

## CONTRIBUTIONS TO ASSESSING THE PRODUCTIVITY OF GRASSLANDS FROM THE MESEȘ MOUNTAINS

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**Abstract.** *The Meseș Mountains with altitudes lower than 400 - 980 m are part of the Western Carpathians of Romania, the northern branch. 123 floristic surveys were carried out on grasslands with an average of 63 species per survey and 20 associations belonging to 13 alliances, 9 orders and 6 phytosociological classes were outlined. The average coverage with vegetation was 85%, of which 36% was represented by forage species and 49% by species harmful to the grass carpet, being grasslands in an advanced stage of degradation. The average pastoral value of the practical associations is 24.3 (poor) and green mass production of 3.9 t/ha (poor) which allows a load of 0.35 LU/ha in a season of 170 days of grazing. At the level of the most important and valuable phytosociological alliances (=habitats), *Agrostion stoloniferae*, *Cynosurion*, *Danthonio-Brachypodion* and *Festucion valesiacae* were assessed on average 9.2 t/ha of green mass, a load of 0.83 LU/ha, a pastoral value of 49 and a production of 5,000 liters of cow's milk per hectare.*

**Keywords:** mountain grasslands, grassland classification, pastoral value, production of green mass and milk

DOI [10.56082/annalsarsciagr.2024.2.98](https://doi.org/10.56082/annalsarsciagr.2024.2.98)

### 1. Introduction

Knowing the productivity of permanent grasslands in the mountain area is one of the main economic objectives necessary for their optimal management over a longer period of time [2].

The current and perspective projects for the development of our mountain area in various stages of abandonment will have to take into account the production of green fodder mass and the pastoral value of the grasslands in order to apply the appropriate

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improvement and use measures in order to achieve good results that will stop the exodus of the population from these disadvantaged mountain areas. [10]

The methods of determining the production of grasslands, which required fenced spaces dispersed over a vast territory, are cumbersome and expensive.

The development of a new method for evaluating green mass production based on floristic survey has solved this problem [5].

In addition, the productivity of grasslands can be evaluated according to the old or more recent geobotanical studies of some biologists with the aim of knowing and clarifying the vegetation.

The present work is a continuation of the evaluation of the productivity of the grasslands of the Apuseni Mountains.

## 2. Materials and methods

The evaluation of the productivity of the mountain grasslands was carried out in a less studied area based on a doctoral thesis entitled "Flora and vegetation of the Meseş Mountains" drawn up by Simina Florica SĂLĂJAN-ȘTEF under the guidance of Prof. university Petru BURESCU from the University of Oradea, thesis defended in 2021.

Overview of grassland associations identified in the Meseş Mountains:

C1. **MOLINIO-ARRHENATHERETEA** R.Tüxen 1937

Ord. **POTENTILLO-POLYGONETALIA** R. Tüxen 1947

Al. **Potentillion anserinae** R.Tüxen 1937

1. *Potentilletum anserinae* Felföldy 1942

2. *Juncetum effusi* Soó (1931) 1949

3. *Junco inflexi-Menthetum longifoliae* Lohmeyer 1953

Ord. **MOLINIETALIA CAERULEAE** Koch 1926

Al. **Filipendulion** Lohmeyer in Oberdorfer et al. 1967

4. *Lysimachio vulgaris-Filipenduletum ulmariae* Balálátová-Tuláčková 1978

Al. **Calthion palustris** R.Tüxen 1937

5. *Scirpetum sylvatici* Ralski 1931, Maloch 1935 em Schwick 1944

6. *Angelico-Cirsietum cani* Burescu 1998

Al. **Molinion caeruleae** Koch 1926

7. *Junco-Molinietum careuleae* Preising in R.Tx. et Preising ex Klapp 1954

Al. **Agrostion stoloniferae** Soó (1933) 1971

8. *Agrostetum stoloniferae* (Ujvároši 1941) Burduja et al. 1956 (*Syn Rorippo sylvestris-Agrostietum stoloniferae* (Moor 1958) Oberdorfer et Th. Müller))

