

PHYTOSOCIOLOGICAL STUDY OF THE GRASSLANDS IN THE DRĂGAN VALLEY AREA (CLUJ COUNTY)

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RESEARCH ARTICLE

Abstract

The present work presents the results of the phytosociological study conducted on the grasslands of the Drăgan Valley, located in Cluj County, an area of special ecological and pastoral importance. The research aimed to identify and characterize the main types of grassland phytocenoses, as well as analyze the floristic structure, species composition, and degree of plant diversity. Field investigations were conducted using classical phytosociological methods, employing vegetation relevés carried out according to the Braun-Blanquet method. Based on the obtained data, two characteristic plant associations of montane and submontane grasslands were identified, dominated by mesophilic and mesoxerophytic species, namely: *Festuco rubrae-Agrostetum capillaris* Horvat 1951 and *Hieracio pilosellae-Nardetum strictae* Pop et al. 1988. The analysis highlights the influence of ecological factors, altitude, and exposure, on the structure and dynamics of the plant cover. The results emphasize the importance of maintaining appropriate management of grasslands for the conservation of biodiversity and the sustainable use of permanent grasslands in the Drăgan Valley area.

Keywords: grasslands, phytocenoses, plant associations, ecological factors, biodiversity

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INTRODUCTION

Grasslands represent complex terrestrial ecosystems, characterized by a high diversity of species and an essential ecological role in maintaining biodiversity, soil protection, and the conservation of natural resources. In Romania, mountain and sub-mountain grasslands occupy extensive areas and are considered important components of the rural landscape, having both ecological and economic value through their role in forage production. Phytocenological studies, which analyze the structure and composition of plant communities, are an essential tool for understanding the dynamics and distribution of species within these ecosystems. This approach allows for the identification of plant associations, the assessment of floristic diversity, and the appreciation of the influence of ecological and anthropic factors over the grasslands.

Drăgan Valley, located in Cluj County, presents a variety of habitats and ecological conditions, characterized by differences in altitude, exposure, and humidity regimes that favor the development of diverse plant communities. This phytocenological study of the permanent grasslands in the area aims to

complement the studies conducted by Resmeriță, 1970; Csűrös & Resmeriță, 1960; Coldea et al. 2008; Marușca et al., 2021.

This paper aims to identify and characterize the main phytocenoses of grasslands in Drăgan Valley, to analyze their structure and floristic composition, and to evaluate the influence of ecological factors on species distribution. The research results contribute to a better understanding of the biodiversity of mountain grasslands and to the foundation of conservation and sustainable management strategies for these ecosystems.

Drăgan Valley is located in the northwest of Cluj County, in the Transylvania region, at the foot of the Apuseni Mountains. Drăgan Valley is a tributary of Someș Ruler, and extends into a predominantly hilly and submontane relief. The valley's slopes are characterized by differences in slope and exposure, which determine varied microclimates and a significant diversity of vegetation.

The climate of the area is temperate-continental, with cold winters and relatively warm summers, with average annual precipitation between 600-900 mm, favorable for the development of grasslands. The predominant soils are brown-grey soils and luvisols, often rich in nutrients, suitable for grassy vegetation.

MATERIAL AND METHOD

In the study of the grasslands vegetation of the Drăgan Valley, the phytosociological methods of the Central European school were applied, developed based on the principles and methodology proposed by Braun-Blanquet (1964). The execution of relevés and the quantitative and qualitative evaluation of species were carried out according to the guidelines presented by Cristea et al. (2004). As a quantitative parameter, the study of phytocoenoses focused on the abundance and dominance of individuals, using the Braun-Blanquet system, later supplemented by Tüxen and Ellenberg through the classification of species into constancy classes (K = I-V).

The naming of associations was established in accordance with the provisions of the Phytosociological Nomenclature Code (Weber et al., 2000), and the classification at the level of cenotaxonomic units, alliance, order, and class, was carried out following the modern ecological-floristic systems proposed by Mucina et al. (1997), Pott (1995), Rothmaler (1994-2000), Borhidi (1996-2003), Coldea et al. (1997), and Sanda et al. (2008).

The research was conducted in 2025, with a total of 28 relevées, of which 17 were for the *Festuco rubrae-Agrostetum capillaris* Horvat 1951 association and 11 for the *Hieracio pilosellae-Nardetum strictae* Pop et al. 1988 association.

Floristically homogeneous sample areas were selected from representative fragments of permanent grasslands, depending on their nature and complexity, with each relevé covering an area of 100 m². For the detailed description of the vegetation, station and habitat conditions were recorded, including altitude, exposure, slope inclination, vegetation layer cover (%), and the complete list of species. The worksheet also recorded the quantitative participation of each species, determined by abundance-dominance according to the Braun-Blanquet and Pavillard scale (1928). The association tables included information regarding: floristic composition, ecological indices of the species, the serial number of the relevées, altitude (m), exposure, slope inclination (°), relevé area (m²), and cover degree (%), differentiated by vegetation layers. The last column of the tables recorded constancy (K). Abundance-dominance values, represented by the symbols +, 1, 2, 3, 4, 5, corresponded to the following percentage

ranges: + = 0.5%, 1 = 5%, 2 = 17.5%, 3 = 37.5%, 4 = 62.5%, 5 = 87.5% (Ivan & Doniță, 1975). The vertical grouping of species in the association tables was done by combining cenotaxonomic criteria, constancy, and the alphabetical order of the species.

The nomenclature of the species used follows Sârbu et al., 2013; Ciocârlan, 2009, and adheres to the nomenclatural solutions considered correct according to the International Code of Botanical Nomenclature of Vienna (McNeill et al., 2005) and the International Code of Botanical Nomenclature of Melbourne (McNeill et al., 2011).

