EVALUATION OF THE PRODUCTIVITY OF SUBALPINE AND ALPINE PASTURES IN THE RÂIOSU AND BUDA MOUNTAINS, FĂGĂRAŞ MASSIF

Teodor MARUȘCA[1], Daniela Ileana STANCU[2], Marcela M. DRAGOȘ[3], Cristina I. PORR[4], Cristina C. COMȘIA[5], Monica A. TOD[6]

Abstract. *The subalpine and alpine pastures of Râiosu and Buda Făgăraș are located between 1,700 and 2,200 m altitude on soils with rocks on the surface, the average slope inclination of 30 degrees (9-50), average number of cormophytes 30 (16-44) and an average vegetation cover of 51% (27-66) of which with fodder value 21% and harmful 30 %. The best results were evaluated in the associations Seslerio haynaldianae - Caricetum sempervirentis with 31 pastoral value index (VP), 2.4 t/ha green mass (GM), a load of 0.52 LU /ha in 70 days of grazing, the association Scorzonero roseae - Festucetum nigricantis with 16.5 PV and 2 t/ha GM, the association Poëtum mediae with 24.2 PV and 1.7 t/ha GM. In the rest of the associations with PV mostly below index 2, GM productions below 1 t/ha with a load of below 0.2 LU/ha in 50-70 days of grazing season with very low productivity. These data are used in particular to establish the optimal animal load in the grazing season for the conservation of biodiversity. Milk production per hectare was assessed at the level of Natura 2000 Grassland Habitats and reaches an average of 620 liters per hectare. In Habitat 6,170 milk production is 39% higher and in degraded Habitat 6520 40% lower than average, data that are used in the economic evaluation of subalpine and alpine grasslands in the study area.*

Keywords: subalpine and alpine pastures, pastoral value, green mass and milk production, animal loading.

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[1]Eng., PhD. Teodor MARUȘCA - Institutul de Cercetare - Dezvoltare pentru Pajiști Brașov, Membru titular al Academiei Oamenilor de Știință din România / Research and development Institute for Grasslands Brașov, Full Member of The Academy of the Romanian Scientists, (e-mail: maruscat@yahoo.com).
[2]PhD Daniela Ileana STANCU - Muzeul Județean Argeș-Pitești / Argeș-Pitești County Museum (e-mail:stancuileana@yahoo.com)
[3]Eng. PhD Marcela M. DRAGOȘ - Institutul de Cercetare - Dezvoltare pentru Pajiști Brașov/ Research and development Institute for Grasslands Brașov, (marcela.dragos@pajisti-grassland.ro).
[4]Eng. Cristina I. PORR - Institutul de Cercetare - Dezvoltare pentru Pajiști Brașov/ Research and development Institute for Grasslands Brașov, (cristina.porr@pajisti-grassland.ro).
[5]Eng. Cristina C. COMȘIA - Institutul de Cercetare - Dezvoltare pentru Pajiști Brașov/ Research and development Institute for Grasslands Brașov, (cristina.comsia@pajisti-grassland.ro).
[6]Biol. PhD Monica A. TOD - Institutul de Cercetare - Dezvoltare pentru Pajiști Brașov/ Research and development Institute for Grasslands Brașov, (monica.tod@pajisti-grassland.ro).

1. Introduction

Data on the production of green fodder mass and pastoral value of a grassland serve to assess the quality of a grassland by establishing the optimal animal load and ultimately their production during the grazing season.

These basic economic indicators continue to serve in the preparation of pastoral arrangements and the appropriate management of grasslands. [5]

Alpine and subalpine grasslands located in high mountains are more difficult to assess due to more difficult relief and accessibility conditions. [2]

Under these conditions, productivity evaluation was carried out using a new method based on floristic survey. [7, 11]

To date, only a first approximation of the mountain areas of the Carpathians have been evaluated and published. [12]

The present work is a continuation of the assessment of the productivity of mountain grasslands in the Făgăraș Mountains in less studied areas with additional data on milk production of subalpine and alpine pasture habitats.

2. Material and method

The basic materials for the productivity assessment were the synthetic surveys prepared according to the Braun-Blanquet phytosociological method from the work "*Flora and vegetation of the Râiosu and Buda Mountains, Făgăraș Massif*" prepared by Daniela Ileana Stancu. [1, 3, 4, 13]

The outline of the associations was as follows:

CARICETEA CURVULAE Br. Bl. 1948
(JUNCETEA TRIFIDI Klika et Hadač 1944 p.p.)
Caricetalia curvulae Br. Bl. in Br. Bl. et Jenny 1926
Caricion curvulae Br. Bl. in Br. Bl. et Jenny 1926
Primulo Caricetum curvulae Br. Bl. 1926 em. Oberd. 1957
Potentillo ternatae Festucetum supinae Boşcaiu 1971
(*Potentillo chrysocraspedae Festucetum airoidis nom. mut. propos*.)
Loiseleurio Vaccinion Br. Bl. in Br. Bl. et Jenny 1926
Cetrario Loiseleurietum procumbentis Br. Bl. in Br. Bl. et Jenny 1926
NARDO CALLUNETEA Prsg. 1949
Nardetalia Oberd. 1949
Potentillo Nardion Simon 1957
Violo declinatae Nardetum Simon 1966
Scorzonero roseae Festucetum nigricantis (Puşcaru et al. 1956) Coldea 1987

