# EVALUATION OF THE PRODUCTIVITY OF PERMANENT GRASSLANDS FROM LĂZĂRENILOR HILLS, BIHOR COUNTY, ROMANIA

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**Abstract.** *The hilly grasslands from western Romania, located between the Apuseni Mountains and the Pannonian Plain, were less studied in terms of productivity, respectively pastoral value and green forage mass production. In this paper, the productivity of the grasslands was evaluated based on floristic surveys - performed between the years 2008 and 2011 in Lăzărenilor Hills area. The grasslands are located at altitudes ranging from 150 to 410 m, on flat land up to slopes of 30 degrees. The average vegetation cover is 87% with limits between 82-90%, comprising on average 54 cormophytes, the smallest number of species – 25, found in Caricetum brizoides and the largest comprising 115 species in Anthoxantho - Agrostietum capillaris. The highest pastoral value was 78.9 in Festucetum pratensis and below 5 in Caricetum brizoides, Caricetum hirtae, Juncetum effusi and Ventenato - Xeranthemetum cylindraceum, considered degraded in terms of forage quality and green mass production. The highest yield of 16-19 t/ha green mass was evaluated in Festucetum pratensis and Lolio - Plantaginetum repenti, which recorded an optimal loading with animals around 1.5 LU/ha in a season of 175 days of grazing. At the level of phytosociological alliances, the lowest productivity and grazing capacity were evaluated for Deschampsion caespitosae and Thero-Airion, with only 0.03-0.05 LU/ha. The data regarding the productivity of the grasslands are useful first of all for the elaboration of the pastoral arrangements and the proper management of the grasslands.*

**Keywords:** hilly grasslands, green mass production, pastoral value, loading with animals

## 2. Introduction

The evaluation of grasslands productivity is equally important as the knowledge of the vegetation in terms of the floristic composition of the grassy carpet [4, 10, and 17].

Until recently, the grass production of grasslands has been determined by mowing and weighing in protected areas, from where samples have been taken for quality chemical analyzes. As this classic method is more difficult to apply in the territory, a new method based on floristic survey has been developed to assess the productivity of grasslands [5].

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Through this method, the productivity of some grasslands from different physical-geographical areas of our country have already been evaluated [6, 7, 8, 11, 12, 13, 15].

The present manuscript continues the evaluation for hilly grasslands, less studied so far, and will finally synthesize the results at the level of grassland habitats in the European sense for comparison and unitary description [14].

## 3. Materials and methods

In order to determine the productivity of the grasslands, the paper "Flora and vegetation of the Lăzăreni hills" was studied, authored by Laura Mariana Herman (2012), [3].

The author of the paper established the following practical phytocenotaxones:

Cls. ***MOLINIO - ARRHENATHERETEA*** R. Tüxen 1937
Ord. *MOLINIETALIA CAERULEAE* Koch 1926
Al. ***Agrostion stoloniferae***
1. As. *Festucetum pratensis* Soó 1938
2. As. *Caricetum hirtae* (non Soó 1927 nom. nud.) Dihoru 1975 em. Burescu 1999
Ord. *ARRHENATHERETALIA* R. Tüxen 1931
Al. ***Cynosurion*** R. Tüxen 1947
3. As. *Anthoxantho - Agrostietum capillaris* Sillinger 1933
4. As. *Trifolio repenti - Lolietum* Krippelová 1967, ResmeriŃă et Pop 1967
Ord. *POTENTILLO- POLYGONETALIA* R. Tüxen 1947
Al. ***Potentillion anserinae*** R. Tüxen 1937
(Al. ***Juncenenion effusi*** Westhoff et van Leeuwen ex Hejnỳ et al 1979)
5. As. *Juncetum effusi* Soó (1931) 1949
6. As. *Junco inflexi - Menthetum longifoliae* Lohmeyer 1953
7. As. *Holcetum lanati* Issler 1936 em Passarge 1964
Ord. *DESCHAMPSIETALIA CAESPITOSAE* Horvatić 1956
Al. ***Deschampsion caespitosae*** Horvatić 1930
8. As. *Caricetum brizoidis* O. Rațiu 1966
Cls. ***FESTUCO BROMETEA*** Br.-Bl. et R. Tüxen in Br.-Bl. 1949
Ord. *FESTUCETALIA VALESIACAE* Br.-Bl. et R. Tüxen in Br.-Bl. 1949
Al. ***Festucion valesiacae*** Klika 1931
9. As. *Agrostio - Festucetum valesiacae* Borisavljevič et al. 1955
10. As. *Poterio - Festucetum valesiacae* J. Danon 1964
11. As. *Festucetum rupicolae* Burduja et al. 1956
12. As. *Botriochloetum (Andropogonetum) ischaemi* (Kristiansen 1937) Pop 1977
Cls. ***KOELERIO - CORYNEPHORETEA*** Klika in Klika et Novák 1941
Ord. ***CORYNEPHORETALIA CANESCENTIS*** Klika 1934