RESULTS AND DISCUSSIONS

The phytocoenoses identified were assigned to two plant associations belonging to two classes, as follows:

- Cls. *Nardo-Callunetea* Preising 1949; Ord. *Nardetalia* Oberdorfer 1949; All. *Potentillo-Nardion* Simon 1959; *Hieracio pilosellae-Nardetum strictae* Pop et al. 1988 association (Syn.: *Xeronardetum* Soó 1931; *Xeronardetum montanum* Resmeriță et Csűrös 1963)

- Cls. *Molinio-Arrhenatheretea* R. Tüxen 1937; Ord. *Arrhenatheretalia* R. Tüxen 1931; All. *Cynosurion* R. Tüxen 1947; *Festuco rubrae-Agrostietum capillaris* association Horvat 1951.

Nardus stricta and *Hieracium pilosella* grasslands are spread across the Drăgan Valley at altitudes of 500-1035 m, on terrains with varying slopes and generally shaded exposures (figure 1).



Figure 1 *Nardus stricta* and *Hieracium pilosella* grasslands on Drăgan Valley (original)

They develop on districambosol soils, moderately acidic and medium fertility. The flora of these grasslands consists of 74 species, of which 12 are characteristic of the *Potentillo-Nardion* alliance, *Nardetalia* order, *Nardo-Callunetea* class: *Potentilla erecta*, *Viola canina*,

Alchemilla vulgaris, *Danthonia decumbens*, *Hypericum maculatum*, *Polygala vulgaris*, *Veronica officinalis*, *Calluna vulgaris* (table 1).

The accompanying species belong to the class *Molinio-Arrhenatheretea*: *Agrostis capillaris*, *Anthoxanthum odoratum*, *Festuca rubra*, *Achillea millefolium*, *Plantago lanceolata*, *Trifolium repens*, *Thymus pulegioides*, *Veronica chamaedrys*, *Holcus lanatus*. In the phytocenoses of this association, acidophilous transgressive species from the *Vaccinio-Piceetea* class also penetrate: *Deschampsia flexuosa*, *Luzula*

luzuloides, *Vaccinium myrtillus*, *Picea abies*, *Vaccinium vitis-idaea*, *Sorbus aucuparia*, some xeromesophilous species from the *Festuco-Brometea* class: *Euphrasia stricta*, *Galium verum*, *Seseli osseum*, *Euphorbia cyparissias*, *Filipendula vulgaris*, *Helianthemum nummularium*, and shrubs from the *Rhamno-Prunetea* class: *Crataegus monogyna*, *Rosa canina*, *Prunus spinosa*, *Salix capraea*, *Corylus avellana*. The bryophyte layer is represented by *Polytrichum strictum* and *Hypnum cupressiforme*.

Table 1

**Hieracio pilosellae-Nardetum strictae Pop et al. 1988 association
(Syn.: Xeronardetum Soó 1931; Xeronardetum montanum Resmeriță et Csűrös 1963)**

