

PRODUCTIVITY OF THE GRASSLANDS IN THE ARIEȘ VALLEY OF THE APUSENI MOUNTAINS

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Abstract

The grasslands of the Aries Valley are an integral part of the Apuseni Mountains, located between 340 and 1280 m altitude. 153 floristic surveys were carried out, which contained an average of 81 species of cormophytes and an average vegetation cover of 89%, of which 58% were forage species and 31% were species harmful to the grassy carpet. The average pastoral value (PV) of the 18 grassland associations was 39 and the production of green fodder mass (GM) was 7.9 t/ha with an optimal load of 0.7 LU/ha in 170 days of grazing season. In the 5 phytosociological alliances (Cynosurion cristati, Violion caninae, Stipion lessingianae, Festucion rupicolae and Cirsio pannonicae-Brachypodium pinnati) used mainly by grazing, an average of 5 t/ha GM was evaluated, an index of almost 30 VP with which 2900 liters of cow's milk per hectare can be produced with an optimal load of 0.5 LU/ha in a 160-day grazing season. In the alliances harvested in haylage regime (Agrostion albae, Arrhenatherion elatioris and Holco-Juncion) 11.8 t/ha GM and 57.6 PV were evaluated with 236% GM and 193 PV index higher than the grassland alliances used by grazing with animals. Economic data on grassland productivity are used both in the preparation of development projects and in their further management.

Keywords: mountain grasslands, pastoral value, green mass production, milk production, optimal load.

INTRODUCTION

The efficient management of permanent grasslands calls for knowledge of the floristic composition of the grassy carpet, the production and forage quality followed by the means of improvement if they are degraded and further rational use through grazing or mowing (ANGHEL et al., 1967; BĂRBULESCU and MOTCĂ, 1983). These data for evaluating the productivity of

grasslands (green mass production and pastoral value) continue to serve for the preparation of their development projects, for establishing the optimal animal load, animal production (milk, meat, etc.) and other economic purposes (MARUȘCA et al., 2014). In this paper, the evaluation of the productivity of mountain grasslands is continued according to the new method based on floristic survey in

order to meet the needs presented above.

MATERIAL AND METHOD

In the present work, the floristic surveys from the work "*The grasslands of the Arieş Valley, between Lupşa and Turda*" author József P. Frink doctoral thesis

under the supervision of Prof. Vasile Cristea from the "Babeş-Bolyai" University of Cluj-Napoca were used.

In this work, 18 grassland associations were identified as follows:

CL. MOLINIO - ARRHENATHERETEA R. Tx. 1937

Ord. MOLINIETALIA Koch 1926

Al. Agrostion albae Soó 1943

1. As. *Agrostio-Deschampsietum caespitosae* Ujvárosi 1947
- *nardosum strictae* (facies cu *Nardus stricta*)

2. As. *Agrostetum albae* Ujvárosi 1941

3. As. *Festucetum pratensis* Soó 1938

Al. Holco-Juncion Pass. 1964

4. As. *Holcetum lanati* Issler 1936 em. Pass. 1964
- *caricosum vulpinae* (facies cu *Carex vulpina*)

Ord. ARRHENATHERETALIA Pawlowski 1928

Al. Arrhenatherion elatioris Koch 1926

5. As. *Arrhenatheretum elatioris* Br.-Bl. Ex Scherrer 1925
- *trisetetosum flavescens* Horvatić 1930

6. As. *Trisetetum flavescens* Rübel 1911

Al. Cynosurion cristati R. Tx. 1947

7. As. *Festuco rubrae-Agrostietum capillaris* Horvat 1951
- *genistetosum sagittalis* Coldea 1991
- *nardosum strictae* (facies *Nardus stricta*)
- *danthoniosum decumbens* (facies cu *Danthonia decumbens*)

CL. NARDO - CALLUNETEA Preising. 1949

Ord. NARDETALIA Oberd. ex Preising. 1949

Al. Violion caninae Schwickerath 1944

8. As. *Nardo-Callunetum vulgaris* (Šmarda 1953) Csűrös 1964

CL. FESTUCO-BROMETEA Br.-Bl. et R. Tx. ex Klika et Hadač 1944

Ord. FESTUCETALIA VALESIACAE Br.-Bl. et R. Tx. ex Br.-Bl. 1949

Al. Stipion lessingianae Soó 1947

9. As. *Stipetum lessingianae* Soó (1927 n. n.) 1947
- *botriochloosum ischaemi* (facies cu *Dichanthium ischaemum*)

10. As. *Stipetum pulcherrimae* Soó 1942

- *botriochloosum ischaemi* (facies cu *Dichanthium ischaemum*)