Al. ***Thero - Airion*** R. Tüxen ex Oberdorfer 1957
13. As. *Filagini - Vulpietum* Oberdorfer 1938
14. As. *Ventenato dubiae - Xeranthemetum cylindraceum* (Borza 1950) Sanda et al. 1988
Cls. ***PLANTAGINETEA MAJORIS*** R. Tüxen et Preising 1950
Ord. *PLANTAGINETALIA MAJORIS* Tüxen et Preising in R. Tüxen 1950
Al. ***Lolio - Plantaginion*** R. Tüxen 1947
15. As. *Lolio -Plantaginetum majoris*(Linkola 1921)Beger 1930 em Sissingh 1969

The statistical calculations were performed after the Braun-Blanquet appreciation scale with grades from "+ to 5" which was transformed into participation percentages, respectively coverage.

For the evaluation of the pastoral value (PV) the species from the surveys were assessed with quality indices F [1, 2, 5, 18 and 19].

**Indices for forage value (F):**

| | |
|---|---|
| 1 = toxic for animals and humans; | 2 = harmful for animal products; |
| 3 = harmful grassy carpet; | 4 = poor forage value (ballast); |
| 5 = medium forage value (ex F1); | 6 = average forage value (ex F2); |
| 7 = good forage value (ex F3); | 8 = very good forage value (ex F4); |
| 9 = excellent forage value (ex F5); | X = species with unknown forage value. |

The pastoral value (PV) and the production of green forage (GM) were assessed after the method proposed by [5] and applied in previous manuscripts published in this journal [9, 16], therefore we won't detail it here again.

Based on these data, the optimal animal loading with animals or grazing capacity (GC) expressed in units of livestock (LU) per hectare is further determined according to the formula:

$$GC(LU/ha) = -\frac{GM(kg/ha)}{RdXGd} \quad (1)$$

where: Rd = daily requirements for grass for 1 LU, 65 kg, respectively 50 kg + 15 kg (30% - season climatic fluctuations and unconsumed remains); Gd = number of grazing days (season).

The evaluation of the optimal loading with animals was performed as follows:

| **Value LU/ha** | **Grassland assessment** |
|---|---|
| 0.01 - 0.20 | Degraded (Degr.) |
| 0.21 - 0.40 | Very poor (VP) |
| 0.41 - 0.60 | Poor (P) |
| 0.61 - 0.80 | Mediocre (Med.) |
| 0.81 - 1.20 | Average (Av.) |

| | |
|---|---|
| 1.21 - 1.60 | Good (G) |
| 1.61 - 2.00 | Very good (VG) |
| Over 2.00 | Excellent (Exc.) |

## 4. Results and discussions

Any research considering the characterization of the vegetation in a certain territory, should first include the seasonal conditions specific to sites location. From this point of view, the Lăzărenilor Hills are located between the Apuseni Mountains and the Western Plain of Romania, with an altitude of 145 - 410 m, including from relatively flat lands to slopes with an inclination of 30 degrees on all exhibitions (Table 1).

**Table 1)** General data comprising the natural conditions and general vegetation cover of the grasslands from the Lăzărenilor Hills