U.	T.	R.	Floristic relevé nr.	1	2	3	4	5	6	7	8	9	10	11	K				
			Altitude (m)	650	1035	680	1025	1035	920	500	975	940	1035	1025					
			Herbaceous layer cover (%)	95	83	74	87	97	96	97	92	90	96	97					
			Shrub and subshrub layer cover (%)	2	12	18	13	3	4	3	3	2	1	2					
			Bryophyte layer cover (%)	3	5	8	-	-	-	-	5	8	3	1					
			Exposition	N	S	N	S, SE	S	E, SE	-	N	E	N	N					
			Slope (degree) (°)	13	7	13	9	8	9	-	10	9	3	3					
			Relevés area (m ²)	100	100	100	100	100	100	100	100	100	100	100					
			GPS coordinates	N: 46.83852	46.8760	46.8334	46.89674	46.89296	46.90572	46.92620	46.77930	46.79481	46.80320	46.80488					
				E: 22.78620	22.7577	22.7751	22.79163	22.77558	22.79913	22.84615	22.69906	22.67339	22.64820	22.65401					
				0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			2.5	0	0	As. <i>Hieracium pilosella</i>	+	1	1	+	+	+	1	1	+	+	+	+	V
			0	0	1.5	As. <i>Nardus stricta</i>	4	4	3	4	4	4	4	4	4	5	5	5	V
			Potentillo-Nardion, Nardetalia, Nardo-Callunetea																
			0	0	0	<i>Potentilla erecta</i>	+	+	+	+	+	+	+	+	+	+	+	+	V
			2.5	3	2	<i>Viola canina</i>	.	+	+	+	.	+	+	+	+	+	+	+	V
			3	2	0	<i>Alchemilla vulgaris</i>	1	+	+	.	.	.	+	+	+	+	+	+	IV
			0	3	2	<i>Danthonia decumbens</i>	.	+	+	+	+	+	1	1	.	.	.	.	IV
			4	3	2	<i>Hypericum maculatum</i>	+	+	+	+	+	.	.	.	+	.	.	.	IV
			3	3	3	<i>Polygala vulgaris</i>	+	+	.	+	.	+	.	.	.	+	+	+	IV
			2	2	2	<i>Veronica officinalis</i>	.	+	+	+	+	.	.	.	+	+	+	+	IV
			0	0	1	<i>Calluna vulgaris</i>	.	+	.	1	+	.	.	.	.	.	.	.	II
			4	2.5	3	<i>Carex ovalis</i>	.	.	+	.	.	.	+	.	.	.	+	.	II
			3.5	3	3	<i>Carex pallescens</i>	.	.	.	.	+	.	.	+	.	.	+	.	II
			3	3	3	<i>Genistella sagittalis</i>	.	+	.	.	.	+	+	.	.	.	.	.	II
			3	3	1	<i>Lycopodium clavatum</i>	+	.	+	.	.	.	.	.	.	.	.	.	I
			Molinio-Arrhenatheretea																
			0	0	0	<i>Agrostis capillaris</i>	+	+	1	+	1	1	1	+	+	+	+	+	V
			0	0	0	<i>Anthoxanthum odoratum</i>	+	.	1	+	1	+	+	+	.	+	+	+	V
			3	0	0	<i>Festuca rubra</i>	1	1	1	+	1	1	1	1	1	+	+	+	V
			3	0	0	<i>Achillea millefolium</i>	+	+	+	+	+	.	+	+	+	+	.	.	IV
			0	0	0	<i>Plantago lanceolata</i>	+	+	.	+	.	.	+	.	.	.	+	+	IV
			3.5	0	0	<i>Trifolium repens</i>	+	.	+	+	.	+	+	.	+	+	.	.	IV
			2.5	3	3	<i>Thymus pulegioides</i>	1	+	1	1	+	.	.	1	.	+	+	+	IV
			3	0	0	<i>Veronica chamaedrys</i>	+	.	.	+	+	.	.	+	+	+	+	+	IV
			3.5	3	0	<i>Holcus lanatus</i>	1	.	.	.	1	1	+	+	+	+	+	.	III
			0	3	0	<i>Briza media</i>	+	.	.	+	.	+	.	.	.	.	.	.	II
			2.5	0	0	<i>Carlina acaulis</i>	.	+	.	+	.	+	.	.	.	.	.	.	II
			3.5	3	3	<i>Centaurea nigrescens</i>	.	.	+	.	.	.	.	+	+	.	.	.	II
			3	2.5	3	<i>Centaurea phrygia</i>	+	.	.	.	.	+	+	.	.	.	.	.	II
			3	0	0	<i>Cerastium holosteoides</i>	.	.	.	.	+	+	.	.	.	.	+	.	II
			3	3	3	<i>Cynosurus cristatus</i>	+	.	.	.	.	.	+	.	.	.	.	+	II
			4	0	0	<i>Deschampsia caespitosa</i>	+	.	+	.	.	.	+	.	+	.	.	.	II
			3	0	3	<i>Galium mollugo</i>	+	.	.	.	+	.	+	+	.	.	.	.	II
			4.5	3	3	<i>Juncus conglomeratus</i>	.	.	.	.	+	.	.	+	.	.	+	.	II
			3	2.5	3	<i>Campanula patula</i>	+	.	.	.	.	.	+	.	.	.	.	.	I
			3	3	2.5	<i>Hypochaeris radicata</i>	.	.	.	.	.	.	+	.	.	.	.	.	I
			4.5	3	3	<i>Juncus effusus</i>	.	.	.	.	.	.	.	1	.	.	.	.	I
			3	0	0	<i>Leontodon autumnalis</i>	+	.	.	.	.	.	+	.	.	.	.	.	I
			3	0	0	<i>Leucanthemum vulgare</i>	.	+	.	.	.	.	.	.	.	.	.	.	I
			4	3	0	<i>Molinia caerulea</i>	.	.	.	.	.	.	.	+	1	.	.	.	I
			2.5	0	3	<i>Pimpinella saxifraga</i>	.	+	+	.	.	.	.	.	.	.	.	.	I

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
3.5	0	0	<i>Phleum pratense</i>	.	.	.	.	.	.	+	.	.	.	.	|
3	0	0	<i>Poa pratensis</i>	.	.	.	.	.	.	+	.	.	.	.	|
3.5	0	0	<i>Ranunculus acris</i>	.	.	.	.	+	.	.	+	.	.	.	|
2.5	3	3	<i>Ranunculus polyanthemos</i>	.	.	+	.	.	.	+	.	.	.	.	|
3	3	0	<i>Stachys officinalis</i>	.	.	+	.	.	.	.	.	.	.	.	|
Vaccinio-Piceetea															
2	0	1	<i>Deschampsia flexuosa</i>	.	1	1	+	1	1	.	+	1	.	.	IV
2.5	2.5	2	<i>Luzula luzuloides</i>	.	.	1	+	+	+	.	+	1	.	+	IV
0	2	1	<i>Vaccinium myrtillus</i>	+	1	1	1	+	+	.	+	+	.	.	IV
0	0	0	<i>Picea abies</i> (seedlings)	.	+	1	.	.	.	.	+	+	+	+	III
3	2	1	<i>Vaccinium vitis-idaea</i>	.	1	+	1	+	+	.	.	.	.	.	III
3	2.5	2	<i>Sorbus aucuparia</i>	.	.	+	+	.	+	.	.	.	.	.	II
Festuco-Brometea															
3	3	0	<i>Euphrasia stricta</i>	.	+	.	.	.	+	.	.	.	.	+	II
2.5	2.5	0	<i>Galium verum</i>	+	.	.	.	+	+	.	.	.	.	.	II
2	3	4	<i>Euphorbia cyparissias</i>	.	.	.	.	+	.	.	.	.	.	.	I
2.5	3	0	<i>Filipendula vulgaris</i>	.	.	+	.	.	.	.	.	.	.	.	I
2	3	4	<i>Helianthemum nummularium</i>	.	.	+	.	.	.	.	.	.	.	+	I
Rhamno-Prunetea															
2.5	3	3	<i>Crataegus monogyna</i>	+	.	+	.	+	.	+	+	.	.	.	III
2	3	3	<i>Rosa canina</i>	.	+	+	+	+	.	+	.	.	.	+	III
2	3	3	<i>Prunus spinosa</i>	+	.	.	.	.	+	+	.	.	.	.	II
3	3	3	<i>Salix caprea</i>	.	.	1	.	.	+	+	.	.	.	+	II
3	3	3	<i>Corylus avellana</i>	.	.	+	.	.	+	.	.	.	.	.	I
Variae Syntaxa															
3	2	2	<i>Betula pendula</i> (seedlings)	+	+	.	+	+	+	.	+	+	.	.	IV
3	2.5	0	<i>Fragaria vesca</i>	+	.	+	+	+	+	.	.	.	+	+	IV
3	2	2	<i>Cruciata glabra</i>	+	.	.	.	.	+	.	+	.	+	+	III
3	3	3	<i>Rubus idaeus</i>	+	.	.	.	+	.	.	+	+	.	.	III
2	0	0	<i>Juniperus communis</i>	.	+	.	+	.	.	.	.	.	.	+	II
5	0	0	<i>Lysimachia vulgaris</i>	.	.	.	.	.	+	+	.	+	.	.	II
3	3	0	<i>Pteridium aquilinum</i>	.	.	.	1	+	1	.	.	.	+	.	II
4	3	0	<i>Dryopteris filix-mas</i>	+	.	+	.	.	.	.	.	.	.	.	I
4	3	3	<i>Frangula alnus</i>	.	.	.	.	.	.	+	.	.	.	.	I
2.5	3	3	<i>Genista ovata</i>	.	.	.	.	.	+	.	.	.	.	.	I
4	2	4	<i>Gentiana asclepiadea</i>	+	.	+	.	.	.	.	.	.	.	.	I
3	3	3	<i>Gnaphalium sylvaticum</i>	+	.	.	.	.	.	.	.	.	.	+	I
3.5	2.5	2	<i>Luzula sylvatica</i>	.	.	.	.	.	.	.	+	+	.	.	I
5	3	3	<i>Salix cinerea</i>	.	.	.	.	.	.	.	+	.	.	.	I
Bryophyta															
-	-	-	<i>Polytrichum strictum</i>	.	1	1	.	.	.	.	1	1	1	+	III
-	-	-	<i>Hypnum cupressiforme</i>	1	.	.	.	.	.	.	.	+	.	.	I