- Ord. *ARRHENATHERETALIA* R.Tüxen 1931  
Al. *Cynosurion* R.Tüxen 1947
9. *Festuco rubrae-Agrostietum capillaris* Horvat 1951  
10. *Trifolio repenti-Lolietum* Krippelová 1987, Resmeriţă et Pop 1967  
11. *Anthoxantho-Agrostietum capillaris* Sillinger 1933
- Cl. *NARDO-CALLUNETEA* Preising 1949  
Ord. *NARDETALIA* Oberdorfer 1949  
Al. *Potentillo-Nardion* Simon 1959
12. *Nardo - Festucetum rubrae fallax* Puşcaru et al. 1959  
Al. *Genistion pillosae* Duvigneaud 1942  
13. *Nardo-Callunetum vulgaris* Csürös 1964
- Cl. *FESTUCO-BROMETEA* Br.-Bl. et R.Tüxen in Br.-Bl. 1949  
Ord. *BRACHYPODIO-CHRYSOPOGONETALIA* (Horvatic1958) Boşcaiu 1972  
Al. *Danthonio-Brachypodion* Boşcaiu 1972
14. *Danthonio-Brachypodietum pinnati* Soó (1946) 1947  
Ord. *FESTUCETALIA VALESIIACAE* Br.-Bl. et R.Tüxen ex Br.-Bl. 1949  
Al. *Festucion valesiaca* Klika 1931
15. *Agrostio-Festucetum valesiaca* Borisavljevič et al. 1955  
16. *Poterio-Festucetum valesiaca* J.Danon 1964  
17. *Botriochloetum (Andropogonetum) ischaemi* (Kristiansen 1937) Pop 1977  
Ord. *STIPIO PULCHERRIMAE-FESTUCETALIA PALLENTIS* I.Pop 1968  
Al. *Seslerio-Festucion pallentis* Klika 1931
18. *Asplenio rutae-murariae-Melicetum ciliatae* Soó 1962
- Cl. *STELLARIETEA MEDIAE* Tüxen et al. Ex von Rochow 1951  
Ord. *SISYMBRIETALIA* Tüxen in Lohmeyer et al.1962  
Al. *Sisymbriion officinalis* Tüxen, Lohmeyer et Preising in R. T Tüxen  
1950
19. *Xeranthemo cylindranei-Brometum arvensis* Popescu 1992
- Cl. *GALIO-URTICETEA* Passarge 1967 em Kopecky 1969  
Ord. *LAMIO ALBI-CHENOPODIETALIA BONI-HENRICI* Kopecky 1969  
Al. *Galio-Alliarion* Lohmeyer et Oberdorfer 1967 in Oderborfer et al. 1967
20. *Sambucetum ebuli* Felföldy 1942

We inventoried and described 20 grassland associations, belonging to 13 alliances, 9 orders and 6 phytosociological classes.

The working method for the research and classification of the vegetation was that of phytosociology [1, 3].

To evaluate the productivity, the data from the floristic surveys were used, respectively the share of species in the grassy carpet of the grasslands, to which were added indices of forage value and green mass production [5].

Milk production was evaluated using conversion indices that are multiplied by the pastoral value, depending on the length of the grazing season [4].

After this evaluation method, several papers were published in these annals of AOS-R, where the working methods were presented, so we will not repeat them. [6, 7, 8, 9]

### 3. Results and discussions

The permanent grasslands of the Meseş Mountains have an average elevation of 575 m between 400 m to 980 m, on flat and sloping terrain with all exposures, having an average slope of 10 degrees and limits between 0 and 40 degrees. (Table 1)

**Table 1.** General data on the season and vegetation of grassland phytocenoses

No.	Association	Survey (no.)	Altitude (m)	Exposition	Slope (degree)	Cormophytes (nr)	Coverage %
<b>Al. <i>Potentillion anserinae</i></b>							
1	<i>Potentilletum anserinae</i>	3	505(500-510)	Even	0	30	75
2	<i>Juncetum effusi</i>	5	600(520-640)	Even	0	42	89
3	<i>Junco inflexi-Menthetum long.</i>	2	450(410-500)	Even	0	74	84
<b>Al. <i>Filipendulion</i></b>							
4	<i>Lysimachio vulgaris - Filipenduletum ulmariae</i>	3	605(600-620)	Even	0	38	88
<b>Al. <i>Calthion palustris</i></b>							
5	<i>Scirpetum sylvatici</i>	6	405(400-500)	Even	0	48	81
6	<i>Angelico-Cirsietum cani</i>	8	445(400-490)	Even	0	81	81
<b>Al. <i>Molinion caeruleae</i></b>							