Poëtum mediae Csürös 1956
CARICI RUPESTRIS – KOBRESIETEA BELLARDI Ohba 1974
Elinetalia Oberd. 1957
Oxytropido-Elynion Br.-Bl. 1949
Achilleo schurii - Dryadetum (Beldie 1967) Coldea 1984
SESLERIETEA ALBICANTIS Br. Bl. 1948 em. Oberd. 1978
Seslerietalia albicantis Br. Bl. in Br. Bl. et Jenny 1926
Festuco saxatilis Seslerion bielzii (Pawl. et Walas 1949) Coldea 1984
Seslerio bielzii Catricetum sempervirentis Puşcaru et al. 1956
Seslerio haynaldianae Caricetum sempervirentis Puşcaru et al. 1956
BETULO ADENOSTYLETEA Br. Bl. et Tx. 1943
Adenostyletalia Br. Bl. 1931
Calamagrostion villosae Pawl. 1928
Phleo alpini Deschampsietum villosae (Krajina 1933) Coldea 1983
Rumicetalia alpini Mucina in Kramer et Mucina 1993
Rumicion alpini Rübel ex Klika in Klika et Hadac 1944
Rumicetum alpini Beger 1922

The actual evaluation based on floristic survey has been described in several papers published in the Annals of the Academy of Romanian Scientists (AOȘR), so we will not repeat its presentation. [6, 8, 9, 10].

3. Results and discussion

In the reference work for the subalpine and alpine grasslands of the Râiosu and Buda Mountains of the Făgăraș Massif, 90 floristic surveys were prepared located between 1,700-2,200 m altitude on flat terrain and slopes with an average inclination of 300 on all exposures. (Table 1)

The average number of cormophytes was 30 species, respectively the richest (38-44 sp.) in the *Scorzonero roseae-Festucetum nigricantis associations, Seslerio haynaldianae - Caricetum sempervirentis* and *Violo declinatae-Nardetum* and the poorest (16-20 sp.), *Rumicetum alpini*, *Potentillo ternatae-Festucetum supinae* and *Cetrario-Loiseleurietum procumbentis.*

The average vegetation cover was 51%, very low due to the surface rocks, wind and rain erosion of the surface soil and sometimes excessive grazing. The lowest vegetation cover of only 27% was recorded for *Achilleo schurii-Dryadetum* and slightly higher than 66% for *Seslerio haynaldianae - Caricetum sempervirentis.*

Table 1. Overview of associations in the Făgăraș Mountains

No. crt.	Plant association	No. of surveys	Altitude (m)	Exposition	Inclination (degrees)	Cormophyte species (no.)	Vegetation cover %
Al. ***Caricion curvulae***							
1	*Primulo-Caricetum curvulae*	10	2,100 (1,950-2,200)	S, W, SE	30 (15-45)	22	43
2	*Potentillo ternatae-Festucetum supinae*	10	1,900 (1,800-2,000)	S, SE, W, E	23 (15-35)	19	42
Al. ***Loisleurio-Vaccinion***							
3	*Cetrario-Loiseleurietum procumbentis*	8	2,000 (1,900-2,100)	N, E, NE, NW	50 (45-65)	20	64
Al. ***Potentillo-Nardion***							
4	*Violo declinatae-Nardetum*	10	2,100 (1,950-2,200)	S, SE, E, F	32 (0-45)	44	39
5	*Scorzonero roseae-Festucetum nigricantis*	8	1,800 (1,700-1,900)	S, SE, E	42 (15-50)	38	48
6	*Poetum mediae*	8	2,150 (2,000-2,200)	S, W, SE, SW, W	15 (0-30)	24	63
Al. ***Oxytropido-Elynion***							
7	*Achilleo schurii-Dryadetum*	5	2,150 (2,100-2,200)	N, W, NW	39 (35-45)	23	27
Al. ***Festuco saxatilis-Seslerion bielzii***							
8	*Seslerio bielzii - Catricetum sempervirentis*	5	1,900 (1,700-2,000)	N, NE	39 (35-45)	36	47
9	*Seslerio haynaldianae - Caricetum sempervirentis*	10	1,900 (1,750-2,000)	S, SE	32 (15-45)	43	66
Al. ***Calamagrostion villosae***							
10	*Phleo alpini - Deschampsietum villosae*	8	1,850 (1,800-1,900)	W, S, N, SW, F	9 (0-15)	31	61
Al. ***Rumicion alpines***							
11	*Alpine Rumicetum*	8	1,750 (1,700-1,850)	W, S, SW, N, F	16 (0-30)	16	58
AVERAGE-TOTAL		**90**	**1,950 (1,700-2,200)**	**ALL**	**30**	**30**	**51**