where: U-humidity; T-temperature; R-chemical reaction of the soil; K-constancy.

The diagram of ecological indices for the *Hieracio pilosellae-Nardetum strictae* association (figure 2) highlights the dominance of mesophilous species ($U_{3-3.5}=47.3\%$), followed by xero-mesophilous species ($U_{2-2.5}=24.32\%$), eurydrophic species ($U_0=13.52\%$), and meso-hygrophilous species ($U_{4-4.5}=12.16\%$).

In terms of temperature preferences, there is a predominance of micro-mesothermophilous species ($T_{3-3.5}=45.94\%$), followed by eurythermic species ($T_0=33.79\%$) and microthermophilous species ($T_{2-2.5}=20.27\%$).

The soil reaction favors the development of euriionic species ($R_0=41.89\%$) and acid-neutrophilous species ($R_3=32.43\%$), followed by acidophilous species ($R_2=13.51\%$) and strongly acidophilous species ($R_1=8.11\%$), suggesting that this association develops on acidic to strongly acidic soils.

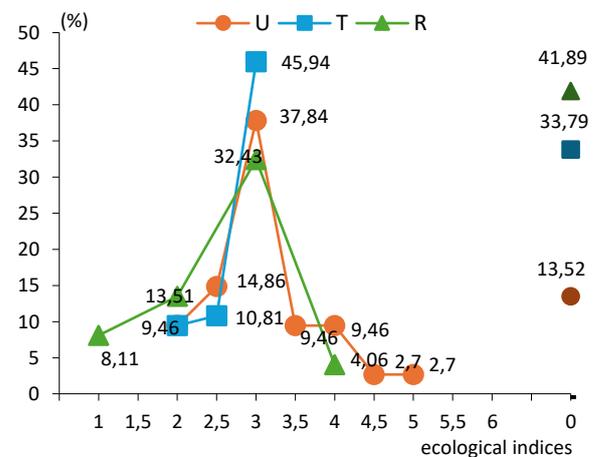


Figure 2 Diagram of ecological indices for the *Hieracio pilosellae-Nardetum strictae* association; where: U-humidity; T-temperature; R-chemical reaction of the soil

The mesophilic grasslands of *Festuca rubrae-Agrostietum capillaris* association grow on districambosol-type soils, which are deep and rich in humus, occurring in the hilly and premountain levels, belt at altitudes of 570-1130 m, on slopes up to 23°, with various exposures (figure 3).



Figure 3 *Festuca rubra* and *Agrostis capillaris* grasslands on Drăgan Valley (original)

The two dominant species, *Festuca rubra* and *Agrostis capillaris*, coexist in a codominant relationship, depending on the soil nutrient content. On soils with higher moisture, compacted and low in nutrients, *Festuca rubra* dominates, whereas on looser soils, *Agrostis capillaris* predominates. The floristic composition of these grasslands is very diverse, totaling 110 species (table 2).

Besides the edifying species, the floristic composition of the association includes a significant proportion of species characteristic of the *Cynosurion* alliance: *Cynosurus cristatus*, *Trifolium repens*, *Carlina acaulis*, *Hypochaeris radicata*, *Leontodon autumnalis*, of the *Arrhenatheretalia* order and the *Molinio-Arrhenatheretea* class, among which the most constant are: *Achillea millefolium*, *Holcus lanatus*, *Lotus corniculatus*, *Thymus pulegioides*, *Briza media* (table 2).

