expeditious and precise method in comparison with other more expensive and difficult to apply methods.
- (3). The meadows in the Poiana Ruscă Mountains present extremely varied pastoral values, from 5.0 (degraded) to 88.3 (very good), and an equally inhomogeneous CGF, from 0.61 t/ha to 18.63 t/ha, on average 6.62 t/ha, being considered low, needing to be further managed properly.
- (4). The method proposed by us (Marușca, 2019) [6], has a good potential for generalization in Romania and also for refining so as to allow more quick, precise and low time and resources consuming assessments of meadows yield.

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