| *No.* | *Plant species association* | *Altitude (m)* | *Exposure* | *Inclination (degrees)* | *Coverage with vegetation (%)* |
|---|---|---|---|---|---|
| 1. | *Festucetum pratensis* | 160-270 | E, SE, NE, NV | 2-5 | 88 |
| 2. | *Caricetum hirtae* | 180-270 | E, SE, NV, NE | 1-5 | 85 |
| 3. | *Anthoxantho - Agrostietum capillaris* | 190-410 | E, S, SE, NE, NV | 4-18 | 90 |
| 4. | *Trifolio repenti - Lolietum* | 160-280 | Toate | 7-18 | 90 |
| 5. | *Juncetum effusi* | 150-270 | Toate | 1-8 | 87 |
| 6. | *Junco inflexi - Menthetum longifoliae* | 150-210 | N, NE, NV, E, S | 2-8 | 83 |
| 7. | *Holcetum lanati* | 150-300 | E, S, V, NE | 2-10 | 84 |
| 8. | *Caricetum brizoidis* | 150-290 | Toate | 4-10 | 84 |
| 9. | *Agrostio-Festucetum valesiacae* | 180-320 | S, SV, V, E | 7-10 | 90 |
| 10. | *Poterio - Festucetum valesiacae* | 180-280 | E, SE, S, V | 1-15 | 82 |
| 11. | *Festucetum rupicolae* | 150-270 | Toate | 1-9 | 84 |
| 12. | *Botriochloetum ischaemi* | 240-290 | S, V, NE | 18-30 | 89 |
| 13. | *Filagini - Vulpietum* | 190-290 | S, E, V, NE | 2-10 | 90 |
| 14. | *Ventinato dubiae - Xeranthemetum cylindraceum* | 250-280 | S, SV, V, NE, NV | 2-10 | 88 |
| 15. | *Lolio – Plantaginetum majoris* | 160-280 | Toate | 7-18 | 87 |
| | **AVERAGE** | **145-410** | **Toate** | **1-30** | **87** |

Source: Own results.

The most unfavorable stationer conditions are found in the association *Botriochloetum ischaemi* located on slopes with an inclination of 18-30 degrees and on eroded soils.

The average vegetation cover is 87%, considered quite good with a minimum of 82% in *Poterio - Festucetum valesiacae* and around 90% in several valuable associations.

Regarding the number of plant species (phytodiversity) in plant associations, an average of 54 taxa were found, respectively from 25 in *Caricetum brizoidis* up to 115 in *Anthoxantho-Agrostietum capillaris* (Table 2).

Another important element is the composition of the vegetation cover in plants with forage value and harmful plants.

**Table 2)** The phytodiversity and productivity of grasslands located in Lăzărenilor Hills

| *No.* | *Plant species association* | *No. of species* | *Coverage with vegetation* | | *Pastoral value* | *Indices for forage green mass (GM)* | *Production* | |
|---|---|---|---|---|---|---|---|---|
| | | | *Forage* | *Harmful* | | | *GM/ha* | *%* |
| | Al. ***Agrostion stoloniferae*** | | | | | | | |
| 1. | *Festucetum pratensis* | 42 | 81.1 | 6.9 | 78.9 | 6.27 | 18.81 | 306 |
| 2. | *Caricetum hirtae* | 36 | 5.5 | 79.5 | 3.5 | 0.31 | 0.56 | 9 |
| | *Al.* ***Cynosurion*** | | | | | | | |
| 3. | *Anthoxantho - Agrostietum capillaris* | 115 | 78,8 | 11,2 | 53,8 | 3,38 | 8,11 | 132 |
| 4. | *Trifolio repenti - Lolietum* | 44 | 85,2 | 4,8 | 75,5 | 4,49 | 11,68 | 190 |
| | *Al.* ***Potentillion anserinae*** *, Al.* ***Juncenenion effusi*** | | | | | | | |
| 5. | *Juncetum effusi* | 55 | 5.7 | 81.3 | 3.6 | 0.32 | 0.58 | 9 |
| 6. | *Junco inflexi - Menthetum longifoliae* | 54 | 17.4 | 65.6 | 8.2 | 1.03 | 2.06 | 33 |
| 7. | *Holcetum lanati* | 50 | 76.8 | 7.2 | 50.3 | 4.41 | 11.47 | 187 |
| | *Al.* ***Deschampsion caespitosae*** | | | | | | | |
| 8. | *Caricetum brizoidis* | 25 | 3,9 | 80,1 | 2,5 | 0,21 | 0,38 | 6 |
| | *Al.* ***Festucion valesiacae*** | | | | | | | |
| 9. | *Agrostio - Festucetum valesiacae* | 54 | 78.7 | 11.3 | 46.1 | 2.61 | 6.00 | 98 |
| 10. | *Poterio - Festucetum valesiacae* | 70 | 71.3 | 10.7 | 39.0 | 2.13 | 4.69 | 76 |
| 11. | *Festucetum rupicolae* | 79 | 74.8 | 9.2 | 40.3 | 3.52 | 8.80 | 143 |
| 12. | *Botriochloetum (Andropogonetum) ischaemi* | 56 | 18.4 | 70.6 | 12.2 | 0.70 | 1.33 | 22 |

Continuation **Table 2**.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *Al. **Thero – Airion*** | | | | | | | |
| 13. | *Filagini - Vulpietum* | 49 | 7.8 | 82.2 | 6.6 | 0.34 | 0.61 | 10 |
| 14. | *Ventenato dubiae* | 39 | 7.7 | 80.3 | 4.8 | 0.27 | 0.49 | 8 |
| | *Al. **Lolio - Plantaginion*** | | | | | | | |
| 15. | *Lolio -Plantaginetum majoris* | 37 | 82.0 | 5.0 | 74.6 | 5.77 | 16.73 | 272 |
| | *AVERAGE for plant species association* | 54 | 46.5 | 40.5 | 33.3 | 2.38 | 6.15 | 100 |

Source: Own results.