In the phytocenoses of the association, a large number of xerophilous and xero-mesophilous transgressive species from the *Festuco-Brometea* class penetrate, among which those with the highest constancy are *Hypericum perforatum*, *Euphorbia cyparissias*, *Anthyllis vulneraria*, *Carlina vulgaris*, *Dianthus carthusianorum*, *Filipendula vulgaris*, *Galium verum*, *Helianthemum nummularium*, *Peucedanum oreoselinum*, as well as acidophilous species from the classes *Nardo-Callunetea*: *Nardus stricta*, *Potentilla erecta*, *Danthonia decumbens*, *Hieracium pilosella*, *Veronica officinalis*, *Viola canina*, *Alchemilla vulgaris*, *Genistella sagittalis*, and from *Vaccinio-Piceetea*: *Luzula luzuloides*, *Vaccinium myrtillus*, *Sorbus aucuparia*. The association also includes in its floristic composition a series of plants originating from the forests and scrublands bordering the analyzed phytocenoses, from the classes *Querco-Fagetea*, *Rhamno-Prunetea*, *Epilobietea angustifolii*.

Table 2

***Festuca rubrae-Agrostetum capillaris* Horvat 1951 association**

U.	T.	R.	Floristic relevé nr.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	K
			Altitude (m)	620	700	570	1130	835	1050	850	1010	675	650	1115	890	715	815	680	1030	1075					
			Herbaceous layer cover (%)	97	97	97	98	96	97	94	95	96	96	96	97	97	98	99	98	99					
			Shrub and subshrub layer cover (%)	3	3	3	2	4	3	6	5	4	4	4	3	3	2	1	2	1					
			Exposition	S	E, SE	E	S	NV	V	S, SE	NV	S	NE	E	S	N	V	V	S	S					
			Slope (degree) (°)	12	7	6	9	10	5	8	7	23	22	6	18	16	10	15	11	10					
			Relevés area (m ²)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100					
			GPS coordinates	N: 46.88328 46.91296 46.92371 46.76932 46.78890 46.78650 46.86771 46.84934 46.84533 46.86904 46.81742 46.81276 46.82653 46.85436 46.89629 46.80500 46.80461 E: 81776 82379 83035 75007 74228 72756 79428 76322 78979 80987 72881 75139 77023 79362 84484 67100 69635																					
				0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
			As. <i>Festuca rubra</i>	3	0	0	As. <i>Festuca rubra</i>	2	2	3	4	3	3	3	3	3	2	4	2	3	4	4	4	4	V
			As. <i>Agrostis capillaris</i>	0	0	0	As. <i>Agrostis capillaris</i>	3	3	3	2	3	3	3	3	4	2	4	3	2	2	2	2	2	V
			<i>Cynosurion</i>																						
			<i>Cynosurus cristatus</i>	3	3	3	<i>Cynosurus cristatus</i>	1	+	+	-	+	-	+	+	+	+	+	+	+	+	+	+	+	V
			<i>Trifolium repens</i>	3.5	0	0	<i>Trifolium repens</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	V
			<i>Carlina acaulis</i>	2.5	0	0	<i>Carlina acaulis</i>	-	+	-	+	+	+	+	-	-	-	-	-	-	-	-	-	-	III
			<i>Hypochaeris radicata</i>	3	3	2.5	<i>Hypochaeris radicata</i>	-	-	+	-	+	-	+	-	-	-	+	+	-	+	-	+	+	III
			<i>Leontodon autumnalis</i>	3	0	0	<i>Leontodon autumnalis</i>	+	-	+	-	+	+	+	-	+	+	+	+	+	+	+	+	+	III
			<i>Bellis perennis</i>	3	2.5	0	<i>Bellis perennis</i>	+	-	+	-	-	-	+	+	-	-	-	-	-	-	-	-	-	II
			<i>Gentiana cruciata</i>	3	3	4	<i>Gentiana cruciata</i>	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	I
			<i>Phleum pratense</i>	3.5	0	0	<i>Phleum pratense</i>	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	I
			<i>Arrhenatheretalia</i>																						
			<i>Achillea millefolium</i>	3	0	0	<i>Achillea millefolium</i>	1	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	V
			<i>Holcus lanatus</i>	3.5	3	0	<i>Holcus lanatus</i>	+	1	+	-	+	-	+	+	+	+	1	+	+	+	1	+	+	V
			<i>Lotus corniculatus</i>	2.5	0	0	<i>Lotus corniculatus</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	V
			<i>Thymus pulegioides</i>	2.5	3	3	<i>Thymus pulegioides</i>	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	V
			<i>Briza media</i>	0	3	0	<i>Briza media</i>	+	1	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+	IV