Al. Festucion rupicolae Soó 1940 corr. 1964

11. As. *Stipetum capillatae* (Hueck 1931) Krausch 1961
- *botriochloosum ischaemi* (facies cu *Dichanthium ischaemum*)
 12. As. *Festuco rupicolae* - *Caricetum humilis* Soó 1930, 1947
- *botriochloetosum* Rațiu et al. 1969
- *festucosum valesiacae* (facies cu *Festuca valesiaca*)
- *stiposum pulcherrimae* (facies cu *Stipa pulcherrima*)
 13. As. *Agrostio* - *Festucetum rupicolae* Csűrös-Káptalan (1962) 1964
 14. As. *Agrostio-Festucetum valesiacae* Borisavljević Jovanović-Dunjić et Mišić 1955
 15. As. *Festucetum valesiaco-rupicolae* Csűrös et Kovács 1962
- *botriochloosum ischaemi* (facies cu *Dichanthium ischaemum*)
 16. As. *Botriochloetum ischaemi* Pop 1977
- Ord. BROMETALIA ERECTI** Br.-Bl. 1936
- Al. Cirsio pannonicae - Brachypodion pinnati** Hadač et Klika 1944
17. As. *Carici humilis* - *Brachypodietum pinnati* Soó 1947, 1949
- *festucetosum rupicolae* Kovács et Coldea 1967
 18. As. *Festuco rupicolae* - *Brachypodietum pinnati* (Soó 1927) Schneider-Binder 1971

The method for evaluating the production of green fodder mass and pastoral value was done according to the new method based on floristic survey (MARUȘCA, 2019, 2022; MARUȘCA et al. 2021, 2023). Following this method,

several works have been published and currently a journal of mountaineering, where more details regarding the working method are presented, on which we will not intervene (MARUȘCA et al. 2020 a, b; MARUȘCA et al. 2023, 2024).

RESULTS AND DISCUSSIONS

In the Arieș Valley between Lupșa and Turda, 18 grassland associations, 8 alliances, 5 orders

and 3 vegetation classes were identified between 340-1280 m altitude. (Table 1)

Table 1

Overview of the grassland associations in the Arieș Valley

No.	Association	No. of survey.	Altitude (m)	Exposition	Slope (grade)	Cormophyte (nr)	Coverage %
Al. <i>Agrostion albae</i>							
1	<i>Agrostio-Deschampsietum caespitosae</i>	4	600 (500-620)	PLAN	0	37	80
2	<i>Agrostetum albae</i>	4	400 (340-460)	PLAN	0	59	93
3	<i>Festucetum pratensis</i>	9	420 (370-450)	PLAN, E, SE	4	106	97
Al. <i>Holco-Juncion</i>							
4	<i>Holcetum lanati</i>	3	370	PLAN	0	47	96

No.	Association	No. of survey.	Altitude (m)	Exposition	Slope (grade)	Cormophyte (nr)	Coverage %
			(350-420)				
Al. <i>Arrhenatherion elatioris</i>							
5	<i>Arrhenatheretum elatioris</i>	23	420 (350-580)	PLAN, W, E, S, SE, NE	3	161	98
6	<i>Trisetetum flavescens</i>	2	400 (380-420)	E	4	46	100
Al. <i>Cynosurion cristati</i>							
7	<i>Festuco rubrae-Agrostetum capillaris</i>	41	730 (450-1280)	N, S, NW, SE, W, NE, E, PLAN	12	186	98
Al. <i>Violion caninae</i>							
8	<i>Nardo-Callunetum vulgaris</i>	4	740 (650-1000)	S	12	42	88
Al. <i>Stipion lessingianae</i>							
9	<i>Stipetum lessingianae</i>	5	420 (400-450)	SW, S	34	34	79
10	<i>Stipetum pulcherrimae</i>	5	400 (350-490)	S, SW	19	61	68
Al. <i>Festucion rupicolae</i>							
11	<i>Stipetum capillatae</i>	6	400 (350-400)	S, SE	16	72	65
12	<i>Festuco rupicolae-Caricetum humilis</i>	8	480 (400-640)	S, W, E	17	108	85
13	<i>Agrostio-Festucetum rupicolae</i>	7	580 (390-680)	W, S, E, SE, SW, P	9	90	95
14	<i>Agrostio-Festucetum valesiacae</i>	7	620 (550-850)	S, SW, E, SE	22	95	96
15	<i>Festucetum valesiaco-rupicolae</i>	9	460 (360-580)	PLAN, S, SW, E, SE	4	113	90
16	<i>Botriochloetum ischaemi</i>	4	370 (350-420)	S, SE	14	39	86
Al. <i>Cirsio pannonicae-Brachypodion pinnati</i>							
17	<i>Carici humilis-Brachypodietum pinnati</i>	4	660 (450-900)	W, S	12	80	92
18	<i>Festuco rupicolae-Brachypodietum pinnati</i>	8	500 (350-550)	N, E, NW, PLAN, W	6	90	87
AVERAGE-TOTAL		153	470 (340-1280)	ALL	10	81	89

