

CONTRIBUTIONS TO THE EVALUATION OF GRASSLAND PRODUCTIVITY ON THE MACINULUI MOUNTAINS NATIONAL PARK

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Abstract

In the Măcinului Mountains National Park, the permanent grasslands have a special biodiversity. The conservation of species and habitats of rare ponto-sarmatic steppes is one of the most important objectives for which this protected area was established. One of the main factors that influence the biodiversity is the valorisation through grazing with the animals. The knowledge of the real productivity of the grasslands and the current load of animals is necessary to create an optimal balance between the feed supply and grazing intensity. The paper establishes the productivity of different phytocenosis practices, based on the floristic surveys, after which the pastoral value is evaluated, the useful production of green mass and the optimal loading with animals during the grazing season. The average pastoral value is 35 (medium), the useful grass production of 5.9 t/ha (poor), which allows an optimum loading of almost 0.5 high livestock units (LU) per hectare in a grazing season of 185 days. After knowing the livestock and the meadow surface, it was found that in the Măcinului Mountains there is a load of 0.95 LU/ha, almost twice above the optimum level.

Keywords: *steppe meadows, productivity, pastoral value, optimal loading with animals.*

INTRODUCTION

Biodiversity conservation of natural areas protected by law is one of the first objectives for which they were established. The main factor influencing permanent grasslands is man and his animals, respectively the anthropozoogen factor.

Overgrowth or lack of livestock loading until abandonment are the main causes of grassland biodiversity degradation in the temperate forested area. Establishing the loading of animals

reported to the surface unit is very important to create a balance between the production of grass and the optimal number of animals per hectare in the grazing season.

To begin with, it is necessary to know the productivity of the permanent grassland (production and feed quality of the grassy carpet).

The most common and accurate method for determining the productivity and establishing the

degree of consumability is through mowing in protected spaces, but also the most difficult to execute, sometimes even impossible.

For this reason, a new method for evaluating the productivity of the grasslands based on floristic relief has been used (Maruşca, 2019). By this simpler

and easy to apply method, sufficiently accurate results can be obtained to assess the productivity of a meadow, respectively the pastoral value, the useful production of grass, on the basis of which the loading of animals expressed in high livestock unit (LU) per hectare is calculated.

MATERIAL AND METHOD

For a first evaluation of grassland productivity, following the method that uses the floristic survey, permanent grasslands from the Măcinului Mountains National Park were studied (Popescu *et al.*,

2013).

The cenotaxonomic units with reference to the permanent grasslands in the “Măcinului Mountains” National Park, are the following:

- Cl. MOLINIO – ARRHENATHERETEA** Tx 1937
- Ord. MOLINIETALIA** W, Koch, 1926
- Al. Agrostion stoloniferae**, Soó, 1971
- Ord. ARRHENATHERETALIA**, Pawl, 1928
- Al. Cynosurion**, R.Tx., 1947
- Al. Potentillion anserinae**, R.Tx., 1937
- Cl. FESTUCO – BROMETEA**, Br-BI et Tx, 1944
- Ord. FESTUCETALIA VALESIIACAE**, Br-BI et Tx., 1949
- Al. Festucion valesiaca**, Klika, 1931
- Al. Stipion lessingiana**, Soó, 1947
- Al. Artemisio – Kochion**, Soó, 1959
- Al. Pimpinello – Thymion zygoide**, Dihoru, 1970
- Cl. PUCCINELLIO – SALICORNIETEA**, Ţopa, 1939
- Ord. PUCCINELLIETALIA**, Soó, 1947
- Al. Puccinellion limosae**, Soó, 1933
- Al. Scorzonero – Juncion gerardii**, Wenberg, 1943
- Al. Cypero – Spergularion salinae**, Slavnic 1948
- Cl. PLANTAGIETEA MAJORIS**, Tx. et P rsg, 1950
- Ord. PLANTAGINETALIA MAJORIS**, Tx., 1947
- Al. Polygonion avicularis**, Br-BI, 1931.