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
3	0	4	<i>Dactylis glomerata</i>	+	-	-	+	-	+	+	+	+	+	+	-	-	-	+	-	-	III
3	0	3	<i>Galium mollugo</i>	-	+	+	-	-	+	-	-	-	-	-	-	-	-	-	+	+	III
2.5	3	0	<i>Daucus carota</i>	+	+	-	-	-	-	-	-	+	+	-	-	-	-	+	-	-	II
2.5	0	0	<i>Leontodon hispidus</i>	-	-	+	-	-	-	-	-	+	+	-	-	-	-	+	-	-	II
3	0	0	<i>Leucanthemum vulgare</i>	+	+	-	-	-	-	+	-	+	-	+	-	-	-	+	-	-	II
3	0	0	<i>Veronica chamaedrys</i>	-	-	-	+	+	+	-	-	-	-	-	-	-	+	-	-	+	II
2.5	2	3	<i>Stellaria graminea</i>	-	-	+	-	-	-	-	-	+	+	-	-	-	-	-	-	+	I
3	3	0	<i>Trifolium campestre</i>	-	+	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	I
Molinio-Arrhenatheretea																					
0	0	0	<i>Anthoxanthum odoratum</i>	1	1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	V
0	0	0	<i>Plantago lanceolata</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	V
3	2.5	3	<i>Centaurea phrygia</i>	+	+	+	-	+	-	+	+	+	+	+	+	+	-	+	-	-	IV
4	0	0	<i>Deschampsia caespitosa</i>	-	+	+	+	+	+	+	-	-	+	+	+	+	+	+	-	+	IV
4.5	3	3	<i>Juncus effusus</i>	-	+	+	+	+	+	-	-	+	-	+	+	+	+	+	+	+	IV
2.5	0	3	<i>Pimpinella saxifraga</i>	+	+	+	-	-	-	-	+	+	+	+	+	+	-	+	-	-	III
2.5	3	3	<i>Ranunculus polyanthemos</i>	-	+	-	+	+	+	-	+	+	+	+	+	-	+	+	-	-	III
3	0	0	<i>Trifolium pratense</i>	+	+	+	-	-	-	-	+	+	+	-	-	-	-	-	-	+	III
3	2.5	3	<i>Campanula patula</i>	-	+	+	-	+	-	-	+	-	-	-	-	-	-	-	-	-	II
3.5	3	3	<i>Centaurea nigrescens</i>	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	II
4	3	0	<i>Molinia caerulea</i>	-	-	-	+	-	-	+	-	-	-	+	-	-	-	-	-	+	II
3	3	3	<i>Polygala vulgaris</i>	-	+	-	-	-	-	+	+	+	-	-	-	-	-	+	-	-	II
3	3	0	<i>Stachys officinalis</i>	+	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	-	II
4	3	0	<i>Succisa pratensis</i>	-	-	-	-	+	-	+	+	-	-	-	-	-	+	+	-	-	II
2.5	3	0	<i>Viola tricolor</i>	+	-	-	-	-	-	+	+	-	-	+	+	-	-	-	-	-	II
3	3	0	<i>Carex tomentosa</i>	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	I
3	0	0	<i>Cerastium holosteoides</i>	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	I
2.5	3.5	4.5	<i>Cichorium intybus</i>	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	I
2.5	4	4.5	<i>Lolium perenne</i>	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
3	0	0	<i>Poa pratensis</i>	-	-	-	-	-	-	-	-	-	+	+	-	-	-	+	-	-	I
3	3	0	<i>Prunella vulgaris</i>	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
3.5	3	4	<i>Trifolium hybridum</i>	+	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	I
3	0	3	<i>Vicia cracca</i>	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	I
Festuco-Brometea																					
3	3	0	<i>Hypericum perforatum</i>	-	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	IV
2	3	4	<i>Euphorbia cyparissias</i>	1	+	+	-	-	-	+	-	-	+	+	+	+	+	+	+	+	III
2	0	4	<i>Anthyllis vulneraria</i>	+	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-	II
2.5	3.5	0	<i>Carlina vulgaris</i>	-	+	+	-	-	-	+	-	-	-	+	+	-	-	+	-	-	II
2	5	5	<i>Dianthus carthusianorum</i>	+	+	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	II
2.5	3	0	<i>Filipendula vulgaris</i>	+	-	+	-	-	-	-	+	-	+	-	-	-	-	-	-	-	II
2.5	2.5	0	<i>Galium verum</i>	-	+	+	-	-	-	-	-	+	+	+	+	+	+	+	+	+	II
2	3	4	<i>Helianthemum nummularium</i>	-	+	-	-	-	+	+	+	+	+	-	-	-	-	-	-	-	II
2.5	3	0	<i>Peucedanum oreoselinum</i>	+	-	-	-	-	+	-	+	-	-	+	-	-	-	-	-	-	II
2.5	3	4	<i>Agrimonia eupatoria</i>	-	-	-	-	-	-	+	+	+	+	-	-	-	-	-	-	-	I
2.5	4	4	<i>Brachypodium pinnatum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	I
3	3	0	<i>Euphrasia stricta</i>	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	I
1.5	4.5	4	<i>Pheum montanum</i>	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	I
2	4	4	<i>Scabiosa ochroleuca</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
2	3.5	4	<i>Teucrium chamaedrys</i>	+	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	I
2	4	0	<i>Thymus glabrescens</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	I
Nardo-Callunetea																					
0	0	1.5	<i>Nardus stricta</i>	-	1	+	1	1	1	1	+	+	+	+	1	1	1	+	1	1	V
0	0	0	<i>Potentilla erecta</i>	-	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	V
0	3	2	<i>Danthonia decumbens</i>	-	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	IV
2.5	0	0	<i>Hieracium pilosella</i>	-	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	IV
2	2	2	<i>Veronica officinalis</i>	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	III
2.5	3	2	<i>Viola canina</i>	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	III
3	2	0	<i>Alchemilla vulgaris</i>	-	-	-	-	+	+	-	-	-	+	-	+	-	-	-	-	+	II
3	3	3	<i>Genistella sagittalis</i>	+	+	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	II
3.5	3	3	<i>Carex pallescens</i>	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	I
4	3	2	<i>Hypericum maculatum</i>	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	I
3	3	1	<i>Lycopodium clavatum</i>	-	-	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	I
Querco-Fagetea																					
3	2	2	<i>Betula pendula</i> (seedlings)	+	+	+	+	+	-	+	+	+	+	+	+	-	-	-	+	-	IV
3	3	3	<i>Fagus sylvatica</i> (seedlings)	-	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	III
3	3	0	<i>Pteridium aquilinum</i>	1	1	+	-	-	-	1	-	-	-	-	-	-	-	+	+	+	III
3	2	2	<i>Cruciata glabra</i>	+	-	-	-	+	-	-	+	-	-	-	-	-	-	+	-	-	II
3	2	2	<i>Populus tremula</i> (seedlings)	+	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	II
2	3	4	<i>Pyrus pyraeaster</i>	-	-	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	II
3	3	0	<i>Trifolium medium</i>	+	+	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	II
2	3	2	<i>Rumex acetosella</i>	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	I
Rhamno-Prunetea																					
2	3	3	<i>Rosa canina</i>	+	+	+	-	-	-	+	+	+	+	+	+	-	+	+	-	-	IV
3	3	3	<i>Corylus avellana</i>	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	III
2.5	3	3	<i>Crataegus monogyna</i>	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	III
2	3	3	<i>Prunus spinosa</i>	+	+	+	-	+	-	+	+	+	+	+	+	+	+	+	+	+	III
3	3	3	<i>Salix capraea</i>	-	-	-	-	+	-	+	-	+	-	-	-	-	-	-	-	-	II
2	3	4	<i>Verbascum phlomoides</i>	-	-	+	-	-	-	-	+	-	+	-	-	-	-	+	-	-	I
Epilobietea angustifolii																					
3	2.5	0	<i>Fragaria vesca</i>	-	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	IV
2	3	0	<i>Calamagrostis epigeios</i>	+	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	II
2.5	3	2	<i>Calamagrostis arundinacea</i>	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	I
3	3	3	<i>Gnaphalium sylvaticum</i>	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	I
3.5	3	3	<i>Senecio germanicus</i>	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	I
Vaccinio-Piceetea																					
2.5	2.5	2	<i>Luzula luzuloides</i>	-	+	+	+	+	+	-	+	-	-	+	+	+	-	-	+	+	IV