In the 153 surveys conducted with an average vegetation cover of 89%, 81 species of cormophytes were determined. The associations with the most cormophyte species were *Festuco rubrae-Agrostetum capillaris* (186 species), *Festucetum valesiaco-rupicolae* (113 species),

Festuco rupicolae - Caricetum humilis (108 species) and *Festucetum pratensis* (106 species) and the lowest number of species was recorded in *Stipetum lessingianae* (34 species), *Agrostio-Deschampsietum caespitosae* (37 species) and *Botriochloetum*

ischaemi (39 species). The average participation in the grassy carpet was 58% species with forage value and 31% harmful species, a ratio that influenced the pastoral value index (PV) which was 39.22

(mediocre), the green mass production (GM) of 7.88 t/ha, with an optimal load of 0.68 LU/ha in 170 days of grazing season (Table 2).

Table 2

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

No.	Association	Species structure (%)		Pastoral value		Green mass production (t/ha)	Grazing season duration (days)	Animal loading (LU/ha)
		Forager	Harmful	Ind.	%			
Al. <i>Agrostion albae</i>								
1	<i>Agrostio-Deschampsietum caespitosae</i>	28	52	18.86	48	2.44	170	0.22
2	<i>Agrostetum albae</i>	75	18	61.22	156	12.56	160	1.21
3	<i>Festucetum pratensis</i>	89	8	74.89	191	14.95	165	1.39
Al. <i>Holco-Juncion</i>								
4	<i>Holcetum lanati</i>	68	28	45.78	117	9.50	155	0.94
Al. <i>Arrhenatherion elatioris</i>								
5	<i>Arrhenatheretum elatioris</i>	91	7	76.79	196	18.46	165	1.72
6	<i>Trisetetum flavescens</i>	93	7	73.87	188	13.57	160	1.30
Al. . <i>Cynosurion cristati</i>								
7	<i>Festuco rubrae-Agrostetum capillaris</i>	81	17	56.84	145	9.02	155	0.90
Al. . <i>Violion caninae</i>								
8	<i>Nardo-Callunetum vulgaris</i>	20	68	13.49	34	1.46	155	0.14
Al. <i>Stipion lessingianae</i>								
9	<i>Stipetum lessingianae</i>	16	63	7.66	20	0.59	165	0.05
10	<i>Stipetum pulcherrimae</i>	16	52	8.00	20	0.77	160	0.07
Al. <i>Festucion rupicolae</i>								
11	<i>Stipetum capillatae</i>	3	62	1.98	5	0.27	160	0.03
12	<i>Festuco rupicolae-Caricetum humilis</i>	60	25	36.06	92	5.45	170	0.49
13	<i>Agrostio-Festucetum rupicolae</i>	82	13	54.08	138	8.94	165	0.83
14	<i>Agrostio-Festucetum valesiacae</i>	69	27	43.88	112	6.00	160	0.58
15	<i>Festucetum valesiaco-rupicolae</i>	77	13	44.16	113	7.87	170	0.71
16	<i>Botriochloetum ischaemi</i>	16	70	8.38	21	1.12	155	0.11
Al. <i>Cirsio pannonicarum-Brachypodium pinnati</i>								
17	<i>Carici humilis-Brachypodietum pinnati</i>	71	21	38.03	97	6.52	165	0.61
18	<i>Festuco rupicolae-Brachypodietum pinnati</i>	74	13	42.02	107	11.35	175	1.0
AVERAGE		57	31	39.22	100	7.82	170	0.68

The highest productivity was evaluated in associations harvested mainly in hay regime such as

Arrhenatheretum elatioris (76.79 PV; 18.46 t/ha GM), *Festucetum pratensis* (74.89 PV; 14.95 t/ha

GM) and *Trisetum flavescens* (73.87 PV; 13.57 t/ha GM). The lowest productivity was evaluated in associations dominated by *Stipa sp.* (2-8 PV; 0.3-0.8 t/ha GM) associations with degraded forage vegetation *Botriochloetum ischaemi* and *Nardo-Callunetum vulgaris* (8-

13.5 PV; 1.12-1.46 t/ha GM) valorized by grazing with animals at a load of only 0.03-0.14 LU/ha. The phytosociological alliance level analysis with data closer to Natura 2000 habitats is presented in Table 3.