The most valuable associations, with the participation of forage species between 80 - 85% are: *Festucetum pratensis, Lolio - Plantaginetum majoris* and *Trifolio repenti - Lolietum*, with the highest pastoral value (75 - 79), the same associations recording also the highest forage green mass productions with values ranging between 12 - 19 t/ha.

The coverage with harmful vegetation (grasslands, animal products and toxic) with values around 80% is found in *Caricetum hirtae, Caricetum brizoidis, Juncetum effusi, Filagini - Vulpietum* and *Ventenato dubiae*, which print a pastoral value of only 3-7, with a green mass production of 0.4 – 0.6 t/ha, very weak.

At the level of phytocenological alliances that according to some authors are assimilated with grassland habitats, the highest pastoral value (PV) was found on *Lolio - Plantaginion* (75), followed by *Cynosurion* (65) and *Agrostion stoloniferae* (41) considered good to medium (Table 3).

**Table 3)** The productivity and optimal loading with animals of the studied grasslands in terms of phytosociologycal (habitat) alliances

| *No.* | *Phytosociologycal alliances (habitat)* | *Pastoral value* | | *Green mass production* | | *Optimal loading UL/ha in 175 days* | *Coverage with vegetation (%)* |
|---|---|---|---|---|---|---|---|
| | | *Ind.* | *%* | *t/ha* | *%* | | |
| 1. | *Agrostion stoloniferae* | 41.2 | 118 | 9.69 | 144 | 0.85 | Average |
| 2. | *Cynosurion* | 64.7 | 186 | 9.90 | 147 | 0.87 | Average |
| 3. | *Potentillion anserinae* | 20.7 | 60 | 4.70 | 70 | 0.41 | Poor |
| 4. | *Deschampsion caespitosae* | 2.5 | 7 | 0.38 | 6 | 0.03 | Degraded |
| 5. | *Festucion valesiacae* | 34.4 | 99 | 5.21 | 77 | 0.46 | Poor |
| 6. | *Thero - Airion* | 5.7 | 16 | 0.55 | 8 | 0.05 | Degraded |
| 7. | *Lolio - Plantaginion* | 74.6 | 214 | 16.73 | 248 | 1.47 | Good |
| | AVERAGE | 34.8 | 100 | 6.74 | 100 | 0.69 | Poor-Mediocre |

Source: Own results.

At the opposite pole we meet the alliances *Deschampsion caespitosae* and *Thero - Airion* with 3-6 PV index, 0.4 – 0.6 t/ha green forage mass, grasslands considered as degraded.

The optimal loading with animals in 175 days of grazing season at the most valuable alliances reached values between 0.9-1.5 LU/ha while on the degraded ones the values recorded ranged between of 0.03 – 0.05 LU/ha.

On average, on the grasslands from Lăzărenilor Hills, an index of 35 PV was evaluated with a production of 6.7 t/ha of green forage that allows a loading with animals of 0.7 UL/ha in a season of 175 days of grazing.

**Conclusions**

(1). The hilly grasslands located on the west side of the country showed a high phytodiversity scoring between 25-115 plant species, with an average number of 54 cormophytes being identified in the study area.

(2). The average pastoral value is 33, showing large differences between the grassland associations, with values between 2.5 for *Caricetum brizoidis* and 79 for *Festucetum pratensis.*

(3). The highest forage green mass production of almost 10 t/ha and a loading with animals of 0.9 LU/ha was evaluated at the *Cynosurion* and *Agrostion stoloniferae* alliances.

(4). The lowest production of 0.4 – 0.6 t/ha with a loading with animals of 0.03 – 0.05 LU/ha was found at *Deschampsion caespitosae* and *Thero – Airion.*

(5). The average grazing capacity on Lăzărenilor Hills for the conservation of current biodiversity must not exceed 0.7 LU/ha in 175 days grazing season.

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