Since the assessment of the abundance - dominance (AD) of the grassy carpet was carried out after the phytosociological scale (Braun-Blanquet), it was necessary to

transform it into participation rates (Klapp-Ellenber) in order to continue to make pastoral value (PV) calculations, production index (P), useful green mass production

(M t/ha) and livestock loading expressed in livestock units (LU/ha).

By transforming the AD into P% one can easily observe the very large differences between the marks of AD appreciation which can be 25% difference between the grades 4 to 5 and 3 to 4 and 20% between 2 and 3 AD appreciation (Cristea *et al.*, 2004).

Thus, no matter how good observer is a botanist specialized in the study of vegetation he can very easily appreciate or miss a note or another close, with quite large errors when later the Braun-Blanquet scale turn it into participation percentages.

For this reason, for the agro-productive study of grasslands, direct scoring in percentages according to the Klapp-Ellenberg method is more useful, when we cannot mistake the participation of a species in the grassy carpet by 20-25% (Marușca *et al.*, 2003).

Forage value indices have been continuously improved over time from a first general assessment made by us, by Kovacs, 1979, supplemented by Păcurar and Rotar, 2014 and Marușca, 2016.

Indices for forage value (F)

- **1** = toxic for animals and humans;
- **2** = harmful for animal products;
- **3** = harmful for the grassy carpet;
- **4** = poor in forage value (ballast);
- **5** = medium in forage value (ex F1);
- **6** = average in forage value (ex F2);
- **7** = good in forage value (ex F3);

- **8** = very good in forage value (ex F4);
- **9** = excellent in forage value (ex F5);
- **X** = species with unknown forage value.

After determining the pastoral value index by dividing by 9 the score obtained from the multiplication P X F, after which the quality of a pasture is appreciated as follows:

- **0 - 5** - degraded grassland;
- **5 - 15** - very poor;
- **15 - 25** - poor;
- **25 - 40** - mediocre;
- **40 - 60** - average;
- **60 - 80** - good;
- **80 - 100** - very good

The indices for useful green mass production (M) based on which the actual level of production per hectare is established is newly introduced in our specialized literature (Marușca, 2016).

M = Indices for green mass production (herbs)

- **1** = very poor (1 – 3 t/ha)
- **2,3** = poor (3 – 6 t/ha)
- **4,5** = mediocre (6 – 10 t/ha)
- **6,7** = good (10 – 15 t/ha)
- **7,8** = very good (15 – 25 t/ha)
- **9** = excellent (over 25 t/ha)

This model was further improved by the introduction of transformation coefficients (1.8 to 3.3) which multiplied by production indices (M) are worth the useful grass production (GM t/ha) (Marușca, 2019). The necessary green mass for a large livestock unit (LU) during the vegetation period is about 12 tonnes, which results from multiplying the daily requirement of

65 kg/LU with the optimal 185-day grazing season. By dividing the production per hectare of a permanent grassland (GM t/ha) to the required 12 t/LU / season, the optimum loading of animals at the

surface unit, expressed in hectares, is obtained. For the evaluation of the loading of animals of a meadow during the grazing season, a new scale of assessment is proposed.

Value	Grassland evaluation
0,01 - 0,20	Degr. = degraded
0,21 - 0,40	FS = very poor
0,41 - 0,60	S = poor
0,61 - 0,80	Med. = mediocre
0,80 - 1,20	Mijl. = average
1,20 - 1,60	B = good
1,61 - 2,00	FB = very good
Over 2,00	Exc. = excellent

In the final evaluation we used statistical data on the current loading of animals of the permanent grasslands of the 5 localities that are incorporated in the national park

under study, respectively the territorial administrative units Cerna, Greci, Hamcearca, Jijila and Măcin.

RESULTS AND DISCUSSION

The permanent grasslands of the Măcinului National Park are spread under various seasonal and operating conditions, from excess humidity to accentuated dryness, on poorly acidic to alkaline soils with varying degrees of use from overgrowth to abandonment and other conditions of recovery.