Table 3

Grazing season duration, pastoral value, green mass production and cow's milk at grassland phytosociological alliance level

Phytosociological alliance		Grazing season duration (days)	Green mass production		Animal loading LU/ha	Pastoral value (ind.)	Milk production	
			t/ha	%			L/ha	%
A. Pasture, main use								
Cynosurion cristati		155	9.02	180	0.90	56.8	5280	182
Violion caninae		155	1.46	29	0.14	13.5	1260	43
Stipion lessingianae		165	0.68	14	0.06	7.8	770	27
Festucion rupicolae		165	4.94	99	0.46	31.4	3110	107
Cirsio pannonicae-Brachypodion pinnati		170	8.93	178	0.81	40.0	4080	141
Average A		160	5.01	100	0.47	29.9	2900	100
B. Hay, main use								
Agrostion albae		x	9.98	84	x	51.7	x	x
Holco-Juncion		x	9.50	80	x	45.8	x	x
Arrhenatherion elatioris		x	16.01	135	x	75.3	x	x
Average B		x	11.83	100	x	57.6	x	x
Difference B-A	+, -	x	+6.82	x	x	+27.7	x	x
	%	x	236	x	x	193	x	x

By synthesizing the 18 grassland associations in 8 phytosociological alliances similar to EU habitats (GAFTA, MAOUNTFORD, 2008), the average productivity results are slightly different from those evaluated at the level of component associations. The equivalent of cow's milk production is a final parameter for evaluating the productivity of a grassland, which in our case varied within very wide limits depending on the pastoral value and the duration of the

grazing season dependent on altitude and air temperature (MARUŞCA, 2022). Thus, in the grasslands used by grazing with animals at the level of the 5 phytosociological alliances, 5t/ha green mass (GM) was evaluated, a pastoral value (PV) of almost 30, 2900 liters of cow's milk per hectare can be produced with a load of almost 0.5 LU /ha in an average season of 160 days grazing season. The most valuable alliance is *Cynosurion cristati* with 9 t/ha GM, PV index of 57, 5280 L/ha milk in

155 days of grazing with a load of 0.9 LU/ha. The worst results were evaluated in the alliance *Stipion lessingianae* with 0.7 t/ha GM, PV index of 7.8, 770 L/ha milk in 165 days of grazing with a load of 0.06 LU /ha. Poor results were also evaluated in one of the most widespread alliances *Violion caninae* which has its origin in *Cynosurion cristati* through its invasion by the species *Nardus stricta*, where 1.46 t/ha GM is obtained, a PV index of only 13.5 and 1260 L/ha milk, achieved in 155 days of grazing with a load of

0.14 LU /ha. The last 3 alliances mainly exploited as hay achieve an average production of 11.8 t/ha GM and a 57.6 PV index with 236% GM and 193% PV index higher than the average of alliances exploited by grazing. The highest GM production and PV index were evaluated in the *Arrhenatherion elatioris* alliance (16t/ha GM and 75 PV) and the lowest in *Holco-Juncion* (9.5t/ha GM and 46 PV). Grasslands used by mowing for hay are better managed and fertilized than those used by grazing with animals.

CONCLUSIONS

The permanent grasslands of the Arieş Valley located between 340-1280 m altitude with a remarkable phytodiversity represented by 372 species of cormophytes, 18 associations, 8 alliances and 5 orders belonging to 3 vegetation classes. The association with the most species was *Festuco rubrae-Agrostetum capillaris* (186 species) and the fewest at *Stipetum lessingianae* (34 species). The best productivity was evaluated at the *Arrhenatheretum elatioris* association with a pastoral value (PV) of 76.8 and a green fodder

mass production (GM) of 18.5 t/ha. The lowest productivity was evaluated at the *Botriochloetum ischaemi* and *Nardo-Callunetum vulgaris* associations with 8-13.5 PV and 1.12-1.46 t/ha GM. At the phytosociological alliance (habitat) level, the most valuable was *Cynosurion cristati* with 9 t/ha GM, 57 PV index, 5280 liters of milk per hectare in 155 days of grazing season, and the weakest was evaluated at *Stipion lessingianae* with 0.7 t/ha GM, 7.8 PV index, 770 L/ha milk in 165 days of grazing season.

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