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
0	2	1	<i>Vaccinium myrtillus</i>	.	.	+	+	+	+	+	+	+	.	+	.	+	.	+	.	+	+	IV
3	2.5	2	<i>Sorbus aucuparia</i>	.	.	.	.	.	+	+	+	+	.	.	+	.	.	.	.	.	.	III
0	0	0	<i>Picea abies</i> (seedlings)	.	.	.	+	+	+	.	.	.	.	.	.	+	.	.	.	+	+	II
3	2	1	<i>Vaccinium vitis-idaea</i>	.	.	+	.	.	+	+	.	.	.	+	.	+	.	.	.	.	.	II
2	0	1	<i>Deschampsia flexuosa</i>	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	I
3.5	2.5	2	<i>Luzula sylvatica</i>	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Variae Syntaxa																						
2	3	0	<i>Carduus acanthoides</i>	+	.	+	.	.	.	.	+	+	.	.	+	.	.	.	.	.	.	II
4	2	4	<i>Gentiana asclepiadea</i>	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	II
5	0	0	<i>Lysimachia vulgaris</i>	.	.	.	.	+	+	+	.	.	.	+	.	.	.	.	.	.	.	II
3	3	3	<i>Rubus idaeus</i>	.	.	+	+	+	+	.	.	+	.	.	.	.	.	.	.	.	.	II
5	3	3	<i>Salix cinerea</i>	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	II
2	3	3	<i>Clinopodium vulgare</i>	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
4	0	4	<i>Erigeron annuus</i>	+	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	I
2	3.5	0	<i>Filago arvensis</i>	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	I
3.5	3	4	<i>Juncus tenuis</i>	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
2	0	0	<i>Juniperus communis</i>	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	I
3	3	4.5	<i>Sambucus ebulus</i>	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	I

where: U-humidity; T-temperature; R-chemical reaction of the soil; K-constancy.

Analyzing the behavior of plants in relation to moisture shows a predominance of mesophilic species ($U_{3-3.5}=45.46\%$) and xero-mesophilic species ($U_{2-2.5}=37.28\%$).

The thermal conditions in which the phytocenoses of the association develop favor micro-mesothermophilous species ($T_{3-3.5}=51.83\%$) and eurythermic species ($T_0=27.28\%$).

The soil preferences of the component species indicate a high proportion of euryionic species ($R_0=42.74\%$), followed by acid-neutrophilous species ($R_3=22.74\%$) and slightly acid-neutrophilous species ($R_4=17.27\%$) (figure 4).

CONCLUSIONS

In the phytosociological study of the grasslands in the Drăgan Valley, two main associations were identified: *Festuco rubrae-Agrostietum capillaris* (*Molinio-Arrhenatheretea* class), characteristic of mesophilous grasslands developed on deep, humus-rich soils with moderate moisture and varied texture, and *Hieracio pilosellae-Nardetum strictae* (*Nardo-Callunetea* class), found on more shaded lands with moderately acidic, medium-nutrient soils, characteristic of montane and submontane grasslands.

The grasslands of the *Festuco rubrae-Agrostietum capillaris* association have a rich floristic composition, totaling 110 species, including species characteristic of the *Cynosurion* alliance, xerophilous and xero-mesophilous transgressive species, acidophilous species, and elements derived from neighboring forests and ruderal areas. The grasslands of the *Hieracio pilosellae-Nardetum*

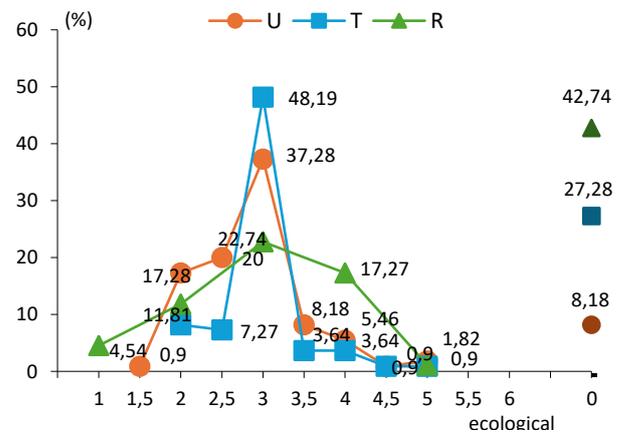


Figure 4 Diagram of ecological indices for the *Festuco rubrae-Agrostetum capillaris* association; where: U-humidity; T-temperature; R-chemical reaction of the soil

strictae association are dominated by mesophilous and micro-mesothermophilous species, with a total of 74 species. The herbaceous layer is complemented by acidophilous and xero-mesophilous transgressive species, as well as shrubs and moss layers representative of mountain ecosystems.