The most valuable meadows are the mesophiles and mesohigrofiles that reunite the phytocenoses belonging to the *Molinio-Arrhenatheretea* Class, found in shape of narrow strips along the Luncavița, Jijila, Suluc and Taița valleys or around small

accumulations of water (ponds, lakes). More representative species for these grasslands are: *Agrostis stolonifera*, *Poa trivialis*, *P. palustris*, *P. pratensis*, *Lolium perene*, *Trifolium fragiferum*, *T. repens*, *Juncus inflexus*, *J. effusus*, *Mentha longifolia*, *Lythrum salicaria*, *Epilobium hirsutum*, *Ranunculus repens*, *Potentilla anserina*, etc. (Popescu et al., 2013). The average pastoral value is almost 67, the production is over 15 t / ha useful green mass, which allows for a season of 185 days a loading with 1.25 LU / ha, which is appreciated as good (table 1).

Table 1

Productivity of mesophilic and mesohygrophil grasslands
in the Măcinului Mountains

Vegetation	Pastoral value (VP)	Indices for useful phytomass (M)	Green mass production (GM, t/ha)	Optimal animal loading (LU/ha)	Evaluation
Al. <i>Agrostion stoloniferae</i>					
<i>As. Agrostioletum stoloniferae</i>	68,5	5,61	15,71	1,31	B
<i>As. Pöetum pratensis</i>	88,9	6,19	18,57	1,55	B
Al. <i>Cynosurion</i>					
<i>As. Trifolio repenti - Lolietum</i>	94,7	7,33	23,46	1,96	FB
Al. <i>Potentillion anserinae</i>					
<i>As. Junco inflexi - Menthetum longifoliae</i>	10,8	1,04	2,09	0,17	FS
<i>As. Poëtum trivialis</i>	71,4	5,48	15,34	1,29	B
Average	66,9	5,13	15,03	1,25	B
Evaluation	B	B	B	B	X

From all these associations only one, eg. *As. Junco inflexi - Menthetum longifoliae* is rated as very weak compared to *As. Trifolio repenti - Lolietum* which is very good, supporting an optimum load of almost 2 LU / ha / grazing season. The most widespread in the Măcinului Mountains are the xerophyte grasslands, which belong mainly to the *Festuco - Brometea* Class (table 2).

They are spread on the slopes of the hills with eroded soil, surface rocks, terraces or communal blocks. The most widespread grasses of these xerophytic grasslands are: *Festuca valesiaca*, *Botriochloa ischaemum*, *Stipa capillata*, *S. lessingiana*, *Agropyron pectiniforme*, *Chrysopogon gryllus*, *Poa angustifolia*, etc. (Popescu et al., 2013).

In terms of productivity, they are very poor, respectively the pastoral value, which is more an expression of fodder quality, is slightly over 35 (mediocre), useful phytomassage production only exceeds 4 t / ha GM, supporting an optimum load of 0.34 LU /ha.

The most valuable in terms of productivity is *As. Agropyretum intermediae* with an average load of 0.93 LU / ha and the weakest *As. Sedo hillebrandtii - Polytrichetum piliferi*, with only 0.01 LU/ha.

On the salted soils (solonets and solonchacos) there is a halophilic vegetation of the *Puccinellio - Salicornietea* Class on restricted areas around the Slatina and Sărat lakes, with numerous phytocenoses (table 3).