The average ratio between the coverage of grassy vegetation with forage value (21%) and harmful vegetation (30%) indicates the advanced stage of vegetation degradation with a pastoral value index of 11, a production of 0.9 t/ha of green mass and an average load of 0.21 LU/ha in approximately 65 days of the grazing season. (Table 2)

Table 2. Forage structure, pastoral value, green mass production and optimal animal loading

No. crt.	Plant association	Species structure (%)		Pastoral value		Green mass production t/ha	Grazing season duration (days)	Animal loading LU/ha
		Forrage	Harmful	Ind.	%			
Al. ***Caricion curvulae***								
1	*Primulo-Caricetum curvulae*	33	10	18.16	165	0.61	55	0.17
2	*Potentillo ternatae-Festucetum supinae*	26	16	14.54	132	0.85	70	0.18
Al. ***Loisleurio-Vaccinion***								
3	*Cetrario-Loiseleurietum procumbentis*	2	62	1.14	10	0.04	62	0.01
Al. ***Potentillo-Nardion***								
4	*Violo declinatae-Nardetum*	3	36	1.82	17	0.14	55	0.04
5	*Scorzonero roseae-Festucetum nigricantis*	23	25	16.48	150	2.03	77	0.40
6	*Poetum mediae*	43	20	24.24	220	1.66	51	0.50
Al. ***Oxytropido-Elynion***								
7	*Achilleo schurii-Dryadetum*	1	26	0.27	2	0.03	51	0.01
Al. ***Festuco saxatilis-Seslerion bielzii***								
8	*Seslerio bielzii - Catricetum sempervirentis*	23	24	10.08	92	1.09	70	0.24
9	*Seslerio haynaldianae - Caricetum sempervirentis*	58	8	31.03	282	2.40	70	0.52
Al. ***Calamagrostion villosae***								
10	*Phleo alpini - Deschampsietum villosae*	9	52	0.16	1	0.49	73	0.10
Al. ***Rumicion alpines***								
11	*Alpine Rumicetum*	5	53	3.09	28	0.60	81	0.11
AVERAGE		**21**	**30**	**11.00**	**100**	**0.90**	**65**	**0.21**

The highest pastoral value index was evaluated in the association *Seslerio haynaldianae - Caricetum sempervirentis* (31.03), *Poetum mediae* (24.24) and

Primulo-Caricetum curvulae (18.16) and the lowest in *Phleo alpini - Deschampsietum villosae* (0.16), *Achilleo schurii-Dryadetum* (0.27) and *Cetrario-Loiseleurietum procumbentis* (1.14), the latter two or three being considered degraded.

Finally, the possible milk production for grassland habitats in the study area was evaluated only for those with a pastoral value index (PV) greater than 10 and a green mass (GM) forage production over 1,000 kg/ha. (Table 3)

Table 3. Cow milk production of the main subalpine and alpine pasture habitats

Habitat (Phytosociological Alliance)	Green mass production		Animal loading (LU/ha)	Pastoral value (ind.)	Grazing season duration (days)	Milk production	
	t/ha	%				L/ha	%
6150 (*Caricion curvulae)*	0.73	63	0.18	16.35	63	620	100
6170 (*Festuco saxatilis-Seslerion bielzii)*	1.75	152	0.38	20.55	70	860	139
6520 degraded (*Potentillo-Nardion* ; *Calamagrostion villosae, Rumicion alpini)*	0.98	85	0.23	0.92	67	370	60
Mediate	**1.15**	**100**	**0.26**	**12.61**	**67**	**620**	**100**

From these data it follows that the average production of GM was 1.15 t/ha, which allows a load of 0.26 LU/ha in a 67-day grazing season in which 620 liters of milk per hectare can be obtained.

The best milk production results were evaluated at Habitatele 6170 with 860 L/ha similar to the alliance *Festuco saxatilis-Seslerion bielzii* and the lowest at the degraded Habitat 6520 of only 370 L/ha with *the Potentillo-Nardion alliance, Calamagrostion villosae, Rumicion alpini, the lack of forage value of the dominant species Nardus stricta,* Deschampsia caespitosae, Rumicion alpinus being known.

In general, subalpine and alpine grasslands have a low economic value, making it more important to optimize animal stocking for biodiversity conservation.

Conclusions

(1). Pastures from the bioclimatic levels of the Făgăraș Mountains have a low average productivity due to the average vegetation coverage of 51%, rocks on the surface, pluvial and wind erosion.

(2). The average production of green fodder mass at the level of NATURA 2000 Habitats was evaluated at 1.15 t/ha, which allows a loading of 0.26 LU/ha in 67 days of grazing.

(3). The average milk production per hectare was 620 l/ha, 39% higher in Habitat 1570 and 40% lower in the degraded Habitat 6520.

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