No.	Association	Survey (no.)	Altitude (m)	Exposition	Slope (degree)	Cormophytes (nr)	Coverage %
7	<i>Junco-Molinietum careuleae</i>	3	600(575-620)	Even	0	28	87
<b>Al. <i>Agrostion stoloniferae</i></b>							
8	<i>Agrostetum stoloniferae</i>	3	430(400-450)	Even	0	33	83
<b>Al. <i>Cynosurion</i></b>							
9	<i>Festuco rubrae - Agrostietum</i>	19	665(450-980)	W,NW,N, NE,E,SE	13 (0-30)	157	92
10	<i>Trifolio repenti - Lolietum</i>	3	420(400-420)	Even,N,NE	3 (0-5)	40	92
11	<i>Anthoxantho - Agrostietum</i>	5	590(500-720)	Even,S,N,NE	6 (0-10)	86	96
<b>Al. <i>Potentillo-Nardion</i></b>							
12	<i>Nardo - Festucetum rubrae</i>	11	700(500-800)	N,NE, NW SW,A,S	18(0-30)	94	91
<b>Al. <i>Genistion pillosae</i></b>							
13	<i>Nardo-Callunetum vulgaris</i>	3	755(720-780)	N,NA,SE	19(18-20)	41	83
<b>Al. <i>Danthonio-Brachypodion</i></b>							
14	<i>Danthonio - Brachypodietum</i>	3	655(630-680)	W,SW	29(28-30)	37	65
<b>Al. <i>Festucion valesiaca</i></b>							
15	<i>Agrostio - Festucetum</i>	5	585(500-700)	N,A,S,W,SW	12(5-22)	70	94
16	<i>Poterio - Festucetum valesiaca</i>	12	615(550-680)	S,SE,V,SW	20 (0-38)	94	89
17	<i>Botriochloetum (Andropogonetum) ischaemi</i>	7	630(540-700)	S,SE,SW	29 (18-40)	96	74
<b>Al. <i>Seslerio-Festucion pallentis</i></b>							
18	<i>Asplenio rutaemurariae - Melicetum ciliatae</i>	3	790(700-750)	W, SW	38(36-40)	42	77
<b>Al. <i>Sisymbrium officinalis</i></b>							
19	<i>Xeranthemo cylindracei - Brometum arvensis</i>	6	560(500-650)	S,E,SE,SW	9 (0-18)	80	89
<b>Al. <i>Galio-Alliarion</i></b>							
20	<i>Sambucetum ebuli</i>	3	580(540-650)	N	14 (5-28)	47	82
TOTAL - AVERAGE		123	575(400-930)	ALL	11(0-40)	63	85

A number of 123 floristic surveys were carried out, comprising an average of 63 cormophyte species.

The highest phytodiversity of 157 cormophyte species was recorded in the *Festuco rubrae - Agrostetum capillaris* association in 19 surveys and the lowest in the *Junco - Molinietum caeruleae* association in 3 surveys.

The average degree of vegetation cover was 85%, with a maximum of 96% in the *Anthoxantho - Agrostetum capillares* association and a minimum of 65% in the *Danthonio - Brachypodietum pinnati* association.

The average participation of species with fodder value in the grassland grass carpet was 36%, which is quite low directly influencing the pastoral value and green mass production. (Table 2)

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

No.	Association	Species structure (%)		Pastoral value		Green mass production		Grazing season (days)	Animal loading (LU/ha)
		Forrager	Harmful	ind	%	t/ha	%		
<b>Al. <i>Potentillion anserinae</i></b>									
1	<i>Potentilletum anserinae</i>	3	72	1.8	7	0.40	10	175	0.04
2	<i>Juncetum effusi</i>	2	87	1.1	5.0	0.20	5	170	0.02
3	<i>Junco inflexi-Menthetum</i>	21	63	10.8	43	2.56	66	180	0.22
<b>Al. <i>Filipendulion</i></b>									
4	<i>Lysimachio vulgaris - Filipenduletum ulmariae</i>	11	77	5.1	21	1.44	37	170	0.13
<b>Al. <i>Calthion palustris</i></b>									
5	<i>Scirpetum sylvatici</i>	6	75	4,4	18	0,59	15	180	0.05
6	<i>Angelico-Cirsietum cani</i>	4	77	2,2	9	0,39	10	180	0.03
<b>Al. <i>Molinion caeruleae</i></b>									
7	<i>Junco-Molinietum careuleae</i>	4	83	2.1	9	0.34	9	170	0.04
<b>Al. <i>Agrostion stoloniferae</i></b>									
8	<i>Agrostetum stoloniferae</i>	73	10	57,9	238	11,49	295	180	0.98
<b>Al. <i>Cynosurion</i></b>									
9	<i>Festuco rubrae - Agrostietum</i>	91	1	70.1	288	12.84	328	165	1.19
10	<i>Trifolio repenti - Lolietum</i>	89	3	83.9	345	8.25	212	180	0.71
11	<i>Anthoxantho - Agrostietum</i>	92	4	68.4	158	11.29	289	165	1.05
<b>Al. <i>Potentillo-Nardion</i></b>									
12	<i>Nardo - Festucetum rubrae</i>	22	69	16.2	67	2.27	58	160	0.22