Table 2

Productivity of xerophytic meadows from the Măcinului Mountains

Vegetation	Pastoral value (VP)	Indices for useful phytomass (M)	Green mass production (GM, t/ha)	Optimal animal loading (LU/ha)	Evaluation
Al. Festucion valesiacae					
<i>As. Orlayo grandiflorae - Cleistogenetum serotinae</i>	4,5	0,28	0,50	0,04	Degr.
<i>As. Cynodonti - Poëtum angustifoliae</i>	65,9	3,93	9,83	0,82	Mijl.
<i>As. Taraxaco serotinae - Festucetum valesiacae</i>	46,7	2,48	5,46	0,42	S
<i>As. Achilleo coarctate - Poëtum versicoloris</i>	61,1	2,74	6,30	0,53	S
<i>As. Artemisio austriacae - Poëtum bulbosae</i>	57,3	1,02	2,04	0,17	Degr.
<i>As. Agropyretum pectiniformae</i>	59,4	0,75	1,43	0,12	Degr.
<i>As. Koelerietum macranthae</i>	42,8	2,11	4,64	0,39	FS
<i>As. Botriochloetum ischaemi</i>	6,0	0,16	0,29	0,02	Degr.
<i>As. Thymio pannonicici - Crhysopogonetum grylli</i>	37,2	3,95	9,88	0,82	Mijl.
<i>As. Stipetum capillatae</i>	5,1	0,23	0,41	0,03	Degr.
<i>As. Ajugo laxmanni - Caricetum intermediae</i>	41,1	1,14	2,28	0,19	Degr.
<i>As. Agropyretum intermediae</i>	38,1	4,28	11,13	0,93	Mijl.
Al. Stipion lessingianae					
<i>As. Jurineo arachnoideae - Stipetum lessingianae</i>	7,8	0,43	0,77	0,06	Degr.
Al. Artemisio – Kochion					
<i>As. Agropyro cristati - Kochietum prostratae</i>	15,0	0,91	1,73	0,14	Degr.
Al. Pimpinello - Thymion zygoidi					
<i>As. Agropyro - Thymetum zygoidi</i>	57,5	3,53	8,47	0,71	Med.
<i>As. Festucetum callieri</i>	46,7	1,70	3,57	0,30	FS
<i>As. Teucrio polii - Melicetum ciliatae</i>	39,8	2,10	4,62	0,39	FS
<i>As. Sedo hillebrandtii - Polytrichetum piliferi</i>	7,0	0,03	0,05	0,01	Degr.
Average	35,5	1,94	4,08	0,34	FS
Evaluation	Med.	FS	S	FS	X

Table 3

Productivity of halophile grassland from Măcinului Mountains

Vegetation	Pastoral value (VP)	Indices for useful phytomass (M)	Green mass production (GM, t/ha)	Optimal animal loading (LU/ha)	Evaluation
1	2	3	4	5	6
AI . <i>Puccinellion limosae</i>					
<i>As. Puccinellietum limosae</i>	68,1	2,63	6,05	0,50	S
<i>As. Staliceo – Artemisietum santonicum</i>	7,2	0,37	0,67	0,06	Degr.
<i>As. Obionetum pedunculatae</i>	2,8	0,10	0,18	0,02	Degr.
<i>As. Hordeetum hystricis</i>	5,0	0,19	0,34	0,03	Degr.
<i>As. Hordeetum jubati</i>	20,8	0,82	1,48	0,12	Degr
<i>As. Agropyretum elongati</i>	3,0	0,14	0,25	0,02	Degr
AI . <i>Scorzonero - Juncion gerardi</i>					
<i>As. Scorzonero parviflorae - Juncetum gerardii</i>	4,1	0,19	0,34	0,03	Degr
<i>As. Caricetum divisae</i>	6,0	0,36	0,65	0,05	Degr
<i>As. Taraxaco bessarabici - Caricetum distantis</i>	7,1	0,29	0,41	0,03	Degr
AI . <i>Cypero - Spergularion salinae</i>					
<i>As. Spergularietum mediae</i>	3,1	0,17	0,31	0,03	Degr
Average	12,7	0,52	1,07	0,09	Degr
Evaluation	FS	FS	FS	FS	X

Their productivity is mostly degraded except for *As. Puccinellietum limosae* which is somewhat more valuable allowing an optimum loading of 0.5 LU/ ha,

quite weak. Also, poor productivity is found on the *Plantagietea majoris* Class grasslands, which support an average optimum load of only 0.43 LU/ ha / season (table 4).

Table 4

Productivity of ruderal grasslands in the Măcinului Mountains

Vegetation	Pastoral value (VP)	Indices for useful phytomass (M)	Green mass production (GM, t/ha)	Optimal animal loading (LU/ha)	Evaluation
Al . Polygonion avicularis					
<i>As. Lolio – Plantaginatum majoris</i>	63,9	3,75	9,37	0,78	Med.
<i>As. Poëtum annuae</i>	70,7	2,04	4,49	0,37	FS
<i>As. Sclerochloa – Polygonetum</i>	51,8	0,82	6,53	0,54	S
<i>As. Ranunculetum sardoii</i>	4,8	0,28	0,50	0,04	Degr.
Average	47,8	1,72	5,22	0,43	S
Evaluation	Mijl.	S	S-M	S	X

For the needs of those who make pastoral arrangements and those of production, it is more important to know the productivity of grasslands at the level of phytosociological alliance that, in the broader, European conception, is closer to the habitat (table 5).