Analysis of ecological indices highlights the predominance of mesophilous and xero-mesophilous species in both associations, a preference for micro-mesothermophilous and eurythermic conditions, the development of grasslands on neutral to moderately acidic soils in *Festuco rubrae-Agrostietum capillaris*, and on acidic to strongly acidic soils in *Hieracio pilosellae-Nardetum strictae*.

The study demonstrates a clear correlation between environmental conditions (altitude, moisture, soil pH, exposure, slope) and the floristic structure of the grasslands, emphasizing the role of edaphic and

microclimatic factors in determining species composition and dominance.

These two associations reflect the conservation status of natural grasslands in the Drăgan Valley, providing useful information for the management and preservation of herbaceous biodiversity in the hilly and mountainous areas of Cluj County.

REFERENCES

- Borhidi, A., 1996. Critical revision of the Hungarian plant communities, Janus Pannonius University, Pécs.
- Borhidi, A., 2003. Magyarország növénytársulásai, Akadémiai Kiadó, Budapest.
- Braun-Blanquet, J., 1964. Pflanzensociologie, Springer Verlag, Wien-New York, 3, Aufl.
- Braun-Blanquet, J., Pavillard, J., 1928. Vocabulaire de Sociologie Végétale, Ed. 3, Impr. Lemaire-Ardres.
- Ciocârlan, V., 2009. Illustrated flora of Romania: *Pteridophyta* et *Spermatophyta*. Ceres Publishing House, Bucharest, 1141 p.
- Coldea, G., Sanda, V., Popescu, A., Ștefan, N., 1997. Les associations végétales de Roumanie. Cluj University Press Publishing House, Tome 1, 109-140.
- Coldea, G., Filipaș, L., Fărcaș, S., Stoica I., A., Ursu T., M., Pop, A., 2008. The relationship between the structure of grasslands from the north-eastern slope of the Vlădeasa Massif and socio-economic activities. Botanical Contributions, XLIII:53-65.
- Cristea, V., Gafta, D., Pedrotti, F., 2004. Phytosociology. Cluj University Press Publishing House, Cluj-Napoca, 396 p.
- Csűrös, Șt., Resmeriță, I., 1960. Studies on the *Festuca rubra* L. grasslands in Transylvania, Botanical Contributions: 149-173.
- Ivan, D., Doniță, N., 1975. Practical methods for the ecological and geographical study of vegetation. The Duplication/Printing Center of the University of Bucharest, 47 p.
- Marușca, T., Roman, A., Taulescu, E., Ursu, T., M., Popa, R. D., 2021. Detecting trends in the quality and productivity of grasslands by analysing the historical vegetation relevés: A case from Southeastern Carpathians, Vlădeasa Mountains (Romania). Notulae Botanicae Horti Agrobotanici Cluj-Napoca, (49), 1-20.
- McNeill, J., Barrie, F., R., Burdet, H., M., Demoulin, V., Hawksworth, D., L., Marhold, K., Nicolson, D., H., Prado, J., Silva, P., C., Skog, J., E., Wiersema, J., H., Turland, N., J., 2007. International Code of Botanical Nomenclature (Vienna Code) adopted by the Seventeenth International Botanical Congress Vienna, Austria, July 2005 - (Regnum Vegetabile, 146), 18, Gantner, Ruggell., 568 p.
- McNeill, J., Barrie, F., R., Buck, W., R., Demoulin, V., Greuter, W., Hawksworth, D., L., Herendeen, P., S., Knapp, S., Marhold, K., Prado, J., Prud'Homme Van Reine, W., F., Smith, G., F., Wiersema, J., H., Turland, N., J., 2011. International Code of Nomenclature for algae, fungi and plants (Melbourne Code) adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011, Regnum Vegetabile, 154, 30, A.R.G. Gantner Verlag KG, 240 p.
- Mucina, L., 1997. Conspectus of classes of European vegetation. Folia Geobot. Phytotax., Praha, 32:117-172.
- Pott, R., 1995. Die Pflanzengesellschaften Deutschlands, 2 Aufl., Ulmer Verlag, Stuttgart.
- Resmeriță, I., 1970. Flora, vegetation, and the productive potential of the Vlădeasa Massif, Academy of the Socialist Republic of Romania Publishing House, 318 p.
- Rothmaler, W., 1994. Exkursionsflora von Deutschland, Band 48 Auflage, Gustav Fischer Verlag, Jena Stuttgart.
- Rothmaler, W., 2000. Exkursionsflora von Deutschland, Band 3, Gefäßpflanzen: Atlasband, Spektrum Akademischer Verlag, Heidelberg-Berlin.
- Sanda, V., Öllerer, K., Burescu, P., 2008. The plant communities of Romania: Syntaxonomy, structure, dynamics, and evolution, Ars Docendi Publishing House, Bucharest, 570 p.
- Sârbu, I., Ștefan, N., Oprea A., 2013. Vascular plants from Romania. Victor B Victor Publishing House, Bucharest, 1317 p.
- Weber, H., E., Moravec, Theurillat, J., P., 2000. International Code of Phytosociological Nomenclature, 3 ed., Journal of Vegetation Science, Uppsala, 739-768.