Al. <i>Genistion pillosae</i>									
13	<i>Nardo-Callunetum vulgaris</i>	4	79	2,5	10	0,22	6	155	0.02
Al. <i>Danthonio-Brachypodion</i>									
14	<i>Danthonio - Brachypodietum</i>	62	3	34,9	142	10,94	281	165	1.02
Al. <i>Festucion valesiaca</i>									
15	<i>Agrostio - Festucetum</i>	80	14	49.7	205	6.66	171	170	0.6
16	<i>Poterio- Festucetum valesiaca</i>	61	28	33.7	139	3.76	96	165	0.35
17	<i>Botriochloetum (Andropogonetum) ischaemi</i>	5	69	3.7	15	0.36	92	160	0.03
Al. <i>Seslerio-Festucion pallentis</i>									
18	<i>Asplenio rutaemurariae - Melicetum ciliatae</i>	62	15	27.8	114	2.54	65	155	0.25
Al. <i>Sisymbrium officinalis</i>									
19	<i>Xeranthemo cylindracei - Brometum arvensis</i>	10	79	5.9	24	0.73	19	170	0.07
Al. <i>Galio-Alliarion</i>									
20	<i>Sambucetum ebuli</i>	8	74	5.1	21	0,77	20	165	0.72
AVERAGE		36	49	24.3	100	3.90	100	170	0.35

The highest participations of 89–92% forage plants were found in the associations *Trifolio repenti – Lolietum*, *Festuco rubrae – Agrostietum capillaris* and *Anthoxantho – Agrostietum capillaris* and the lowest participations of barely 2–4% in the associations *Juncetum effusi*, *Junco – Molinietum coeruleae* and *Nardo – Callunetum vulgaris*.

The highest pastoral value of 83.9 (very good) was evaluated in the association *Trifolio repenti – Lolietum* and the lowest of 1.1 (degraded) in *Juncetum effusi*, directly proportional to the participation of forage species in the grass carpet.

The average evaluated production of green mass production was 3.9 t/ha, very low with large variations from one association to another.

Thus, the highest green mass productions of 11.29 - 12.84 t/ha were evaluated in the associations *Anthoxantho – Agrostietum capillaris* and *Festuco rubrae – Agrostietum capillaris*, which support a loading of 1.05 - 1.19 LU/ha in 165 day grazing season.

At the opposite pole with 0.2 - 0.4 t/ha are the associations with the lowest proportion of forage plants in the grass carpet and as a result the animal load is only 0.02 - 0.04 LU/ha in a season to graze.

Of the 13 phytosociological alliances described in the Meseş Mountains, only 4 have an economic importance, being more widespread in the territory under study. (Table 3).

**Table 3.** Evaluation of forage green mass production and optimal animal loading in the grazing season of the main grassland alliances

Alliance	Grazing season (days)	Green mass production		Animal loading	
		t/ha	%	LU/ha	%
<i>Agrostion stoloniferae</i>	180	11.49	125	0.98	118
<i>Cynosurion</i>	170	10.79	117	0.98	118
<i>Danthonio-Brachypodion</i>	165	10.94	119	1.02	123
<i>Festucion valesiacaе</i>	165	3.59	39	0.33	40
AVERAGE	170	9.2	100	0.83	100

Thus, the highest green mass production was evaluated in the *Cynosurion* alliance of 11.49 t/ha, 25% higher than the average, which allows a load of 0.98 LU/ha in 180 days of grazing.

Poorer results were evaluated in the *Festucion valesiacaе* alliance, with 3.59 t/ha of green mass with a loading of 0.33 LU/ha in 165 days of grazing season.

On average, the production of the most valuable and widespread phytosociological alliances registers 9.2 t/ha of green mass with a load of 0.83 LU/ha in 170 days of the grazing season, being considered quite good for the mountain area.

The average pastoral value index for the 4 most important alliances was evaluated at 49 (medium) which ensures an average production of 5000 liters of cow's milk per hectare of grassland with variations from 2900 l/ha in *Festucion valesiacaе* alliances to 7550 l/ha to *Cynosurion*, which is very good. (Table 4)



**Table 4.** Evaluation of possible cow milk production on the main phytosociological grassland alliances

Alliance	Average altitude (m)	Pastoral value (ind.)	Milk conversion indices	Milk production	
				l/ha	%
<i>Agrostion stoloniferae</i>	430	57.9	108	6,250	125
<i>Cynosurion</i>	560	74.1	102	7,550	151
<i>Danthonio-Brachypodion</i>	655	34.1	100	3,490	70
<i>Festucion valesiacae</i>	610	29.0	100	2,900	58
Media	565	49.0	102	5,000	100

From what has been presented so far, it follows that the grasslands in the Meseş Mountains have a high phytodiversity and productivity compared to other mountain areas in the Romanian Carpathians.

### Conclusions

- (1). The permanent grasslands in the Meseş Mountains have a high phytodiversity, respectively 63 species of cormophytes on average for the 123 floristic surveys;
- (2). The production of green fodder mass in the most widespread alliances (habitats) is 9.2 t/ha which allows a load of 0.83 LU/ha being one of the best in the Western Carpathians;
- (3). The average pastoral value of 49 allows the production of 5,000 liters of cow's milk per hectare, in a season of 170 days of grazing.

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