The most valuable alliance is *Cynosurion* and the weakest *Cypero - Spergularion salinae*, on average the grasslands of the Măcinului Mountains have a pastoral value of 35 (mediocre) with a useful green mass production of almost 5.9 t / ha, which supports an optimal loading of almost 0.5 LU/ha/season. These data confirm the very advanced state of degradation of the grass carpet, mainly due to overgrowth, arid conditions, salinity, beatings and other pedoclimatic and zooanthropic limiting factors.

Of major interest is the knowledge of the current loading of animals of the communal pastures in the localities bordering the Măcin Mountains (table 6).

Thus, on an area of almost 8 thousand hectares of permanent pastures there are 7,535 LU, of which 95% are sheep and goats and the remaining 5% are cattle. The livestock load per hectare ranges from 0.90 to 1.08 LU/ha on average 0.95 LU/ha, almost double the optimum of 0.50 evaluated for these pastures. Considering that the xerophyte meadows of the *Festuco-Brometea* class with an optimum load evaluated at 0.34 LU / ha, the weight with over 80% of the territory can be stated that the loading with animals in the Măcinului Mountains and the surrounding area is almost 3 times more high above normality.

Table 5

Productivity and optimal loading with animals at the level of phytosociological alliances of permanent grasslands in the Măcinului Mountains

Phytosociological alliance	Value		Production		Animal loading LU/ha	Evaluation
	Pastoral value (VP)	Relativ (%)	Forage (t/ha)	Relativ (%)		
<i>Agrostion stoloniferae</i>	81,6	233	16,52	280	1,38	B
<i>Cynosurion</i>	94,7	271	23,46	398	1,96	FB
<i>Potentillion anserinae</i>	38,6	110	6,53	111	0,54	S
<i>Festucion valesiacaе</i>	37,3	107	4,86	83	0,39	FS
<i>Stipion lessingianaе</i>	7,8	22	0,77	13	0,06	Degr.
<i>Artemisio – Kochion</i>	15,0	43	1,73	29	0,14	Degr.
<i>Pimpinello–Thymion zygoidi</i>	36,0	103	3,84	65	0,32	FS
<i>Puccinellion limosae</i>	18,0	51	1,35	23	0,11	Degr.
<i>Scorzonero – Juncion gerardii</i>	5,4	15	0,43	7	0,04	Degr.
<i>Cypero – Spergularion salinae</i>	3,1	9	0,31	5	0,03	Degr.
<i>Polygonion avicularis</i>	48,3	138	4,99	85	0,42	S
Average	35,0	100	5,89	100	0,49	S
Evaluation	Med.	X	S-Med.	X	S	X

Table 6

Animal loading on pastures from the Măcinului Mountains National Park

Location	Grassland surface (ha)	Animal number		Total LU (no.)	LU/ ha	% compared to optimum 0,5 LU/ha
		Cattle	Sheep + goats			
Cerna	4.751	47	30.410	4.293	0,90	180
Greci	976	52	6.870	1.001	1,03	206
Hamcearca	529	123	3.420	671	1,08	216
Jijila	1.234	200	7.500	1.200	0,97	194
Măcin	477	124	2.690	470	0,99	198
Total	7.967	546	50.890	7.535	0,95	190
Coef. LU	x	0,75	0,14	x	x	x
LU nr.	x	410	7.125	7.535	x	x
% compared to total	x	5	95	100	x	x

CONCLUSIONS

The productivity of permanent grasslands in the Măcinului Mountains is very low, which is why it would withstand an optimum load of only 0.5 LU / ha /

185 days grazing season. The current load of animals is on average of 0.95 LU / ha during the grazing season, being 2 to 3 times higher than the optimal grassland support

capacity. Regulating the use of pastures as livestock loading and grazing time, providing feed from forage crops on arable land for the

current herd would substantially contribute to the restoration of biodiversity of overgrown grassland.

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